MICRO-EPSILON

Operating Instructions

thermoMETER CSmicro

SF02
SF15
M-3L
M-3H

2W
2W-SF15H
2W-SF22H
HS

M-2SF40
M-2SF75

Infrarot sensor

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Contents

1. Safety

The handling of the system assumes knowledge of the instruction manual.

1.1 Symbols Used

The following symbols are used in the instruction manual:

⚠ CAUTION	Indicates a hazardous situation which, if not avoided, may result in minor or moderate injuries.
NOTICE	Indicates a situation which, if not avoided, may lead to property damage
➪	Indicates a user action.
i	Indicates a user tip.
`Measure`	Indicates a hardware or a button/menu in the software

1.2 Warnings

⚠ CAUTION

Connect the power supply and the display/output device in accordance with the safety regulations for electrical equipment.
> Danger of injury

> Damage to or destruction of the sensor and/or controller

NOTICE

Avoid shock and vibration to the sensor and the controller.
> Damage to or destruction of the sensor and/or controller

The power supply must not exceed the specified limits.
> Damage to or destruction of the sensor and/or controller

Protect the sensor cable against damage.
> Destruction of the sensor, failure of the measuring device

Do not kink the sensor cable and bend the sensor cable in tight radius. The minimum bending radius is 14 mm (static). A dynamic movement is not allowed.
> Damage to the sensor cable, failure of the measuring device

No solvent-based cleaning agents may have an effect on the sensor (neither for the optics nor the housing)
> Damage to or destruction of the sensor

Avoid static electricity and keep away from very strong EMF (electromagnetic fields) e.g. arc welders or induction heaters.
> Damage to or destruction of the sensor

Avoid changes of the operating temperature.
> Inaccurate measuring values

If sensors of the type CS / CSmi / CSmi2W und CsmiHS are connected to a USB-programmer TM-USBK-CS, please ensure that the used CompactConnect Software has got a version 1.8.7 or higher.
> Version below 1.8.7 will destroy the sensor after the first write attempt!

1.3 Notes on CE Identification

The following applies to the thermoMETER CSmicro:
- EU-Directive 2014/30/EU
- EU-Directive 2011/65/EU, „RoHS", category 9

Products which carry the CE mark satisfy the requirements of the quoted EU directives and the European standards (EN) listed therein. The EC declaration of conformity is kept available according to EC regulation, article 10 by the authorities responsible at

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The system is designed for use in industry and laboratory and satisfies the requirements.

1.4 Proper Use

- The thermoMETER CSmicro is designed for use in industrial and laboratory areas. It is used for non-contact temperature measurement.
- The system may only be operated within the limits specified in the technical data, see Chap. 2..
- Use the system in such a way that in case of malfunctions or failure personnel or machinery are not endangered.
- Take additional precautions for safety and damage prevention for safety-related applications.

1.5 Proper Environment

- Protection class:
  - Sensor: IP 65 (NEMA 4)
- Operating temperature:
  - Sensor: See also Chapter Measurement Specification, see Chap. 2.6
  - Controller (in cable): -20 ... 80 °C (-4 ... +176 °C) (all SF models)
    -20 ... 75 °C (-4 ... +167) [1] (all 2W models)

NOTICE

Avoid abrupt changes of the operating temperatures both of the sensor and the controller.
> Inaccurate measuring values

- Storage temperature: -40 ... 85 °C
- Humidity: 10 ... 95 %, non condensing

1) Or Vcc (supply voltage) 5 - 12 VDC/ at Vcc > 12 VDC the max. ambient temperature of the electronics is 65 °C.

2. Technical Data

2.1 Functional Principle

The sensors of the thermoMETER CSmicro series are non-contact measuring infrared temperature sensors. They calculate the surface temperature based on the emitted infrared energy of objects, see Chap. 11.

The sensor housing of the thermoMETER CSmicro is made from stainless steel (protection class IP 65), the controller is integrated in the cable.

i The thermoMETER CSmicro sensor is a sensitive optical system. Please only use the thread for mechanical installation.

NOTICE

Avoid mechanical violence on the sensor.
> Destruction of the system

2.2 Sensor Models

The sensors of thermoMETER CSmicro series are available in the following versions:

Series	Models	Measurement range	Spectral response	Output	Optics	Speciality
SF	SF15	-40 to 1030 °C	8 - 14 µm	0 - 5 / 10 V	15:1	
	SF02	-40 to 1030 °C	8 - 14 µm	0 - 5 / 10 V	2:1	
M-3	M-3L	50 to 350 °C	2.3 µm	0 - 5 / 10 V	22:1	
	M-3H	100 to 600 °C	2.3 µm	0 - 5 / 10 V	33:1	
2W	2W	-40 to 1030 °C	8 - 14 µm	4 - 20 mA	15:1	
	2W-SF15H	-40 to 1030 °C	8 - 14 µm	4 - 20 mA	15:1	180 °C T_{amb} max.
	2W-SF22H	-40 to 1030 °C	8 - 14 µm	4 - 20 mA	22:1	180 °C T_{amb} max.
	HS	-20 to 150 °C	8 - 14 µm	4 - 20 mA	15:1	0.025 K resolution
2WM-2	M-2SF40	250 to 800 °C	1.6 µm	4 - 20 mA	40:1	
	M-2SF75	385 to 1600 °C	1.6 µm	4 - 20 mA	75:1	

2.3 General Specifications

thermoMETER CSmicro		
Protection class		IP 65 (NEMA-4)
Operating temperature	Sensor	see Measurement Specifications
	Controller (in cable)	-20 ... 80 °C (SF15/SF02/M-3-L/M-3H) -20 ... 75 °C [1] (2W/2W-SF15H/2W-SF22H/HS)
Storage temperature		-40 ... 85 °C
Relative humidity		10 ... 95 %, non condensing
Material (Sensor)		Stainless steel
Dimensions	Sensor	28 mm x 14 mm (SF15/SF02/M-3-L/M-3H/2W/2W-SF15H/2W-SF22H/ (SF15/SF02/M-3-L/M-3H/2W/2W-SF15H/2W-SF22H/HS) S)55 mm x 29,5 mm (HS)
	Controller	35 mm x 12 mm
Weight		42 g (SF15/SF02/M-3-L/M-3H/2W/2W-SF15H/2W-SF22H/HS) 200 g (HS)
Cable length	Sensor - controller	0.5 m (Standard), 3 m, 6 m (SF15/SF02/M-3L/M-3H) [2] (2W-SF15/2W-SF15H/2W-SF22H/2WM-2SF40/2WM-2SF75)
	After controller	.5 m (Standard), 3 m (SF15/SF02/M-3L/M-3H) (2W-SF15/2W-SF15H/2W-SF22H/2WM-2SF40/2WM-2SF75)
	Sensor - controller	0.5 m (HS)
	After controller	0.5 (Standard), 3 m (HS)
Cable diameter	Sensor - controller	2.8 mm
	Controller - cable end	4.3 mm

thermoMETER CSmicro	
Vibration	IEC 60068-2-6 /-64: 3 G, 11 – 200 Hz, any axis
Shock	IEC 60068-2-27: 25 G and 50 G, 11 ms, any axis
Pressure resistance (sensor)	8 bar
Software (optional)	CompactConnect

1) For Vcc (power supply) 5 - 12 VDC/ at Vcc > 12 VDC the maximum operating temperature of the controller is 65 °C
2) 6 m cable length not available for 3M version.

2.4 Electrical Specifications

Used pin		Function	SF02/SF15/M-3L/M-3H	2W/2W-SF15H/2W-SF22H/HS
OUT	IN/ OUT			
X		Analog	0 - 5 V [1] 0 - 10 V [2]	4 - 20 mA/ scalable (current loop between Power and GND pin)
X		Alarm	Output voltage adjustable; N/O or N/C	Output current adjustable; N/O or N/C (current loop between Power and GND Pin)
X		Alarm	3-state alarm output (3 voltage level for no alarm, pre-alarm, alarm)	-
	X	Alarm	Programmable open collector output (0 - 30 VDC/ 50 mA) [4]	Programmable open collector output (0 - 30 VDC/ 500 mA)
	X	Temp. Code	Temp.-Code Output (open collector) (0 - 30 VDC/ 50 mA) [4]	Temp.-Code Output (open collector) (0 - 30 VDC/ 500 mA)

Used pin		Function	SF02/SF15/M-3L/M-3H	2W/2W-SF15H/2W-SF22H/HS
OUT	IN/ OUT			
	X	Input	Programmable functions: - external emissivity adjustment - operating temperature compensation - triggered signal output and peak hold function [5] - Reset of hold function [6]	Programmable functions: - triggered signal output and peak hold function [5] - Reset of hold function [7]
X	**X**	Serial digital [3]	uni- (burst mode) or bidirectional	
Output impedances			min. 10 kΩ impedance	max. 1 kΩ loop impedance
Current draw			9 mA	4 - 20 mA
Power supply			5 ... 30 VDC	
Status LED			Green LED with programmable functions: - alarm display (threshold independent from alarm outputs) - Automatic aiming support - Self diagnostics - Temperature code indication	
Vcc adjust mode			- 10 adjustable emissivity and alarm values by variation of power supply/ service mode for analog output (SF02/SF15 only)	

1) 0 ... 4.6 V at power supply 5 VDC; also applies for alarm output
2) Only at power supply ≥ 11 V
3) Inverted RS232 signal, TTL, 9.6 kBaud
4) 500 mA if the mV output is not used
5) High level: > 0.8 V/Low level: < 0.8 V
6) Resetting peak or valley hold by high level on the IN/ OUT pin (low: open or GND / high: > 2.4 V ... 11 V)
7) Resetting of peak or valley hold by low level on the IN/ OUT pin (low: GND / high: open or > 1 V ... 11 V)

2.5 Pin Assignment

white	Power	Power supply
yellow	OUT	Analog output/ TxD/ Alarm output
green	IN/ OUT	Analog input/ RxD/ Open collector output
brown	GND	Ground (⊥)
black	Shield	Shield

white	Power	Current loop (+)/ Alarm output
yellow	OUT	Analog output/ TxD/ Alarm output
green	IN/ OUT	Analog input/ RxD/ Open collector output
brown	GND	Current loop (-)/ Ground (⊥)
black	Shield	Shield

You will find a detailed description of the different sensor connections in Chapter Electrical Installation, see Chap. 8.

