

CTlaser LT/ 1M/ 2M/ CTglass

Infrared Sensor



Operators manual

CE-Conformity

The product complies with the following standards:

EMC: EN 61326-1
Safety Regulations: EN 61010-1:1993/ A2:1995



The product accomplishes the requirements of the EMC Directive 89/336/EEC and of the low-voltage directive 73/23/EEC.

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Read the manual carefully before the initial start-up. The producer reserves the right to change the herein described specifications in case of technical advance of the product.

Warranty

Each single product passes through a quality process. Nevertheless, if failures occur please contact the customer service at once. The warranty period covers 24 months starting on the delivery date. After the warranty is expired the manufacturer guarantees additional 6 months warranty for all repaired or substituted product components. Warranty does not apply to damages, which result from misuse or neglect. The warranty also expires if you open the product. The manufacturer is not liable for consequential damage. If a failure occurs during the warranty period the product will be replaced, calibrated or repaired without further charges. The freight costs will be paid by the sender. The manufacturer reserves the right to exchange components of the product instead of repairing it. If the failure results from misuse or neglect the user has to pay for the repair. In that case you may ask for a cost estimate beforehand.

Content

	Page		Page
Description	3	Outputs and Inputs	33
Scope of Supply	3	Analog Outputs	33
Maintenance	3	Digital Interfaces	34
Cautions	4	Relay Outputs	34
Model Overview	4	Functional Inputs	35
Factory Default Settings	5	Alarms	36
Technical Data	6	Operating	37
General Specifications	6	Sensor Setup	37
Electrical Specifications	7	Digital Command Set	42
Measurement Specifications [LT models]	8	Laser Sighting	43
Measurement Specifications [1M/ 2M models]	9	Error messages	43
Measurement Specifications [G5 models]	10	Software CompactConnect	44
Optical Charts	11	Installation	44
Mechanical Installation	22	Basics of Infrared Thermometry	45
Accessories	22	Emissivity	46
Air Purge Collar	24	Definition	46
Mounting Bracket	25	Determination of unknown Emissivities	46
Water Cooled Housing	26	Characteristic Emissivities	47
Electrical Installation	27	Appendix A – Emissivity Table Metals	48
Cable Connections	27	Appendix B – Emissivity Table Non Metals	50
Ground Connection	30		
Exchange of the Sensing Head	31		
Exchange of the Head Cable	32		

Description

The sensors of the optris CTlaser series are noncontact infrared temperature sensors.

They calculate the surface temperature based on the emitted infrared energy of objects [**► Basics of Infrared Thermometry**]. An integrated double laser aiming marks the real measurement spot location and spot size at any distance on the object surface.

The sensor housing of the CTlaser head is made of stainless steel (IP65/ NEMA-4 rating) – the sensor electronics is placed in a separate box made of die casting zinc.

The CTlaser sensing head is a sensitive optical system. Please use only the thread for mechanical installation.

Avoid mechanical violence on the head – this may destroy the system (expiry of warranty).

Scope of Supply

- CTlaser sensing head with connection cable and electronic box
- Mounting nut and mounting bracket (fixed)
- Operators manual

Maintenance

Lens cleaning: Blow off loose particles using clean compressed air. The lens surface can be cleaned with a soft, humid tissue moistened with water or a water based glass cleaner.

PLEASE NOTE: Never use cleaning compounds which contain solvents (neither for the lens nor for the housing).

Cautions

Avoid static electricity, arc welders, and induction heaters. Keep away from very strong EMF (electromagnetic fields). Avoid abrupt changes of the ambient temperature. In case of problems or questions which may arise when you use the CTlaser, please contact our service department.

Model Overview

The sensors of the CTlaser series are available in the following basic versions:

Model	Model code	Measurement range	spectral response	typical applications
CTlaser LT	LT	-40 to 975 °C	8-14 μm	non-metallic surfaces
CTlaser F	LTF	-40 to 975 °C	8-14 μm	fast processes
CTlaser 1M	1M	485 to 1800 °C	1 μm	metals and ceramic surfaces
CTlaser 2M	2M	250 to 1600 °C	1 μm	metals and ceramic surfaces
CTglass	G5	100 to 1650 °C	5,2 μm	measurement of glass

In the following chapters of this manual you will find only the short model codes.

On the 1M/ 2M and G5 models the whole measurement range is split into two sub ranges (L and H).

Factory Default Settings

The unit has the following presetting at time of delivery:

Smart Averaging means a dynamic average adaptation at high signal edges.
[Activation via software only].

Signal output object temperature 0 – 5 V
 Emissivity 0,970 (1,000 at 1M/ 2M)
 Transmissivity 1,000
 Average time (AVG) 0,2 s/ LTF: 0,1 s/ 1M, 2M: inactive
 Smart Averaging inactive (LTF: active)
 Peak hold inactive
 Valley hold inactive

	LT	1ML	1MH	2ML	2MH	G5L	G5H
Lower limit temperature range [°C]	0	485	650	250	385	100	250
Upper limit temperature range [°C]	500	1050	1800	800	1600	1200	1650
Lower alarm limit [°C] (normally closed)	30	600	800	350	500	200	350
Upper alarm limit [°C] (normally open)	100	900	1400	600	1200	500	900
Lower limit signal output	0 V						
Upper limit signal output	5 V						
Temperature unit	°C						
Ambient temperature compensation	head temperature probe (Output at OUT-AMB: 0-5 V ► -20–180 °C; not available on 1M and 2M models)						
Baud rate	9,6 kBaud						
Laser	inactive						

Technical Data

General Specifications

	Sensing head	Electronic box
Environmental rating	IP65 (NEMA-4)	IP65 (NEMA-4)
Ambient temperature ¹⁾	-20...85 °C	0...85 °C
Storage temperature	-40...85 °C	-40...85 °C
Relative humidity	10...95 %, non condensing	10...95 %, non condensing
Material	stainless steel	die casting zinc
Dimensions	100 mm x 50 mm, M48x1,5	89 mm x 70 mm x 30 mm
Weight	600 g	420 g
Cable length	3 m (Standard), 8 m, 15 m	
Cable diameter	5 mm	
Ambient temperature cable	105 °C max. [High temperature cable (optional): 180 °C]	
Vibration	IEC 68-2-6: 3G, 11 – 200Hz, any axis	
Shock	IEC 68-2-27: 50G, 11ms, any axis	
EMI	89/336/EWG	

¹⁾ Laser will turn off automatically at ambient temperatures >50 °C.

Electrical Specifications

Power Supply	8–36 VDC
Current draw	max. 160 mA
Aiming laser	635 nm, 1 mW, On/ Off via programming keys or software
Outputs/ analog	
Channel 1	selectable: 0/ 4–20 mA, 0–5/ 10 V, thermocouple (J or K) or alarm output (Signal source: object temperature)
Channel 2 (LT/ LTF/ G5 only)	Head temperature [-20...180 °C] as 0–5 V or 0–10 V output or alarm output (Signal source switchable to object temperature or electronic box temperature if used as alarm output)
Alarm output	Open collector output at Pin AL2 [24 V/ 50 mA]
Output impedances	
mA	max. loop resistance 500 Ω (at 8-36 VDC),
mV	min. 100 K Ω load impedance
Thermocouple	20 Ω
Digital interfaces	USB, RS232, RS485, CAN, Profibus DP, Ethernet (optional plug-in modules)
Relay outputs	2 x 60 VDC/ 42 VAC _{RMS} , 0,4 A; optically isolated (optional plug-in module)
Functional inputs	F1-F3; software programmable for the following functions: - external emissivity adjustment, - ambient temperature compensation, - trigger (reset of hold functions)

Measurement Specifications [LT models]

	LT	LTF
Temperature range (scalable)	-40...975 °C	-40...975 °C
Spectral range	8...14 μm	8...14 μm
Optical resolution	75:1	50:1
System accuracy ^{1) 2)}	± 1 °C or ± 1 % ³⁾	$\pm 1,5$ °C or $\pm 1,5$ % ⁴⁾
Repeatability ^{1) 2)}	$\pm 0,5$ °C or $\pm 0,5$ % ³⁾	± 1 °C or ± 1 % ⁴⁾
Temperature resolution (NETD)	0,1 °C ³⁾	0,5 °C ⁴⁾
Response time (90% signal)	120 ms	9 ms
Warm-up time	10 min	10 min
Emissivity/ Gain	0,100...1,100 (adjustable via programming keys or software)	
Transmissivity	0,100...1,000 (adjustable via programming keys or software)	
Signal processing	Average, peak hold, valley hold (adjustable via programming keys or software)	
Software (optional)	CompactConnect	

¹⁾ at ambient temperature 23 ± 5 °C; whichever is greater

²⁾ Accuracy for thermocouple output: $\pm 2,5$ °C or ± 1 %

³⁾ at object temperatures > 0 °C

⁴⁾ at object temperatures ≥ 20 °C

Measurement Specifications [1M/ 2M models]

