

Operator's Manual



optris[®] CSvideo

2M

Infrared-thermometer

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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 [**► 8 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
- 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 water based glass 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		

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 presetting 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
Lower limit temperature range [°C]	250	385
Upper limit temperature range [°C]	800	1600
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 (optional)	CompactConnect

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⁾ $\varepsilon = 1$ / Response time 1 s

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 <http://www.optris.com/spot-size-calculator>.

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

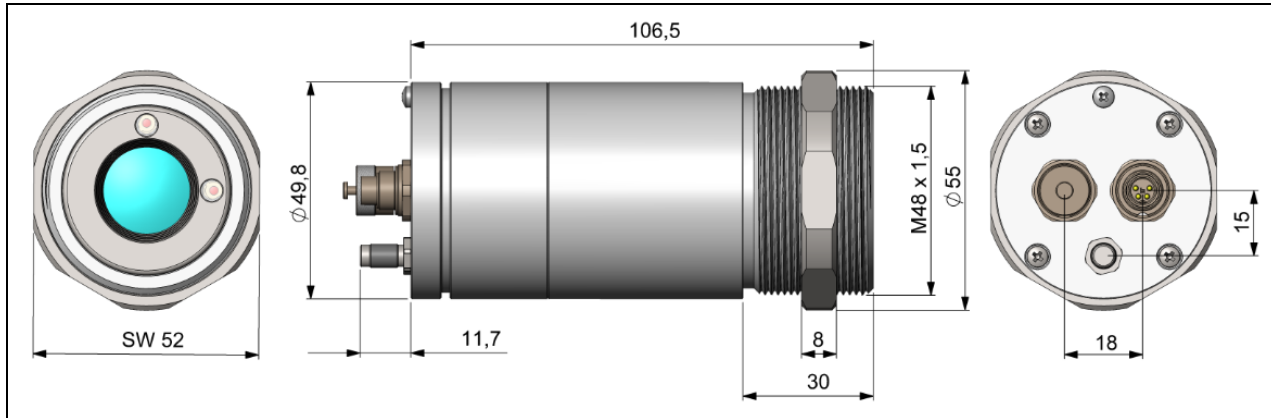
2ML: CF optics (D:S=150:1)							
spot size	mm	0,6	0,8	1,0	1,2	1,4	1,7
measurement distance	mm	90	120	150	180	210	250

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

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.



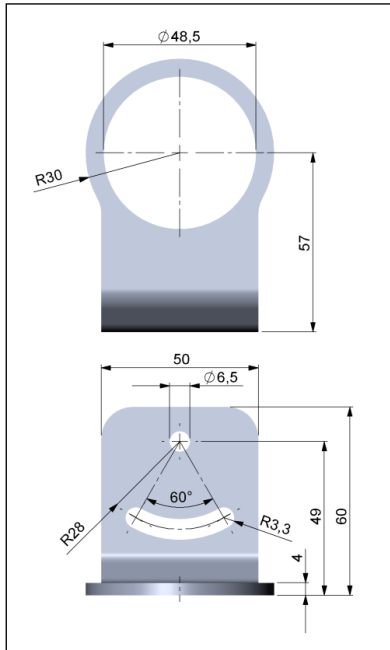
CSvideo sensing head



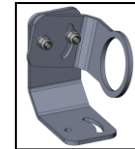
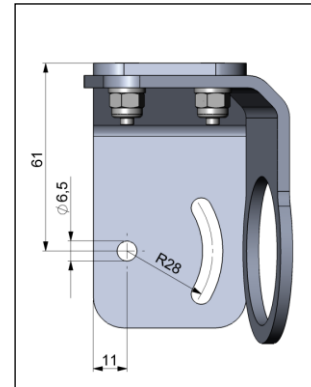
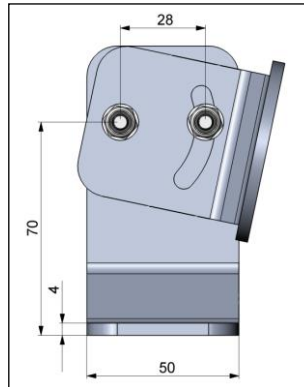
Make sure to keep the optical path clear of any obstacles.

