Operator's Manual

optris® CSvideo

2M, 3M

Infrared-thermometer

Table of Contents

1 General Information

1.1 Description

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

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

They calculate the surface temperature based on the emitted infrared energy of objects **[►9 Basics of Infrared Thermometry]**. The alignment of the sensor can be done with the integrated video sighting and cross laser aiming.

The sensor housing of the CSvideo head is made of stainless steel (IP65/ NEMA-4 rating).

> The CSvideo 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 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 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 Supply

- CSvideo
- Mounting nut and mounting bracket (fixed)
- 5 m USB cable
- Software CompactConnect (as a download)
- Operators manual

1.4   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 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).

1.5   Model Overview

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

Model	Model code	Measurement range	Spectral response	Typical applications
CSvideo 2M	2ML	250 to 800 °C	1,6 µm	Metals and ceramic surfaces
	2MH	385 to 1600 °C		
CSvideo 3M	3ML	50 to 400 °C	2,3 µm	
	3MH	100 to 600 °C		

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

1.6   Factory Default Settings

The unit has the following pre-setting at time of delivery:

Signal output object temperature	4-20 mA			
Emissivity	1,000			
Transmissivity	1,000			
Average time (AVG)	0,1 s			
Smart Averaging	active			
Peak hold	inactive			
Valley hold	Inactive			
	2ML	**2MH**	**3ML**	**3MH**
Lower limit temperature range [°C]	250	385	50	100
Upper limit temperature range [°C]	800	1600	400	600
Lower limit signal output	4 mA			
Upper limit signal output	20 mA			
Temperature unit	°C			
Ambient temperature compensation	internal head temperature probe			
Laser	active			

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

2   Technical Data

2.1   General Specifications

Environmental rating	IP65 (NEMA-4)
Ambient temperature [1]	-20…70 °C
Storage temperature	-40...85 °C
Relative humidity	10...95 %, non-condensing
Material	stainless steel
Dimensions	118,5 mm x 50 mm, M48x1,5
Weight	600 g
Cable length (analog+alarm)	3 m, 8 m, 15 m
Cable length (USB)	5 m (incl.), 10 m, 20 m
Cable diameter	5 mm
Ambient temperature cable	80 °C max. [High temperature cable (optional): 180 °C]
Vibration	IEC 68-2-6: 3G, 11 – 200 Hz, any axis
Shock	IEC 68-2-27: 50G, 11 ms, any axis
Software / App (optional)	CompactConnect / IRmobile

[1] The lasers will turn off automatically at ambient temperatures >50 °C.

2.2   Electrical Specifications

Power Supply	5–30 VDC
Current draw (laser)	45 mA @ 5 V 20 mA @ 12 V 12 mA @ 24 V
Aiming laser	Crosshair laser, 635 nm, 1 mW, On/ Off via external switch (needs to be installed by user before start-up) or software
Video sighting	Digital (USB 2.0), 640 x 480 px, FOV 3.1° x 2.4°
Output/ analog	4–20 mA current loop
Alarm output	Programmable open collector output at RxD pin [0-30 V/ 500 mA]
Output impedance	max. loop resistance 1000 Ω (in dependence on supply voltage)
Output/ digital	USB 2.0

2.3   Measurement Specifications

	2ML	2MH
Temperature range (scalable)	250...800 °C	385...1600 °C
Spectral range	1,6 µm	
Optical resolution	150:1	300:1
System accuracy [1), 2)]	±(0,3 % of reading +2 °C)	
Repeatability [1), 2)]	±(0,1 % of reading +1 °C)	
Temperature resolution	0,1 K	
Response time (90% signal)	10 ms	
Emissivity/ Gain	0,100…1,100 (adjustable via switches on sensor or via software)	
IR window correction	0,100…1,000 (adjustable via software)	
Signal processing	Average, peak hold, valley hold, extended hold functions with threshold and hysteresis (adjustable via software)	