	1ML	1MH	2ML	2MH
Temperature range (scalable)	485...1050 °C	650...1800 °C	250...800 °C	385...1600 °C
Spectral range	1 μm	1 μm	1,6 μm	1,6 μm
Optical resolution	150:1	300:1	150:1	300:1
System accuracy ^{1) 2)}	----- ±(0,3 % of reading +2 °C) ³⁾ -----			
Repeatability ^{1) 2)}	----- ±(0,1 % of reading +1 °C) ³⁾ -----			
Temperature resolution	----- 0,1 °C ³⁾ -----			
Exposure time (90% signal)	----- 1 ms ⁴⁾ -----			
Emissivity/ Gain	0,100...1,100 (adjustable via programming keys or software)			
Transmissivity	0,100...1,000 (adjustable via programming keys or software)			
Signal processing	Average, peak hold, valley hold (adjustable via programming keys or software)			
Software (optional)	CompactConnect			

¹⁾ at ambient temperature 23±5 °C; whichever is greater

²⁾ Accuracy for thermocouple output: ±2,5 °C or ±1 %

³⁾ ε = 1/ Response time 1 s

⁴⁾ with dynamic adaptation at low signal levels

Measurement Specifications [G5 models]

	G5L	G5H
Temperature range (scalable)	100...1200 °C	250...1650 °C
Spectral range	5,2 μm	5,2 μm
Optical resolution	45:1	70:1
Accuracy ^{1) 2)}	±1 °C or ±1 %	±1 °C or ±1 %
Repeatability ^{1) 2)}	±0,5 °C or ±0,5 %	±0,5 °C or ±0,5 %
Temperature resolution (NETD)	0,1 °C	0,2 °C
Response time (90% signal)	120 ms	80 ms
Warm-up time	10 min	10 min
Emissivity/ Gain	0,100...1,100 (adjustable via programming keys or software)	
Transmissivity	0,100...1,000 (adjustable via programming keys or software)	
Signal processing	Average, peak hold, valley hold (adjustable via programming keys or software)	
Software (optional)	CompactConnect	

¹⁾ at ambient temperature 23±5 °C; whichever is greater

²⁾ Accuracy for thermocouple output: ±2,5 °C or ±1 %

Optical Charts

The following optical charts show the diameter of the measuring spot in dependence on the distance between measuring object and sensing head. The spot size refers to 90 % of the radiation energy. The distance is always measured from the front edge of the sensing head.

The size of the measuring object and the optical resolution of the infrared thermometer determine the maximum distance between sensing head and measuring object. In order to prevent measuring errors the object should fill out the field of view of the optics completely. Consequently, the spot should at all times have at least **the same size** like the object or should be **smaller than that**.

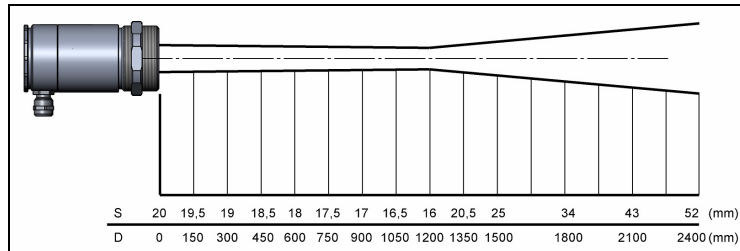
D = Distance from front of the sensing head to the object
S = Spot size

LT

Optics: SF

D:S (focus distance) = 75:1 / 16mm@ 1200mm

D:S (far field) = 34:1

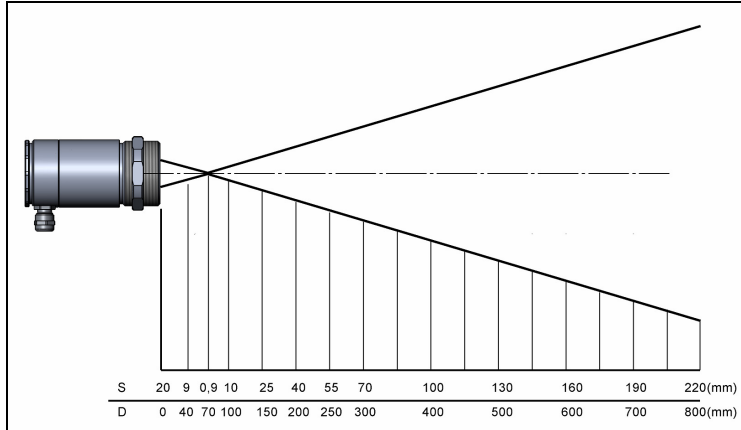




Optics: CF1

D:S (focus distance) = 75:1/ 0,9mm@ 70mm

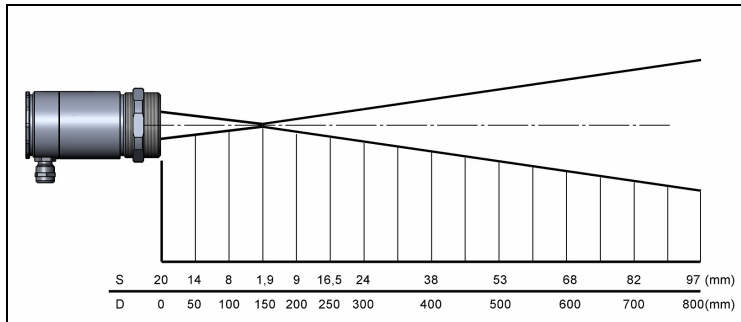
D:S (far field) = 3,5:1



Optics: CF2

D:S (focus distance) = 75:1/ 1,9mm@ 150mm

D:S (far field) = 7:1

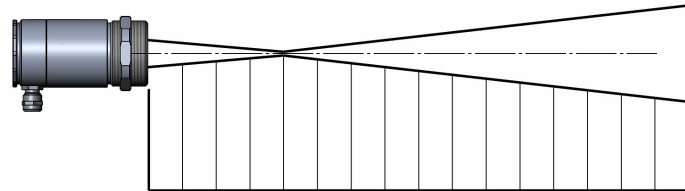




Optics: CF3

D:S (focus distance) = 75:1/ 2,75mm@ 200mm

D:S (far field) = 9:1



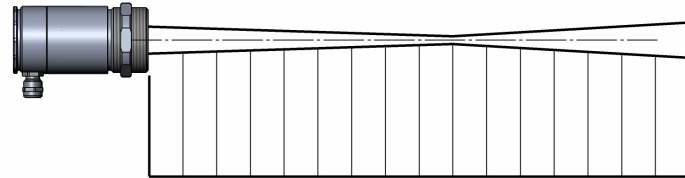
S	20	16	11	7	2,75	8,5	14	25,5	37	48	60	71 (mm)
D	0	50	100	150	200	250	300	400	500	600	700	800(mm)



Optics: CF4

D:S (focus distance) = 75:1/ 5,9mm@ 450mm

D:S (far field) = 18:1



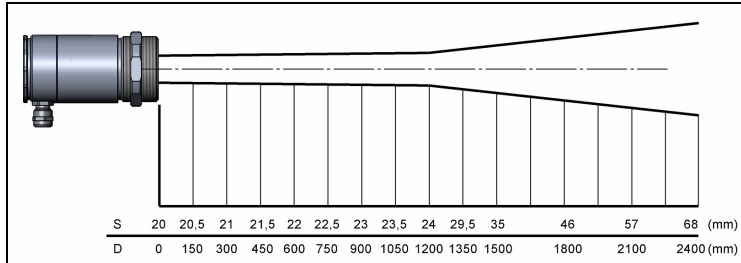
S	20	18,5	17	15,5	14	12,5	11	9	7,5	5,9	9	15	20	26 (mm)
D	0	50	100	150	200	250	300	350	400	450	500	600	700	800(mm)

