MICRO-EPSILON

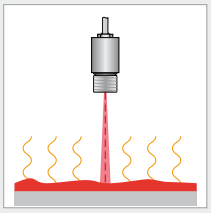
More Precision.

thermoMETER

Non-contact IR temperature sensors

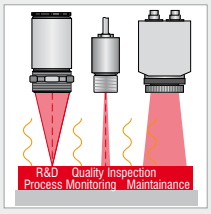
Precise temperature measurement with thermoMETER from Micro-Epsilon

Quick start



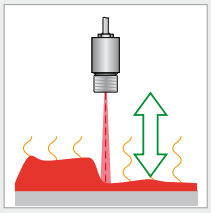
Non-contact measurement of the surface temperature

Each Micro-Epsilon IR temperature sensor model incorporates state of the art technology to achieve one goal: Measure accurate and non contact temperature. With this method we can offer a precise, wear free and fully non contact temperature reading without any physical effect or impact on the target.



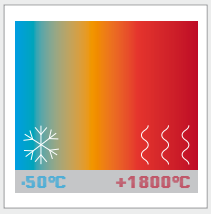
Wide range of applications

IR temperature sensors and IR cameras are used in a variety of applications within any industry from R&D to production and process monitoring.



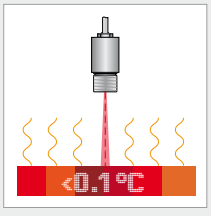
Selectable target distance and spot size

Depending on the application, one can choose the ideal distance from the sensor to the target. Due to the many different optics offered, very small spot sizes, even at large distances are possible.



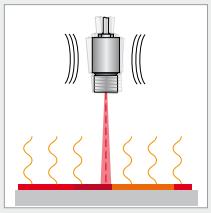
Wide temperature range

IR Sensors made by Micro-Epsilon cover a huge span of temperature readings. Starting as low as -50°C in cooling processes or labs and measuring up to 1800°C on molten metals, these sensors measure precise and fast within the blink of an eye.



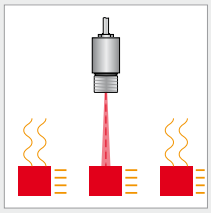
Precise and stable measurements

Micro-Epsilon's diversity of spectral ranges from 0.7μm to 14μm results in a stable and accurate temperature reading regardless of the application challenge.



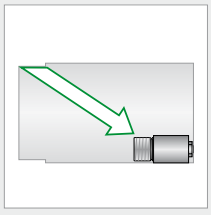
Proven technology

IR Sensors developed and produced by Micro-Epsilon are the most durable, robust and reliable with an extreme long life expectancy. Cutting edge technology and continuous improvement in the design, results in IR sensor performances which are unrivaled. Sensors operate in 250°C environment without cooling, survive 50g acceleration and read with a NEDT resolution of 25 milli Kelvin.



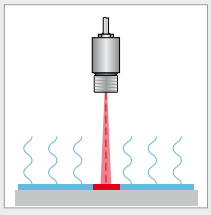
For fast measurement events

Temperature of moving objects and fast events can be captured with the Micro-Epsilon IR sensors which offer the fastest thermopile detector with an exposure <9ms or photon detectors with a response time of 1ms. Even the IR imager takes real time frames every 10ms.



Compact sensor design

For restricted spaces or complete integration the Micro-Epsilon IR sensors represent the most compact size in its class. Special models offer integrated miniaturized signal process electronics for maximum compactness.

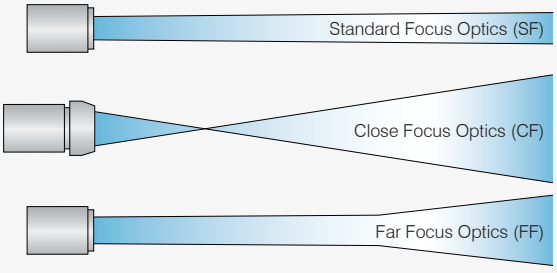


Smallest spot-diameter for tiny targets

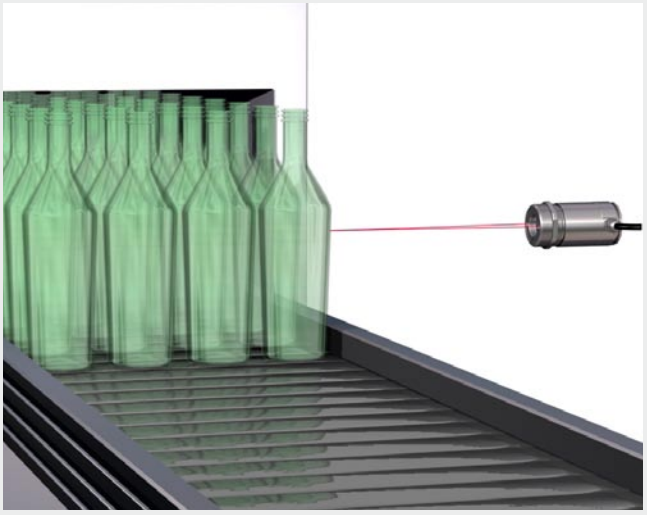
Common IR sensors on the market can not measure temperature of tiny small parts such as leads of ICs, small hot spots on circuit boards, fiber strands etc. Micro-Epsilon offers the most sophisticated optics for the IR sensors to measure with the world's smallest spot sizes <1mm.

thermoMETER optics

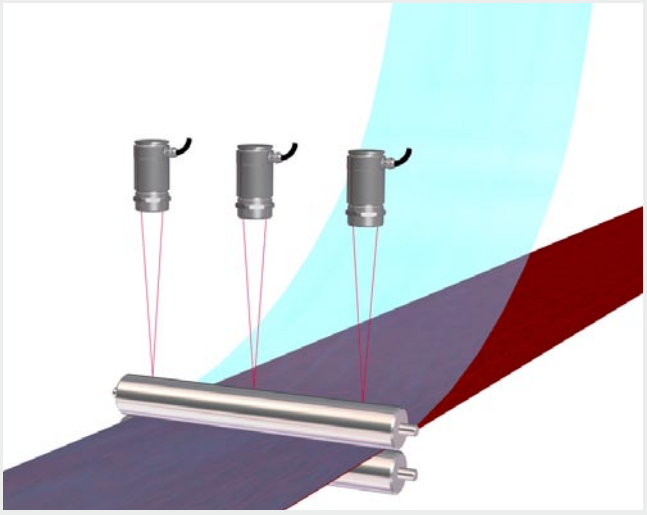
There are several different lenses available for the various series. The lenses are basically differentiated by the ratio of the distance of the measuring object to the diameter of the measuring spot.
SF Lenses (Standard Focus) have an almost linear ratio while the CF Lenses (Close Focus) have a smaller measuring spot in distances close to the sensor. FF Lenses (Far Focus) offer a small spot even at large distances.



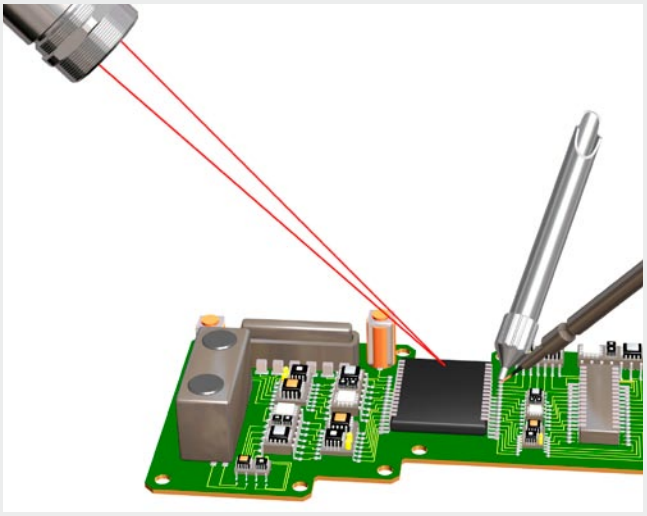
Spot size should be less or equal than the size of the measured target area.



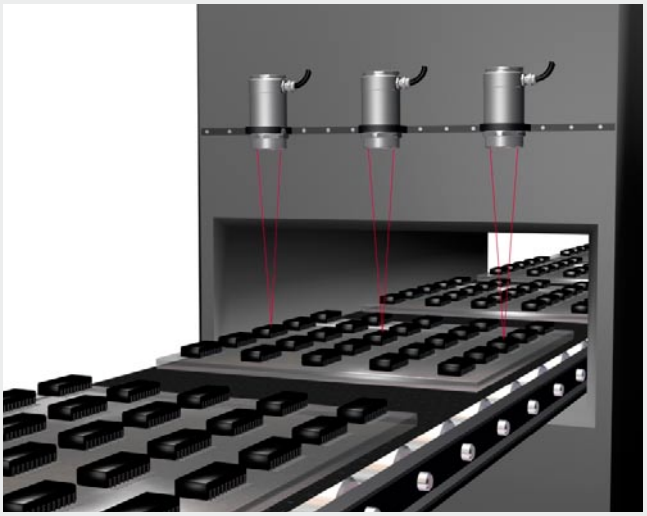
Temperature measurement in drying machines



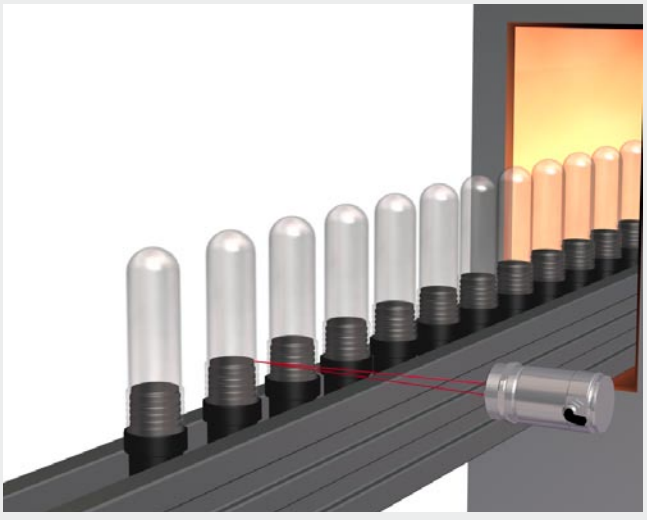
Measurement on calandars



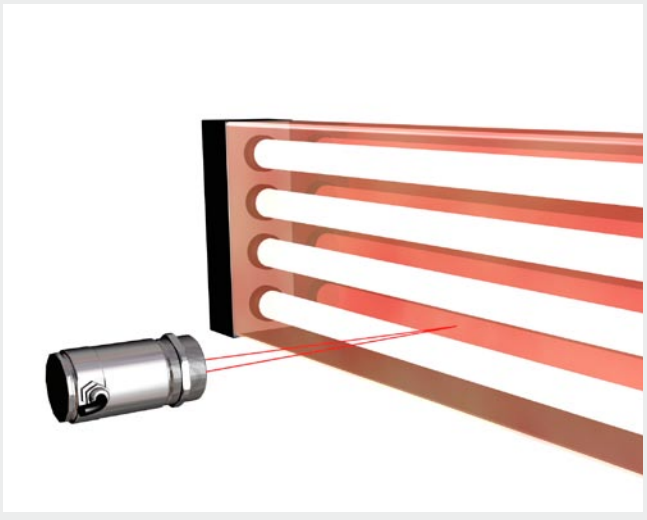
Soldering processes



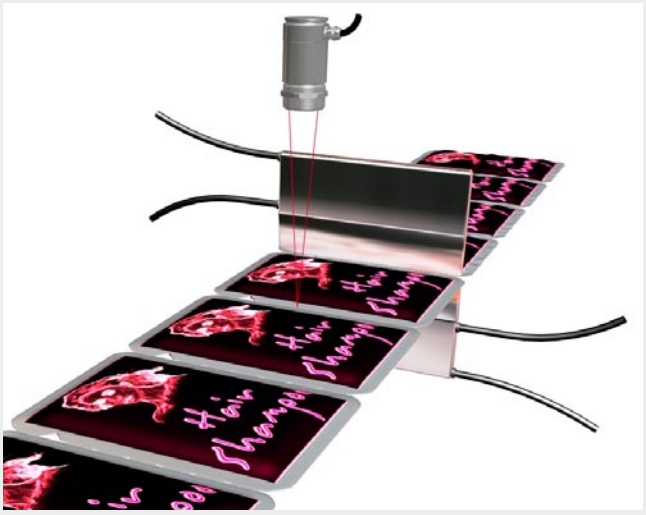
Glass cooling



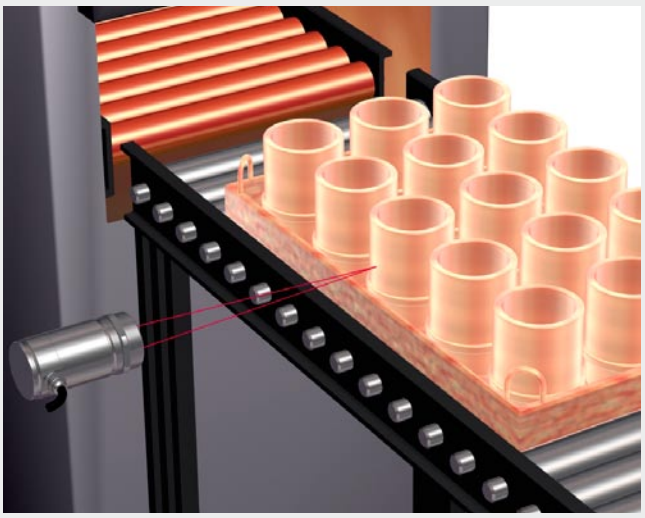
Measurement of plastic forming processes



Temperature measurement of lamps

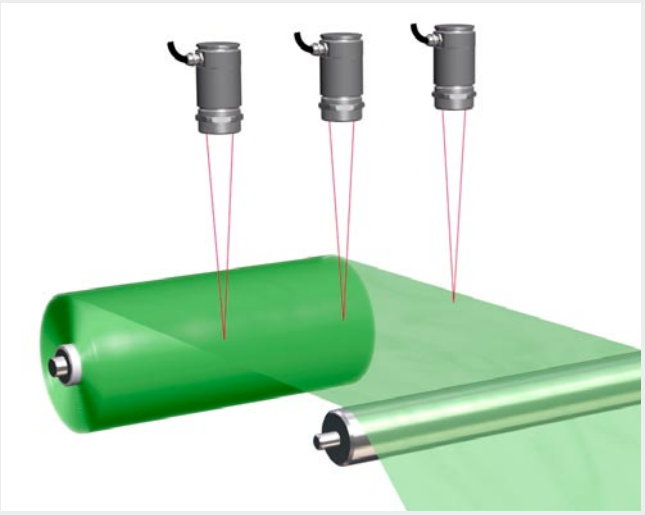


Sealing processes

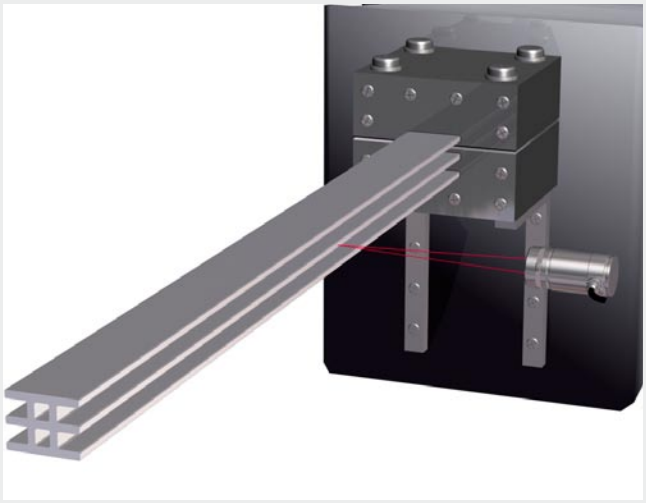


Temperature monitoring of oven

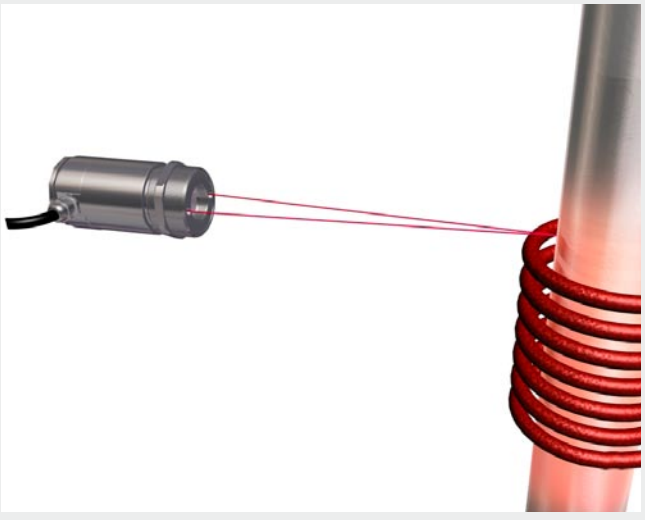
Temperature monitoring of baked goods



Temperature monitoring of film materials



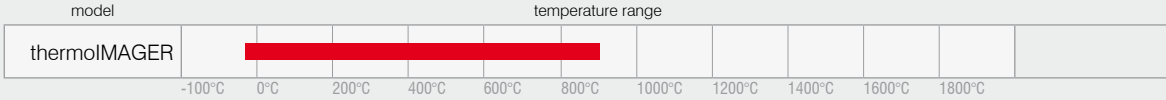
Temperature measurement in extrusion lines



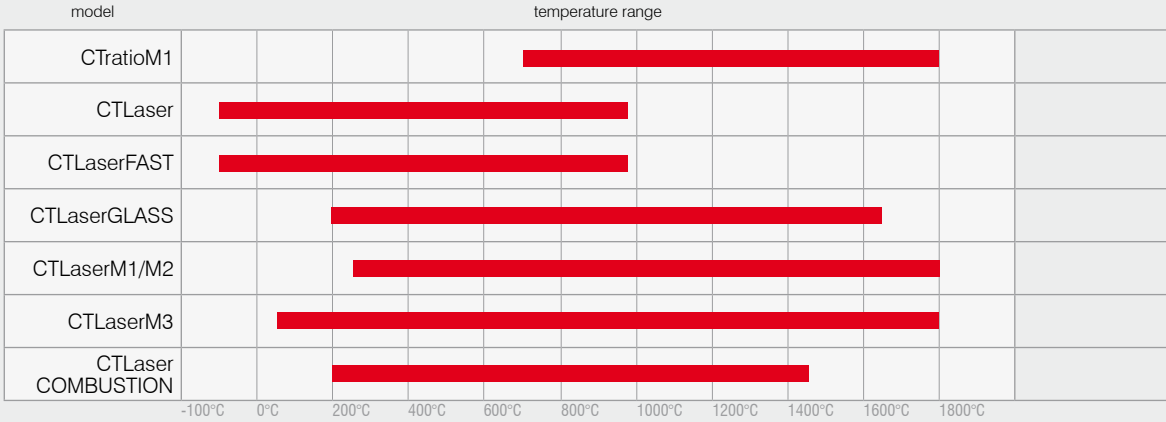
Temperature measurement in heating processes

thermoMETER at a glance

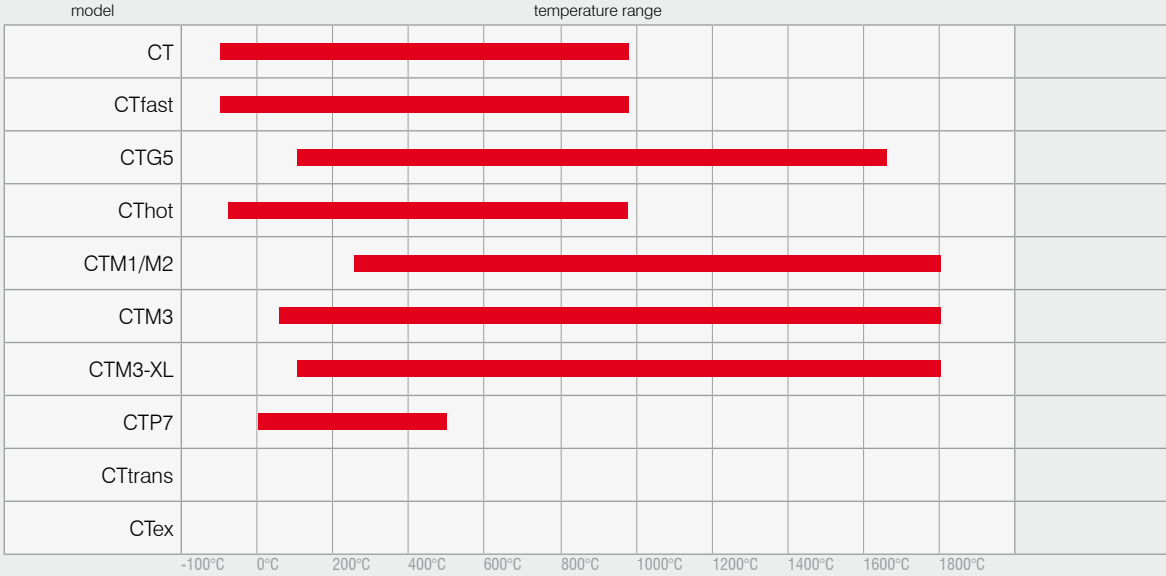
IR process imager



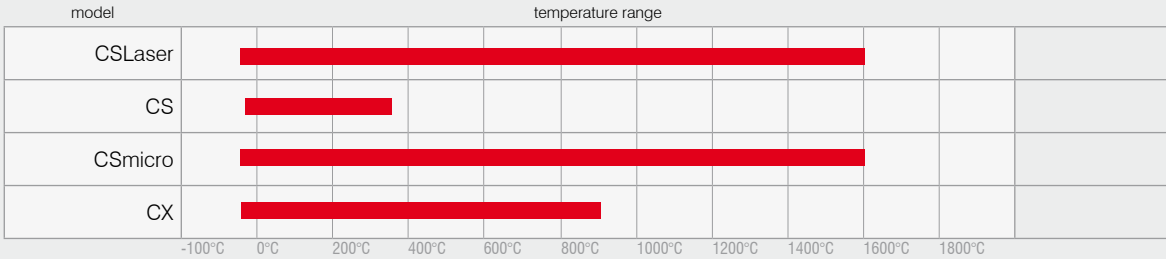
High-Performance IR sensor with double laser aiming



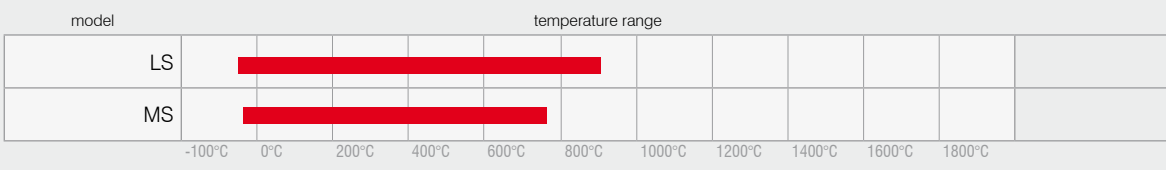
Infrared sensor for general purpose applications



Compact infrared temperature sensor for OEM applications



Handheld devices



IR process imager

spectral range	ambient temperature	response time	optics	temperature resolution (NEDT)	accuracy	page
7.5 - 13µm	0 °C ... +50 °C	96Hz / 120Hz	48° / 23° / 6°	<0.1%/<0.08K	<2%/<2°C	8 - 15

High-Performance IR sensor with double laser aiming

spectral range	ambient temperature	response time	optics	temperature resolution (NEDT)	accuracy	page
0.7 - 1.1µm	-20 °C ... +250°C	5ms	80:1 / 60:1	<0.5%/+1°C	<0.5% / +1°C	16 - 17
8 - 14µm	-20 °C ... +85°C	120ms	75:1	<1%/<1°C	<1% / <1°C	18 - 19
8 - 14µm	-20 °C ... +85°C	9ms	50:1	<1.5%/1.5°C	<1.5% / 1.5°C	20 - 21
5.2µm	-20 °C ... +85°C	80ms	45:1 / 70:1	<1%/<1°C	<1% / <1°C	22 - 23
1µm / 1.6µm	-20 °C ... +85°C	9ms	150:1 / 300:1	<0.3% (<1°C / <2°C)	<0.3% / <1°C <0.3% / <2°C	24 - 25
2.3µm	-20 °C ... +85°C	80ms	60:1 / 100:1 / 300 : 1	0.1°C	<(0.3% of reading +2°C)	26 - 27
3.9 / 4.24 / 4.64µm	-20 °C ... +85°C	10ms	45:1	<0.1°C	<1% / 1.5°C	28 - 29

Infrared sensor for general purpose applications

spectral range	ambient temperature	response time	optics	temperature resolution (NEDT)	accuracy	page
8 - 14µm	-20 °C ... +180°C	150ms	2:1 / 15:1 / 22:1	<0.1°C	<1% (<1°C)	32 - 33
8 - 14µm	-20 °C ... +120°C	6ms; 3ms	15:1 / 25:1	<0.2°C / <0.4°C	<1% (<2°C)	34 - 35
5.2µm	-20 °C ... +85°C	80ms	10:1 / 20:1	<0.1°C / <0.2°C	<1% (<2°C)	36 - 37
8 - 14µm	-20 °C ... +250°C	100ms	2:1 / 10:1	<0.25°C	<1% (<1.5°C)	38 - 39
1µm / 1.6µm	-20 °C ... +125°C	1ms	40:1 / 75:1	<0.1°C	<0.3% (+2°C)	40 - 41
2.3µm	-40 °C ... +85°C	1ms	22:1 / 33:1 / 75:1	<0.1°C	±(0.3% of reading +2°C)	42 - 43
2.3µm	-40 °C ... +85°C	1ms	100:1 / 300:1	0.1°C	±(0.3% of reading +2°C)	44 - 45
7.9µm	-20 °C ... +85°C	150ms	10:1	<0.5 C	<1.5% (<1°C)	46 - 47
8 - 14µm	-20 °C ... +100°C					48 - 49
8 - 14µm	-20 °C ... +60°C					50 - 51

Compact infrared temperature sensor for OEM applications

spectral range	ambient temperature	response time	optics	temperature resolution (NEDT)	accuracy	page
1.6 / 8 - 14µm	-20 °C ... +85°C	150ms;10ms	50:1 / 300:1	<0.1°C	<1% (<1°C) <0.3% (+2°C)	56 - 57
8 - 14µm	-20 °C ... +80°C	30ms	10:1	<0.2°C	<1.5% (<1.5°C)	58 - 59
1.6 / 8 - 14µm	-20 °C ... +125°C	150ms; 30ms; 10ms	2:1 / 10:1 15:1 / 75:1	<0.2°C / <0.1°C / <0.025°C	<1.5% (<1.5°C); <1% (<1.5°C) <0.3% (+2°C); <1% (<1°C)	60 - 61
8 - 14µm	-20 °C ... +75°C	150ms	15:1 / 22:1	<0.025°C / 0.1°C	<1% (<1°C/<1.4°C)	62 - 63

Handheld devices

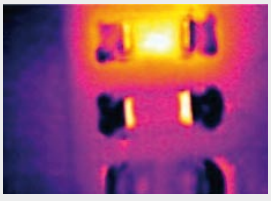
spectral range	ambient temperature	response time	optics	temperature resolution (NEDT)	accuracy	page
8 - 14µm	0 ... +50°C	150ms	75:1	<0.1 °C	<0.75°C/<0.75%	66 - 67
8 - 14µm	0 ... +50°C	300ms	20:1 / 40:1	<0.2°C / <0.1°C	<1%/<1°C	68 - 69

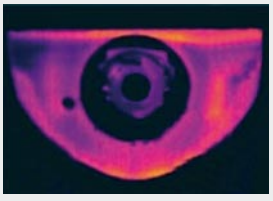
thermoIMAGER TIM 160

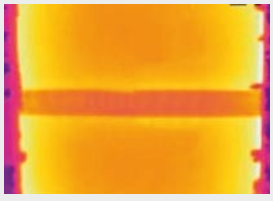
Miniature real time thermal imager with USB interface

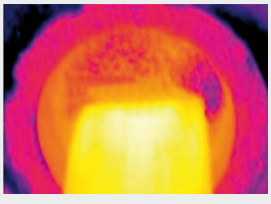
- ➔ Measuring range from -20°C to 900°C (optional 1500°C)
- ➔ Excellent thermal sensitivity of 0.08K (NEDT)
- ➔ Exchangeable lenses with 6°FOV, 23°FOV and 48°FOV
- ➔ Real time video recording at 120Hz frame rate with slow motion playback capability
- ➔ Power supply and operation via USB 2.0 interface
- ➔ Extremely lightweight (195g) and rugged (IP67)
- ➔ Very compact 45x45x62mm
- ➔ Analog input and output, trigger interface
- ➔ Image analysis software, developer kit and Labview driver are included at no charge

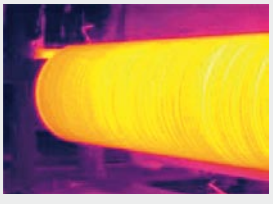
Applications

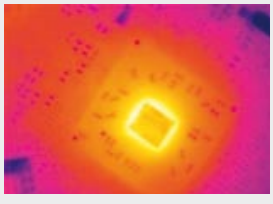

R&D electronic


R&D mechanical components


Production of solar panels


Process control extrusion

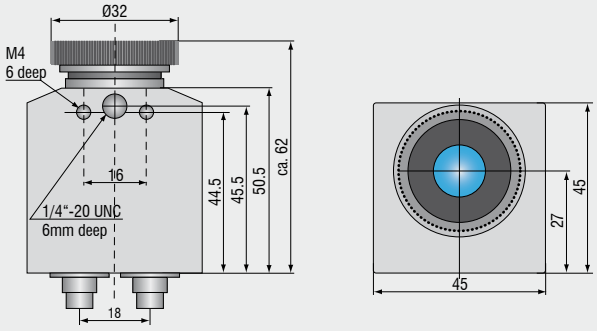

Process control calendering


R&D electronic devices

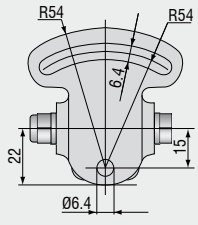
Model	thermoIMAGER TIM 160
Optical resolution	160x120 pixel
Temperature ranges	-20°C to 100°C / 0°C to 250°C / 150°C to 900°C (optional 1500°C)
Spectral range	7.5 to 13µm
Frame rate	120Hz
System accuracy	±2% or ±2°C
Resolution (Display)	±0.1°C
Lenses	48° / f = 4.5mm (min. distance 20mm); 23° / f = 10mm (min. distance 20mm); 6° / f = 35.5mm (min. distance 500mm)
Emissivity	0.10 to 1.00 adjustable
Thermal Sensitivity	0.1K with 48° FOV [1] / 0.08K with 23° FOV [1] / 0.3K with 6° FOV [2]
Detector	Focal Plane Array (FPA) - uncooled micro bolometer 25x25µm²
Measurement modes	Flexible spot with crosshair marking, fixed measurement field with automatic display of maximum-, minimum- or average value
Colour palettes	Iron, rainbow, black-white, black-white inverted
Set up controls (via menu)	Mesurement modes, full automatic, manual, colour palettes, emissivity, file management, date/time, °C/ °F, language
Outputs/digital	USB 2.0
Process interface (electrically isolated)	0-10 V output, 0-10 V input, trigger input
Digital communication	via RS232 of PC / DLL interface
Cable length	1m (standard), 5m, 10 m, 20m
Power supply	USB powered
Tripod mount	1/4-20 UNC
Environmental rating	IP 67
Ambient temperature	0°C to 50°C (up to 240°C with cooling jacket)
Storage temperature	-40°C to 70°C
Relative humidity	20 to 80%, non-condensing
Vibration	2G, IEC 68-2-6 11-200Hz each axis
Shock	25G, IEC 68-2-29 11ms each axis
Weight	195g; incl. lens

