



Operator's Manual

optris[®] CTvideo

1M/ 2M/ 3M



Infrared-thermometer

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1 General Information

1.1 Description

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

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

They calculate the surface temperature based on the emitted infrared energy of objects [**► 10 Basics of Infrared Thermometry**]. The alignment of the sensor can be done with the integrated video sighting and crosshair laser aiming.

The sensor housing of the CTvideo head is made of stainless steel (IP65/ NEMA-4 rating) – the sensor electronics is placed in a separate box made of die casting zinc.



The CTvideo 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

- CTvideo sensing head with connection cable and electronic box
- 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 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 CTvideo series are available in the following basic versions:

| Model | Model code | Measurement range | Spectral response | Typical applications |
|-------------|------------|-------------------|-------------------|--|
| CT video 1M | 1ML | 485 to 1050 °C | 1,0 µm | Metals and ceramic surfaces |
| | 1MH | 650 to 1800 °C | | |
| | 1MH1 | 800 to 2200 °C | | |
| CT video 2M | 2ML | 250 to 800 °C | 1,6 µm | Metals and ceramic surfaces |
| | 2MH | 385 to 1600 °C | | |
| | 2MH1 | 490 to 2000 °C | | |
| CT video 3M | 3ML | 50 to 400 °C | 2,3 µm | Metals at low object temperatures (ab 50 °C) |
| | 3MH | 100 to 600 °C | | |
| | 3MH1 | 150 to 1000 °C | | |
| | 3MH2 | 200 to 1500 °C | | |
| | 3MH3 | 250 to 1800 °C | | |

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

On the 1M, 2M, 3M models the whole measurement range is split into several sub ranges (L, H, H1 etc.).

1.6 Factory Default Settings

The unit has the following presetting at time of delivery:

| | | | | | | | | | |
|---|------------|------------|-------------|------------|------------|-------------|------------|------------|-------------|
| Signal output object temperature | 0-5 V | | | | | | | | |
| Emissivity | 1,000 | | | | | | | | |
| Transmissivity | 1,000 | | | | | | | | |
| Average time (AVG) | inactive | | | | | | | | |
| Smart Averaging | active | | | | | | | | |
| Peak hold | inactive | | | | | | | | |
| Valley hold | inactive | | | | | | | | |
| | 1ML | 1MH | 1MH1 | 2ML | 2MH | 2MH1 | 3ML | 3MH | 3MH1 |
| Lower limit temperature range [°C] | 485 | 650 | 800 | 250 | 385 | 490 | 50 | 100 | 150 |
| Upper limit temperature range [°C] | 1050 | 1800 | 2200 | 800 | 1600 | 2000 | 400 | 600 | 1000 |
| Lower alarm limit [°C] (normally closed) | 600 | 800 | 1200 | 350 | 500 | 800 | 100 | 250 | 350 |
| Upper alarm limit [°C] (normally open) | 900 | 1400 | 1600 | 600 | 1200 | 1400 | 300 | 500 | 600 |

| | 3MH2 | 3MH3 | |
|---|---------------------------------|------|--|
| Lower limit temperature range [°C] | 200 | 250 | |
| Upper limit temperature range [°C] | 1500 | 1800 | |
| Lower alarm limit [°C] (normally closed) | 550 | 750 | |
| Upper alarm limit [°C] (normally open) | 1000 | 1200 | |
| Lower limit signal output | 0 V | | |
| Upper limit signal output | 5 V | | |
| Temperature unit | °C | | |
| Ambient temperature compensation | internal head temperature probe | | |
| Baudrate [kBaud] | 115 | | |
| Laser | inactive | | |



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

| | Sensing head | Electronic box |
|-----------------------------------|--|-----------------------|
| Environmental rating | IP65 (NEMA-4) | |
| Ambient temperature ¹⁾ | -20...70 °C | -20...85 °C |
| Storage temperature | -40...85 °C | |
| Relative humidity | 10...95 %, non condensing | |
| Material | stainless steel | die casting zinc |
| Dimensions | 116 mm x 50 mm, M48x1,5 | 89 mm x 70 mm x 30 mm |
| Weight | 600 g | 420 g |
| Cable length | 3 m (standard), 5 m, 10 m | |
| Cable diameter | 5 mm | |
| Ambient temperature cable | | |
| Cable sensing head-electronics | max. 80 °C [High temperature cable (optional): 180 °C] | |
| USB-cable | max. 80 °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⁾ Laser will turn off automatically at ambient temperatures >50 °C. The functionality of the LCD display can be limited at ambient temperatures below 0 °C.

2.2 Electrical Specifications

| | |
|-------------------|--|
| Power Supply | 8–36 VDC |
| Current draw | max. 160 mA |
| Aiming laser | 635 nm, 1 mW, On/ Off via programming keys or software |
| Video sighting | Digital (USB 2.0), 640 x 480 px, FOV 3.1° x 2.4° |
| Output/ analog | selectable: 0/ 4–20 mA, 0–5/ 10 V, thermocouple (J or K) or alarm output (Signal source: object temperature) |
| Alarm output | Open collector output at Pin AL2 [24 V/ 50 mA] |
| Output impedances | |
| mA | max. loop resistance 500 Ω (at 8-36 VDC) |
| mV | min. 100 k Ω load impedance |
| Thermocouple | 20 Ω |
| Digital interface | USB 2.0 |
| Functional inputs | <p>F1-F3; software programmable for the following functions:</p> <ul style="list-style-type: none"> • external emissivity adjustment • ambient temperature compensation • trigger (reset of hold functions) <p>Input impedance F2 and F3: 43 kΩ</p> |

2.3 Measurement Specifications [1M models]

| | 1ML | 1MH | 1MH1 |
|--|---|---------------|---------------|
| Temperature range (scalable) | 485...1050 °C | 650...1800 °C | 800...2200 °C |
| Spectral range | 1,0 µm | | |
| Optical resolution | 150:1 | 300:1 | |
| System accuracy ^{1), 2), 3)} | ±(0,3 % of reading +2 °C) | | |
| Repeatability ^{1), 3)} | ±(0,1 % of reading +1 °C) | | |
| Temperature resolution (NETD) | 0,1 K | | |
| Exposure time (90% signal) ⁴⁾ | 1 ms | | |
| Emissivity/ Gain | 0,100...1,100 (adjustable via programming keys or software) | | |
| Transmissivity | 0,100...1,100 (adjustable via programming keys or software) | | |
| Signal processing | Average, peak hold, valley hold (adjustable via programming keys or software) | | |