[1)] at ambient temperature 23±5 °C
[2)] ε = 1/ Response time 1 s

	3ML	3MH
Temperature range (scalable) [1]	50...400 °C	100...600 °C
Spectral range	2,3 µm	
Optical resolution	60:1	100:1
System accuracy [2], [3]	±(0,3 % of reading +2 °C)	
Repeatability [2], [3]	±(0,1 % of reading +1 °C)	
Temperature resolution	0,1 K	
Response time (90% signal) [4]	20 ms	
Emissivity/ Gain	0,100…1,100 (adjustable via switches on sensor or via software)	
IR window correction	0,100…1,000 (adjustable via software)	
Signal processing	Average, peak hold, valley hold, extended hold functions with threshold and hysteresis (adjustable via software)	

[1] $T_{Object} > T_{Sensor\ head} + 25$ °C
[2] at ambient temperature 23±5 °C
[3] ε = 1/ response time 1 s
[4] with dynamic adaption at low signal levels

2.4   Optics

The vario optics of the CSvideo allows a smooth focusing of the optics to the desired distance. The sensors are available in two optic versions:

Optics	Focus adjustable in the range
SFV	200 mm till infinity
CFV	90 mm till 250 mm

ⓘ 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 tables show the diameter of the measuring spot for some selected distances. 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 the Optris calculator app. The app can be downloaded for free from the Google Play store (see QR code).
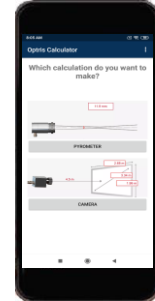
D = Distance from front of the sensing head to the object
S = Spot size

2ML SF optics (D:S=150:1)									
Spot size	mm	1,3	2,0	3,0	4,7	7,3	10,7	16,7	33,3
Measurement distance	mm	200	300	450	700	1100	1600	2500	5000

2ML CF optics (D:S=150:1)							
Spot size	mm	0,6	0,8	1,0	1,2	1,4	1,7
Measurement distance	mm	90	120	150	180	210	250

2MH SF optics (D:S=300:1)									
Spot size	mm	0,7	1,0	1,5	2,3	3,7	5,3	8,3	16,7
Measurement distance	mm	200	300	450	700	1100	1600	2500	5000

2MH CF optics (D:S=300:1)							
Spot size	mm	0,3	0,4	0,5	0,6	0,7	0,8
Measurement distance	mm	90	120	150	180	210	250

3ML SF optics (D:S=60:1)

Spot size	mm	3,3	5,0	7,5	11,7	18,3	26,7	41,7	83,3
Measurement distance	mm	200	300	450	700	1100	1600	2500	5000

3ML CF optics (D:S=60:1)

Spot size	mm	1,5	2,0	2,5	3,0	3,5	4,2
Measurement distance	mm	90	120	150	180	210	250

3MH SF optics (D:S=100:1)

Spot size	mm	2,0	3,0	4,5	7,0	11,0	16,0	25,0	50,0
Measurement distance	mm	200	300	450	700	1100	1600	2500	5000

3MH CF optics (D:S=100:1)

Spot size	mm	0,9	1,2	1,5	1,8	2,1	2,5
Measurement distance	mm	90	120	150	180	210	250

