optris
infrared measurements

Operator's Manual

optris® CS

Infrared thermometer

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1 General notes

1.1 Intended use

Thank you for choosing the **optris® CS** infrared thermometer.

The sensors of the optris CS series are non-contact infrared temperature sensors. They calculate the surface temperature based on the emitted infrared energy of objects **[►7 Basics of Infrared Thermometry]**

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

- Avoid abrupt changes of the ambient temperature.
- Avoid mechanical violence on the head – this may destroy the system (expiry of warranty).
- If you have any problems or questions, please contact our service department.

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.

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

1.2   Warranty

Each single product passes through a quality process. Nevertheless, if failures occur 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 or in case of a non-intended use of the product.

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.

1.3   Scope of delivery

- CS incl. connection cable
- Two mounting nuts
- Quick start guide

1.4   Maintenance

Blow off loose particles using clean compressed air. The lens surface can be cleaned with a soft, humid tissue (moistened with water) or a lens cleaner (e.g. Purosol or B+W Lens Cleaner).

> **❗** Never use cleaning compounds which contain solvents (neither for the lens nor for the housing).

2 Technical Data

2.1 Default settings

ℹ **Smart Averaging** means a dynamic average adaptation at high signal edges. [Activation via software only]. **[►Appendix D** – **Smart Averaging]**

ℹ The default settings can be changed with the optional IR App Connector (USB adapter cable & software). If the unit is supplied together with the IR App Connector cable the output is already preset to digital communication (bidirectional).

At time of delivery the unit has the following pre-settings:

Emissivity	0.950
Transmission	1.000
Average time	0.3 s
Smart averaging	active
Smart averaging hysteresis	2 °C
Ambient temperature source	internal (head)
Status-LED function	Self-diagnostic

Input (IN/ OUT/ green)	inactive
Output (OUT/ yellow)	mV output
Temperature range	0...350 °C
Output voltage	0...3.5 V
Thermocouple output	Inactive
Vcc adjust	inactive
Signal processing	Hold mode: off
Calibration	Gain 1.000/ Offset 0.0
Failsafe	Inactive

For a usage of the CS 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

2.2   General specifications

Environmental rating	IP63
Ambient temperature	-20...80 °C
Storage temperature	-40...85 °C
Relative humidity	10...95 %, non-condensing
Material	Stainless steel
Dimensions	85 mm, M12x1
Weight	58 g
Cable length	1 m (Standard), 3 m, 8 m, 15 m
Cable diameter	4.3 mm
Vibration	IEC 60068-2-6 (sinus shape), IEC 60068-2-64 (broad band noise)
Shock	IEC 60068-2-27 (25G and 50G)

2.3   Electrical specifications

Used Pin		Function	
OUT	IN/ OUT		
x		Analog	0-5 V [1] or 0-10 V [2]/ scalable
x		Alarm	output voltage adjustable; N/O or N/C
x		Alarm	3-state alarm output (three voltage level for no alarm, pre-alarm, alarm)
	x	Analog	programmable open collector output (NPN type) [0-30 V DC/ 50 mA] [4]
	x	Temp. Code	Temp. Code Output (open collector (NPN type)) [0-30 V DC/ 50 mA] [4]
	x	Input	programmable functions: • external emissivity adjustment • ambient temperature compensation • triggered signal output and peak hold function [5]
x	x	Serial digital [3]	uni- (burst mode) or bidirectional
OUT t/c K		Analog	Thermocouple output type K; alternatively selectable to the mV output (software necessary)
Status LED		green LED with programmable functions: • alarm indication (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 supply voltage/ Service mode for analog output
Output impedances	min. 10 kΩ load impedance
Current draw	10 mA
Power supply	5...30 VDC [6]

