



Operating Instructions

thermoMETER TIM 8

thermoIMAGER TIM 40 / TIM 41

Spot finder IR camera

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1. Safety

System operation assumes knowledge of the operating instructions.

1.1 Symbols Used

The following symbols are used in these operating instructions:



Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.



Indicates a situation that may result in property damage if not avoided.



Indicates a user action.



Indicates a tip for users.

Measure

Indicates hardware or a software button/menu.

1.2 Warnings



Connect the power supply and the display/output device according to the safety regulations for electrical equipment.

- > Risk of injury
- > Damage to or destruction of the camera



Avoid the alignment of the camera to intensive energy sources (e.g. devices which emit laser radiation or reflections of such equipment). This is also valid if the camera is switched off.

- > Effect on the accuracy of the measurement
- > Irreparable defect of the infrared detector

Avoid static electricity, arc welders, and induction heaters. Keep away from very strong EMF (electromagnetic fields).

- > Damage to or destruction of the camera

Avoid shocks, impacts and vibration to the camera.

> Damage to or destruction of the camera

The supply voltage must not exceed the specified limits.

> Damage to or destruction of the camera

No solvent-based cleaning agents may have an effect on the camera (neither for the optics nor the housing).

> Damage to or destruction of the camera

Avoid abrupt changes of the ambient temperature.

> Incorrect display of the device

Protect the USB cable against damage.

> Failure of the camera

1.3 Notes on CE Marking

The following apply to the thermoIMAGER TIM:

- EU Directive 2014/30/EU
- EU Directive 2011/65/EU

Products which carry the CE mark satisfy the requirements of the EU directives cited and the relevant applicable harmonized European standards (EN). The measuring system is designed for use in industrial environments.

The EU Declaration of Conformity and the technical documentation are available to the responsible authorities according to the EU Directives.

1.4 Intended Use

- The thermoIMAGER TIM is designed for use in industrial and laboratory areas. It is used for measuring the surface temperature based on the emitted energy of objects, [see 10](#).
- The system must only be operated within the limits specified in the technical data, [see 2](#).
- The system must be used in such a way that no persons are endangered or machines and other material goods are damaged in the event of malfunction or total failure of the system.
- Take additional precautions for safety and damage prevention in case of safety-related applications.

1.5 Proper Environment

- Protection class: IP67 (NEMA-4)
- Operating temperature: 0 ... +50 °C (+32 ... +122 °F)
- Storage temperature: -40 ... +70 °C (-40 ... +158 °F)
- Relative humidity: 10 ... 95 %, non-condensing

| |
|---------------|
| NOTICE |
|---------------|

Avoid abrupt changes of the ambient temperature.
> Incorrect display of the device

2. Technical Data

2.1 Functional Principle

The thermoMETER TIM 8 and the thermoIMAGER TIM 40 calculates the surface temperature based on the emitted infrared energy of objects, [see 10](#). The two-dimensional detector (FPA - focal plain array) allows a measurement of an area and will be shown as thermographic image using standardized palettes. The radiometric processing of the picture data enables the user to do a comfortable detailed analysis with the software TIM Connect.

2.2 Model Overview

The cameras of the TIM series are available in the following basic versions:

| Model | Type | Temperature range | Spectral range | Frame rate | Typical applications |
|---------------------|------|-------------------|----------------------|------------------------------|---|
| thermoMETER TIM 8 | IR | -20 to 900 °C | 8 - 14 μm | USB/Ethernet: 50 Hz | Surface measurements in industrial application, autonomous operation with automatic spot finder |
| thermoIMAGER TIM 40 | IR | -20 to 900 °C | 8 - 14 μm | USB: 80 Hz / 27 Hz | Real-time thermographic images in high speed; Detection of smallest temperature differences |
| thermoIMAGER TIM 41 | IR | -20 to 900 °C | 8 - 14 μm | Ethernet: 25 HZ USB: 4 Hz | Surface measurements in industrial application, autonomous operation with automatic spot finder |

2.3 General Specifications

| Model | thermoMETER TIM 8 | thermoIMAGER TIM 40 | thermoIMAGER TIM 41 |
|-------------------------|--|--------------------------------------|---|
| Protection class | IP 67 (NEMA-4) ¹ | | |
| Operating temperature | 0 ... 50 °C (+32 ... +122 °F) | | |
| Storage temperature | -40 ... 70 °C (-40 ... +158 °F) | | |
| Relative humidity | 10 ... 95 %, non-condensing | | |
| Material (housing) | Stainless steel | | |
| Dimensions | 36 x 90 mm / M30 | 36 x 100 mm / M30 | |
| Weight (inclusive lens) | 201 - 221 g (depending on optics) | 216 - 220 g (depending on optics) | |
| Cable length (USB) | USB | 1 m (Standard), 3 m, 5 m | 1 m (Standard), 3 m, 5 m, 10 m, 20 m |
| | Ethernet/ RS485 | 100 m | - |
| Vibration ¹ | IEC 68-2-6: (sinus shaped), see 2.4 IEC 60068-2-64 (broadband noise), see 2.4 | | |
| Shock ¹ | IEC 68-2-27: 25 g and 50 g, see 2.4 | | |

1) Used standards for vibration and shock

2.4 Vibration / Shock

2.4.1 Used Standards

IEC EN 60068-1: 1995-03

Environmental testing - Part 1: General and guidance

IEC 60068-2-6: 2008-10

Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)

IEC 60068-2-27: 2010-02

Environmental testing - Part 2-27: Test Ea and guidance: Shock

IEC 60068-2-47: 2006-03

Environmental testing - Part 2-47: Mounting of specimens for vibration, impact and similar dynamic tests

IEC 60068-2-64: 2009-04

Environmental testing - Part 2-64: Tests - Tests Fh: Vibration, broadband random and guidance

2.4.2 Stress Program (Camera in Operation)

| Shock, half sinus 25 g – testing Ea 25 g (acc. IEC 60068-2-27) | | |
|---|----------------------|---------------------------------|
| Acceleration | 245 m/s ² | (25 g) |
| Pulse duration | 11 ms | |
| Number of directions | 6 | (3 axes with 2 directions each) |
| Duration | 600 shocks | (100 shocks each direction) |
| Shock, half sinus 50 g – testing Ea 50 g (acc. IEC 60068-2-27) | | |
| Acceleration | 490 m/s ² | (50 g) |
| Pulse duration | 11 ms | |
| Number of directions | 6 | (3 axes with 2 directions each) |
| Duration | 18 shocks | (3 shocks each direction) |

| Vibration, sinus shaped – testing Fc (acc. IEC60068-2-6) | | | |
|---|------------------------|---|------------------------------|
| Frequency range | 10 - 500 Hz | | |
| Acceleration | 29.42 m/s ² | (3 g) | |
| Frequency change | 1 octave/ min | | |
| Number of axes | 3 | | |
| Duration | 1:30 h | (3 x 0.30 h) | |
| Vibration, broadband noise – testing Fh (acc. IEC60068-2-64) | | | |
| Frequency change | 10 - 2000 Hz | | |
| Acceleration, effective | 39.3 m/s ² | (4.01 g _{RMS}) | |
| Frequency spectrum | 10 - 106 Hz | 0.9610 (m/s ²) ² /Hz | (0.010 g ² /Hz) |
| | 106 - 150 Hz | +6 dB/ octave | |
| | 150 - 500 Hz | 1.9230 (m/s ²) ² /Hz | (0.020 g ² /Hz) |
| | 500 - 2000 Hz | -6 dB/ octave | |
| | 2000 Hz | 0.1245 (m/s ²) ² /Hz | (0.00126 g ² /Hz) |
| Number of axes | 3 | | |
| Duration | 3 h | (3 x 1 h) | |

2.5 Electrical Specifications

| Model | thermoMETER TIM 8 | thermoIMAGER TIM 40 | thermoIMAGER TIM 41 |
|--|---|--|--------------------------|
| Power supply | USB/ PoE/ 5 - 30 VDC | USB | USB/ PoE/ 5 - 30 VDC |
| Current draw | max. 500 mA | | |
| AO: Output Process Interface (PIF out) | 0/4 - 20 mA | 0 - 10 V | 0/4 - 20 mA |
| | (Main measure area, measure area, internal temperature, flag status, alarm, frame sync, fail-safe, external communication), see A 12. | | |
| AI: Input Process Interface (PIF in) | 0 - 10 V (Emissivity, ambient temperature, reference temperature, uncommitted value, flag control, triggered recording, triggered snapshots, triggered line-scanner, triggered event grabber, reset peak-/valley-hold), see A 12. | | |
| DI: Digital Input Process Interface | Flag control, triggered recording, triggered snapshots, triggered line-scanner, triggered event grabber, reset peak-/valley-hold | | |
| DO: Digital Output Process Interface | Flag Status, alarm, frame sync, fail-safe, external communication | | |
| Digital interface | USB 2.0/ Ethernet/ RS485 | USB 2.0/ optional USB to GigE (PoE) conversion | USB 2.0/ Ethernet/ RS485 |

2.7 Measurement Specification

| Model | thermoMETER TIM 8 | thermoIMAGER TIM 40 | thermoIMAGER TIM 41 |
|-------------------------------|---|---|---|
| Temperature ranges (scalable) | -20 ... 100 °C; 0 ... 250 °C; (20) 150 ... 900 °C ¹⁾ | 20 ... 100 °C; 0 ... 250 °C; (20) 150 ... 900 °C ¹⁾ | -20 ... 100 °C; 0 ... 250 °C; (20) 150 ... 900 °C ¹⁾ |
| Spectral range | 8 - 14 μm | | |
| Detector | UFPA, 80 x 80 Pixel @ 50 Hz | UFPA, 382 x 288 Pixel @ 80 Hz/27 Hz | UFPA, Ethernet: 384 x 240 Pixel @ 25 Hz USB: 384 x 240 Pixel @ 4 Hz |
| Lenses (FOV) | 12° x 12° (F=1,0); 30° x 30° (F=0,9); 55° x 55° (F=0,9); 80° x 80° (F=0,9) | 18° x 14° (F=1,1); 29° x 22° (F=0,9); 53° x 38° (F=0,9); 80° x 54° (F=0,9) | 18° x 12° (F=1,1); 29° x 18° (F=0,9); 53° x 31° (F=0,9); 80° x 44° (F=0,9) |
| Optical resolution (D:S) | 190:1 (12° optic) | 390:1 (18° optic) | |
| System accuracy ²⁾ | ±2°C or ±2 % | | |
| Temperature resolution (NETD) | 100 mK | 80 mK | |
| Warm-up time | 10 min | | |
| Emissivity | 0.100 ... 1.100 | | |
| Software | TIMConnect | | |

1) Accuracy statement effective from 150 °C

2) At ambient temperature 23±5 °C; whichever is greater.

3. Delivery

3.1 Unpacking, Included in Delivery

1 thermoMETER TIM 8, thermoIMAGER TIM 40 or thermoIMAGER TIM 41

1 USB cable (1 m ¹)

1 Ethernet PoE cable: 1 m (only for thermoIMAGER TIM 41)

1 Mounting nut and mounting bracket (adjustable in one axis, tripod thread)

1 Process interface cable inclusive terminal block (1 m)

1 USB stick with software package TIM Connect

1 Assembly instructions

- ➡ Carefully remove the components of the measuring system from the packaging and ensure that the goods are forwarded in such a way that no damage can occur.
- ➡ Check the delivery for completeness and shipping damage immediately after unpacking.
- ➡ If there is damage or parts are missing, immediately contact the manufacturer or supplier.


Optional accessories are available in the appendix, [see A 1](#).

3.2 Storage

- Storage temperature: -40 ... +70 °C (-40 ... +158 °F)
- Relative humidity: 10 ... 95 %, non-condensing

1) The camera plug of USB cable (1 m) does not feature an IP67 protection class. For industrial applications there are cables with 1 m, 3 m, 10 m and 20 m with IP67 available as optional accessories.

4. Optical Charts

i Make sure that the focus of thermal channel is adjusted correctly. The cameras have a motorized focus, which can be adjusted in the TIM Connect Software via Menu `View > Windows > Distance` or over the icon . An adjustment to the left leads to the focus setting “near” and an adjustment to the right to the focus setting “infinite”.

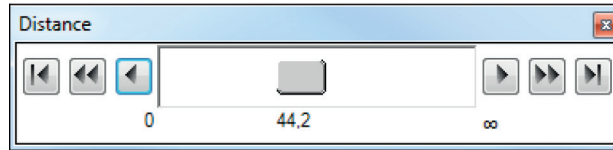


Fig. 1 Motorized focus settings in TIM Connect software

The variety of different lenses offers the possibility to precisely measure objects in different distances. We offer lenses for close, standard distances and large distances.

i Please note that the TIM camera has a fixed optic. A change of optics is not possible.
i Please note that the motorized focus should only be used for startup and installation purposes and that permanent movement of the focus motor is not allowed.