2.6 Measurement Specifications

Model	SF15/SF02	M-3L	M-3H
Temperature range IR (scalable via software)	-40 ... 1030 °C	50 ... 350 °C	100 ... 600 °C
Operating temperature (sensor)	-20 ... 120 °C	-20 ... 85 °C	-20 ... 85 °C
Spectral range	8 ... 14 µm	2.3 µm	2.3 µm
Optical resolution	15:1/ 2:1	22:1	33:1
CF lens (optional)	0.8 mm@ 10 mm/ 2.5 mm@ 23 mm	-	-
CF lens (built-in)	-	5.0 mm@ 110 mm	3.4 mm@ 110 mm
CF1 lens (built-in)	-	1.5 mm@ 30 mm	1.0 mm@ 30 mm
Accuracy [1]	±1 °C or 1 % [2]	------- ±(0.3 % T of reading + 2 °C) -------	
Repeatability [1]	±0,5 °C or 0,5 % [2]	------- ±(0.1 % T of reading + 1 °C) -------	
Temperature coefficient [3]	±0.05 K/ K or ±0.05 %/ K (whichever is greater)		
Temperature resolution	0.1 K	0.1 K	0.1 K
Response time	30 ms (90 % signal)	25 ms (90 % signal)	25 ms (90 % signal)
Warm-up time	10 min	-	-
Emissivity/ Gain	0,100 ... 1,100 (adjustable via software)		
Transmissivity	0,100 ... 1,100 (adjustable via software)		
Interface (optional)	USB (programming interface)		
Signal processing	Average, Peak hold, Valley hold (adjustable via software)		

1) At operating temperature 23±5 °C, whichever is greater; Epsilon = 1; response time 1 s
2) At object temperatures > 0 °C
3) For operating temperatures < 18 °C and > 28 °C

Model	2W	2W-SF15H	2W-SF22H
Temperature range (scalable via software)	-40 ... 1030 °C	-40 ... 1030 °C	-40 ... 1030 °C
Operating temperature (sensor)	-20 ... 120 °C	-20 ... 180 °C	-20 ... 180 °C
Specral range	8 ... 14 µm	8 ... 14 µm	8 ... 14 µm
Optical resolution	15:1	15:1	22:1
CF lens (optional)	0.8 mm@ 10 mm	0.8 mm@ 10 mm	0.6 mm@ 10 mm
Accuracy [1)]	±1 °C or 1 % [2)]		
Repeatability [1)]	±0.5 °C or 0.5 % [2)]		
Temperature coefficient [3)]	±0.05 K/ K or ±0.05 %/ K (whichever is greater)		
Temperature resolution	0.1 K	0.1 K	0.1 K
Response time	30 ms (90 % signal)	150 ms (90 % signal)	150 ms (90 % signal)
Warm-up time	10 min		
Emissivity/ Gain	0,100 ... 1,100 (adjustable via software)		
Transmissivity	0,100 ... 1,100 (adjustable via software)		
Interface (optional)	USB programming interface		
Signal processing	Average, Peak hold, Valley hold (adjustable via software)		

1) At operating temperature 23±5 °C, whichever is greater; Epsilon = 1; response time 1 s
2) At object temperatures > 0 °C
3) For operating temperatures < 18 °C and > 28 °C

Model	HS	M-2SF40	M-2SF75
Temperature range (scalable via software)	-20 ... 150 °C	250 ... 800 °C	385 ... 1600 °C
Operating temperature (sensor)	-20 ... 75 °C	-20 ... 125 °C	-20 ... 125 °C
Spectral range	8 ... 14 µm	1.6 µm	1.6 µm
Optical resolution	15:1	40:1	75:1
Accuracy [1]	±1 °C o. ±1 % [3]	----- ±(0,3 % T of reading + 2 °C) [2] -----	
Repeatability [1]	±0,3 °C o. ±0,3 % [3]	----- ±(0,1 % T of reading + 1 °C) [2] -----	
Temperature coefficient [5]	±0.05 K/ K or ±0.05 %/ K (whichever is greater)		
Temperature resolution	0.025 K [3][4]	0.1 K [4]	0.1 K [4]
Response time	150 ms (90 % signal)	10 ms (90 % signal)	10 ms (90 % signal)
Warm-up time	10 min	-	-
Emissivity/ Gain	0,100 ... 1,100 (adjustable via software)		
Transmissivity	0,100 ... 1,100 (adjustable via software)		
Interface (optional)	USB programming interface		
Signal processing	Average, Peak hold, Valley hold (adjustable via software)		

1) At operating temperature 23±5 °C; Epsilon = 1; response time 1 s
2) At object temperatures > 450 °C
3) At object temperatures > 20 °C
4) At time constants > 0.2 s
5) For operating temperatures < 18 °C and > 28 °C

3. Delivery

3.1 Unpacking

1 thermoMETER CSmicro sensor including connection cable

1 Mounting nut

1 Instruction manual

1 isolated mounting bracket [1]

➡ Check the delivery for completeness and shipping damage immediately after unpacking.

➡ In case of damage or missing parts, please contact the manufacturer or supplier.

You will find optional accessories in appendix, see Chap. A 1.

3.2 Storage

- Storage temperature: -40 ... 85 °C (-4 ... +185 °F)
- Humidity: 10 ... 95 %

1) Only supplied with the 2W-SF15H und 2W-SF22H sensor, see Chap. 8.1.3.

4. Optical Charts

The following optical charts show the diameter of the measuring spot in dependence on the distance between measuring object and sensor. The spot size refers to 90 % of the radiation energy. The distance is always measured from the front edge of the sensor housing / CF-lens holder/ air purge.

i The size of the measuring object and the optical resolution of the infrared thermometer determine the maximum distance between sensor 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.

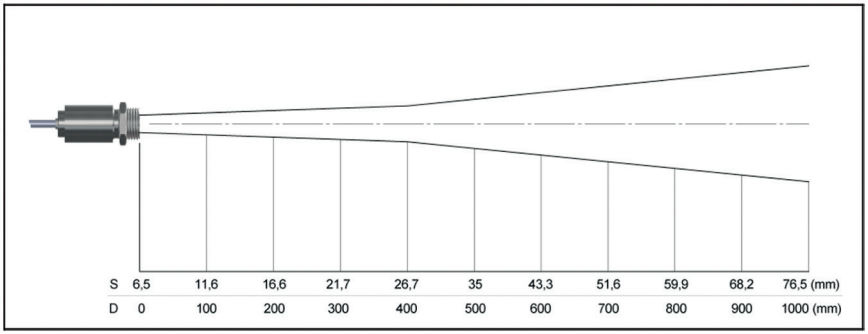
D = Distance from front of the sensor to the object

S = Spot size

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

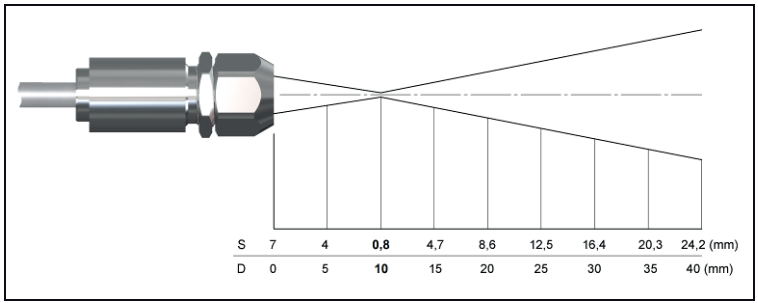
SF15/ 2W/ 2W-SF15H/ HS

D:S = 15:1



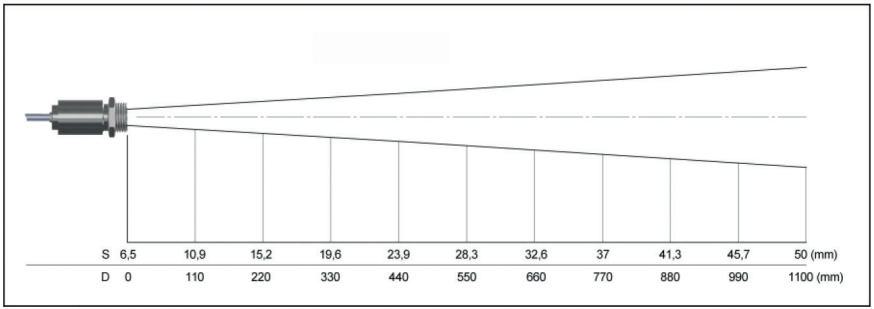
SF15/ 2W/ 2W-SF15H/ HS

with CF lens
(0.8 mm@ 10 mm)