3   Mechanical Installation

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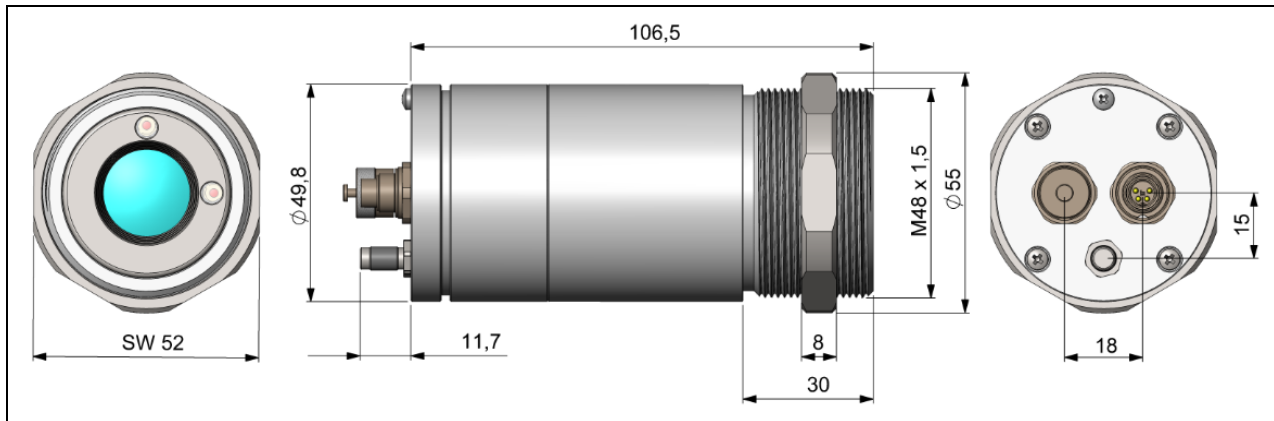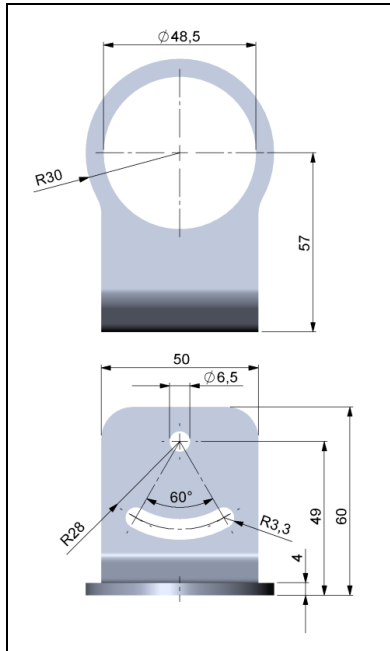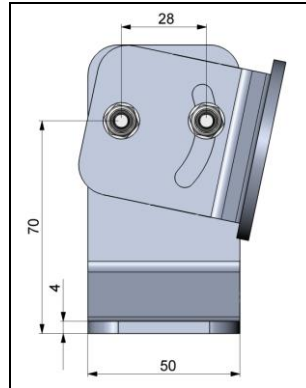

CSvideo sensing head

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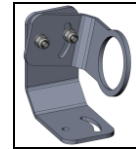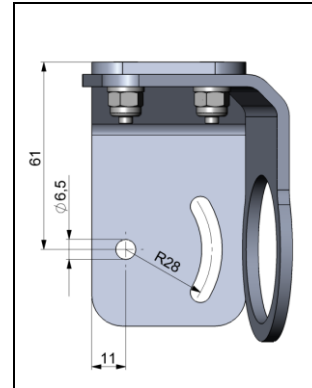
4   Accessories

4.1   Mounting Brackets

Mounting bracket, adjustable in one axis [ACCTLFB]


Mounting bracket, adjustable in two axes [ACCTLAB]

For an exact sensor alignment to the object please activate the integrated video and/ or cross laser sighting.

[►6 Sighting]