¹⁾ at ambient temperature 23±5 °C

²⁾ Accuracy for thermocouple output: ±2,5 °C or ±1 %

³⁾ $\varepsilon = 1$ / Response time 1 s

⁴⁾ with dynamic adaptation at low signal levels

2.4 Measurement Specifications [2M models]

| | 2ML | 2MH | 2MH1 |
|--|---|---------------|---------------|
| Temperature range (scalable) | 250...800 °C | 385...1600 °C | 490...2000 °C |
| Spectral range | 1,6 µm | | |
| Optical resolution | 150:1 | 300:1 | |
| System accuracy ^{1), 2), 3)} | ±(0,3 % of reading +2 °C) | | |
| Repeatability ^{1), 3)} | ±(0,1 % of reading +1 °C) | | |
| Temperature resolution (NETD) | 0,1 K | | |
| Exposure time (90% signal) ⁴⁾ | 1 ms | | |
| Emissivity/ Gain | 0,100...1,100 (adjustable via programming keys or software) | | |
| Transmissivity | 0,100...1,100 (adjustable via programming keys or software) | | |
| Signal processing | Average, peak hold, valley hold (adjustable via programming keys or software) | | |

¹⁾ at ambient temperature 23±5 °C

²⁾ Accuracy for thermocouple output: ±2,5 °C or ±1 %

³⁾ ε = 1/ Response time 1 s

⁴⁾ with dynamic adaptation at low signal levels

2.5 Measurement Specifications [3M models]

| | 3ML | 3MH | 3MH1 | 3MH2 | 3MH3 |
|---|---|----------------------------|---------------|---------------|---------------|
| Temperature range (scalable) | 50...400 °C ¹⁾ | 100...600 °C ¹⁾ | 150...1000 °C | 200...1500 °C | 250...1800 °C |
| Spectral range | 2,3 µm | | | | |
| Optical resolution | 60:1 | 100:1 | 300:1 | | |
| System accuracy ^{2), 3), 4)} | ±(0,3 % of reading +2 °C) | | | | |
| Repeatability ^{2), 4)} | ±(0,1 % of reading +1 °C) | | | | |
| Temperature resolution (NETD) ⁴⁾ | 0,1 K | | | | |
| Exposure time (90 % signal) ⁵⁾ | 1 ms | | | | |
| Emissivity/ Gain | 0,100...1,100 (adjustable via programming keys or software) | | | | |
| Transmissivity | 0,100...1,100 (adjustable via programming keys or software) | | | | |
| Signal processing | Average, peak hold, valley hold (adjustable via programming keys or software) | | | | |

¹⁾ T_{Object} > T_{Head}+25 °C

²⁾ at ambient temperature 23±5 °C

³⁾ Accuracy for thermocouple output: ±2,5 °C or ±1 %

⁴⁾ ε = 1/ Response time 1 s

⁵⁾ with dynamic adaptation at low signal levels

2.6 Optical Charts

The vario optics of the CTvideo 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.

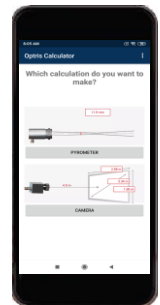
In order to prevent measuring errors the object should fill out the field of view of the optics completely.

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 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

| 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 |

| 1ML/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 |

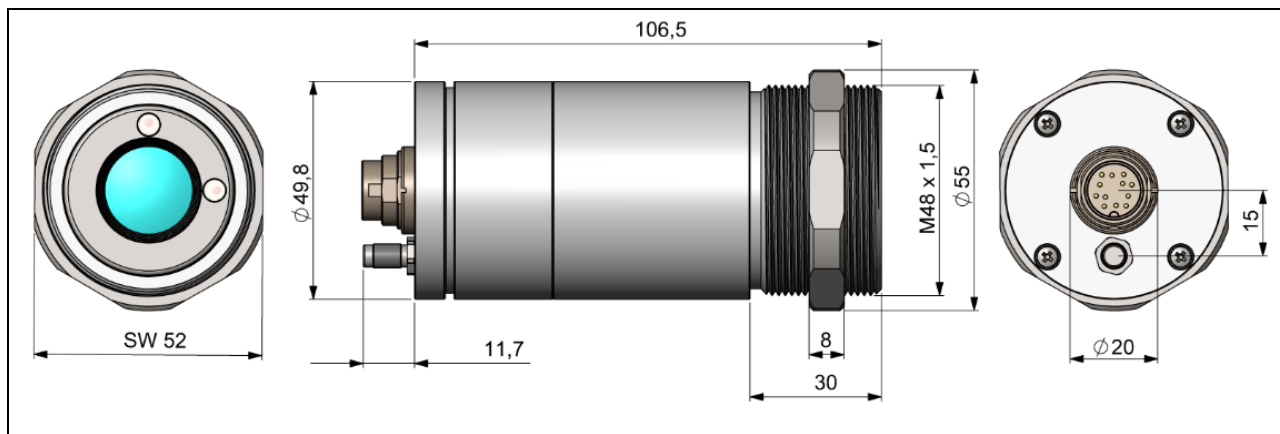
| 1ML/2ML: CF optics (D:S=150:1) | | | | | | | |
|--------------------------------|----|-----|-----|-----|-----|-----|-----|
| spot size | mm | 0,6 | 0,8 | 1,0 | 1,2 | 1,4 | 1,7 |
| measurement distance | mm | 90 | 120 | 150 | 180 | 210 | 250 |