Different parameters are important if using infrared cameras. They display the connection between the distance of the measured object and the size of the pixel, [see Fig. 3](#), [see Fig. 4](#), [see Fig. 5](#).

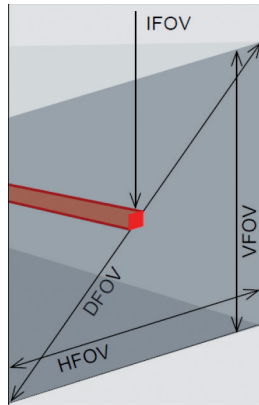


Fig. 2 Dependency between field of view (FOV) and distance

| | |
|------|--|
| HFOV | Horizontal enlargement of the total measuring at object level |
| VFOV | Vertical enlargement of the total measuring at object level |
| IFOV | Size at the single pixel at object level |
| DFOV | Diagonal dimension of the total measuring field at object level |
| MFOV | Recommended, smallest measured object size of 3 x 3 Pixel (thermoIMAGER TIM 40 / TIM 41) and 2 x 2 (thermoMETER TIM 8), not shown in the drawing above, see Fig. 2 . |

Geometric resolution for ideal temperature measurement

When designing optics for measuring IR cameras, special attention must be paid to the quality of detail contrast with which an object can be represented in the image. This is described by the modulation transfer function (MTF). Since in contrast to visual cameras, with IR cameras the thermal contrast is of more interest, this is used together with the slit response function (SRF). The result is determined by the number of pixels an object needs to fill to allow its temperature to be measured exactly. In high-performance infrared optical systems, this is 3×3 pixels or 2x2 pixels. A high-performance camera lens also allows a larger measuring distance with the same number of pixels of the detector, or the precise temperature measurement of smaller structures and objects. The 3×3 pixel (2x2 pixel) geometry is described as MFOV (measurement field of view) - one single pixel on the object surface is described as IFOV (instantaneous field of view). The MFOV is comparable with the measuring spot definition with infrared thermometers.

The following tables with examples showing what spot sizes and pixel sizes will be reached in which distance. For individual configuration there are different lenses available. Wide angle lenses have a radial distortion due to their large opening angle; the software TIM Connect has an algorithm which corrects this distortion. As an alternative to the tables below, the optics calculator can also be used. You will find the latest software at: <https://www.micro-epsilon.com/temperature-sensors/thermoIMAGER/optics/>

4.1 Lenses thermoMETER TIM 8

| TIM 8 | Focal length [mm] | Angle | Minimum measurement distance ¹ | Distance to measurement object [m] | | | | | | | | | | | | |
|-------------------------------------|-------------------|--------------------------|---|------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-------|-------|--------|
| | | | | | 0.05 | 0.1 | 0.2 | 0.3 | 0.5 | 1 | 2 | 4 | 6 | 10 | 30 | 100 |
| 80 x 80 px 30 ° Standard lens | 5 | 30° 30° 6.67 mrad | 0.2 m | HFOV [m] | 0.028 | 0.056 | 0.111 | 0.167 | 0.279 | 0.557 | 1.115 | 2.23 | 3.346 | 5.6 | 16.7 | 55.8 |
| | | | | VFOV [m] | 0.028 | 0.056 | 0.111 | 0.167 | 0.279 | 0.557 | 1.115 | 2.23 | 3.346 | 5.6 | 16.7 | 55.8 |
| | | | | Ifov [mm] | 0.33 | 0.67 | 1.33 | 2.0 | 3.33 | 6.67 | 13.33 | 26.67 | 40.0 | 66.67 | 200.0 | 666.67 |
| 12 ° Telephoto lens | 13 | 12° 12° 2.66 mrad | 0.3 m | HFOV [m] | | 0.022 | 0.043 | 0.065 | 0.21 | 0.21 | 0.43 | 0.85 | 1.28 | 2.1 | 6.4 | 21.3 |
| | | | | VFOV [m] | | 0.022 | 0.043 | 0.065 | 0.11 | 0.21 | 0.43 | 0.85 | 1.28 | 2.1 | 6.4 | 21.3 |
| | | | | Ifov [mm] | | 0.3 | 0.5 | 0.8 | 1.3 | 2.7 | 5.3 | 10.6 | 15.9 | 26.6 | 79.7 | 265.6 |
| 55 ° Wide angle lens | 3 | 55° 55° 11.15 mrad | 0.2 m | HFOV [m] | 0.057 | 0.110 | 0.218 | 0.325 | 0.539 | 1.07 | 2.14 | 4.27 | 6.41 | 10.7 | 32.0 | 106.7 |
| | | | | VFOV [m] | 0.057 | 0.110 | 0.218 | 0.325 | 0.539 | 1.07 | 2.14 | 4.27 | 6.41 | 10.7 | 32.0 | 106.7 |
| | | | | Ifov [mm] | 0.6 | 1.2 | 2.3 | 3.4 | 5.6 | 11.2 | 22.4 | 44.6 | 66.9 | 111.5 | 334.5 | 1114.8 |
| 80 ° Super wide angle lens | 2 | 80° 80° 15.45 mrad | 0.2 m | HFOV [m] | 0.090 | 0.174 | 0.343 | 0.509 | 0.884 | 1.682 | 3.357 | 6.708 | 10.058 | 16.8 | 50.3 | 167.5 |
| | | | | VFOV [m] | 0.090 | 0.174 | 0.343 | 0.509 | 0.88 | 1.682 | 3.357 | 6.08 | 10.058 | 16.8 | 50.3 | 167.5 |
| | | | | Ifov [mm] | 0.08 | 1.6 | 3.2 | 4.7 | 7.8 | 15.5 | 31.0 | 61.9 | 92.8 | 154.6 | 463.7 | 1545.5 |

Fig. 3 Table with examples (TIM 8) showing what spot sizes and pixel sizes will be reached in which distance

FOV: Horizontal enlargement of the total measuring field at object level

VFOV: Vertical enlargement of the total measuring field at object level

Ifov: Size of the single pixel at object level

1) The accuracy of measurement can be outside of the specifications for distances below the defined minimum distance.

4.2 Lenses thermoIMAGER TIM 40

| TIM 40 382 x 288 px | Focal length [mm] | Angle | Minimum measurement distance ¹ | Distance to measurement object [m] | | | | | | | | | | | | |
|---------------------------------|----------------------|------------------------|---|------------------------------------|-------|-------|-------|-------|------|------|------|------|------|------|-------|-------|
| | | | | | 0.05 | 0.1 | 0.2 | 0.3 | 0.5 | 1 | 2 | 4 | 6 | 10 | 30 | 100 |
| 29° Standard lens | 13 | 29° 22° 1.3 mrad | 0.35 m | HFOV [m] | | 0.059 | 0.111 | 0.16 | 0.27 | 0.53 | 1.06 | 2.1 | 3.2 | 5.3 | 15.8 | 52.5 |
| | | | | VFOV [m] | | 0.043 | 0.082 | 0.12 | 0.20 | 0.39 | 0.78 | 1.5 | 2.3 | 3.9 | 11.6 | 38.5 |
| | | | | IIFOV [mm] | | 0.2 | 0.3 | 0.4 | 0.7 | 1.4 | 2.8 | 5.5 | 8.3 | 13.8 | 41.2 | 137.4 |
| 18° Telephoto lens | 20 | 18° 14° 0.9 mrad | 0.35 m | HFOV [m] | | | 0.069 | 0.102 | 0.17 | 0.33 | 0.66 | 1.30 | 1.9 | 3.2 | 9.7 | 32.4 |
| | | | | VFOV [m] | | | 0.051 | 0.076 | 0.12 | 0.25 | 0.49 | 0.98 | 1.5 | 2.5 | 7.4 | 24.6 |
| | | | | IIFOV [mm] | | | 0.2 | 0.3 | 0.4 | 0.9 | 1.7 | 3.4 | 5.1 | 8.5 | 25.4 | 84.8 |
| 53° Wide angle lens | 8 | 53° 38° 2.2 mrad | 0.25 m | HFOV [m] | | 0.099 | 0.20 | 0.30 | 0.49 | 0.99 | 2.0 | 4.0 | 5.9 | 9.9 | 29.6 | 98.6 |
| | | | | VFOV [m] | | 0.071 | 0.14 | 0.21 | 0.34 | 0.68 | 1.4 | 2.7 | 4.1 | 6.8 | 20.4 | 68.1 |
| | | | | IIFOV [mm] | | 0.26 | 0.53 | 0.78 | 1.3 | 2.6 | 5.2 | 10.4 | 15.5 | 25.9 | 77.5 | 258.2 |
| 80° Super wide angle lens | 6 | 80° 54° 3.0 mrad | 0.2 m | HFOV [m] | 0.084 | 0.16 | 0.32 | 0.48 | 0.81 | 1.6 | 3.3 | 6.5 | 9.8 | 16.6 | 49.9 | 166.4 |
| | | | | VFOV [m] | 0.056 | 0.11 | 0.21 | 0.331 | 0.51 | 1.0 | 2.0 | 4.1 | 6.1 | 10.2 | 30.6 | 101.9 |
| | | | | IIFOV [mm] | 0.2 | 0.4 | 0.8 | 1.3 | 2.1 | 4.2 | 8.5 | 17.0 | 25.7 | 43.6 | 130.7 | 435.5 |

Fig. 4 Table with examples (TIM 40) showing what spot sizes and pixel sizes will be reached in which distance

FOV: Horizontal enlargement of the total measuring field at object level

VFOV: Vertical enlargement of the total measuring field at object level

IIFOV: Size of the single pixel at object level

1) The accuracy of measurement can be outside of the specifications for distances below the defined minimum distance.

4.4 Lenses thermoIMAGER TIM 41

| TIM 41 | Focal length [mm] | Angle | Minimum measurement distance ¹ | Distance to measurement object [m] | | | | | | | | | | | | |
|------------------------------|-------------------|------------------------|---|------------------------------------|-------|-------|-------|-------|------|------|------|------|------|------|-------|-------|
| | | | | | 0.05 | 0.1 | 0.2 | 0.3 | 0.5 | 1 | 2 | 4 | 6 | 10 | 30 | 100 |
| 29° Standard lens | 13 | 29° 18° 1.4 mrad | 0.35 m | HFOV [m] | | 0.059 | 0.112 | 0.17 | 0.27 | 0.53 | 1.07 | 2.1 | 3.2 | 5.3 | 15.9 | 52.9 |
| | | | | VFOV [m] | | 0.036 | 0.068 | 0.10 | 0.16 | 0.32 | 0.64 | 1.3 | 1.9 | 3.2 | 9.5 | 31.7 |
| | | | | Ifov [mm] | | 0.2 | 0.3 | 0.4 | 0.7 | 1.4 | 2.8 | 5.5 | 8.3 | 13.8 | 41.3 | 137.7 |
| 18° Telephoto lens | 20 | 18° 12° 0.9 mrad | 0.35 m | HFOV [m] | | | 0.069 | 0.102 | 0.17 | 0.33 | 0.66 | 1.31 | 2.0 | 3.3 | 9.8 | 32.6 |
| | | | | VFOV [m] | | | 0.043 | 0.064 | 0.10 | 0.21 | 0.41 | 0.82 | 1.2 | 2.1 | 6.1 | 20.5 |
| | | | | Ifov [mm] | | | 0.2 | 0.3 | 0.4 | 0.9 | 1.7 | 3.4 | 5.1 | 8.5 | 25.5 | 84.8 |
| 53° Wide angle lens | 8 | 53° 31° 2.6 mrad | 0.25 m | HFOV [m] | | 0.100 | 0.20 | 0.30 | 0.49 | 0.99 | 2.0 | 4.0 | 5.9 | 9.9 | 29.7 | 98.9 |
| | | | | VFOV [m] | | 0.057 | 0.11 | 0.17 | 0.28 | 0.55 | 1.1 | 2.2 | 3.3 | 5.5 | 16.5 | 54.9 |
| | | | | Ifov [mm] | | 0.3 | 0.5 | 0.8 | 1.3 | 2.6 | 5.1 | 10.3 | 15.5 | 25.8 | 77.2 | 257.4 |
| 80° Super wide angle lens | 6 | 80° 44° 4.3 mrad | 0.2 m | HFOV [m] | 0.084 | 0.16 | 0.32 | 0.48 | 0.81 | 1.6 | 3.3 | 6.5 | 9.8 | 16.6 | 49.9 | 166.4 |
| | | | | VFOV [m] | 0.044 | 0.08 | 0.17 | 0.25 | 0.41 | 0.8 | 1.6 | 3.2 | 4.8 | 8.0 | 24.1 | 80.4 |
| | | | | Ifov [mm] | 0.2 | 0.4 | 0.8 | 1.3 | 2.1 | 4.2 | 8.5 | 16.9 | 25.5 | 43.4 | 130.0 | 433.2 |

Fig. 5 Table with examples (TIM 41) showing what spot sizes and pixel sizes will be reached in which distance

FOV: Horizontal enlargement of the total measuring field at object level

VFOV: Vertical enlargement of the total measuring field at object level

Ifov: Size of the single pixel at object level

1) The accuracy of measurement can be outside of the specifications for distances below the defined minimum distance.