LTF

Optics: SF

D:S (focus distance) = 50:1/ 24mm@ 1200mm

D:S (far field) = 20:1

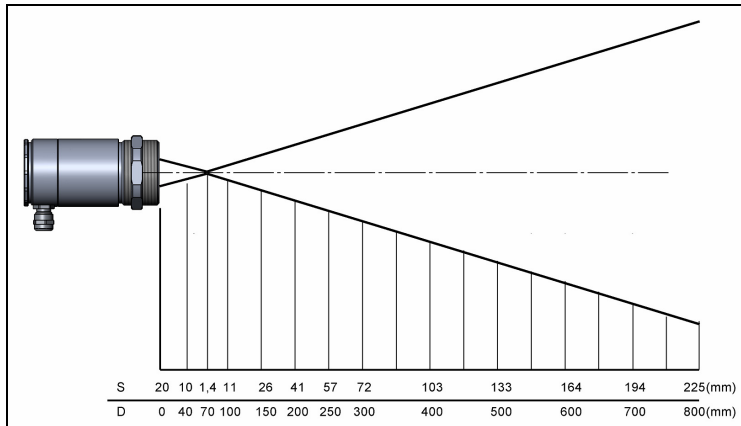


LTF

Optics: CF1

D:S (focus distance) = 50:1/ 1,4mm@ 70mm

D:S (far field) = 1,5:1

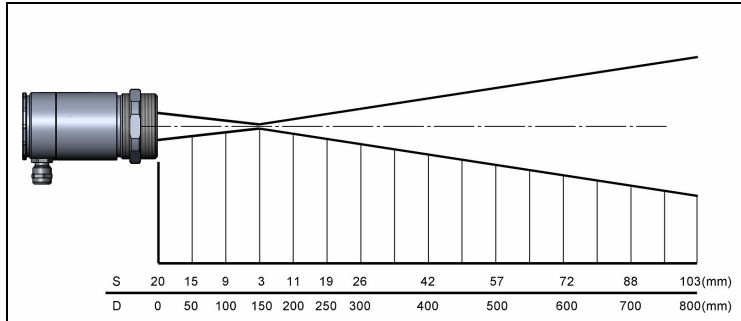


LTF

Optics: CF2

D:S (focus distance) = 50:1/ 3mm@ 150mm

D:S (far field) = 6:1

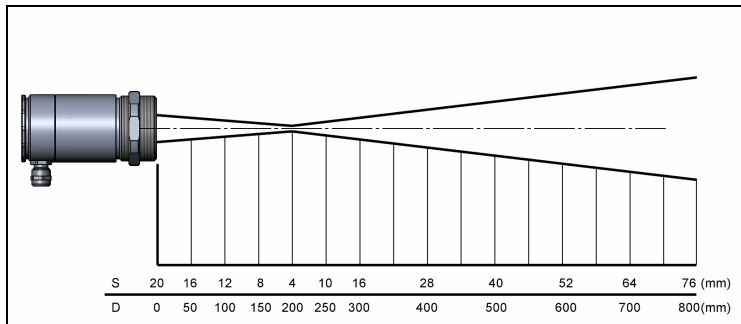


LTF

Optics: CF3

D:S (focus distance) = 50:1/ 4mm@ 200mm

D:S (far field) = 8:1

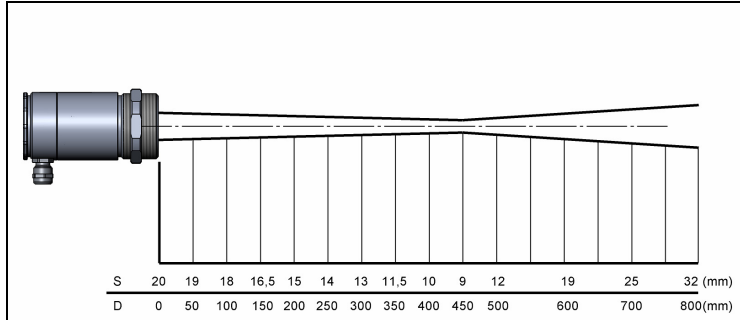


LTF

Optics: CF4

D:S (focus distance) = 50:1/ 9mm@ 450mm

D:S (far field) = 16:1



1MH/ 2MH

Optics: FF

D:S (focus distance) = 300:1/ 12mm@ 3600mm

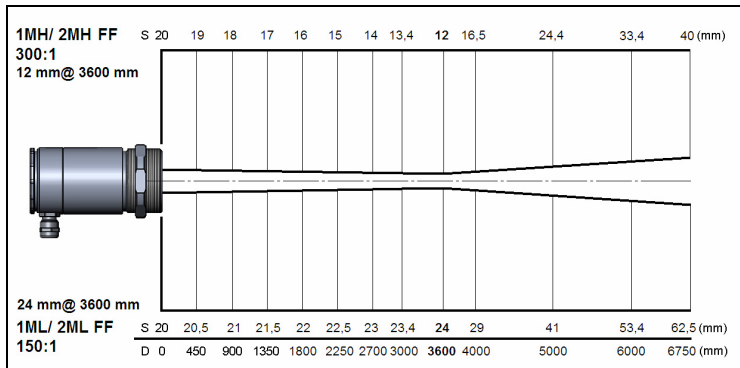
D:S (far field) = 115:1

1ML/ 2ML

Optics: FF

D:S (focus distance) = 150:1/ 24mm@ 3600mm

D:S (far field) = 84:1



1MH/ 2MH

Optics: SF

D:S (focus distance) = 300:1/ 3,7mm@ 1100mm

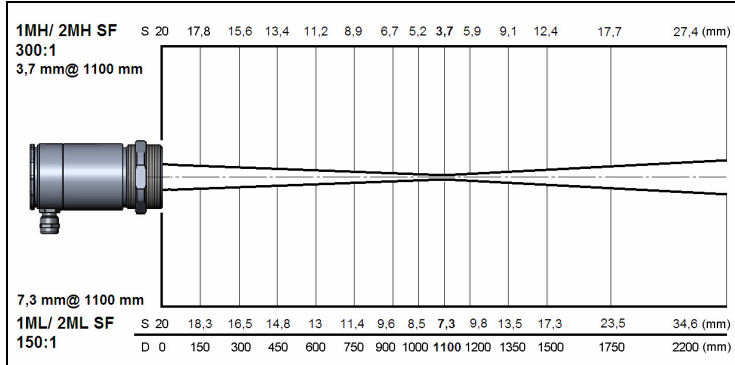
D:S (far field) = 48:1

1ML/ 2ML

Optics: SF

D:S (focus distance) = 150:1/ 7,3mm@ 1100mm

D:S (far field) = 42:1



1MH/ 2MH

Optics: CF2

D:S (focus distance) = 300:1/ 0,5mm@ 150mm

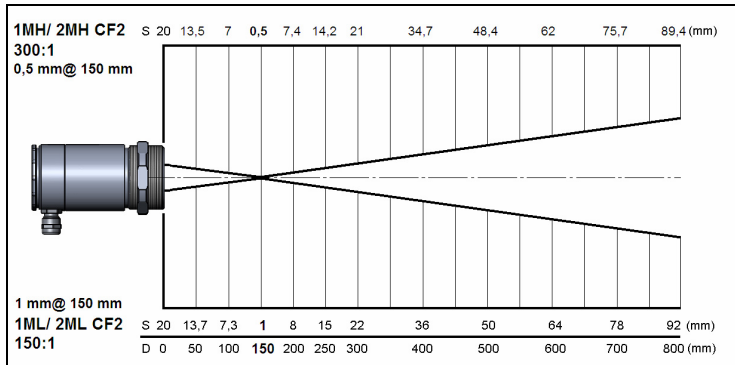
D:S (far field) = 7,5:1

1ML/ 2ML

Optics: CF2

D:S (focus distance) = 150:1/ 1mm@ 150mm

D:S (far field) = 7:1



1MH/ 2MH

Optics: CF3

D:S (focus distance) = 300:1/ 0,7mm@ 200mm

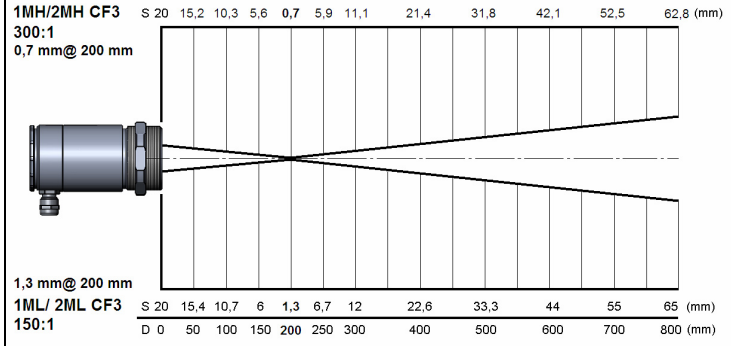
D:S (far field) = 10:1

1ML/ 2ML

Optics: CF3

D:S (focus distance) = 150:1/ 1,3mm@ 200mm

D:S (far field) = 10:1



1MH/ 2MH

Optics: CF4

D:S (focus distance) = 300:1/ 1,5mm@ 450mm

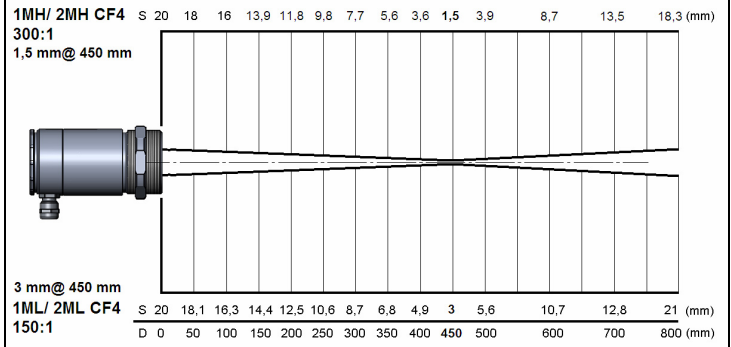
D:S (far field) = 22:1

1ML/ 2ML

Optics: CF4