| 1MH-H1/2MH-H1/3MH1-H3: 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 |

| 1MH-H1/2MH-H1/3MH1-H3: 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

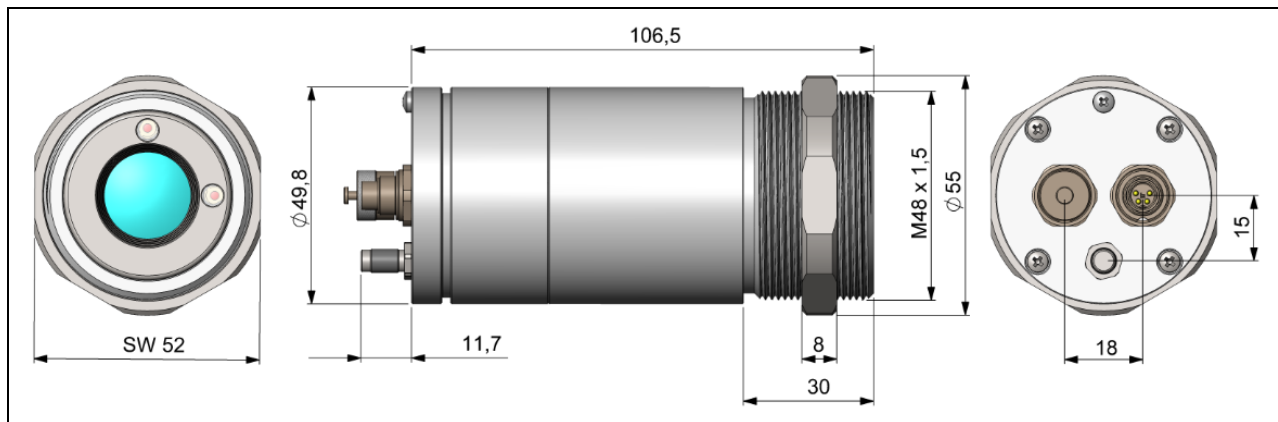
The CTvideo is equipped with a metric M48x1,5 thread and can be installed either directly via the sensor thread or with help of the supplied mounting nut (standard) and fixed mounting bracket (standard) to a mounting device available.



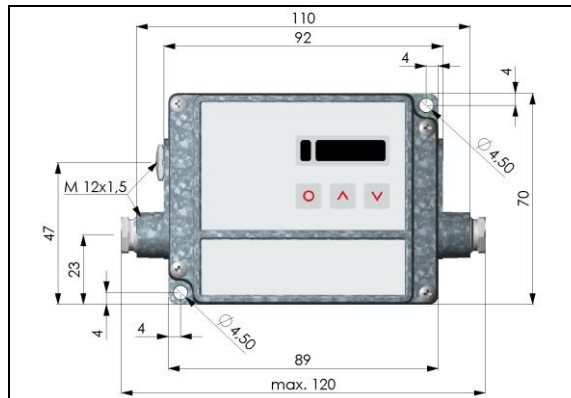
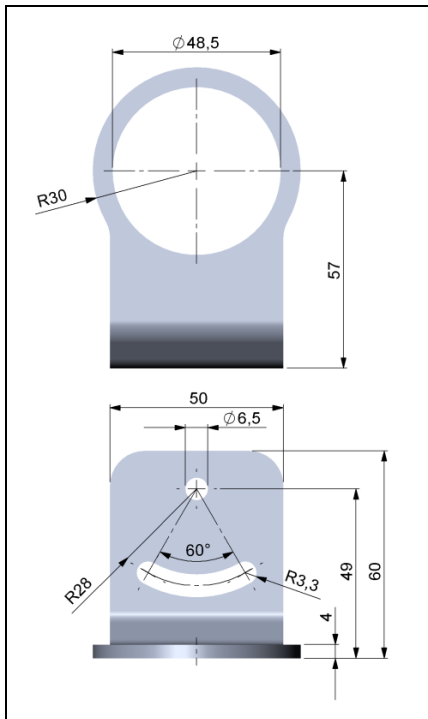
CTvideo sensing head (Basic version)



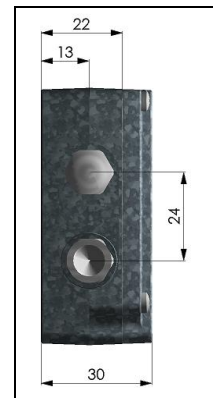
Make sure to keep the optical path clear of any obstacles.



CTvideo sensing head (High temperature version)



Electronic box



For an exact alignment of the head to the object please activate the integrated video and/ or crosshair laser sighting.

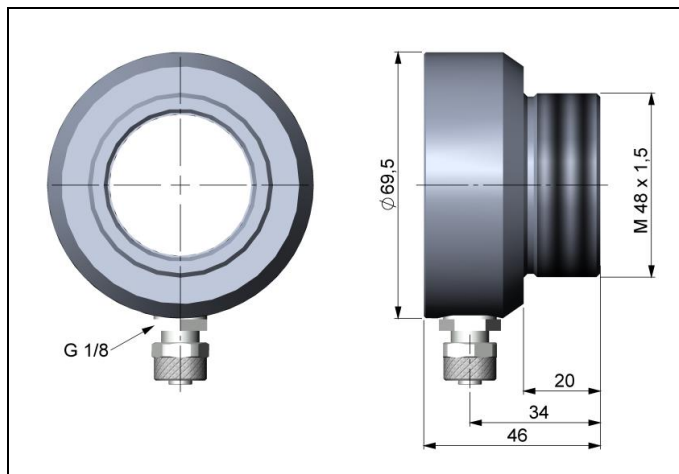
[► 7 Operating, 7.2 Sighting]

Mounting bracket, adjustable in one axis [ACCTLFB] – standard scope of supply

4 Accessories

4.1 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.

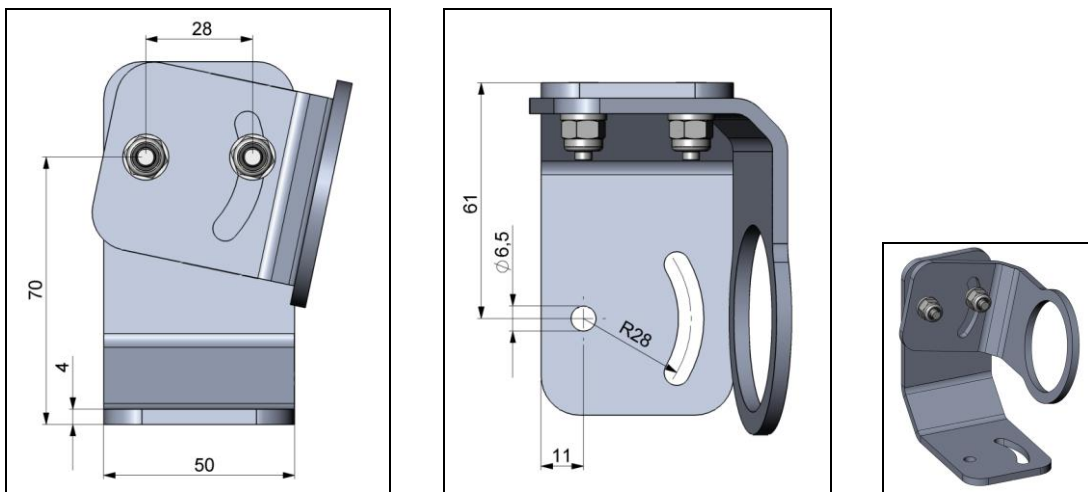


The needed amount of air (approx. 2...10 l/min.) depends on the application and the installation conditions on-site.