5. Mechanical Installation

The thermoMETER TIM 8 and the thermoIMAGER TIM 40 / TIM 41 are equipped with a metric M30x1 thread and can be installed either directly via the sensor thread or with help of the supplied mounting nut (standard) and adjustable mounting bracket (standard) to a mounting device available, [see Fig. 7](#).

5.1 Dimensional Drawings



Fig. 6 thermoMETER TIM 8 / thermoIMAGER TIM 40 / TIM 41 with mounting bracket

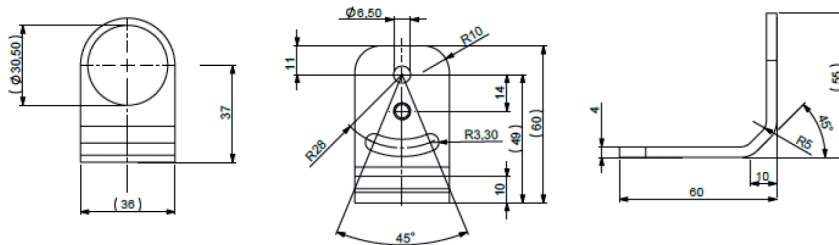


Fig. 7 Mounting bracket, adjustable in one axis, with tripod thread

i For correct orientation, the USB port must be on the left side and the PIF port on the right side, [see Fig. 8](#), [see Fig. 9](#), [see Fig. 10](#).

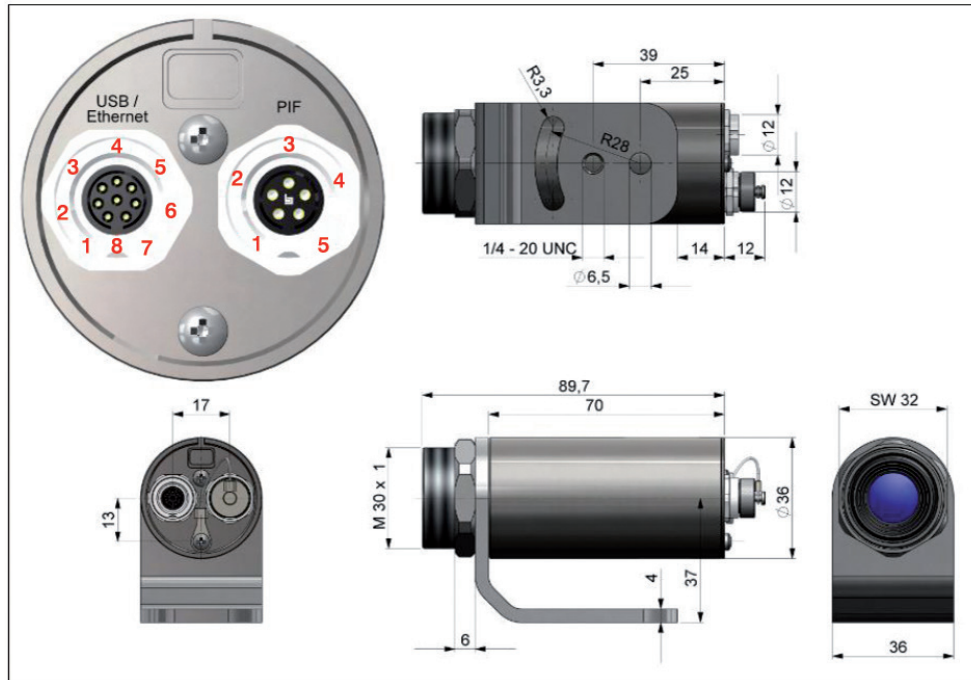


Fig. 8 Dimensional drawing thermoMETER TIM 8, dimensions in mm

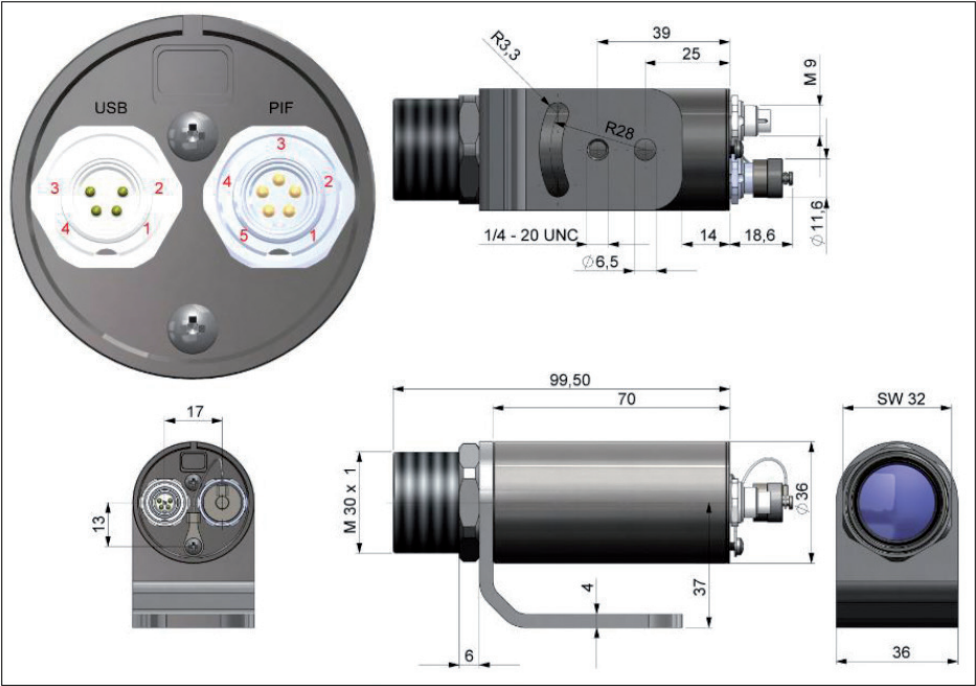


Fig. 9 Dimensional drawing thermoMETER TIM 40, dimensions in mm

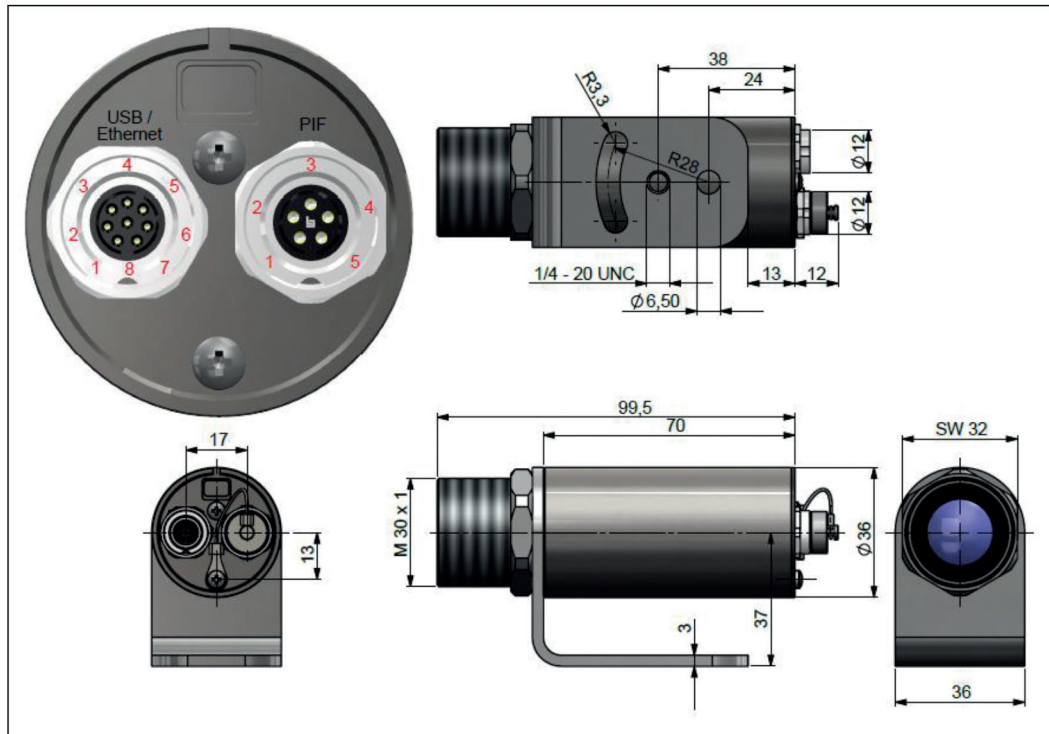


Fig. 10 Dimensional drawing thermoIMAGER TIM 41, dimensions in mm

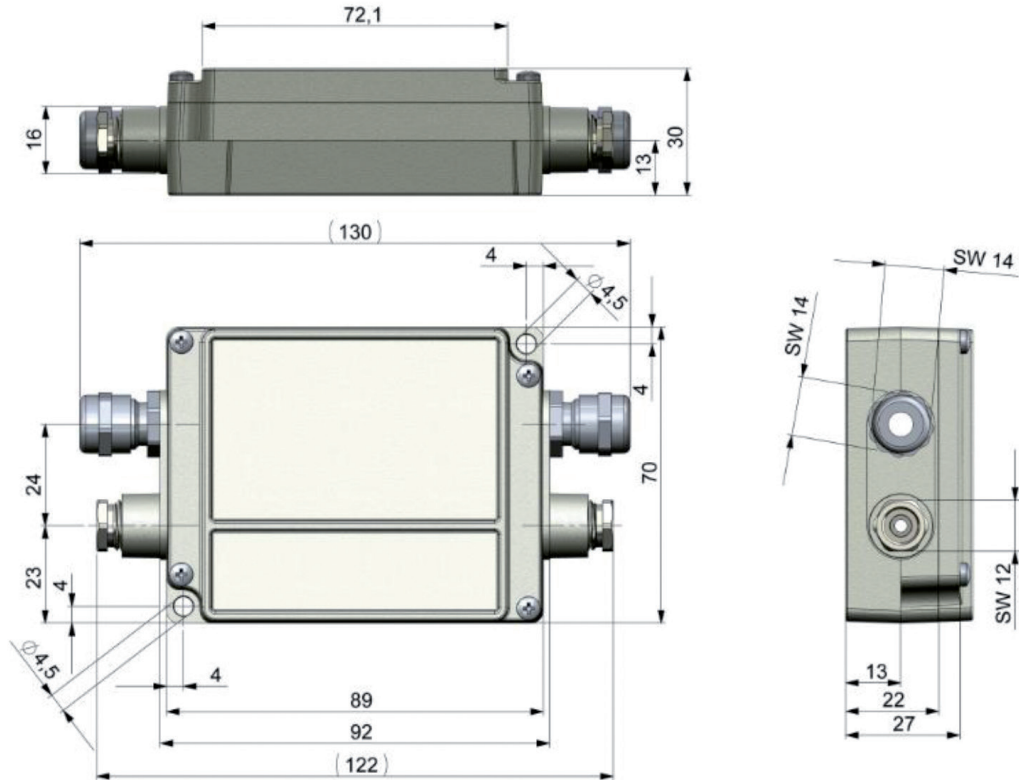


Fig. 11 Industrial/stackable PIF (Process Interface) - electronic box, control box shutter, dimensions in mm

6. Electrical Installation

At the back side of the thermoMETER TIM 8 / thermoIMAGER TIM 41 and the thermoIMAGER TIM 40 cameras there are the two connector plugs, see Fig. 12, see Fig. 13.



Fig. 12 Back side of the thermoMETER TIM 8 / thermoIMAGER TIM 41 with connectors

- 1 Plug for USB/ Ethernet ¹⁾ / PoE cable
- 2 Plug for in- and outputs or RS485



Fig. 13 Back side of the thermoIMAGER TIM 40 with connectors

- 1 Plug for USB cable
- 2 Plug for PIF cable

1) When using the Ethernet interface, either a PoE source or a 5 ... 30 V DC power supply via the terminal block must be used.