D:S (focus distance) = 150:1/ 3mm@ 450mm

D:S (far field) = 20:1



G5L

Optics: SF

D:S (focus distance) = 45:1/ 27mm@1200mm

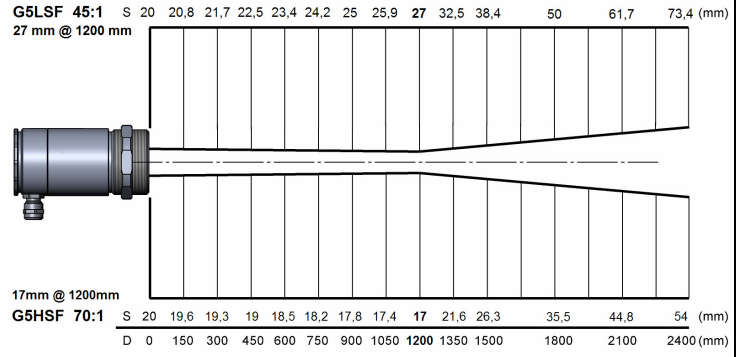
D:S (far field) = 25:1

G5H

Optics: SF

D:S (focus distance) = 70:1/ 17mm@1200mm

D:S (far field) = 33:1

**G5L**

Optics: CF1

D:S (focus distance) = 45:1/ 1,6mm@70mm

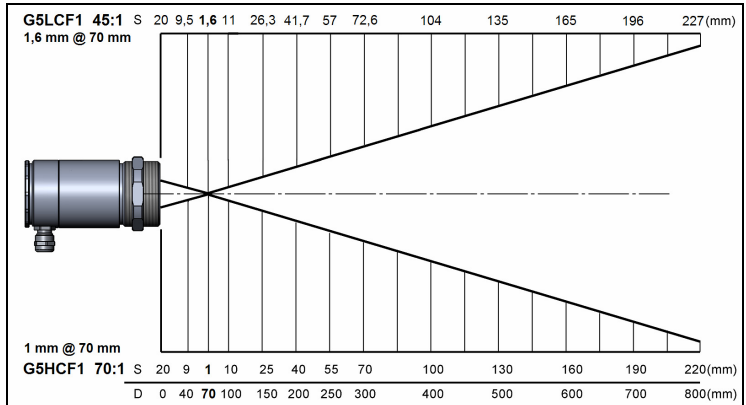
D:S (far field) = 3:1

G5H

Optics: CF1

D:S (focus distance) = 70:1/ 1mm@70mm

D:S (far field) = 3,4:1



G5L

Optics: CF2

D:S (focus distance) = 45:1/ 3,4mm@150mm

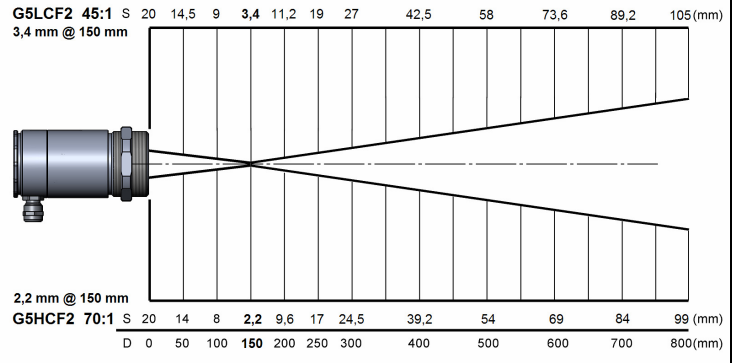
D:S (far field) = 6:1

G5H

Optics: CF2

D:S (focus distance) = 70:1/ 2,2mm@150mm

D:S (far field) = 6,8:1

**G5L**

Optics: CF3

D:S (focus distance) = 45:1/ 4,5mm@200mm

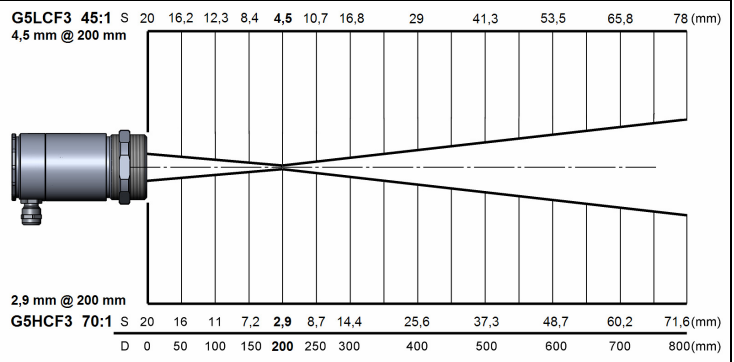
D:S (far field) = 8:1

G5H

Optics: CF3

D:S (focus distance) = 70:1/ 2,9mm@200mm

D:S (far field) = 9,2:1



G5L

Optics: CF4

D:S (focus distance) = 45:1/ 10mm@450mm

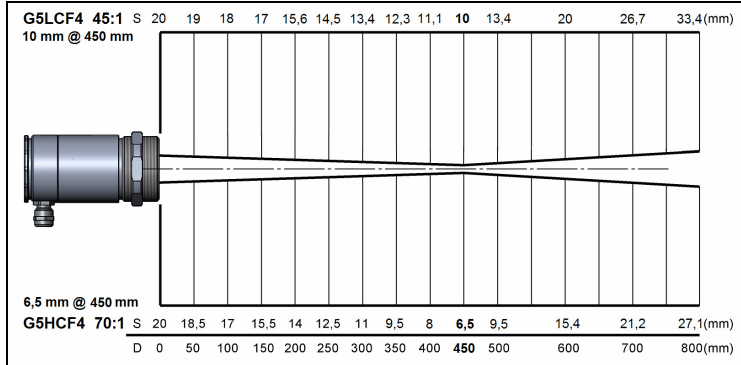
D:S (far field) = 15:1

G5H

Optics: CF4

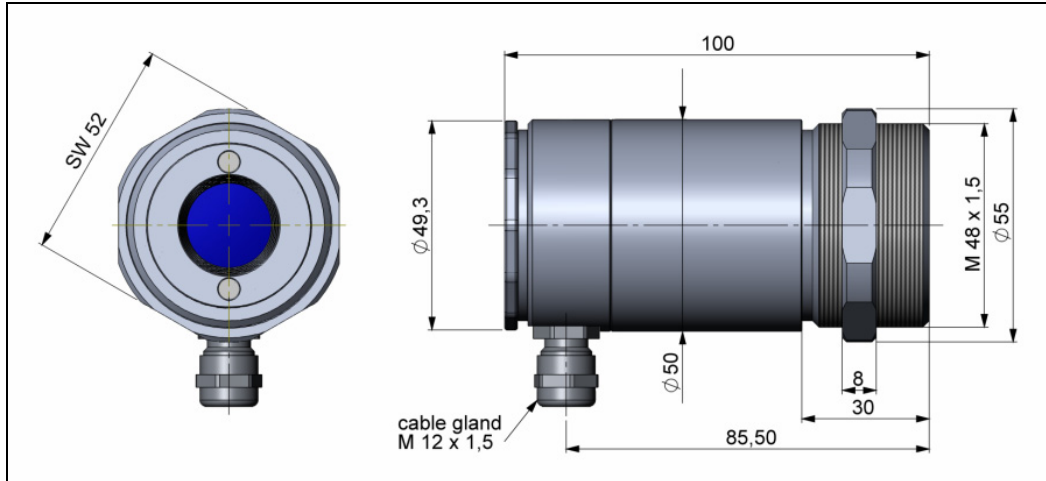
D:S (focus distance) = 70:1/ 6,5mm@450mm

D:S (far field) = 17,7:1



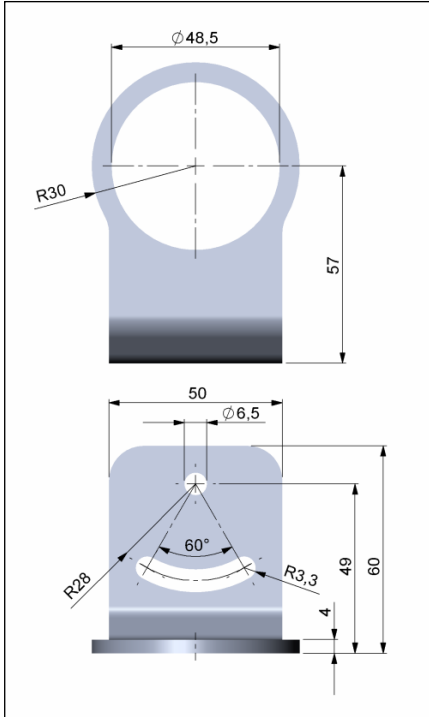
Mechanical Installation

The CTlaser is equipped with a metric M48x1,5 thread and can be installed either directly via the sensor thread or with help of the supplied mounting nut (standard) and fixed mounting bracket (standard) to a mounting device available.

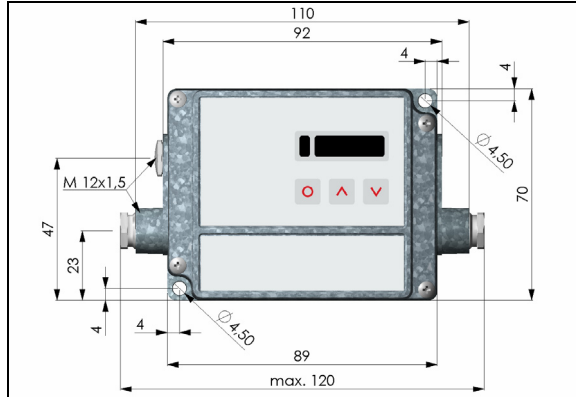


CTlaser sensing head

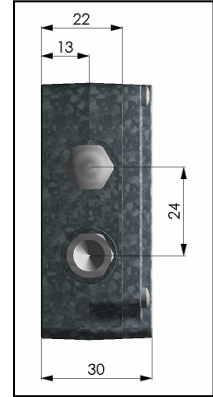
Make sure to keep the optical path clear of any obstacles.