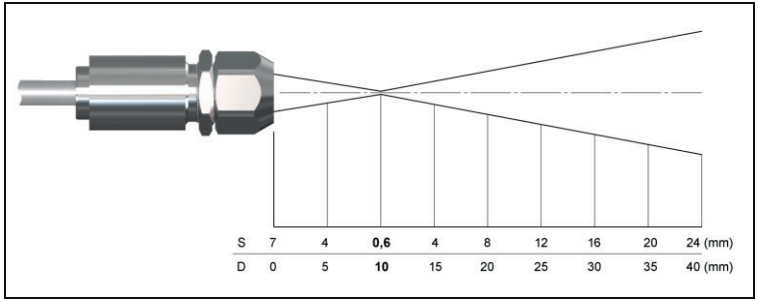
2W-SF22H

D:S = 22:1



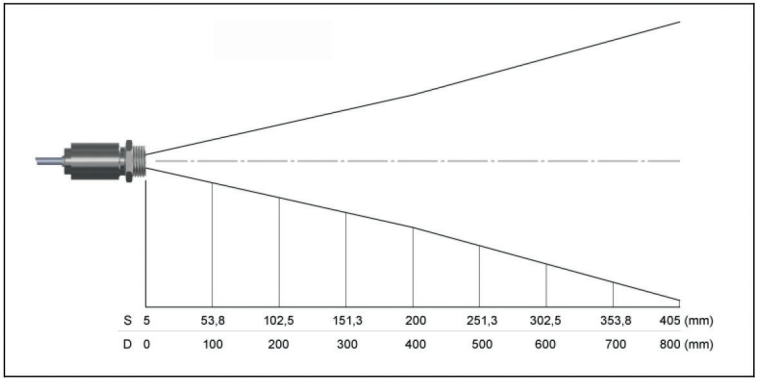
2W-SF22H

with CF lens
(0.6 mm@ 10 mm)



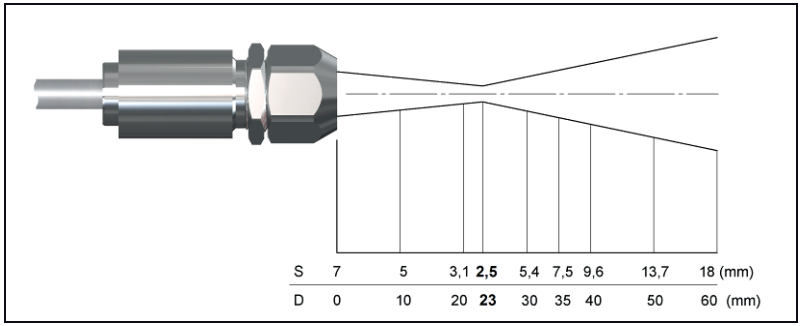
SF02

D:S = 2:1



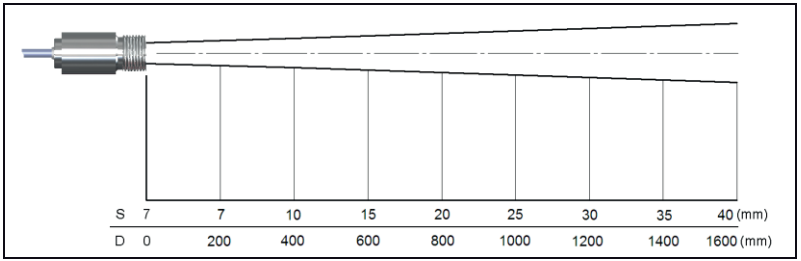
SF02

with CF lens
(2.5 mm@ 23 mm)



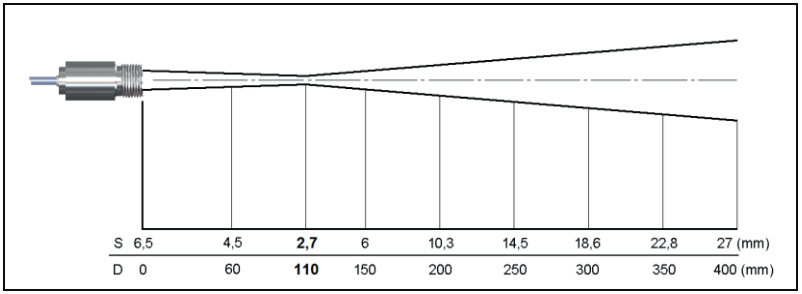
M-2SF40 SF

D:S = 40:1



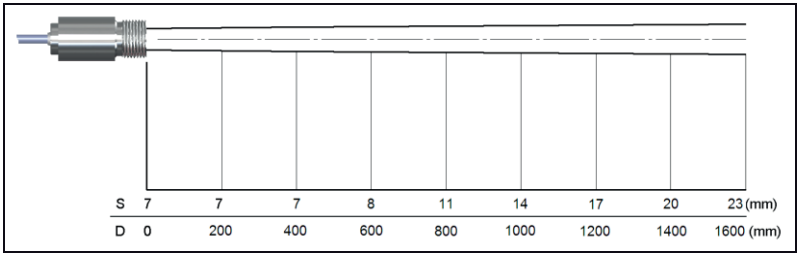
M-2SF40 CF

D:S = 40:1/
D:S Far field = 12:1



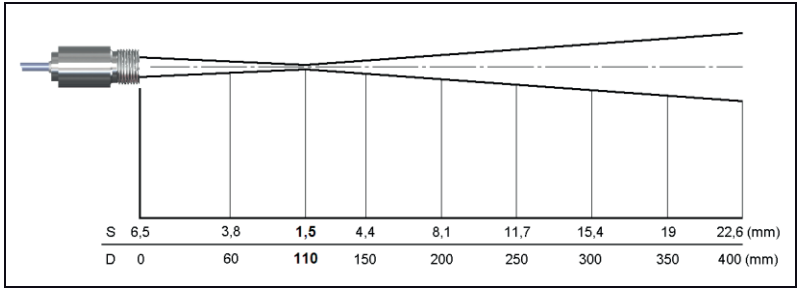
M-SF75 SF

D:S = 75:1



M-2SF75 CF

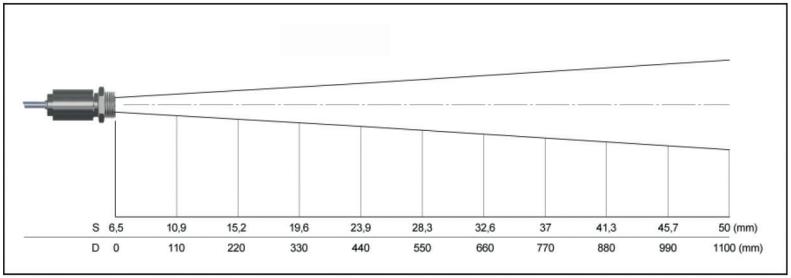
D:S = 75:1/
D:S Far field = 14:1



i If the lens (TM-CFH-CT or TM-CFHAG-CT) is used in connection with 2W2M units (SF or CF optics) the focus is shifted to a distance of 11 mm.