6.1 Process Interface

6.2 Process Interface thermoMETER TIM 8 / thermoIMAGER TIM 41

The thermoMETER TIM 8 / thermoIMAGER TIM 41 is equipped with an integrated process interface (cable with terminal block included in scope of supply), which can be programmed via the software as an direct analog input (AI) / digital input, as an direct analog output (AO) in order to control the process or as an RS485 interface ¹⁾. The signal level is 0 - 10 V for AI, 24 V for DI and 0/4 - 20 mA for AO.


The process interface can be activated choosing the following options:

| | |
|--------------------|---|
| Analog Input (AI) | Emissivity, ambient temperature, reference temperature, uncommitted value, flag control, triggered recording, triggered snapshots, triggered line-scanner, triggered event grabber, reset peak-/valley-hold |
| Analog Output (AO) | Main measure area, measure area, internal temperature, flag status, alarm, frame sync, fail-safe, external communication |

1) Power supply only necessary when using the Ethernet connection (without PoE) or self-sufficient operation.



Fig. 14 Configuration terminal block thermoMETER TIM 8 / thermoIMAGER TIM 41

| Designation | | Description | Color |
|---|----------|-----------------------------------|--------|
|  | | Shield | Black |
| GND | 0 V | Ground | Brown |
| VCC | 5 - 30 V | Power supply ¹⁾ | White |
| IN | A | Analog/Digital Input or RS485 (A) | Green |
| OUT | B | Analog output or RS485 (B) | Yellow |
| GND | ISO | Isolated Ground for IN and OUT | Gray |

1) Power supply only necessary when using the Ethernet connection (without PoE) or self-sufficient operation (minimum voltage when using the Ethernet connection: 12 V)

The thermoMETER TIM 8 / thermoIMAGER TIM 41 provides the following direct inputs and outputs:

| Designation | Description | max range / status |
|--------------------|---|----------------------------|
| AI | Analog input | 0 - 10 V ¹⁾ |
| or DI | Digital input (Low-active = 0 ... 0.6 V) | 24 V |
| AO | Analog output Alarm output | 0/4 - 20 mA 0/4 - 20 mA |

In addition to the above direct in- and outputs, the TIM 8 / TIM 41 has an RS485 interface. This interface can be used to control the external industrial PIF.

1) The AI is designed for max. 24 V, the voltage level above 10 V is not interpreted.

6.3 Process Interface thermoIMAGER TIM 40

i The process interface (electronics within cable as well as industrial interface) must be powered separately (5 - 24 VDC).

➡ Connect the PIF cable to the camera before switching on the power.


The TIM is equipped with a process interface (cable with integrated electronics and terminal block), which can be programmed via the software as an Analog Input (AI) and Digital Input (DI) in order to control the camera or as an Analog Output (AO) in order to control the process. The signal level is always 0 - 10 V (DI = 24 V).

The process interface can be activated choosing the following options:

| | |
|--------------------|---|
| Analog input (AI) | Emissivity, ambient temperature, reference temperature, uncommitted value, flag control, triggered recording, triggered snapshots, triggered line-scanner, triggered event grabber, reset peak-/valley-hold |
| Analog output (AO) | Main measure area, measure area, internal temperature, flag status, alarm, frame sync, fail-safe, external communication |
| Digital input (DI) | Flag control, triggered recording, triggered snapshots, triggered line-scanner, triggered event grabber, reset peak-/valley-hold |



Fig. 15 Configuration terminal block thermoIMAGER TIM 40

| Designation | Description | Color |
|---|-----------------------------|--------|
|  | Shield | Black |
| GND | Ground | Brown |
| DI | Digital input | Gray |
| Vcc | Power supply, 5 ... 24 V DC | White |
| AI | Analog input | Green |
| AO | Analog output | Yellow |


The standard process interface can be activated choosing the following options:

| Designation | Description | max range ¹⁾ / status |
|-------------|---|----------------------------------|
| AI | Analog input | 0 - 10 V ²⁾ |
| DI | Digital input (Low-active = 0 ... 0.6 V) | 24 V |
| AO | Analog output Alarm output | 0 - 10 V 0/ 10 V |

1) Depending on supply voltage; for 0 - 10 V on the AO the PIF has to be powered with min. 12 V.

2) The AI is designed for max. 24 V, the voltage level above 10 V is not interpreted.

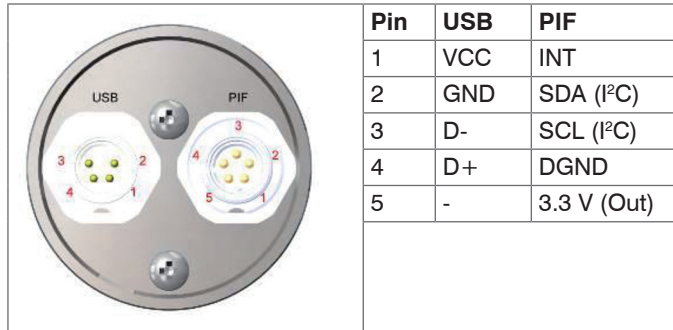
6.4 Pin Assignment thermoMETER TIM 8 / thermoIMAGER TIM 41



| Pin | USB | Ethernet | PIF |
|-----|-----|----------|-------------|
| 1 | VCC | | VCC |
| 2 | D+ | | RS485 or AO |
| 3 | D- | | RS485 or AI |
| 4 | | Tx+ | GND |
| 5 | | Tx- | GND-ISO |
| 6 | | Rx+ | |
| 7 | | Rx- | |
| 8 | GND | | |

Fig. 16 Rear side thermoMETER TIM 8 / thermoIMAGER TIM 41 connector

6.5 Pin Assignment thermoIMAGER TIM 40



| Pin | USB | PIF |
|-----|-----|------------------------|
| 1 | VCC | INT |
| 2 | GND | SDA (I ² C) |
| 3 | D- | SCL (I ² C) |
| 4 | D+ | DGND |
| 5 | - | 3.3 V (Out) |

Fig. 17 Rear side thermoIMAGER TIM 40 connector

If the process interface of the camera is directly connected to external hardware ¹ (without using the supplied PIF cable) an activation of the field `Support proprietary PIF cable` in the menu `Tools > Configuration > Device (PIF)` in the TIM Connect software is necessary.

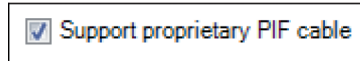


Fig. 18 Support proprietary PIF cable

i Consider that the input of the PIF is not protected if there is a direct PIF connection!



In this case, avoid a voltage > 3 V at INT pin.
> Destruction of the camera

1) We recommend using only a switching contact between INT and DGND as external hardware (button, relay).

7. Commissioning

➡ Please install at first the software TIM Connect from the delivered USB stick, [see 9.1](#).

• Further information regarding software installation as well as software features you will find in the operating instructions from the delivered USB stick.

➡ Now you can connect the thermoIMAGER TIM camera into an USB port (USB 2.0) of your PC.

➡ If connecting the thermoIMAGER TIM camera and the computer please plug at first the USB cable into the camera and then into the computer.

NOTICE

If disconnecting the thermoIMAGER TIM camera and the computer please remove at first the USB cable from the computer and then from the camera.


> Damage to or destruction of the camera

After the software has been started, you should see the live image from the camera inside a window on your PC screen, [see Fig. 19](#).



Fig. 19 Live image of camera

At first start of software you will be asked to install the calibration data of camera. You will find them on the delivered USB stick or can be accessed online via the Internet.

➡ Adjust the focus of the image by using the distance function in the software (menu View > Windows > Distance or over the icon ):

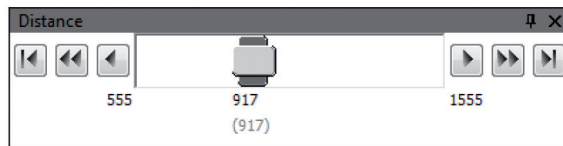


Fig. 20 Window Distance

8. Instructions for Operation

8.1 Cleaning

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).

> Destruction of the sensor and/or the controller

NOTICE

9. Software TIM Connect

9.1 Minimum System Requirements

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

A detailed description is provided in the software manual on delivered USB stick. See also **Help** menu in the TIM Connect software under **Help > Documentation**.

9.2 Installation and Initial Operation


I All drivers are booted via Windows OS automatically. A driver installation is not necessary. By default the program starts automatically in the installed language.

- ➡ 1. Insert the included USB stick in your PC.
- ➡ 2. Please start the `Setup.exe`. Follow the instructions of the wizard until the installation is finished.

The installation wizard places a launch icon on the desktop and in the start menu: `Start\Programs\TIM Connect`.

- ➡ 3. To connect the camera to the PC, plug the USB cable to the camera first. Afterwards connect it with the PC (to disconnect the camera and the computer remove the USB cable from the computer first and then disconnect it from the camera).
- ➡ 4. Start the software.

At the initial start the software asks for the calibration files which are available via internet or on the USB stick (only for TIM 40). With the TIM 8 / TIM 41, the calibration files are already included in the device.

- ➡ 5. Choose the desired language in the menu `Tools > Language`.
- ➡ 6. Adjust the focus of the image by using the distance function in the software (Menu `View > Windows > Distance` or over the icon ):

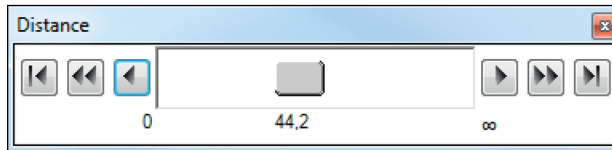


Fig. 21 Window Distance

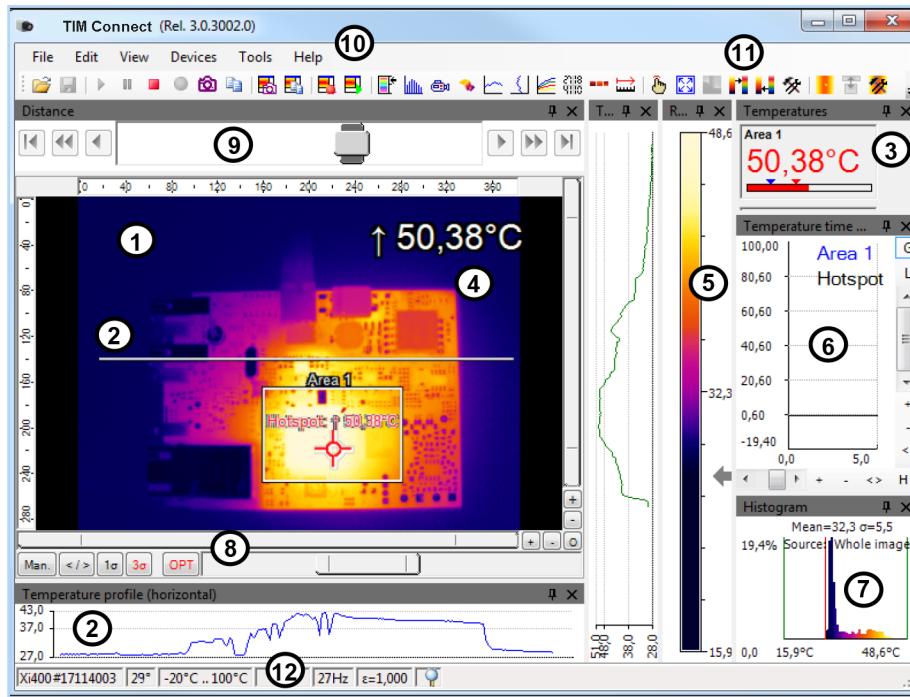


Fig. 22 Software window

- i** Further information regarding software installation as well as software features you will find in the operation instructions.
They are available online at:
<http://www.micro-epsilon.com/download/manuals/man--thermoIMAGER-TIM-Connect--en.pdf>

| | |
|----|---|
| 1 | IR image from the camera |
| 2 | Temperature profile: Shows the temperatures along max. 2 lines at any size and position in the image. |
| 3 | Control displays: Displays all temperature values in the defined measure areas like Cold Spots, Hot Spots, temperature at cursor, internal temperature and chip temperature. Alarm settings: Bar showing the defined temperature thresholds for low alarm value (blue arrow) and high alarm value (red arrow). The color of numbers within control displays changes to red (when temp. above the high alarm value) and to blue (when temp. below the low alarm value). |
| 4 | Temperature of measure area: Analyses the temperature according to the selected shape, e.g. average temperature of the rectangle. The value is shown inside the IR image and the control displays. |
| 5 | Reference bar: Shows the scaling of temperature within the color palette. |
| 6 | Temperature time diagram: Shows the temperature curves over time for selectable region of interest (ROI) |
| 7 | Histogram: Shows the statistic distribution of single temperature values. |
| 8 | Automatic / manual scaling of the palette (displayed temperature range): Man., </> (min, max), 1σ : 1 Sigma, 3σ : 3 Sigma, OPT: Palette optimization |
| 9 | Distance function: Adjustment of the motor focus to focus the IR picture |
| 10 | Menu and Toolbar (Icons) |
| 11 | Icon enabling switching between color palettes |
| 12 | Status bar: Serial number, optic, temperature range, cursor position, device framerate/ display framerate, emissivity, ambient temperature, flag status |

Further details to the software are in the enclosed USB stick.