Mounting bracket, fixed [ACCTLFB] – standard scope of supply



Electronic box



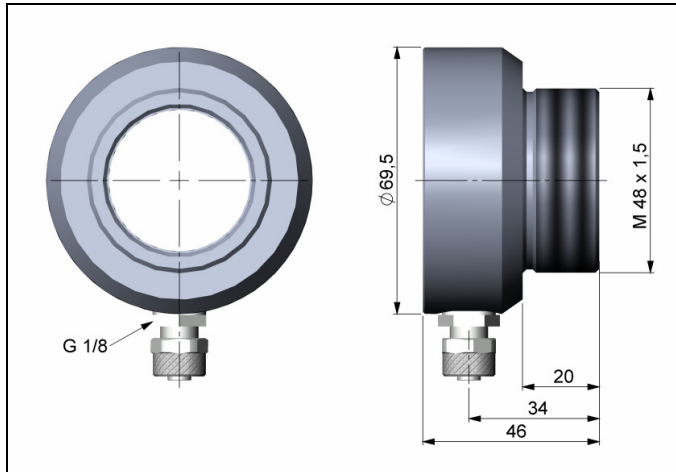
For an exact alignment of the head to the object please activate the integrated double laser.

[▶ Operating/ Laser sighting]

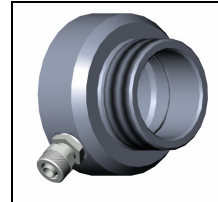
Accessories

Air Purge Collar

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**. Make sure to use oil-free, technically clean air, only.

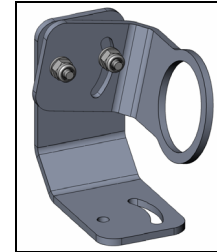
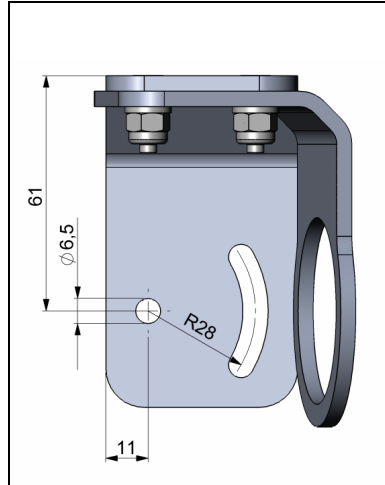
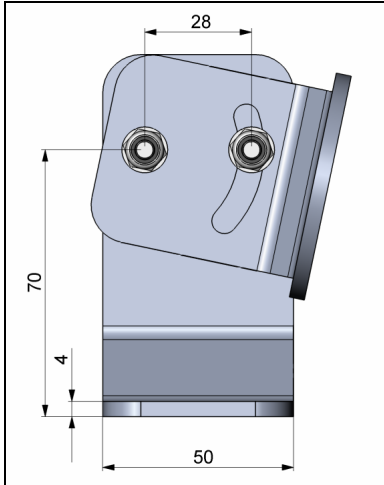


The needed amount of air (approx. 2...10 l/ min.) depends on the application and the installation conditions on-site.



Air purge collar [ACCTLAP]

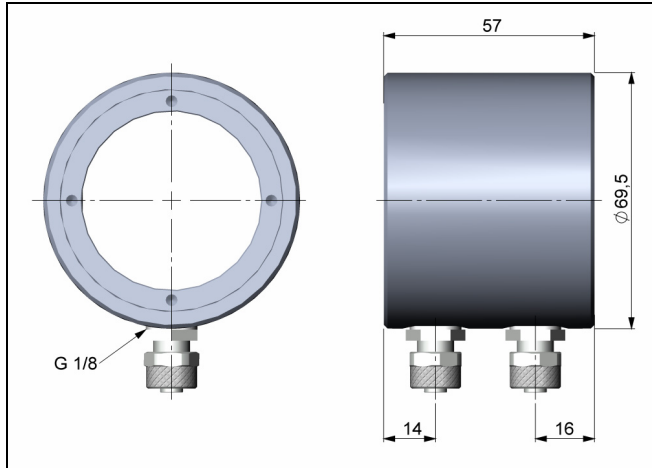
Mounting Bracket



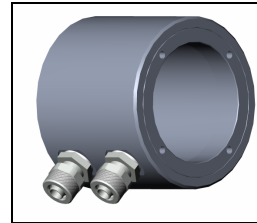
Mounting bracket, adjustable [ACCTLAB]

The adjustable mounting bracket allows an adjustment of the sensor in two axis.

Water Cooled Housing



To avoid condensation on the optics an air purge collar is recommended.



Water cooled housing [ACCTLW]

The sensing head can be used at ambient temperatures up to 85 °C without cooling. For applications, where the ambient temperature can reach higher values, the usage of the optional water cooled housing is recommended (operating temperature up to 175 °C). The sensor should be equipped with the optional high temperature cable (operating temperature up to 180 °C).

► All accessories can be ordered using the according part numbers in brackets [].

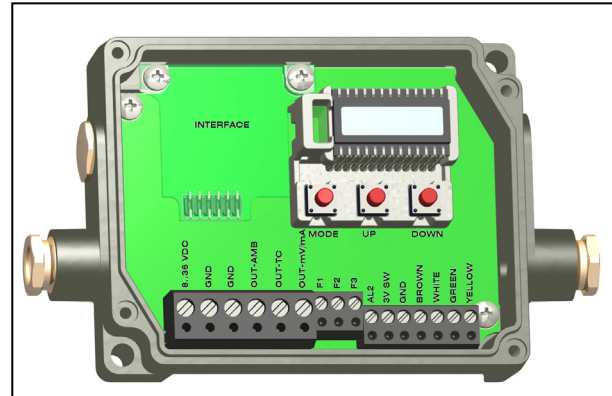
Electrical Installation

Cable Connections

For the electrical installation of the CTlaser please open at first the cover of the electronic box (4 screws). Below the display are the screw terminals for the cable connection.

Designation [models LT/ LTF/ G5]

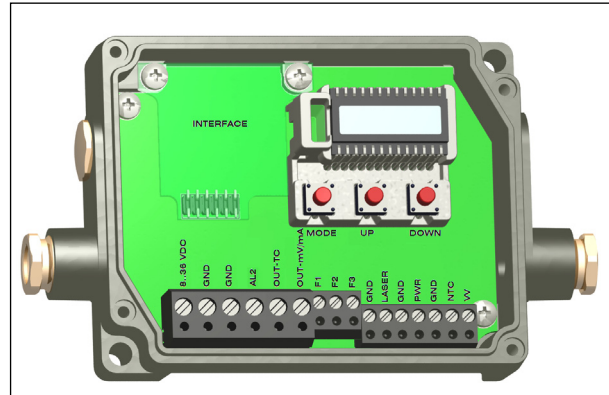
+8..36VDC	Power supply
GND	Ground (0V) of power supply
GND	Ground (0V) of internal in- and outputs
OUT-AMB	Analog output head temperature (mV)
OUT-TC	Analog output thermocouple (J or K)
OUT-mV/mA	Analog output object temperature (mV or mA)
F1-F3	Functional inputs
AL2	Alarm 2 (Open collector output)
3V SW	PINK/ Power supply Laser (+)
GND	GREY/ Ground Laser (-)
BROWN	Temperature probe head
WHITE	Temperature probe head
GREEN	Detector signal (-)
YELLOW	Detector signal (+)



Opened LT/ G5 electronic box
with terminal connections

Designation [models 1M/ 2M]

+8..36VDC	Power supply
GND	Ground (0V) of power supply
GND	Ground (0V) of internal in- and outputs
AL2	Alarm 2 (Open collector output)
OUT-TC	Analog output thermocouple (J or K)
OUT-mV/mA	Analog output object temperature (mV or mA)
F1-F3	Functional inputs
GND	Ground (0V)
LASER	PINK/ Power supply Laser (+)
GND	GREY/ Ground Laser (-)
PWR	GREEN/ Head power
GND	WHITE/ Head ground
NTC	BROWN/ Temperature probe head (NTC)
VV	YELLOW/ Detector signal



Opened 1M/2M electronic box
with terminal connections

Power supply

Please use a power supply unit with an output voltage of **8–36 VDC** which can supply **160 mA**.

**CAUTION: Please do never connect a supply voltage to the analog outputs as this will destroy the output !
The CTlaser ist not a 2-wire sensor!**

Cable Assembling

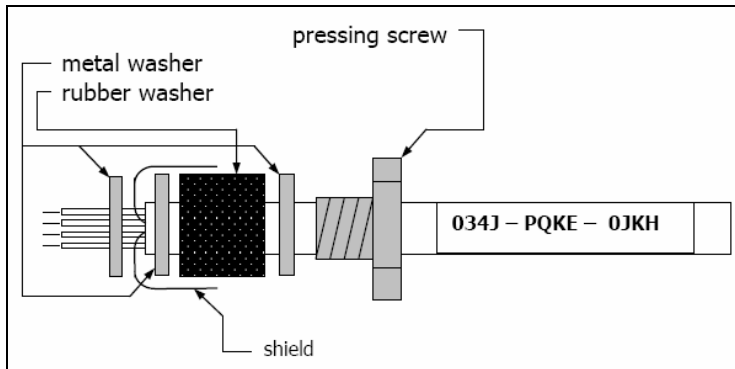
The cable gland M12x1,5 allows the use of cables with a diameter of 3 to 5 mm.

Remove the isolation from the cable (40 mm power supply, 50 mm signal outputs, 60 mm functional inputs).

