

# IR sensors

DM21 / 101 / 151 / 201 / 401 / 601

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Infrared Sensor



Operating Instructions

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Operators manual



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## 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.

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.

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## Description

The sensors of the DM series are noncontact infrared temperature sensors.

They calculate the surface temperature based on the emitted infrared energy of objects [► Basics of Infrared Thermometry]. The sensor housing of the DM 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 DM 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

- DM sensing head with connection cable and electronic box
- Mounting nut
- 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 DM, please contact our service department.

## Factory Default Settings

The unit has the following presetting at time of delivery:

Signal output object temperature	0-5 V		
Emissivity	0,970 (1,000 for DM401 / 601)		
Transmissivity	1,000		
Average time (AVG)	1 s/ DM401-601: 0 s		
Smart Averaging	DM401 / 601: activ		
Peak hold	inactive		
Valley hold	inactive		
	DM21/151/201/101	DM401	DM601
Lower limit temperature range [°C]	0	250	385 <sup>1)</sup>
Upper limit temperature range [°C]	500	800	1600
Lower alarm limit [°C]	30	350	500 (norm. closed)
Upper alarm limit [°C]	100	600	1200 (norm. open)
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)		
Baud rate	9,6 kBaud		

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

<sup>1)</sup> at cable length >3 m the lower temperature range limit is 450 °C

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## Technical Data

### General Specifications

	Sensing head	Electronic box
Environmental rating	IP65 (NEMA-4)	IP65 (NEMA-4)
Ambient Temperature	see: Measurement Specifications	0...85 °C
Storage temperature	see: Measurement Specifications	-40...85 °C
Relative humidity	10...95%, non condensing	10...95%, non condensing
Material	stainless steel	die casting zinc
Dimensions	28 mm x 14 mm, M12x1	89 mm x 70 mm x 30 mm
Dimensions DMhot	55 mm x 29,5 mm, M18x1 (with massive housing)	
Weight	40 g	420 g
Cable length	1 m (only DM21 / 201 / 151), 3 m, 8 m, 15 m	
Cable diameter	2,8 mm	
Ambient temperature cable	180 °C max. [High temperature cable for DMHot: 250 °C]	
Vibration	IEC 68-2-6: 3G, 11 – 200Hz, any axis	
Shock	IEC 68-2-27: 50G, 11ms, any axis	
EMI	89/336/EWG	

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## Electrical Specifications

Power Supply	8–36 VDC
Current draw	max. 100 mA
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	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 $\Omega$ (at 8-36 VDC),
mV	min. 100 K $\Omega$ load impedance
Thermocouple	20 $\Omega$
Digital interfaces	USB, RS232, RS485, CAN, Profibus DP, Ethernet (optional plug-in modules)
Relay outputs	2 x 60 VDC/ 42 VAC <sub>RMS</sub> , 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)



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## Measurement Specifications [DM 21D, DM 151D, DM201D

	DM 21	DM 151	DM 201
Temperature range (scalable)	-40...600 °C	-40...600 °C	-40...900 °C
Ambient temperature (head)	-20...130 °C	-20...180 °C	-20...180 °C
Storage temperature (head)	-40...130 °C	-40...180 °C	-40...180 °C
Spectral range	8...14 µm	8...14 µm	8...14 µm
Optical resolution	2:1	15:1	22:1
System accuracy <sup>1) 2)</sup>	±1 °C or ±1% <sup>3)</sup>	±1 °C or ±1% <sup>3)</sup>	±1 °C or ±1% <sup>3)</sup>
Repeatability <sup>1)</sup>	±0,5 °C or ±0,5% <sup>3)</sup>	±0,5 °C or ±0,5% <sup>3)</sup>	±0,5 °C or ±0,5% <sup>3)</sup>
Temperature resolution (NETD)	0,1 °C <sup>3)</sup>	0,1 °C <sup>3)</sup>	0,1 °C <sup>3)</sup>
Response time (90% signal)	150 ms	150 ms	150 ms
Warm-up time	10 min	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		

<sup>1)</sup> at ambient temperature 23±5 °C; whichever is greater

<sup>2)</sup> Accuracy for thermocouple output: ±2,5°C or ±1%

<sup>3)</sup> at object temperatures >0 °C

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## Measurement Specifications [DM Hot]

	LT10H
Temperature range (scalable)	-40...975 °C
Ambient temperature (head)	20...250 °C
Storage temperature (head)	-40...250 °C
Spectral range	8...14 μm
Optical resolution	10:1
System accuracy <sup>1) 2)</sup>	±1,5 °C or ±1% <sup>3)</sup>
Repeatability <sup>1) 2)</sup>	±0,5 °C or ±0,5% <sup>3)</sup>
Temperature resolution (NETD)	0,5 °C <sup>3)</sup>
Response time (90% signal)	100 ms
Warm-up time	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

<sup>1)</sup> at ambient temperature 23±5 °C; whichever is greater

<sup>2)</sup> Accuracy for thermocouple output: ±2,5 °C or ±1%

<sup>3)</sup> at object temperatures ≥20 °C

On the DM Hot models the head cable must not be moved during the measurement.