[1] *0...4.6 V at supply voltage 5 VDC; also valid for alarm output*
[2] *only at supply voltage ≥ 11 V*
[3] *inverted RS232, TTL, 9.6 kBaud*
[4] *loadable up to 500 mA if the mV output is not used*
[5] *High level: > 0.8 V/ Low level: < 0.8 V*
[6] *The CS sensor may only be powered either via USB or externally, but not simultaneously!*
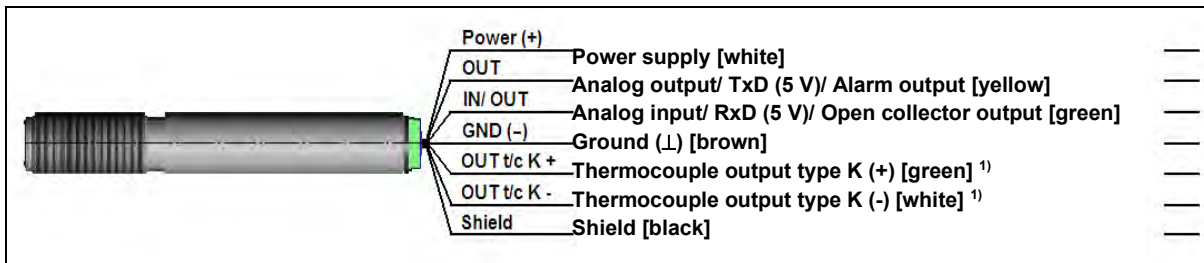
[1] *The t/c wires are indicated with an additional cable marker to avoid wrong connections due to the identical cable colors of other wires (white, green).*

2.4   Measurement specifications

Temperature range	-50...1030 °C (scalable via Software)
Spectral range	8...14 µm
Optical resolution	15:1
CF-lens (optional)	0.8 mm@ 10 mm
Accuracy [1] [2]	±1.5 °C or ±1.5 % of reading (whichever is greater)
Repeatability [1]	±0.75 °C or ±0.75 % of reading (whichever is greater)
Temperature coefficient [3]	±0.05 K/ K or ±0.05 %/ K (whichever is greater)
Temperature resolution (NETD) [4]	50 mK
Response time	14 ms (90 % Signal/ adjustable to 999 s via Software)
Warm-up time	10 min
Emissivity/ Gain	0,100...1,100 (adjustable via 0-10 VDC input or software)
Transmissivity	0,100...1,000 (adjustable via software)
Interface (optional)	USB programming interface
Signal processing	Average, Peak hold, Valley hold, Advanced peak hold with threshold and hysteresis, Triggered signal output, Triggered peak hold function (adjustable via software)

Software / App	optional (CompactConnect / IRmobile)

[1] *at ambient temperature 23±5 °C and object temperatures >0 °C*
[2] *Accuracy for thermocouple output: ±2.5°C or ±1%*
[3] *for ambient temperatures <18 °C and >28 °C*
[4] *at time constant of 200 ms and an object temperature of 200 °C*

2.5   Optical charts

> (i)
> - 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.

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.

As an alternative to the optical diagrams, the spot size calculator can also be used on the Optris website (https://www.optris.global/spot-size-calculator) or via the Optris calculator app. The app can be downloaded for free from the Google Play store (see QR code).

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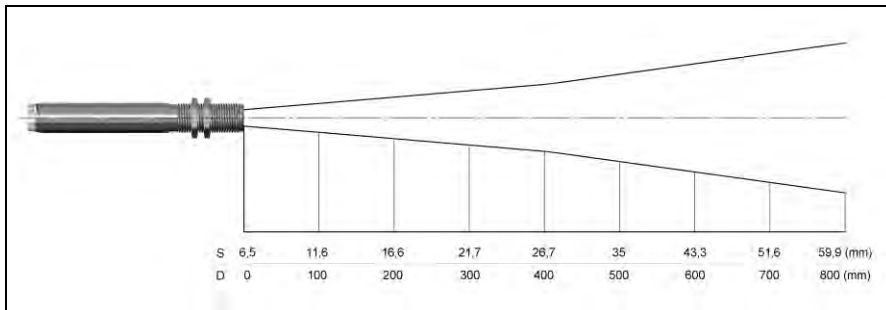
S = Spot size

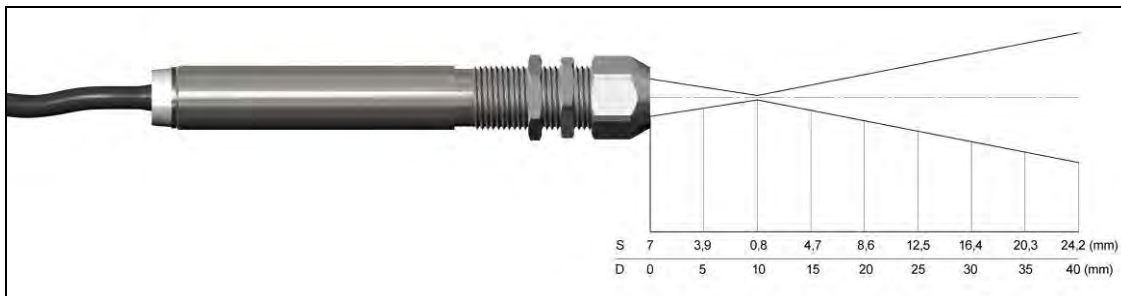**Figure 1:** Optical chart CS (15:1)