PC requirements: minimum 1.5GHz, 1GB RAM, Windows XP SP2, Windows 7
[1] Caution: at distances below 200mm measurement accuracy can be out of specification
[2] Caution: at distances below 500mm measurement accuracy can be out of specification

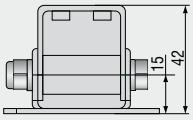
Dimensions



Accessories



TM-MB-TIM Mounting base, adjustable



TM-PH-TIM Protective housing incl. mounting base

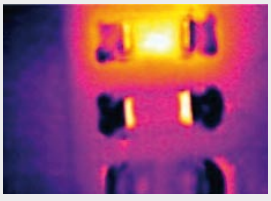
TM-J-TIM Cooling jacket
(length 228mm, ø89mm) with adjustable mounting bracket TM-JAB-TIM;
recommended high temperature cable TM-USBC5H-TIM (up to 240°C)

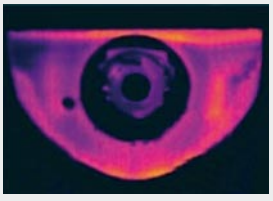
thermoIMAGER TIM 200

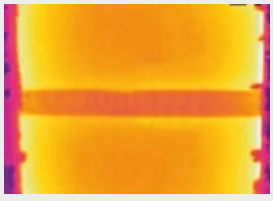
Themal imager with BI-SPECTRAL technology

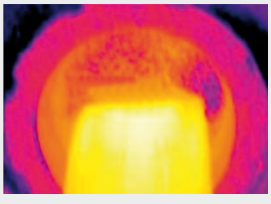
- ➔ **NEW:** BI-SPECTRAL technology
- ➔ Measuring range from -20°C to 900°C (optional 1500°C)
- ➔ Excellent thermal sensitivity of 0.08K (NEDT)
- ➔ Exchangeable lenses with 6°FOV, 23°FOV and 48°FOV
- ➔ Thermal images in real time with 128Hz via USB 2.0 interface
- ➔ Time synchronous visual image recording (VIS) with 32Hz (640 x 480 pixel)
- ➔ Power supply and operation via USB 2.0 interface
- ➔ Extremely lightweight (215g) and rugged (IP67)
- ➔ Very compact 45x45x62mm
- ➔ Analogue input and output, trigger interface
- ➔ Image analysis software, developer kit and Labview driver are included at no charge

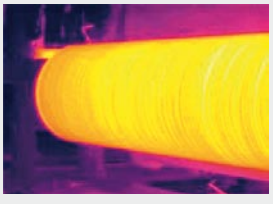
Applications

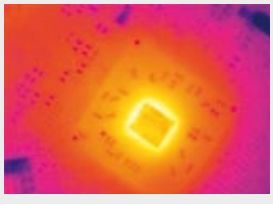

R&D electronic


R&D mechanical components


Production of solar panels


Process control extrusion

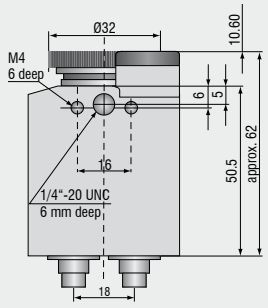

Process control calendering

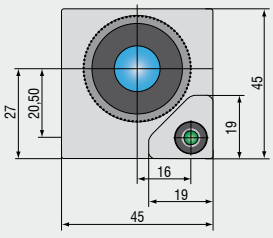

R&D electronic devices

Model	thermoIMAGER TIM 200
Optical resolution	160x120 pixel
Temperature ranges	-20°C to 100°C / 0°C to 250°C / 150°C to 900°C (optional 1500°C)
Spectral range	7.5 to 13µm
Frame rate	128Hz
System accuracy	±2% or ±2°C
Resolution (Display)	±0.1°C
Lenses	48° / f = 4.5mm (min. distance 20mm); 23° / f = 10mm (min. distance 20mm); 6° / f = 35.5mm (min. distance 500mm)
Emissivity	0.10 to 1.00 adjustable
Thermal Sensitivity	0.1K with 48° FOV [1] / 0.08K with 23° FOV [1] / 0.3K with 6° FOV [2]
Detector	Focal Plane Array (FPA) - uncooled micro bolometer 25x25µm²
Measurement modes	Flexible spot with crosshair marking, fixed measurement field with automatic display of maximum-, minimum- or average value
Colour palettes	Iron, rainbow, black-white, black-white inverted
Set up controls (via menu)	Mesurement modes, full automatic, manual, colour palettes, emissivity, file management, date/time, °C/ °F, language
Data of visual camera	Optical resolution: 640 x 480 Pixel; Frame rate: 32Hz; Lenses (FOV): 54° x 40°
Outputs/digital	USB 2.0
Process interface (electrically isolated)	0-10 V output, 0-10 V input, trigger input
Digital communication	via RS232 of PC / DLL interface
Cable length	1m (standard), 5m, 10 m, 20m
Power supply	USB powered
Tripod mount	1/4-20 UNC
Environmental rating	IP 67
Storage temperature	-40°C to 70°C
Relative humidity	20 to 80%, non-condensing
Vibration	2G, IEC 68-2-6 11-200Hz each axis
Shock	25G, IEC 68-2-29 11ms each axis
Weight	215g; incl. lens

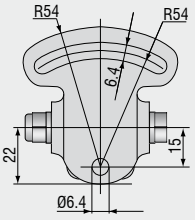
PC requirements: minimum 1.5GHz, 1GB RAM, Windows XP SP2, Windows 7
1) Caution: at distances below 200mm measurement accuracy can be out of specification
2) Caution: at distances below 500mm measurement accuracy can be out of specification

Dimensions

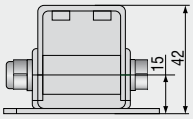




Accessories



TM-MB-TIM Mounting base, adjustable



TM-PH-TIM Protective housing incl. mounting base

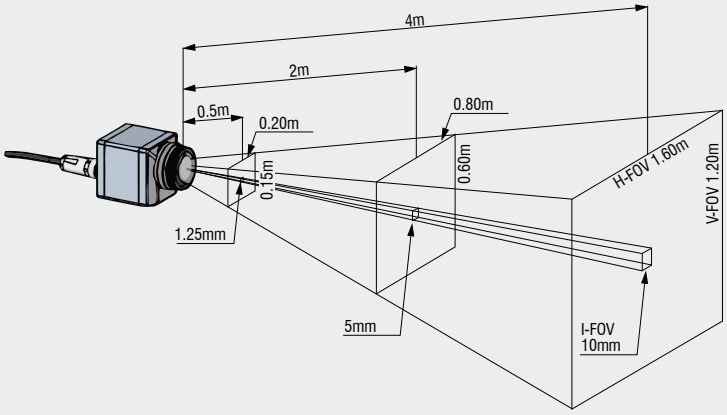
Plug&Play thermal imager

Powered from just one USB cable, the system is truly plug and play. Data is streaming from the camera to the software via USB 2.0. in real time. This process and analysis tool, provided with every camera, enables the user to capture, record and monitor real time thermal process images at 120/128Hz. The software will store the data to a file, which allows playback at user defined speeds, e.g. in slow motion, frame by frame if required. The image can be viewed and monitored either online with the camera connected, or off line at a later time without the camera being connected. A perfect tool for R&D applications, failure diagnostics or process monitoring.
Additionally the software can be used as a runtime application where the user is able to program and configure a custom environment. (multiple monitoring windows, alarms, hot spot localization, line profilen etc.) A programmable process Interface, hard wired input and output, (PIF in) enables external control and communication for the emissivity of the target material, trigger functions, shutter control or alarm outputs and other useful features.

The right optics for many applications

- Standard-, tele- and wide angle lens for different applications
- High quality germanium lenses and a special antireflective coating
- Factory calibrated lenses allowing the easy exchange of optics without recalibration

Dependence between field of view (FOV) and distance (lens 23° x 17°)

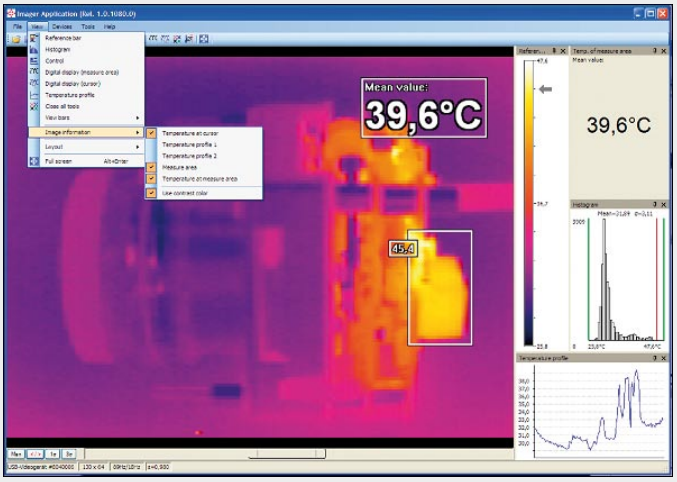


Objective 48° x 37° wide angle; focal distance 4.5 mm; min distance 0.02m											
HFOV	m	0.09	0.27	0.44	1.07	1.78	3.56	5.3	8.9	26.7	88.9
VFOV	m	0.07	0.20	0.33	0.80	1.33	2.67	4.0	6.7	20.0	66.7
IFOV	mm	0.56	1.67	2.78	6.67	11.11	22.22	33.3	55.6	166.7	555.6
Distance in m		*0.1*	*0.3*	*0.5*	*1.2*	*2*	*4*	*6*	*10*	*30*	*100*

Objective 23° x 17° wide angle; focal distance 10 mm; min distance 0.02m											
HFOV	m	0.04	0.12	0.20	0.48	0.80	1.60	2.40	4.00	12.00	40.00
VFOV	m	0.03	0.09	0.15	0.36	0.60	1.20	1.80	3.00	9.00	30.00
IFOV	mm	0.25	0.75	1.25	3.00	5.00	10.00	15.00	25.00	75.00	250.00
Distance in m		*0.1*	*0.3*	*0.5*	*1.2*	*2*	*4*	*6*	*10*	*30*	*100*

Objective 6° x 5° wide angle; focal distance 35.5 mm; min distance 0.5m											
HFOV	m	-	-	0.06	0.14	0.23	0.45	0.7	1.1	3.4	11.3
VFOV	m	-	-	0.04	0.10	0.17	0.34	0.5	0.8	2.5	8.5
IFOV	mm	-	-	0.35	0.85	1.41	2.82	4.2	7.0	21.1	70.4
Distance in m		*0.1*	*0.3*	*0.5*	*1.2*	*2*	*4*	*6*	*10*	*30*	*100*

FOV = Field of view; HFOV = Horizontal field of view; VFOV = Vertical field of view; IFOV = Indicated field of view



Software

➔Display of the thermal image in real time (120/128 Hz) with recording function (video, snap shot)

➔Complete set up of parameters and remote control of the camera

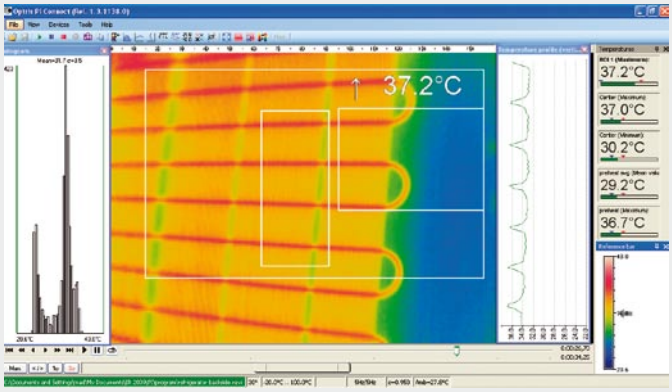
➔Detailed analysis of fast thermodynamic processes

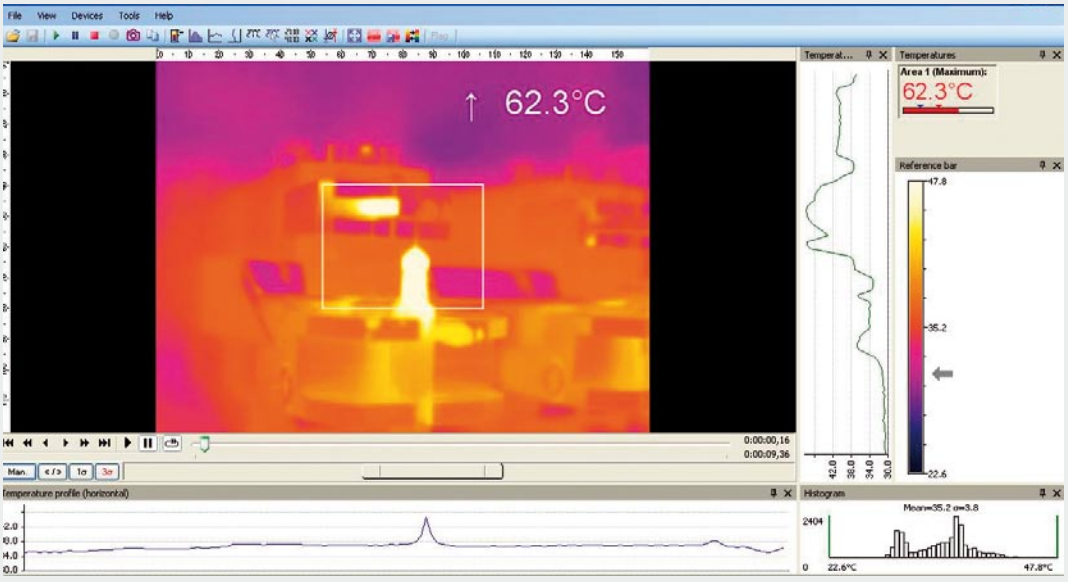
➔In-process and offline analysis

➔Process interface supports analog and digital output

➔Free software development kit for individual programming

➔RS232 software interface for PLC connection





In-process monitoring, e.g. linecamera with hotspot detection

Scope of supply TIM160/200

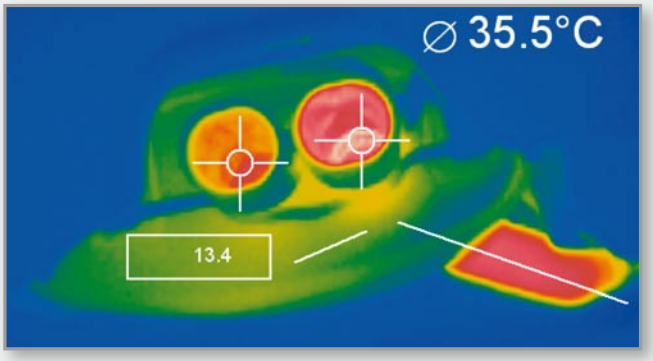
- TIM process camera including one selected lens
- Tripod mount
- Operation manual
- USB cable 1m
- Image processing and analysis software
- PIF cable 1m

Scope of supply TIM160/200 /DK

- TIM process camera including 6°, 23°, 48° optics
- Certificate of calibration, matched with the optics
- Tripod mount 200 to 1000mm
- Rugged carrying case
- Operation manual
- USB cable 1m and 10m
- Image processing and analysis software
- PIF cable 1m

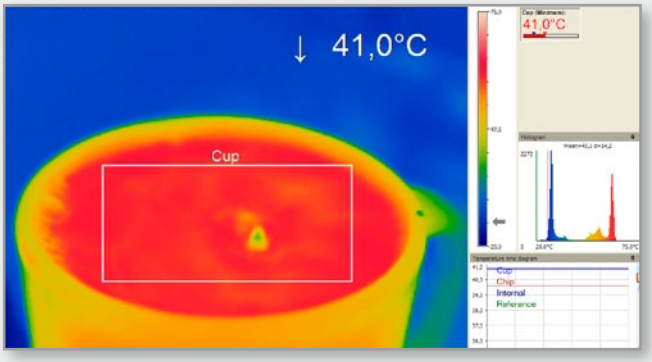
Automatic hot spot detection

Objects can be monitored for hot or cold areas, where hot or cold spots can be found automatically.



Fast measurements

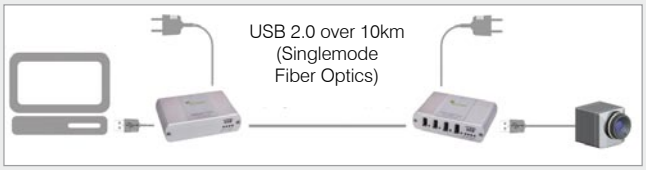
Surface temperature distributions for fast moving events can be captured precisely within an millisecond intervall.



Easy process integration

Advanced interface concepts allow the integration within networks and automated systems:

- ➔ USB cable extension up to 100m (over Ethernet) or 10km (over fibre)
- ➔ Process interface (PIF) at the camera as analog input / output (0 to 10V) and digital input (low and high-level)
- ➔ Software interface via Dynamic-link Library (DLL), Computer-Port (ComPort)
- ➔ RS232 Serial data communication
- ➔ incl. LabVIEW interface/port

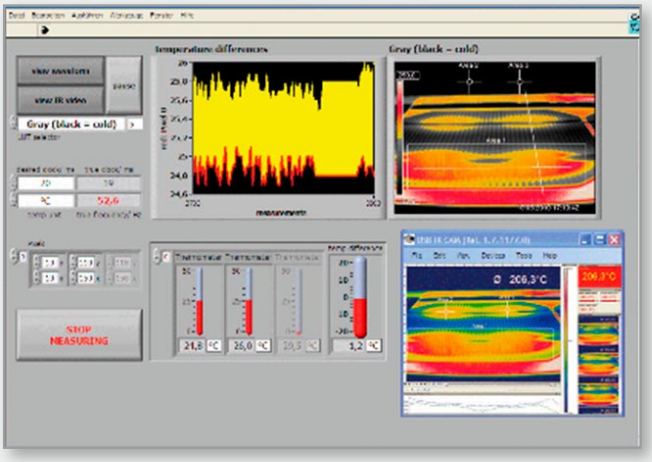


NATIONAL INSTRUMENTS LabVIEW

Software Features

Automatic process and quality control

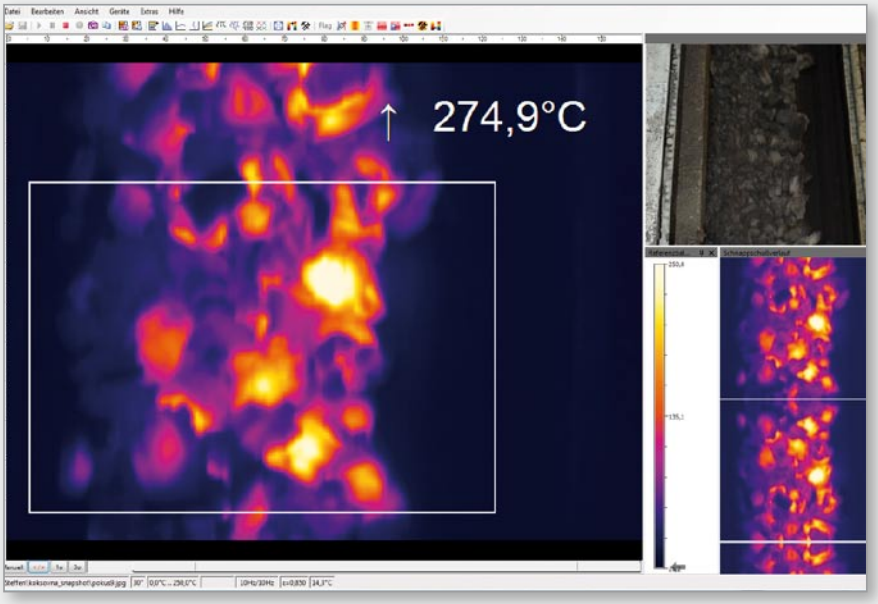
- ➔ Individual setup of alarm levels depending on the process
- ➔ BI-SPECTRAL process monitoring (IR and VIS) for easy orientation at point of measurement
- ➔ Line-scan camera function to control processes of moving measurement objects
- ➔ Definition of visual or acoustic alarms and analog data output via the process interface
- ➔ Analog and digital signal input (process parameter)
- ➔ External communication of software via Comports, DLL and LabVIEW driver



BI-SPECTRAL technology

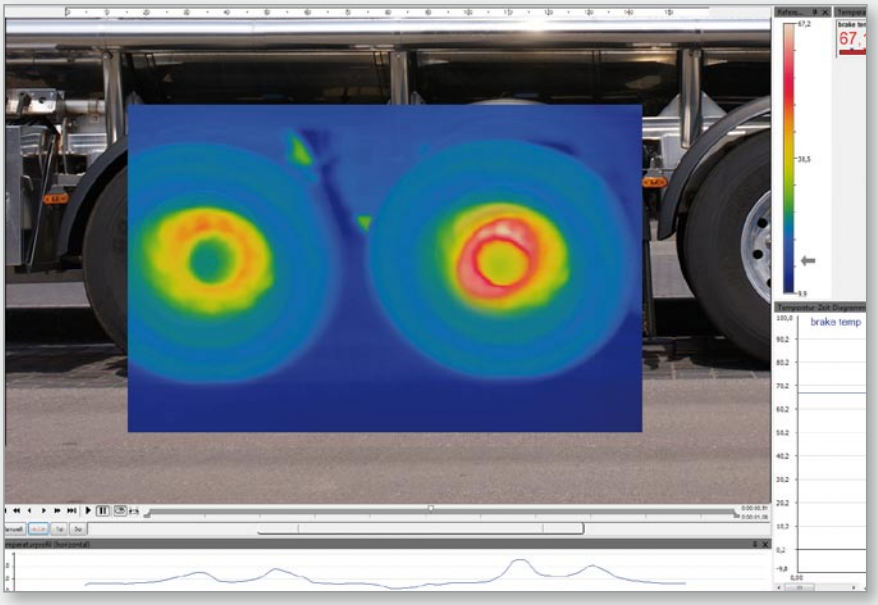
With the help of BI-SPECTRAL technology, a visual image (VIS) can be combined with a thermal image (IR). Both can be captured and recorded time synchronously.

Monitoring mode:
Easy orientation at point of measurement



thermoIMAGER TIM Connect Software - conveyor of living embers

Cross-fading mode:
Highlighting of critical temperatures



thermoIMAGER TIM Connect Software - tires

thermoMETER CTratioM1

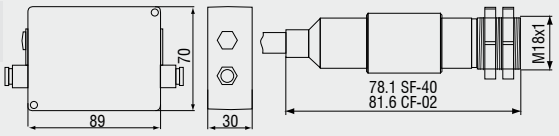
Glass fiber 2 color ratio thermometer for extreme temperature measurements. The ratiometric principle minimizes measurement errors caused by intensity change (e.g. contamination due to dust, fumes..), low emissivity and partial spot size coverage of the target.

- ➔ Temperature range from 700°C to 1800°C
- ➔ 5ms response time for fast readings
- ➔ Short wave length 0.7 and 1.1µm
- ➔ Rugged sensor head withstands 250°C without cooling
- ➔ High optical resolution with variable focus optics
- ➔ Laser target marker down to 1.3 mm spot size
- ➔ Programmable 1 or 2 color mode
- ➔ Separate controller with easy accessible programming keys and multi color LCD backlit display

Optical specification thermoMETER CTratioM1

□ = smallest spot size (mm)

Standard optics										
SF40 optics	**40:1**	6.6	10.6	21.1	31.3	41.4	52	62.6	73.3	84
	distance in mm	*102*	*305*	*762*	*1143*	*1524*	*1905*	*2286*	*2667*	*3048*
Close Focus optics										
CF02 optics	**2:1**	5.1	6.4	7.7	23.6	50.1	77.6	104.1		
	distance in mm	*102*	*200*	*305*	*762*	*1524*	*2286*	*3048*		



Product identification

CTratioM - 1 CF02 - C2

- Fiber cable length [3 m (standard) / 6 / 10 / 15 / 22 m]
- Focus [CF02/SF40]
- Spectral range
- thermoMETER CTratio

Model		CTratioM-1CF02-C2	CTratioM-1SF40-C2
Optical resolution (95% Energy)		40:1	
Temperature range		700°C to 1800°C	
Spectral range		0.7 and 1.1µm	
System accuracy [1,3]		<(0.5% of reading +1°C)	
Repeatability [1,3]		<(0.2% of reading +1°C)	
Temperature resolution (>900°C)		0.1°C	
Response time (95% signal) [2]		5ms - 10s	
Slope [4]		0.800 to 1.200	
Emissivity [4]		0.100 to 1.100	
Signal processing [4]		1 color / 2 color mode; attenuation monitoring / alarms; peak hold, valley hold, average; extended hold function with threshold and hysteresis	
Outputs/analog		0/4 - 20 mA, 0 to 5/10 V	
Outputs/analog	optional	relay: 2 x 60VDC/ 42VAC$_{eff}$; 0.4A; optically isolated	
Alarm output		2 x open - collector (24 V/1 A)	
Outputs/digital	optional	USB, RS232, RS485, CAN, Profibus DP, Ethernet	
Output impedances	current output	mA max. 500 Ω (with 5 - 36 VDC)	
	voltage output	mV min. 100 kΩ load impedance	
Inputs/outputs digital		2 programmable in-/ outputs, usable as: Alarm output (open collector output [24 V/ 1 A]) Digital input for triggered signal output and peak hold function	
Fiber cable length		3m (standard), 6m, 10m, 15m , 22m; stainless steel armour, 400µm fiber diameter	
Power supply		8 to 36VDC or USB; max. 200mA	
Optical aiming		Laser 650nm, 1mW, ON/OFF via controller or software	
Environmental rating		IP 65 (NEMA-4)	
Operation temperature		sensor: -20°C to 250°C (70°C if Laser ON); controller: 0°C to 85°C	
Storage temperature		sensor: -40°C to 250°C ; controller: -40°C to 85°C	
Relative humidity		10 to 95%, non condensing	
Vibration	sensor	IEC 68-2-6: 3 G, 11-200Hz, any axis	
Shock	sensor	IEC 68-2-27: 50 G, 11ms, any axis	
Weight		fiber cable with sensor: 375g; controller: 420g	

[1] E = 1, response time 1s
[2] with dynamic adaptation at low signal levels
[3] ± at ambient temperature 23 ±5°C
[4] adjustable via programming keys or software

LASER RADIATION
DO NOT STARE IN THE BEAM
CLASS 2 LASER
EN60825-1:2002
P≤1mW; λ=650nm

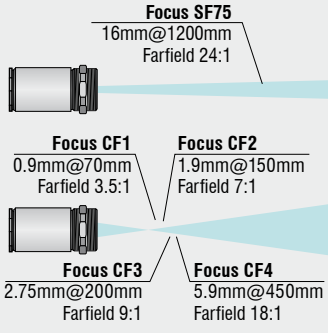
thermoMETER CTlaser

Innovative precision infrared temperature sensor marking
the actual spot size on your measurement target at any distance

- ➔ Measuring range from -50°C to 975°C
- ➔ Extreme small measurement spot down to 0.9mm
- ➔ Real mapping of the actual spot size, with automatic laser protection
- ➔ Precision optics (75:1) with different models for a specific focus point
- ➔ Up to 85°C ambient temperature without cooling
- ➔ Fully programmable instrument for enhanced signal processing and I/O control
- ➔ Separate controller with easy accessible programming keys and multi color LCD backlit display

Software CompactConnect

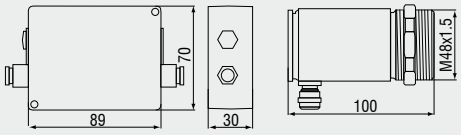
- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels



Optical specifications thermoMETER CTlaser

□ = smallest spot size (mm)

Standard optics															
SF75 optics 75:1	20	19.5	19	18.5	18	17.5	17	16.5	16	20.5	25	34	43	52	
distance in mm	*0*	*150*	*300*	*450*	*600*	*750*	*900*	*1050*	*1200*	*1350*	*1500*	*1800*	*2100*	*2400*	
Close Focus optics															
CF1 optics 75:1	20	9	5	0.9	10	25	40	55	70	85	100	115	130	160	190	220
CF2 optics 75:1	20	16	14	11	8	1.9	9	16.5	24	31	38	45.5	53	68	82	97
CF3 optics 75:1	20	17	16	14	11	7	2.75	8.5	14	19.5	25.5	31	37	48	60	71
CF4 optics 75:1	20	19	18.5	18	17	15.5	14	12.5	11	9	7.5	5.9	9	15	20	26
distance in mm	*0*	*40*	*50*	*70*	*100*	*150*	*200*	*250*	*300*	*350*	*400*	*450*	*500*	*600*	*700*	*800*



Product identification

CTL - SF75 - C3

- Cable length [3 m Standard / 8 m / 15 m]
- Focus [SF75 / CF1 / CF2 / CF3 / CF4]
- thermoMETER CTLaser

Model		CTL-SF75-C3
Optical resolution		75:1
Temperature range [1]		-50°C to 975°C
Spectral range		8 to 14 μm
System accuracy [2,3]		<1% or <1°C
Repeatability [2]		<0.5% or <0.5°C
Temperature resolution		0.1°C
Response time (90% signal)		120ms
Emissivity/gain [1]		0.100 to 1.100
Transmissivity/gain [1]		0.100 to 1.000
Signal processing [1]		peak hold, valley hold, average; extended hold function with threshold and hysteresis
Certificate of calibration		optional
Outputs/analog	channel 1	0/4 to 20mA, 0 to 5/10 V, thermocouple J, K
	channel 2	sensor temperature (-40 to 85°C as 0 to 5V or 0 to 10V), alarm output
	optional	relay: 2 x 60VDC/ 42VAC$_{eff}$; 0.4A; optically isolated
Alarm output		open - collector (24V/ 50mA)
Outputs/digital	optional	USB, RS232, RS485, CAN, Profibus DP, Ethernet
Output impedances	current output	mA max. 500Ω (with 5 to 36VDC)
	voltage output	mV min. 100kΩ load impedance; thermocouple 20Ω
Inputs		programmable functional inputs for external emissivity adjustment, ambient temperature compensation, trigger (reset of hold functions)
Cable length		3m (standard), 8m, 15m
Power supply		8 to 36VDC; max. 160mA
Laser		class II (635nm), 1mW, ON/OFF via controller or software
Environmental rating		IP 65 (NEMA-4)
Ambient temperature		sensor: -20°C to 85°C (50°C if Laser ON) controller: 0°C to 85°C
Storage temperature		sensor: -40°C to 85°C controller: -40°C to 85°C
Relative humidity		10 to 95%, non condensing
Vibration	sensor	IEC 68-2-6: 3 G, 11 to 200Hz, any axis
Shock	sensor	IEC 68-2-27: 50 G, 11ms, any axis
Weight		sensor: 600g; controller: 420g

[1] adjustable via controller or software
[2] ± ambient temperature: 23 ±5°C; whichever is greater
[3] temperature of the object >0°C

Accessories page 30 - 31

- Mounting bracket
- Air purge collar
- Rail mount adapter for controller
- Water cooled housing
- Interface kit
- Software CompactConnect
- Certificate of calibration

LASER RADIATION
DO NOT STARE IN THE BEAM
CLASS 2 LASER
EN60825-1:2002
P≤1mW; λ=630-650nm

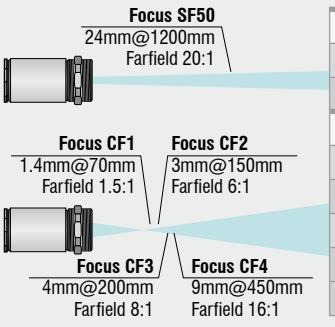
thermoMETER CTlaserFAST

Innovative precision high speed infrared temperature sensor marking the actual spot size on your measurement target at any distance with short response time for extreme fast response.