## Measurement Specifications [DM 401 and 601 ]

	2ML	2MH
Temperature range (scalable)	250...800 °C	385...1600 °C <sup>5)</sup>
Ambient temperature (head)	-20...125 °C	-20...125 °C
Storage temperature (head)	-40...125 °C	-40...125 °C
Spectral range	1,6 µm	1,6 µm
Optical resolution	40:1	75:1
System accuracy <sup>1) 2)</sup>	----- ±(0,3% of reading +2 °C) <sup>3)</sup> -----	
Repeatability <sup>1) 2)</sup>	----- ±(0,1% of reading +1 °C) <sup>3)</sup> -----	
Temperature resolution	----- 0,1 °C <sup>3)</sup> -----	
Exposure time (90% signal)	----- 1 ms <sup>4)</sup> -----	
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	

<sup>1)</sup> at ambient temperature 23±5 °C; whichever is greater

<sup>2)</sup> Accuracy for thermocouple output: ±2,5°C or ±1%

<sup>3)</sup>  $\epsilon = 1 / \text{Response time } 1s$

<sup>4)</sup> with dynamic adaptation at low signal levels

<sup>5)</sup> at cable length >3 m the lower temperature range limit is 450 °C

## 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.

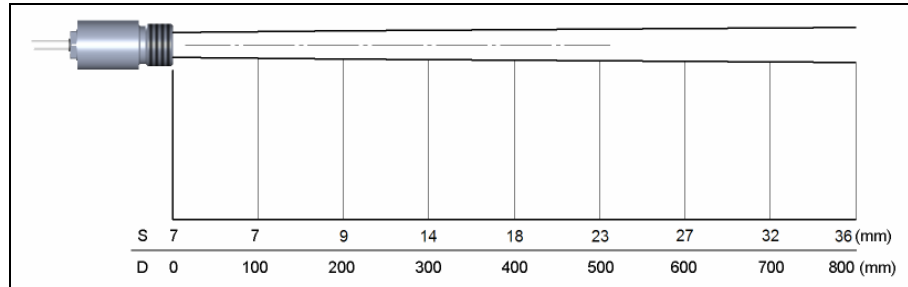
D = Distance from front of the sensing head to the object

S = Spot size

The D:S ratio is valid for the focus point.