4.2 Air Purge Collar

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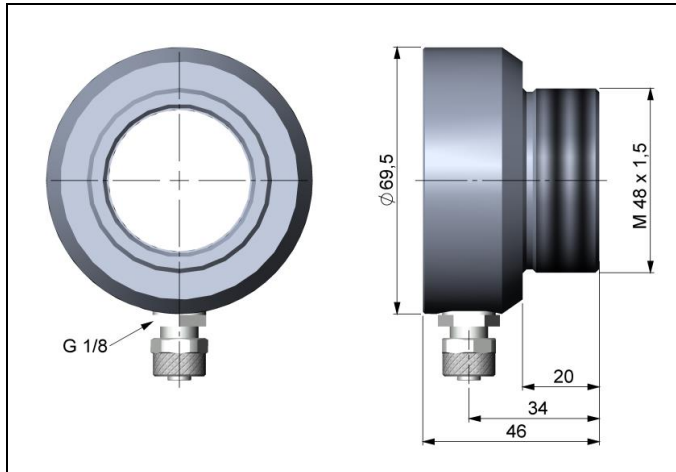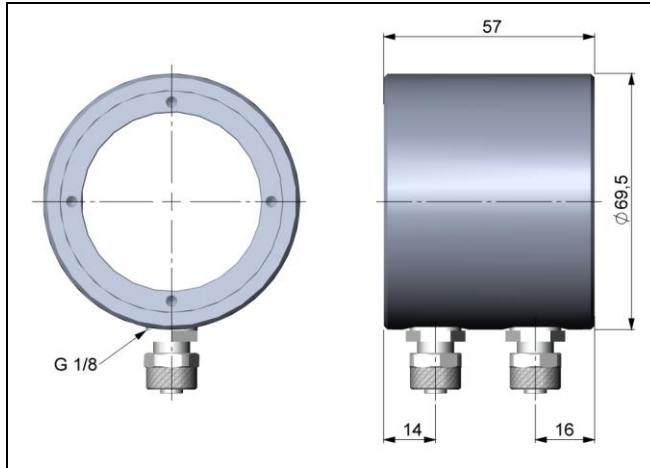

The needed amount of air (approx. 2...10 l/min.) depends on the application and the installation conditions on-site.
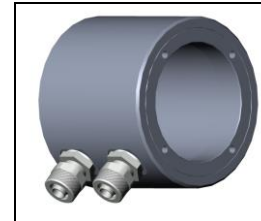

Air purge collar [ACCTLAP]
Hose connection: 6x8 mm
Thread (fitting): G 1/8 inch

4.3   Water Cooled Housing

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

Water flow rate: approx. 2 l/ min
(Cooling water temperature should not exceed 30 °C)

Water cooled housing [ACCTLW]
Hose connection: 6x8 mm
Thread (fitting): G 1/8 inch

The CSvideo can be used at ambient temperatures up to 70 °C without cooling. For applications, where the ambient temperature can reach higher values, the usage of the optional water cooled housing is recommended (operating temperature up to 175 °C). The sensor should be equipped with the optional high temperature cables (operating temperature up to 180 °C).

5   Electrical Installation

5.1   Cable Connections

The CSvideo has two connector plugs integrated in the sensor backplane. Therefore, an opening of the sensor for cable assembling is not necessary. For connection to a PC you can use the supplied 5 m USB cable with a 4-pin sensor connector (lengths of 10 m and 20 m are optional available).

For the analog connection (4-20 mA current loop, alarm, laser) a cable with a 7-pin plug is needed. **This cable is not included in the scope of supply and has to be ordered separately.**
Lengths of 3, 8 and 15 m are available.
Please use the original ready-made, fitting connection cables.
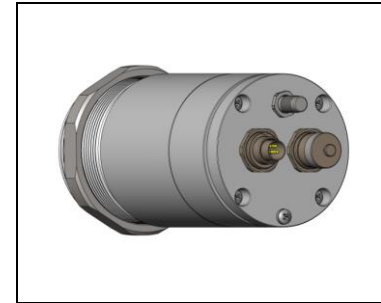
5.2   Power supply

Please use a separate, stabilized power supply unit with an output voltage of **5–30 VDC** which can supply **100 mA.** The ripple should be max. **200 mV**.
Please use shielded cables only for all power and data lines.
The sensor shield has to be grounded.