- ➔ High speed temperature sensor with precise laser aiming
- ➔ Measuring range from -50°C to 975°C
- ➔ 9ms response time for fast moving objects or events
- ➔ Extreme small measurement spot down to 1.4mm
- ➔ Real mapping of the actual spot size, with automatic laser protection
- ➔ Precision optics (50:1) with different models for a specific focus point
- ➔ Up to 85°C ambient temperature without cooling
- ➔ Fully programmable instrument for enhanced signal processing and I/O control
- ➔ Separate controller with easy accessible programming keys and multi color LCD backlit display

Software CompactConnect

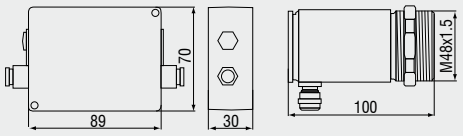
- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels



Optical specifications thermoMETER CTlaserFAST

□ = smallest spot size (mm)

Standard optics																	
SF50 optics	**50:1**	20	20.5	21	21.5	22	22.5	23	23.5	24	29.5	35	48	57	68		
distance in mm		*0*	*150*	*300*	*450*	*600*	*750*	*900*	*1050*	*1200*	*1350*	*1500*	*1800*	*2100*	*2400*		
Close Focus optics																	
CF1 optics	**50:1**	20	10	8.5	1.4	11	26	41	57	72	60	103	118	133	164	194	225
CF2 optics	**50:1**	20	15.5	15	12	9	3	11	19	26	33	42	49	57	72	88	103
CF3 optics	**50:1**	20	16.5	16	14	12	8	4	10	16	21	28	33	40	52	64	76
CF4 optics	**50:1**	20	19.5	19	18.4	18	16.5	15	14	13	11.5	10	9	12	19	25	32
distance in mm		*0*	*40*	*50*	*70*	*100*	*150*	*200*	*250*	*300*	*350*	*400*	*450*	*500*	*600*	*700*	*800*



Product identification

CTLF - SF50 - C3

- Cable length [3 m Standard / 8 m / 15 m]
- Focus [SF50 / CF1 / CF2 / CF3 / CF4]
- thermoMETER CTLaserFAST

Model		CTLF-SF50-C3
Optical resolution		50:1
Temperature range [1]		-50°C to 975°C
Spectral range		8 to 14µm
System accuracy [2,3]		<1.5% or <1.5°C
Repeatability [2]		<1% or <1°C
Temperature resolution		0.5°C
Response time (90% signal)		9ms
Emissivity/gain [1]		0.100 to 1.100
Transmissivity/gain [1]		0.100 to 1.000
Signal processing [1]		peak hold, valley hold, average; extended hold function with threshold and hysteresis
Certificate of calibration		optional
Outputs/analog	channel 1	0/4 to 20mA, 0 to 5/10V, thermocouple J, K
	channel 2	sensor temperature (-40 to 85°C as 0 to 5V or 0 to 10V), alarm output
	optional	relay: 2 x 60VDC/ 42VACeff; 0.4A; optically isolated
Alarm output		open - collector (24V/ 50mA)
Outputs/digital	optional	USB, RS232, RS485, CAN, Profibus DP, Ethernet
Output impedances	current output	mA max. 500Ω (with 5 to 36VDC)
	voltage output	mV min. 100kΩ load impedance; thermocouple 20Ω
Inputs		programmable functional inputs for external emissivity adjustment, ambient temperature compensation, trigger (reset of hold functions)
Cable length		3m (standard), 8m, 15m
Power supply		8 to 36VDC; max. 160mA
Laser		class II (635nm), 1mW, ON/OFF via controller or software
Environmental rating		IP 65 (NEMA-4)
Ambient temperature		sensor: -20°C to 85°C (50°C if Laser ON) controller: 0°C to 85°C
Storage temperature		sensor: -40°C to 85°C controller: -40°C to 85°C
Relative humidity		10 to 95%, non condensing
Vibration	sensor	IEC 68-2-6: 3 G, 11 to 200Hz, any axis
Shock	sensor	IEC 68-2-27: 50 G, 11ms, any axis
Weight		sensor: 600g; controller: 420g

[1] adjustable via controller or software
[2] ± ambient temperature: 23 ±5°C; whichever is greater
[3] temperature of the object >0°C

Accessories page 30 - 31

- Mounting bracket
- Air purge collar
- Rail mount adapter for controller
- Water cooled housing
- Interface kit
- Software CompactConnect
- Certificate of calibration

LASER RADIATION
DO NOT STARE IN THE BEAM
CLASS 2 LASER
EN60825-1:2002
P≤1mW; λ=630-650nm

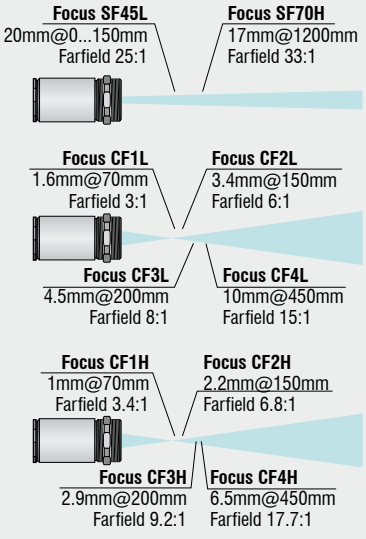
thermoMETER CTlaserGLASS

Innovative precision infrared temperature sensor marking the actual spot size on your measurement target at any distance with 5.2 µm wavelength for glass targets

- ➔ Measuring range from 100°C to 1650°C
- ➔ Accurate glass temperature measurements on flat glass lines, container glass machines, bulb manufacturing, car glass finishing and the production of solar panels
- ➔ Cooling and protection accessories for harsh environmental conditions available
- ➔ Real mapping of the actual spot size, with automatic laser protection
- ➔ Precision optics (45:1 / 70:1) with different models for a specific focus point
- ➔ Extreme small measurement spot down to 1mm
- ➔ Up to 85°C ambient temperature without cooling
- ➔ Fully programmable instrument for enhanced signal processing and I/O control
- ➔ Separate controller with easy accessible programming keys and multi color LCD backlit display

Software CompactConnect

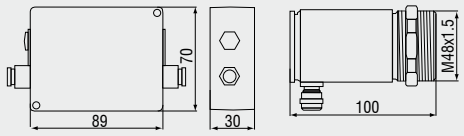
- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels



Optical specifications thermoMETER CTlaserGLASS

□ = smallest spot size (mm)

Standard Focus optics																
SF45L	**45:1**	20	20.8	21.7	22.5	23.4	24.2	25	25.9	27	32.5	38.4	50	61.7	73.4	
SF70H	**70:1**	20	19.6	19.3	19	18.5	18.2	17.8	17.4	17	21.6	26.3	35.5	44.8	54	
distance in mm		*0*	*150*	*300*	*450*	*600*	*750*	*900*	*1050*	*1200*	*1350*	*1500*	*1800*	*2100*	*2400*	
Close Focus optics																
CF1L	**45:1**	20	9.5	7	1.6	11	26.3	41.7	57	72.6	88.2	104	119.6	135	165	196	227
CF1H	**70:1**	20	9	6.5	1	10	25	40	55	70	85	100	115	130	160	190	220
CF2L	**45:1**	20	16	14.5	12	9	3.4	11.2	19	27	35	42.5	50.3	58	73.6	89.2	105
CF2H	**70:1**	20	15.5	14	11	8	2.2	9.6	17	24.5	42	39.2	47	54	69	84	99
CF3L	**45:1**	20	17	16.2	14.5	12.3	8.4	4.5	10.7	16.8	23	29	35	41.3	53.5	65.8	78
CF3H	**70:1**	20	16.9	16	14	11	7.2	2.9	8.7	14.4	20	25.6	31.2	37.3	48.7	60.2	71.6
CF4L	**45:1**	20	19.2	19	18.6	18	17	15.6	14.5	13.4	12.3	11.1	10	13.4	20	26.7	33.4
CF4H	**70:1**	20	18.9	18.5	17.8	17	15.5	14	12.5	11	9.5	8	6.5	9.5	15.4	21.2	27.1
distance in mm		*0*	*40*	*50*	*70*	*100*	*150*	*200*	*250*	*300*	*350*	*400*	*450*	*500*	*600*	*700*	*800*



Product identification

CTLG - SF45L - C3

- Cable length [3 m Standard / 8 m / 15 m]
- Focus [SF45L/ SF70H / CF1L/H / CF2L/H / CF3L/H / CF4L/H]
- thermoMETER CTLaserGLASS

Model		CTLG-SF45L-C3	CTLG-SF70H-C3
Optical resolution		45:1	70:1
Temperature range [1]		100 to 1200°C	250 to 1650°C
Spectral range		5,2µm	
System accuracy [2]		<1% or <1°C	
Repeatability [2]		< 0.5% or <0.5°C	
Temperature resolution		0.1°C	0.2°C
Response time (90% signal)		120ms	80ms
Emissivity/gain [1]		0.100 to 1.100	
Transmissivity/gain [1]		0.100 to 1.000	
Signal processing [1]		peak hold, valley hold, average; extended hold function with threshold and hysteresis	
Certificate of calibration		optional	
Outputs/analog	channel 1	0/4 to 20mA, 0 to 5/10V, thermocouple J, K	
	channel 2	sensor temperature (-40 to 85°C as 0 to 5V or 0 to 10V), alarm output	
	optional	relay: 2 x 60VDC/ 42VACeff; 0.4A; optically isolated	
Alarm output		open - collector (24V/ 50mA)	
Outputs/digital	optional	USB, RS232, RS485, CAN, Profibus DP, Ethernet	
Output impedances	current output	mA max. 500Ω (bei 5 to 36VDC)	
	voltage output	mV min. 100kΩ load impedance; thermocouple 20Ω	
Inputs		programmable functional inputs for external emissivity adjustment, ambient temperature compensation, trigger (reset of hold functions)	
Cable length		3m (standard), 8m, 15m	
Power supply		8 to 36VDC; max. 160mA	
Laser		class II (635nm), 1mW, ON/OFF via controller or software	
Environmental rating		IP 65 (NEMA-4)	
Ambient temperature		sensor: -20°C to 85°C (50°C if Laser is ON) controller: 0°C to 85°C	
Storage temperature		sensor: -40°C to 85°C controller: -40°C to 85°C	
Relative humidity		10 to 95%, non condensing	
Vibration	sensor	IEC 68-2-6: 3 G, 11 to 200Hz, any axis	
Shock	sensor	IEC 68-2-27: 50 G, 11 ms, any axis	
Weight		sensor: 600g; controller: 420g	

[1] adjustable via controller or software
[2] ± ambient temperature: 23 ±5°C; whichever is greater

Accessories page 30 - 31

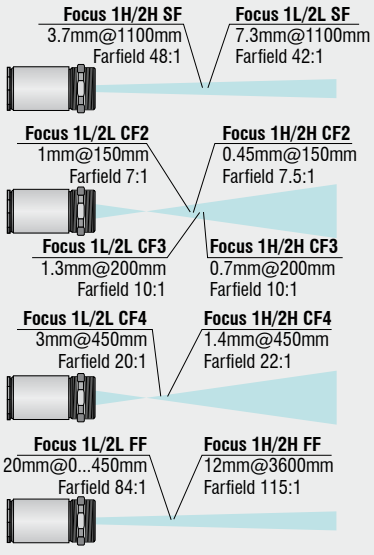
- Mounting bracket
- Air purge collar
- Rail mount adapter for controller
- Water cooled housing
- Interface kit
- Software CompactConnect
- Certificate of calibration

LASER RADIATION
DO NOT STARE IN THE BEAM
CLASS 2 LASER
EN60825-1:2002
P≤1mW; λ=630-650nm

thermoMETER CTlaserM1/M2

Innovative precision infrared temperature sensor marking the actual spot size on your measurement target at any distance with 1/1.6 µm wavelength for metal, ceramic and shiny targets

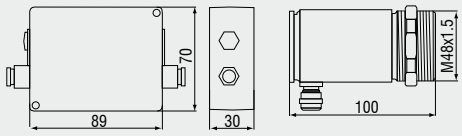
- ➔ Measuring range from 250°C to 1800°C
- ➔ Special short wavelength (1/1.6µm) minimizes errors caused by low emissivity for accurate temperature measurements on metal, shiny and ceramic targets
- ➔ Cooling and protection accessories for harsh environmental conditions
- ➔ Real mapping of the actual spot size, with automatic laser protection
- ➔ Precision optics (300:1 / 150:1) with different models for a specific focus point
- ➔ Extreme small measurement spot down to 0.45mm, only 1ms response time to capture fast events
- ➔ Up to 85°C ambient temperature without cooling
- ➔ Fully programmable instrument for enhanced signal processing and I/O control



Optical specifications thermoMETER CTlaser M1/M2

□ = smallest spot size (mm)

Standard Focus optics														
1L/2L SF	**150:1**	20	18.3	16.5	14.8	13	11.4	9.6	8.5	7.3	9.8	13.5	17.3	23.5	34.6
1H/2H SF	**300:1**	20	17.8	15.5	13.2	11	8.6	6.4	4.8	3.7	5.5	8.6	11.8	17	26.6
	distance in mm	*0*	*150*	*300*	*450*	*600*	*750*	*900*	*1000*	*1100*	*1200*	*1350*	*1500*	*1750*	*2200*
Close Focus optics															
1L/2L CF2	**150:1**	20	13.7	7.3	1	8	15	22	36	50	64	78	92		
1H/2H CF2	**300:1**	20	13.5	7	0.5	7.3	14	21	34.5	48.2	61.8	75.4	89		
1L/2L CF3	**150:1**	20	15.4	10.7	6	1.3	6.7	12	22.6	33.3	44	55	65		
1H/2H CF3	**300:1**	20	15.2	10.3	5.6	0.7	5.9	11	21.2	31.5	41.8	52.1	62.4		
	distance in mm	*0*	*50*	*100*	*150*	*200*	*250*	*300*	*400*	*500*	*600*	*700*	*800*		
Close Focus optics															
1L/2L CF4	**150:1**	20	18.1	16.3	14.4	12.5	10.6	8.7	6.8	4.9	3	5.6	10.7	12.8	21
1H/2H CF4	**300:1**	20	18	16	13.8	11.8	9.7	7.6	5.6	3.5	1.4	3.8	8.6	13.3	18
	distance in mm	*0*	*50*	*100*	*150*	*200*	*250*	*300*	*350*	*400*	*450*	*500*	*600*	*700*	*800*
Far Focus optics															
1L/2L FF	**150:1**	20	20.5	21	21.5	22	22.5	23	23.4	24	29	41	53.4	62.5	
1H/2H FF	**300:1**	20	19	18	17	16	15	14	13.4	12	16.5	24.4	33.4	40	
	distance in mm	*0*	*450*	*900*	*1350*	*1800*	*2250*	*2700*	*3000*	*3600*	*4000*	*5000*	*6000*	*6750*	



Product identification

CTLM - 1 L SF150 - C3

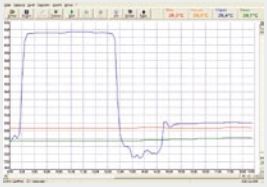
- Cable length [3 m Standard / 8 m / 15 m]
- Focus [SF / CF2 / CF3 / CF4 / FF]
- Temperature range [L / H]
- Spectral range [1 µm / 1,6 µm]
- thermoMETER CTLaserM

Model	CTLM-1LSF150-C3	CTLM-1HSF300-C3	CTLM-2LSF150-C3	CTLM-2HSF300-C3
Optical resolution	150:1	300:1	150:1	300:1
Temperature range [1]	485 to 1050°C	650 to 1800°C	250 to 800°C	385 to 1600°C
Spectral range	1µm		1.6µm	
System accuracy [2]	<(0.3% of reading +2°C)			
Repeatability [2]	<(0.1% of reading +1°C)			
Temperature resolution	0.1°C	0.2°C	0.1°C	0.2°C
Response time (90% signal) [3]	1ms			
Emissivity/gain [1]	0.100 to 1.100			
Transmissivity/gain [1]	0.100 to 1.000			
Signal processing [1]	Peak hold, valley hold, average; extended hold function with threshold and hysteresis			
Certificate of calibration	optional			

Outputs/analog	channel 1	0/4 to 20mA, 0 to 5/ 10V, thermocouple J, K
	channel 2	sensor temperature (-40 to 85°C as 0 to 5V or 0 to 10V), alarm output
	optional	relay: 2 x 60 VDC/ 42VAC$_{eff}$; 0.4A; optically isolated
Alarm output		open-collector (24V/ 50mA)
Outputs/digital	optional	USB, RS232, RS485, CAN, Profibus DP, Ethernet
Output impedances	current output	mA max. 500Ω (with 5 - 36VDC)
	voltage output	mV min. 100kΩ load impedance
		thermocouple 20Ω
Inputs		programmable functional inputs for external emissivity adjustment, ambient temperature compensation, trigger (reset of hold functions)
Cable length		3m (standard), 8m, 15m
Power supply		8 to 36VDC; max. 160mA
Laser		class II (635nm), 1mW, ON/OFF via controller or software

Environmental rating		IP 65 (NEMA-4)
Ambient temperature		sensor: -20°C to 85°C (50 °C if laser ON) controller: 0°C to 65°C
Storage temperature		sensor: -40°C to 85°C controller: -40°C to 85°C
Relative humidity		10 to 95%, non condensing
Vibration	sensor	IEC 68-2-6: 3 G, 11-200Hz, any axis
Shock	sensor	IEC 68-2-27: 50 G, 11ms, any axis
Weight		sensor: 600g; controller: 420g

[1] adjustable via controller or software
[2] E=1, response time 1s; ± ambient temperature: 23 ±5°C
[3] with dynamic adaptation at low signal levels



Software CompactConnect

- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels

Accessories page 30 - 31

- Mounting bracket
- Air purge collar
- Rail mount adapter for controller
- Water cooled housing
- Interface kit
- Software CompactConnect
- Certificate of calibration

LASER RADIATION
DO NOT STARE IN THE BEAM
CLASS 2 LASER
EN60825-1:2002
P≤1mW; λ=630-650nm

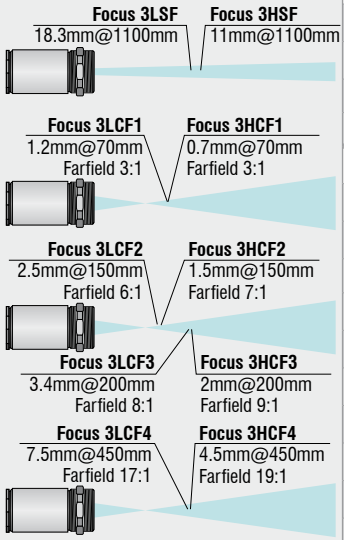
thermoMETER CTlaserM3

Innovative precision infrared temperature sensor marking the actual spot size on your target at any distance with 2.3µm wavelength for metal, ceramic and shiny targets

- ➔ Measuring range from 50°C to 1800°C
- ➔ Special short wavelength (2.3µm) minimizes errors caused by low emissivity for accurate measurements on metal, shiny and ceramic targets down to 50°C
- ➔ Cooling and protection accessories for harsh environmental conditions
- ➔ Real mapping of the actual spot size, with automatic laser protection
- ➔ Precision optics (300:1 / 100:1 / 60:1) with different models for a specific focus point
- ➔ Only 1ms response time to capture fast events
- ➔ Up to 85°C ambient temperature without cooling
- ➔ Fully programmable instrument for enhanced signal processing and I/O control

Software CompactConnect

- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels

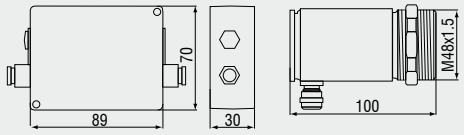


Optical specifications thermoMETER CTlaserM3

□ = smallest spot size (mm)

Standard Focus optics															
3LSF	60:1	20	20	20	20	20	19	19	19	18.3	19	25	30	40	53
3HSF	100:1	20	19	18	17	16	15	14	12	11	13	16	20	28	38
3 H1/H2/H3 SF300	300:1	20	17.8	15.5	13.2	11	8.6	6.4	4.8	3.7	5.5	8.6	11.8	17	26.6
	distance (mm)	*0*	*150*	*300*	*450*	*600*	*750*	*900*	*1000*	*1100*	*1200*	*1350*	*1500*	*1750*	*2200*

Close Focus optics														
3LCF1	60:1	20	9.3	1.2	10.3	25.5	40.5	56	71	102	132	162	192	223
3HCF1	100:1	20	9	0.7	9.6	24.4	39.2	54	69	99	128	158	187	217
	distance (mm)	*0*	*40*	*70*	*100*	*150*	*200*	*250*	*300*	*400*	*500*	*600*	*700*	*800*
3LCF2	60:1	20	14.2	8.4	2.5	10	17.5	25	40	55	70	85	100	
3HCF2	100:1	20	14	7.7	1.5	8.7	16	23	38	52	66	81	95	
3 H1/H2/H3 CF2	300:1	20	13.5	7	0.45	7.3	14	21	34.5	48.2	61.8	75.4	89	
3LCF3	60:1	20	16	11.7	7.6	3.4	9.3	15.1	27	39	51	62	74	
3HCF3	100:1	20	15.5	11	6.5	2	7.5	13	24	35	46	57	68	
3 H1/H2/H3 CF3	300:1	20	15.2	10.3	5.5	0.6	5.8	11	21.2	31.5	41.8	52.1	62.4	
	distance (mm)	*0*	*50*	*100*	*150*	*200*	*250*	*300*	*400*	*500*	*600*	*700*	*800*	



Product identification

CTLM - 3 L SF60 - C3

- Cable length [3 m Standard / 8 m / 15 m]
- Focus [SF / CF1 / CF2 / CF3 / CF4]
- Temperature range [L / H]
- Spectral range [2,3 µm]
- thermoMETER CTLaserM3

Model	CTLM-3LSF60-C3	CTLM-3HSF100-C3	CTLM-3H1SF300-C3	CTLM-3H2SF300-C3	CTLM-3H3SF300-C3
Optical resolution	60:1	100:1	300:1	300:1	300:1
Temperature range [1,2]	50 to 400°C	100 to 600°C	150 to 900°C	200 to 1200°C	350 to 1800°C
Spectral range	2.3 µm				
System accuracy [3]	<(0.3% of reading +2°C)				
Repeatability [3]	<(0.1% of reading +1°C)				
Temperature resolution (digital)	0.1°C				
Response time (90% signal) [4]	1 ms				
Emissivity/gain [1]	0.100 to 1.100				
Transmissivity/gain [1]	0.100 to 1.100				
Signal processing [1]	peak hold, valley hold, average; extended hold function with threshold and hysteresis				
Certificate of calibration	optional				

Outputs/analog	channel 1 channel 2	0/4 to 20mA, 0 to 5/ 10V, thermocouple J, K sensor temperature (-40 to 85°C as 0 to 5 V or 0 to 10 V), alarm output
Outputs/analog (option)		relay: 2 x 60 VDC / 42 VAC; 0.4 A; optically isolated
Alarm output		open-collector (24 V / 50 mA)
Outputs/digital	option	USB, RS232, RS485, CAN, Profibus DP, Ethernet
Output impedances	current output voltage output	mA max. 500Ω (with 5 - 36VDC) mV min. 100kΩ load impedance; thermocouple 20Ω
Inputs		programmable functional inputs for external emissivity adjustment, ambient temperature compensation, trigger (reset of hold functions)
Cable length		3 m (standard), 8 m, 15 m
Power supply		8 to 36 VDC; max. 160 mA
Laser		class II (635nm), 1mW, ON/OFF via controller or software

Environmental rating		IP 65 (NEMA-4)
Ambient temperature		sensor: -20°C to 85°C (50 °C if laser ON) controller: 0 °C to 85 °C
Storage temperature		sensor: -40 °C to 85 °C controller: -40 °C to 85 °C
Relative humidity		10 to 95%, non condensing
Vibration	sensor	IEC 68-2-6: 3 G, 11-200Hz, any axis
Shock	sensor	IEC 68-2-27: 50 G, 11 ms, any axis
Weight		sensor: 600 g; controller: 420 g

[1] adjustable via controller or software
[2] target temperature > sensor temperature + 25°C
[3] E=1, response time 1s; ± ambient temperature: 23 ±5°C
[4] with dynamic adaptation at low signal levels

Optical specifications thermoMETER CTlaserM3

□ = smallest spot size (mm)

Close Fokus															
3LCF4	**60:1**	20	18.7	17.3	15.9	14.5	13.1	11.7	10.3	9	7.5	10.6	17	23	29
3HCF4	**100:1**	20	18.3	16.6	14.9	13.2	11.4	9.7	8	6.3	4.5	7.3	13	19	24
3 H1/H2/H3 CF4	**300:1**	20	18	16	13.8	11.8	9.7	7.6	5.6	3.5	1.4	3.8	8.6	13.3	18
distance (mm)		*0*	*50*	*100*	*150*	*200*	*250*	*300*	*350*	*400*	*450*	*500*	*600*	*700*	*800*
Far Field															
3 H1/H2/H3 FF	**300:1**	20	19	18	17	16	15	14	13.4	12	16.5	24.4	33.4	40	
distance (mm)		*0*	*450*	*900*	*1350*	*1800*	*2250*	*2700*	*3000*	*3600*	*4000*	*5000*	*6000*	*6750*	

LASER RADIATION
DO NOT STARE IN THE BEAM
CLASS 2 LASER
EN60825-1:2002
P≤1mW; λ=630-650nm

Accessories page 26 - 27

- Mounting bracket
- Air purge collar
- Rail mount adapter for controller
- Water cooled housing
- Interface kit
- Software CompactConnect
- Certificate of calibration

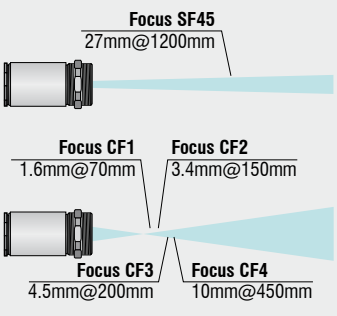
thermoMETER CTLaserCOMBUSTION

The combustion temperature sensors has been designed specially for the measurement of combustion processes. The thermoMETER CTlaser C2/C4/C6 sensors can measure the temperature of objects through flames or directly record the temperature of the flame itself.