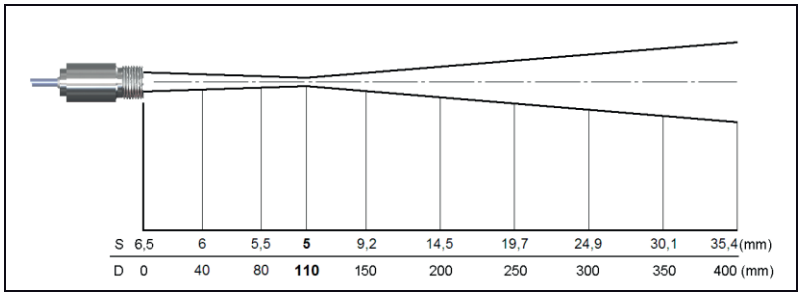
M-3L SF

D:S = 22:1



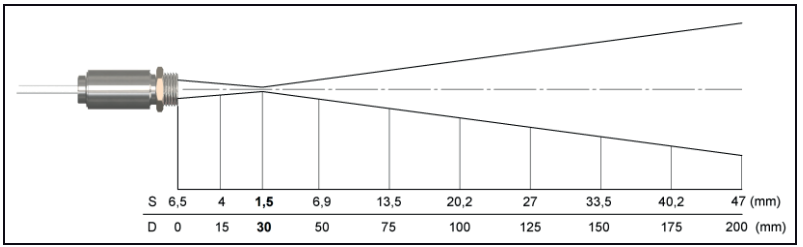
M-3L CF

D:S = 22:1/
D:S Far field = 9:1



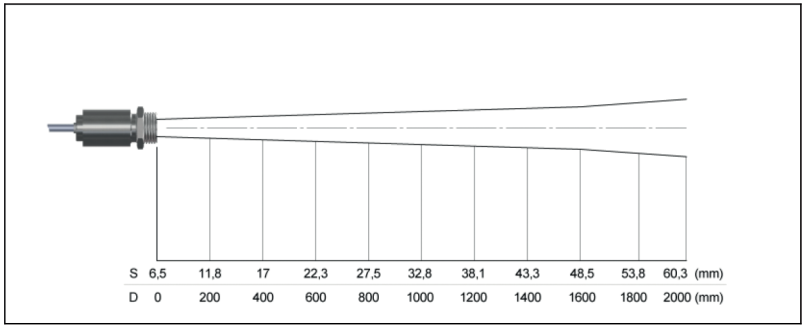
M-3L CF1

D:S = 22:1/
D:S Far field = 3.5:1



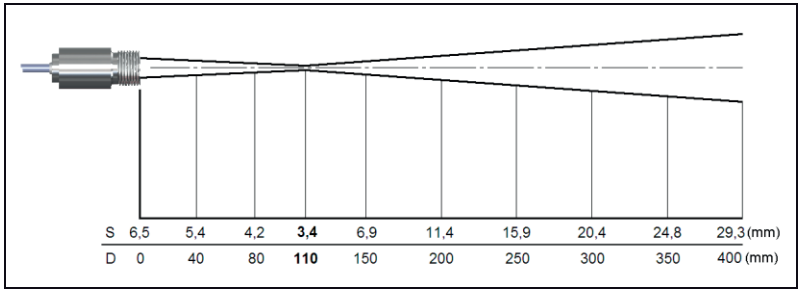
M-3H SF

D:S = 33:1



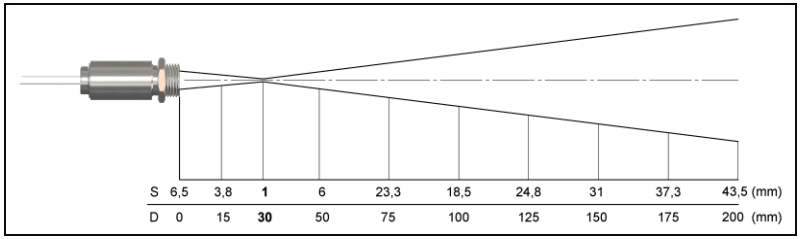
M-3H CF

D:S = 33:1/
D:S Far field = 11:1



M-3H CF1

D:S = 33:1/
D:S Far field = 4:1



5. CF Lens and Protective Window

The optional CF lens allows the measurement of very small objects. The minimum spot size depends on the used sensor. The distance is always measured from the front edge of the CF lens holder or laminar air purge collar. The installation on the sensor will be done by turning the CF lens until end stop.

➡ To combine it with the HS model please use the version with external thread M12x1.

i When using the CF lens (averages) the following transmission values have to be set:

SF15/ SF02/ 2W	0.78
2WM-2	0.87
2WM-3	0.92

Versions overview:

TM-CF-CS	CF lens for installation on sensor [SF15/ SF02/ 2W/ HS]
TM-CFH-CS	CF lens for installation on sensor [2WM-2/ 2WM-3]
TM-CFAG-CS	CF lens with external thread for installation in massive housing [SF15/ SF02/ 2W]
TM-CFHAG-CS	CF lens with external thread for installation in massive housing [2WM-2/ 2WM-3]

For protection of the sensor optics a protective window is available. The mechanical dimensions are equal to the CF lens. It is available in the following versions:

TM-PW-CS	Protective window for installation on sensor [SF15/ SF02/ 2W]
TM-PWH-CS	Protective window for installation on sensor [2WM-2/ 2WM-3]
TM-PWAG-CS	Protective window with external thread for installation in massive housing [SF15/ SF02/ 2W]
TM-PWHAG-CS	Protective window with external thread for installation in massive housing [2WM-2/ 2WM-3]

i When using the protective window (average) the following transmission values have to be set:

SF15/ SF02/ 2W	0.83
2WM-2	0.93
2WM-3	0.93

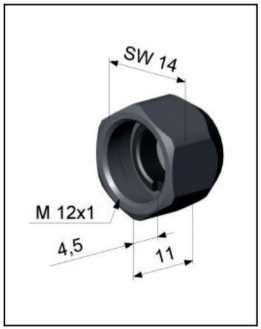


Fig. 1 CF lens:
[TM-CF-CS/ TM-CFH-CS]
Protective window:
[TM-PW-CS/ TM-PWH-CS]

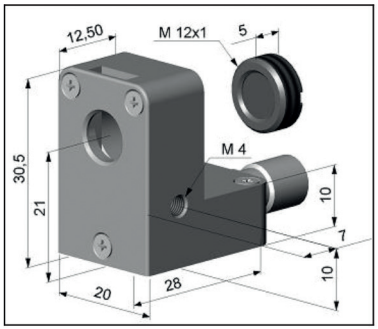


Fig. 2 Laminar air purge with integrated CF lens:
[TM-APLCF-CS/ TM-APLCFH-CT]

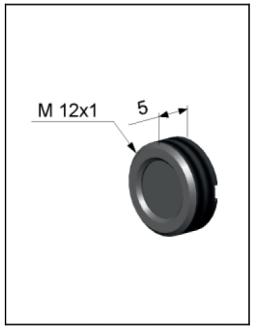


Fig. 3 CF lens with external thread:
[TM-CFAG-CS]
Protective window with external thread: [TM-PWAG-CS]

To change the transmission value the optional USB-Kit (including software) is necessary.

6. LED Functions

The green LED can be programmed for the following functions. For the programming the USB adapter cable inclusive software (option) is necessary. The factory default setting for the LED is self diagnostic.

LED Alarm	LED lights up if the object temperature exceeds or deceeds an alarm threshold.
Automatic aiming support	Sighting feature for an accurate aiming of the sensor to hot or cold objects
Self diagnostic	LED is indicating different states of the sensor.
Temperature Code indication	Indication of the object temperature via the LED
Off	LED deactivated

6.1 Automatic Aiming Support

The automatic aiming support helps to adjust the unit to an object which has a temperature different to the background. If this function is activated via software the sensor is looking for the highest object temperature; means the threshold value for activating the LED will be automatically tuned.

This works also if the sensor is aimed at a new object (with probably colder temperature). After expiration of a certain reset time (default setting: 10 s) the sensor will adjust the threshold level for activation of the LED new.

6.2 Self Diagnostic

With this function the current status of the sensor will be indicated by different flash modes of the LED.

If activated, the LED will show one out of five possible states of the sensor:

Status	**LED mode**	
Normal	intermittent off	- - - -
Sensor overheated	fast flash	----------
Out of measuring range	double flash	-- -- -- -- -- -- --
Not stable	intermittent on	— — — —
Alarm fault	always on	

i At a power supply (Vcc) ≥ 12 V it takes about 5 minutes until the sensor works in a stable mode. Therefore, after switching on the unit, the LED will show a not stable state for up to 5 minutes.

Sensor overheated: The internal temperature probes have detected an invalid high internal temperature of the thermoMETER CSmicro.

Out of measuring range: The object temperature is out of measuring range.

Not stable: The internal temperature probes have detected an unequally internal temperature of the thermoMETER CSmicro.

Alarm fault: Current through the switching transistor of the open-collector output is to high.

6.3 Temperature Code Indication

With this function the current measured object temperature will be indicated as percentage value by long and short flashing of the LED.

At a range setting of 0 - 100 °C → 0 - 100 %, the LED flashing indicates the temperature in °C.

Long flashing → first digit:	**x**x
Short flashing → second digit:	x**x**
10-times long flashing → first digit = 0:	**0**x
10-times short flashing → second digit = 0:	x**0**

Examples:

87 °C	8-times long flashing indicates	**8**7
and afterwards	7-times short flashing indicates	8**7**
31 °C	3-times long flashing	**3**1
and afterwards	1-time short flashing indicates	3**1**
8 °C	10-times long flashing indicates	**0**8
and afterwards	8-times short flashing	0**8**
20 °C	2-times long flashing	**2**0
and afterwards	10-times short flashing	2**0**

7. Mechanical Installation

The CSmicro is equipped with a metric M48x1.5 thread and can be installed either directly via the sensor thread or with help of the hex nut (standard) to the mounting bracket available. The CSmicro HS will be delivered with the massive housing and can be installed via the M18x1-thread.

The thermoMETER CSmicro sensor is a sensitive optical system.

Please use only the thread for mechanical installation.