Pin assignment of 7-pin connector (current loop/ alarm/ laser)

PIN	Designation	Wire color (original sensor cable)
1	–	yellow
2	LOOP –	brown
3	LOOP +	white
4	Alarm	green
5	LASER –	grey
6	LASER +	pink
7	–	
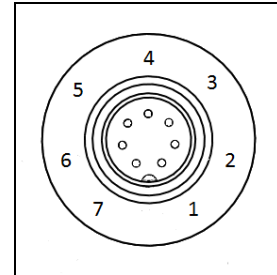
Pin assignment of 4-pin connector (USB)

PIN	Designation
1	VCC
2	GND
3	D-
4	D+
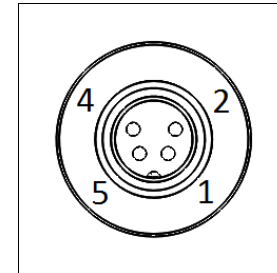
5.3   Analog Mode
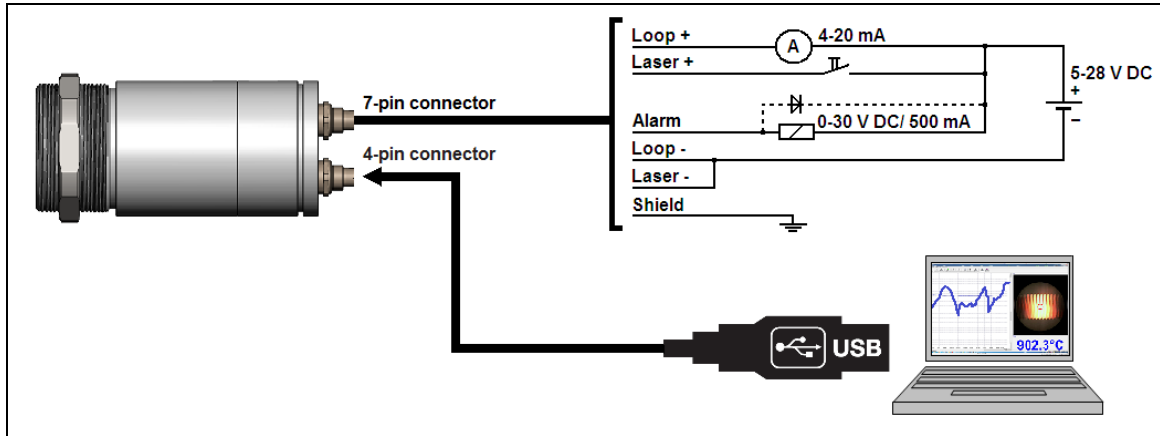
If the CSvideo is used as analog device the sensor provides beside the 4-20 mA signal in addition an alarm output (open-collector). To activate the alarm output and set the alarm threshold value the software is needed.

The supply line for the sighting laser must be led via a switch or pushbutton, which has to be installed max. 2 m away from installation site of the sensor.

With a laptop or tablet PC, the sensor parameterization and alignment can be carried out on site. The USB cable can be plugged into the sensor during operation (hot plug & play).

5.4   Digital Mode

In the digital mode the sensor and the laser will be powered via the 5 V from USB interface. The activation/ deactivation of the laser has to be made via the software.

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)

5.5   Maximum Loop Impedance

The maximum impedance of the current loop depends on the supply voltage level:
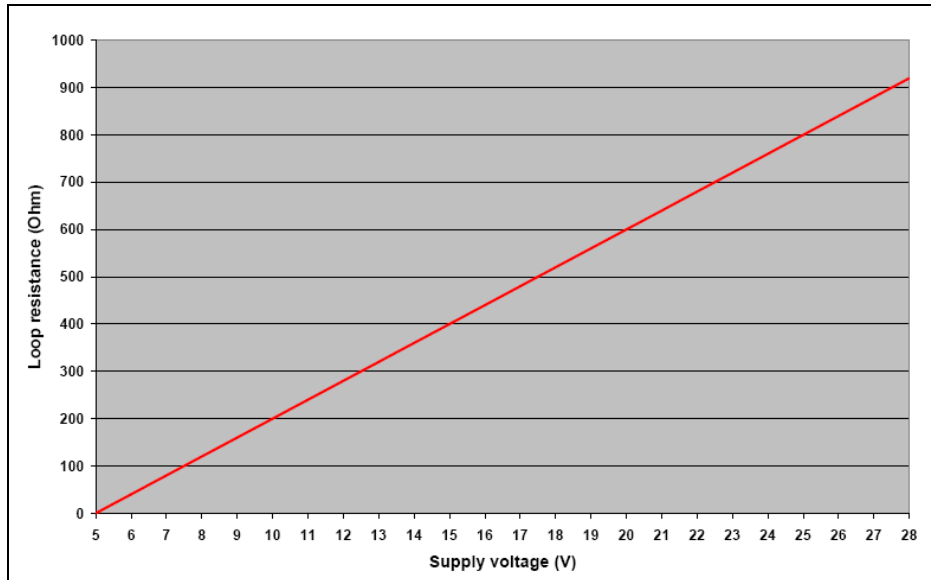
6   Sighting