9.3 Autonomous Operation thermoMETER TIM 8 / thermoIMAGER TIM 41

A special feature of the thermoMETER TIM 8 / thermoIMAGER TIM 41 is the autonomous operation. There is no need for a permanent connection to the TIM Connect software. Only a few settings must be set in advance in the software.

- ➡ To do this, connect the PIF and Ethernet or USB cables to the device.
- ➡ Then connect the thermoMETER TIM 8 / thermoIMAGER TIM 41 to your PC and start the TIM Connect software, [see 9](#).
- ➡ Position and focus, [see 4](#), the camera so that your object to be measured is perfectly visible in the image.
- ➡ First define the desired measurement area with the corresponding mode you want to output.

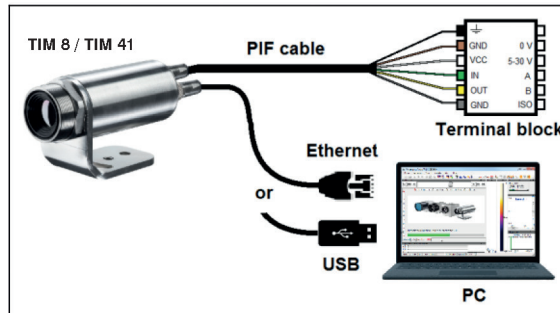


Fig. 23 Connection thermoMETER TIM 8 / thermoIMAGER TIM 41 to PC via USB

- ➡ Now go to the configuration menu on Device (PIF).
- ➡ There you first select the PIF type (in this case: Internal PIF). Then select under Analog Outputs (AO) the function that is to be output autonomously.

➡ Then press **Setup**, make your settings and make sure that the checkbox is set to using autonomously by device.

By pressing the **OK** button an @ sign can be found in the configuration menu Devices (PIF), which indicates the autonomous operation.

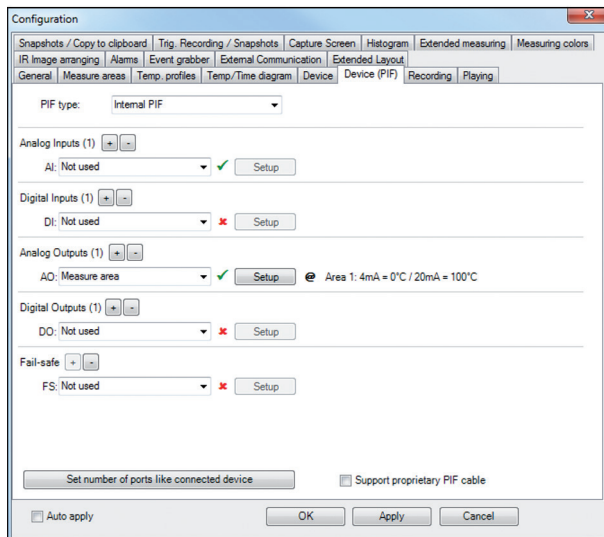


Fig. 24 Configurations menu Device (PIF)

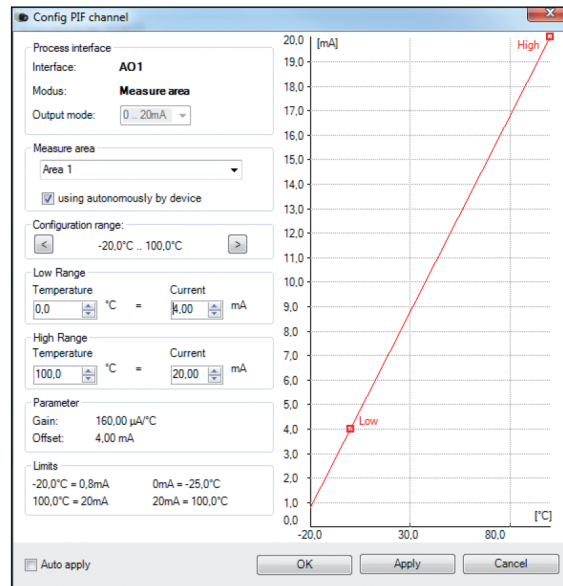


Fig. 25 Setup

9.3.1 Special Settings for thermoIMAGER TIM 41

When using the thermoIMAGER TIM 41 camera, an important additional setting must be made for autonomous operation. When all the configurations have been made, it is important to write them to the device. This is done in the menu under `Devices` and `Set configuration to device`.

If the device is reconnected to a PC after autonomous operation and the settings are to be transferred from the device to the software, this is done in the menu under `Devices` and `Get configuration from device`.

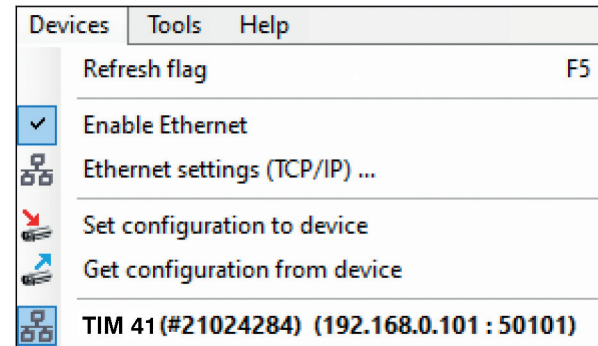


Fig. 26 Set configuration to device

If the device is reconnected to a PC after autonomous operation and the settings are to be transferred from the device to the software, this is done in the menu under `Devices` and `Get configuration from device`.

i An arrow marked in red means that the configuration is different between the camera and the software. As soon as the configuration is loaded into the device, the arrow appears in blue .

In general these are all the settings that must be set in the TIM Connect software in order to operate the device autonomously. You can now close the software and then disconnect the USB cable. In order to start up the device autonomously, a 5 - 30 V power supply must be connected to the terminal block. Now the used input/output has to be connected. The resulting value can be displayed for example on a multimeter, see Fig. 25.

When using this variant, it can last for about half a minute until the device is ready for use in autonomous mode.

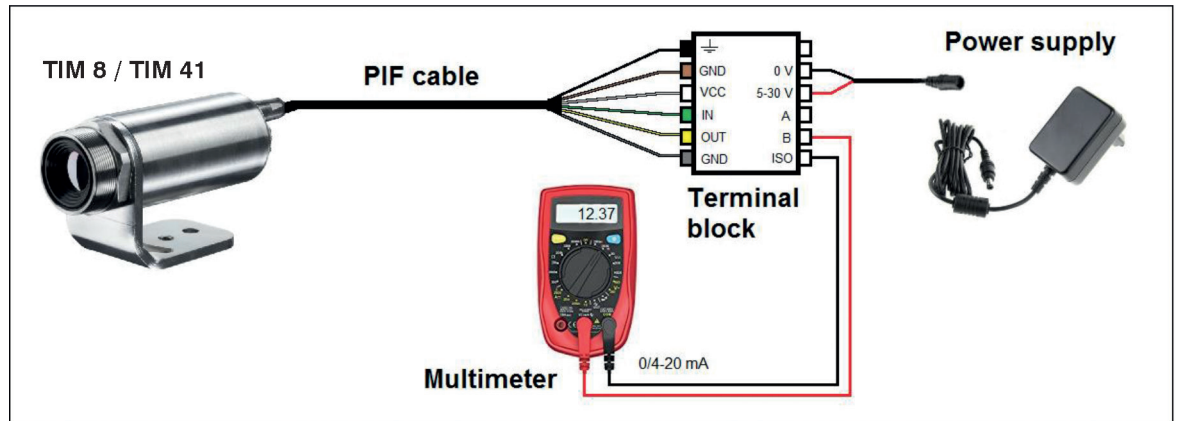
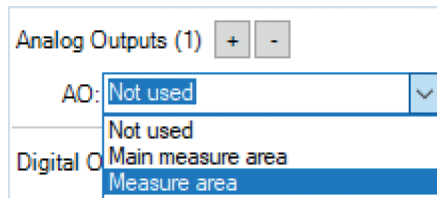


Fig. 27 Electrical installation for autonomous operation of thermoMETER TIM 8 / thermoIMAGER TIM 41

- i
- Autonomous operation also works via the industrial/stackable PIF of the thermoMETER TIM 8 / thermoIMAGER 41. The device is powered by the power supply of the PIF.
 - Up to 9 measure areas (for TIM 8 with firmware 3013 or higher) and up to 3 measure areas (TIM 41) can be output autonomously. The prerequisite in this respect with the TIM 8 is the use of three stackable PIFs.
 - Three analog outputs are possible per stackable PIF. The response time is 20 ms for TIM 8 and 640 ms for TIM 41.
Note: Several measuring areas can be combined into one measuring area via a so-called super area.
 - Autonomous mode cannot be set using the `Main measure area` function (configuration menu device (PIF)). To output a measure area autonomously, the function `Measure area` must be used.



9.3.2 Hot-/Coldspot Function in Autonomous Operation

The setting for a hot- or coldspot in autonomous mode differs from the general procedure. It is not enough to mark a measuring area as hot- or coldspot. Instead, a User defined rectangle must be selected under the tab `measure areas` of the configuration dialog. In addition, under `Mode`, you must set whether the maximum (for hotspot) or minimum (for coldspot) should be output.

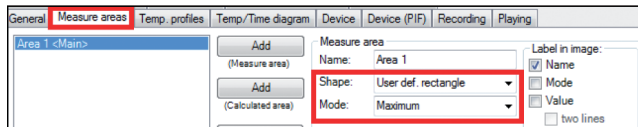


Fig. 28 Setting a hotspot for autonomous operation

For a hot- or coldspot output in the full field of view of the camera, the user defined rectangle must also fill out this size.

Note: Predefined Layout in the software available under Tools and Layouts: TIM 8 Hot spot autonomous or TIM 41 Hot spot autonomous.

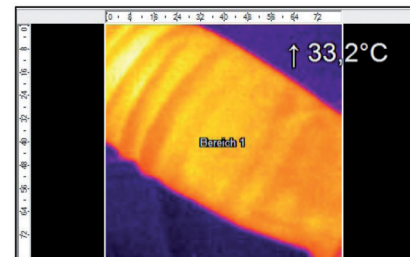


Fig. 29 Measure area over entire field of view

9.4 Ethernet thermoMETER TIM 8 / thermoIMAGER TIM 41

The thermoMETER TIM 8 / thermoIMAGER TIM 41 has a direct Ethernet interface. The advantage is cable lengths of up to 100 m. For example, a switch can be used to extend the distances.

The associated Ethernet cable (Order No.: TM-ETCx-TIM8) must be ordered separately. Ethernet is supported from software version Rel. 3.2.3020.0 and firmware 3008.

Using the Ethernet connection, the device must be supplied with power. This can be done either via:

- the internal PIF cable via the terminal block (5 - 30 V),
- via the stackable PIF (5 - 25 V, Order No.: TM-PIFCx-TIM8) or
- via PoE (Power over Ethernet).

i For the PoE variant, a PoE adapter (Order No.: TM-ETPOEC1-TIM8) and a PoE injector (Order No.: TM-POE-TIM) or PoE switch (e.g. Netgear GS110TP) are also required.