Figure 2: Optical chart CS (15:1) with CF-lens (0.8 mm@ 10 mm)

2.6 Close focus optics

ⓘ
- If the CF-lens is used, the transmission has to be set to **0.78**. To change this value the optional USB-Kit (including software) is necessary.
- The assigned transmission (average value) is a characteristic value which may has a certain scattering. If required the transmission has to be determined.

The optional CF-lens allows the measurement of small objects. The CF optics can also be combined with a laminar air purge

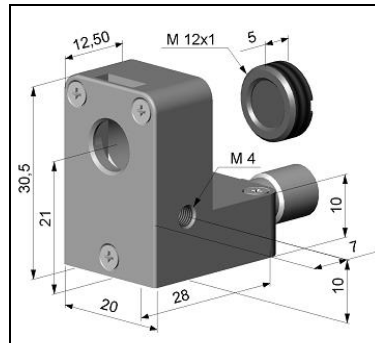**Figure 3:** CF-lens [**Order-No.: ACCTCF**]

Figure 4: Laminar air purge with integrated CF-lens [**Order-No.: ACCTAPLCF**]

2.7   LED-Functions

The green LED can be programmed for the following functions. For the programming the **USB adapter cable incl. 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 CS 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

2.7.1   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.

2.7.2 Self-diagnostic

> (i) At a supply voltage (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.

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	———————————

Figure 5: Sensor status

Sensor overheated	The internal temperature probes have detected an invalid high internal temperature of the CS.
Out of meas. range	The object temperature is out of measuring range.
Not stable	The internal temperature probes have detected an unequally internal temperature of the CS.
Alarm fault	Current through the switching transistor of the open-collector output is too high.

2.7.3   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 $\rightarrow$ 0-100 % the LED flashing indicates the temperature in °C.

Long flashing $\rightarrow$ first digit:	**x**x
Short flashing $\rightarrow$ second digit:	x**x**
10-times long flashing $\rightarrow$ first digit=0:	**0**x
10-times short flashing $\rightarrow$ 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 indicates	**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 indicates	0**8**
20 °C	2-times long flashing indicates	**2**0
and afterwards	10-times short flashing indicates	2**0**

3 Installation

3.1 Mechanical Installation

The CS is equipped with a metric M12x1 thread and can be installed either directly via the sensor thread or with the help of the both hex nuts (standard) to the mounting bracket available.
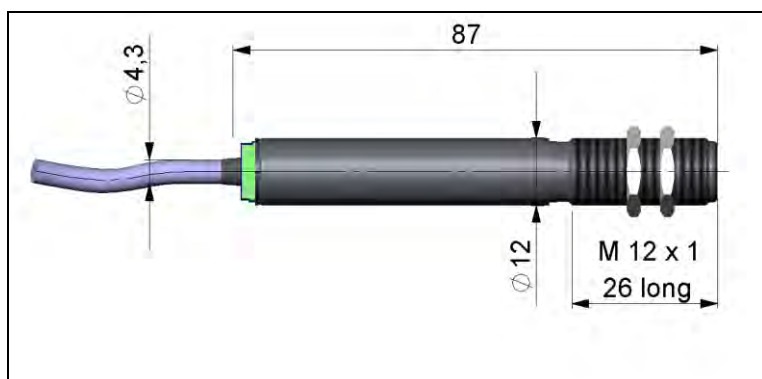

Figure 6: Dimensions CS

For an exact aiming of the sensor to an object the LED function ►**2.7.1 Automatic aiming support** can be used.

3.1.1 Mounting accessories

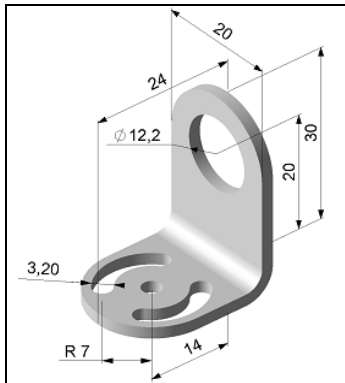> ⓘ The **Mounting fork** can be combined with the **Mounting bracket [Order No.: ACCTFB]** using the M12x1 thread.