- ➔ Measuring range from 200°C to 1450°C
- ➔ Double laser aiming marks real spot location at any location
- ➔ Extreme small measurement spot down to 1.6mm
- ➔ 10 ms response time for fast moving objects or events
- ➔ Optics 45:1 with selectable focus
- ➔ Up to 85°C ambient temperature without cooling
- ➔ Cooling and protection accessories for harsh environmental conditions available
- ➔ Fully programmable instrument for enhanced signal processing and I/O control
- ➔ Separate controller with easy accessible programming keys and multi color LCD backlit display

Software CompactConnect

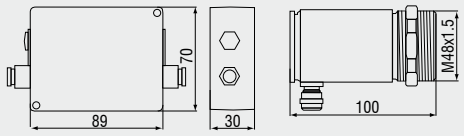
- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels



Optical specifications thermoMETER CTLaserCOMBUSTION

□ = smallest spot size (mm)

Standard Focus optics																	
SF45	**45:1**	20	20.8	21.7	22.5	23.4	24.2	25	25.9	27	32.5	38.4	50	61.7	73.4		
distance in mm		*0*	*150*	*300*	*450*	*600*	*750*	*900*	*1050*	*1200*	*1350*	*1500*	*1800*	*2100*	*2400*		
Close Focus optics																	
CF1	**45:1**	20	9.5	7	1.6	11	26.3	41.7	57	72.6	88.2	104	1196	135	165	196	227
CF2	**45:1**	20	16	14.5	12	9	3.4	11.2	19	27	35	42.5	50.3	58	73.6	89.2	105
CF3	**45:1**	20	17	16.2	14.5	12.3	8.4	4.5	10.7	16.8	23	29	35	41.3	53.5	65.8	78
CF4	**45:1**	20	19.2	19	18.6	18	17	15.6	14.5	13.4	12.3	11.1	10	13.4	20	26.7	33.4
distance in mm		*0*	*40*	*50*	*70*	*100*	*150*	*200*	*250*	*300*	*350*	*400*	*450*	*500*	*600*	*700*	*800*



Product identification

CTLC - 4 SF45 - C3

- Cable length [3 m Standard / 8 m / 15 m]
- Focus [SF45 / CF1 / CF2 / CF3 / CF4]
- Spectral range [3.9 μm / 4.24 μm / 4.64 μm]
- thermoMETER CTLaserCOMBUSTION

Model	CTLC-4SF45-C3	CTLC-2SF45-C3	CTLC-6SF45-C3
Optical resolution	45:1	45:1	45:1
Temperature range [1]	200°C to 1450°C		
Spectral range	3.9μm	4.24μm	4.64μm
Fields of application	through flames to monitor workpieces inside ovens, to measure inside chemical reactors, to observe the brick temperature in combustion chambers	CO_2 flame gases in combustion processes, garbage burning or processes inside chemical reactors	CO flame gases in combustion processes, garbage burning or processes inside chemical reactors
System accuracy [3, 4]	±1% or ±1.5°C		
Repeatability [3]	±0.5% or ±0.5°C		
Temperature resolution	0.1°C		
Response time (90% signal) [2]	10ms		
Emissivity/gain [1]	0.100 - 1.100		
Transmissivity/gain [1]	0.100 - 1.000		
Signal processing [1]	peak hold, valley hold, average; extended hold function with threshold and hysteresis		

Outputs/analog	channel 1	0/4 - 20mA, 0 - 5/10V, thermocouple J, K
	channel 2	sensing head temperature (-20°C to 85°C as 0 to 5V or 0 to 10V), alarm output
Alarm output		24V / 50mA (open collector)
Optional		relay: 2 x 60 V DC/42 V AC_{eff}; 0.4 A; optically isolated
Outputs/digital	optional	USB, RS232, RS485, CAN, Profibus DP, Ethernet
Output impedances	current output	mA max. 500 Ω (with 8 to 36 V DC)
	voltage output	mV min. 100 Ω load impedance ; thermocouple 20 Ω
Inputs		programmable functional inputs for external emissivity adjustment, ambient temperature compensation, trigger (reset of hold functions)
Cable length		3m (standard), 8m, 15m
Power supply		8 to 36VDC; max. 160mA
Laser		class II (635nm), 1mW, ON/OFF via controller or software

Environmental rating	IP 65 (NEMA-4)
Ambient temperature	sensor: -20°C to 85°C (50°C if Laser ON) ; controller: 0°C to 85°C
Storage temperature	-40°C to 85°C
Relative humidity	10 to 95%, non condensing
Vibration	IEC 68-2-6: 3 G, 11 - 200Hz, any axis
Shock	IEC 68-2-27: 50 G, 11ms, any axis
Weight	sensor: 600g ; controller: 420g

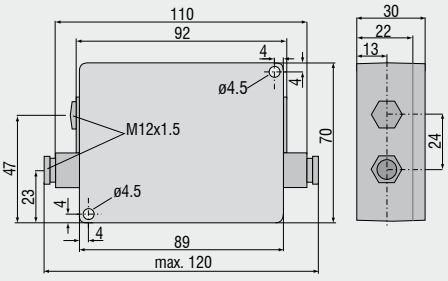
[1] adjustable via programming keys or software
[2] with dynamic adaption at low signal levels
[3] at ambient temperature 23 ±5°C; whichever is greater; temperature of the object >0°C
[4] ε = 1, response time 1s

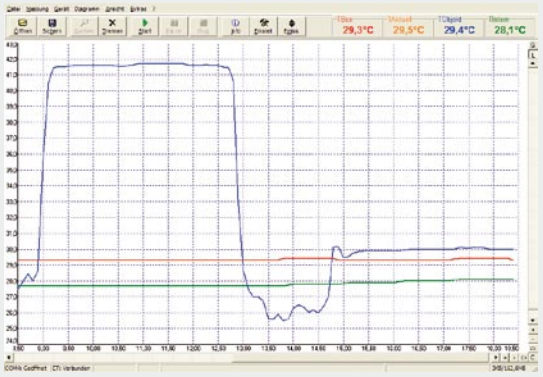
Accessories page 30 - 31

- Mounting bracket
- Air purge collar
- Rail mount adapter for controller
- Water cooled housing
- Interface kit
- Software CompactConnect
- Certificate of calibration

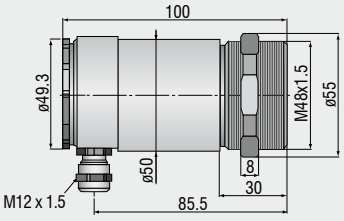
LASER RADIATION
DO NOT STARE IN THE BEAM
CLASS 2 LASER
EN60825-1:2002
P≤1mW; λ=630-650nm

Controller





CTLaser / CTlaserGLASS / CTlaserM1/M2 CTlaserM3 / CTLaserCOMBUSTION

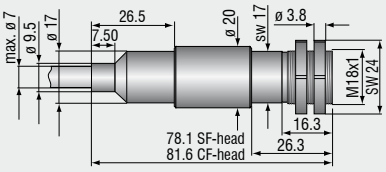


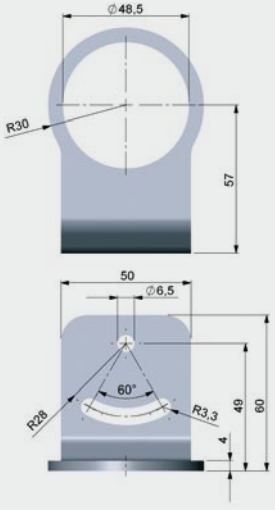
Software CompactConnect

- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels

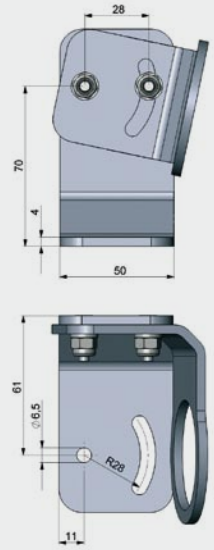
System requirements
- Windows XP, Vista, Windows 7
- USB 2.0
- Hard disc min. 30 MByte
- min. 128 MByte RAM
- CD-ROM drive

CTratioM1



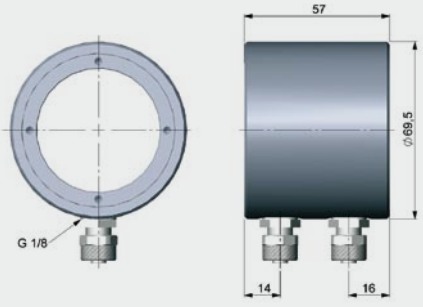


TM-FB-CTL Mounting bracket (fixed)

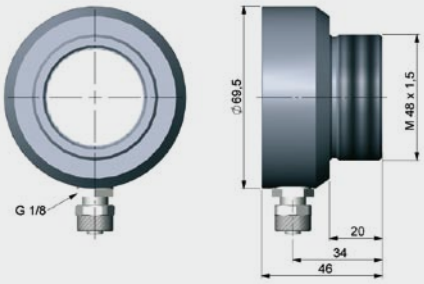


TM-AB-CTLMounting bracket (adjustable)

TM-W-CTL Water cooled housing and air purge collar TM-AP-CTL, mounted on adjustable mounting bracket TM-AB-CTL



TM-W-CTL Water cooled housing



TM-AP-CTL Air purge collar

Mechanical accessories

Art. No.	*Model*	
2970238	TM-AB-CTL	Mounting bracket, adjustable, stainless steel
2970239	TM-AP-CTL	Air purge collar, stainless steel
2970240	TM-W-CTL	Water cooled housing, stainless steel, for ambient temperatures up to 175°C
2970241	TM-RAIL-CTL	Rail mount adapter for CTlaser controller
2970242	TM-COV-CTL	Closed cover for controller
2970243	TM-MN-CTL	Mounting nut, stainless steel (spare)
2970244	TM-FB-CTL	Mounting bracket, fixed, stainless steel (spare)

High temperature accessories

2970366	TM-J-CTL	Cooling jacket (length 228mm, ø89mm) (connection kit TM-CONK-CTL is required)
2970374	TM-CONK-CTL	Connection kit: sensor with axial cable exit, for integration in cooling jacket
2970368	TM-JAB-CTL	Adjustable mounting bracket for cooling jacket
2970369	TM-AST300-CTL	Sighting tube M48x1.5, 300 mm length
2970370	TM-PA-CTL	Pipe adapter M48x1.5
2970371	TM-RM-CTL	Furnace wall mount accessory for CTLaser (TM-MF-CTL, TM-AST300-CTL and TM-PA-CTL)
2970372	TM-MF-CTL	Mounting flange M48x1.5 for mounting a CTL sensor

Calibration

2970253	TM-CERT-CTL	Certificate of calibration
2970324	TM-HTCERT-CTL	Certificate of calibration for CTlaser M1-/M2-/M3-/G-

Interfaces

2970245	TM-USBK-CTL	USB interface kit incl. computer cable, software CompactConnect
2970246	TM-RS232K-CTL	RS232 interface kit incl. computer cable, software CompactConnect
2970338	TM-RS485USBK-CTL	RS485-USB-adapter, incl. PC cable, RS485 board, software CTconnect, terminal block, for use with TM-485B-CTL
2970248	TM-RS485B-CTL	RS485 interface board
2970249	TM-CANK-CTL	CAN-Bus interface for optris CT/ protocol: CANopen Presettings: module address 20 (14H), 250kBaud, 0-60°C
2970250	TM-PFBDPK-CTL	Profibus-DPv1 interface for CT selectable with DIN M12 or SUB-D connection
2970251	TM-ETHNK-CTL	Ethernet-Kit: interface board, external Ethernet adapter, software CompactConnect
2970252	TM-RI-CTL	Relay interface: Two optically isolated relays, 60VDC/ 42VACRMS, 0.4A

Sensor cables and high temperature cables

2970374	TM-CONK-CTL	Connector-Kit for additional cable connector
4800254.003	TM-CB3C-CTL	Sensor cable with adapter (3m)
4800254.003H	TM-CB3HC-CTL	High-temperature sensor cable with adapter (3m)
4800254.008	TM-CB8C-CTL	Sensor cable with adapter (8m)
4800254.008H	TM-CB8HC-CTL	High-temperature sensor cable with adapter (8m)
4800254.015	TM-CB15C-CTL	Sensor cable with adapter (15m)
4800254.015H	TM-CB15HC-CTL	High-temperature sensor cable with adapter (15m)

TM-J-CTL Cooling jacket (length 228mm, ø89mm) with adjustable mounting bracket TM-JAB-CTL; up to 200°C ambient temperature

TM-MF-CTL Mounting flange M48x1.5 for mounting a CTL sensor

TM-RM-CTL Furnace wall mount accessory for CTLaser / CTratio: TM-MF-CTL, TM-AST300-CTL und TM-PA-CTL

CTratio

Art. No.	*Model*	
2970348	TM-FB-CTR	Mounting bracket, adjustable in one axis
2970349	TM-AB-CTR	Mounting bracket, adjustable in two axes
2970350	TM-AP-CTR	Air purge collar
2970351	TM-CERT-CTR	Certificate of calibration for CTratio
	TM-RM-CTR	Furnace wall mount accessory for CTratio

Spare parts

Controller, sensors and cables also available as spare parts - please contact Micro-Epsilon

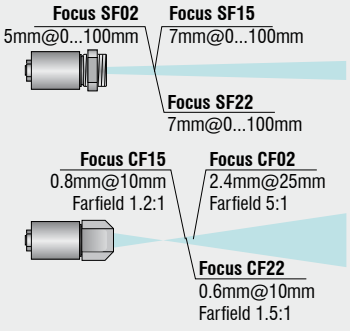
thermoMETER CT

This state of the art non contact infrared temperature sensor sets the industry standard for common applications with a spectral range of 8...14µm. It offers the most compact sensing head packaging in conjunction with a sophisticated fully instrumented controller.

- ➔ Measuring range from -50 to 975°C
- ➔ World's smallest sensor with 22:1 precision optics
- ➔ Rugged design, operates in an environment up to 180°C without cooling
- ➔ Analog and digital output, thermocouple J/K emulation and serial interface
- ➔ 150ms response time
- ➔ Fully programmable instrument for enhanced signal processing and I/O control
- ➔ Separate controller with easy accessible programming keys and multi color LCD backlit display
- ➔ Best price / performance value

Software CompactConnect

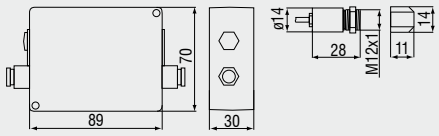
- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels



Optical specifications thermoMETER CT

□ = smallest spot size (mm)

Standard Focus optics										
SF02	**2:1**	5	50	100	150	200	250	300	350	400
SF15	**15:1**	7	8	13	20	27	33	40	47	53
SF22	**22:1**	7	7	9	14	18	23	27	32	36
distance in mm		*0*	*100*	*200*	*300*	*400*	*500*	*600*	*700*	*800*
Close Focus optics (CF lense optional available)										
CF02	**2:1**	7	5.6	4.3	3	2.5	2.4	3	4.7	6.3
CF15	**15:1**	7	5	0.8	5	11	16	21	27	32
CF22	**22:1**	7	4	0.6	4	8	12	16	20	24
distance in mm		*0*	*5*	*10*	*15*	*20*	*25*	*30*	*35*	*40*



Product identification

CT - SF02 - C3

- Cable length [1m / 3m (standard) / 8m / 15m]
- Focus [SF02 / SF15 /SF22]
- thermoMETER CT

Model		CT-SF02-C3	CT-SF15-C3	CT-SF22-C3
Optical resolution		2:1	15:1	22:1
Temperature range [1]		-50°C to 600°C	-50°C to 600°C	-50°C to 975°C
Spectral range		8 to 14µm		
System accuracy [2]		<1% or <1°C		
Repeatability [2]		<0.5% or <0.5°C		
Temperature resolution		<0.1°C		
Response time		150ms (95%)		
Emissivity/gain [1]		0.100 to 1.100		
Transmissivity/gain [1]		0.100 to 1.100		
Signal processing [1]		peak hold, valley hold, average; extended hold function with threshold and hysteresis		
Certificate of calibration		optional		
Outputs/analog	channel 1	0/4 to 20mA, 0 to 5/10V, thermocouple J, K		
	channel 2	sensor temperature (-20 to 180°C as 0 to 5V or 0 to 10V), alarm output		
	optional	relay: 2 x 60VDC/ 42VACeff; 0.4A; optically isolated		
Outputs/digital	optional	USB, RS232, RS485, CAN, Profibus DP, Ethernet		
Output impedances	current output	mA max. 500Ω (with 8 to 36VDC)		
	voltage output	mV min. 100kΩ load impedance		
		thermocouple 20Ω		
Inputs		programmable functional inputs for external emissivity adjustment, ambient temperature compensation, trigger (reset of hold functions)		
Cable length		1m , 3m (standard), 8m, 15m		
Power supply		8 to 36VDC; max. 100mA		
Environmental rating		IP 65 (NEMA-4)		
Ambient temperature	sensor	-20°C to 130°C	-20°C to 180°C	
	controller	0 °C to 85°C		
Storage temperature	sensor	-40°C to 130°C	-40°C to 180°C	
	controller	-40°C to 85°C		
Relative humidity		10 - 95%, non condensing		
Vibration	sensor	IEC 68-2-6: 3 G, 11 to 200Hz, any axis		
Shock	sensor	IEC 68-2-27: 50 G, 11ms, any axis		
Weight		sensor: 40g; controller: 420g		

[1] adjustable via controller or software

[2] ± ambient temperature 23 ±5°C; whichever is greater

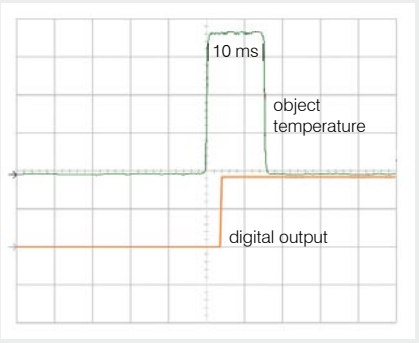
Accessories page 52 - 55

- CF lense
- Protective window
- Mounting bracket / Mounting bolt
- Air purge collar
- Right angle mirror
- Rail mount adapter for controller
- Massive housing
- Protective tube
- Laser sighting tool
- Digital-Interface kit
- Relay output module
- Accessory-Kit for use of the CT in hazardous locations
- Software CompactConnect
- Certificate of calibration

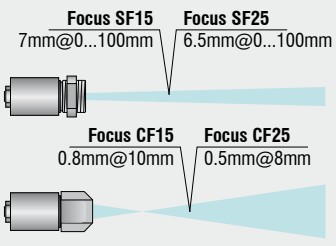
thermoMETER CTfast

This unit incorporates the world's fastest thermopile detector. It captures fastest events or moving objects and gets an accurate temperature reading with an response time as little as 3ms / 6ms.

- ➔ Measuring range from -50 to 975°C
- ➔ One of the smallest infrared sensors worldwide with response times as short as 3ms (50% signal) and 6ms (90% signal)
- ➔ Continuous process monitoring with an unchoppered sensor system. Note: Conventional fast pyroelectrical infrared sensors with mechanical chopper see processes only part of the time
- ➔ Easy to assemble in multiple arrays for line scanning of small and fast objects (hotspot detection) using a bus communication
- ➔ Analog and digital output, thermocouple J/K emulation and serial interface
- ➔ Fully programmable instrument for enhanced signal processing and I/O control
- ➔ Separate controller with easy accessible programming keys and multi color LCD backlit display



Time constants for temperature jumps between 25°C and 180°C (Model SF 15)

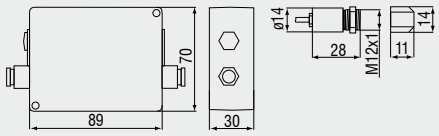


Optical specifications thermoMETER CTfast

□ = smallest spot size (mm)

Standard Focus optics													
SF15	**15:1**	7	8	13	20	27	33	40	47	53			
SF25	**25:1**	6.5	7.3	8	12	16	20	24	28	32	36	40	44
distance in mm		*0*	*100*	*200*	*300*	*400*	*500*	*600*	*700*	*800*	*900*	*1000*	*1100*

Close Focus optics (CF lens optional available)											
CF15	**15:1**	7	5	0.8	5	11	16	21	27	32	
distance in mm		*0*	*5*	*10*	*15*	*20*	*25*	*30*	*35*	*40*	
CF25	**25:1**	6.2	3.4	0.5	3.8	7.1	10.4	14.5	18.7	22.8	27
distance in mm		*0*	*4*	*8*	*12*	*16*	*20*	*25*	*30*	*35*	*40*



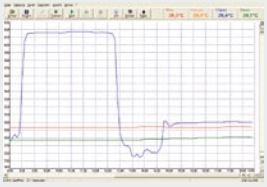
Product identification

CTF - SF15 - C3

- Cable length [1 m / 3 m (standard) / 8 m / 15 m]
- Focus [SF15 / SF25 / CF15 / CF25]
- thermoMETER CTfast

Model		CTF-SF15-C3	CTF-SF25-C3
Optical resolution		15:1	25:1
Temperature range [1]		-50°C to 975°C	
Spectral range		8 to 14µm	
System accuracy [2]		<1% or ±2°C	
Repeatability [2]		<0.75% or ±0.75°C	
Temperature resolution [3, 4]		<0.2°C	<0.4°C
Response time [5]		9ms (90%) at analog output 4ms (50%) at digital output	6ms (90%) at analog output 3ms (50%) at digital output
Emissivity/gain [1]		0.100 to 1.100	
Transmissivity/gain [1]		0.100 to 1.100	
Signal processing [1]		Peak hold, valley hold, average; extended hold function with threshold and hysteresis	
Certificate of calibration		optional	
Outputs/analog		0/4 to 20mA; 0 to 5/10V; thermocouple J, K	
Alarm output		open-collector (24V/ 50mA)	
Outputs/digital	standard	0/10V (10mA)	
	optional	optional: relay: 2 x 60VDC/ 42V AC; 0.4 mA; optically isolated	
Digitales Interface	optional	USB, RS232, RS485, CAN, Profibus DP, Ethernet	
Output impedances	current output	mA max. 500Ω (8 to 36VDC)mV	
	voltage output	min. 100kΩ load impedance ; thermocouple 20Ω	
Inputs		programmable functional inputs for external emissivity adjustment, ambient temperature compensation, trigger (reset of hold functions)	
Cable length		1m, 3m (standard), 8m, 15m	
Power supply		8 to 36VDC; max. 100mA	
Environmental rating		IP 65 (NEMA-4)	
Ambient temperature		sensor: -20°C to 120°C controller: 0°C to 85°C	
Storage temperature		sensor: -40°C to 120°C controller: -40°C to 85°C	
Relative humidity		10 to 95%, non condensing	
Vibration	sensor	IEC 68-2-6: 3 G, 11 to 200Hz, any axis	
Shock	sensor	IEC 68-2-27: 50 G, 11ms, any axis	
Weight		sensor: 40g; controller: 420g	

[1] adjustable via programming keys or software
[2] ± ambient temperature 23 ±5°C; whichever is greater with dynamic noise compression
[3] at object temperature ≥20°C
[4] at time constant 100ms with smart averaging and T_{obj} 25°C
[5] with dynamic adaption at low signal levels



Software CompactConnect

- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels

Accessories page 48 - 51

- CF lense
- Protective window
- Mounting bracket / Mounting bolt
- Air purge collar
- Right angle mirror
- Rail mount adapter for controller
- Massive housing
- Protective tube
- Laser sighting tool
- Digital-Interface kit
- Software CompactConnect
- Certificate of calibration

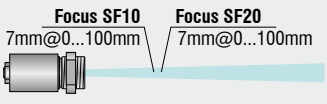
thermoMETER CTG5

This state of the art non contact infrared temperature sensor operates with a wavelength of 5.2µm. This special spectral range optimizes the IR temperature reading against glass.

- ➔ Measuring range from 100° to 1650°C
- ➔ 5.2µm wave length for measurements applications on flat glass, container glass, light bulb manufacturing, gar glass production and manufacturing of photovoltaic cells
- ➔ Up to 85°C ambient temperature without cooling
- ➔ Precision optics (20:1/10:1) with different models for a specific focus point
- ➔ 80ms response time
- ➔ Fully programmable instrument for enhanced signal processing and I/O control
- ➔ Separate controller with easy accessible programming keys and multi color LCD backlit display

Software CompactConnect

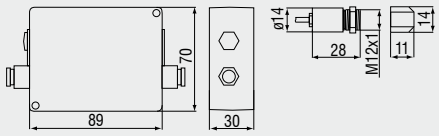
- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels



Optical specifications thermoMETER CTG5

□ = smallest spot size (mm)

Standard Focus optics										
SF10	**10:1**	7	10	20	30	40	50	60	70	80
SF20	**20:1**	7	7	10	15	20	25	30	35	40
	distance in mm	*0*	*100*	*200*	*300*	*400*	*500*	*600*	*700*	*800*



Product identification

CTG - SF10 - C3

- Cable length [3 m (standard) / 8 m / 15 m]
- Focus [SF10 / SF20]
- thermoMETER CTG5

Model		CTG-SF10-C3	CTG-SF20-C3
Optical resolution		10:1	20:1
Temperature range [1]		100 to 1200°C	250 to 1650°C
Spectral range		5.2µm	
System accuracy [2]		<1% or <2°C	
Repeatability [2]		<0.5% or <0.5°C	
Temperature resolution		<0.1°C	<0.2°C
Response time		80ms	120ms
Emissivity/gain [1]		0.100 to 1.100	
Transmissivity/gain [1]		0.100 to 1.100	
Signal processing [1]		Peak hold, valley hold, average; extended hold function with threshold and hysteresis	
Outputs/analog	channel 1	0/4 to 20mA, 0 to 5/10V, thermocouple J, K	
	channel 2	sensor temperature (-40 to 85°C as 0 to 5V or 0 to 10V), alarm output	
	optional	relay: 2 x 60V DC/ 42VAC$_{eff}$; 0.4A; optically isolated	
Outputs/digital	optional	USB, RS232, RS485, CAN, Profibus DP, Ethernet	
Output impedances	current output	mA max. 500Ω (8 to 36VDC)	
	voltage output	mV min. 100kΩ load impedance	
		thermocouple 20Ω	
Inputs		programmable functional inputs for external emissivity adjustment, ambient temperature compensation, trigger	
Cable length		3m (standard), 8m, 15m	
Power supply		8 to 36VDC; max. 100mA	
Environmental rating		IP 65 (NEMA-4)	
Ambient temperature		sensor: -20°C to 85°C controller: 0°C to 85°C	
Storage temperature		sensor: -40°C to 85°C controller: -40°C to 85°C	
Relative humidity		10 to 95%, non condensing	
Vibration	sensor	IEC 68-2-6: 3 G, 11 to 200Hz, any axis	
Shock	sensor	IEC 68-2-27: 50 G, 11ms, any axis	
Weight		sensor: 42g; controller: 420g	

[1] adjustable via programming keys or software
[2] ± ambient temperature: 23±5°C; whichever is greater

Accessories page 48 - 51

- CF lense
- Protective window
- Mounting bracket / Mounting bolt
- Air purge collar
- Right angle mirror
- Rail mount adapter for controller
- Massive housing
- Protective tube
- Laser sighting tool
- Digital-Interface kit
- Software CompactConnect
- Certificate of calibration
- Relay output module

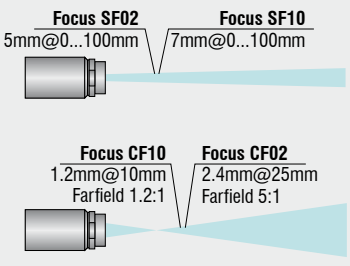
thermoMETER CThot

The CThot has been designed for the most extreme temperature environment applications. The thermopile detector embedded inside the sensor head is absolutely unique. It can measure in an ambient environment of 250°C without any additional external cooling. The compact sensor head is housed in a special housing to reduce any thermal shock.

- ➔ Measuring range from -40°C to 975°C
- ➔ Sensor operates in up to 250°C environment without any cooling
- ➔ Integrated high temperature cable
- ➔ Ideal for applications in dryers, ovens, heat treatment lines in the metal and glass industry, paper, plastic and textile manufacturing and semiconductor processing
- ➔ Analog and digital output, thermocouple J/K emulation and serial interface (optional)
- ➔ Fully programmable instrument for enhanced signal processing and I/O control
- ➔ Separate controller with easy accessible programming keys and multi color LCD backlit display

Software CompactConnect

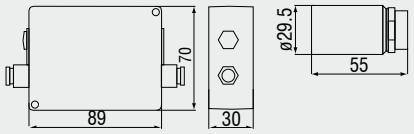
- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels



Optical specifications thermoMETER CThot

□ = smallest spot size (mm)

Standard Focus optics										
SF02	2:1	5	50	100	150	200	250	300	350	400
SF10	10:1	7	10	20	30	40	50	60	70	80
distance in mm		*0*	*100*	*200*	*300*	*400*	*500*	*600*	*700*	*800*
Close Focus optics (CF lens optional available)										
CF02	2:1	7	5.6	4.3	3	2.5	2.4	3	4.7	6.3
CF10	10:1	7	5	1.2	8	18	24			
distance in mm		*0*	*5*	*10*	*15*	*20*	*25*	*30*	*35*	*40*



Product identification

CTH - SF02 - C3H

- Cable length [3 m (standard) / 8 m / 15 m]
- Focus [SF02 / SF10]
- thermoMETER CThot

Model		CTH-SF02-C3H	CTH-SF10-C3H
Optical resolution		2:1	10:1
Temperature range [1]		-40 to 975°C	
Spectral range		8 to 14µm	
System accuracy [2]		<1% or <1.5°C	
Repeatability [2]		<0.5% or <0.5°C	
Temperature resolution		<0.25°C	
Response time		100ms	
Emissivity/gain [1]		0.100 to 1.100	
Transmissivity/gain [1]		0.100 to 1.100	
Signal processing [1]		Peak hold, valley hold, average; extended hold function with threshold and hysteresis	
Certificate of calibration		optional	
Outputs/analog	channel 1	0/4 to 20mA, 0 to 5/10V, thermocouple J, K	
	channel 2	sensor temperature (-40 to 250°C as 0 to 5V or 0 to 10V), alarm output	
	optional	relay: 2 x 60V DC/ 42VACeff; 0.4A; optically isolated	
Outputs/digital	optional	USB, RS232, RS485, CAN, Profibus DP, Ethernet	
Output impedances	current output	mA max. 500Ω (5 to 36VDC)	
	voltage output	mV min. 100kΩ load impedance	
		thermocouple 20Ω	
Inputs		programmable functional inputs for external emissivity adjustment, ambient temperature compensation, trigger (reset of hold functions)	
Cable length		3m (standard), 8m, 15m	
Power supply		8 to 36VDC; max. 100mA	
Environmental rating		IP 65 (NEMA-4)	
Ambient temperature		sensor: -20°C to 250°C controller: 0°C to 85°C	
Storage temperature		sensor: -40°C to 250°C controller: -40°C to 85°C	
Relative humidity		10 to 95%, non condensing	
Vibration	sensor	IEC 68-2-6: 3 G, 11 to 200Hz, any axis	
Shock	sensor	IEC 68-2-27: 50 G, 11ms, any axis	
Weight		sensor: 40g (without massive housing); controller: 420g	

[1] adjustable via programming keys or software

[2] ± ambient temperature: 23±5°C; whichever is greater; at object temperatures ≥20°C

Accessories page 48 - 51

- Rail mount adapter for controller
- Digital-Interface kit
- Software CompactConnect
- Relay output module
- Certificate of calibration

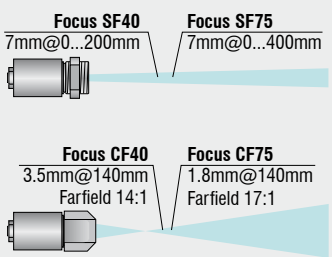
thermoMETER CTM1/M2

This state of the art non contact infrared temperature sensor operates with a wavelength of 1/1.6µm. This special spectral range minimizes the emissivity errors on shiny targets and allows readings through glass. The integrated photon detector guarantees maximum sensitivity and extreme fast response time.