The CSvideo has an integrated video camera which is using the same optical channel than the IR detector. In addition, the sensor has a cross laser aiming which marks the center of the measurement spot at any distance. The combination of video and laser sighting enables a perfect alignment of the sensor to the object.

LASER LIGHT
DO NOT STARE INTO BEAM
CLASS 2 LASER

< 1 mW / 500 - 650 nm
EN 60825 1: 2014

COMPLIES WITH 21 CFR 1040.10 AND
1040.11 EXCEPT FOR CONFORMANCE
WITH IEC 60825-1 ED. 3., AS
DESCRIBED IN LASER NOTICE NO. 56,
DATED MAY 8, 2019.

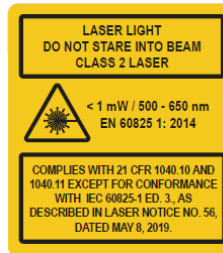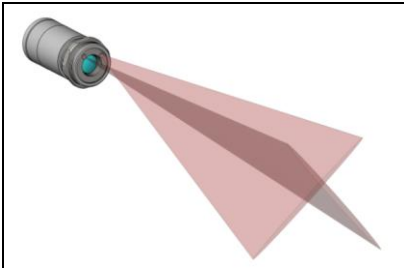**WARNING: Do not point the laser directly at the eyes of persons or animals!**
Do not stare into the laser beam. Avoid indirect exposure via reflective surfaces!

The supply line for the sighting laser must be led via a switch or pushbutton, which has to be installed max. 2 m away from installation site of the sensor.

The laser can be activated/ deactivated via this switch (which needs to be installed by the user) or via the software.
At ambient temperatures >50 °C the laser will be switched off automatically.

The laser should only be used for sighting and positioning of the sensor. A permanent use of the laser can reduce the lifetime of the laser diodes and also the measurement accuracy can be affected.

6.1   Focusing and Video Sighting

On the back plane of the sensor you will find a rotary button for focusing of the optics.
To set the focus to the desired measurement distance you have to connect the sensor with a PC using the USB cable. Please start the CompactConnect software. You will see the video beside the temperature-time diagram. The position of the measurement spot is indicated by a circle inside the video picture. The size of this circle is equivalent to the IR spot size.
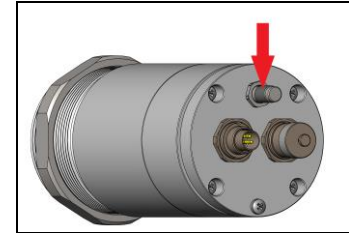
By turning the rotary button *clockwise* you will change the focus in direction *far*. By turning *counterclockwise* you will change the focus in direction *close*.

After a successful focusing please enter the measurement distance (distance sensor front – object) in the according field in the software (underneath the video picture).

You will find a detailed description of the video settings in the software description which you can call via the menu **[?/ Help...]**.
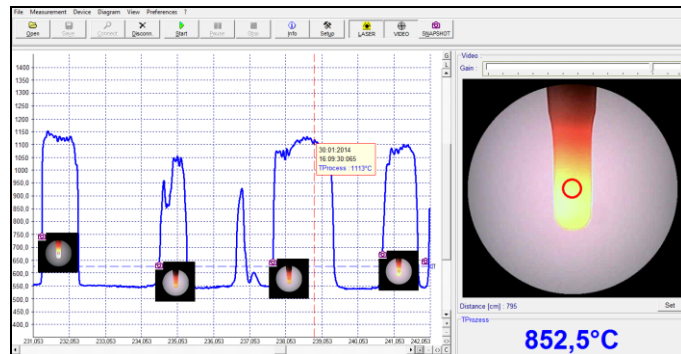
7   IRmobile app

The CSvideo 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 IRmobile app connector is recommended for connection to the device (**Part-No.: ACPIIAC**).