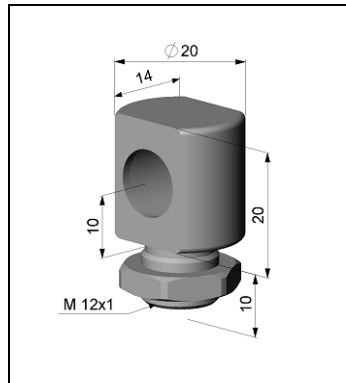**Figure 7:** Mounting bracket, adjustable in one axis [**Order No.: ACCTFB**]

Figure 8: Mounting bolt with M12x1 thread, adjustable in one axis [**Order No.: ACCTMB**]
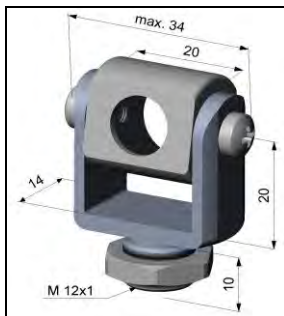
Figure 9: Mounting fork with M12x1 thread, adjustable in 2 axes [**Order No.: ACCTMG**]

Figure 10: Mounting bracket, adjustable in two axes [**Order No.: ACCTAB**]

3.1.2   Air purge collar

> ⓘ
> - Use oil-free, technically clean air only.
> - The needed amount of air (approx. 2...10 l/ min.) depends on the application and the installation conditions on-site.

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**.

Figure 11: Standard air purge collar; fits to the mounting bracket; hose connection: 3x5 mm [**Order No.: ACCSAP**]
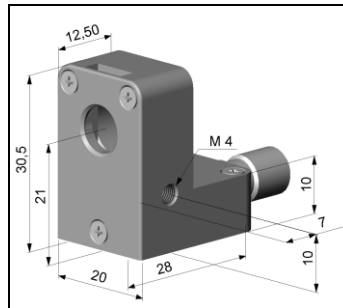

Figure 12: Laminar air purge collar – the side air outlet prevents a cooling down of the object in short distances; hose connection: 3x5 mm [**Order No.: ACCTAPL**]

Figure 13: A combination of the laminar air purge collar with the bottom section of the mounting fork allows an adjustment in two axes. [**Order No.: ACCTAPL+ACCTMG**]

3.1.3   Other accessories

> ℹ️ If the protective window is used, the transmission has to be set to **0.83**. To change this value the optional USB-Kit (including CompactConnect software) is necessary.
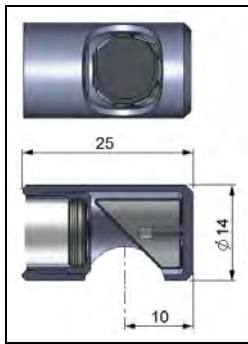

Figure 14: Right angle mirror enables measurement with 90° angle, for sensing heads with optical resolution ≥10:1 [**Order No.: ACCTRAM**]

Figure 15: Protective window same mechanical size as CF lens [**Order No.: ACCTPW**]
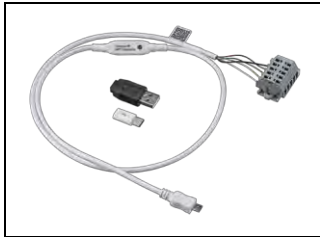
Figure 16: IR App Connector: USB adapter cable incl. terminal block **[Order No.: ACCSMIAC]**

3.1.4 Tilt assembly

With this mounting accessory a fine adjustment of the CS with an off-axis angle +/- 6.5° is possible.
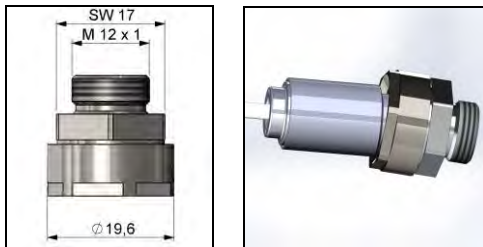

Figure 17: Tilt assembly **[Order No.: ACCTTAS]**

3.2   Electrical Installation

ⓘ   Use a separate, stabilized power supply unit with an output voltage in the range of **5–30 VDC** which can supply **100 mA**. The residual ripple should be max **200 mV**.