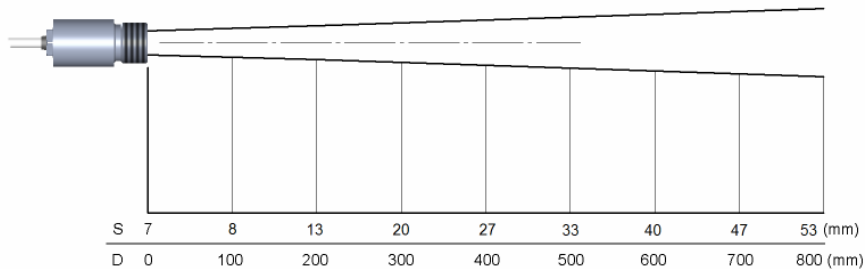
DM201

D:S = 22:1



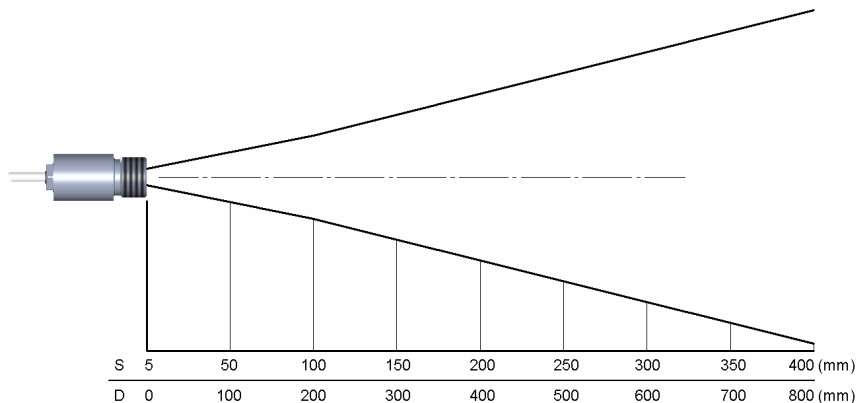
**DM151**

D:S = 15:1



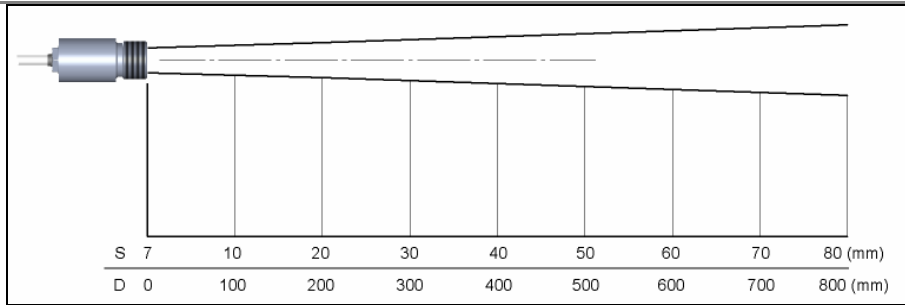
**DM21**

D:S = 2:1



**DM101**

D:S = 10:1

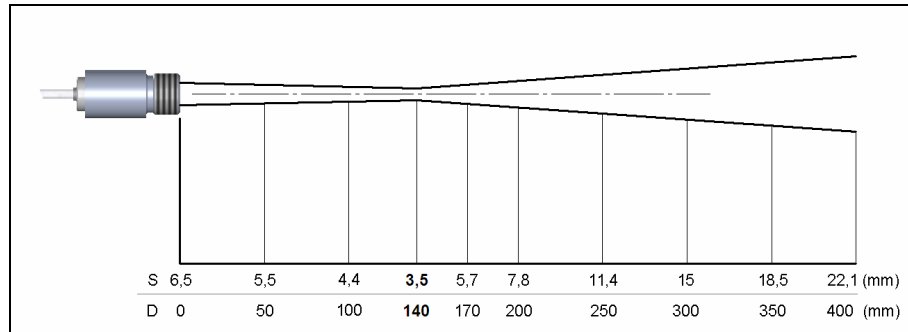


**DM401**

Optics: CF

D:S = 40:1/ 3,5mm@ 140mm

D:S (far field) = 14:1

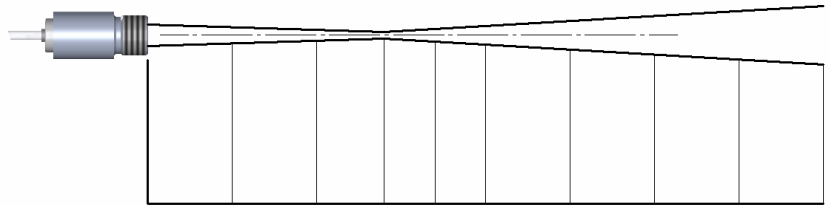


**DM601**

Optics: CF

D:S = 75:1/ 1,8mm@ 140mm

D:S (far field) = 17:1



S	6,5	5	3,2	1,8	3,6	5,4	8,4	11,3	14,3	17,3 (mm)
D	0	50	100	140	170	200	250	300	350	400 (mm)

## CF Lens and Protective Window

The optional CF lens allows the measurement of very small objects and can be used in combination with all LT models. The minimum spot size depends on the used sensing head. The distance is always measured from the front edge of the CF lens holder or laminar air purge collar.

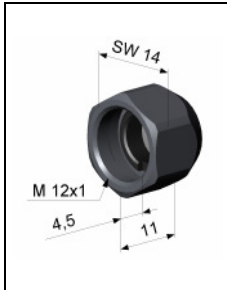
The installation on the sensing head will be done by turning the CF lens [ACCTCF] until end stop. To combine it with the massive housing please use the version with external thread M12x1 [D2DACCTCF].

For protection of the sensing head optics a protective window is available. The mechanical dimensions are equal to the CF lens. It is also available in both versions:

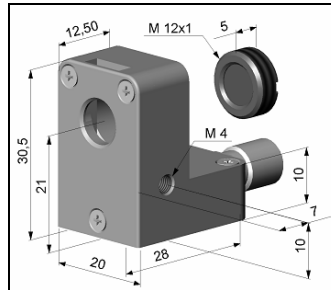
ACCTPW      Protective window for installation on sensing head  
D2DACCTPW      Protective window for installation in massive housing

If the CF lens is used, the transmission has to be set to **0,78**.

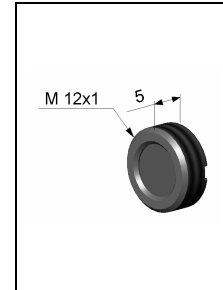
If the protective window is used, the transmission has to be set to **0,83**.



CF lens [ACCTCF]  
resp. protective window  
[ACCTPW]



Laminar air purge with integrated  
CF lens [ACCTAPLCF]



CF lens [D2DACCTCF]  
resp. protective window  
[D2DACCTPW] with external thread

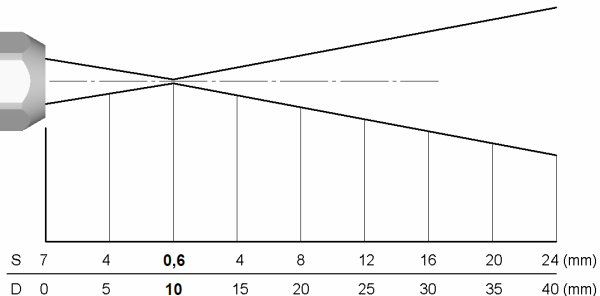


**DM201 + CF lens**

0,6 mm@ 10 mm

0,6 mm@ 8 mm [ACCTAPLCF]