4 Accessories

4.1 Mounting Brackets



Mounting bracket, adjustable in one axis [ACCTLFB]



Mounting bracket, adjustable in two axes [ACCTLAB]

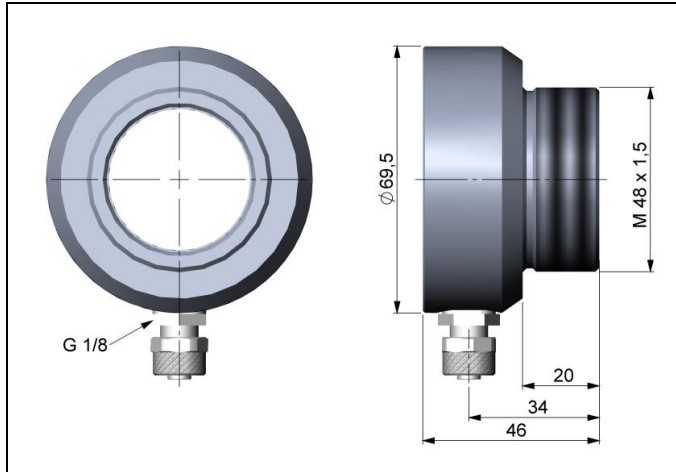


For an exact sensor alignment to the object please activate the integrated video and/ or cross laser sighting.

[▶ 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.

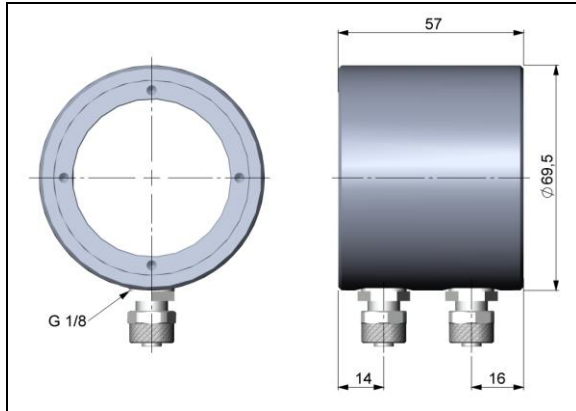


Air purge collar [ACCTLAP]

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

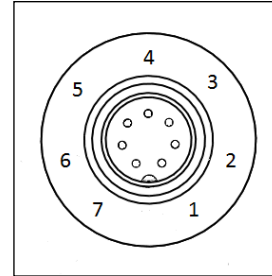
Please use a separate, stabilized power supply unit with an output voltage of **5–30 VDC** which can supply **100 mA**. The ripple should be max. **200 mV**.

Please use shielded cables only for all power and data lines.

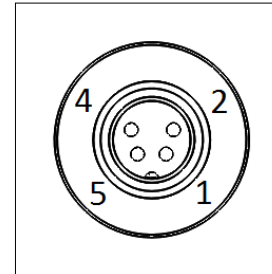
The sensor shield has to be grounded.