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 CSvideo 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
> ➢ Aligning the sensor via live video with integrated simultaneous temperature display (CSvideo/CTvideo)
> ➢ 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
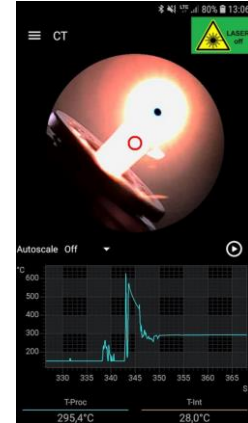
Supported for:

> ➢ 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)

8   Software CompactConnect

8.1   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.

> **Min. system requirements:**
>
> - Windows 7, 8, 10
> - USB interface
> - Hard disc with at least 30 MByte free space
> - At least 128 MByte RAM

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.

ⓘ A detailed description is provided in the software manual on the downloaded software package.
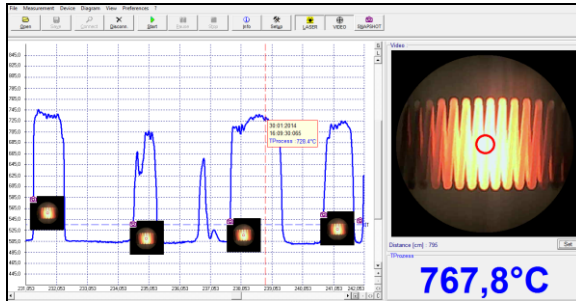
Main Features:

- Alignment of the sensor
- 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

8.2   Communication Settings

Serial Interface

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

Protocol

All sensors of the CSvideo 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 reset.

8.3   Digital Command Set

CSlaser/ CSvideo Commands

Decimal	HEX	Binary/ ASCII	Command	Data	Answer	Result	Unit
1	0x01	binary	READ Temp - Target	no	byte1 byte2	= (byte1 x 256 + byte2 - 1000) / 10	°C
2	0x02	binary	READ Temp - Head	no	byte1 byte2	= (byte1 x 256 + byte2 - 1000) / 10	°C
3	0x03	binary	READ current Temp - Target	no	byte1 byte2	= (byte1 x 256 + byte2 - 1000) / 10	°C
4	0x04	binary	READ Emissivity	no	byte1 byte2	= (byte1 x 256 + byte2) / 1000	
5	0x05	binary	READ Transmission	no	byte1 byte2	= (byte1 x 256 + byte2) / 1000	
9	0x09	binary	READ Processor Temperature	no	byte1	= (byte1 x 256 + byte2 - 1000) / 10	
14	0x0E	binary	READ Serial number	no	byte1 byte2 byte3	= byte1 x 65536 + byte2 x 256 + byte3	
15	0x0F	binary	READ FW Rev.	no	byte1 byte2	= byte1 x 256 + byte2	
16	0x10	binary	READ Laser status	no	byte1	0 = off/ 1 = on	
17	0x11	binary	READ Emissivity switch setting	no		HEX value (e.g. 0x58) = Switch setting (e.g. SW1=5/ SW2=8 -> Eps. = 0,58)	
129	0x81	binary	SET DAC mA	byte1	byte1	byte 1= mA x 10 (z.B. 4mA = 4 x 10=40)	°C
130	0x82	binary	RESET of DAC mA output				
132	0x84	binary	SET Emissivity	byte1 byte2	byte1 byte2	= (byte1 x 256 + byte2) / 1000	
133	0x85	binary	SET Transmission	byte1 byte2	byte1 byte2	= (byte1 x 256 + byte2) / 1000	
144	0x90	binary	SET Laser	byte1	byte1	0 = off/ 1 = on	