- ➔ Measuring range from 250° to 1800°C
- ➔ 1.0µm and 1.6µm wave length for measurements of metals, metal oxides, ceramic materials and shiny targets
- ➔ Short measuring wave length reduces error of temperature readings on surfaces with low or unknown emissivity
- ➔ Up to 125°C ambient temperature without cooling
- ➔ Precision optics (75:1/40:1) with different models for a specific focus point
- ➔ 1ms response time to capture fast events
- ➔ Fully programmable instrument for enhanced signal processing and I/O control
- ➔ Separate controller with easy accessible programming keys and multi color LCD backlit display

Software CompactConnect

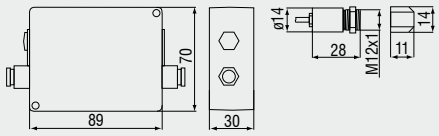
- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels



Optical specifications thermoMETER CTM1/M2

□ = smallest spot size (mm)

Standard Focus optics										
1SF40/2SF40	**40:1**	7	7	10	15	20	25	30	35	40
1SF75/2SF75	**75:1**	7	7	7	8	11	14	17	20	23
distance in mm		*0*	*200*	*400*	*600*	*800*	*1000*	*1200*	*1400*	*1600*
Close Focus optics (integrated CF lens)										
1CF40/2CF40	**40:1**	6.5	5.5	4.4	2.7	5.7	7.8	11.4	15	18.5	22.1
1CF75/2CF75	**75:1**	6.5	5	3.2	1.5	3.6	5.4	8.4	11.3	14.3	17.3
distance in mm		*0*	*50*	*100*	*110*	*170*	*200*	*250*	*300*	*350*	*400*



Product identification

CTM - 1 SF40 - C3

- Cable length [3 m (standard) / 8 m / 15 m]
- Focus [SF40 / SF75 / CF40 / CF75]
- Spectral range [1 µm / 1.6 µm]
- thermoMETER CTM

Model		CTM-1SF40-C3	CTM-1SF75-C3	CTM-2SF40-C3	CTM-2SF75 -C3
Optical resolution		40:1	75:1	40:1	75:1
Temperature range [1]		485 to 1050°C	650 to 1800°C	250 to 800°C	385 to 1600°C
Spectral range		1.0µm		1.6µm	
System accuracy [2,3]		±(0.3% of reading +2°C)			
Repeatability [2]		±(0.1% of reading +1°C)			
Temperature resolution		<0.1°C			
Response time [4]		1ms (90%)			
Emissivity/gain [1]		0.100 to 1.100			
Transmissivity/gain [1]		0.100 to 1.100			
Signal processing [1]		Peak hold, valley hold, average; extended hold function with threshold and hysteresis			
Certificate of calibration		optional			
Outputs/analog	channel 1	0/4 to 20mA, 0 to 5/10V, thermocouple J, K			
	channel 2	sensor temperature (-20 to 100°C as 0 to 5V or 0 to 10V), alarm output			
	optional	relay: 2 x 60V DC/ 42V ACeff; 0.4A; optically isolated			
Outputs/digital	optional	USB, RS232, RS485, CAN, Profibus DP, Ethernet			
Output impedances	current output	mA max. 500Ω (8 to 36VDC)			
	voltage output	mV min.100kΩ load impedance			
		thermocouple 20Ω			
Inputs		programmable functional inputs for external emissivity adjustment, ambient temperature compensation, trigger (reset of hold functions)			
Cable length		3m (standard), 8m, 15m			
Power supply		8 to 36VDC; max. 100mA			
Environmental rating		IP 65 (NEMA-4)			
Ambient temperature	sensor	-20°C to 100°C		-20°C to 125°C	
	controller	0°C to 85°C			
Storage temperature	sensor	-40°C to 100°C		-40°C to 125°C	
	controller	-40°C to 85°C			
Relative humidity		10 to 95%, non condensing			
Vibration	sensor	IEC 68-2-6: 3 G, 11 to 200Hz, any axis			
Shock	sensor	IEC 68-2-27: 50 G, 11ms, any axis			
Weight		sensor: 40g; controller: 420g			

[1] adjustable via programming keys or software
[2] ± ambient temperature 23 ±5°C
[3] E=1, response time 1s
[4] with dynamic adaption at low signal levels

Accessories page 48 - 51

- CF lense
- Protective window
- Mounting bracket / Mounting bolt
- Air purge collar
- Right angle mirror
- Rail mount adapter for controller
- Massive housing
- Protective tube
- Laser sighting tool
- Digital-Interface kit
- Software CompactConnect
- Certificate of calibration
- Relay output module

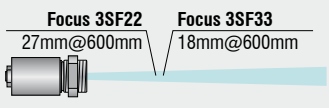
thermoMETER CTM3

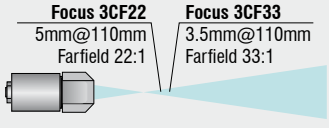
This state of the art non contact infrared temperature sensor operates with a wavelength of 2.3µm. This special spectral range minimizes the emissivity errors and allows readings through glass down to low temperatures of 50°C. The integrated photon detector guarantees maximum sensitivity and extreme fast response time.

- ➔ Measuring range from 50° to 1800°C
- ➔ 2.3µm wave length for measurements of metals, metal oxides, ceramic materials and shiny targets
- ➔ Short measuring wave length reduces error of temperature readings on surfaces with low or unknown emissivity
- ➔ Up to 125°C ambient temperature without cooling
- ➔ Precision optics (75:1/33:1/22:1) with different models for a specific focus point
- ➔ 1ms response time to capture fast events
- ➔ Fully programmable instrument for enhanced signal processing and I/O control
- ➔ Separate controller with easy accessible programming keys and multi color LCD backlit display

Software CompactConnect

- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels



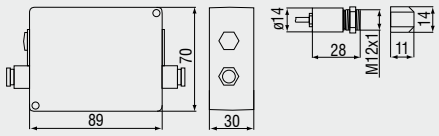


Optical specifications thermoMETER CTM3

□ = smallest spot size (mm)

Standard Focus optics										
3SF22	**22:1**	7	9	18	27	36	45	55	64	73
3SF33	**33:1**	7	7	12	18	24	30	36	42	48
3SF75H1/H2/H3	**75:1**	7	7	7	8	11	14	17	20	23
	distance in mm	*0*	*200*	*400*	*600*	*800*	*1000*	*1200*	*1400*	*1600*

Close Focus optics (integrated CF lens)										
3CF22	**22:1**	6.5	6	5.5	5	9.2	14.5	19.7	24.9	30.1	35.4
3CF33	**33:1**	6.5	5.4	4.2	3.4	6.9	11.4	15.9	20.4	24.8	29.3
3CF75H1/H2/H3	**75:1**	6.5	5	3.2	1.5	3.6	5.4	8.4	11.3	14.3	17.3
	distance in mm	*0*	*40*	*80*	*110*	*150*	*200*	*250*	*300*	*350*	*400*



Product identification

CTM - 3 SF22 - C3

- Cable length [3 m]
- Focus [SF22 / SF33 / SF75 / CF22 / CF33 / CF75]
- Spectral range [2.3 µm]
- thermoMETER CTM

Model	CTM-3SF22-C3	CTM-3SF33-C3	CTM-3SF75H1-C3	CTM-3SF75H2-C3	CTM-3SF75H3-C3
Optical resolution [1]	22:1	33:1	75:1	75:1	75:1
Temperature range [2,3]	50 to 400°C	100 to 600°C	150 to 900°C	200 to 1200°C	400 to 1800°C
Spectral range	2.3 µm				
System accuracy [4,5]	±(0.3% of reading +2°C)				
Repeatability [4]	±(0.1% of reading +1°C)				
Temperature resolution (digital)	<0.1°C				
Response time [6]	1 ms (90 %)				
Emissivity/gain [2]	0.100 to 1.100				
Transmissivity/gain [2]	0.100 to 1.100				
Signal processing [2]	Peak hold, valley hold, average; extended hold function with threshold and hysteresis				
Certificate of calibration	optional				

Outputs/analogue	channel 1	0/4 to 20 mA, 0 to 5/10 V, thermocouple J, K
	channel 2	sensor temperature (-20 to 100 °C as 0 to 5 V or 0 to 10 V), alarm output
Outputs/analogue	optional	relay: 2 x 60 VDC/42 VAC_{eff}; 0,4 A; optically isolated
Alarm output		open-collector (24 V / 50 mA)
Outputs/digital	optional	USB, RS232, RS485, CAN, Profibus DP, Ethernet
Output impedances	current output	relay max. 500 Ω (8 to 36 VDC)
	voltage output	min. 100 kΩ load impedance; thermocouple 20 Ω
Inputs		programmable functional inputs for external emissivity adjustment, ambient temperature compensation, trigger (reset of hold functions)
Cable length		3 m
Power supply		8 to 36 VDC; max. 100 mA

Environmental rating	IP 65 (NEMA-4)
Ambient temperature	sensor: -40 °C to 85 °C controller: 0 °C to 85 °C
Storage temperature	sensor: -40 °C to 125 °C controller: -40 °C to 85 °C
Relative humidity	10 to 95 %, non condensing
Vibration sensor	IEC 68-2-6: 3 G, 11 to 200 Hz, any axis
Shock sensor	IEC 68-2-27: 50 G, 11 ms, any axis
Weight	sensor: 40 g; controller: 420 g

[1] 90 % energy
[2] adjustable via programming keys or software
[3] target temperature > sensor temperature + 25°C
[4] ± ambient temperature 23 ±5°C
[5] E=1, response time 1 s
[6] with dynamic adaption at low signal levels

Accessories page 48 - 51

- CF lense
- Protective window
- Mounting bracket / Mounting bolt
- Air purge collar
- Right angle mirror
- Rail mount adapter for controller
- Massive housing
- Protective tube
- Laser sighting tool
- Digital-Interface kit
- Software CompactConnect
- Certificate of calibration
- Relay output module

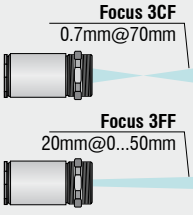
thermoMETER CTM-3XL

This state of the art non contact infrared temperature sensor operates with a wavelength of 2.3µm. This special spectral range minimizes the emissivity errors and allows readings through glass down to low temperatures of 100°C. A special filter blocks all visible light and no visible ***up to 1800nm, as well as the 10.6µm*** *wavelength.*

- ➔ Non contact temperature measurement from 100°C to 1800°C in laser processing applications
- ➔ New IR thermometer for laser material processing, laser welding and laser soldering
- ➔ Special blocking filter against laser radiation from almost all laser diodes and solid state lasers (VIS to 1800nm and 10.6 µm)
- ➔ FF: Far focus optics for use with laser collimator optics
- ➔ CF: close focus optics for miniature spot size of 0.5mm
- ➔ Sensor operation temperature up to 85°C without cooling
- ➔ Short wave length range of 2.3 µm to minimize error when measuring against materials with unknown emissivity
- ➔ Measures through glass
- ➔ Fully programmable instrument for enhanced signal processing and I/O control
- ➔ Separate controller with easy accessible programming keys and multi color LCD backlit display

Software CompactConnect

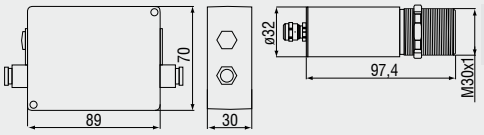
- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels



Optical specifications thermoMETER CTM-3XL

□ = smallest spot size (mm)

Standard Focus optics															
SF100	**100:1**	20	19	18	17	16	15	14	12	11	13	16	20	28	38
3SF H1/H2/H3	**300:1**	20	17.8	15.5	13.2	11	8.6	6.4	4.8	3.7	5.5	8.6	11.8	17	26.6
	distance in mm	*0*	*150*	*300*	*450*	*600*	*750*	*900*	*1000*	*1100*	*1200*	*1350*	*1500*	*1750*	*2200*
Close Focus optics															
CF1	**100:1**	20	9	0.7	9.6	24.4	39.2	54	69	99	128	158	187	217	
	distance in mm	*0*	*40*	*70*	*100*	*150*	*200*	*250*	*300*	*400*	*500*	*600*	*700*	*800*	
Close Focus optics															
CF2	**100:1**	20	14	7.7	1.5	8.7	16	23	38	52	66	81	95		
CF2 H1/H2/H3	**300:1**	20	13.5	7	0.5	7.3	14	21	34.5	48.2	61.8	75.4	89		
CF3	**100:1**	20	15.5	11	6.5	2	7.5	13	24	35	46	57	68		
CF3 H1/H2/H3	**300:1**	20	15.2	10.3	5.5	0.7	5.8	11	21.2	31.5	41.8	52.1	62.4		
	distance in mm	*0*	*50*	*100*	*150*	*200*	*250*	*300*	*400*	*500*	*600*	*700*	*800*		



Product identification

CTM - 3 FF100XL - C3

- Cable length [3 m]
- Focus [SF100 / SF300 / CF1 / CF2 / CF3 / CF4 / FF]
- Spectral range [2.3 μm]
- thermoMETER CTM

Model	CTM-3SF100XL-C3	CTM-3SF300XLH1-C3	CTM-3SF300XLH2-C3	CTM-3SF300XLH3-C3
Optical resolution	100:1	300:1	300:1	300:1
Temperature range [1,2]	100 to 600°C	150 to 900°C	200 to 1200°C	400 to 1800°C
Spectral range	2.3 μm			
System accuracy [3]	±(0.3% of reading +2°C)			
Repeatability [3]	±(0.1% of reading +1°C)			
Temperature resolution (digital)	0.1°C			
Response time (90% signal) [4]	1 ms			
Emissivity/gain [1]	0.100 to 1.100			
Transmissivity/gain [1]	0.100 to 1.100			
Signal processing [1]	peak hold, valley hold, average; extended hold function with threshold and hysteresis			
Certificate of calibration	optional			

Outputs/analogue		0/4 to 20mA, 0 to 5/ 10V, thermocouple J, K, alarm
Outputs/analogue (option)		relay: 2 x 60 VDC / 42 VAC; 0.4 A; optically isolated
Alarm output		open-collector (24 V / 50 mA)
Outputs/digital	option	USB, RS232, RS485, CAN, Profibus DP, Ethernet
Output impedances	current output	mA max. 500Ω (with 5 - 36VDC)
	voltage output	mV min. 100kΩ load impedance; thermocouple 20Ω
Inputs		programmable functional inputs for external emissivity adjustment, ambient temperature compensation, trigger (reset of hold functions)
Cable length		3 m
Power supply		8 to 36 VDC; max. 100 mA

Environmental rating		IP 65 (NEMA-4)
Ambient temperature		sensor: -40°C to 85°C controller: 0 °C to 85 °C
Storage temperature		sensor: -40 °C to 125 °C controller: -40 °C to 85 °C
Relative humidity		10 to 95%, non condensing
Vibration	sensor	IEC 68-2-6: 3 G, 11-200Hz, any axis
Shock	sensor	IEC 68-2-27: 50 G, 11 ms, any axis
Weight		sensor: 150 g; controller: 420 g

[1] adjustable via controller or software
[2] target temperature > sensor temperature + 25°C
[3] E=1, response time 1s; ± ambient temperature: 23 ±5°C
[4] with dynamic adaptation at low signal levels

Optical specifications thermoMETER CTM-3XL

□ = smallest spot size (mm)

Close Focus optics															
CF4	**100:1**	20	18.3	16.6	14.9	13.2	11.4	9.7	8	6.3	4.5	7.3	13	19	24
CF4 H1/H2/H3	**300:1**	20	18	16	13.8	11.8	9.7	7.6	5.6	3.5	1.5	3.8	8.6	13.3	18
	distance in mm	*0*	*50*	*100*	*150*	*200*	*250*	*300*	*350*	*400*	*450*	*500*	*600*	*700*	*800*
Far Focus optics															
FF	**100:1**	20	22	24	26	28	30	32	33.4	36	42.5	58	73.5	85	
FF H1/H2/H3	**300:1**	20	19	18	17	16	15	14	13.4	12	16.5	24.4	33.4	40	
	distance in mm	*0*	*450*	*900*	*1350*	*1800*	*2250*	*2700*	*3000*	*3600*	*4000*	*5000*	*6000*	*6750*	

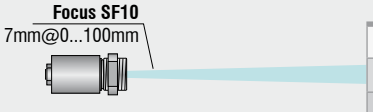
thermoMETER CTP7

This state of the art non contact infrared temperature sensor operates with a wave-length of 7.9µm. This special spectral range allows the IR temperature sensor to measure accurate against thin plastic film materials such as PET, PU, PTFE and PA.

- ➔ Measuring range from 0° to 500°C
- ➔ Accurate temperature measurement of thin plastic film materials
- ➔ Up to 85°C ambient temperature without cooling
- ➔ 150 ms response time
- ➔ Fully programmable instrument for enhanced signal processing and I/O control
- ➔ Separate controller with easy accessible programming keys and multi color LCD display

Software CompactConnect

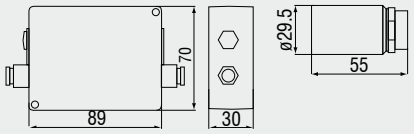
- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels



Optical specifications thermoMETER CTP7

□ = smallest spot size (mm)

Standard Focus optics										
SF10	**10:1**	7	10	20	30	40	50	60	70	80
	distance in mm	*0*	*100*	*200*	*300*	*400*	*500*	*600*	*700*	*800*



Product identification

CTP - 7 SF10 - C3

- Cable length [3 m (standard) / 8 m / 15 m]
- Focus
- Spectral range [7.9 µm]
- thermoMETER CTP7

Model		CTP-7SF10-C3
Optical resolution		10:1
Temperature range [1]		0 to 500°C
Spectral range		7.9µm
System accuracy [2]		<1% or <1.5°C
Repeatability [2]		<0.5% or <0.5°C
Temperature resolution		<0.5°C
Response time		150ms
Emissivity/gain [1]		0.100 to 1.100
Transmissivity/gain [1]		0.100 to 1.100
Signal processing [1]		Peak hold, valley hold, average; extended hold function with threshold and hysteresis
Outputs/analog	channel 1	0/4 to 20mA, 0 to 5/10V, thermocouple J, K
	channel 2	sensor temperature (-20 to 180°C as 0 to 5V or 0 to 10V), alarm output
	optional	relay: 2 x 60V DC/ 42VAC$_{eff}$; 0.4A; optically isolated
Outputs/digital	optional	USB, RS232, RS485, CAN, Profibus DP
Output impedances	current output	mA max. 500Ω (8 to 36VDC)
	voltage output	mV min. 100kΩ load impedance
		thermocouple 20Ω
Inputs		programmable functional inputs for external emissivity adjustment, ambient temperature compensation, trigger (reset of hold functions)
Cable length		3m (standard), 8m, 15m
Power supply		8 to 36VDC; max. 100mA
Environmental rating		IP 65 (NEMA-4)
Ambient temperature		sensor: -20°C to 85°C controller: 0°C to 85°C
Storage temperature		sensor: -40°C to 85°C controller: -40°C to 85°C
Relative humidity		10 to 95%, non condensing
Vibration	sensor	IEC 68-2-6: 3 G, 11 to 200Hz, any axis
Shock	sensor	IEC 68-2-27: 50 G, 11ms, any axis
Weight		sensor: 200g; controller: 420g

[1] adjustable via programming keys or software
[2] ± ambient temperature: 23±5°C; whichever is greater

thermoMETER CTtrans

CTtrans is a compact material analysis system to measure transmissvity, emissivity or degree of reflection. The system uses an active infrared transmitter in combination with an IR CT detector. A programmable controller with display processes the measurement data and outputs the information analog or digitally.

- ➔ Combination of miniaturized infrared radiator and CT - infrared sensor
- ➔ Different modes for evaluation of the material parameters transmissivity, emissivity and reflection
- ➔ 0-10V - output allows transmission of the determined emissivity to a CT sensor
- ➔ Infrared temperature measurement with automatic material detection
- ➔ Available as a mobile system (with carrying case) or for fixed installations
- ➔ High life span of the infrared source (40.000h operating time)

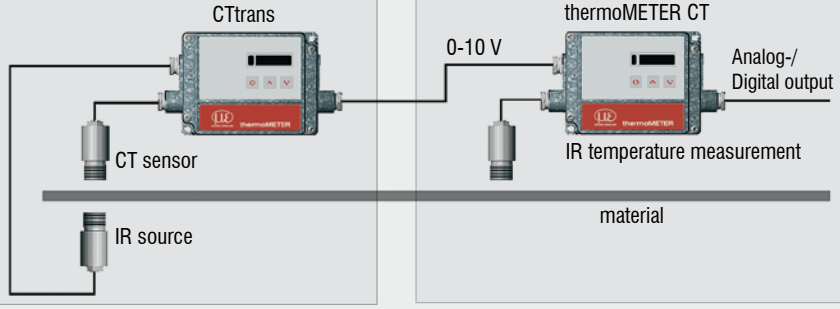
Software CompactConnect

- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels

Emissivity

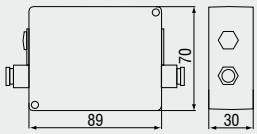
Transmissivity

scope of supply CTtrans



Online detection of emissivity and transmissivity

If material changes the new emissivity and transmissivity will be determined by the CTtrans and transferred via 0-10V output to the CT connected for temperature measurement.



Product identification

CTT - SF15 - C3
- Cable length 3m
- SF=Standard Focus
- thermoMETER CTtrans

Model		CTT-SF15-C3
Spectral range		8 to 14µm
Repeatability [1]		<2,5%
Probe size		>7mm
Emissivity		10 to 100%
Transmissivity/gain		0 to 100%
Reflexion		0 to 100%
Measurement cycle		0.1 to 99s
Recommended distance (IR source - sensor)		30 to 60mm
Outputs/analog		0/4 to 20mA, 0 to 5/10V
Output/digital		3.3V/ 30mA
Relay output	optional	2 x 60VDC/ 42VACeff; 0.4A; optically isolated
Outputs/digital	optional	USB, RS232, RS485 (optional)
Output impedances	current output voltage output	mA max. 500W (with 8 to 36VDC) mV min. 100kW load impedance thermocouple 20W
Input/digital		calibration input
Cable length		3m (standard)
Power supply		10 to 24VDC; max. 150mA
Environmental rating		IP 65 (NEMA-4)
Ambient temperature		sensor: -20°C to 100°C IR source: -20°C to 100°C
Storage temperature		sensor: -40°C to 120°C IR source: -40°C to 120°C
Relative humidity		10 to 95%, non condensing
Vibration		IEC 68-2-6: 3 G, 11 to 200Hz, any axis
Shock		IEC 68-2-27: 50 G, 11ms, any axis
Weight		sensor: 40g; IR source: 40g; controller: 450g

[1] ± ambient temperature: 23 ±5°C

Scope of supply
- CT 15:1 sensor
- IR source
- CTtrans controller
- Power supply (AA-batteries)
- Adjustment board
- Manual
- Case

thermoMETER CTex

This conversion kit allows the use of any IR thermometer series CT in hazardous environment.

- ➔ Economic and easy solution for EX rated applications
- ➔ CT sensing heads are defined as simple electrical devices (according to EN 50014)
- ➔ No special approval for intrinsic safety necessary
- ➔ CT gets intrinsically safe by limitation of the energy with two double zener barriers, type 9002/22-032-300-111 (R. STAHL AG)

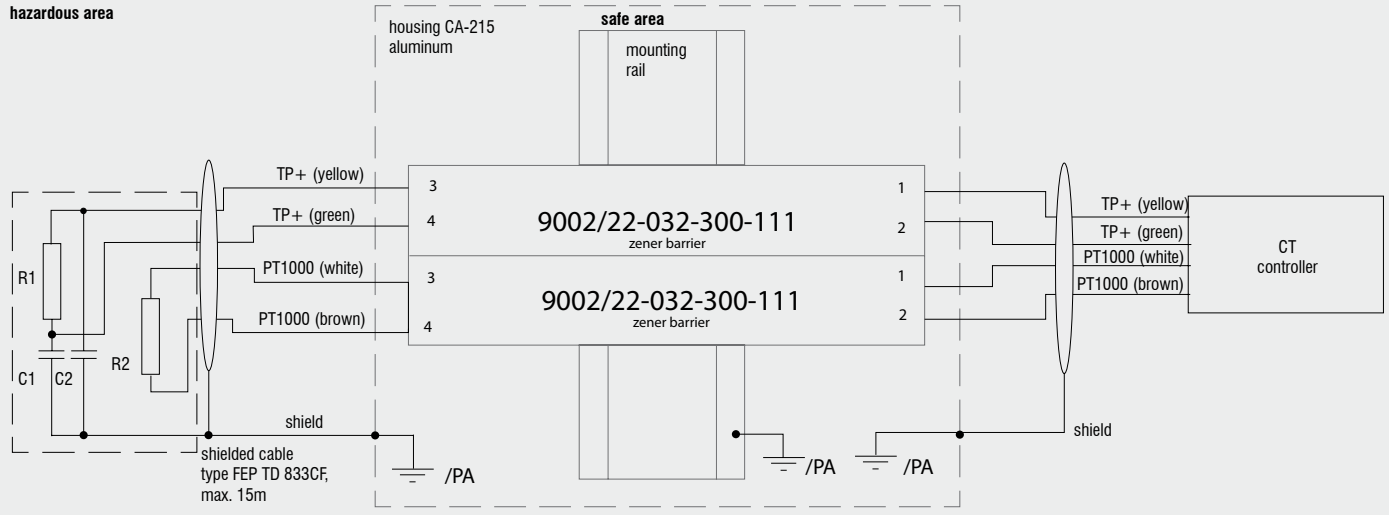
Zener barriers

Double zener barriers (type 9002/22-032-300-111) can be included in the scope of supply if required.

NOTE: The functionality and correct reading of the CT sensor can only be guaranteed, if the recommended barriers are used.

Technical data (zener barriers)[1] type 9002/22-032-300-111		
Approvals	Europe (CENELEC)	for zone 1: PTB 01 ATEX 2053
		for zone 2: PTB 01 ATEX 2054
	USA	FM Approval 3010778
	Canada	CSA 1284580 (LR 43394)
Explosion protection	Europe (CENELEC)	for zone 1: E-II (1/2) G [EEx ia/ib] IIC/IIB
		for zone 2: E II 3 G EEx nA II T4
	USA	I.S. circuits for: Class I, II, III, Division 1, Groups A, B, C, D, E, F, G
		I.S. circuits for: Class I, Zone 0, Group IIC
		Class I, Division 2, Groups A, B, C, D
		Class I, Zone 2, Group IIC
	Canada	I.S. circuits for: Class I, Groups A, B, C, D; Class II, Groups E, F, G
		Class III
		Class I, Division 2, Groups A, B, C, D
		Class I, Zone 2, Groups IIC
Installation	in zone 2, division 2 and in safe area	
Environmental rating	acc. to IEC 60529/terminal IP 20/housing IP 40	
Ambient temperature	-20°C to 60°C	
Technical data of controller and sensor - page 28		

[1] Declaration of company R. STAHL AG
Modifications reserved



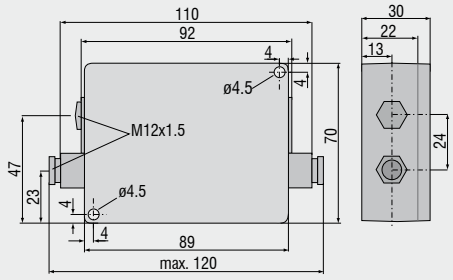
Sensor: "simple electrical device"
(according to EN 50014)

PA-terminals of the barriers must be grounded.

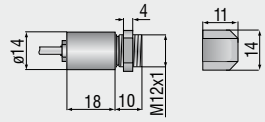
Scope of supply

- aluminum housing with mounting appliance for two zener barriers and CT controller
- pre-assembled cable for CT controller
- CD with software tool for calibrating the barrier resistance into the head code

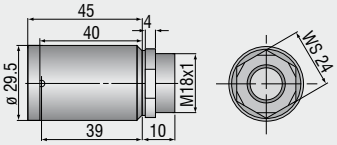
Controller



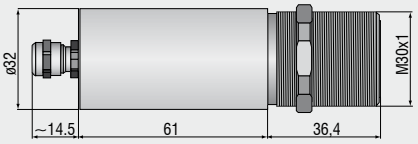
CT / CTG5 / CTfast / CTM1/M2/M3



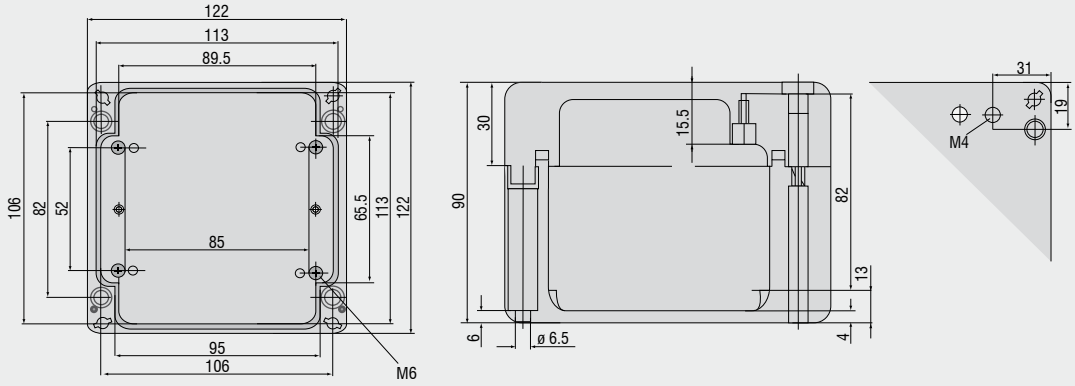
CThot / CTP7



CTM3-XL



CTex



Software CompactConnect
- Graphic display and recording of temperature trends
- Remote control of outputs, easy sensor calibration
- Adjustment of signal processing functions
- Setup of output parameters and functional inputs

System requirements
- Windows XP, Vista, Windows 7
- USB 2.0
- Hard disc min. 30 MByte
- min. 128 MByte RAM
- CD-ROM drive

Mechanical accessories

Art. No.	*Model*	
2970203	TM-FB-CT	Mounting bracket, fixed
2970325	TM-FB2-CT	Mounting bracket, adjustable in one axis, for simultaneous assembly of CT sensor and laser-sighting-tool
2970336	TM-FBMH-CT	Mounting bracket, adjustable in one axis, for massive housing
2970204	TM-AB-CT	Mounting bracket, adjustable in 2 axes
2970205	TM-MB-CT	Mounting bolt with M12x1 thread
2970206	TM-MG-CT	Mounting fork, adjustable in 2 axes, with thread M12x1
2970207	TM-AP-CT	Air purge collar from 10:1 optics
2970208	TM-AP2-CT	Air purge collar for 2:1 optic
2970209	TM-APL-CT	Air purge collar, laminar
2970210	TM-APLCF-CT	Air purge collar, laminar, with integral CF-lens
2970357	TM-APLCFH-CT	Air purge collar, laminar, with integral CF-lens for M1/M2/M3 sensors
2970211	TM-RAM-CT	Right angle mirror for 90°C measurements
2970212	TM-RAIL-CT	Rail mount adapter for CT controller
2970213	TM-COV-CT	Closed cover for controller
2970214	TM-MHS-CT	Massive housing, compact, stainless steel
2970215	TM-MHS-CF-CT	Massive housing, compact, stainless steel with integrated CF-lens
2970358	TM-MHSCFH-CT	Massive housing, compact, stainless steel with integrated CF-lens for M1/M2/M3 sensors
2970216	TM-MHA-CT	Massive housing, compact, anodized aluminium
2970217	TM-MHACF-CT	Massive housing, compact, anodized aluminium with integrated CF-lens
2970359	TM-MHACFH-CT	Massive housing, compact, anodized aluminium with integrated CF-lens for M1/M2/M3 sensors
2970218	TM-MHB-CT	Massive housing, compact, brass
2970219	TM-MHBCF-CT	Massive housing, compact, brass with integrated CF-lens
2970360	TM-MHBCFH-CT	Massive housing, compact, brass with integrated CF-lens for M1/M2/M3 sensors
2970220	TM-PT-CT	Protective tube, lang, brass
2970326	TM-PA-CT	Pipe adapter for sighting tube
2970327	TM-ST20-CT	Sighting tube, length 20 mm
2970328	TM-ST40-CT	Sighting tube, length 40 mm
2970329	TM-ST88-CT	Sighting tube, length 88 mm
2970221	TM-LST-CT	Laser sighting tool for CT sensors incl. batteries (2xalkaline cells AA)
2970300	TM-LSTOEM-CT	OEM Laser pointing device, 635 nm, rotation symmetrical, 3.5 m cable
2970300.008	TM-LSTOEM-CT(008)	OEM Laser pointing device, 635 nm, rotation symmetrical, 8m cable
2970222	TM-EX-CT	CTex-Kit: Accessory-Kit for use of the CT in hazardous locations according zone 1: PTB 01 ATEX 2053/ E II (1/2) G [EEx ia/ib] IIC/IIB, preassembled Ex-box without zener barriers, combinable with all standard CT SF sensors (except CTfast)