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

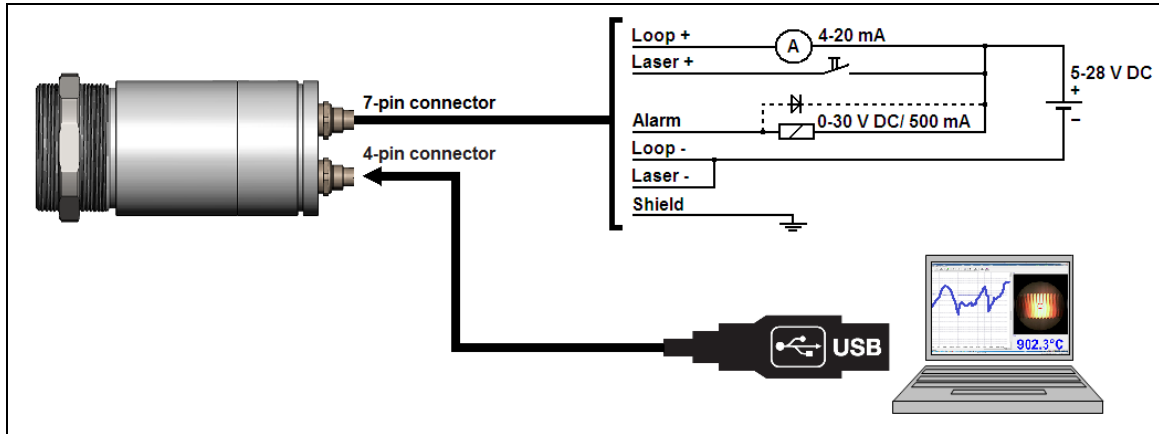
<u>PIN</u>	<u>designation</u>	<u>wire color (original sensor cable)</u>
1	–	yellow
2	LOOP –	brown
3	LOOP +	white
4	Alarm	green
5	LASER –	grey
6	LASER +	pink
7	–	

**Pin assignment of 4-pin connector (USB)**

<u>PIN</u>	<u>designation</u>
1	VCC
2	GND
3	D-
4	D+



5.3 Analog Mode

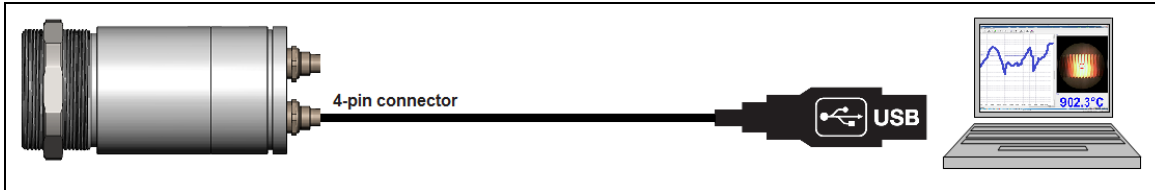


If the CSvideo is used as analog device the sensor provides beside the 4-20 mA signal in addition an alarm output (open-collector). To activate the alarm output and set the alarm threshold value the software is needed.

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



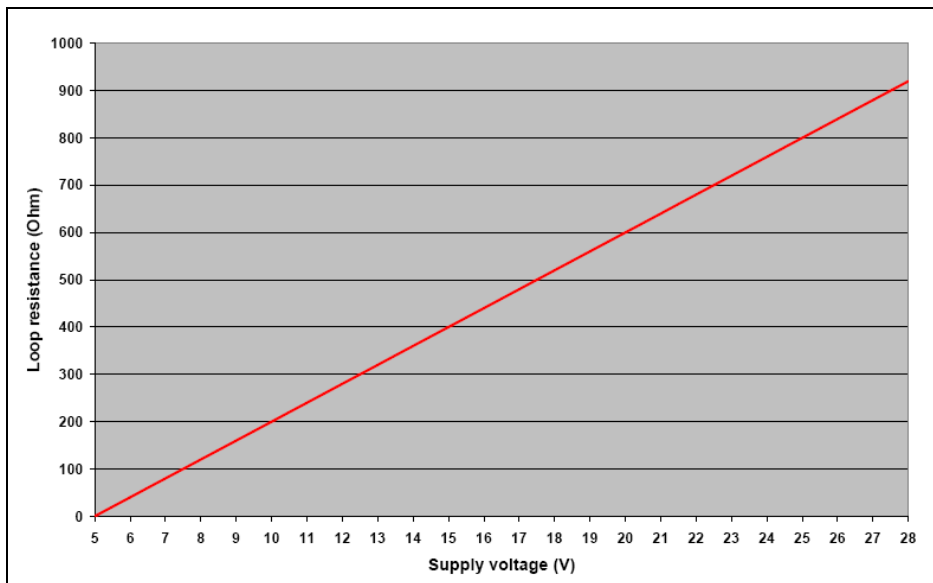
In the digital mode the sensor and the laser will be powered via the 5 V from USB interface. The activation/deactivation of the laser has to be made via the software.