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

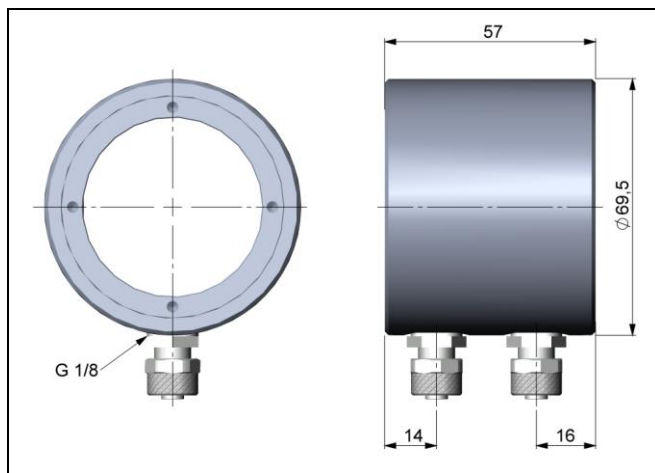
4.2 Mounting Bracket



Mounting bracket, adjustable in two axes [ACCTLAB]

This adjustable mounting bracket allows an adjustment of the sensor in two axis.

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]

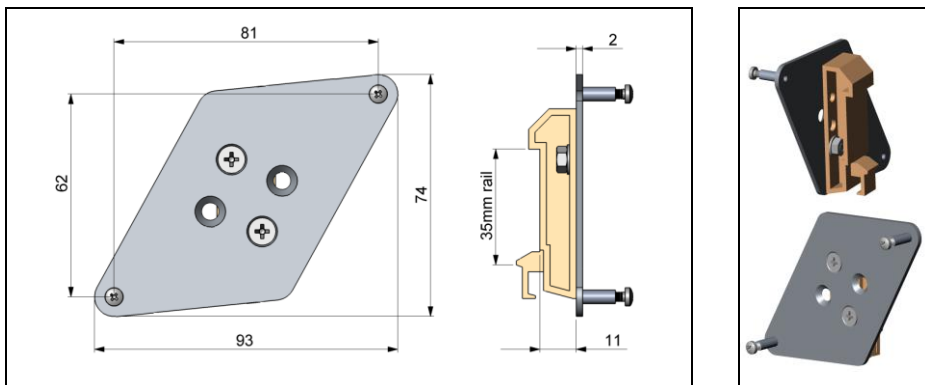
Hose connection: 6x8 mm

Thread (fitting): G 1/8 inch

The sensing head 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).

4.4 Rail Mount Adapter for Electronic box

With the rail mount adapter the CTvideo electronics can be mounted easily on a DIN rail (TS35) according EN50022.



Rail mount adapter [ACCTRAIL]



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

5 Electrical Installation

5.1 Cable Connections

The CTvideo sensing heads are equipped with connectors in the backplane. Therefore an opening of the sensing head for assembling or disassembling is not necessary. An USB cable (5 m) is already connected on the electronics and can be used for linking to a computer.

5.1.1 Basic version

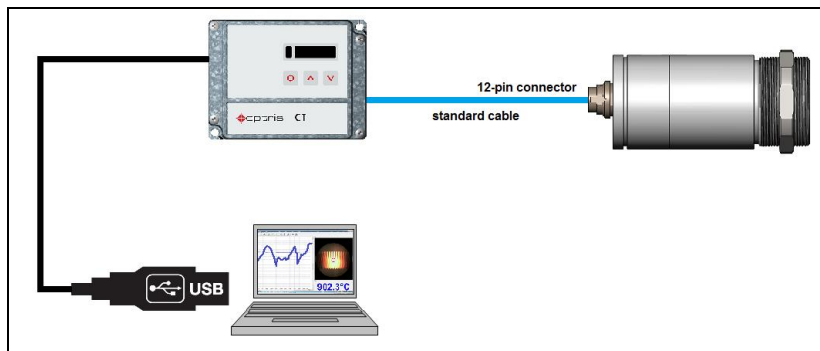
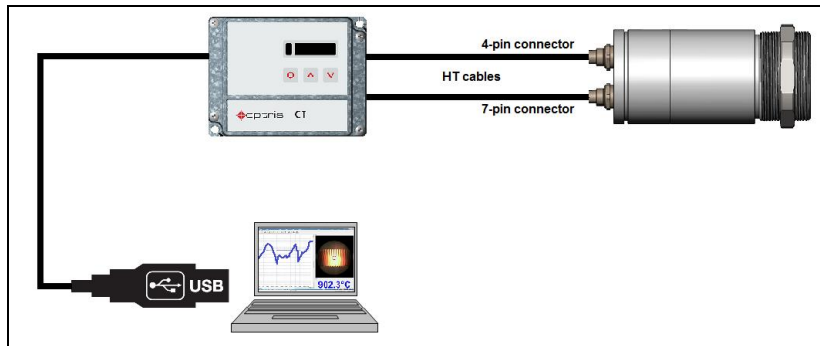
The standard version of the CTvideo has a 12-pin connector which is integrated in the sensors backplane. The connection to the electronics is done by the blue sensor cable. Cable lengths of 3 m, 5 m and 10 m are available.



5.1.2 High temperature version

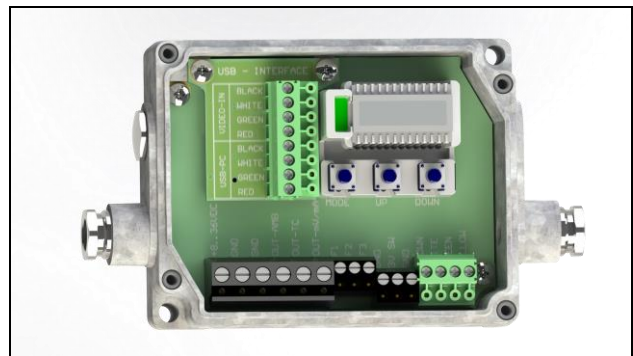
The high temperature version of the CTvideo has two connectors (7-pin and 5-pin) which are integrated in the sensor backplane. The connection sensing head – electronics will be done in this case via: a 7-core high temperature cable (sensor signals, laser) and a 4-core high temperature cable (video signal). Cable lengths of 3 m, 5 m and 10 m are available.