CTM3-XL

2970352	TM-FBXL-CT	Mounting bracket, adjustable in one axis
2970353	TM-ABXL-CT	Mounting bracket, adjustable in two axes
2970354	TM-APXL-CT	Air purge collar
2970361	TM-XLCERT-CT	Certificate of calibration

Optical accessoires

Art. No.	*Model*	
2970201	TM-CF-CT	CF-lens (SF sensors only)
2970202	TM-PW-CT	Protective window (SF sensors only)
2970297	TM-CFAG-CT	Lens with external thread
2970330	TM-CFH-CT	Lens for M1/M2/M3 sensors
2970331	TM-CFHAG-CT	Lens with external thread for M1/M2/M3 sensors
2970299	TM-PWAG-CT	Protective window with external thread
2970332	TM-PWH-CT	Protective window for M1/M2/M3 sensors
2970333	TM-PWHAG-CT	Protective window with external thread for M1/M2/M3 sensors

Interfaces

2970223	TM-USBK-CT	USB interface kit incl. computer cable, software CompactConnect
2970224	TM-RS232K-CT	RS232 interface kit incl. computer cable, software CompactConnect
2970338	TM-RS485USBK-CT	RS485-USB-adapter, incl. PC cable, software CTconnect, terminal block, for use with TM-485B-CT
2970227	TM-CANK-CT	CAN-Bus interface for optris CT/ protocol: CANopen Presettings: module address 20 (14H), 250kBaud, 0-60°C
2970228	TM-PFBDPK-CT	Profibus-DPv1 interface for CT selectable with DIN M12 or SUB-D connection
2970229	TM-ETHNK-CT	Profibus-DPv1 interface for CT selectable with DIN M12 or SUB-D connection
2970230	TM-RI-CT	Relay interface: Two optically isolated relays, 60VDC/ 42VACRMS, 0,4A
2970226	TM-RS485B-CT	RS485 interface

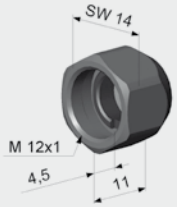
Calibration

2970231	TM-CERT-CT	Certificate of calibration acc. ISO9001: testing procedure with defined ambient temperatures, target dimensions and distances; Test temperatures 20°C/ 100°C/ 500°C
2970310	TM-HTCERT-CT	Certificate of calibration for CTM sensors

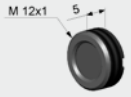
Spare parts

Controller, sensors and cables also available as spare parts - please contact Micro-Epsilon

TM-FB-CT Mounting bracket, fixed

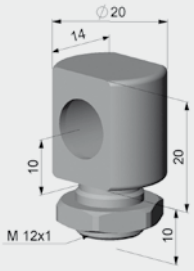


TM-CF-CT Close Focus Lens (SF sensors only)

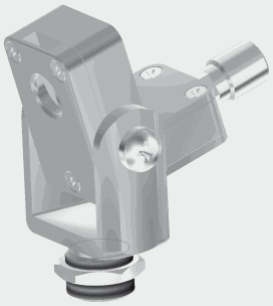


TM-CFAG-CT CF lens with external thread resp.
TM-PWAG-CT Protective window with external thread

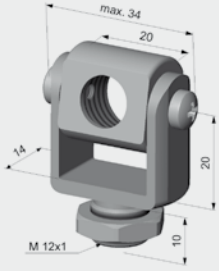
TM-AB-CT Mounting gimble, adjustable in two axes



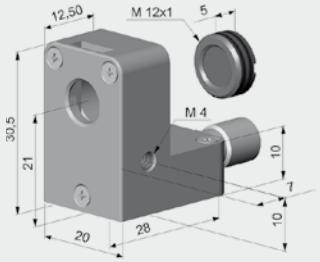
TM-MB-CT Mounting bolt with M12x1 thread adjustable



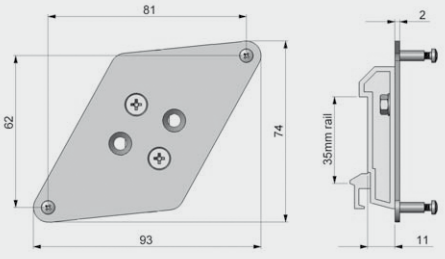
TM-APL-CT Laminar air purge collar and
TM-MG-CT Mounting fork



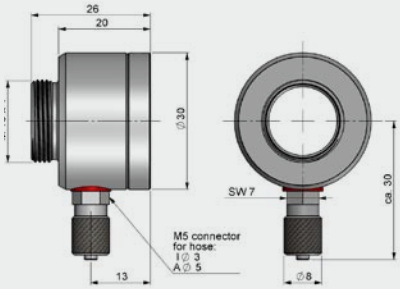
TM-MG-CT Mounting fork witth M 12x1 thread adjustable in two axes



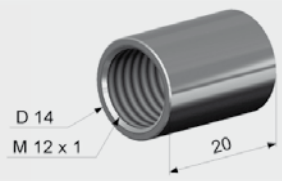
TM-APLCF-CT
CF lense/ protective window - integral option for air purge collar



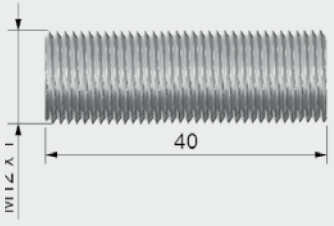
TM-RAIL-CT Rail mount adapter for controller



TM-AP-CTR Air purge collar



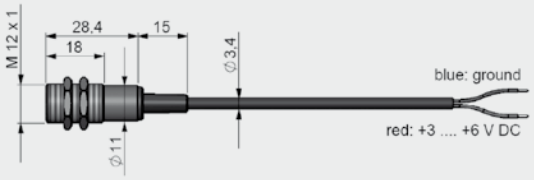
TM-PA-CT Pipe adapter for sighting tube



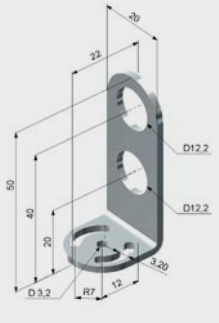
TM-ST40-CT Sighting tube

TM-LST-CT Laser-Sighting tool

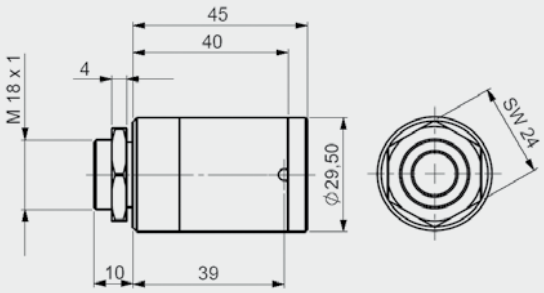
TM-RAM-CT Right angle mirror



TM-LSTOEM-CT Laser-Sighting tool for OEM

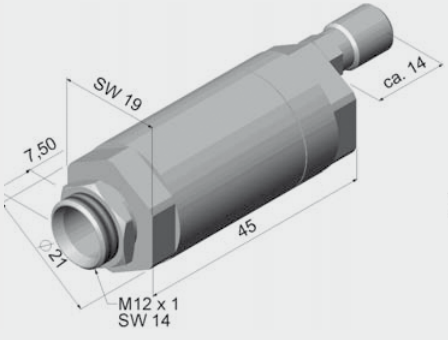


TM-FB2-CT
Laser-Sighting mounting bracket

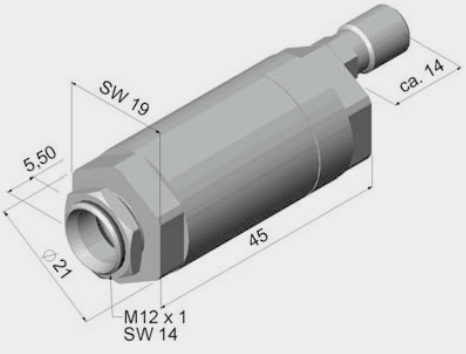


TM-MHS-CT Massive housing, compact, stainless steel
TM-MHA-CT Massive housing, compact, aluminium
TM-MHB-CT Massive housing, compact, brass

The lens must be kept clean at all times from dust, smoke, fumes and other contaminants in order to avoid reading errors. These effects can be reduced by using an air purge collar.



TM-AP-CT Standard air purge collar for
10:1 / 15:1 / 22:1 optics



TM-AP2-CT Standard air purge collar for 2:1 optics

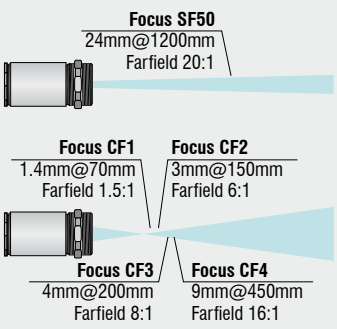
thermoMETER CSLaser

The thermoMETER CSlaser has a two-beam laser aiming feature, which marks the actual spot size at any distance. The controller is not necessary with this model, because the controller is already integrated into the sensor. This represents a major technical advantage, especially where space is limited. The sensor can be optimised for specific measurement tasks by using different lenses.

- ➔ Measuring range from -30°C to 1600°C
- ➔ No external controller; Integrated electronic
- ➔ Extreme small measurement spot down to 0.5mm
- ➔ 10ms /150ms response time for fast moving objects or events
- ➔ Double laser aiming marks real spot location and spot size at any distance
- ➔ Scalable 4 - 20mA analog output/ additional simultaneous alarm output
- ➔ Optional USB programming interface and software
- ➔ Emissivity directly adjustable at the sensor or via software
- ➔ Up to 85°C ambient temperature without cooling
- ➔ Wide power input range: 5 -28V DC

Software CompactConnect

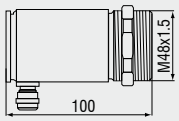
- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels



Optical specifications thermoMETER CSLaser CSL-SF50

□ = smallest spot size (mm)

Standard Fokus																
SF50	**50:1**	20	20.5	21	21.5	22	22.5	23	23.5	24	29.5	35	48	57	68	
distance in mm		*0*	*150*	*300*	*450*	*600*	*750*	*900*	*1050*	*1200*	*1350*	*1500*	*1800*	*2100*	*2400*	
Close Fokus																
CF1	**50:1**	20	10	8.5	1.4	11	26	41	57	72	60	103	118	133	164	194	225
CF2	**50:1**	20	15.5	15	12	9	3	11	19	26	33	42	49	57	72	88	103
CF3	**50:1**	20	16.5	16	14	12	8	4	10	16	21	28	33	40	52	64	76
CF4	**50:1**	20	19.5	19	18.4	18	16.5	15	14	13	11.5	10	9	12	19	25	32
distance in mm		*0*	*40*	*50*	*70*	*100*	*150*	*200*	*250*	*300*	*350*	*400*	*450*	*500*	*600*	*700*	*800*



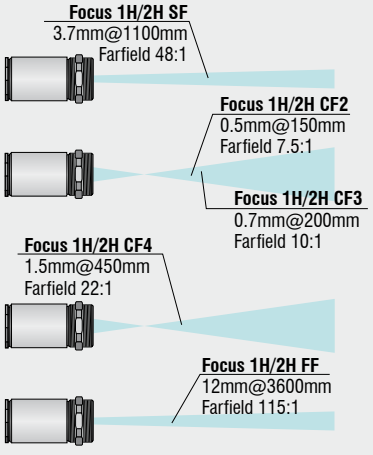
Product identification

CSL - 2 H SF300

- Focus [SF50/300 / CF1 / CF2 / CF3 / CF4]
- Temperature range [H]
- Spectral range [8-14 µm / 1.6 µm]
- thermoMETER CSLaser

Model	CSL-SF50	CSLM-2HSF300
Optical resolution	50:1	300:1
Temperature range [1]	-30°C to 1000°C	385°C to 1600°C
Spectral range	8 to 14µm	1.6µm
System accuracy [3]	±1% or ±1°C	<(0.3% of reading < 2°C) [4]
Repeatability [3]	±0.5% or ±0.5°C	<(0.1% of reading < 1°C) [4]
Temperature resolution	0.1°C	
Response time (90% signal)	150ms	10ms
Emissivity/Gain [1]	0.100 - 1.100	
IR window correction [2]	0.100 - 1.100	
Signal processing [2]	peak hold, valley hold, average; extended hold function with threshold and hysteresis	
Outputs/analog	4 to 20mA	
Alarm output	0 to 30V / 500mA (open collector)	
Outputs/digital (optional)	uni-/ bidirectional, 9.6 kBaud, 0/3V digital level, USB	
Output impedances	max. 1000Ω (depending on supply voltage)	
Current draw (Laser)	45mA at 5V / 20mA at 12V / 12mA at 24V	
Power supply	5 to 28V DC	
Laser	class II (635nm), 1mW, ON/OFF via software	
Environmental rating	IP 65 (NEMA-4)	
Ambient temperature	-20°C to 85°C (50°C if Laser ON)	
Storage temperature	-40°C to 85°C	
Relative humidity	10 to 95%, non condensing	
Vibration	IEC 68-2-6: 3 G, 11 to 200 Hz, any axis	
Shock	IEC 68-2-27: 50 G, 11ms, any axis	
Weight	600g	

[1] adjustable via programming keys or software
[2] adjustable via software
[3] at ambient temperature 23 ±5°C; whichever is greater; temperature of the object >0°C
[4] ε = 1, response time 1s



Optical specifications thermoMETER CSLaser CSLM-2HSF300

□ = smallest spot size (mm)

Standard Fokus															
2H SF	**300:1**	20	17.8	15.5	13.2	11	8.6	6.4	4.8	3.7	5.5	8.6	11.8	17	26.6
	distance in mm	*0*	*150*	*300*	*450*	*600*	*750*	*900*	*1000*	*1100*	*1200*	*1350*	*1500*	*1750*	*2200*
Close Fokus															
2H CF2	**300:1**	20	13.5	7	0.5	7.3	14	21	n.v.	34.5	n.v.	48.2	61.8	75.4	89
2H CF3	**300:1**	20	15.2	10.3	5.5	0.7	5.8	11	n.v.	21.2	n.v.	31.5	41.8	52.1	62.4
2H CF4	**300:1**	20	18	16	13.8	11.8	9.7	7.6	5.6	3.5	1.5	3.8	8.6	13.3	18
	distance in mm	*0*	*50*	*100*	*150*	*200*	*250*	*300*	*350*	*400*	*450*	*500*	*600*	*700*	*800*
Far Focus optics															
2H FF	**300:1**	20	19	18	17	16	15	14	13.4	12	16.5	24.4	33.4	40	
	distance in mm	*0*	*450*	*900*	*1350*	*1800*	*2250*	*2700*	*3000*	*3600*	*4000*	*5000*	*6000*	*6750*	

Accessories page 64 - 65

- CF lense
- Protective window
- Mounting bracket / Mounting bolt
- Air purge collar
- Right angle mirror
- Software CompactConnect
- USB Kit (TM-USBK-CS)

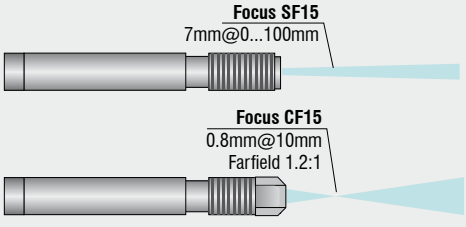
thermoMETER CS

This self contained, non contact infrared temperature sensor requires no external signal condition controller, which makes it an ideal product for OEM applications. It is fully programmable via the digital interface and provides an accurate temperature reading via the analog or digital interface.

- ➔ Measuring range from -40 to 400°C
- ➔ Robust precision silicon optics with AR coating
- ➔ Integrated controller with LED alarm indicator and smart electronic sighting support, selfdiagnostic or temperature code indication
- ➔ Up to 80°C ambient temperature without cooling
- ➔ Short circuit and reverse polarity protection
- ➔ Field programmable
- ➔ Adjustable emissivity
- ➔ Fast response time: 25ms
- ➔ Analog outputs with digital interfaces option
- ➔ Wide input range: 5 - 30V DC
- ➔ Please note: available from 10 pieces

Software CompactConnect

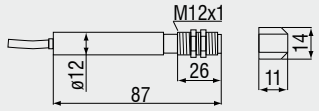
- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels



Optical specifications thermoMETER CS

□ = smallest spot size (mm)

Standard Focus optics										
SF15	15:1	7	8	13	20	27	33	40	47	53
distance in mm		*0*	*100*	*200*	*300*	*400*	*500*	*600*	*700*	*800*
Close Focus optics (CF lense optional available)										
CF15	15:1	7	5	0.8	5	11	16	21	27	32
distance in mm		*0*	*5*	*10*	*15*	*20*	*25*	*30*	*35*	*40*



Product identification

CS - SF15 - C1

- Cable length [1 m (standard) / 3 m / 8 m / 15 m]
- Focus [SF]
- thermoMETER CS

Model	CS-SF15-C1
Optical resolution	15:1
Temperature range [1]	-40 to 400°C
Spectral range	8 to 14μm
System accuracy [2]	±1.5% or ±1.5°C
Repeatability [2]	±0.75% or ±0.75°C
Temperature resolution [3]	±0.1°C
Response time	25ms to 999s (90%), adjustable
Emissivity/gain	0.100 to 1.100 (adjustable via 0 to 5V DC input or software)
Transmissivity/gain [1]	0.100 to 1.100
Signal processing [1]	peak hold, valley hold, average; extended hold function with threshold and hysteresis
Certificate of calibration	optional
Outputs/analog	0 to 5V or 0 to 10V 1/10/100 mV/ °C
Outputs/digital optional	USB or Alarm 0-30V / 500mA (open collector)
LED functions	alarm indication, automatic aiming support, self diagnostic, temperature indication (via temp. code)
Inputs	programmable functional input for external emissivity/ambient temperature adjustment (0 to 5VDC), hold function or RS232 / USB (optional) communication
Cable length	1m (standard), 3m, 8m, 15m
Power supply	4mA (without LED), 10mA (5 to 30VDC)
Environmental rating	IP 63 (NEMA-4)
Ambient temperature	-20°C to 80°C
Storage temperature	-20°C to 85°C
Relative humidity	10 to 95%, non condensing
Vibration	IEC 68-2-6: 3 G, 11 to 200Hz, any axis
Shock	IEC 68-2-27: 50 G, 11ms, any axis
Weight	58g

[1] adjustable via software
[2] ± ambient temperature: 23 ±5°C; whichever is greater; object temperature ≥0°C
[3] temperature of the object <100°C and time constant >0.2s

Accessories page 64 - 65

- CF lense
- Protective window
- Mounting bracket / Mounting bolt
- Air purge collar
- Right angle mirror
- Software CompactConnect
- USB Kit

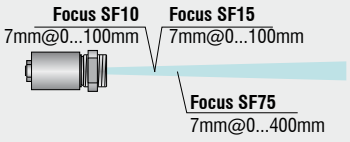
thermoMETER CSmicro

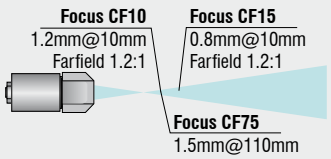
This non contact infrared temperature sensor is the world's smallest IR instrument. With just the compact optical head left, this instrument is perfect for the integration in space restricted applications. The electronic is miniaturized and integrated inside the sensor cable. The CSmicro is fully programmable and is available in four basic models, where each has a unique feature to succeed in the most challenging applications.

- ➔ Measuring range from -40 to 1600°C
- ➔ Robust precision silicon optics with AR coating
- ➔ Integrated controller with LED alarm indicator and smart electronic sighting support, selfdiagnostic or temperature code indication
- ➔ Up to 125°C ambient temperature without cooling
- ➔ Micro electronics integrated into the cable, field programmable; adjustable emissivity
- ➔ Analog output: 0 - 10V or 0 - 5V, 2wire current option, alarm output
- ➔ Short circuit and reverse polarity protection
- ➔ 8...14µm spectrum or short wavelength model with 1.6µm
- ➔ Optional USB programming interface and software

Software CompactConnect

- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels

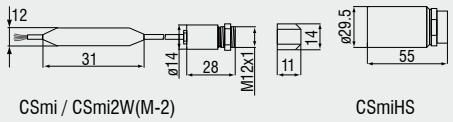




Optical specifications thermoMETER CSmicro

□ = smallest spot size (mm)

Standard focus optics										
SF10	**10:1**	7	10	20	30	40	50	60	70	80
SF15	**15:1**	7	8	13	20	27	33	40	47	53
distance (mm)		*0*	*100*	*200*	*300*	*400*	*500*	*600*	*700*	*800*
SF75	**75:1**	7	7	7	8	11	14	17	20	23
distance (mm)		*0*	*200*	*400*	*600*	*800*	*1000*	*1200*	*1400*	*1600*
Close focus optics										
CF10	**10:1**	7	5	1.2	8	16	24			
CF15	**15:1**	7	5	0.8	5	11	16	21	27	32
distance (mm)		*0*	*5*	*10*	*15*	*20*	*25*	*30*	*35*	*40*
Close focus optics (Integrated CF lense in the sensor head)										
CF75	**75:1**	6.5	3.8	1.5	4.4	8.1	11.7	15.4	19	22.6
distance (mm)		*0*	*60*	*110*	*150*	*200*	*250*	*300*	*350*	*400*



CSmi / CSmi2W(M-2) CSmiHS

Product identification

CSmi - SF10 - C1

- Cable length
- Fokus [SF / CF]
- thermoMETER CSmi
- thermoMETER CSmi2W (TwoWire sensor)

Model	CSmi-SF02-C1	CSmi-SF15-C1	CSmiHS-SF15-C4	CSmi2W-SF15-C1	CSmi2WM-2SF75-C1
Optical resolution	2:1	15:1	15:1	15:1	75:1
Temperature range	-40°C to 1030°C [1]		-20°C to 150°C	-40°C to 1030°C [1]	385°C to 1600°C [1]
Spectral range	8 to 14µm		8 to 14µm	8 to 14µm	1.6µm
System accuracy	±1.5% or ±1.5°C [3]		±1.0% or ±1.0°C [5]	±1.0% or ±1.5°C [3]	±(0.3% of reading +2°C) [4]
Repeatability	±0.75% or ±0.75°C [3]		±0.3% or ±0.3°C [5]	±0.75% or ±0.75°C [3]	±(0.1% of reading +1°C) [4]
Temperature coefficient	± 0.05 K/K or ± 0.05% K				
Temperature resolution	0.15°C [7]		0.025°C [7]	0.1°C [7]	0.1°C
Response time (90%)	30ms		150ms	30ms	10ms
Emissivity/gain	0.100 to 1.100 [2]		0.100 to 1.100 [1]		
Transmissivity/gain [1]	0.100 to 1.100				
Signal processing [1]	peak hold, valley hold, average; extended hold function with threshold and hysteresis				
Dimensions controller	length 35mm; ø12mm				
Outputs/analogue	0 to 5V or 0 to 10V 1/10/100 mV/°C		4 to 20mA		
Loop resistance	-		1000Ω[8]		
Outputs/alarm	Alarm (50mA / 24V)		0-30V / 500mA (open collector)		
Outputs/digital (optional)	USB				
Inputs	programmable functional input for external emissivity adjustment (0 - 5VDC), hold function or USB communication		programmable functional input for triggered signal output or peak-hold function		
LED functions	alarm indication, automatic aiming support, self diagnostic, temperature indication (via temp. code)				
Cable length	1m (standard); 0.5m between sensor and controller; 0.4m between controller and terminal		**4m (0.5m sensor-controller) sensor with massive housing TM-MHS-CT ø29.5mm x 55mm**	1m (standard); 0.5m between sensor and controller; 0.4m between controller and terminal	
Power supply	9mA (5 to 30VDC)		4...20mA (5 to 30VDC)		
Environmental rating	IP 65 (NEMA-4) sonsor head				
Ambient temperature	Sensor: -20°C to 120°C Controller: -20°C to 80°C		Sensor -20°C to 75°C Controller: -20°C to 75°C	Sensor: -20°C to 120°C Controller: -20°C to 75°C	Sensor: -20°C to 125°C Controller: -20°C to 75°C
Storage temperature	-40°C to 85°C (sensor and controller)				
Relative humidity	10 - 95%, non condensing				
Vibration	IEC 68-2-6: 3 G, 11-200Hz, any axis				
Shock	IEC 68-2-27: 50 G, 11ms, any axis				
Weight	42g		200g	42g	

[1] adjustable via software
[2] adjustable via 0 - 5VDC input or software
[3] ± at ambient temperature 23±5°C; object temperature >0°C; whichever is greater
[4] Epsilon =1, response time 1s; object temperature >450°C
[5] at ambient temperature 23±5°C; object temperature >20°C; whichever is greater
[6] object temperature <100°C; and time constant >0.2s
[7] object temperature > 20°C; and time constant >0.2s
[8] in dependence on supply voltage

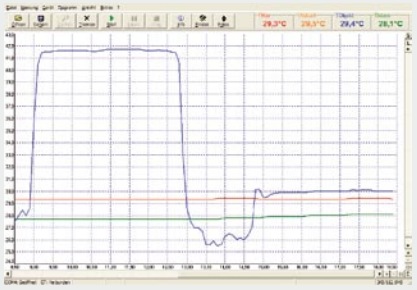
Accessories page 64 - 65

- CF lense
- Protective window
- Mounting bracket / Mounting bolt
- Air purge collar
- Right angle mirror
- Software CompactConnect
- USB Kit

thermoMETER CX

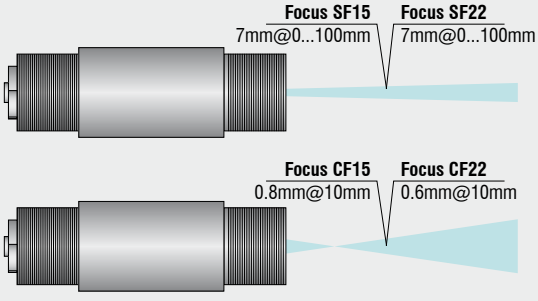
This self contained, non contact infrared temperature sensor requires no external signal condition controller, which makes it an ideal product for OEM applications. It is fully programmable via the digital interface and provides an accurate temperature reading via the analog or digital interface. The larger head size yields extra stable and precise measurement in harsh environments and reduces thermal shock.

- ➔ Measuring range from -30 to 900°C
- ➔ Robust precision silicon optics with AR coating
- ➔ Analog output: 2 wire 4…20mA
- ➔ Easy two wire installation
- ➔ Wide input range: 5-30V DC
- ➔ Optical resolution of 15:1 / 22:1
- ➔ Field programmable
- ➔ Adjustable emissivity
- ➔ Response time from 150ms
- ➔ Extreme high resolution model HS with 25mK NEDT



Software CompactConnect

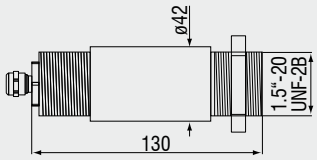
- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels



Optical specifications thermoMETER CX

□ = smallest spot size (mm)

Standard Focus optics										
SF15	**15:1**	7	8	13	20	27	33	40	47	53
SF22	**22:1**	7	7	9	14	18	23	27	32	36
distance in mm		*0*	*100*	*200*	*300*	*400*	*500*	*600*	*700*	*800*
Close Focus optics										
CF15	**15:1**	7	5	0.8	5	11	16	21	27	32
CF22	**22:1**	7	4	0.6	4	8	12	16	20	24
distance in mm		*0*	*5*	*10*	*15*	*20*	*25*	*30*	*35*	*40*



Product identification

CX - SF15 - C8

- Cable length [8 m]
- Focus [SF / CF]
- thermoMETER CX

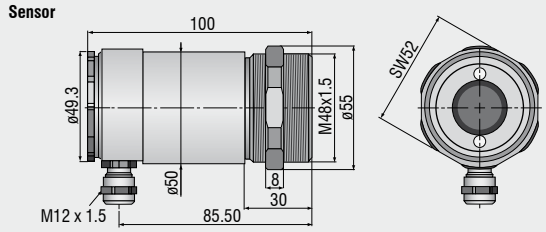
Model	CX-SF15-C8	CX-SF22-C8
Optical resolution	15:1	22:1
Temperature range [1]	-20°C to 150°C	-30°C to 900°C
Spectral range	8 to 14µm	
System accuracy [2]	<1% or <1°C	<1% or <1.4°C
Repeatability [2]	<0.3% or <0.3°C	<0.5% or <0.7°C
Temperature resolution	0.025°C [3]	0.1°C
Response time	150ms (95%)	
Emissivity/gain [1]	0.100 to 1.100	
Transmissivity [1]	0.100 to 1.100	
Signal processing [1]	peak hold, valley hold, average; extended hold function with threshold and hysteresis	
Output /analog	4 to 20mA	
Alarm output	0 to 30V/ 500mA (open collector)	
Outputs/digital (optional)	USB	
Loop impedance	max. 1000Ω (depends on supply voltage)	
Cable length	8m	
Power supply	5 to 30V DC	
Environmental rating	IP 65 (NEMA-4)	
Ambient temperature	-20°C to 75°C	
Storage temperature	-40°C to 85°C	
Relative humidity	10 to 95%, non condensing	
Vibration	IEC 68-2-6: 3 G, 11 to 200Hz, any axis	
Shock	IEC 68-2-27: 50 G, 11ms, any axis	
Weight	350g	

[1] adjustable via software
[2] ± object temperature >0°C; at ambient temperature 23±5°C; whichever is greater
[3] at object temperature <100°C and time constant >0.2s

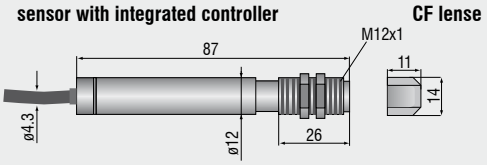
Accessories page 64 - 65

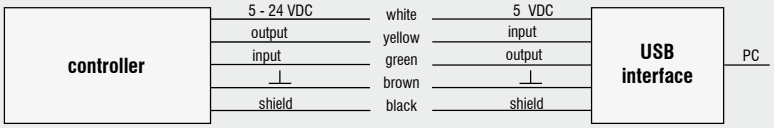
- CF lense
- Protective window
- Air purge collar
- Software CompactConnect
- USB Kit

CSLaser

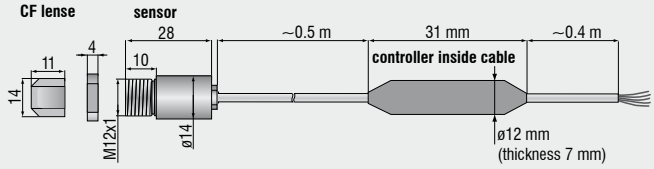


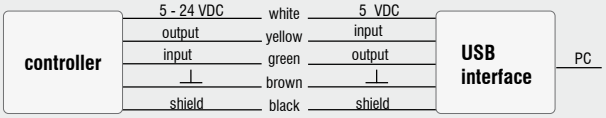
CS



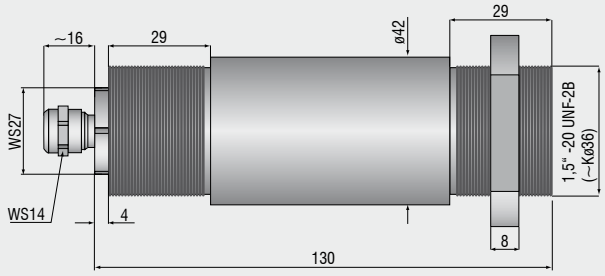


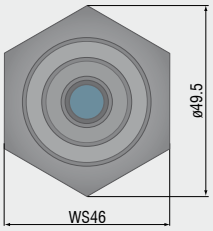
CSmicro





CX





Software CompactConnect

- Display, graphic charting and recording of temperature readings
- Easy system configuration and sensor calibration
- Sophisticated signal processing features
- Programming of input and output channels