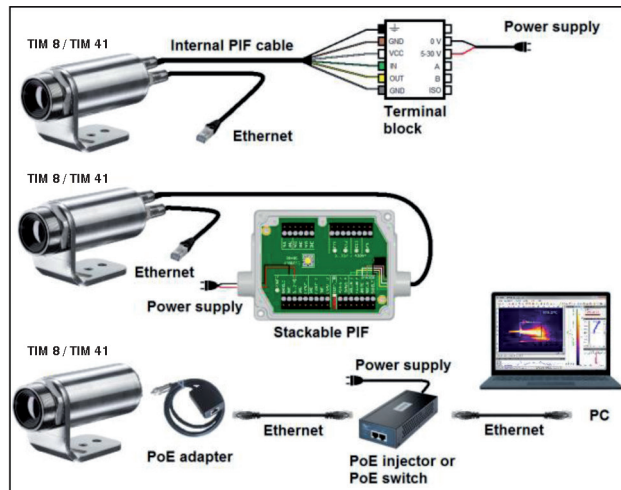


Fig. 30 Possibilities of power supply for thermoMETER TIM 8 / thermoIMAGER TIM 41 via Ethernet connection

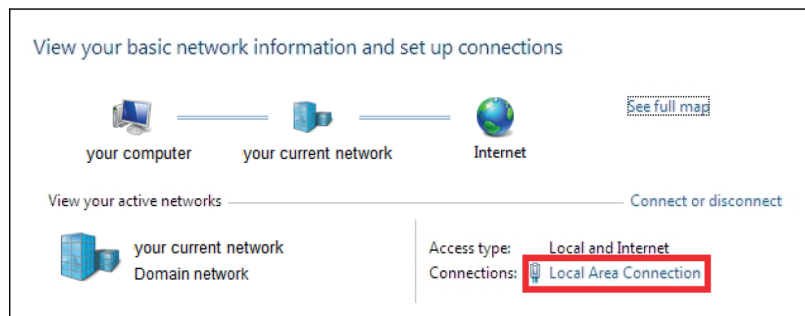
9.4.1 Ethernet Setup (Point-to-Point-Connection)

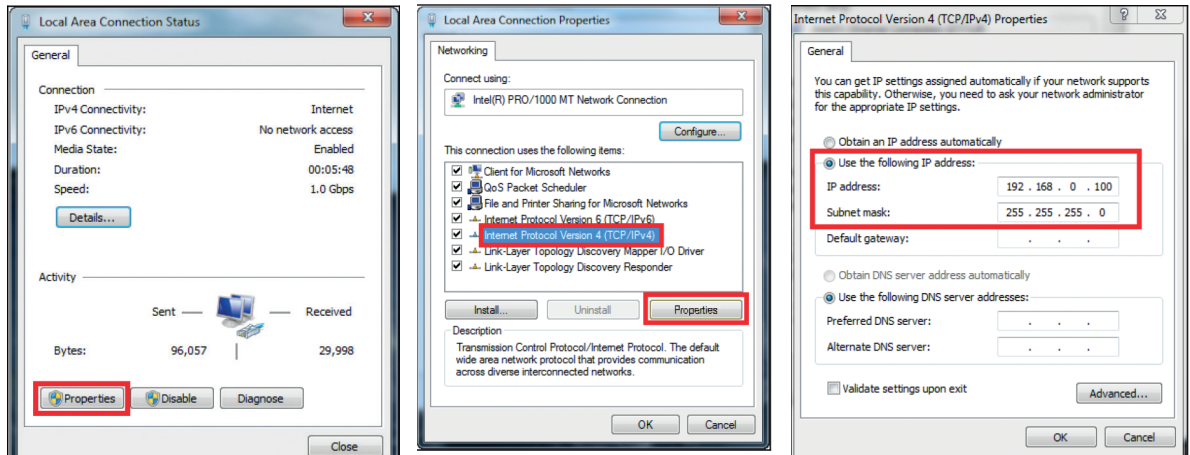
After connecting the Ethernet cable to the camera and the PC, the first thing you need to do is to make the network settings on the PC.

- i The devices are delivered with the following factory settings:
 - IP address camera: 192.168.0.101
 - IP address PC: 192.168.0.100
 - Port number: 50101

➡ To do this, go to Control Panel and open the Network and Sharing Center.

➡ Go on LAN connection.





➡ Click on Properties.

➡ Mark Internet protocol Version 4 (TCP/IPv4) and go to Properties again.

➡ In the register card General enable the checkbox Use the following IP address.

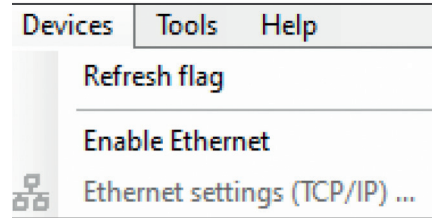
➡ Now enter a user defined IP address for your PC (192.168.0.100).

This must be identical to the address set in the TIM Connect software.

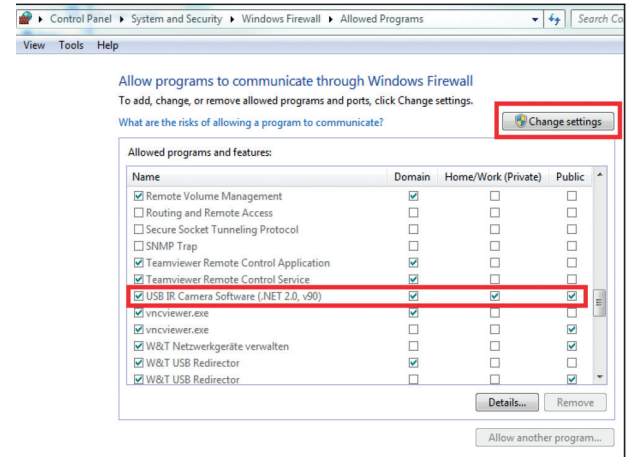
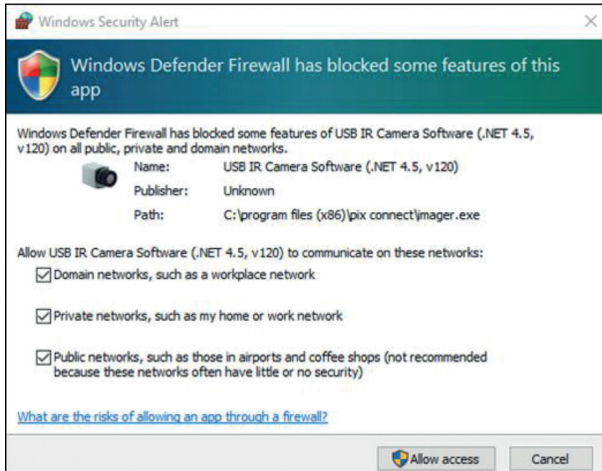
➡ Then close the windows with OK.

The network settings on the PC are complete.

- ▶ Now start the TIM Connect software and activate the Ethernet function.
- ▶ To do this, go to the menu **Devices** and **Enable Ethernet**.



i When a Firewall windows appears, make sure to select all three network parts (domain, private, public) in order to allow the communication with the device.



i The approval of programs can also be activated afterwards in the Windows Firewall settings of the PC (under Windows Firewall and Allow a Program or feature through Windows Firewall).

The device is now ready for the Ethernet connection and is listed in the menu under `Devices`. The camera is identified by a network icon and the network address and port number.

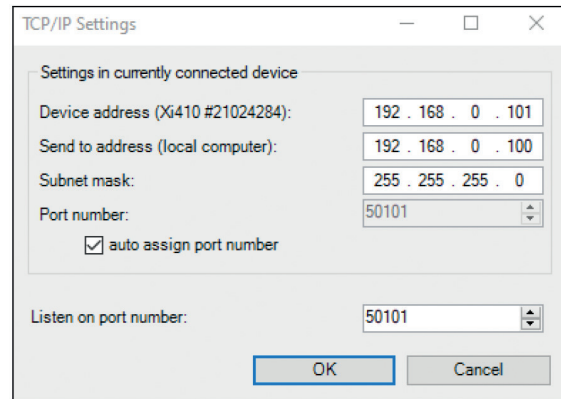
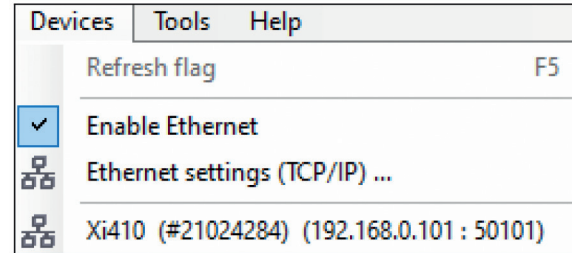
➡ Select the device.

A connection to the device is established and the temperature measurement can begin.

➡ To change the address settings, go to `Devices` and `Ethernet settings (TCP/IP)`.

The address for the device is assigned under `Device address`. This must have a different address (last block) to the other participant (e.g., PC) (`Send to address (local computer)`).

i It is important that the network part (first three blocks) must be identical for both addresses. The address range of the individual blocks can be between 0 and 255.



Additionally, a separate `port number` must be configured. The selected number can be between 1 and 65535.

The option `auto assign port number` assigns a port number automatically.

If several cameras with different port numbers are connected and a specific camera is to be communicated with, the corresponding camera can be determined via `Listen on port number`.

i The port range used should be between 49152 ... 65535. When using other ports, it could be that they are already reserved or assigned.

- i** When using multiple TIM 8 / TIM 41 cameras in a network, the data rate must be considered:
- Switch with 100 Mbps/s: approx. 17 devices (TIM 8), approx. 2 devices (TIM 41 with 25 Hz)
 - Switch with 1000 Mbps/s: approx. 170 devices (TIM 8), approx. 26 devices (TIM 41 with 25 Hz)
- In addition to the data rate also make sure the power performance of the PC is high enough. Each device used requires its own instance.

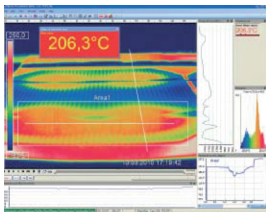
9.5 Basic Features of Software TIM Connect

Extensive infrared camera software



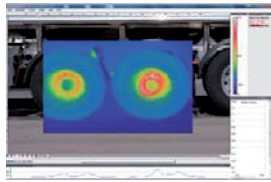
- No restrictions in licensing
- Modern software with intuitive user interface
- Remote control of camera via software
- Display of multiple camera images in different windows
- Compatible with Windows XP, Vista, 7, 8, 10 sowie LabVIEW

High level of individualization for customer specific display



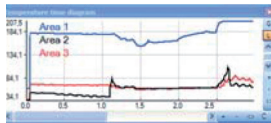
- Various language option including a translation tool
- Temperature display in °C or °F
- Different layout options for an individual setup (arrangement of windows, toolbar)
- Range of individual measurement parameter fitting for each application
- Adaption of thermal image (mirror, rotate)
- Individual start options (full screen, hidden, etc.)

Video recording and snapshot function (IR or BI-SPECTRAL)



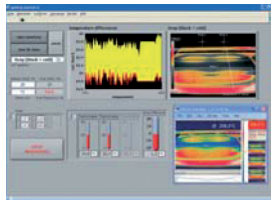
- Recording of video sequences and detailed frames for further analysis or documentation
- Adjustment of recording frequency to reduce data volume
- Display of snapshot history for immediate analysis

Extensive online and offline data analysis



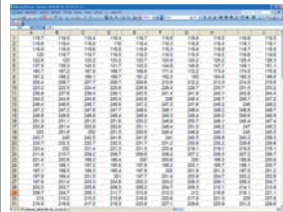
- Analysis supported by measurement fields, hot and cold spot searching, image subtraction
- Real time temperature information within main window as digital or graphic display (line profile, temperature time diagram)
- Slow motion repeat of radiometric files and analysis without camera being connected
- Editing of sequences such as cutting and saving of individual images
- Various color palettes to highlight thermal contrasts

Automatic process control



- Individual setup of alarm levels depending on the process
- Definition of visual or acoustic alarms and analog data output
- Analog and digital signal input (process parameter)
- External communication of software via Comports, DLL and LabVIEW
- Adjustment of thermal image via reference values

Temperature data analysis and documentation



The screenshot shows a data table with multiple columns of numerical values, likely representing temperature readings over time. The table is organized into several columns, with some values appearing to be in scientific notation or specific units. The data is presented in a grid format, typical of a spreadsheet or data viewer application.

- Triggered data collection
- Radiometric video sequences (*.ravi) radiometric snapshots (*.jpg, *.tiff)
- Text files including temp. information for analysis in Excel (*.csv, *.dat)
- Data with color information for standard programmes such as Photoshop or Windows Media Player (*.avi, *.jpg, *.tiff)
- Data transfer in real time to other software programmes via LabVIEW, DLL or Comport interfaces

10. Basics of Infrared Thermometry

10.1 Introduction

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.

Searching for new optical material William Herschel by chance found the infrared radiation in 1800.

He blackened the peak of a sensitive mercury thermometer. This thermometer, a glass prism that led sun rays onto a table made his measuring arrangement.

With this, he tested the heating of different colors of the spectrum. Slowly moving the peak of the blackened thermometer through the colors of the spectrum, he noticed the increasing temperature from violet to red.

The temperature rose even more in the area behind the red end of the spectrum. Finally he found the maximum temperature far behind the red area.

Nowadays this area is called infrared wavelength area.