**CTvideo Basic version****CTvideo High temperature version**

5.1.3 Designation

| | |
|---------------|---|
| +8..36 VDC | Power supply |
| GND | Ground (0 V) of power supply |
| GND | Ground (0 V) of internal in- and outputs |
| AL2 | Alarm 2 (Open collector output) |
| OUT-TC | Analog output thermocouple (J or K) |
| OUT-mV/mA | Analog output object temperature (mV or mA) |
| F1-F3 | Functional inputs |
| GND | Ground (0 V) |
| 3V SW | BLACK/ Power supply Laser (+) |
| GND | GREY/ Ground Laser (-) |
| ORANGE | Temperature probe head (NTC) |
| BLUE | Head ground |
| PURPLE | Head power |
| YELLOW | Detector signal |



Opened electronic box with terminal connections

5.1.4 Power supply

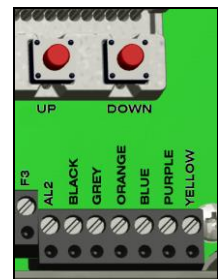
Please use a separate, stabilized power supply unit with an output voltage of **8–36 VDC** which can supply **160 mA**. The ripple should be max. **200 mV**.

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

The sensor shield has to be grounded.



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



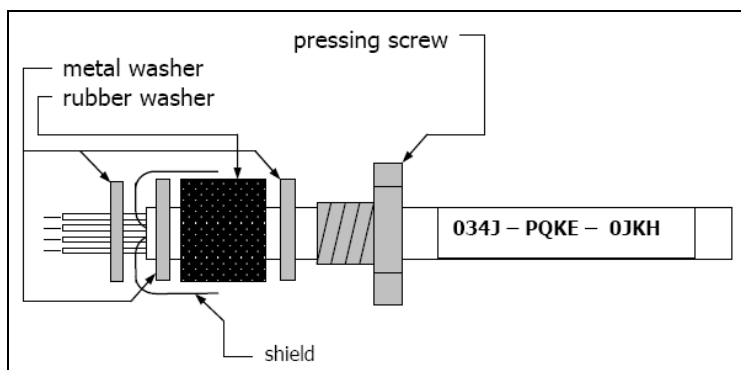
5.1.5 Cable Assembling

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

Remove the isolation from the cable (40 mm power supply, 50 mm signal outputs, 60 mm functional inputs). Cut the shield down to approximately 5 mm and spread the strands out. Extract about 4 mm of the wire isolation and tin the wire ends.

Place the pressing screw, the rubber washer and the metal washers of the cable gland one after the other onto the prepared cable end. Spread the strands and fix the shield between two of the metal washers. Insert the cable into the cable gland until the limit stop. Screw the cap tight.

Every single wire may be connected to the according screw clamps according to their colors.



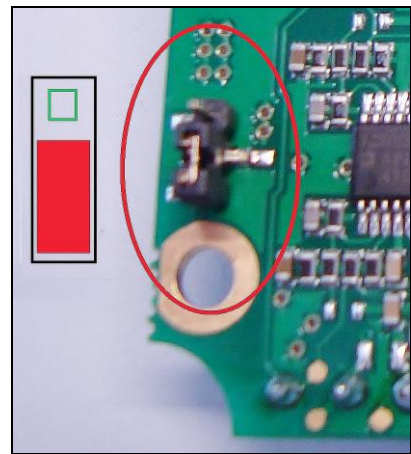
Use shielded cables only. The sensor shield has to be grounded.

5.2 Ground Connection

At the bottom side of the mainboard PCB you will find a connector (jumper) which has been placed from factory side as shown in the picture [**bottom** and **middle** pin connected]. In this position the ground connections (GND power supply/ outputs) are connected with the ground of the electronics housing.

To avoid ground loops and related signal interferences in industrial environments it might be necessary to interrupt this connection. To do this please put the jumper in the opposite position [**middle** and **top** pin connected].

If the thermocouple output is used the connection GND – housing should be interrupted generally.



CTvideo mainboard

5.3 Sensing head Calibration Code

Every head has a specific calibration code, which is printed on the head. For a correct temperature measurement and functionality of the sensor this calibration code must be stored into the electronic box. The calibration code consists of five blocks with 4 characters each.

Example: **EKJ0** – **00UD** – **0A1B** – **A17U** – **93OZ**
 block1 block2 block3 block4 block5

For entering the code please press the **Up** and **Down** key (keep pressed) and then the **Mode** key. The display shows **HCODE** and then the 4 signs of the first block. With **Up** and **Down** each sign can be changed, **Mode** switches to the next sign or next block.



After you have modified the head code a reset is necessary to activate the change.
[► 7 Operating]



You will find the calibration code on a label fixed on the head. Please do not remove this label or make sure the code is noted anywhere.



6 Outputs and Inputs

6.1 Analog Output

This output is used for the object temperature. The selection of the output signal can be done via the programming keys [**►7 Operating**]. The CompactConnect software allows the programming of output channel 1 as an alarm output.

| Output signal | Range | Connection pin on CTvideo board |
|---------------|-------------|---------------------------------|
| Voltage | 0 ... 5 V | OUT-mV/mA |
| Voltage | 0 ... 10 V | OUT-mV/mA |
| Current | 0 ... 20 mA | OUT-mV/mA |
| Current | 4 ... 20 mA | OUT-mV/mA |
| Thermocouple | TC J | OUT-TC |
| Thermocouple | TC K | OUT-TC |



According to the chosen output signal there are different connection pins on the mainboard (**OUT-mV/mA** or **OUT-TC**).

6.2 Digital Interface

The CTvideo sensors are equipped with an USB interface. The interface board is located beside the LCD display. To uninstall the board please disconnect both of the M3x5 screws. Please pay attention to the correct positioning of the pin strip if you install the board.



6.3 Functional Inputs

The three functional inputs F1 – F3 can be programmed with the CompactConnect software, only.

- F1 (digital):** trigger (a 0 V level on F1 resets the hold functions)
- F2 (analog):** external emissivity adjustment [0–10 V: 0 V ► $\epsilon=0,1$; 9 V ► $\epsilon=1$; 10 V ► $\epsilon=1,1$]
- F3 (analog):** external compensation of ambient temperature/ the range is scalable via software [0–10 V ► -40–900 °C / preset range: -20–200 °C]
- F1-F3 (digital):** emissivity (digital choice via table)

A non connected input represents:

F1=High | F2, F3=Low.

[High level: $\geq +3$ V...+36 V | Low level: $\leq +0,4$ V...-36 V]

6.4 Alarms

The CTvideo has the following Alarm features:

All alarms (alarm 1, alarm 2, output channel 1 and 2 if used as alarm output) have a fixed **hysteresis of 2 K**.

6.4.1 Output channel 1

To activate the alarm function the output channel has to be switched into digital mode. For this purpose the software CompactConnect is required.