NOTICE

Avoid mechanical violence on the sensor.
> Destruction of the system

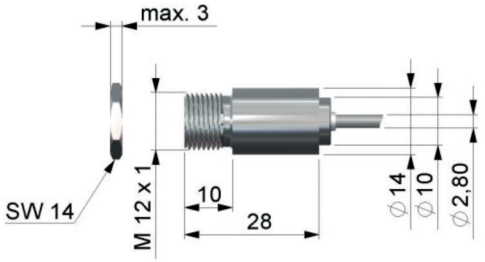


Fig. 4 Sensor thermoMETER CSmicro SF15/ SF02/ 2W/ 2WM-2/ 2WM-3

Dimensions in mm, not to scale

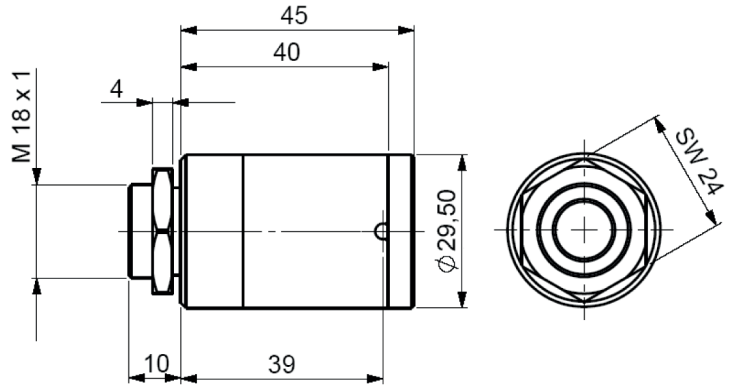


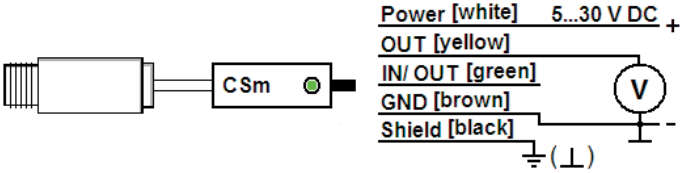
Fig. 5 Sensor thermoMETER CSmicro HS

Dimensions in mm, not to scale

8. Electrical Installation

8.1 Analog Mode

8.1.1 CSmicro SF15/ SF02/ M-3L/ M-3H as Analog Device (mV output on OUT)



The output impedance must be ≥ 10 kΩ.

The shield (black) on the thermoMETER CSmicro (exception: CSmi2W-SFxxH) is not connected to GND (brown).

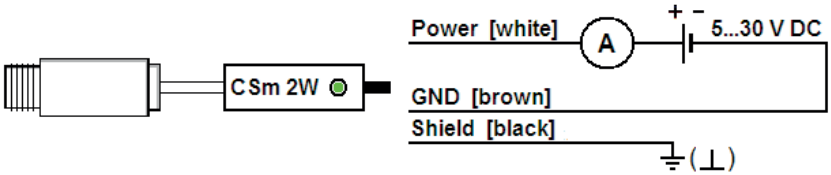
In any case it is necessary to connect the shield to ground on GND!

NOTICE

The residual ripple of the power supply should be max. 200 mV.

> Defect of controller

8.1.2 CSmicro 2W as Analog Device (mA-two-wire-output)



The maximum loop impedance is 1000 Ω.

The shield (black) on the thermoMETER CSmicro (exception: CSmi2W-SFxxH) is not connected to GND (brown).

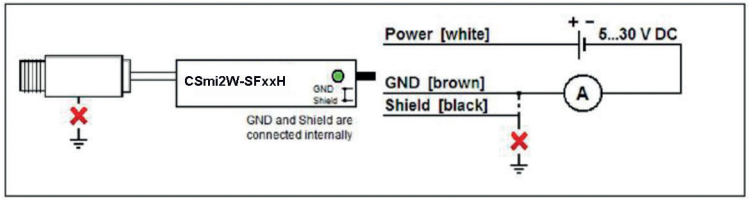
In any case it is necessary to connect the shield to ground on GND!

NOTICE

The residual ripple of the power supply should be max. 200 mV.

> Defect of controller

8.1.3 CSmicro 2W-SF15H/ 2W-SF22H as Analog Device (mA two-wire-output) - Current Measure ment in GND- (Loop-) Line



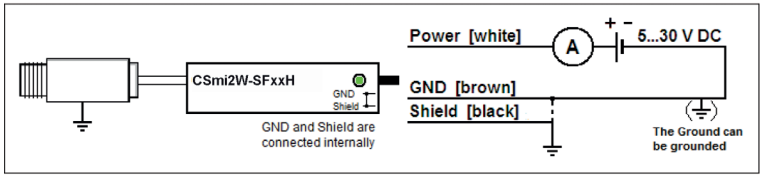
On the models 2W-SF15H/ 2W-SF22H (sensors for ambient temperatures up to 180 °C) and on the special versions for 250 °C ambient temperature the GND and Shield is connected inside the controller.

Special note for current measurement in GND- (Loop-) line:

In this case the sensor must be installed isolated from ground. An isolated mounting bracket is included (for CSmi2W-SFxxH). A connection of the GND or Shield wire to earth is also not allowed.

For current measurement in the Power- (Loop+) line the drawing CSmicro 2W as analog device is valid. The shield should be connected to ground or GND.

i The maximum loop impedance is 1000 Ω.



8.1.4 Maximum Loop Impedance (2W Models)

The maximum impedance of the current loop depends on the power supply level.

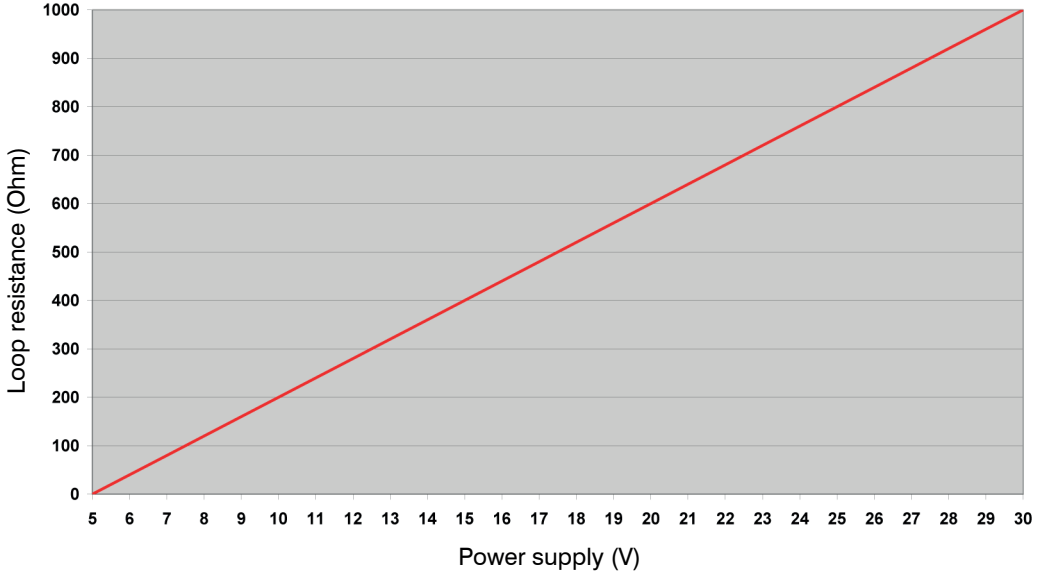


Fig. 6 Maximum loop impedance

8.2 Digital Mode

For a digital communication the optional USB programming kit is required.

NOTICE

Please read this before your first starting-up of the sensor:

If sensors of the type CS / CSmi / CSmi2W und CsmiHS are connected to a USB-programmer TM-USBK-CS, please ensure that the used CompactConnect Software has got a version 1.8.7 or higher.
> Version below 1.8.7 will destroy the sensor after the first write attempt!

➡ Please connect each wire of the USB adapter cable with the same colored wire of the sensor cable by using the terminal block.

➡ Press with a screw driver as shown in the picture to loose a contact, see Fig. 7.

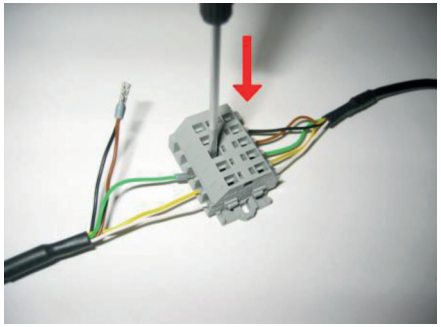
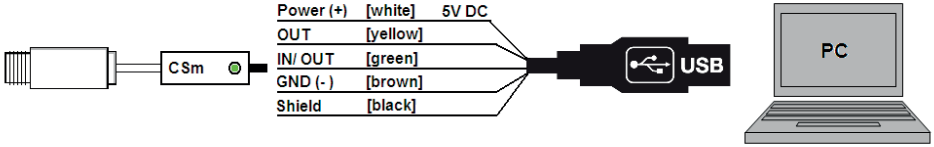


Fig. 7 Cable connection using the terminal block

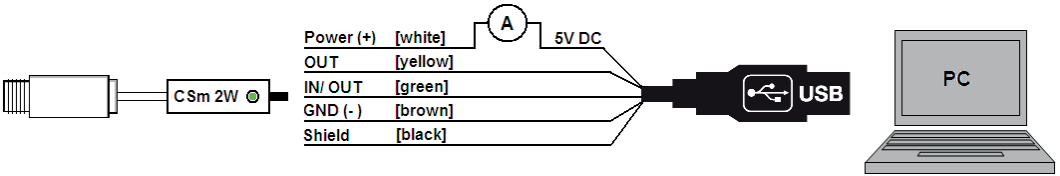
The sensor is offering two ways of digital communication:
- Bidirectional communication (sending and receiving data)
- Unidirectional communication (burst mode - the sensor is sending data only)

Digital Mode (SF15/ SF02/ 3M)



8.3 Analog and Digital Mode Combined (2W)

The two-wire models are able to work in the digital mode and simultaneously as analog device (4 - 20 mA). In this case the sensor will be powered by the USB interface (5 V).