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

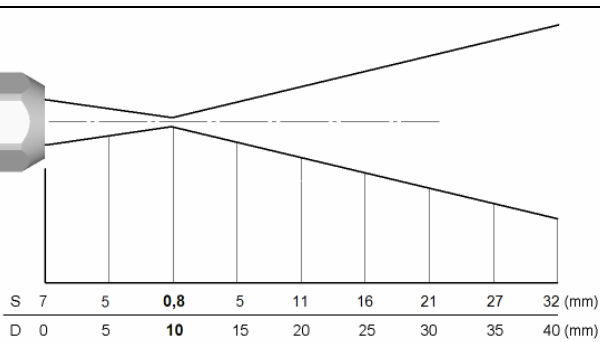


**DM151 + CF lens**

0,8 mm@ 10 mm

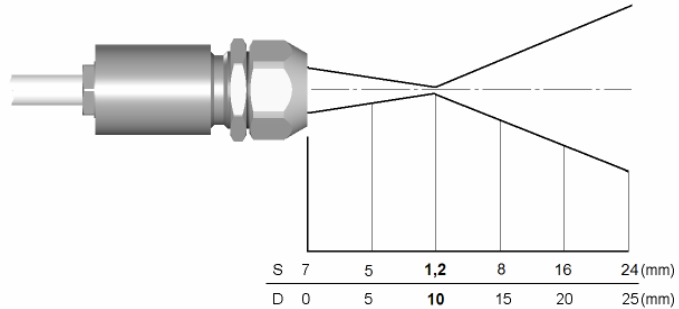
0,8 mm@ 8 mm [ACCTAPLCF]

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



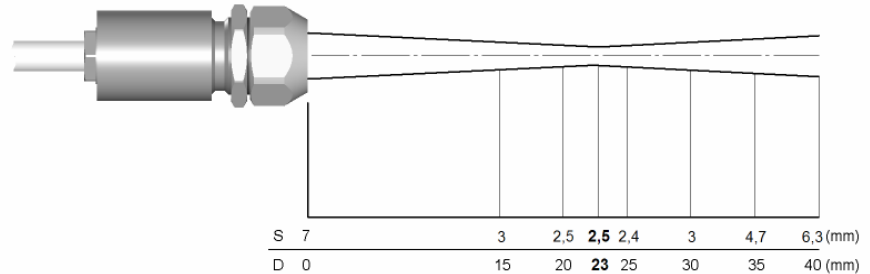
**DM101Hot + CF lens**

1,2 mm@ 10 mm  
1,2 mm@ 8 mm [ACCTAPLCF]  
D:S (far field) = 1,2:1



**DM21 + CF lens**

2,5 mm@ 23 mm  
2,5 mm@ 21 mm [ACCTAPLCF]  
D:S (far field) = 5:1

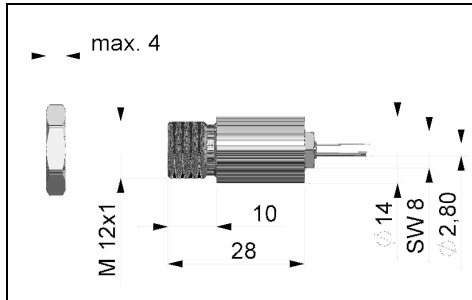


## Mechanical Installation

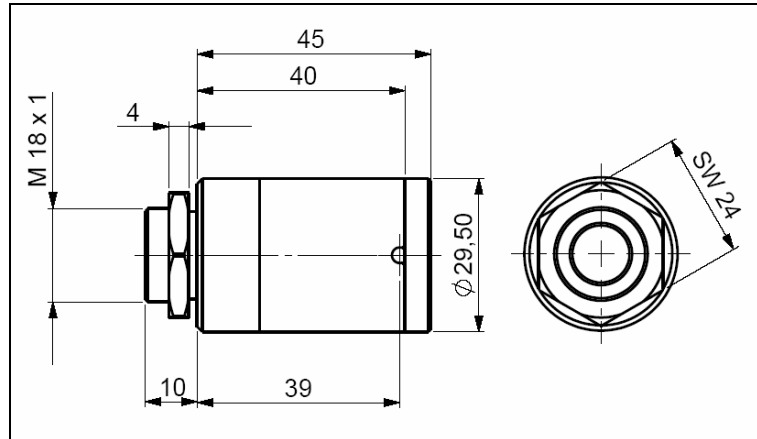
The DM sensing heads are equipped with a metrical M12x1-thread and can be installed either directly via the sensor thread or with help of the hex nut (included in scope of supply) to the mounting bracket available. Various mounting brackets, which make the adjustment of the sensing head easier, can be additionally ordered as accessories.

The DMhot will be delivered with the massive housing and can be installed via the M18x1-thread.

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

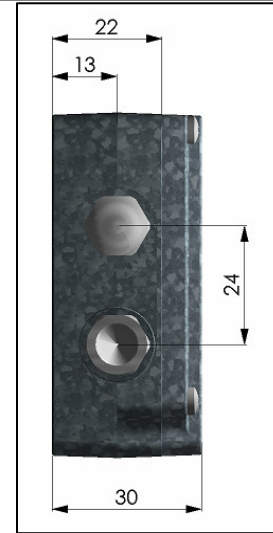
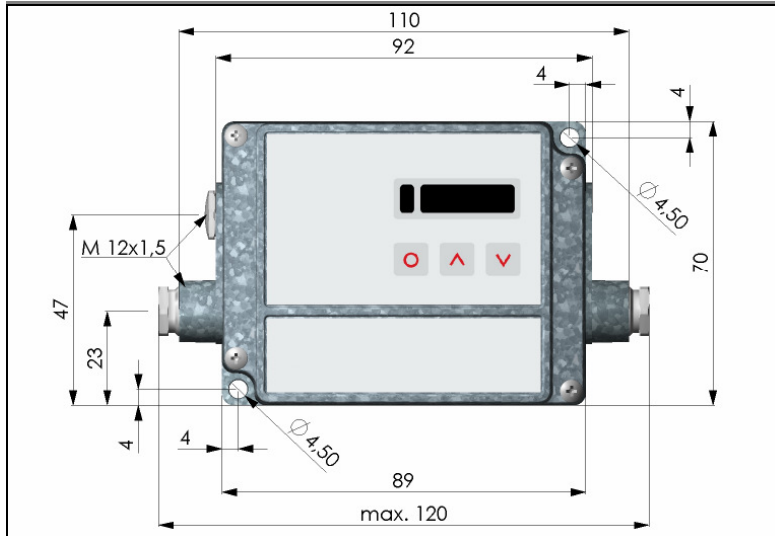