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)

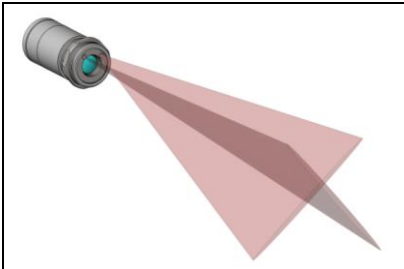
5.5 Maximum Loop Impedance

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.



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.

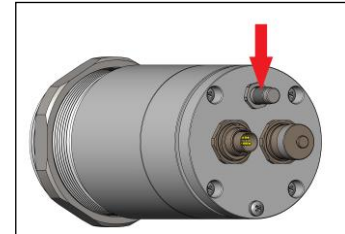


The laser should only be used for sighting and positioning of the sensor. A permanent use of the laser can reduce the lifetime of the laser diodes and also the measurement accuracy can be affected.

6.1 Focusing and Video Sighting

On the back plane of the sensor you will find a rotary button for focusing of the optics.

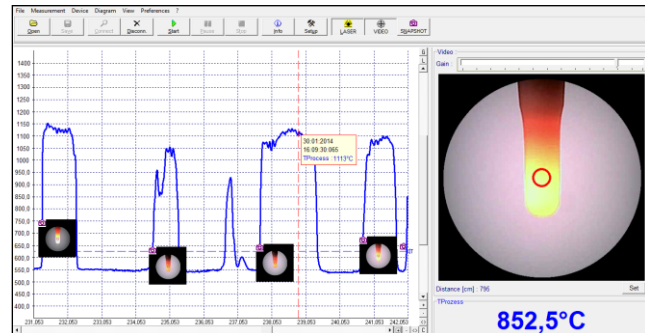
To set the focus to the desired measurement distance you have to connect the sensor with a PC using the USB cable. Please start the CompactConnect software. You will see the video beside the temperature-time diagram. The position of the measurement spot is indicated by a circle inside the video picture. 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 Software CompactConnect

7.1 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:

[Start]ProgramsCompactConnect.

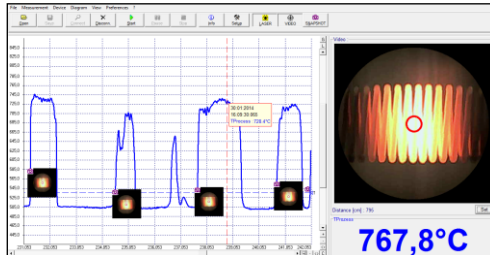
If you want to uninstall the software from your system please use the **uninstall icon** in the start menu.

Min. 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



You will find a detailed software manual on the CD.



Main Features:

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

7.2 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.