8.4 Direct Connection to an RS232 Interface on the Computer

For a bidirectional RS232 connection of the sensor the following interface circuit can be used:
MAX3381E (manufacturer: Maxim, see Chap. A 6).

Model	CSmi V1	CSmi V2 / V3	CSmi 2W
UART voltage (RxD)	5 V	3.3 V	3.3 V
UART voltage (TxD)	5 V	3.3 V	2.5 V

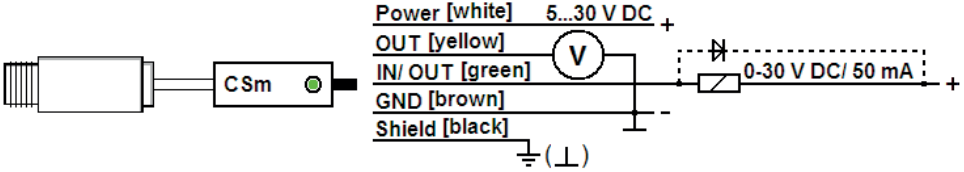
Previous sensor versions

CSmi V1 Version bis 09/2011
CSmi V2 Version bis 07/2018

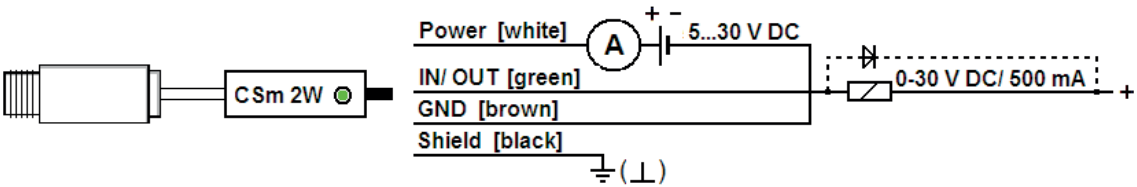
8.5 Alarm Output

8.5.1 Open Collector Output (SF/ M-3)

The open collector output is an additional alarm output on the thermoMETER CSmicro and can control an external relay e.g. In addition the analog output can be used simultaneously.



8.5.2 Open-collector-Ausgang (2W)



9. Instructions for Operation

9.1 Cleaning

Lens cleaning: Blow off loose particles using clean compressed air. Clean the lens surface using a soft, damp cloth (moistened with water) or a lens cleaner (e.g. Purosol or B + W Lens Cleaner).

NOTICE

Never use cleaning compounds which contain solvents (neither for the lens nor for the housing).
> Destruction of the sensor and/or the controller

10. Software

10.1 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 CDsetup.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.

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

i You will find a detailed software manual on the CD.

NOTICE

Please read this before your first starting-up of the sensor:

If sensors of the type CS / CSmi / CSmi2W und CsmiHS are connected to a USB-programmer TM-USBK-CS, please ensure that the used CompactConnect Software has got a version 1.8.7 or higher.
> Version below 1.8.7 will destroy the sensor after the first write attempt!

The newest version you can download here:

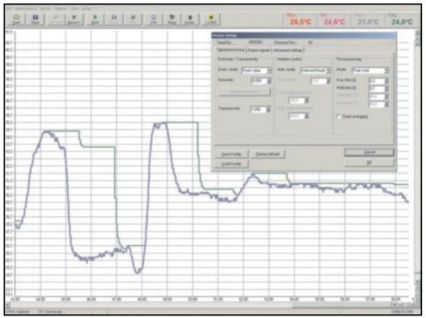
http://www.micro-epsilon.de/download/software/thermoMETER-CompactConnect.zip

10.2 Minimum System Requirements

- Windows XP, Vista, 7, 8, 10
- USB interface
- Hard disc with at least 30 MByte free space
- At least 128 MByte RAM
- CD-ROM drive

10.3 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



10.4 Communication Settings

10.4.1 Serial Interface

Baud rate:	9600 Baud
Data bits:	8
Parity:	none
Stop bits:	1
Flow control:	off

10.4.2 Protocol

All thermoMETER CSmicro series are using a binary protocol. To get a fast communication the protocol has no additional overhead with CR, LR or ACK bytes.

To power the sensor the control signal `DTR` has to be set.

Command overview, see CD directory `\Commands, see Chap. 10.4.3`

10.4.3 Digital Command Set (Excerpt from the Document in the CD Directory \Commands)

Command list CSmicro							
Decimal	**HEX**	**Binary / ASCII**	**Command**	**Data**	**Reply**	**Result**	**Unit**
1	0x01	Binary	READ Temp - Target	no	byte 1 byte 2	= (byte1 x 256 + byte2 - 1000) / 10	°C
2	0x02	Binary	READ Temp - Head	no	byte 1 byte 2	= (byte1 x 256 + byte2 - 1000) / 10	°C
3	0x03	Binary	READ current Temp - Target	no	byte 1 byte 2	= (byte1 x 256 + byte2 - 1000) / 10	°C
4	0x04	Binary	READ Emissivity	no	byte 1 byte 2	= (byte1 x 256 + byte2) / 1000	
5	0x05	Binary	READ Transmission	no	byte 1 byte 2	= (byte1 x 256 + byte2) / 1000	
9	0x09	Binary	READ Processor Temperature	no	byte 1	= (byte1 x 256 + byte2 - 1000) / 10	
14	0x0E	Binary	READ Serial number	no	byte 1 byte 2 byte 3	= byte1 x 65536 + byte2 x 256 + byte 3	
15	0x0F	Binary	READ FW Rev.	no	byte 1 byte 2	= byte1 x 256 + byte2	
129	0x81	Binary	SET DAC mV/ mA	byte 1	byte 1	byte1 = mV (mA) x 10 (e.g. 4 mA = 4 x 10 = 40)	°C
130	0x82	Binary	RESET of DAC mV/ mA output				
132	0x84	Binary	SET Emissivity	byte 1 byte 2	byte 1 byte 2	= (byte1 x 256 + byte2) / 1000	
133	0x85	Binary	SET Transmission	byte 1 byte 2	byte 1 byte 2	= (byte1 x 256 + byte2) / 1000	

Temperature calculation at CSmicro hs: (byte1 x 256 + byte2 - 10000) / 100			
EXAMPLES (all bytes in HEX)			
Readout of object temperature			
Send:	01	Command for readout of object temperature	04 D3 = dez. 1235 1235 - 1000 = 235 235 / 10 = 23.5 °C
Receive:	04 D3	Object temperature tenth degree + 1000	

Readout of object temperature (at CSmicro 2Whs)			
Send:	01	Command for readout of object temperature	
Receive:	30 3E	Object temperature in hundredth degree + 10000	30 3E = dez. 12350 12350 - 10000 = 2350 2350 / 100 = 23.50 °C
Set of emissivity			
Send:	84 03 B6		03B6 = dez. 950
Receive:	03 B6		950 / 1000 = 0.950
Burstmode (unidirectional)			
After switch on a continuous serial signal will be created. The burst string can be configured with the software.			
Burst string	**Example**	**Complete burst string**	**Conversion in decimal value**
2 synchronisation bytes: AAAA	------		------
2 bytes for each output value (HI LO)	03B8	AAAA 03B8	Process temp (°C) = (HEX → Dec(03B8)-1000)/10 = -4.8

11. 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 μ and 20 μm. The intensity of the emitted radiation depends on the material. This material contingent constant is described with the help of the emissivity (ε - Epsilon) which is a known value for most materials, see Chap. 12. 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
- Controller (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 emitted infrared radiation is transformed into electrical signals by the detector and the controller.

12. Emissivity

12.1 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.

12.2 Determination of Unknown Emissivity

- First of all, determine the current temperature of the measuring object with a thermocouple or contact sensor. The second step is to measure the temperature with the infrared thermometer and modify the emissivity until the displayed measuring value corresponds to the current temperature.
- If you monitor temperatures of up to 380 °C you may place a special plastic sticker (Part number: TM-ED-CT emissivity dots) 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.

i On all three methods the object temperature must be different from the operating temperature.