Sensing head



Massive housing (Standard on DMhot)

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

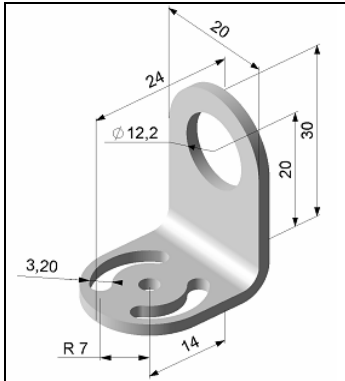


Electronic box

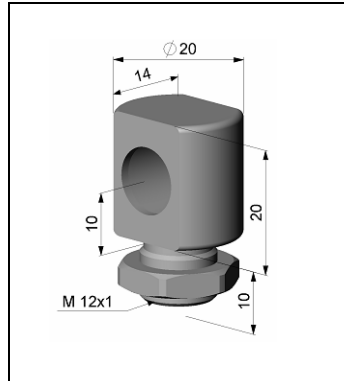
The electronic box is also available with closed cover (display and programming keys with no access from outside) [ACCTCOV].



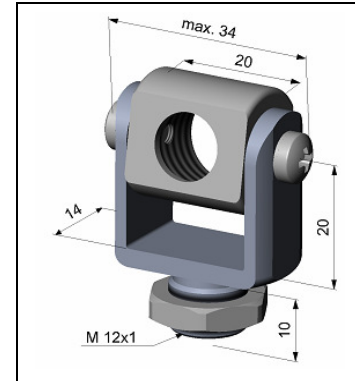
## Mounting Accessories



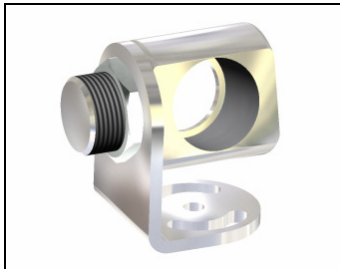
Mounting bracket, adjustable in one axis [ACCTFB]



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



Mounting fork with M12x1 thread, adjustable in 2 axes [ACCTMG]

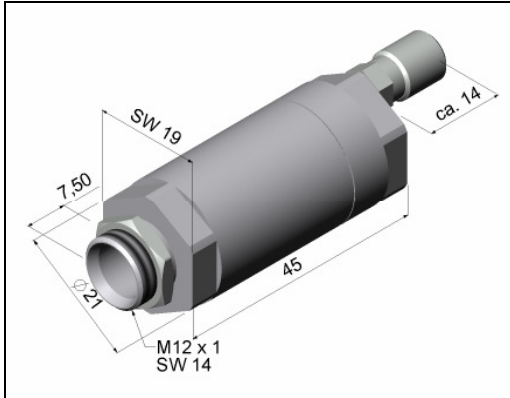


Mounting bracket, adjustable in two axes [ACCTAB] consisting of: ACCTFB and ACCTMB

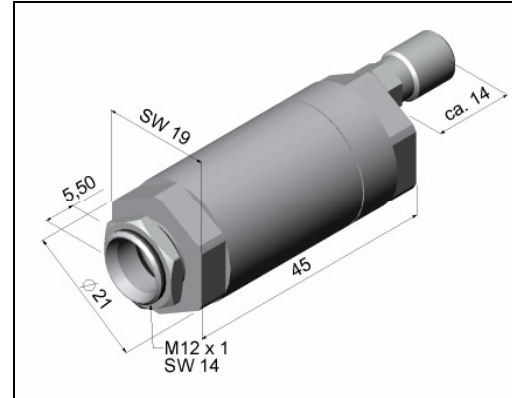
The **Mounting fork** can be combined with the **Mounting bracket** [ACCTFB] using the M12x1 thread.

## Air Purge Collars

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.