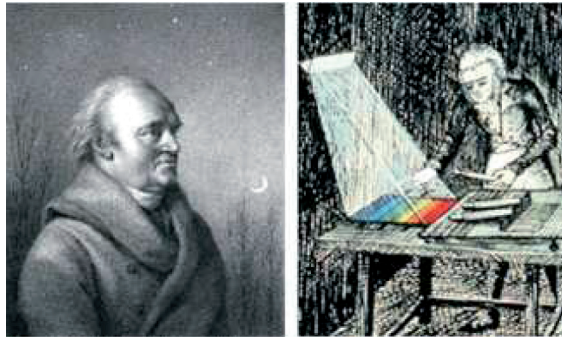


Fig. 31 William Herschel (1738 – 1822)

For the measurement of “thermal radiation” infrared thermometry uses a wave-length ranging between 1μ and $20 \mu\text{m}$.

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, [see 11](#).

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 (sensor)
- Electronics (amplifier/ linearization/ signal processing)

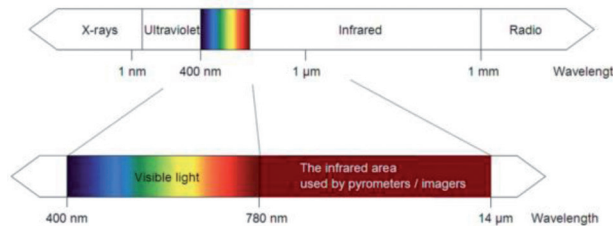
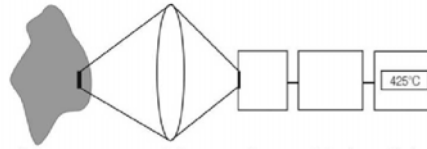


Fig. 32 The electromagnetic spectrum and the area used for temperature measurement

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.



Object Lens Sensor Electronics Display
Infrared system

Fig. 33 Optical path

The advantages of non-contact temperature measurement are clear - it supports:

- temperature measurements of moving or overheated
- objects and of objects in hazardous surroundings
- very fast response and exposure times
- measurement without inter-reaction, no influence on the
- measuring object
- non-destructive measurement
- long lasting measurement, no mechanical wear

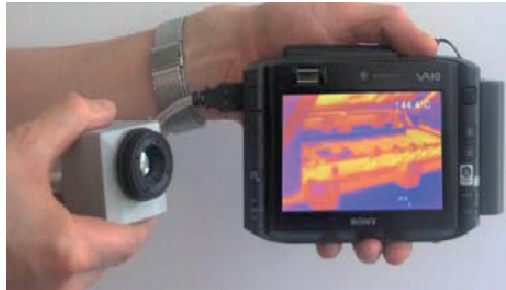
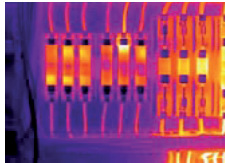
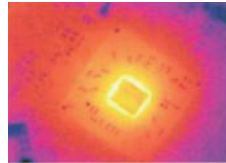


Fig. 34 TIM with tablet PC

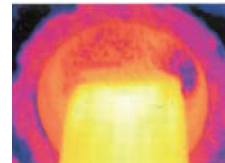
10.2 Application Examples



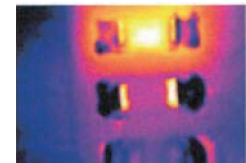
Monitoring of electronic cabinets



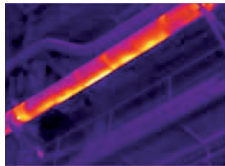
Electronic development



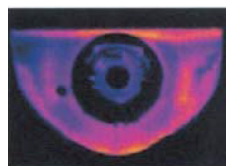
Process control extruding plastic parts



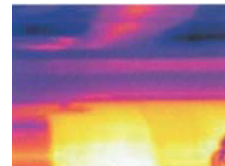
Development of electronic components



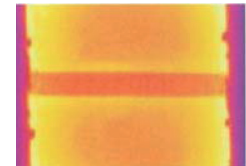
Monitoring of cables



Development of mechanical parts



Process control at calendaring



Process control in solar cell production

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.

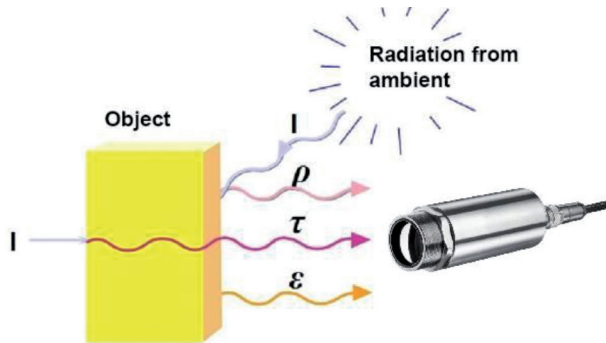


Fig. 35 Composition of IR radiation

- | | | | |
|------------|--------------|--------|--------------|
| I | IR radiation | ρ | Reflection |
| ϵ | Emission | τ | Transmission |

$$\epsilon + \rho + \tau = 1$$

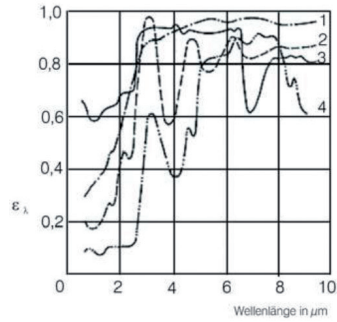


Fig. 36 Spectral emissivity of several materials

- | | |
|-----------|------------|
| 1 Enamel | 3 Concrete |
| 2 Plaster | 4 Chamotte |

11.2 Determination of Unknown Emissivity

There are 3 methods:

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

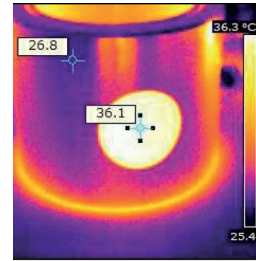


Fig. 37 Plastic sticker at metal surface

- ➡ 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.
- 3

➡ Cover a part of the surface of the measuring object with a black, flat paint with an emissivity of 0.98.

➡ Adjust the emissivity of your infrared thermometer to 0.98 and take the temperature of the colored surface.



Fig. 38 Shiny metal surface



Fig. 39 Blackened metal surface

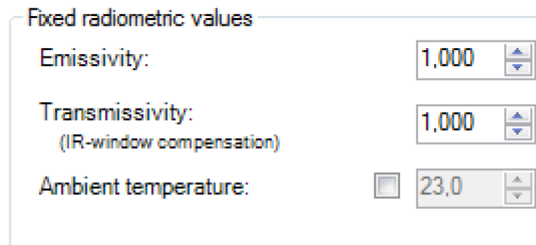
➡ Afterwards, determine the temperature of a directly adjacent area and modify the emissivity until the measured value corresponds to the temperature of the colored surface.

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

11.3 Characteristic Emissivity

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

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



Fixed radiometric values

Emissivity: 1,000

Transmissivity: 1,000
(IR-window compensation)

Ambient temperature: 23,0

Fig. 40 Adjustment of the emissivity in the software TIM Connect under the menu item Tools / Configuration / Device

12. Disclaimer

All components of the device have been checked and tested for functionality in the factory. However, should any defects occur despite careful quality control, these shall be reported immediately to MICRO-EPSILON or to your distributor / retailer.

MICRO-EPSILON undertakes no liability whatsoever for damage, loss or costs caused by or related in any way to the product, in particular consequential damage, e.g., due to

- non-observance of these instructions/this manual,
- improper use or improper handling (in particular due to improper installation, commissioning, operation and maintenance) of the product,
- repairs or modifications by third parties,
- the use of force or other handling by unqualified persons.

This limitation of liability also applies to defects resulting from normal wear and tear (e.g., to wearing parts) and in the event of non-compliance with the specified maintenance intervals (if applicable).

MICRO-EPSILON is exclusively responsible for repairs. It is not permitted to make unauthorized structural and / or technical modifications or alterations to the product. In the interest of further development, MICRO-EPSILON reserves the right to modify the design.

In addition, the General Terms of Business of MICRO-EPSILON shall apply, which can be accessed under Legal details | Micro-Epsilon <https://www.micro-epsilon.com/impressum/>.

For translations into other languages, the German version shall prevail.

13. Service, Repair

If the camera is defective, please send us the affected parts for repair or exchange.

If the cause of a fault cannot be clearly identified, please send the entire measuring system to:

For customers in USA applies:

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

For customers in Canada or South America applies:

Please contact your local distributor.

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me-usa@micro-epsilon.com
www.micro-epsilon.com

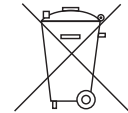
14. Decommissioning, Disposal

In order to avoid the release of environmentally harmful substances and to ensure the reuse of valuable raw materials, we draw your attention to the following regulations and obligations:

- Remove all cables from the sensor and/or controller.
- Dispose of the sensor and/or the controller, its components and accessories, as well as the packaging materials in compliance with the applicable country-specific waste treatment and disposal regulations of the region of use.
- You are obliged to comply with all relevant national laws and regulations.

For Germany / the EU, the following (disposal) instructions apply in particular:

- Waste equipment marked with a crossed garbage can must not be disposed of with normal industrial waste (e.g. residual waste can or the yellow recycling bin) and must be disposed of separately. This avoids hazards to the environment due to incorrect disposal and ensures proper recycling of the old appliances.



- A list of national laws and contacts in the EU member states can be found at https://ec.europa.eu/environment/topics/waste-and-recycling/waste-electrical-and-electronic-equipment-weee_en. Here you can inform yourself about the respective national collection and return points.
- Old devices can also be returned for disposal to MICRO-EPSILON at the address given in the imprint at <https://www.micro-epsilon.de/impressum/>.
- We would like to point out that you are responsible for deleting the measurement-specific and personal data on the old devices to be disposed of.
- Under the registration number WEEE-Reg.-Nr. DE28605721, we are registered at the foundation Elektro-Altgeräte Register, Nordostpark 72, 90411 Nuremberg, as a manufacturer of electrical and/or electronic equipment.

Appendix

A 1 Accessories

A 1.1 Air Purge Laminar

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 TM-APL.

- **i** 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.
The laminar air purge has a Si-protective window. Typical transmission value: 0.82 (deviations possible)
The corresponding mounting bracket TM-APLAB-TIM8/40 is mandatory.
Material: Anodized aluminum, weight: 218 g / 494 g with mounting bracket
Ambient temperature: 0 ... +80 °C (T_{Amb} camera: 0 ... +50 °C); with water cooled housing up to +250 °C

Air flow

The air purge can be mounted in four different positions.

- **i** The direction of the airflow must always be clear.

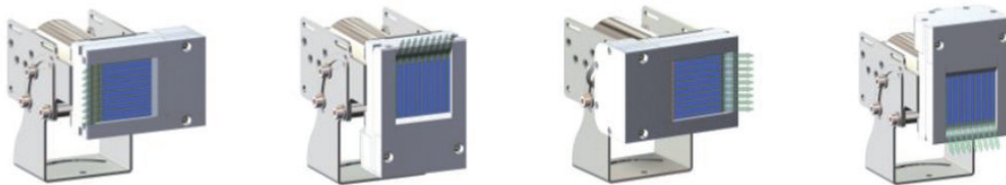


Fig. 41 Directions of airflow at different mounting positions

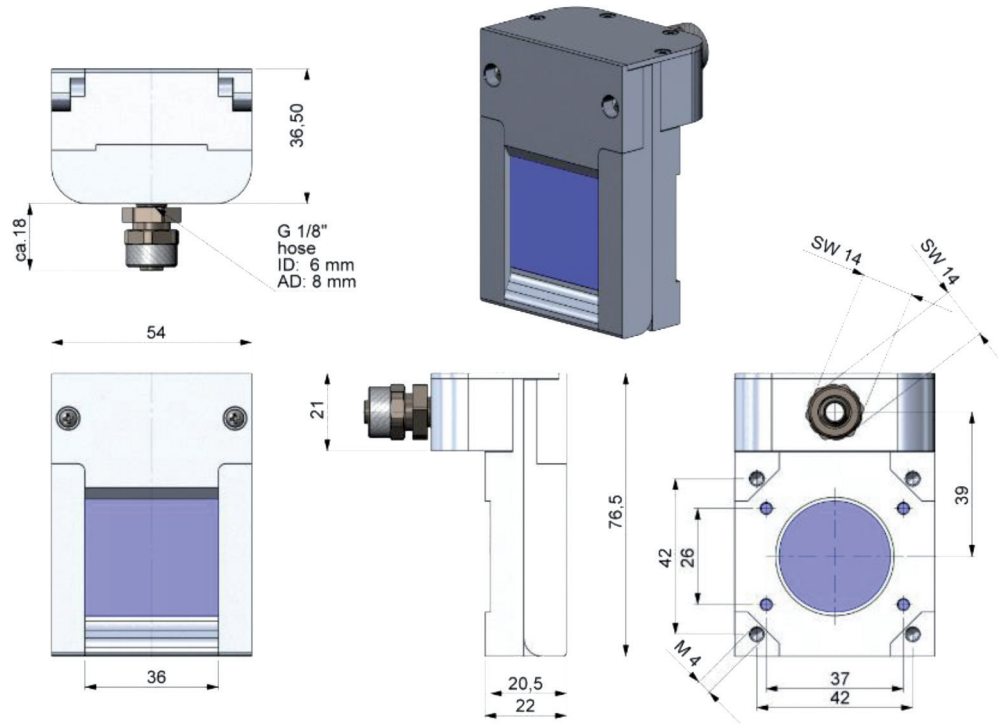


Fig. 42 Laminar air purge with SI protective window TM-APL-TIM8/40, dimensions in mm