12.3 Characteristic Emissivity

In the case that none of the methods mentioned above help to determine the emissivity you may use the emissivity tables, see Chap. A 3, see Chap. A 4. These are only average values. The actual emissivity of a material depends on the following factors:

- Temperature
- Measuring angle
- Geometry of the surface (smooth, convex, concave)
- Thickness of the material
- Constitution of the surface (polished, oxidized, rough, sandblast)
- Spectral range of the measurement
- Transmissivity (e.g. with thin films)

13. Warranty

All components of the device have been checked and tested for perfect function in the factory. In the unlikely event that errors should occur despite our thorough quality control, this should be reported immediately to MICRO-EPSILON.

The warranty period lasts 12 months following the day of shipment. Defective parts, except wear parts, will be repaired or replaced free of charge within this period if you return the device free of cost to MICRO-EPSILON. This warranty does not apply to damage resulting from abuse of the equipment and devices, from forceful handling or installation of the devices or from repair or modifications performed by third parties.

No other claims, except as warranted, are accepted. The terms of the purchasing contract apply in full. MICRO-EPSILON will specifically not be responsible for eventual consequential damages. MICRO-EPSILON always strives to supply the customers with the finest and most advanced equipment. Development and refinement is therefore performed continuously and the right to design changes without prior notice is accordingly reserved.

For translations in other languages, the data and statements in the German language operation manual are to be taken as authoritative.

14. Service, Repair

In the event of a defect on the sensor or the sensor cable please send us the affected parts for repair or exchange.

In the case of faults the cause of which is not clearly identifiable, the entire measuring system must be sent back to:

MICRO-EPSILON MESSTECHNIK
GmbH & Co. KG
Königbacher Str. 15
94496 Ortenburg / Germany

Tel. +49 (0) 8542/ 168-0
Fax +49 (0) 8542 / 168-90
info@micro-epsilon.de
www.micro-epsilon.com

For customers in USA applies:

Send the affected parts or the entire measuring system back to:

MICRO-EPSILON USA
8120 Brownleigh Dr.
Raleigh, NC 27617 /USA

Tel. +1 919 / 787-9707
Fax +1 919 / 787-9706
me-usa@micro-epsilon.com
www.micro-epsilon.com

For customers in Canada or South America applies:

Please contact your local distributor.

15. Decommissioning, Disposal

➡ Disconnect the sensor and sensor cables.

Incorrect disposal may cause harm to the environment.

➡ Dispose of the device, its components and accessories, as well as the packaging materials in compliance with the applicable country-specific waste treatment and disposal regulations of the region of use.

Appendix

A 1 Optional Accessories

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

A 1.1 Mounting Accessories SF15/ SF02/ M-2/ M-3/ 2W/ 2WM-2

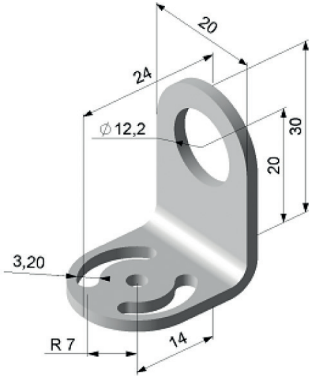


Fig. 8 Mounting brackjet, adjustable in one axis [TM-FB-CS]

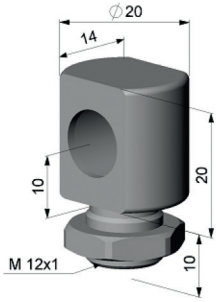


Fig. 9 Mounting bolt with M12x1 thread, adjustable in one axis [TM-MB-CS]

Dimensions in mm, not to scale

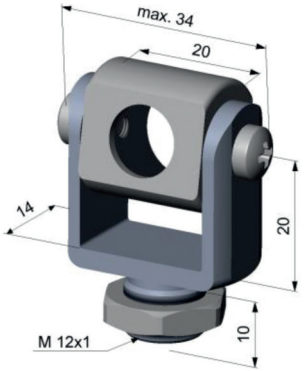


Fig. 10 Mounting fork with M12x1 thread, adjustable in 2 axes [TM-MG-CS]

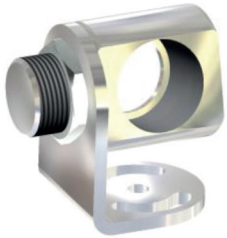


Fig. 11 Mounting bracket, adjustable in 2 axes [TM-AB-CS]

Dimensions in mm, not to scale

The mounting fork can be combined with the mounting bracket [TM-FB-CS] using the M12x1 thread.

A 1.2 Mounting Accessories HS

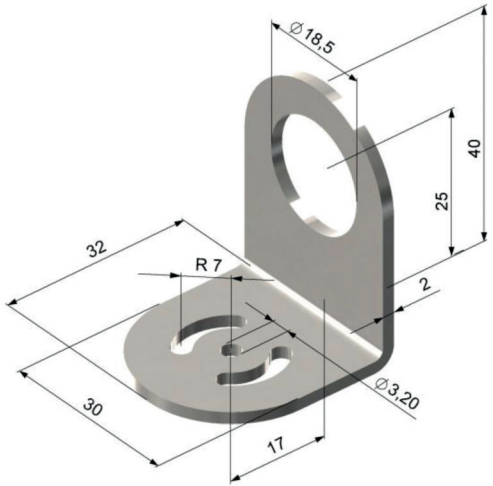


Fig. 12 Mounting bracket, adjustable in one axis for HS [TM-FBMH-CT]

Dimensions in mm, not to scale

A 1.3 Air Purge Collars SF02/ SF15/ 2W/ 2WM-2

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.

i Make sure to use oil-free, technically clean air, only!

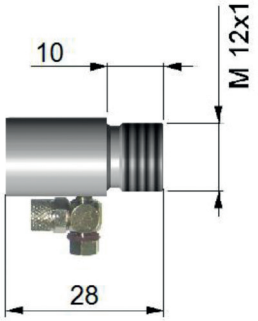


Fig. 13 Standard air purge collar; fits to the mounting bracket; hose connection: 3x5 mm [TM-AP-CS]/ for sensors with D:S ≥ 10:1

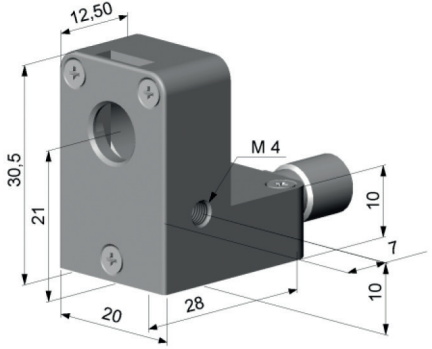


Fig. 14 Laminar air purge collar - the sideward air outlet prevents a cooling down of the object in short distances; hose connection: 3x5 mm [TM-APL-CS]

Fig. 15 Combination of the laminar air purge collar with the bottom section of the mounting fork

Dimensions in mm, not to scale

A combination of the laminar air purge collar with the bottom section of the mounting fork allows an adjustment in two axis [TM-APL-CS +TM-MG-CS].

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

A 1.4 Air Purge Collar HS

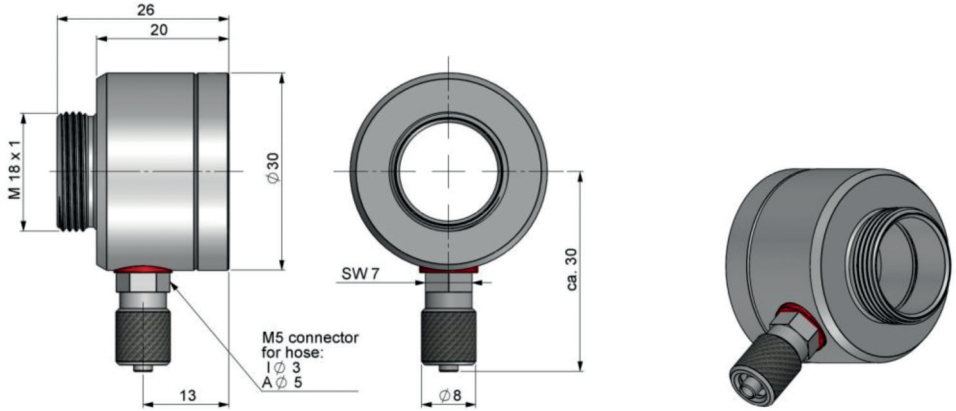


Fig. 16 Air purge collar for sensor HS [TM-APMH-CT]

A 1.5 Right Angle Mirror

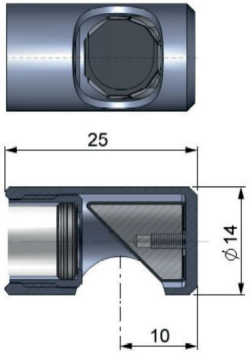


Fig. 17 Right angle mirror Enables measurement with 90° angle ([TM-RAM-CS]

Dimensions in mm, not to scale

For optics with a D:S ≥ 10:1

The mirror has a reflexion of 96 % [1] in combination with SF models.

If the mirror is used this value has to be multiplied by the emissivity value of the measurement object.

Example: SF15 and object with emissivity = 0.85

0.85 x 0.96 = 0.816

Thus the emissivity in the thermoMETER CSmicro hast to be set to the resulting value of 0.816.