6.4.2 Visual Alarms

These alarms will cause a change of the color of the LCD display and will also change the status of the optional relays interface. In addition the Alarm 2 can be used as open collector output at pin **AL2** on the mainboard **[24 V/ 50 mA]**.

From factory side the alarms are defined as follows:

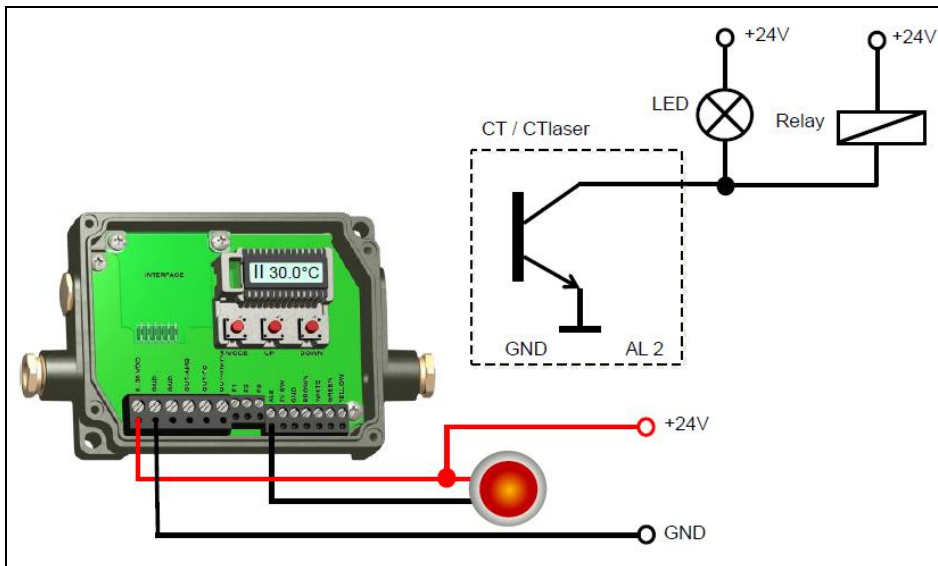
| | |
|----------------|--------------------------------|
| Alarm 1 | Norm. closed/ Low-Alarm |
| Alarm 2 | Norm. open/ High-Alarm |

Both of these alarms will have effect on the LCD color:

| | |
|---------------|------------------------|
| BLUE: | alarm 1 active |
| RED: | alarm 2 active |
| GREEN: | no alarm active |

Extended setup like definition as low or high alarm **[via change of normally open/ closed]**, selection of the signal source [**T_{Obj}**, **T_{Head}**, **T_{Box}**] can be done with the software CompactConnect.

6.4.3 Open collector output / AL2



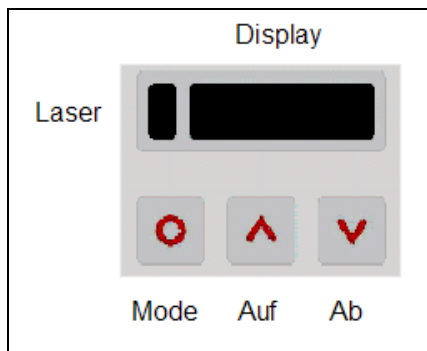
- The transistor acts as a switch. In case of alarm, the contact is closed.
- A load/consumer (Relay, LED or a resistor) must always be connected.
- The alarm voltage (here 24V) must not be connected directly to the alarm output (short circuit).

7 Operating

After power up the unit the sensor starts an initializing routine for some seconds. During this time the display will show **INIT**. After this procedure the object temperature is shown in the display. The display backlight color changes according to the alarm settings [► 6.4 Alarms].

7.1 Sensor Setup

The programming keys **Mode**, **Up** and **Down** enable the user to set the sensor on-site. The current measuring value or the chosen feature is displayed. With **Mode** the operator obtains the chosen feature, with **Up** and **Down** the functional parameters can be selected – **a change of parameters will have immediate effect**. If no key is pressed for more than 10 seconds the display automatically shows the calculated object temperature (according to the signal processing).



Pressing the Mode button again recalls the last called function on the display. The signal processing features **Peak hold** and **Valley hold** cannot be selected simultaneously.

Factory Default Setting

To set the CTvideo back to the factory default settings, please press at first the **Down**-key and then the **Mode**-key and keep both pressed for approx. 3 seconds.

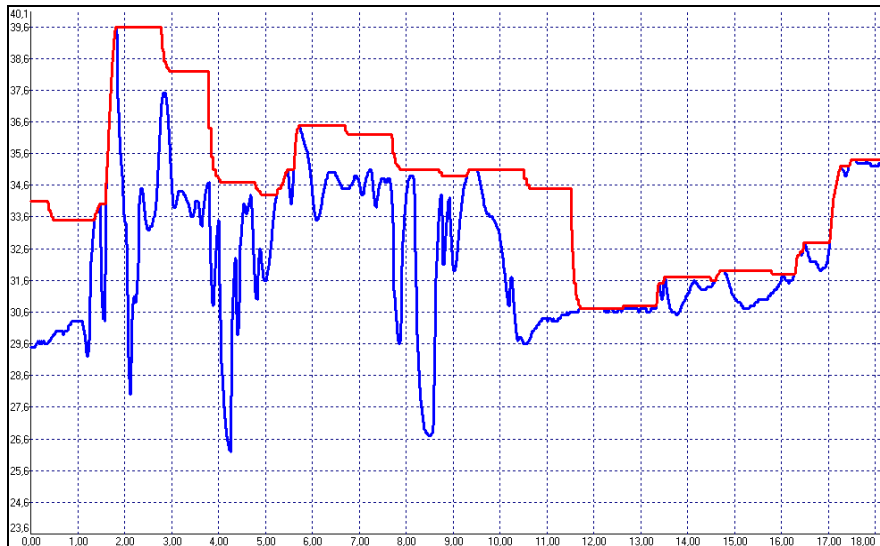
The display will show **RESET** for confirmation.