7.3 Digital Command Set

CSlaser/ CSvideo Commands							
Decimal	HEX	Binary/ ASCII	Command	Data	Answer	Result	Unit
1	0x01	binary	READ Temp - Target	no	byte1 byte2	$= (\text{byte1} \times 256 + \text{byte2} - 1000) / 10$	°C
2	0x02	binary	READ Temp - Head	no	byte1 byte2	$= (\text{byte1} \times 256 + \text{byte2} - 1000) / 10$	°C
3	0x03	binary	READ current Temp - Target	no	byte1 byte2	$= (\text{byte1} \times 256 + \text{byte2} - 1000) / 10$	°C
4	0x04	binary	READ Emissivity	no	byte1 byte2	$= (\text{byte1} \times 256 + \text{byte2}) / 1000$	
5	0x05	binary	READ Transmission	no	byte1 byte2	$= (\text{byte1} \times 256 + \text{byte2}) / 1000$	
9	0x09	binary	READ Processor Temperature	no	byte1	$= (\text{byte1} \times 256 + \text{byte2} - 1000) / 10$	
14	0x0E	binary	READ Serial number	no	byte1 byte2 byte3	$= \text{byte1} \times 65536 + \text{byte2} \times 256 + \text{byte3}$	
15	0x0F	binary	READ FW Rev.	no	byte1 byte2	$= \text{byte1} \times 256 + \text{byte2}$	
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	$\text{byte1} = \text{mA} \times 10$ (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	$= (\text{byte1} \times 256 + \text{byte2}) / 1000$	
133	0x85	binary	SET Transmission	byte1 byte2	byte1 byte2	$= (\text{byte1} \times 256 + \text{byte2}) / 1000$	
144	0x90	binary	SET Laser	byte1	byte1	0 = off/ 1 = on	

Temperature calculation at CSlaser hs: $(\text{byte1} \times 256 + \text{byte2} - 10000) / 100$

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

8 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 (► **9 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.

9 Emissivity

9.1 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.

9.2 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.

9.3 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			
		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

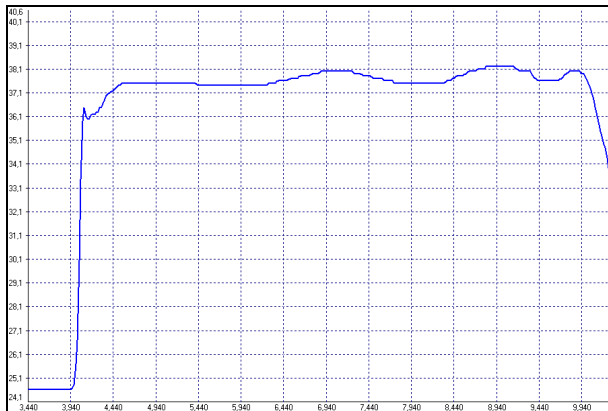
Appendix B – Emissivity Table Non Metals

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

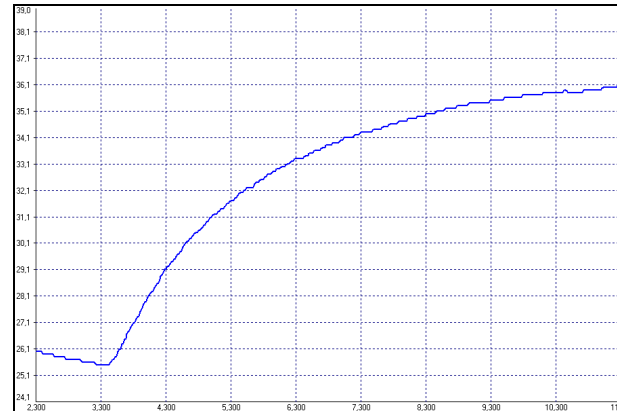
Appendix C – Smart Averaging

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

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 Niederspannungsrichtlinie 2014/35/EU entspricht. meets the provisions of the EMC Directive 2014/30/EU and the Low Voltage Directive 2014/35/EU.	
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 60825-1:2015 (Lasersicherheit / Laser safety)	
Dieses Produkt erfüllt die Vorschriften der Richtlinie 2011/65/EU (RoHS) des Europäischen Parlaments und des Rates vom 8. Juni 2011 zur Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten. This product is in conformity with Directive 2011/65/EU (RoHS) of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.	
Berlin, 04.11.2015	Dr. Ulrich Klenitz Geschäftsführer / General Manager
Ort, Datum / place, date	

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