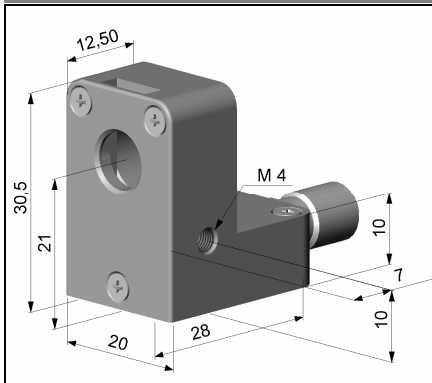


Standard air purge collar [ACCTAP]  
for DM201, 151  
fits to the mounting bracket  
Hose connection: 3x5 mm  
Thread (fitting): M5



Standard air purge collar [ACCTAP2]  
for DM21  
fits to the mounting bracket  
Hose connection: 3x5 mm  
Thread (fitting): M5

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



A combination of the **Laminar air purge collar** with the bottom section of the **Mounting fork** allows an adjustment in two axes. [ACCTAPL+ACCTMG]

Laminar air purge collar [ACCTAPL]

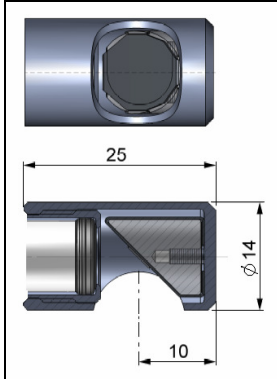
The sideward air outlet prevents a cooling down of the object in short distances.

Hose connection: 3x5 mm

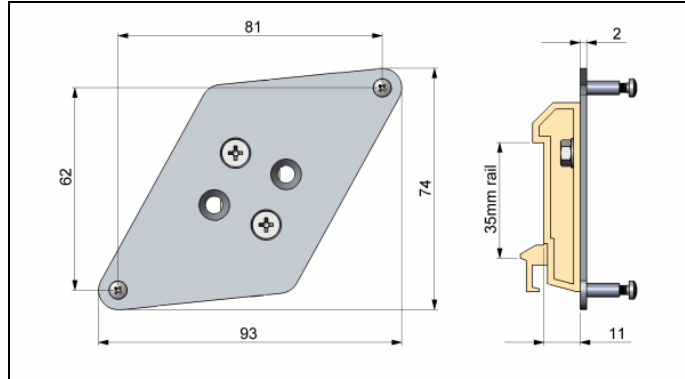
Thread (fitting): M5

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

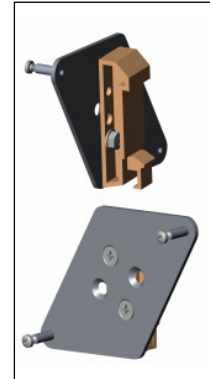
## Further Accessories



Right angle mirror  
Enables measurements  
with 90° angle to sensor  
axis [ACCTRAM].



Rail mount adapter for electronic box [ACCTRAIL]

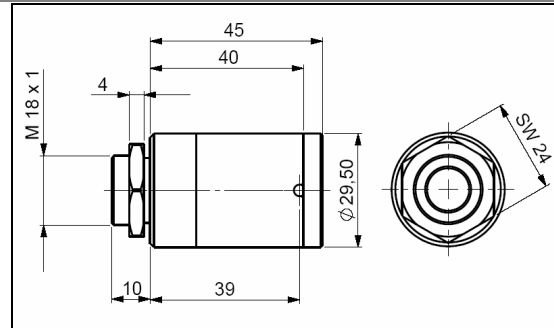


Laser-Sighting tool [D08ACCTLST],  
battery powered (2x Alkaline AA), for alignment of DM sensing  
heads. The laser head has the same mechanical dimensions as  
the DM sensing head.

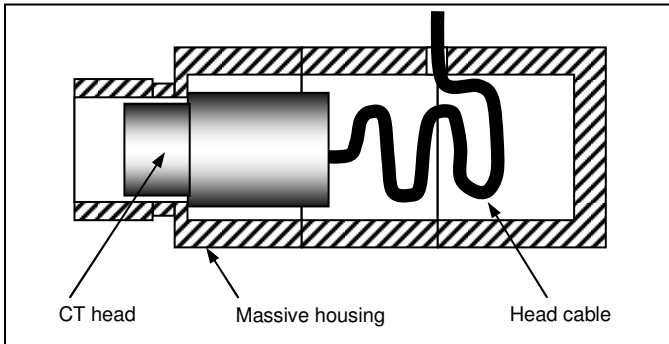
**WARNING:** Do not point the laser directly at the eyes of persons  
or animals! Do not stare into the laser beam. Avoid indirect  
exposure via reflective surfaces!







Massive housing, stainless steel [D06ACCTMHS] – also available in aluminum (anodized) or brass



The Massive housing allows reproducible and stable measurements on applications with significant and short-term variation in ambient temperatures. It can be combined with the CF lens [D2DACCTCF] or with the protective window [D2DACCTPW].

[▶ CF Lens and Protective Window]

**IMPORTANT:** For an optimum function of the massive housing **10 cm** of the head cable must be installed in loops inside the housing.