Cut the shield down to approximately 5 mm and spread the strands out. Extract about 4 mm of the wire isolation and tin the wire ends.

Place the pressing screw, the rubber washer and the metal washers of the cable gland one after the other onto the prepared cable end. Spread the strands and fix the shield between two of the metal washers. Insert the cable into the cable gland until the limit stop. Screw the cap tight.

Every single wire may be connected to the according screw clamps according to their colors.



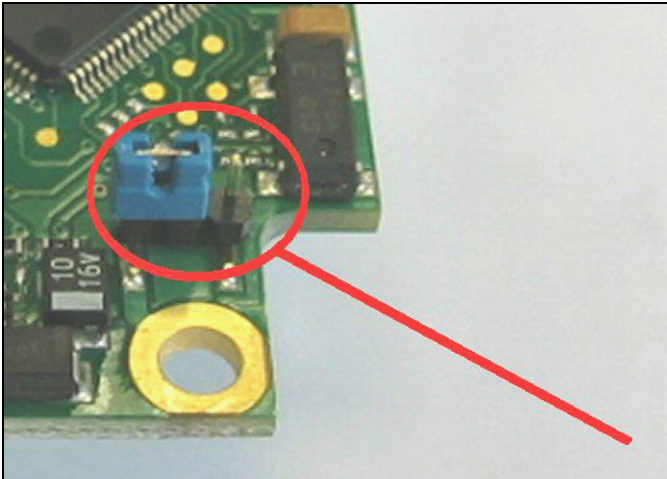
Use shielded cables only. The sensor shield has to be grounded.

Ground Connection

At the bottom side of the mainboard PCB you will find a connector (jumper) which has been placed from factory side as shown in the picture [**left** and **middle** pin connected]. In this position the ground connections (GND power supply/ outputs) are connected with the ground of the electronics housing.

To avoid ground loops and related signal interferences in industrial environments it might be necessary to interrupt this connection. To do this please put the jumper in the other position [**middle** and **right** pin connected].

If the thermocouple output is used the connection GND – housing should be interrupted generally.



Exchange of the Sensing Head

From factory side the sensing head has already been connected to the electronics. Inside the model group **LT** and inside the model group **G5** an exchange of sensing heads and electronics is possible.

The sensing heads and electronics of the models **LTF**, **1ML**, **1MH**, **2ML**, **2MH** cannot be exchanged.

After exchanging a head the calibration code of the new head must be entered into the electronics.

Entering of the Calibration Code

Every head has a specific calibration code, which is printed on the head. For a correct temperature measurement and functionality of the sensor this calibration code must be stored into the electronic box. The calibration code consists of **five blocks** with **4 characters** each.

Example: **EKJ0 – 00UD – 0A1B – A17U – 93OZ**
 block1 block2 block3 block4 block5

For entering the code please press the **Up** and **Down** key (keep pressed) and then the **Mode** key. The display shows **HCODE** and then the 4 signs of the first block. With **Up** and **Down** each sign can be changed, **Mode** switches to the next sign or next block.

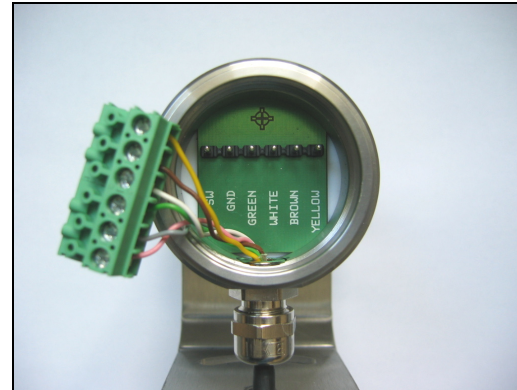


You will find the calibration code on a label fixed on the head. Please do not remove this label or make sure the code is noted anywhere. The code is needed if the head has to be exchanged.

Exchange of the Head Cable

The sensing head cable can also be exchanged if necessary. For a dismantling on the head side please open at first the cover plate on the back side of the head. Then please remove the terminal block and loose the connections. After the new cable has been installed please do the same steps in reverse order. Please take care the cable shield is properly connected to the head housing.

As exchange cable a cable type with same wire profiles and specification should be used to avoid influences on the accuracy.



Outputs and Inputs

Analog Outputs

The CTlaser has two analog output channels.

Output channel 1

This output is used for the object temperature. The selection of the output signal can be done via the programming keys [► **Operating**]. The CompactConnect software allows the programming of output channel 1 as an alarm output.

Output signal	Range	Connection pin on CTlaser board
Voltage	0 ... 5 V	OUT-mV/mA
Voltage	0 ... 10 V	OUT-mV/mA
Current	0 ... 20 mA	OUT-mV/mA
Current	4 ... 20 mA	OUT-mV/mA
Thermocouple	TC J	OUT-TC
Thermocouple	TC K	OUT-TC

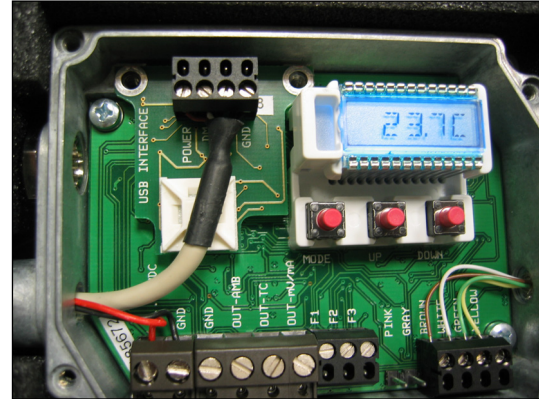
According to the chosen output signal there are different connection pins on the mainboard (OUT-mV/mA or OUT-TC).

Output channel 2 [only for LT, LTF, G5]

The connection pin OUT AMB is used for output of the head temperature [-20–180 °C as 0–5 V or 0–10 V signal]. The CompactConnect software allows the programming of output channel 2 as an alarm output. Instead of the head temperature **THead** also the object temperature **TObj** or electronic box temperature **TBox** can be selected as alarm source.

Digital Interfaces

CTlaser sensors can be optionally equipped with an USB-, RS232-, RS485-, CAN Bus-, Profibus DP- or Ethernet-interface. If you want to install an interface, plug the interface board into the place provided, which is located beside the display. In the correct position the holes of the interface match with the thread holes of the electronic box. Now press the board down to connect it and use both M3x5 screws for fixing it. Plug the preassembled interface cable with the terminal block into the male connector of the interface board.



The Ethernet interface requires at minimum 12 V supply voltage.

Please pay attention to the notes on the according interface manuals.

Relay Outputs

The CTlaser can be optionally equipped with a relay output. The relay board will be installed the same way as the digital interfaces. **A simultaneous installation of a digital interface and the relay outputs is not possible.** The relay board provides two fully isolated switches, which have the capability to switch max. 60 VDC/ 42 VAC_{RMS}, 0,4 A DC/AC. A red LED shows the closed switch.

The switching thresholds are in accordance with the values for alarm 1 and 2 [► **Alarms/ Visual Alarms**].
The alarm values are set according to the ► **Factory Default Settings**.
To make advanced settings (change of low- and high alarm) a digital interface (USB, RS232) and the software CompactConnect is needed.

Functional Inputs

The three functional inputs F1 – F3 can be programmed with the CompactConnect software, only.

- F1 (digital):** trigger (a 0 V level on F1 resets the hold functions)
F2 (analog): external emissivity adjustment [0–10 V: 0 V ► $\varepsilon=0,1$; 9 V ► $\varepsilon=1$; 10 V ► $\varepsilon=1,1$]
F3 (analog): external compensation of ambient temperature/ the range is scalable via software
[0–10 V ► -40–900 °C / preset range: -20–200 °C]
F1-F3 (digital): emissivity (digital choice via table, non-connected input represents high-level)
high-level: $\geq +3 \text{ V} \dots +36 \text{ V}$
low-level: $\leq +0,4 \text{ V} \dots -36 \text{ V}$

Alarms

The CTlaser has the following Alarm features:

All alarms (alarm 1, alarm 2, output channel 1 and 2 if used as alarm output) have a fixed hysteresis of 2 K.

Output channel 1 and 2

To activate the according output channel has to be switched into digital mode. For this the software CompactConnect is required.

Visual Alarms

These alarms will cause a change of the color of the LCD display and will also change the status of the optional relays interface. In addition the Alarm 2 can be used as open collector output at pin **AL2** on the mainboard [24V/ 50mA].

From factory side the alarms are defined as follows:

Alarm 1	Norm. closed/ Low-Alarm
Alarm 2	Norm. open/ High-Alarm

Both of these alarms will have effect on the LCD color:

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

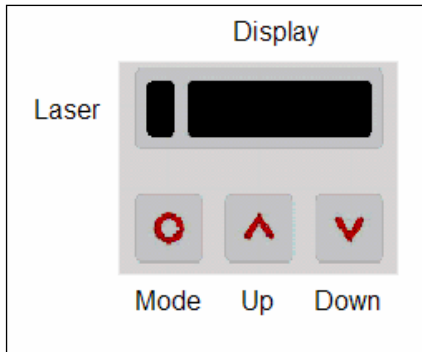
For extended setup like definition as low or high alarm [via change of normally open/ closed], selection of the signal source [TObj, THead, TBox] a digital interface (e.g. USB, RS232) including the software CompactConnect is needed.