System requirements

- Windows XP, Vista, Windows 7
- USB 2.0
- Hard disc min. 30 MByte
- min. 128 MByte RAM
- CD-ROM drive

Mechanical accessories CS / CSmicro

Art. No.	*Model*	
2970279	TM-FB-CS	Mounting bracket, fixed
2970280	TM-AB-CS	Mounting bracket, adjustable
2970281	TM-MB-CS	Mounting bolt with M12x1 thread
2970282	TM-MG-CS	Mounting fork, adjustable in 2 axes, with thread M12x1
2970283	TM-AP-CS	Air purge collar for 10:1 sensors
2970284	TM-APL-CS	Air purge collar, laminar
2970285	TM-APLCF-CS	Air purge collar, laminar, integrated CF-lens
2970286	TM-RAM-CS	Right angle mirror for 90°C measurements
2970287	TM-USBK-CS	USB interface kit incl. software Compact-Connect

Optical accessories CS / CSmicro

2970277	TM-CF-CS	CF-Lens for CS series
2970278	TM-PW-CS	Protective window for CS series
	TM-CFH-CS	CF-Lens for 1.6µm sensor
	TM-PWH-CS	Protective window for 1.6µm sensor

Calibration CS / CSmicro

2970288	TM-CERT-CS	Certificate of calibration

Mechanical accessories CX

Art. No	*Model*	
2970307	TM-AP-CX	Air purge collar, aluminium (anodized)
2970321	TM-FB-CX	Mounting bracket, adjustable in one axis, stainless steel
2970322	TM-AB-CX	Mounting bracket, adjustable in two axes, stainless steel
2970311	TM-USBK-CX	USB-Kit: USB programming adapter, Software CompactConnect

Optical accessories CX

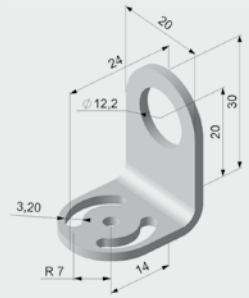
2970302	TM-CF-CX	CF-lens for thermoMETER CX
2970303	TM-PW-CX	Protective window for thermoMETER CX

Calibration CX

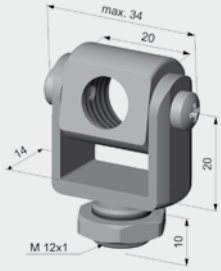
2970323	TM-CERT-CX	Certificate of calibration

Spare parts

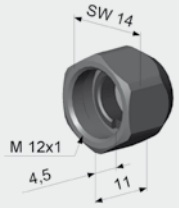
Controller, sensors and cables also available as spare parts - please contact Micro-Epsilon



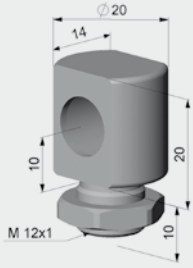
TM-FB-CS Mounting bracket, fixed



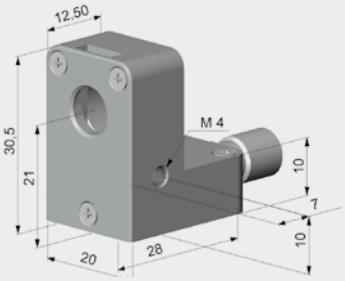
TM-MG-CS Mounting fork with M 12x1 thread adjustable in two axes



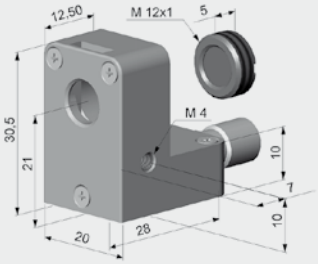
TM-CF-CS Close Focus Lens (LT sensors only)



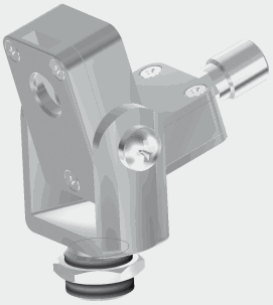
TM-MB-CS Mounting bolt with M12x1 thread adjustable



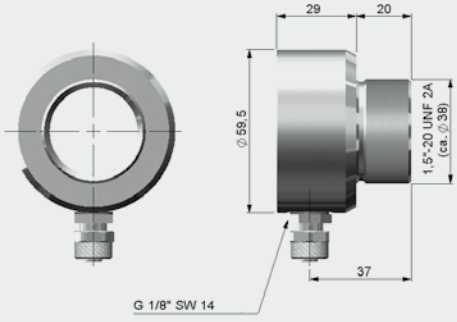
TM-APL-CS Air purge collar



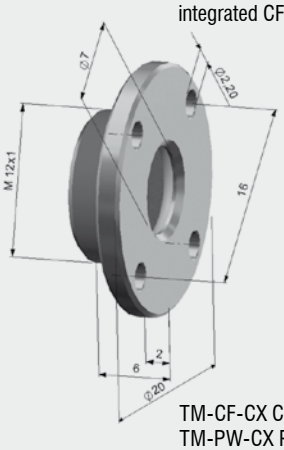
TM-APLCF-CS Air purge collar, laminar, integrated CF-lens



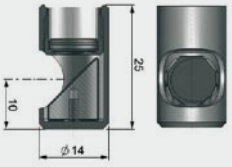
TM-APL-CS Laminar air purge collar and TM-MG-CS Mounting fork



TM-AP-CX Air purge collar CX sensors



TM-CF-CX CF-Lens
TM-PW-CX Protective window



TM-RAM-CS Right angle mirror

thermoMETER LS Infrared thermometer with crosshair laser sighting

The LS is the most sophisticated IR hand held device. It provides an accurate measurement with its precision optics (adjustable for close or far field focus) and marks the actual true measurement with a laser crosshair, eliminating the guesswork out of handheld IR devices. It is fully programmable, offers a digital interface for on and offline data logging and includes a thermocouple plug in.

- ➔ Measuring range from -35° to +900°C
- ➔ The new performance standard with spot sizes as small as 1mm
- ➔ Crosshair laser sighting marks the actual spot size at any distance
- ➔ Optical resolution 75:1
- ➔ Response time 150ms
- ➔ Thermocouple input
- ➔ USB interface and graphic software with oscilloscope function
- ➔ Multi function flip display
- ➔ Programmable emissivity
- ➔ High and low limits
- ➔ Statistical data processing

Flip display for multi purposes:
Measurement of smallest objects (1mm) on a circuit board - data transfer via USB to a common PC

Optical specifications thermoMETER LS

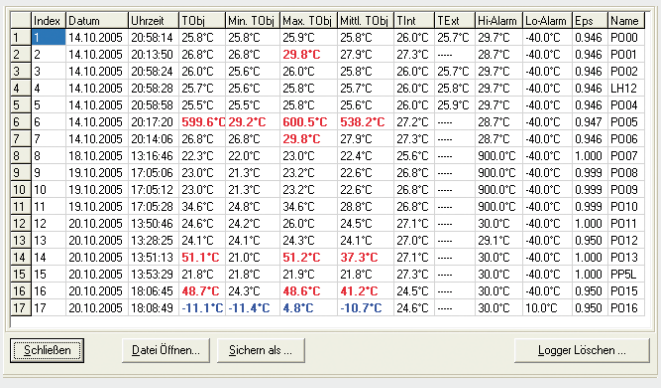
□ = smallest spot size (mm)

Standard Focus optics	**75:1**	20	16	40	70	100	130
	distance in mm	*0*	*1200*	*2000*	*3000*	*4000*	*5000*
Close Focus optics	**CF 75:1**	17	1	123	262		
	distance in mm	*0*	*62*	*500*	*1000*		

Model	thermoMETER LS
Optical resolution	75:1
Temperature range	-35 to 900°C
Spectral response	8 to 14µm
System accuracy	<0.75°C or <0.75% [1]
Temperature coefficient	<0.05°C or <0.05% [1]
Response time (95%)	150ms
Repeatability	<0.5°C or <0.5% [1]
Switchable to focus	1mm @ 62mm (90%)
Smallest spot	1mm
Laser class II	standard focus: patented crosshair laser (crosshair size = IR spot size@any distance) close focus: two point laser (laser dot size = IR spot size@focus distance)
Emissivity/gain	0.100 to 1.100 (adjustable)
Configurations	MAX/MIN/HOLD/DIF/AVG/°C/°F
Alarm functions	audible and visible HIGH/LOW alarm
Display	LC flip display (horizontal and vertical viewing directions controlled by position sensor)
Display LCD backlight	green and alarm colors (red, blue)
Bar graph display	auto scaling
Ambient temperature	0 to 50°C
Storage temperature	-30 to 65°C
Relative humidity	10 - 95% (non condensing)
Weight	420g
EMV	89/336/EWG
Vibration/Shock	IEC 68-2-6: 3 G, 11-200Hz, any axis IEC 68-2-27: 50 G, 11ms duration, any axis
Temperature range t/c probe input	-35 to 900°C (-30 to 1650°F)
Accuracy t/c probe input	±0.75°C or ±1% of reading [1]
Interface, data output	USB
Data memory	100 measurement protocols with time stamps, customizable 4 digit location and material names
Software	CompactConnect oscilloscope software with 20 readings per second
Power	battery 2xAA Alkaline or via USB
Battery life time	5h with laser on and 50% backlight use 10h with laser on and w/o backlight 25h w/o laser and backlight
Tripod mount	1/4-20 UNC
Option	certificate of calibration or DKD certificate

[1] whichever is greater; ± at ambient temperatures 23 ±5°C; 20 to 900°C range

Scope of supply
- thermoMETER LS
- USB cable and software
- t/c type K insertion probe
- carrying case
- padded pouch
- wrist strap
- manual
- cells



	Index	Datum	Uhrzeit	TObj	Min. TObj	Max. TObj	Mittl. TObj	TInt	TExt	Hi-Alarm	Lo-Alarm	Eps	Name
1	1	14.10.2005	20:58:14	25.8°C	25.8°C	25.9°C	25.8°C	26.0°C	25.7°C	29.7°C	-40.0°C	0.946	P000
2	2	14.10.2005	20:13:50	26.8°C	26.8°C	29.8°C	27.9°C	27.3°C	-----	28.7°C	-40.0°C	0.946	P001
3	3	14.10.2005	20:58:24	26.0°C	25.6°C	26.0°C	25.8°C	26.0°C	25.7°C	29.7°C	-40.0°C	0.946	P002
4	4	14.10.2005	20:58:28	25.7°C	25.6°C	25.8°C	25.7°C	26.0°C	25.8°C	29.7°C	-40.0°C	0.946	LH12
5	5	14.10.2005	20:58:58	25.5°C	25.5°C	25.8°C	25.6°C	26.0°C	25.9°C	29.7°C	-40.0°C	0.946	P004
6	6	14.10.2005	20:17:20	599.6°C	29.2°C	600.5°C	538.2°C	27.2°C	-----	28.7°C	-40.0°C	0.947	P005
7	7	14.10.2005	20:14:06	26.8°C	26.8°C	29.8°C	27.9°C	27.3°C	-----	28.7°C	-40.0°C	0.946	P006
8	8	18.10.2005	13:16:46	22.3°C	22.0°C	23.0°C	22.4°C	25.6°C	-----	900.0°C	-40.0°C	1.000	P007
9	9	19.10.2005	17:05:06	23.0°C	21.3°C	23.2°C	22.6°C	26.8°C	-----	900.0°C	-40.0°C	0.999	P008
10	10	19.10.2005	17:05:12	23.0°C	21.3°C	23.2°C	22.6°C	26.8°C	-----	900.0°C	-40.0°C	0.999	P009
11	11	19.10.2005	17:05:28	34.6°C	24.8°C	34.6°C	28.8°C	26.8°C	-----	900.0°C	-40.0°C	0.999	P010
12	12	20.10.2005	13:50:46	24.6°C	24.2°C	26.0°C	24.5°C	27.1°C	-----	30.0°C	-40.0°C	1.000	P011
13	13	20.10.2005	13:28:25	24.1°C	24.1°C	24.3°C	24.1°C	27.0°C	-----	29.1°C	-40.0°C	0.950	P012
14	14	20.10.2005	13:51:13	51.1°C	21.0°C	51.2°C	37.3°C	27.1°C	-----	30.0°C	-40.0°C	1.000	P013
15	15	20.10.2005	13:53:29	21.8°C	21.8°C	21.9°C	21.8°C	27.3°C	-----	30.0°C	-40.0°C	1.000	PP5L
16	16	20.10.2005	18:06:45	48.7°C	24.3°C	48.6°C	41.2°C	24.5°C	-----	30.0°C	-40.0°C	0.950	P015
17	17	20.10.2005	18:08:49	-11.1°C	-11.4°C	4.8°C	-10.7°C	24.6°C	-----	30.0°C	10.0°C	0.950	P016

Schließen | Datei Öffnen... | Sichern als ... | Logger Löschen ...

Software IRConnect
- Data logging
- Display and recording of temperature graphs
- Modifications of handheld settings

System requirements
- Windows XP, Windows 2000
- USB 2.0
- Hard disc min. 30 MByte
- min. 128 MByte RAM
- CD-ROM drive

thermoMETER MS Intelligent universal infrared thermometer

The MS series offers the most economic IR hand held device. With three different models, it provides the best performance / price ratio for your individual application. With a digital interface data logging and analysis are made really easy.

- ➔ Measuring range from -32° to + 760°C
- ➔ The new performance standard with spot sizes as small as 1mm
- ➔ Laser aiming aid
- ➔ Optical resolution 40:1
- ➔ Response time 300ms
- ➔ USB interface and graphic software with oscilloscope function
- ➔ Programmable emissivity
- ➔ High and low limits

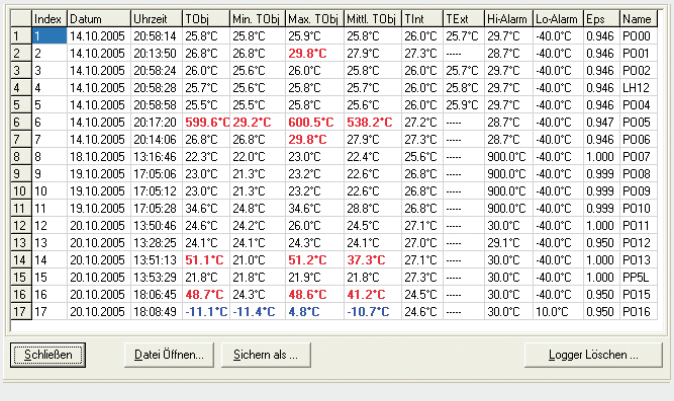
Optical specifications thermoMETER MS

□ = smallest spot size (mm)

MS / MS Plus	**20:1**	13	20	37	50
	distance in mm	*140*	*300*	*700*	*1000*
MS Pro	**40:1**	13	15	22	27
	distance in mm	*260*	*400*	*800*	*1000*

Model	MS	MS Plus	MS Pro
Optical resolution	20:1		40:1
Temperature range [1]	-32°C to 420°C	-32°C to 530°C	-32°C to 760°C
Spectral range	8 to 14µm		
System accuracy [2,3]	<1% / <1°C (from 0°C to 420°C)	<1% / <1°C (from 0°C to 530°C) <1°C±0.07°C / °C (from 0°C to -32°C)	<1% / <1°C (from 0°C to 760°C)
Repeatability [2,3]	<0.5% / <0.7°C (from 0°C to 420°C) <0.7°C±0.05°C / °C (from 0°C to -32°C)	<0.5% / <0.7°C (from 0°C to 530°C)	<0.75% / <0.75°C (from 0°C to 760°C) <0.75°C±0.07°C / °C (from 0°C to -32°C)
Temperature resolution	0.2°C	0.1°C	
Response time	300ms (95%)		
Ambient temperature	0°C to 50°C		
Storage temperature	-20°C to 60°C without battery		
Emissivity	fixed: 0.95	0.1 – 1.1 adjustable	
Configurations	Min/Max/Hold/°C/°F	Min/Max/Hold/°C/°F/Offset	
Alarm functions	-	Visual and acoustic HIGH-/LOW-alarm	
PC Interface, Software, Thermocouple Input	USB interface	USB interface, IRConnect software	USB interface, IRConnect software, thermocouple element type K
Laser	<1mW laser class IIa, laser beam with 9mm offset		
Weight/Dimensions	150g; 190 x 38 x 45mm		180g; 190 x 38 x 45mm
Battery	9V alkaline battery		
Battery life	20h with laser and backlight on 50% 40h with laser and backlight off		
Relative humidity	10 – 95% RH non condensing, at <30°C ambient temperature		
Standard accessories	-	soft pouch, wrist strap, tripod adapter, rubber protection boot	
Optional	certificate of calibration		

[1] adjustable via software
[2] object temperature >0°C; whichever is greater
[3] ± at ambient temperature 23 <5°C



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15	15	20.10.2005	13:53:29	21.8°C	21.8°C	21.9°C	21.8°C	27.3°C	-----	30.0°C	-40.0°C	1.000	PP5L
16	16	20.10.2005	18:06:45	48.7°C	24.3°C	48.6°C	41.2°C	24.5°C	-----	30.0°C	-40.0°C	0.950	P015
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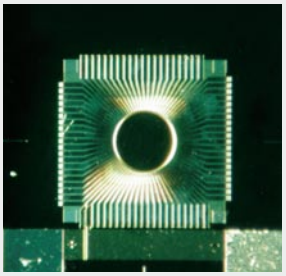
Schließen | Datei Öffnen... | Sichern als ... | Logger Löschen ...

Software IRConnect
(included with MS Pro series)
- Data logging
- Display and recording of temperature graphs
- Modifications of handheld settings

System requirements
- Windows XP, Windows 2000
- USB 2.0
- Hard disc min. 30 MByte
- min. 128 MByte RAM
- CD-ROM drive

Radiation Thermocouple Elements (Thermopiles)

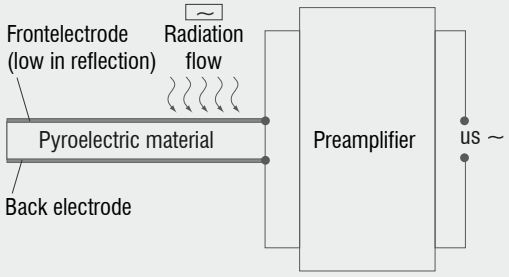
If the joint between two wires of different metallic material heats up, the thermoelectrical effect results in an electrical voltage. If the connection is warm because of absorbed radiation, this component is called radiation thermocouple. The illustration shows thermocouples made of bismuth/antimony which are arranged on a chip round an absorbing element. In case the temperature of the detector increases, this results in a proportional voltage, which can be caught at the end of the bond isles.



Pyroelectric Detectors

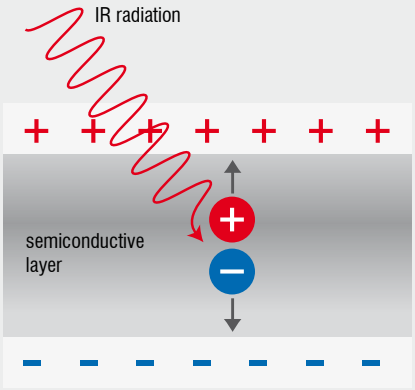
The illustration shows the common construction of a pyroelectric detector. This sensitive element consists of pyroelectric material with two electrodes. The absorbed infrared radiation results in a changed temperature of the sensitive element which leads to a changed surface loading due to the pyroelectric effect. The so created electric output signal is processed by a preamplifier. Due to the nature of how the loading is generated in the pyroelectric element the radiation flow has to be continuously and alternately interrupted. The advantage of the frequence selective preamplifying is a better signal to noise ratio.

Pyroelectric detectors



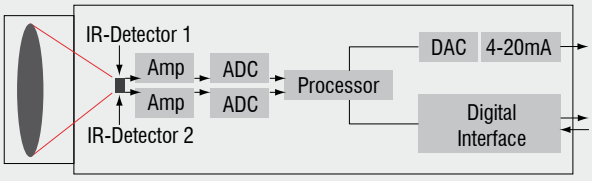
Quantum Detectors

The decisive difference between quantum detectors and thermal detectors is their faster reaction on absorbed radiation. The mode of operation of quantum detectors is based on the photo effect. The striking photons of the infrared radiation lead to an increase of the electrons into a higher energy level inside the semiconductor material. When the electrons fall back an electric signal (voltage or power) is generated. Also a change of the electric resistance is possible. These signals can be analysed in an exact way. Quantum detectors are very fast (ns to µs). The temperature of the sensitive element of a thermal detector changes relatively slowly. Time constants of thermal detectors are usually bigger than time constants of quantum detectors. Roughly approximated one can say that time constants of thermal detectors can be measured in milliseconds whereas time constants of quantum detectors can be measured in nanoseconds or even microseconds.



Ratio pyrometer

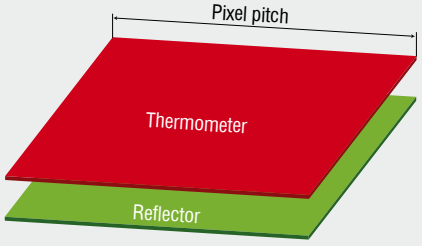
A 2-color pyrometer operates analogue to a usual pyrometer in principle, besides measuring at two close wavelengths at the same time. Therefore, two different filter are used in the pyrometer. The results of both measurements are divided, so that the emissivity of the measurement doesn't matter anymore. That means, the influence ot the emissivity is dropped and can be unknown. This principle is very usefull at high temperatures like metal processing applications. Smoke or steam have no influence to the measurement. Also the measuring object can be smaller than the measuring spot with this principle.



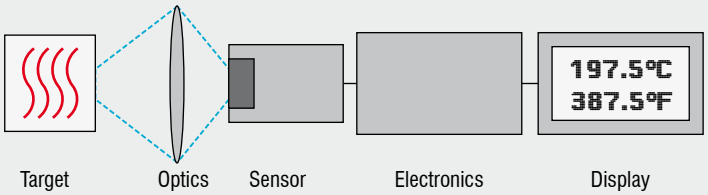
Bolometers

Bolometers use the temperature dependency of the electric resistance. The sensitive element consists of a resistor, which changes when it absorbs heat. The change in resistance leads to a changed signal voltage. The material should have a high temperature factor of the electrical resistance in order to work with high sensitivity and high specific detectivity.

Bolometers which work at room temperature use the temperature coefficient of metallic resistors (e.g. black layer and thin layer bolometer) as well as of semiconductor resistors (e.g. thermistor bolometers).



With our eyes we see the world in visible light. Whereas visible light fills only a small part of the radiation spectrum, the invisible light covers most of the remaining spectral range. The radiation of invisible light carries much more additional information.



The infrared temperature measurement System

Each body with a temperature above the absolute zero (-273.15°C = 0 Kelvin) emits an electromagnetic radiation from its surface, which is proportional to its intrinsic temperature. A part of this so-called intrinsic radiation is infrared radiation, which can be used to measure a body's temperature. This radiation penetrates the atmosphere. With the help of a lens (input optics) the beams are focused on a detector element, which generates an electrical signal proportional to the radiation. The signal is amplified and, using successive digital signal processing, is transformed into an output signal proportional to the object temperature. The measuring value may be shown in a display or released as analog output signal, which supports an easy connection to control systems of the process management.

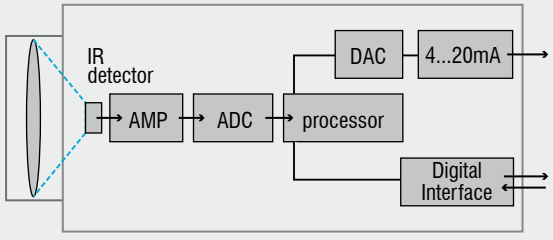
The advantages of non-contact temperature measurement

- Temperature measurements of moving or overheated objects and of objects in hazardous surroundings
- Very fast response and exposure times
- Measurement without interreaction, no influence on the measuring object
- Non-destructive measurement
- Long lasting measurement, no mechanical wear

Construction and operation of infrared thermometers

The illustration shows the general construction of an infrared thermometer. With the help of input optics the emitted object radiation is focused onto an infrared detector. The detector generates a corresponding electrical signal which then is amplified and may be used for further processing. Digital signal processing transforms the signal into an output value proportional to the object temperature. The temperature result is either shown on a display or may be used as analog signal for further processing. In order to compensate influences from the surroundings a second detector catches the temperature of the measuring device and of his optical channel, respectively. Consequently, the temperature of the measuring object is mainly generated in three steps:

1. Transformation of the received infrared radiation into an electrical signal
2. Compensation of background radiation from thermometer and object
3. Linearization and output of temperature information.



Block diagram of an infrared thermometer

The grey body

Only few bodies meet the ideal of the black body. Many bodies emit far less radiation at the same temperature. The emissivity ε defines the relation of the radiation value in real and of the black body. It is between zero and one. The infrared sensor receives the emitted radiation from the object surface, but also reflected radiation from the surroundings and perhaps penetrated infrared radiation from the measuring object:

$\varepsilon + \varphi + \tau = 1$

ε emissivity

φ reflection

τ transmissivity

Most bodies do not show transmissivity in infrared, therefore the following applies:

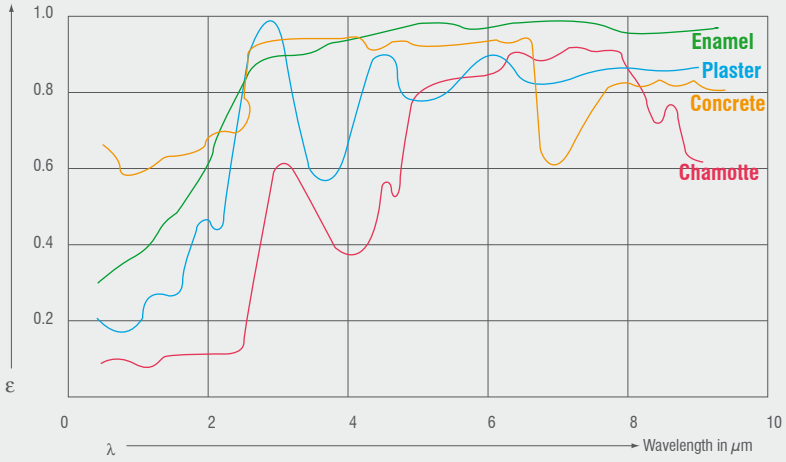
$\varepsilon + \varphi = 1$

This fact is very helpful as it is much easier to measure the reflection than to measure the emissivity.

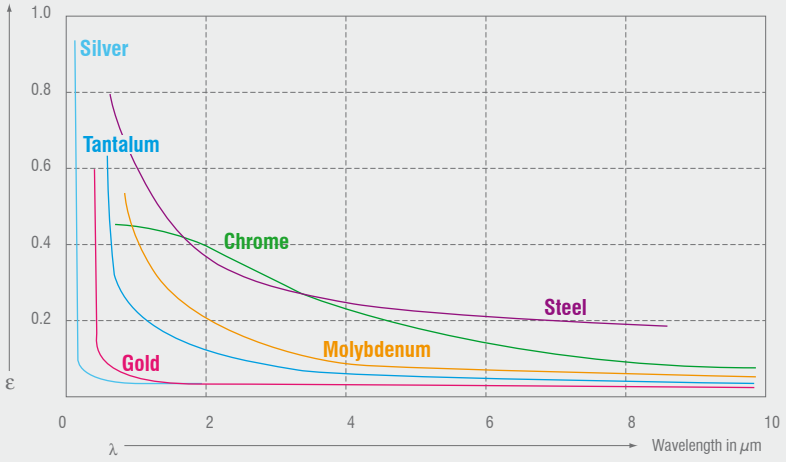
Emissivity

The formula shows that the emissivity ε is of central significance, if you want to determine the temperature with radiation measurement. The emissivity stands for the relation of thermal radiations, which are generated by a grey and a black body at the same temperature. The maximum emissivity for the black body is 1. A grey body is an object, which has the same emissivity at all wavelengths and emits less infrared radiation than a black radiator ($\varepsilon < 1$). Bodies with emissivities, which depend on the temperature as well as on the wavelength, are called non grey or selective bodies (e.g. metals).

The emissivity depends on the material, its surface, temperature, wavelength and sometimes on the measuring arrangement. Many objects consisting of nonmetallic material show a high and relatively constant emissivity independent from their surface consistency, at least in longwave ranges. Generally metallic materials show a low emissivity, which strongly depends on the surface consistency and which drop in higher wavelengths.



Spectral emissivity of nonmetalls

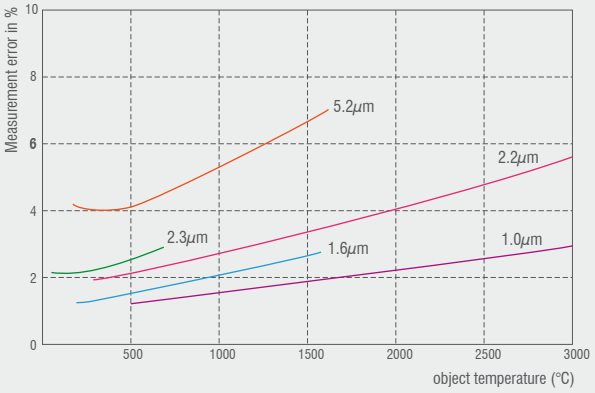


Spectral emissivity of metalls

Temperature measurement of metallic materials

This may result in varying measuring results. Consequently, already the choice of the infrared thermometer depends on the wavelength and temperature range, in which metallic materials show a relatively high emissivity. For metallic materials the shortest possible wavelength should be used, as the measuring error increases in correlation to the wavelength.

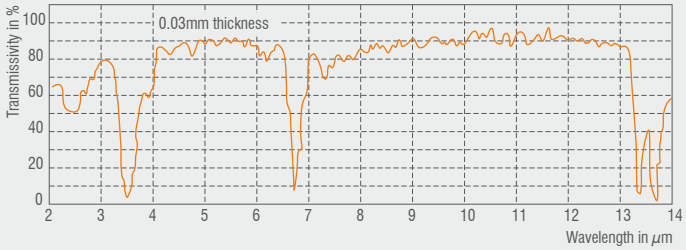
The optimal wavelength for metals ranges with 0.8 to 1.0 µm for high temperatures at the limit of the visible area. Additionally, wavelengths of 1.6 µm, 2.3 µm and 5.2 µm are possible.