Temperature calculation at CSlaser hs: (byte1 x 256 + byte2 - 10000) / 100

EXAMPLES (all bytes in HEX)

Readout of object temperature

Send:	01	Command for readout of object temperature	
Receive:	04 D3	Object temperature in tenth degree + 1000	04 D3 = dec. 1235
			1235 - 1000 = 235
			235 / 10 = **23,5 °C**

Readout of object temperature (at hs version)

Send:	01	Command for readout of object temperature	
Receive:	30 3E	Object temperature in hundredth degree + 10000	30 3E = dec. 12350
			12350 - 10000 = 2350
			2350 / 100 = 23.50 °C

Set of emissivity

Send:	84 03 B6	03B6 = dec. 950
Receive:	03 B6	950 / 1000 = **0,950**

9 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 (►10 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.

10 Emissivity

10.1 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.

10.2 Determination of unknown Emissivities

► First, determine the actual temperature of the measuring object with a thermocouple or contact sensor. Second, measure the temperature with the infrared thermometer and modify the emissivity until the displayed result corresponds to the actual temperature.

► If you monitor temperatures of up to 380 °C you may place a special plastic sticker (emissivity dots – part number: ACLSED) onto the measuring object, which covers it completely. Now set the emissivity to 0,95

and take the temperature of the sticker. Afterwards, determine the temperature of the adjacent area on the measuring object and adjust the emissivity according to the value of the temperature of the sticker.

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

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

10.3 Characteristic Emissivities

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

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

Appendix A – Emissivity Table Metals

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

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

Appendix B – Emissivity Table Non Metals

| Material		typical Emissivity		
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 – 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.
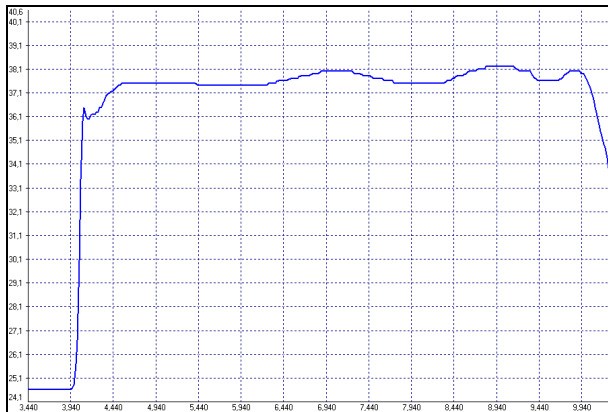
Signal graph with Smart Averaging function
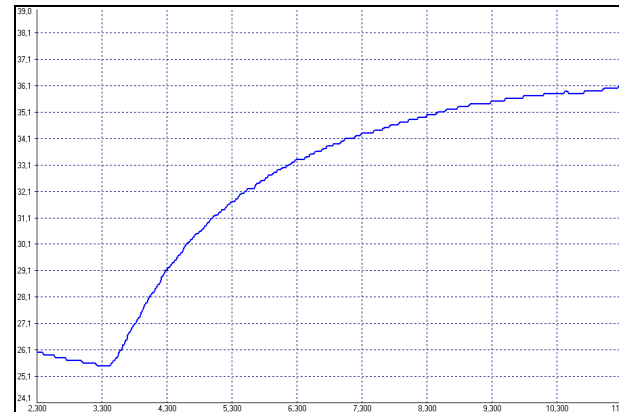
Signal graph without Smart Averaging function

Appendix D – Declaration of Conformity

optris
infrared measurements

EG-Konformitätserklärung
EU Declaration of Conformity

Wir / We

Optris GmbH
Ferdinand Buisson Str. 14
D-13127 Berlin

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

die Produktserie optris CSvideo
the product group optris CSvideo

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, 05.10.2020

Ort, Datum / place, date

Dr. Ulrich Kienitz
Geschäftsführer / General Manager