Operating

After power up the unit the sensor starts an initializing routine for some seconds. During this time the display will show INIT. After this procedure the object temperature is shown in the display. The display backlight color changes according to the alarm settings [► **Alarms/ Visual Alarms**].

Sensor Setup

The programming keys **Mode**, **Up** and **Down** enable the user to set the sensor on-site. The current measuring value or the chosen feature is displayed. With **Mode** the operator obtains the chosen feature, with **Up** and **Down** the functional parameters can be selected – **a change of parameters will have immediate effect**. If no key is pressed for more than 10 seconds the display automatically shows the calculated object temperature (according to the signal processing).



Pressing the Mode button again recalls the last called function on the display. The signal processing features **Peak hold** and **Valley hold** cannot be selected simultaneously.

Factory Default Setting

To set the CTlaser back to the factory default settings, please press at first the **Down**-key and then the **Mode**-key and keep both pressed for approx. 3 seconds. The display will show RESET for confirmation.

Display	Mode [Sample]	Adjustment Range
S ON	Laser Sighting [ON]	ON/ OFF
142.3C	Object temperature (after signal processing) [142,3 °C]	fixed
127CH	Head temperature [127 °C]	fixed
25CB	Box temperature [25 °C]	fixed
142CA	Current object temperature [142 °C]	fixed
□ MV5	Signal output channel 1 [0-5 V]	□0-20 = 0–20 mA/ □4-20 = 4–20 mA/ □MV5 = 0–5 V/ □MV10 = 0–10 V/ □TCJ = Thermocouple type J/ □TCK = Thermocouple type K
E0.970	Emissivity [0,970]	0,100 ... 1,100
T1.000	Transmissivity [1,000]	0,100 ... 1,100
A 0.2	Signal output Average [0,2 s]	A---- = inactive/ 0,1 ... 999,9 s
P----	Signal output Peak hold [inactive]	P---- = inactive/ 0,1 ... 999,9 s/ P ∞ = infinite
V----	Signal output Valley hold [inactive]	V---- = inactive/ 0,1 ... 999,9 s/ V ∞ = infinite
u 0.0	Lower limit temperature range [0 °C]	-40,0 ... 975,0 °C/ inactive at TCJ- and TCK-output
n 500.0	Upper limit temperature range [500 °C]	-40,0 ... 975,0 °C/ inactive at TCJ- and TCK-output
[0.00	Lower limit signal output [0 V]	according to the range of the selected output signal
] 5.00	Upper limit signal output [5 V]	according to the range of the selected output signal
U °C	Temperature unit [°C]	°C/ °F
30.0	Lower alarm limit [30 °C]	-40,0 ... 975,0 °C
100.0	Upper alarm limit [100 °C]	-40,0 ... 975,0 °C
XHEAD	Ambient temperature compensation [head temperature]	XHEAD = head temperature/ -40,0 ... 900,0 °C as fixed value for compensation/ returning to XHEAD (head temperature) by pressing Up and Down together
M 01	Multidrop adress [1] (only with RS485 interface)	01 ... 32
B 9.6	Baud rate in kBaud [9,6]	9,6/ 19,2/ 38,4/ 57,6/ 115,2 kBaud

S ON

Activating (**ON**) and Deactivating (**OFF**) of the **Sighting Laser**. By pressing **Up** or **Down** the laser can be switched on and off.

□ MV5

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

E0.970

Setup of **Emissivity**. Pressing **Up** increases the value, **Down** decreases the value (also valid for all further functions). The emissivity is a material constant factor to describe the ability of the body to emit infrared energy [**► Emissivity**].

T1.000

Setup of **Transmissivity**. This function is used if an optical component (protective window, additional optics e.g.) is mounted between sensor and object. The standard setting is 1.000 = 100% (if no protective window etc. is used).

A 0.2

Setup of **Average time**. If the value is set to **0.0** the display will show --- (function deactivated). In this mode an arithmetic algorithm will be performed to smoothen the signal. The set time is the time constant. This function can be combined with all other post processing functions.

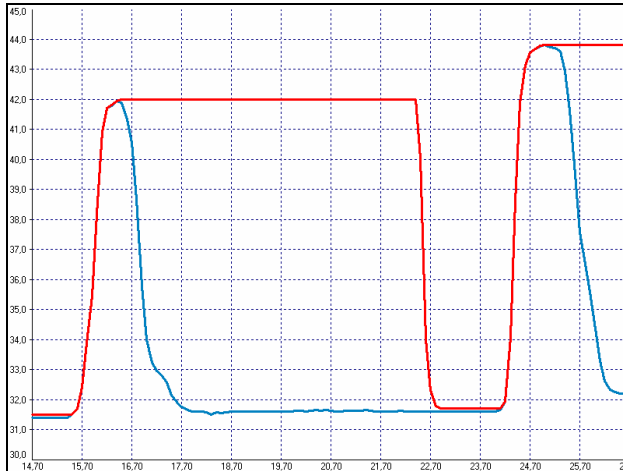
P----

Setup of **Peak hold**. If the value is set to **0.0** the display will show --- (function deactivated). In this mode the sensor is waiting for descending signals. If the signal descends the algorithm maintains the previous signal peak for the specified time.

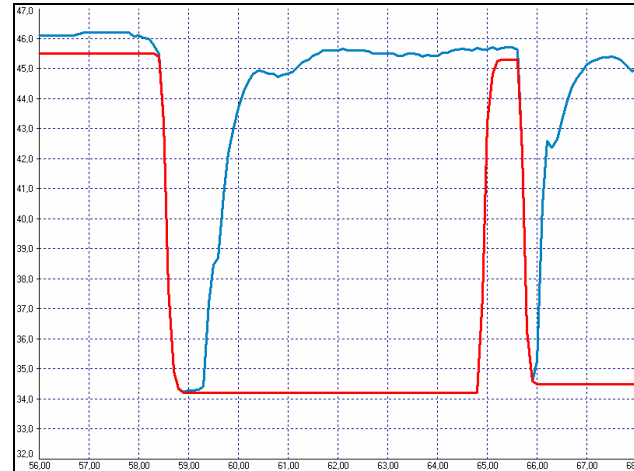
V----

Setup of **Valley hold**. If the value is set to **0.0** the display will show --- (function deactivated). In this mode the sensor waits for ascending signals. If the signal ascends the algorithm maintains the previous signal valley for the specified time.

Signal graphs with **P----** and **V----**



- TObj with Peak hold
- Temperature without post processing



- TObj with Valley hold
- Temperature without post processing

u 0.0

Setup of the **Lower limit of temperature range**. The minimum difference between lower and upper limit is **20 K**. If you set the lower limit to a value \geq upper limit the upper limit will be adjusted to **[lower limit + 20 K]** automatically.

n 500.0

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

[0.00

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

] 5.00

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

U °C

Setup of the **Temperature unit** [°C or °F].

| 30.0

Setup of the **Lower alarm limit**. This value corresponds to Alarm 1 [**► Alarms/ Visual Alarms**] and is also used as threshold value for relay 1 (if the optional relay board is used).

|| 100.0

Setup of the **Upper alarm limit**. This value corresponds to Alarm 2 [**► Alarms/ Visual Alarms**] and is also used as threshold value for relay 2 (if the optional relay board is used).

XHEAD

Setup of the **Ambient temperature compensation**. In dependence on the emissivity value of the object a certain amount of ambient radiation will be reflected from the object surface. To compensate this impact, this function allows the setup of a fixed value which represents the ambient radiation.

If **XHEAD** is shown the ambient temperature value will be taken from the head-internal probe. To return to **XHEAD** please press **Up** and **Down** together.

Especially if there is a big difference between the ambient temperature at the object and the head temperature the use of **Ambient temperature compensation** is recommended.

M 01

Setup of the **Multidrop address**. In a RS485 network each sensor will need a specific address. This menu item will only be shown if a RS485 interface board is plugged in.

B 9.6

Setup of the **Baud rate** for digital data transfer.

Digital Command Set

The digital communication of the CTlaser sensors is based on a binary protocol.

You will find a protocol and command description of the software CD CompactConnect in the directory:

\Commands.

Laser Sighting

The CTlaser has an integrated double laser aiming. Both of the laser beams are marking the exactly location and size of the measurement spot, independent from the distance. At the focus point of the according optics [► **Optical Charts**] both lasers are crossing and showing as one dot the minimum spot. This enables a perfect alignment of the sensor to the object.

**WARNING: Do not point the laser directly at the eyes of persons or animals!
Do not stare into the laser beam. Avoid indirect exposure via reflective surfaces!**

The laser can be activated/ deactivated via the programming keys on the unit or via the software. If the laser is activated a yellow LED will shine (beside temperature display).
At ambient temperatures >50 °C the laser will switch off automatically.



Error messages

The display of the sensor can show the following error messages:

- **OVER** temperature overflow
- **UNDER** temperature underflow
- **^^^CH** head temperature to high
- **vvvCH** head temperature to low

Software CompactConnect

Installation

Insert the installation CD into the according drive on your computer. If the autorun option is activated the installation wizard will start automatically. Otherwise please start **setup.exe** from the CD-ROM. Follow the instructions of the wizard until the installation is finished.