Note: The CS sensor may only be powered either via USB or externally, but not simultaneously!

ⓘ
- Use shielded cables only. The sensor shield has to be grounded.
- The shield [black] on the CS is not connected to GND [brown].In any case it is necessary to connect the shield to ground or GND (whichever works best)!
- When using the thermocouple and an external power supply, there must be a connection between ground and shield.

Analog device (mV-output at OUT pin)
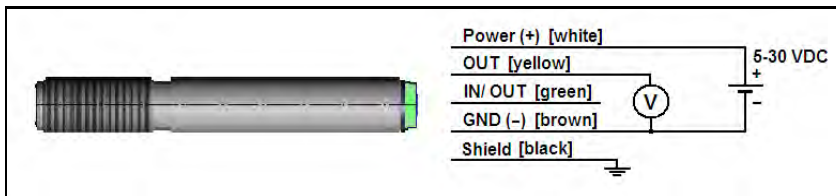
ⓘ   The output impedance must be ≥ 10 kΩ.

Figure 18: Analog device (mV output at OUT pin)

Analog device (Thermocouple typ K at OUT t/c K pins)

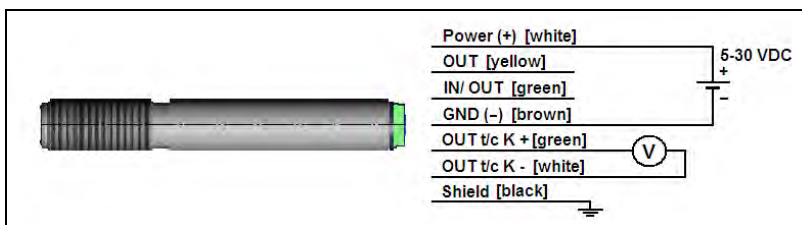> ℹ The output impedance must be ≥ 20 kΩ.

Figure 19: Analog device (Thermocouple typ K at OUT t/c K pins)

You can choose between an mV output (0-5 or 0-10 V; scalable via software) and a thermocouple output type K. Therefor the optional software is needed. The factory default setting is mV output.
►2.1 Default settings

The thermocouple output supplies a voltage according to the t/c characteristic curve type K. If you want to extend this output you have to use a suitable thermocouple extension cable (NiCr-Ni).

3.2.1   Digital communication

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

1. 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 lose a contact.
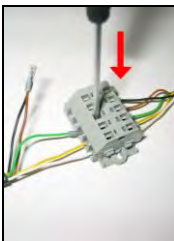
Figure 20: Connection USB cable

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)
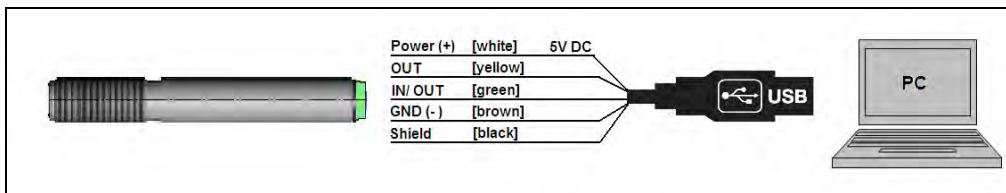
Figure 21: Digital communication

3.2.2 Open collector output

In case of long lines there is a drop voltage at the ground wire and the mV-output is distorted. Because of that the brown wire can be used as ground supply and the t/c- wire (type K) as measuring ground.
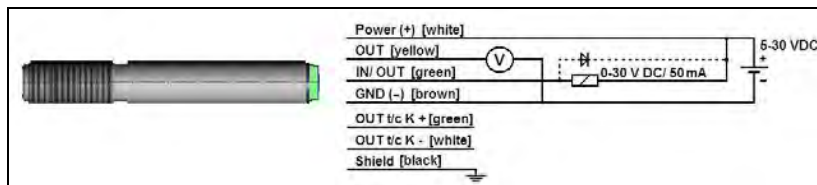
Figure 22: Open collector output as additional alarm output

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

3.2.3   Direct connection to a RS232 on the computer

For a bidirectional RS232 connection of the sensor the following interface circuit can be used: MAX3381E (manufacturer: Maxim) ► **Appendix C** – **Direct connection to a RS232 interface**:

4 Schematic circuit diagrams for maintenance applications

Figure 23: Open collector output for direct 24 V DC signal lamp control
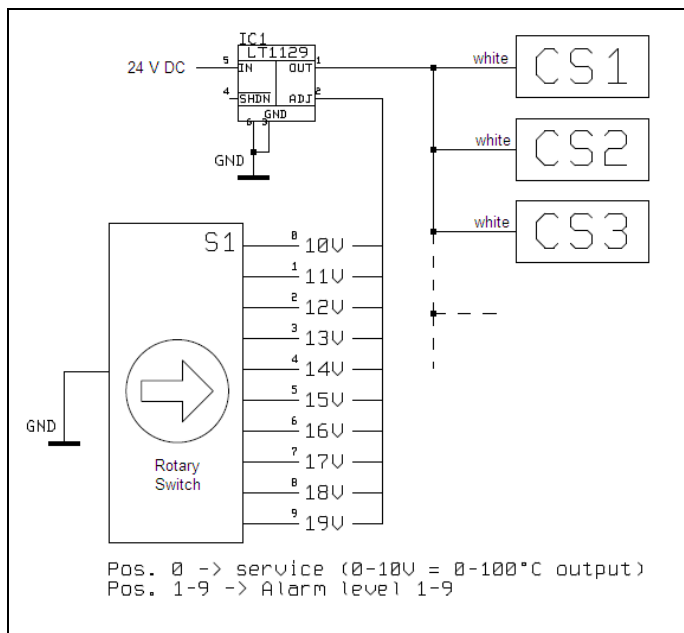
Figure 24: Common power supply voltage change to adjust simultaneously alarm levels and emissivity values [Vcc adjust mode]
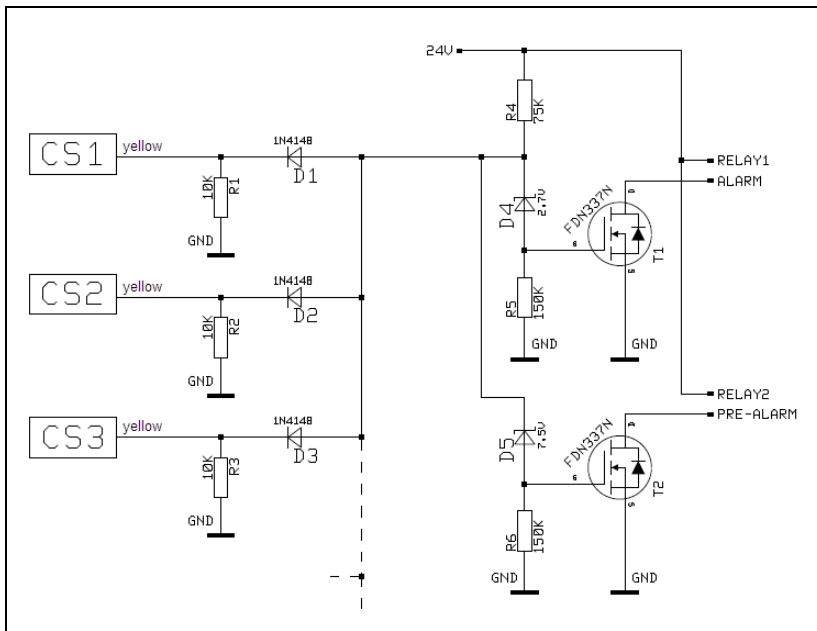
Figure 25: Simple common alarm and pre-alarm generation

5 IRmobile app

The CS sensor has a direct connection to an Android smartphone or tablet. All you have to do is download the IRmobile app for free in the Google Play store. This can also be done via the QR code. An IR app connector is required for connection to the device (**Part-No.: ACCSMIAC**).
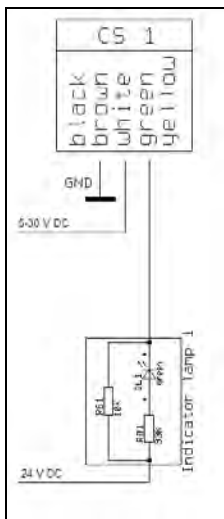

With IRmobile you are able to monitor and analyse your infrared temperature measurement on a connected smartphone or tablet. This app works on most Android devices running 5.0 or higher with a micro USB or USB-C port supporting USB-OTG (On The Go). It is easy to operate: after you plug your CS device to your phone or tablet, the app will start automatically. The device is powered by your phone. Different digital temperature values can be displayed in the temperature time diagram. You can easily zoom-in the diagram to see more details and small signal changes.