| Display | Mode [Sample] | Adjustment Range |
|-----------------|---|---|
| 142.3C | Object temperature (after signal processing) [142,3 °C] | fixed |
| S ON | Laser Sighting [On] | ON/ OFF |
| 127CH | Head temperature [127 °C] | fixed |
| 25CB | Box temperature [25 °C] | fixed |
| 142CA | Current object temperature [142 °C] | fixed |
| δ MV5 | Signal output channel 1 [0-5 V] | δ 0-20 = 0–20 mA/ δ 4-20 = 4–20 mA/ δ MV5 = 0–5 V/ δ MV10 = 0-10 V/ δ TCJ = thermocouple type J/ δ TCK = thermocouple type K |
| E0.970 | Emissivity [0,970] | 0,100 ... 1,100 |
| T1.000 | Transmissivity [1,000] | 0,100 ... 1,100 |
| A 0.2 | Signal output Average [0,2 s] | A---- = inactive/ 0,1 ... 999,9 s |
| P---- | Signal output Peak hold [inactive] | P---- = inactive/ 0,1 ... 999,9 s / P oo oo oo oo = infinite |
| V---- | Signal output Valley hold [inactive] | V---- = inactive/ 0,1 ... 999,9 s / V oo oo oo oo = infinite |
| u 0.0 | Lower limit temperature range [0 °C] | depending on model / inactive at TCJ- and TCK-output |
| n 500.0 | Upper limit temperature range [500 °C] | depending on model / inactive at TCJ- and TCK-output |
| [0.00 | Lower limit signal output [0 V] | according to the range of the selected output signal |
|] 5.00 | Upper limit signal output [5 V] | according to the range of the selected output signal |
| U °C | Temperature unit [°C] | °C/ °F |
| 30.0 | Lower alarm limit [30 °C] | depending on model |
| 100.0 | Upper alarm limit [100 °C] AL2 | depending on model |
| XHEAD | Ambient temperature compensation [head temperature] | XHEAD = head temperature/ -40,0 ... 900,0 °C (for LT) as fixed value for compensation/ returning to XHEAD (head temperature) by pressing Up and Down together |
| B 9.6 | Baud rate in kBaud [9,6] | 9,6/ 19,2/ 38,4/ 57,6/ 115,2 kBaud |

- δ MV5** Selection of the **Output signal**. By pressing **Up** or **Down** the different output signals can be selected (see table).
- S ON** Activating (**ON**) and Deactivating (**OFF**) of the **Sighting Laser**. By pressing **Up** or **Down** the laser can be switched on and off.
- E0.970** Setup of **Emissivity**. Pressing **Up** increases the value, **Down** decreases the value (also valid for all further functions). The emissivity is a material constant factor to describe the ability of the body to emit infrared energy [**► 11 Emissivity**].
- T1.000** Setup of **Transmissivity**. This function is used if an optical component (protective window, additional optics e.g.) is mounted between sensor and object. The standard setting is 1.000 = 100 % (if no protective window etc. is used).
- A 0.2** Setup of **Average time**. In this mode an arithmetic algorithm will be performed to smoothen the signal. The set time is the time constant. This function can be combined with all other post processing functions. On 1M/ 2M/ 3M models the shortest value is 0,001 s (other models: 0,1 s) and can be increased/ decreased only by values of the power series of 2 (0,002, 0,004, 0,008, 0,016, 0,032, ...).
If the value is set to **0.0** the display will show --- (function deactivated).
- P----** Setup of **Peak hold**. In this mode the sensor is waiting for descending signals. If the signal descends the algorithm maintains the previous signal peak for the specified time. After the hold time the signal will drop down to the second highest value or will descend by 1/8 of the difference between the previous peak and the minimum value during the hold time. This value will be held again for the specified time. After this the signal will drop down with slow time constant and will follow the current object temperature.
If the value is set to **0.0** the display will show --- (function deactivated).
- V----** Setup of **Valley hold**. In this mode the sensor waits for ascending signals. The definition

of the algorithm is according to the peak hold algorithm (inverted).
If the value is set to **0.0** the display will show --- (function deactivated).

Signal graph with **P----**



— TProcess with Peak Hold (Hold time = 1s)
— TActual without post processing

| | |
|-----------------|--|
| u 0.0 | Setup of the Lower limit of temperature range . The minimum difference between lower and upper limit is 20 K . If you set the lower limit to a value \geq upper limit the upper limit will be adjusted to [lower limit + 20 K] automatically. |
| n 500.0 | Setup of the Upper limit of the temperature range . The minimum difference between upper and lower limit is 20 K . The upper limit can only be set to a value = lower limit + 20 K. |
| [0.00 | Setup of the Lower limit of the signal output . This setting allows an assignment of a certain signal output level to the lower limit of the temperature range. The adjustment range corresponds to the selected output mode (e.g. 0-5 V). |
|] 5.00 | Setup of the Upper limit of the signal output . This setting allows an assignment of a certain signal output level to the upper limit of the temperature range. The adjustment range corresponds to the selected output mode (e.g. 0-5 V). |
| U °C | Setup of the Temperature unit [°C or °F]. |
| 30.0 | Setup of the Lower alarm limit . This value corresponds to Alarm 1 [►6.4 Alarms] and is also used as threshold value for relay 1 (if the optional relay board is used). |
| 100.0 | Setup of the Upper alarm limit . This value corresponds to Alarm 2 [►6.4 Alarms] and is also used as threshold value for relay 2 (if the optional relay board is used). |
| XHEAD | Setup of the Ambient temperature compensation . In dependence on the emissivity value of the object a certain amount of ambient radiation will be reflected from the object surface. To compensate this impact, this function allows the setup of a fixed value which represents the ambient radiation. |

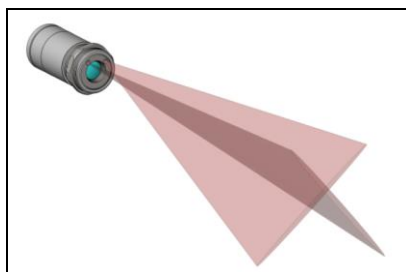


Especially if there is a big difference between the ambient temperature at the object and the head temperature the use of **Ambient temperature compensation** is recommended.

B 9.6 Setup of the **Baud rate** for digital data transfer.

7.2 Sighting

The CTvideo 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.



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 laser can be activated/ deactivated via the programming keys on the unit or via the software. If the laser is activated a yellow LED will shine (beside temperature display).

At ambient temperatures >50 °C the laser will be switched off automatically.

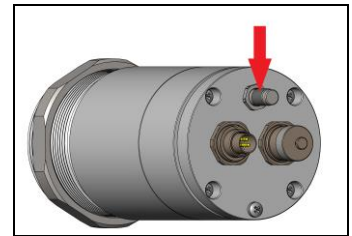


The laser should only be used for sighting and positioning of the sensor. A permanent use of the laser can reduce the lifetime of the laser diodes and also the measurement accuracy can be affected.