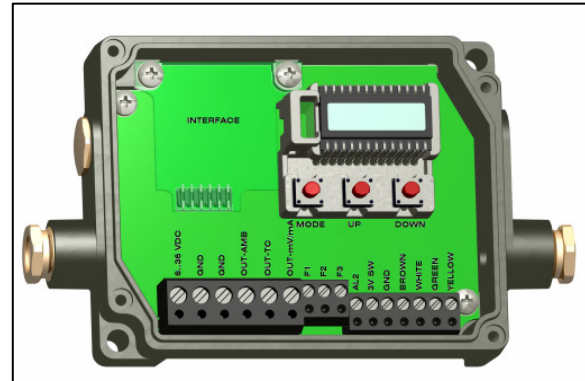
## Electrical Installation

### Cable Connections

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

#### Designation

+8...36 VDC	Power supply
GND	Ground (0 V) of power supply
GND	Ground (0 V) 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	not used
GND	not used
BROWN	Temperature probe head
WHITE	Temperature probe head
GREEN	Detector signal (-)
YELLOW	Detector signal (+)



Opened electronic box with terminal connections

#### Power supply

Please use a power supply unit with an output voltage of 8–36 VDC/ 100 mA.

#### Cable Assembling

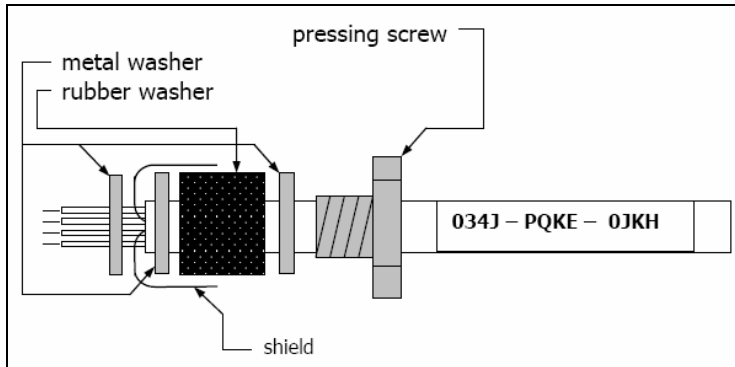
The cable gland M12x1,5 allows the use of cables with a diameter of 3 to 5 mm.

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.



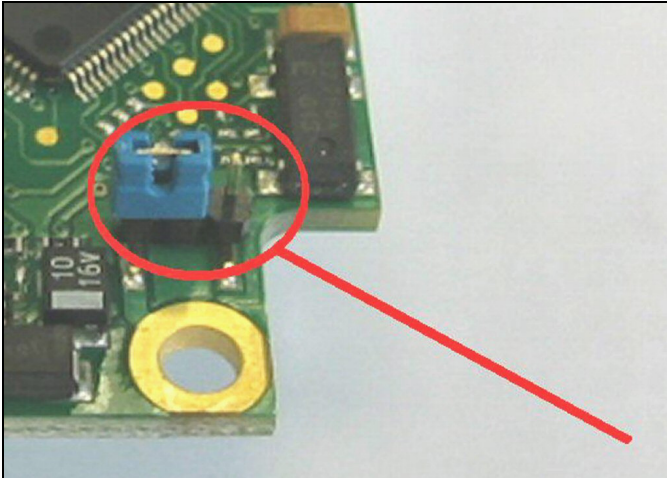
Use shielded cables only. The sensor shield has to be grounded.

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## 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.



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## Exchange of the Sensing Head

From factory side the sensing head has already been connected to the electronics and the calibration code has been entered. Inside the model group DM201, 151, 21 and 101 any exchange of sensing heads and electronics is

possible. The sensing heads and electronics of the models DM601 und 401 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 cable. 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 3 blocks (DM401 und DM601= 5 blocks) with 4 characters each.

Example:      **A6FG - 22KB - 0AS0**  
                  block1  block2  block3



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. The entering of a new calibration code can also be made via the CompactConnect software (optional).

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You will find the calibration code on a label fixed on the head cable (near the electronics). Please do not remove this label or make sure the code is noted anywhere. The code is needed if the electronics has to be exchanged or in case of a necessary recalibration of the sensor.

### Sensing Head Cable

On the models DM201, DM151, DM21, DM101 the sensing head cable can be shortened if necessary. A shortening of the cable will cause an additional measuring error of about 0,1 K/ m.

On the models DM401 und 601 the sensing head cable may not be changed in its length.

On the DMhot models [DM101 hot] the head cable must not be moved during the measurement.

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## Outputs and Inputs

### Analog Outputs

The DM has two analog output channels.

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

#### 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 DM 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 different connection pins on the mainboard are used (**OUT-mV/mA** or **OUT-TC**).

#### Output channel 2

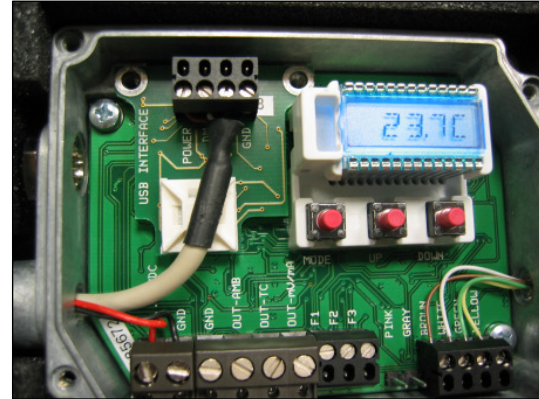
The connection pin OUT-AMB is used for output of the head temperature [-20–180 °C as 0–5 V or 0–10 V signal]. The CompactConnect software allows the programming of output channel 2 as an alarm output. Instead of the head temperature THead also the object temperature TObj or electronic box temperature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

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## Digital Interfaces

All DM 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.