IRmobile app features:

- Temperature time diagram with zoom function
- Digital temperature values
- Setup of emissivity, transmissivity and other parameters
- Scaling of the analog output and setting of the alarm output
- Change of temperature unit: Celsius or Fahrenheit
- Saving/loading of configurations and T/t diagrams
- Restore factory default sensor settings
- Integrated simulator
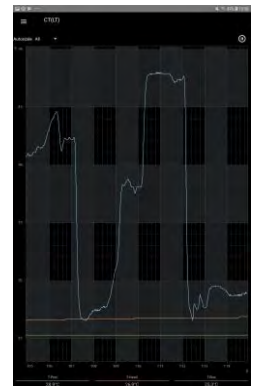
Supported for:

- Optris pyrometers: Compact series, high performance series and video thermometers
- Optris IR cameras: PI and Xi series
- For android devices running 5.0 or higher with a micro USB or USB-C port supporting USB-OTG (On The Go)

6   Software CompactConnect

Minimum system requirements:

- Windows 7, Windows 8, Windows 10
- USB interface
- Hard disc with at least 30 MByte of free space
- At least 128 MByte RAM

- A detailed description is provided in the software manual on the downloaded software package.
- The software only supports USB cables ordered directly from Optris.

6.1   Installation

The software can be downloaded under https://www.optris.global/downloads-software. Unzip and open the program and start the **CDsetup.exe**. 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.
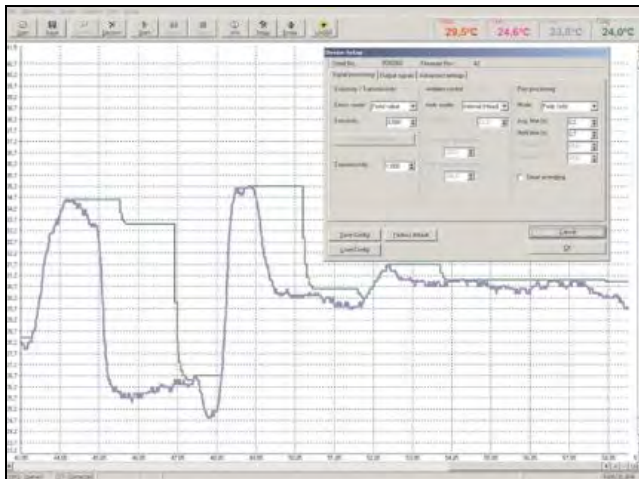
Figure 26: Software CompactConnect

Main functions:

- 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

6.2 Communication settings

> For further information see protocol and command description on the software package CompactConnect in the directory: \Commands.

6.2.1 Serial Interface

Baud rate:	9,6 / 115,2 kBaud (adjustable via software)
Data bits:	8
Parity:	none
Stop bits:	1
Flow control	off

6.2.2 Protocol

All sensors of the CS 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.

7 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 μm 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 which is a known value for most materials (►8 **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.

8   Emissivity

8.1   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.

8.2   Determination of unknown emissivity

► 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 – **Order No.: ACLSED**) onto the measuring object, which covers it completely. Set the emissivity to 0.95 and take the temperature of the sticker. Afterwards, determine the temperature of the adjacent area on the measuring object and adjust the emissivity according to the value of the temperature of the sticker.

► Cove a part of the surface of the measuring object with a black, flat paint with an emissivity of 0.98. Adjust the emissivity of your infrared thermometer to 0.98 and take the temperature of the colored surface. Afterwards, determine the temperature of a directly adjacent area and modify the emissivity until the measured value corresponds to the temperature of the colored surface.