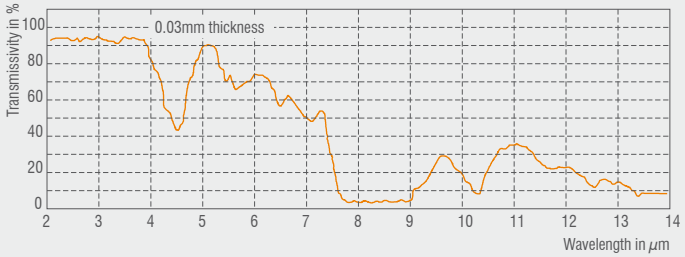
Measurement error of 10 % as result of wrongly adjusted emissivity and in dependence on wavelength and object temperature.

Temperature measurement of plastics

Transmissivities of plastics vary with the wavelength. They react inversely proportional to the thickness, whereas thin materials are more transmissive than thick plastics. Optimal measurements can be carried out with wavelengths, where transmissivity is almost zero and independent from the thickness. Polyethylene, polypropylen, nylon and polystyrene are non-transmissive at 3.43 μm, polyester, polyurethane, teflon, FEP and polyamide are non-transmissive at 7.9 μm. For thicker and pigmented films wavelengths between 8 and 14 μm will do. The manufacturer of infrared thermometers can determine the optimal spectral range for the temperature measurement by testing the plastics material. The reflection is between 5 and 10 % for almost all plastics.



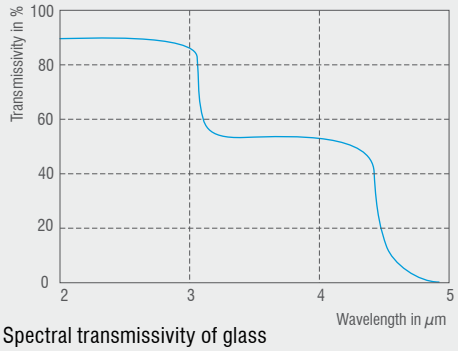
Spectral permeability of plastics made from polethylene.



Spectral transmissivity of plastic layers made of polyester

Temperature measurement of glass

If you measure temperatures of glass it implies that you take care of reflection and transmissivity. A careful selection of the wavelength facilitates measurements of the glass surface as well as of the deeper layers of the glass. Wavelengths of 1.0 μm, 1.6 μm or 2.3 μm are appropriate for measuring deeper layers whereas 5 μm are recommended for surface measurements. If temperatures are low, you should use wavelengths between 8 and 14 μm in combination with an emissivity of 0.85 in order to compensate reflection. For this purpose a thermometer with short response time should be used as glass is a bad heat conductor and can change its surface temperature quickly.



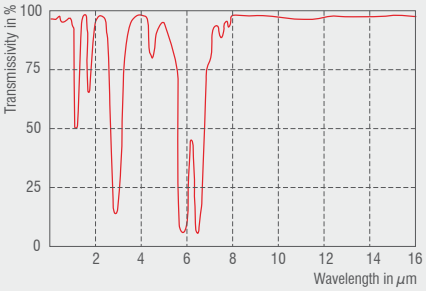
Spectral transmissivity of glass

Influence from the surroundings

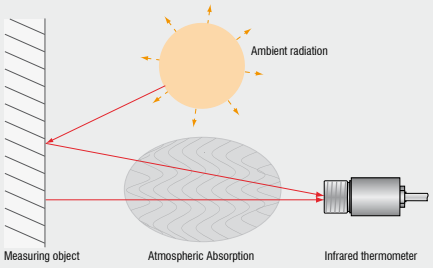
The illustration shows that the transmissivity of air strongly depends on the wavelength. Strong flattening alternates with areas of high transmissivity - the so-called “atmospheric windows”. The transmissivity in the longwave atmospheric window (8 - 14 μm) is constantly high whereas there are measurable alleviations by the atmosphere in the shortwave area, which may lead to false results. Typical measuring windows are 1.1 … 1.7 μm, 2 … 2.5 μm and 3 … 5 μm.

Additional influences can arise from heat sources in the environment of the measuring object. To prevent wrong measuring results due to increased ambient temperatures, the infrared thermometer compensates the influence of ambient temperatures beforehand (as e.g. when measuring temperatures of metals in industrial ovens, where the oven walls are hotter than the measuring object). A second temperature sensing head helps to generate accurate measuring results by automatically compensating the ambient temperatures and a correctly adjusted emissivity.

Dust, smoke and suspended matter in the atmosphere can pollute the optics and result in false measuring data. Here air purge collars (which are installed in front of the optics with compressed air) help to prevent deposition of suspended matter in front of the optics. Accessories for air and water cooling support the use of infrared thermometers even in hazardous surroundings.



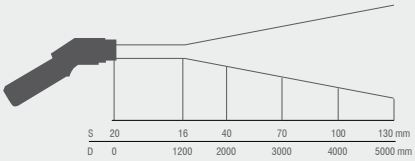
Spectral transmissivity of air (1 m, 32°C, 75 % r. F.)



Compensating ambient influences

Optics and windows

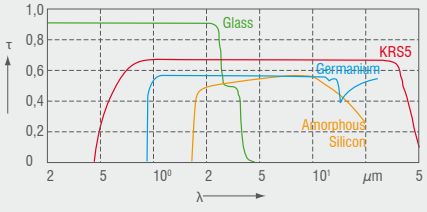
An optical system - mostly consisting of lens optics - forms the beginning of the measuring chain. The lens receives the emitted infrared energy from a measuring object and focuses it onto a detector. Measurements based on this technology can only be correct, if the measuring object is bigger in size than the detector spot. The distance ratio describes the size of the measuring spot at a certain distance. It is defined as D:S-ratio: relation of measuring distance to spot diameter. The optical resolution improves with increasing values of the D:S ratio.



Optical Diagram of an infrared sensor

Because of their material infrared optics can be used for a certain range of wavelengths, only. The following illustration shows typical lenses and window materials with their corresponding wavelength for infrared thermometers.

Some measurements make it necessary to take the temperature through an appropriate measuring window, as in closed reaction containers, ovens or vacuum chambers. The transmissivity of the measuring window should match the spectral sensitivity of the sensor. Quartz crystal fits for high measuring temperatures. Special material like Germanium, AMTIR or Zinkselenid should be used for low temperatures in the spectral range between 8 - 14 μm. Also diameter of the window, temperature conditions and maximum compression balance are important features for the selection of a qualified window material. A window of 25 mm in diameter, which has to resist a compression balance of 1 atmosphere, should be 1.7 mm thick. Window material, which is transparent also in the visible range, might help in order to appropriately adjust the sensor onto the measuring object (e.g. inside the vacuum container).

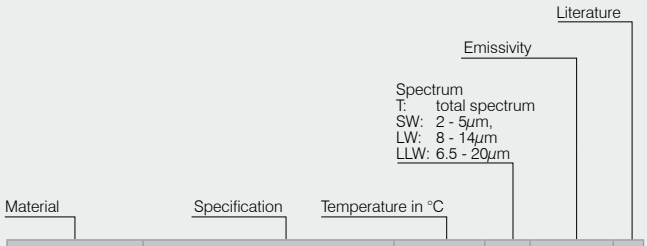


Transmissivity of typical infrared materials

The table shows various window materials in a survey.

Window material/features	Al2O3	SiO2	CaF2	BaF2	AMTIR	ZnS
Recommended infrared wavelength in μm	1…4	1…2.5	2…8	2…8	3…14	2…14
Max. window temperature in °C	1800	900	600	500	300	250
Transmissivity in visible area	yes	yes	yes	yes	no	yes
Resistiveness against humidity, acids, ammoniac combinations	very good	very good	few	few	good	good

Windows with anti reflection coating have a significantly higher transmissivity (up to 95%). The transmissivity loss can be corrected with the transmissivity setup, in case the manufacturer specified the corresponding wavelength area. If not, it has to be identified with an infrared thermometer and a reference source.



Material	Specification	°C	Spec.	Emissivity	Lit.
Aluminumbrass		20	T	0.6	1
Aluminum	Plate, 4 samples differently scratched	70	LW	0.03 - 0.06	9
Aluminum	Plate, 4 samples differently scratched	70	SW	0.05 - 0.08	9
Aluminum	anodized, light grey, dull	70	LW	0.97	9
Aluminum	anodized, light grey, dull	70	SW	0.61	9
Aluminum	anodized, light grey, dull	70	LW	0.95	9
Aluminum	anodized, light grey, dull	70	SW	0.67	9
Aluminum	anodized plate	100	T	0.55	2
Aluminum	film	27	3µm	0.09	3
Aluminum	film	27	10µm	0.04	3
Aluminum	harshened	27	3µm	0.28	3
Aluminum	harshened	27	10µm	0.18	3
Aluminum	Cast, sandblasted	70	LW	0.46	9
Aluminum	Cast, sandblasted	70	SW	0.47	9
Aluminum	dipped in HNO3, plate	100	T	0.05	4
Aluminum	polished	50 - 100	T	0.04 - 0.06	1
Aluminum	polished, plate	100	T	0.05	2
Aluminum	polished plate	100	T	0.05	4
Aluminum	harshened surface	20 - 50	T	0.06 - 0.07	1
Aluminum	deeply oxidized	50 - 500	T	0.2 - 0.3	1
Aluminum	deeply weather beaten	17	SW	0.83 - 0.94	5
Aluminum	unchanged, plate	100	T	0.09	2
Aluminum	unchanged, plate	100	T	0.09	4
Aluminum	vacuumcoated	20	T	0.04	2
Aluminumoxide	activated, powder		T	0.46	1
Aluminumhydroxide	powder		T	0.28	1
Aluminumoxide	clean, powder (aluminumoxide)		T	0.16	1
Asbestos	Floor tiles	35	SW	0.94	7
Asbestos	Boards	20	T	0.96	1
Asbestos	Tissue		T	0.78	1
Asbestos	Paper	40 - 400	T	0.93 - 0.95	1
Asbestos	Powder		T	0.40 - 0.60	1
Asbestos	brick	20	T	0.96	1
Asphalt road surface		4	LLW	0.967	8
Brass	treated with 80-sandpaper	20	T	0.2	2
Brass	plate, milled	20	T	0.06	1
Brass	plate, treated with sandpaper	20	T	0.2	1
Brass	stronlgy polished	100	T	0.03	2
Brass	oxidized	70	SW	0.04 - 0.09	9
Brass	oxidized	70	LW	0.03 - 0.07	9
Brass	oxidized	100	T	0.61	2
Brass	oxidized at 600°C	200 - 600	T	0.59 - 0.61	1
Brass	polished	200	T	0.03	1
Brass	blunt, patchy	20 - 350	T	0.22	1
Brick	Aluminumoxide	17	SW	0.68	5
Brick	Dinas-Siliziumoxide, fireproof	1000	T	0.66	1
Brick	Dinas-Siliziumoxid, glazed, harshened	1100	T	0.85	1
Brick	Dinas-Siliziumoxid, unglazed, harshened	1000	T	0.8	1
Brick	fireproof product, corundom	1000	T	0.46	1
Brick	fireproof product, magnesit	1000 - 1300	T	0.38	1
Brick	fireproof product, mildly beaming	500 - 1000	T	0.65 - 0.75	1
Brick	fireproof product, strongly beaming	500 - 1000	T	0.8 - 0.9	1
Brick	fire brick	17	SW	0.68	5
Brick	glazed	17	SW	0.94	5

Material	Specification	°C	Spec.	Emissivity	Lit.
Brick	brickwork	35	SW	0.94	7
Brick	brickwork, plastered	20	T	0.94	1
Brick	normal	17	SW	0.86 - 0.81	5
Brick	red, normal	20	T	0.93	2
Brick	red, grey	20	T	0.88 - 0.93	1
Brick	chamotte	20	T	0.85	1
Brick	chamotte	1000	T	0.75	1
Brick	chamotte	1200	T	0.59	1
Brick	amorphous silicon 95% SiO_2	1230	T	0.66	1
Brick	Sillimanit, 33% SiO_2, 64% Al_2O_3	1500	T	0.29	1
Bronze	Phosphorbronze	70	LW	0.06	9
Bronze	Phosphorbronze	70	SW	0.08	1
Bronze	polished	50	T	0.1	1
Bronze	Porous, harshened	50 - 100	T	0.55	1
Bronze	powder		T	0.76 - 0.80	1
Carbon	fluent	20	T	0.98	2
Carbon	plumbago powder		T	0.97	1
Carbon	charcoal powder		T	0.96	1
Carbon	candle soot	20	T	0.95	2
Carbon	lamp soot	20 - 400	T	0.95 - 0.97	1
Cast Iron	treated	800 - 1000	T	0.60 - 0.70	1
Cast Iron	fluent	1300	T	0.28	1
Cast Iron	cast	50	T	0.81	1
Cast Iron	blocks made of cast iron	1000	T	0.95	1
Cast Iron	oxidized	38	T	0.63	4
Cast Iron	oxidized	100	T	0.64	2
Cast Iron	oxidized	260	T	0.66	4
Cast Iron	oxidized	538	T	0.76	4
Cast Iron	oxidized at 600°C	200 - 600	T	0.64 - 0.78	1
Cast Iron	polished	38	T	0.21	4
Cast Iron	polished	40	T	0.21	2
Cast Iron	polished	200	T	0.21	1
Cast Iron	untreated	900 - 1100	T	0.87 - 0.95	1
Chipboard	untreated	20	SW	0.9	6
Chrome	polished	50	T	0.1	1
Chrome	polished	500 - 1000	T	0.28 - 0.38	1
Clay	burnt	70	T	0.91	1
Cloth	black	20	T	0.98	1
Concrete		20	T	0.92	2
Concrete	pavement	5	LLW	0.974	8
Concrete	harshened	17	SW	0.97	5
Concrete	dry	36	SW	0.95	7
Copper	electrolytic, brightly polished	80	T	0.018	1
Copper	electrolytic, polished	-34	T	0.006	4
Copper	scraped	27	T	0.07	4
Copper	molten	1100 - 1300	T	0.13 - 0.15	1
Copper	commercial, shiny	20	T	0.07	1
Copper	oxidized	50	T	0.6 - 0.7	1
Copper	oxidized, dark	27	T	0.78	4
Copper	oxidized, deeply	20	T	0.78	2
Copper	oxidized, black		T	0.88	1
Copper	polished	50 - 100	T	0.02	1
Copper	pollished	100	T	0.03	2
Copper	polished, commercial	27	T	0.03	4
Copper	polished, mechanical	22	T	0.015	4
Copper	clean, thoroughly prepared surface	22	T	0.008	4
Copper-dioxide	powder		T	0.84	1
Copper-dioxide	red, powder		T	0.7	1
Earth	saturated with water	20	T	0.95	2
Earth	dry	20	T	0.92	2
Enamel		20	T	0.9	1
Enamel	paint	20	T	0.85 - 0.95	1

Material	Specification	°C	Spec.	Emissivity	Lit.
Fiberboard	hard, untreated	20	SW	0.85	6
Fiberboard	Ottrelith	70	LW	0.88	9
Fiberboard	Ottrelith	70	SW	0.75	9
Fiberboard	particle plate	70	LW	0.89	9
Fiberboard	particle plate	70	SW	0.77	9
Fiberboard	porous, untreated	20	SW	0.85	6
Glazing Rebates	8 different colors and qualities	70	LW	0.92 - 0.94	9
Glazing Rebates	8 different colors and qualities	70	SW	0.88 - 0.96	9
Glazing Rebates	aluminum, different age	50 - 100	T	0.27 - 0.67	1
Glazing Rebates	on oily basis, average of 16 colors	100	T	0.94	2
Glazing Rebates	chrome green		T	0.65 - 0.70	1
Glazing Rebates	cadmium yellow		T	0.28 - 0.33	1
Glazing Rebates	cobalt blue		T	0.7 - 0.8	1
Glazing Rebates	plastics, black	20	SW	0.95	6
Glazing Rebates	plastics, white	20	SW	0.84	6
Glazing Rebates	oil	17	SW	0.87	5
Glazing Rebates	oil, different colors	100	T	0.92 - 0.96	1
Glazing Rebates	oil, shiny grey	20	SW	0.96	6
Glazing Rebates	oil, grey, matt	20	SW	0.97	6
Glazing Rebates	oil, black, matt	20	SW	0.94	6
Glazing Rebates	oil, black, shiny	20	SW	0.92	6
Gold	brightly polished	200 - 600	T	0.02 - 0.03	1
Gold	strongly polished	100	T	0.02	2
Gold	polished	130	T	0.018	1
Granite	polished	20	LLW	0.849	8
Granite	harshened	21	LLW	0.879	8
Granite	harshened, 4 different samples	70	LW	0.77 - 0.87	9
Granite	harshened, 4 different samples	70	SW	0.95 - 0.97	9
Gypsum		20	T	0.8 - 0.9	1
Gypsum, applied		17	SW	0.86	5
Gypsum, applied	gypsum plate, untreated	20	SW	0.9	6
Gypsum, applied	harshened surface	20	T	0.91	2
Ice: see Water					
Iron and Steel	electrolytic	22	T	0.05	4
Iron and Steel	electrolytic	100	T	0.05	4
Iron and Steel	electrolytic	260	T	0.07	4
Iron and Steel	electrolytic, brightly polished	175 - 225	T	0.05 - 0.06	1
Iron and Steel	freshly milled	20	T	0.24	1
Iron and Steel	freshly processed with sandpaper	20	T	0.24	1
Iron and Steel	smoothed plate	950 - 1100	T	0.55 - 0.61	1
Iron and Steel	forged, brightly polished	40 - 250	T	0.28	1
Iron and Steel	milled plate	50	T	0.56	1
Iron and Steel	shiny, etched	150	T	0.16	1
Iron and Steel	shiny oxide layer, plate	20	T	0.82	1
Iron and Steel	hotly milled	20	T	0.77	1
Iron and Steel	hotly milled	130	T	0.6	1
Iron and Steel	coldly milled	70	LW	0.09	9
Iron and Steel	coldly milled	70	SW	0.2	9
Iron and Steel	covered with red rust	20	T	0.61 - 0.85	1
Iron and Steel	oxidized	100	T	0.74	1
Iron and Steel	oxidized	100	T	0.74	4
Iron and Steel	oxidized	125 - 525	T	0.78 - 0.82	1
Iron and Steel	oxidized	200	T	0.79	2
Iron and Steel	oxidized	200 - 600	T	0.8	1
Iron and Steel	oxidized	1227	T	0.89	4
Iron and Steel	polished	100	T	0.07	2
Iron and Steel	polished	400 - 1000	T	0.14 - 0.38	1
Iron and Steel	polished plate	750 - 1050	T	0.52 - 0.56	1
Iron and Steel	harshened, even surface	50	T	0.95 - 0.98	1
Iron and Steel	rusty, red	20	T	0.69	1
Iron and Steel	rusty red, plate	22	T	0.69	4
Iron and Steel	deeply oxidized	50	T	0.88	1

Material	Specification	°C	Spec.	Emissivity	Lit.
Iron and Steel	deeply oxidized	500	T	0.98	1
Iron and Steel	deeply rusted	17	SW	0.96	5
Iron and Steel	deeply rusted plate	20	T	0.69	2
Iron galvanized	plate	92	T	0.07	4
Iron galvanized	plate, oxidized	20	T	0.28	1
Iron galvanized	plate, oxidized	30	T	0.23	1
Iron galvanized	deeply oxidized	70	LW	0.85	9
Iron galvanized	deeply oxidized	70	SW	0.64	9
Iron tinned	plate	24	T	0.064	4
Leather	tanned fur		T	0.75 - 0.80	1
Limestone			T	0.3 - 0.4	1
Magnesium		22	T	0.07	4
Magnesium		260	T	0.13	4
Magnesium		538	T	0.18	4
Magnesium	polished	20	T	0.07	2
Magnesiumpowder			T	0.86	1
Molybdenum		600 - 1000	T	0.08 - 0.13	1
Molybdenum		1500 - 2200	T	0.19 - 0.26	1
Molybdenum	twine	700 - 2500	T	0.1 - 0.3	1
Mortar		17	SW	0.87	5
Mortar	dry	36	SW	0.94	7
Nickel	wire	200 - 1000	T	0.1 - 0.2	1
Nickel	electrolytic	22	T	0.04	4
Nickel	electrolytic	38	T	0.06	4
Nickel	electrolytic	260	T	0.07	4
Nickel	electrolytic	538	T	0.1	4
Nickel	galvanized, polished	20	T	0.05	2
Nickel	galvanized on iron, not polished	20	T	0.11 - 0.40	1
Nickel	galvanized on iron, non polished	22	T	0.11	4
Nickel	galvanized on iron, non polished	22	T	0.045	4
Nickel	lightly matt	122	T	0.041	4
Nickel	oxidized	200	T	0.37	2
Nickel	oxidized	227	T	0.37	4
Nickel	oxidized	1227	T	0.85	4
Nickel	oxidized at 600°C	200 - 600	T	0.37 - 0.48	1
Nickel	polished	122	T	0.045	4
Nickel	clean, polished	100	T	0.045	1
Nickel	clean, polished	200 - 400	T	0.07 - 0.09	1
Nickel-chrome	wire, bare	50	T	0.65	1
Nickel-chrome	wire, bare	500 - 1000	T	0.71 - 0.79	1
Nickel-chrome	wire, oxidized	50 - 500	T	0.95 - 0.98	1
Nickel-chrome	milled	700	T	0.25	1
Nickel-chrome	sandblasted	700	T	0.7	1
Nickeloxide		500 - 650	T	0.52 - 0.59	1
Nickeloxide		1000 - 1250	T	0.75 - 0.86	1
Oil, Lubricating Oil	0.025-mm-layer	20	T	0.27	2
Oil, Lubricating Oil	0.05-mm-layer	20	T	0.46	2
Oil, Lubricating Oil	0.125-mm-layer	20	T	0.72	2
Oil, Lubricating Oil	thick layer	20	T	0.82	2
Oil, Lubricating Oil	layer on Ni-basis: only Ni-Basis	20	T	0.05	2
Paint	3 colors, sprayed on aluminum	70	LW	0.92 - 0.94	9
Paint	3 colors, sprayed on aluminum	70	SW	0.50 - 0.53	9
Paint	aluminum on harshened surface	20	T	0.4	1
Paint	bakelite	80	T	0.83	1
Paint	heat-proof	100	T	0.92	1
Paint	black, shiny, sprayed on iron	20	T	0.87	1
Paint	black, matt	100	T	0.97	2
Paint	black, blunt	40 - 100	T	0.96 - 0.98	1
Paint	white	40 - 100	T	0.8 - 0.95	1
Paint	white	100	T	0.92	2
Paper	4 different colors	70	LW	0.92 - 0.94	9
Paper	4 different colors	70	SW	0.68 - 0.74	9

Material	Specification	°C	Spec.	Emissivity	Lit.
Paper	coated with black paint		T	0.93	1
Paper	dark blue		T	0.84	1
Paper	yellow		T	0.72	1
Paper	green		T	0.85	1
Paper	red		T	0.76	1
Paper	black		T	0.9	1
Paper	black, blunt		T	0.94	1
Paper	black, blunt	70	LW	0.89	9
Paper	black, blunt	70	SW	0.86	9
Paper	white	20	T	0.7 - 0.9	1
Paper	white, 3 different shiny coatings	70	LW	0.88 - 0.90	9
Paper	white, 3 different shiny coatings	70	SW	0.76 - 0.78	9
Paper	white, bonded	20	T	0.93	2
Plastics	fiber optics laminate (printed circuit board)	70	LW	0.91	9
Plastics	fiber optics laminate (printed circuit board)	70	SW	0.94	9
Plastics	polyurethane-insulating plate	70	LW	0.55	9
Plastics	polyurethane-insulating plate	70	SW	0.29	9
Plastics	PVC, plastic floor, blunt, structured	70	LW	0.93	9
Plastics	PVC, plastic floor, blunt, structured	70	SW	0.94	9
Plate	shiny	20 - 50	T	0.04 - 0.06	1
Plate	white plate	100	T	0.07	2
Platinum		17	T	0.016	4
Platinum		22	T	0.05	4
Platinum		260	T	0.06	4
Platinum		538	T	0.1	4
Platinum		1000 - 1500	T	0.14 - 0.18	1
Platinum		1094	T	0.18	4
Platinum	band	900 - 1100	T	0.12 - 0.17	1
Platinum	wire	50 - 200	T	0.06 - 0.07	1
Platinum	wire	500 - 1000	T	0.10 - 0.16	1
Platinum	wire	1400	T	0.18	1
Platinum	clean, polished	200 - 600	T	0.05 - 0.10	1
Plumb	shiny	250	T	0.08	1
Plumb	non oxidized, polished	100	T	0.05	4
Plumb	oxidized, grey	20	T	0.28	1
Plumb	oxidized, grey	22	T	0.28	4
Plumb	oxidized at 200°C	200	T	0.63	1
Plumb rot		100	T	0.93	4
Plumb rot, Powder		100	T	0.93	1
Polystyrene	heat insulation	37	SW	0.6	7
Porcelain	glazed	20	T	0.92	1
Porcelain	white, glowing		T	0.70 - 0.75	1
Rubber	hard	20	T	0.95	1
Rubber	soft, grey, harshened	20	T	0.95	1
Sand			T	0.6	1
Sand		20	T	0.9	2
Sandpaper	coarse	80	T	0.85	1
Sandstone	polished	19	LLW	0.909	8
Sandstone	harshened	19	LLW	0.935	8
Silver	polished	100	T	0.03	2
Silver	clean, polished	200 - 600	T	0.02 - 0.03	1
Skin	Human Being	32	T	0.98	2
Slag	basin	0 - 100	T	0.97 - 0.93	1
Slag	basin	200 - 500	T	0.89 - 0.78	1
Slag	basin	600 - 1200	T	0.76 - 0.70	1
Slag	basin	1400 - 1800	T	0.69 - 0.67	1
Snow: see Water					
Stainless Steel	plate, polished	70	LW	0.14	9
Stainless Steel	plate, polished		SW	0.18	9
Stainless Steel	plate, not treated, scratched	70	LW	0.28	9
Stainless Steel	plate, not treated, scratched	70	SW	0.3	9
Stainless Steel	milled	700	T	0.45	1
Stainless Steel	alloy, 8% Ni, 18% Cr	500	T	0.35	1
Stainless Steel	sandblasted	700	T	0.7	1
Stainless Steel	type 18-8, shiny	20	T	0.16	2
Stainless Steel	type 18-8, oxidized at 800°C	60	T	0.85	2
Tar			T	0.79 - 0.84	1
Tar	paper	20	T	0.91 - 0.93	1
Titanium	oxidized at 540°C	200	T	0.4	1
Titanium	oxidized at 540°C	500	T	0.5	1
Titanium	oxidized at 540°C	1000	T	0.6	1
Titanium	polished	200	T	0.15	1
Titanium	polished	500	T	0.2	1
Titanium	polished	1000	T	0.36	1
Tungsten		200	T	0.05	1
Tungsten		600 - 1000	T	0.1 - 0.16	1
Tungsten		1500 - 2200	T	0.24 - 0.31	1
Tungsten	twine	3300	T	0.39	1
Varnish	on parquet flooring made of oak	70	LW	0.90 - 0.93	9
Varnish	on parquet flooring made of oak	70	SW	0.9	9
Varnish	matt	20	SW	0.93	6
Vulcanite			T	0.89	1
Wall Paper	slightly patterned, light grey	20	SW	0.85	6
Wall Paper	slightly patterned, red	20	SW	0.9	6
Water	distilled	20	T	0.96	2
Water	ice, strongly covered with frost	0	T	0.98	1
Water	ice, slippery	-10	T	0.96	2
Water	ice, slippery	0	T	0.97	1
Water	frost crystals	-10	T	0.98	2
Water	coated >0.1 mm thick	0 - 100	T	0.95 - 0.98	1
Water	snow		T	0.8	1
Water	snow	-10	T	0.85	2
Wood		17	SW	0.98	5
Wood		19	LLW	0.962	8
Wood	planed	20	T	0.8 - 0.9	1
Wood	planed oak	20	T	0.9	2
Wood	planed oak	70	LW	0.88	9
Wood	planed oak	70	SW	0.77	9
Wood	treated with sandpaper		T	0.5 - 0.7	1
Wood	pine, 4 different samples	70	LW	0.81 - 0.89	9
Wood	pine, 4 different samples	70	SW	0.67 - 0.75	9
Wood	plywood, even, dry	36	SW	0.82	7
Wood	plywood, untreated	20	SW	0.83	6
Wood	white, damp	20	T	0.7 - 0.8	1
Zinc	plate	50	T	0.2	1
Zinc	oxidized at 400°C	400	T	0.11	1
Zinc	oxidized surface	1000 - 1200	T	0.50 - 0.60	1
Zinc	polished	200 - 300	T	0.04 - 0.05	1

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Absorption	Ratio of absorbed radiation by an object to incoming radiation. A number between 0 and 1.
Emissivity	Emitted radiation of an object compared to the radiation from a black bodysource. A number between 0 and 1.
Filter	Material, permeable for certain infrared wavelengths only
FOV	Field of view: Horizontal field of view of an infrared lens.
FPA	Focal Plane Array: type of an infrared detector.
Grey Body Source	An object, which emits a certain part of the energy which a black body source emits at every wavelength.
IFOV	Instantaneous field of view: A value for the geometric resolution of a thermal imager.
NETD	Noise equivalent temperature difference. A value for the noise (in the image) of a thermal imager.
Object parameter	Values, with which measurement conditions and measuring object are described (e.g. emissivity, ambient temperature, distance a.s.o.)
Object signal	A noncalibrated value, which refers to the radiation the thermal imager receives from the measuring object. a
Palette	Colors of the infrared image
Pixel	Synonym for picture element. A single picture point in an image.
Reference temperature	Temperature value to compare regular measuring data with.
Reflection	Ratio of radiation reflected by the object and incoming radiation. A number between 0 and 1.
Black body source	Object with a reflection of 0. Any radiation is to be traced back to its temperature.
Spectral specific radiation	Energy emitted by an object related to time, area and wavelength ($W/m^2/\mu m$).
Specific radiation	Energy emitted from an object related to units of time and area (W/m^2).
Radiation	Energy emitted by an object related to time, area and solid angle ($W/m^2/sr$).
Radiation flow	Energy emitted by an object related to the unit of time (W)
Temperature difference	A value, which is determined by subtraction of two temperature values.
Temperature range	Current temperature measuring range of a thermal imager. Imagers can have several temperature ranges. They are described with the help of two black body source values, which serve as threshold values for the current calibration.
Thermogram	Infrared image
Transmissity	Gases and solid states have different transmissivities. Transmissivity describes the level of infrared radiation, which permeates the object. A number between 0 and 1.
Ambient surroundings	Objects and gases, which pass radiation to the measuring object.

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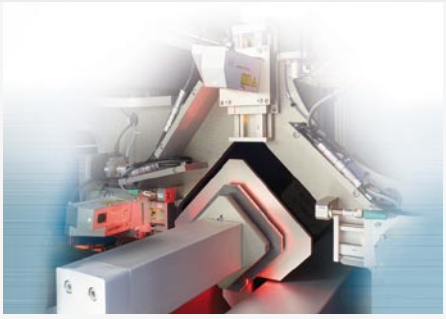

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