7.3 Focusing and Video Sighting

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

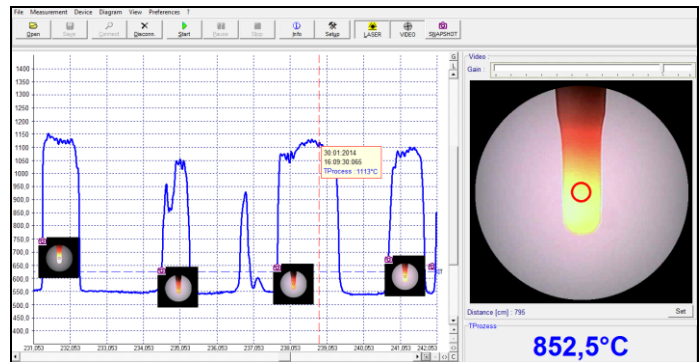
To set the focus to the desired measurement distance you have to connect the sensor with a PC using the USB cable. Please start the CompactConnect software. You will see the video beside the temperature-time diagram. The position of the measurement spot is indicated by a circle inside the video picture.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



7.4 Error messages

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

1. Digit:

| | |
|----|---|
| 0x | No error |
| 1x | Head temperature probe short circuit to GND |
| 2x | Box temperature too low |
| 4x | Box temperature too high |
| 6x | Box temperature probe disconnected |
| 8x | Box temperature probe short circuit to GND |

2. Digit:

| | |
|----|-------------------------------------|
| x0 | No error |
| x2 | Object temperature too high |
| x4 | Head temperature too low |
| x8 | Head temperature too high |
| xC | Head temperature probe disconnected |

8 IRmobile app

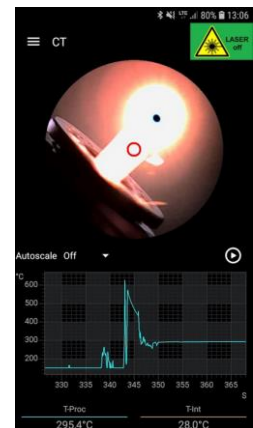
The CTvideo sensor has a direct connection to an Android smartphone or tablet. All you have to do is download the IRmobile app for free in the Google Play store. This can also be done via the QR code.



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 CTvideo 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 (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)

9 Software CompactConnect

9.1 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.

Min. system requirements:

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



Alternatively, the software can also be downloaded via the Optris website under the following

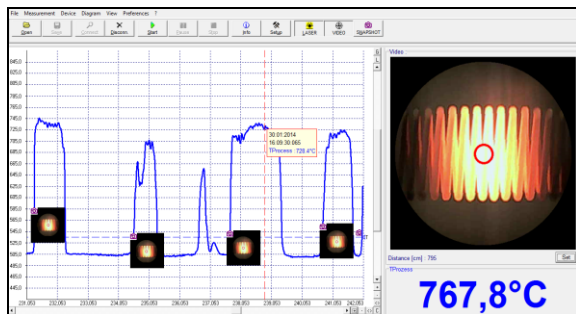
The installation wizard will place a launch icon on the desktop and in the start menu:

[Start]\Programs\CompactConnect.

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



You will find a detailed software manual on the CD.

**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

9.2 Communication Settings

9.2.1 Serial Interface

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

9.2.2 Protocol

All sensors of the CTvideo series are using a binary protocol. Alternatively they can be switched to an ASCII protocol. To get a fast communication the protocol has no additional overhead with CR, LR or ACK bytes.

9.2.3 ASCII protocol

To switch to the ASCII protocol please use the following command:

Decimal: 131
HEX: 0x83
Data, Answer: byte 1
Result: 0 – Binary protocol
 1 – ASCII protocol

9.2.4 Saving of parameter settings

After power on of the CTvideo sensor the flash mode is active. It means, changed parameter settings will be saved in the internal Flash-EEPROM and will be kept also after the sensor is switched off.

In case settings should be changed quite often or continuously the flash mode can be switched off by using the following command:

| | |
|----------------------|---|
| Decimal: | 112 |
| HEX: | 0x70 |
| Data, Answer: | byte 1 |
| Result: | 0 – Data will be written into the flash memory |
| | 1 – Data will not be written into the flash memory |

If the flash mode is deactivated, all settings will only be kept as long as the unit is powered. If the unit is switched off and powered on again all previous settings are lost.

The command 0x71 will poll the current status.

You will find a detailed protocol and command description on the software CD CompactConnect in the directory: **\Commands**.

10 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 (► **11 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.

11 Emissivity

11.1 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.

11.2 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.

11.3 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 | | | 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 | | 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 | | 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 |

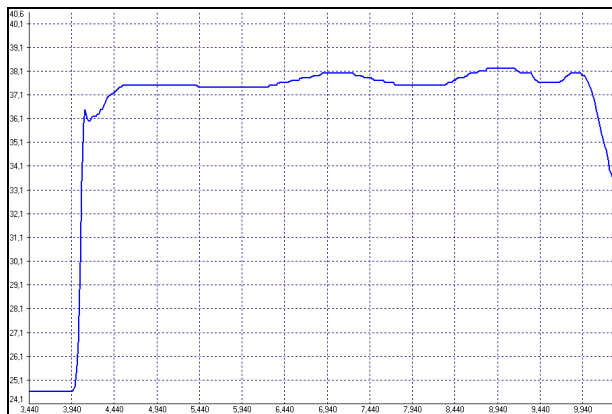
Appendix B – Emissivity Table Non Metals

| 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 |

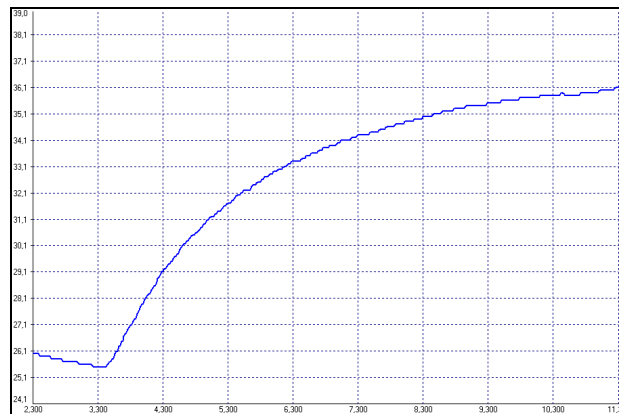
Appendix C – Smart Averaging

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 CTVideo the product group optris CTVideo |
| 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 60825-1:2014 (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. |  Dr. Ulrich Kienitz Geschäftsführer / General Manager |
| Berlin, 04.11.2015 | |
| Ort, Datum / place, date | |