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

## Relay Outputs

The DM 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<sub>RMS</sub>, 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 factory default preset alarm values are:

Alarm 1 = 30 °C/ norm. closed (Low-Alarm) and Alarm 2 = 100 °C/ norm. open (High-Alarm).

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 ►  $\epsilon=0,1$ ; 9 V ►  $\epsilon=1$ ; 10 V ►  $\epsilon=1,1$ ]

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 DM 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 following threshold values (alarm values) are preset:

Alarm 1            30 °C [norm. closed/ Low-Alarm]

Alarm 2            100 °C [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.

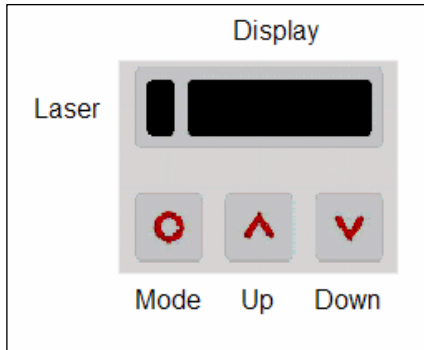
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## Operating

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.

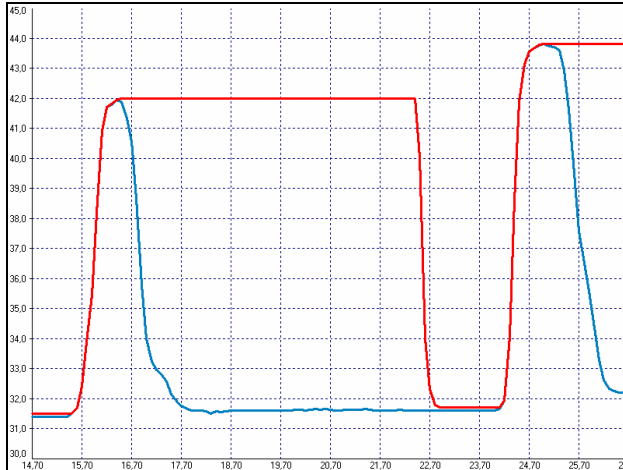
### Factory Default Setting

To set the DM 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.

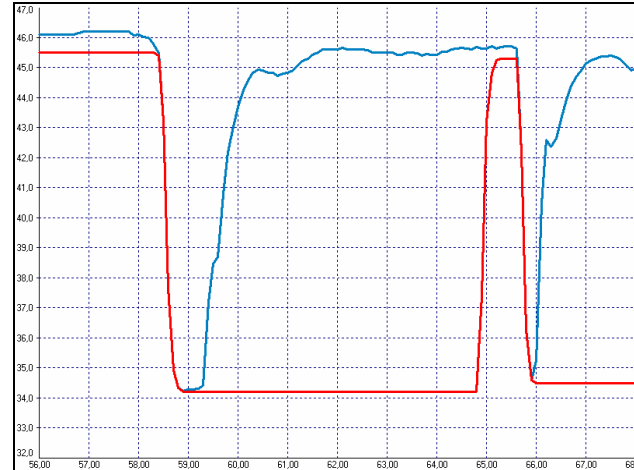
Display	Mode [Sample]	Adjustment Range
142.3C	Object temperature (after signal processing) [142,3 °C]	fixed
127CH	Head temperature [127 °C]	fixed
25CB	Box temperature [25 °C]	fixed
142CA	Current object temperature [142 °C]	fixed
□ MV5	Signal output channel 1 [0-5 V]	□0-20 = 0-20 mA/ □4-20 = 4-20 mA/ □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 <b>[Up]</b> and <b>[Down]</b> 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

- 
- MV5** Selection of the Output signal. By pressing **Up** or **Down** the different output signals can be selected [► Outputs and Inputs].
- 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.

**l 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).

**l 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].

**l 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.

### **Error messages**

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

- OVER temperature overflow
- UNDER temperature underflow
- **^^^CH** head temperature to high
- vvCH 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.

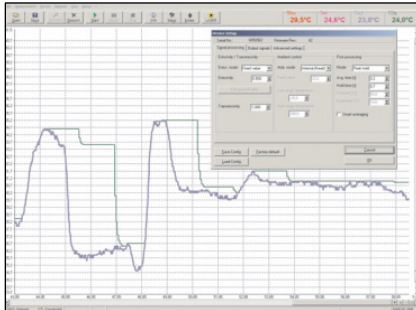
The installation wizard will place a launch icon on the desktop and in the start menu: [Start]\Programs\CompactConnect.

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

You will find a detailed software manual on the CD.

### System requirements:

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



### 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

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## 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 1  $\mu$  and 20  $\mu$ 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.

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## **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 ( $\epsilon$  - 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.

- 
- ▶ Cover 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.

### **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			
		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			
		1,0 µm	1,6 µm	5,1 µm	8-14 µm
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				
	Spectral response	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 graphite		0,8-0,9	0,8-0,9	0,8-0,9
			0,8-0,9	0,7-0,9	0,7-0,8
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