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

8.3   Characteristic emissivity

In case none of the methods mentioned above help to determine the emissivity you may use the emissivity table ► **Appendix A** and **Appendix 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 – Table of emissivity for metals

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

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

Appendix B - Table of emissivity for 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		0,8-0,9	0,8-0,9	0,8-0,9
	graphite		0,8-0,9	0,7-0,9	0,7-0,8
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

Appendix C – Direct connection to a RS232 interface

For a bidirectional RS232 connection of the sensor we recommend the interface circuit from Maxim, e.g. **MAX3381E**.
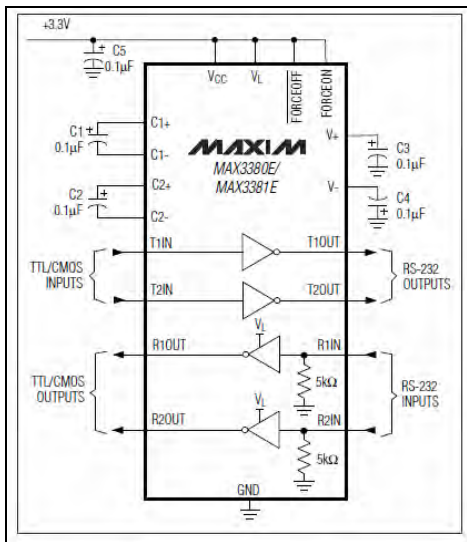
Model	CSv1	CSv2	CSv3
UART voltage (RxD)	5 V	3,3 V	3,3 V
UART voltage (TxD)	5 V	3,3 V	3,3 V

Previous sensor versions:

CSv1   CS/ version 1 ($\rightarrow$ 12/2010)

CS connections: TxD (yellow) an T1IN

                       RxD (green) an R1OUT

                       GND (brown) an GND

PC connections: connect T1OUT with RxD (PC)

   connect R1IN with TxD (PC)

Appendix D – 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.
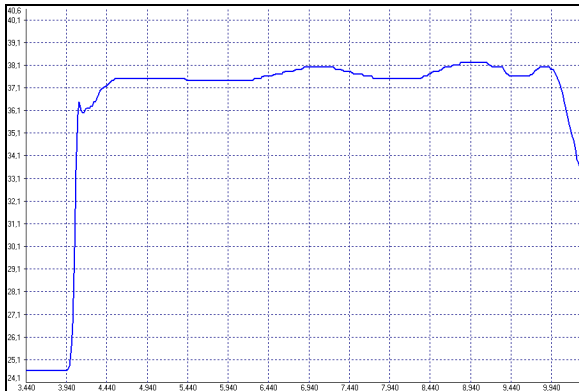
Signal graph with Smart Averaging function
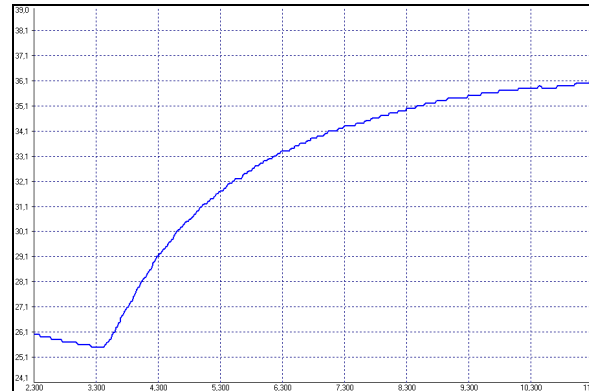
Signal graph without Smart Averaging function

Appendix E – Declaration of Conformity

EG-Konformitätserklärung
EU Declaration of Conformity

Wir / We

Optris GmbH
Ferdinand Buisson Str. 14
13127 Berlin
Deutschland / Germany

erklären in alleiniger Verantwortung, dass
declare on our own responsibility that

die Produktserie optris CS
the product group optris CS

den Anforderungen der EMV-Richtlinie 2014/30/EU und der allgemeinen Produktsicherheits-richtlinie 2001/95/EG entspricht.
meets the provisions of the EMC Directive 2014/30/EU and the General Product Safety Directive 2001/95/EC.

Angewandte harmonisierte Normen:
Applied harmonized standards:

EMV Anforderungen / EMC General Requirements:
EN 61326-1:2013 (Grundlegende Prüfanforderungen / Basic requirements)
EN 61326-2-3:2013

Gerätesicherheit von Messgeräten / Safety of measurement devices:
EN 61010-1:2010
EN 60825-1:2014 (Lasersicherheit / Laser safety)

Dieses Produkt erfüllt die Vorschriften der Richtlinie 2015/863/EU (RoHS) des Europäischen Parlaments und des Rates vom 4. Juni 2015 zur Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten.
This product is in conformity with Directive 2015/863/EU (RoHS) of the European Parliament and of the Council of 4 June 2015 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Berlin, 03.09.2020

Ort, Datum / place, date

Dr. Ulrich Kienitz
Geschäftsführer / General Manager