The installation wizard will place a launch icon on the desktop and in the start menu:

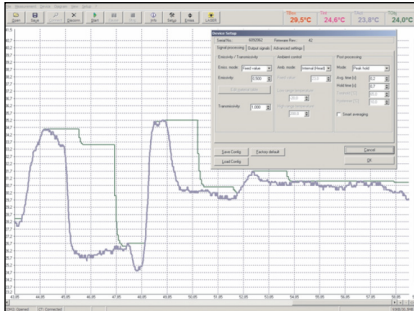
[Start]\Programs\CompactConnect.

If you want to uninstall the software from your system please use the **uninstall icon** in the start menu.

System requirements:

- Windows XP, 2000
- USB interface
- Hard disc with at least 30 MByte free space
- At least 128 MByte RAM
- CD-ROM drive

You will find a detailed software manual on the CD.



Main Features:

- Graphic display for temperature trends and automatic data logging for analysis and documentation
- Complete sensor setup and remote controlling
- Adjustment of signal processing functions
- Programming of outputs and functional inputs

Basics of Infrared Thermometry

Depending on the temperature each object emits a certain amount of infrared radiation. A change in the temperature of the object is accompanied by a change in the intensity of the radiation. For the measurement of “thermal radiation” infrared thermometry uses a wave-length ranging between 1μ and $20 \mu\text{m}$.

The intensity of the emitted radiation depends on the material. This material contingent constant is described with the help of the emissivity which is a known value for most materials (see enclosed table emissivity).

Infrared thermometers are optoelectronic sensors. They calculate the surface temperature on the basis of the emitted infrared radiation from an object. The most important feature of infrared thermometers is that they enable the user to measure objects contactless. Consequently, these products help to measure the temperature of inaccessible or moving objects without difficulties. Infrared thermometers basically consist of the following components:

- lens
- spectral filter
- detector
- electronics (amplifier/ linearization/ signal processing)

The specifications of the lens decisively determine the optical path of the infrared thermometer, which is characterized by the ratio Distance to Spot size.

The spectral filter selects the wavelength range, which is relevant for the temperature measurement. The detector in cooperation with the processing electronics transforms the emitted infrared radiation into electrical signals.

Emissivity

Definition

The intensity of infrared radiation, which is emitted by each body, depends on the temperature as well as on the radiation features of the surface material of the measuring object. The emissivity (ϵ – Epsilon) is used as a material constant factor to describe the ability of the body to emit infrared energy. It can range between 0 and 100 %. A “blackbody” is the ideal radiation source with an emissivity of 1,0 whereas a mirror shows an emissivity of 0,1.

If the emissivity chosen is too high, the infrared thermometer may display a temperature value which is much lower than the real temperature – assuming the measuring object is warmer than its surroundings. A low emissivity (reflective surfaces) carries the risk of inaccurate measuring results by interfering infrared radiation emitted by background objects (flames, heating systems, chamottes). To minimize measuring errors in such cases, the handling should be performed very carefully and the unit should be protected against reflecting radiation sources.

Determination of unknown Emissivities

- ▶ First, determine the actual temperature of the measuring object with a thermocouple or contact sensor. Second, measure the temperature with the infrared thermometer and modify the emissivity until the displayed result corresponds to the actual temperature.
- ▶ If you monitor temperatures of up to 380°C you may place a special plastic sticker (emissivity dots – part number: ACLSED) onto the measuring object, which covers it completely. Now set the emissivity to 0,95 and take the temperature of the sticker. Afterwards, determine the temperature of the adjacent area on the measuring object and adjust the emissivity according to the value of the temperature of the sticker.

-
- Cove a part of the surface of the measuring object with a black, flat paint with an emissivity of 0,98. Adjust the emissivity of your infrared thermometer to 0,98 and take the temperature of the colored surface. Afterwards, determine the temperature of a directly adjacent area and modify the emissivity until the measured value corresponds to the temperature of the colored surface.

CAUTION: On all three methods the object temperature must be different from ambient temperature.

Characteristic Emissivities

In case none of the methods mentioned above help to determine the emissivity you may use the emissivity tables ► **Appendix A and B**. These are average values, only. The actual emissivity of a material depends on the following factors:

- temperature
- measuring angle
- geometry of the surface
- thickness of the material
- constitution of the surface (polished, oxidized, rough, sandblast)
- spectral range of the measurement
- transmissivity (e.g. with thin films)

Appendix A – Emissivity Table Metals

Material		typical Emissivity			
Spectral response		1,0 μm	1,6 μm	5,1 μm	8-14 μm
Aluminium	non oxidized	0,1-0,2	0,02-0,2	0,02-0,2	0,02-0,1
	polished	0,1-0,2	0,02-0,1	0,02-0,1	0,02-0,1
	roughened	0,2-0,8	0,2-0,6	0,1-0,4	0,1-0,3
	oxidized	0,4	0,4	0,2-0,4	0,2-0,4
Brass	polished	0,35	0,01-0,05	0,01-0,05	0,01-0,05
	roughened	0,65	0,4	0,3	0,3
	oxidized	0,6	0,6	0,5	0,5
Copper	polished	0,05	0,03	0,03	0,03
	roughened	0,05-0,2	0,05-0,2	0,05-0,15	0,05-0,1
	oxidized	0,2-0,8	0,2-0,9	0,5-0,8	0,4-0,8
Chrome		0,4	0,4	0,03-0,3	0,02-0,2
Gold		0,3	0,01-0,1	0,01-0,1	0,01-0,1
Haynes	alloy	0,5-0,9	0,6-0,9	0,3-0,8	0,3-0,8
Inconel	electro polished	0,2-0,5	0,25	0,15	0,15
	sandblast	0,3-0,4	0,3-0,6	0,3-0,6	0,3-0,6
	oxidized	0,4-0,9	0,6-0,9	0,6-0,9	0,7-0,95
Iron	non oxidized	0,35	0,1-0,3	0,05-0,25	0,05-0,2
	rusted		0,6-0,9	0,5-0,8	0,5-0,7
	oxidized	0,7-0,9	0,5-0,9	0,6-0,9	0,5-0,9
	forged, blunt	0,9	0,9	0,9	0,9
	molten	0,35	0,4-0,6		
Iron, casted	non oxidized	0,35	0,3	0,25	0,2
	oxidized	0,9	0,7-0,9	0,65-0,95	0,6-0,95

Material		typical Emissivity			
Spectral response		1,0 μm	1,6 μm	5,1 μm	8-14 μm
Lead	polished	0,35	0,05-0,2	0,05-0,2	0,05-0,1
	roughened	0,65	0,6	0,4	0,4
	oxidized		0,3-0,7	0,2-0,7	0,2-0,6
Magnesium		0,3-0,8	0,05-0,3	0,03-0,15	0,02-0,1
Mercury			0,05-0,15	0,05-0,15	0,05-0,15
Molybdenum	non oxidized	0,25-0,35	0,1-0,3	0,1-0,15	0,1
	oxidized	0,5-0,9	0,4-0,9	0,3-0,7	0,2-0,6
Monel (Ni-Cu)		0,3	0,2-0,6	0,1-0,5	0,1-0,14
Nickel	electrolytic	0,2-0,4	0,1-0,3	0,1-0,15	0,05-0,15
	oxidized	0,8-0,9	0,4-0,7	0,3-0,6	0,2-0,5
Platinum	black		0,95	0,9	0,9
Silver		0,04	0,02	0,02	0,02
Steel	polished plate	0,35	0,25	0,1	0,1
	rustless	0,35	0,2-0,9	0,15-0,8	0,1-0,8
	heavy plate			0,5-0,7	0,4-0,6
	cold-rolled	0,8-0,9	0,8-0,9	0,8-0,9	0,7-0,9
	oxidized	0,8-0,9	0,8-0,9	0,7-0,9	0,7-0,9
Tin	non oxidized	0,25	0,1-0,3	0,05	0,05
Titanium	polished	0,5-0,75	0,3-0,5	0,1-0,3	0,05-0,2
	oxidized		0,6-0,8	0,5-0,7	0,5-0,6
Wolfram	polished	0,35-0,4	0,1-0,3	0,05-0,25	0,03-0,1
Zinc	polished	0,5	0,05	0,03	0,02
	oxidized	0,6	0,15	0,1	0,1

Appendix B – Emissivity Table Non Metals

Material	typical Emissivity			
	1,0 μm	2,2 μm	5,1 μm	8-14 μm
Asbestos	0,9	0,8	0,9	0,95
Asphalt			0,95	0,95
Basalt			0,7	0,7
Carbon		non oxidized	0,8-0,9	0,8-0,9
		graphite	0,8-0,9	0,7-0,9
Carborundum		0,95	0,9	0,9
Ceramic	0,4	0,8-0,95	0,8-0,95	0,95
Concrete	0,65	0,9	0,9	0,95
Glass	plate	0,2	0,98	0,85
	melt	0,4-0,9	0,9	
Grit			0,95	0,95
Gypsum			0,4-0,97	0,8-0,95
Ice				0,98
Limestone			0,4-0,98	0,98
Paint	non alkaline			0,9-0,95
Paper	any color		0,95	0,95
Plastic >50 μm	non transparent		0,95	0,95
Rubber			0,9	0,95
Sand			0,9	0,9
Snow				0,9
Soil				0,9-0,98
Textiles			0,95	0,95
Water				0,93
Wood	natural		0,9-0,95	0,9-0,95