1) Deviations possible

A 1.6 USB Programming Adaptor

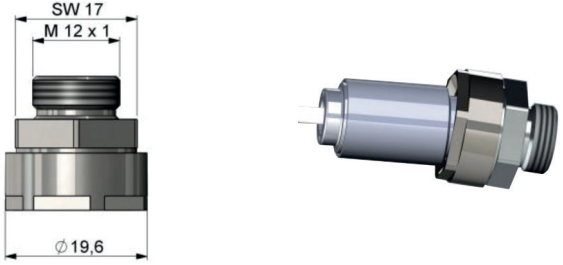
NOTICE

Make sure before connection of sensors of the type CS / CSmi / CSmi2W or CSmiHS with the USB programming adapter TM-USBK-CS that the software CompactConnect used is a version 1.8.7 or later!
> In versions older than the version 1.8.7 the sensor after the first write access becomes useless.

Fig. 18 USB-Kit: USB programming adaptor inclusive terminal block and software CD [TM-USBK-CS]

A 1.7 Tilt Assembly

With this mounting accessory a fine adjustment of the thermoMETER CSmicro with an off-axis angle +/- 6,5° is possible.



Dimensions in mm, not to scale

Fig. 19 Tilt assembly [TM-TAS-CT]

A 2 Factory Settings

The units have the following presetting at time of delivery:

Model CSmicro	**SF15**	**SF02**	**M-3L**	**M-3H**
Temperature range	0 ... 350 °C	0 ... 350 °C	50 ... 350 °C	100 ... 600 °C
Output	0 ... 3,5 V	0 ... 3,5 V	0 ... 10 V	0 ... 10 V
Emissivity	0.950	0.950	0.950	0.950
Transmission	1.000	1.000	1.000	1.000
Average time	0.3 s	0.3 s	0.3 s	0.3 s
Smart averaging	Active	Active	Active	Active
Smart averaging hysteresis	2 °C	2 °C	2 °C	2 °C
Operating temperature source	Internal (sensor temperature)			
Status-LED function	Self diagnostic			
Input (IN/ OUT/ green)	Inactive			
Output (OUT/ yellow)	mV output			
Vcc adjust	Inactive			
Signal processing	Hold mode: off			
Calibration	Gain 1,000/ Offset 0,0			
Failsafe	Inactive			

Model	2W-SF15	2W-SF15H	2W-SF22H	hsSF	2WM-2L	2WM-2H
Temperature range	0 ... 350 °C	0 ... 500 °C	0 ... 500 °C	-20 ... 150 °C	250 ... 800 °C	385 ° ... 1600 °C
Output	4 ... 20 mA	4 ... 20 mA	4 ... 20 mA	4 ... 20 mA	4 ... 20 mA	4 ... 20 mA
Emissivity	0,950	0,950	0,950	0,950	0,950	0,950
Transmission	1,000	1,000	1,000	1,000	1,000	1,000
Average time	0,3 s	0,3 s	0,3 s	0,3 s	0,3 s	0,3 s
Smart Averaging	Active	Active	Active	Active	Active	Active
Smart Averaging hysteresis	2 °C	2 °C	2 °C	2 °C	2 °C	2 °C
Operating temperature source	Internal (sensor temperature)					
Status-LED function	Self diagnostic					
Input (IN/ OUT/ green)	Communication input					
Output (OUT/ yellow)	Communication output					
Vcc adjust	Inactive					
Signal processing	Hold mode: off					
Calibration	Gain 1,000/ Offset 0,0					
Failsafe	Inactive					

Smart Averaging means a dynamic average adaptation at high signal edges (activation/ deactivation via software only), see Chap. A 5.

For a usage of the thermoMETER CSmicro SF for online maintenance applications (in electrical cabinets e.g.) the following recommend settings are already included in the factory default setting (but not active):

OUT

At 3-state output the following settings are default:

Pre-alarm difference	2 °C
No alarm level	8 V
Pre-alarm level	5 V
Alarm level	0 V
Service voltage	10 V

IN/OUT

At Alarm output (open collector) the following settings are default:

Mode	Normally closed
Temp code output	Activated (for values above alarm level)
Range settings	0 °C = 0 %/ 100 °C = 100 %

Vcc adjust

If activated the following settings are default:

Output voltage range	0 - 10 V
Difference mode	Activated

Alarm level	Alarm value (IN/ OUT pin)	Vcc
1	40 °C	11 V
2	45 °C	12 V
3	50 °C	13 V
4	55 °C	14 V
5	60 °C	15 V
6	65 °C	16 V
7	70 °C	17 V
8	75 °C	18 V
9	80 °C	19 V
10	85 °C	20 V

A 3 Emissivity Table Metals

Please note that these are only approximate values, which were taken from various sources.

Material		Typical Emissivity			
Spectral response		1.0 µm	1.6 µm	5.1 µm	8 - 14 µm
Aluminum	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

Material		**Typical Emissivity**			
Spectral response		1.0 µm	1.6 µm	5.1 µm	8 - 14 µm
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
	Forget, 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
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

Material		**Typical Emissivity**			
Spectral response		1.0 µm	1.6 µm	5.1 µm	8 - 14 µm
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	0.9 - 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

A 4 Emissivity Table Non Metals

i Please note that these are only approximate values which were taken from various sources.

Material		**Typical Emissivity**			
Spectral response		1.0 µm	2.3 µm	5.1 µm	8 - 14 µm
Asbest		0.9	0.8	0.9	0.95
Aphalt				0.95	0.95
Basalt				0.7	0.7
Carbon	Non oxidized		0.8 - 0.9	0.8 - 0.9	0.8 - 0.9
	Graphite		0.8 - 0.9	0.7 - 0.9	0.7 - 0.9
Carborundum		0.4	0.8 - 0.95	0.8 - 0.95	0.95
Cement		0.65	0.9	0.9	0.95
Ceramic		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 alcaline				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

Material	**Typical Emissivity**			
Spectral response	1.0 μm	2.3 μm	5.1 μm	8 - 14 μm
Sand			0.9	0.95
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

A 5 Smart Averaging

The average function is generally used to smoothen the output signal. With the adjustable parameter time this function can be optimal adjusted to the respective application. One disadvantage of the average function is that fast temperature peaks which are caused by dynamic events are subjected to the same averaging time. Therefore those peaks can only be seen with a delay on the signal output.

The function Smart Averaging eliminates this disadvantage by passing those fast events without averaging directly through to the signal output.

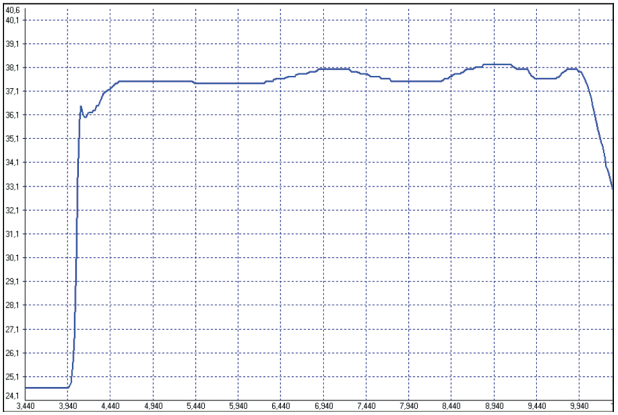


Fig. 20 Signal graph with Smart Averaging function

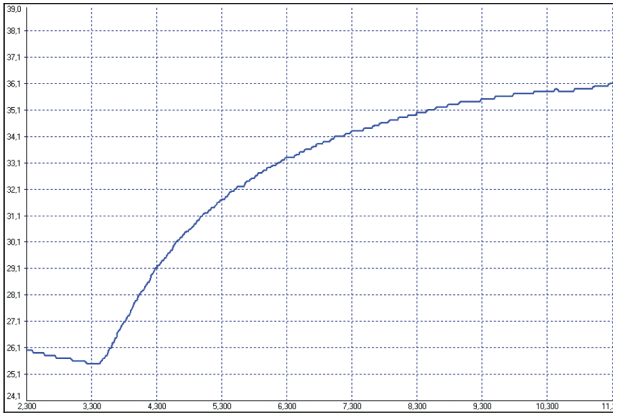
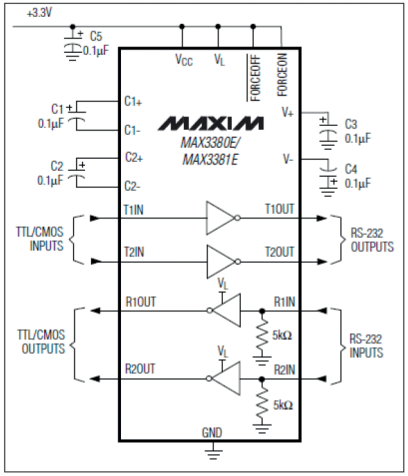


Fig. 21 Signal graph without Smart Averaging function

A 6 Direct Connection to an RS232 Interface



CSmi connections: TxD (yellow) to T1IN
RxD (green) to R1OUT
GND (brown) to GND

PC connections: connect T1OUT with RxD (PC)
connect R1IN with TxD (PC)

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