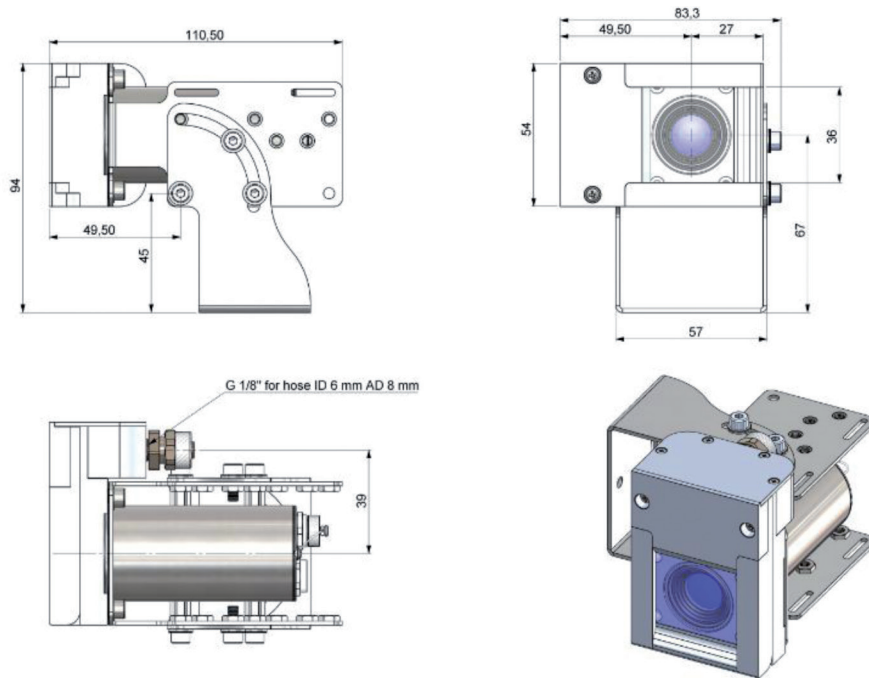


Fig. 43 Laminar air purge with SI protective window TM-APL and mounting bracket TM-APLAB, dimensions in mm

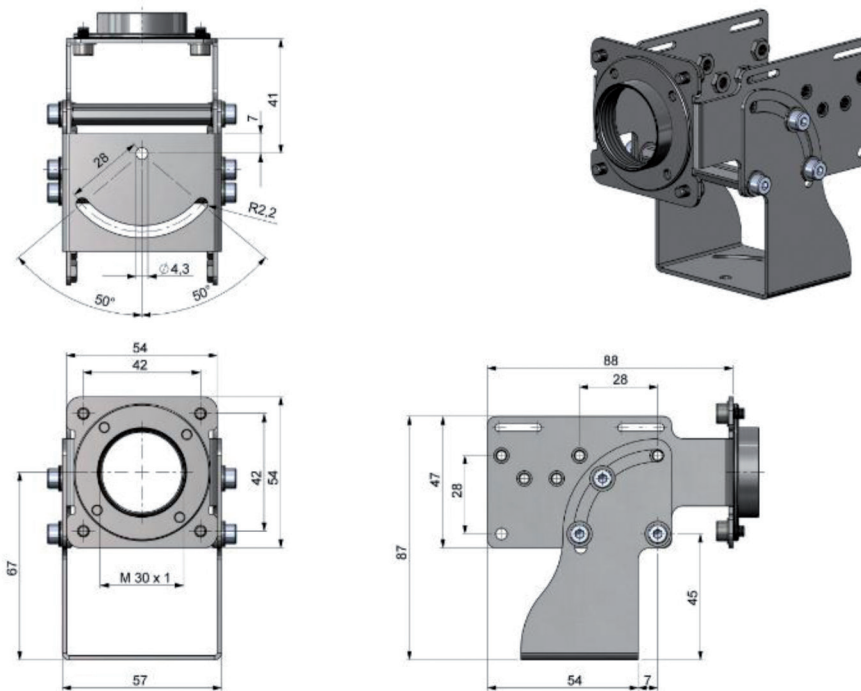


Fig. 44 Mounting bracket TM-APLAB, dimensions in mm

A 1.2 Water Cooling

The IR camera is for application at ambient temperatures up to 50 °C. For applications at higher ambient temperatures we recommend the usage of the optional water cooled housing (operating temperature up to 250 °C) and the optional high temperature cable (operating temperature up to 250 °C).

- Then using water cooling, a corresponding mounting kit (TM-WAKx-TIMxx) is required.
- Water flow rate: approx. 2 l/ min (cooling water temperature should not exceed 30 °C)

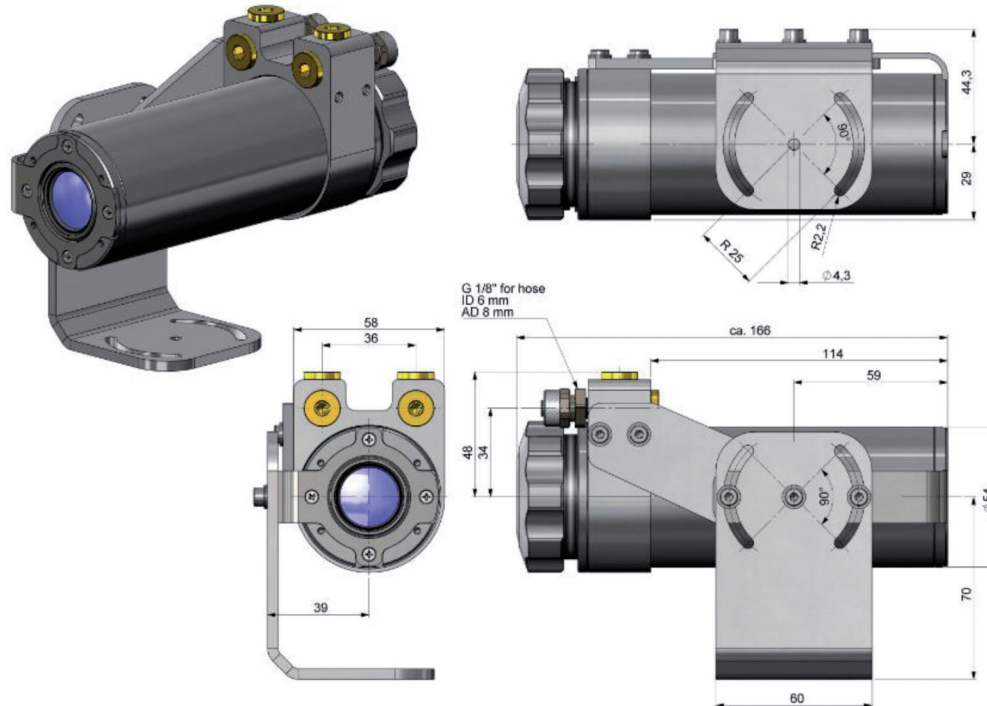


Fig. 45 Water cooling TM-W-TIM8/4 and mounting kit TM-WAK1-TIMxx, dimensions in mm

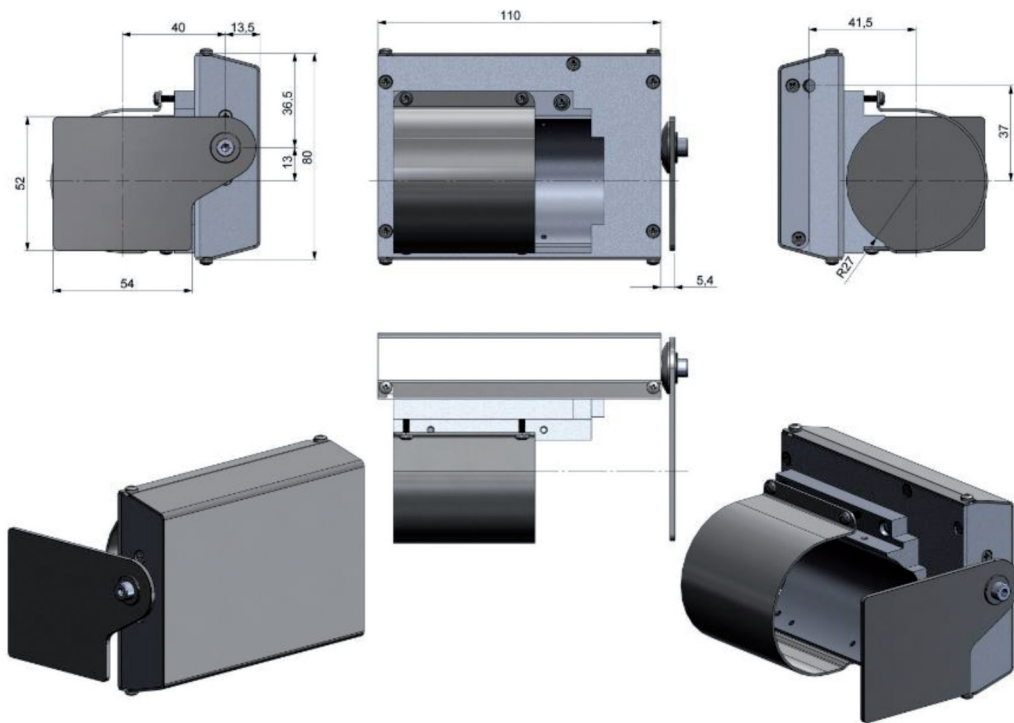


Fig. 46 Shutter for water cooling TM-SW-TIM8/40, dimensions in mm

A 1.3 Shutter

To protect the optics of the camera, an optional shutter (closing mechanism), can be purchased. It is equipped with a servomotor that can open and close a mechanical lock as needed. The special feature of the shutter is not only the opening and closing, but also the complete seal in the closed state. This ensures that the shutter is completely closed and no dirt can get on the optics.

•
i

The shutter has a 100 ms fast-closing mode.

Complete seal when closed.

Includes a control box for connections.

Shutter can be used in combination with Process Interface (PIF).

The corresponding mounting bracket (TM-APLAB-TIM8/40) is mandatory.

Material: Stainless steel

Weight: 550 g / 826 g Shutter with mounting bracket

When using more than one shutter and the opening / closing of the shutter should be simultaneously, the switch S4 on one control box must be set to mA and the others to mV, [see Fig. 49](#).

Ambient temperature: 0 ... +60 °C (T_{Amb} camera: 0 ... +50 °C); with water cooled housing up to +250 °C

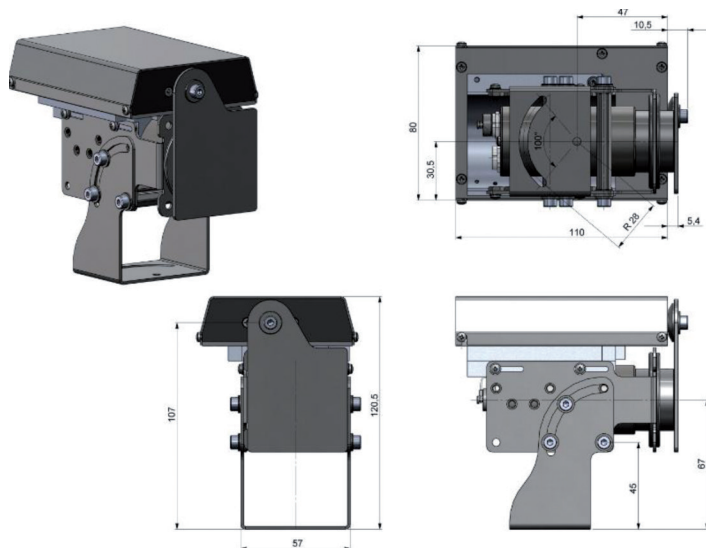


Fig. 47 Shutter TM-S-TIM8/40 with mounting bracket TM-APLAB-TIM8/40, dimensions in mm

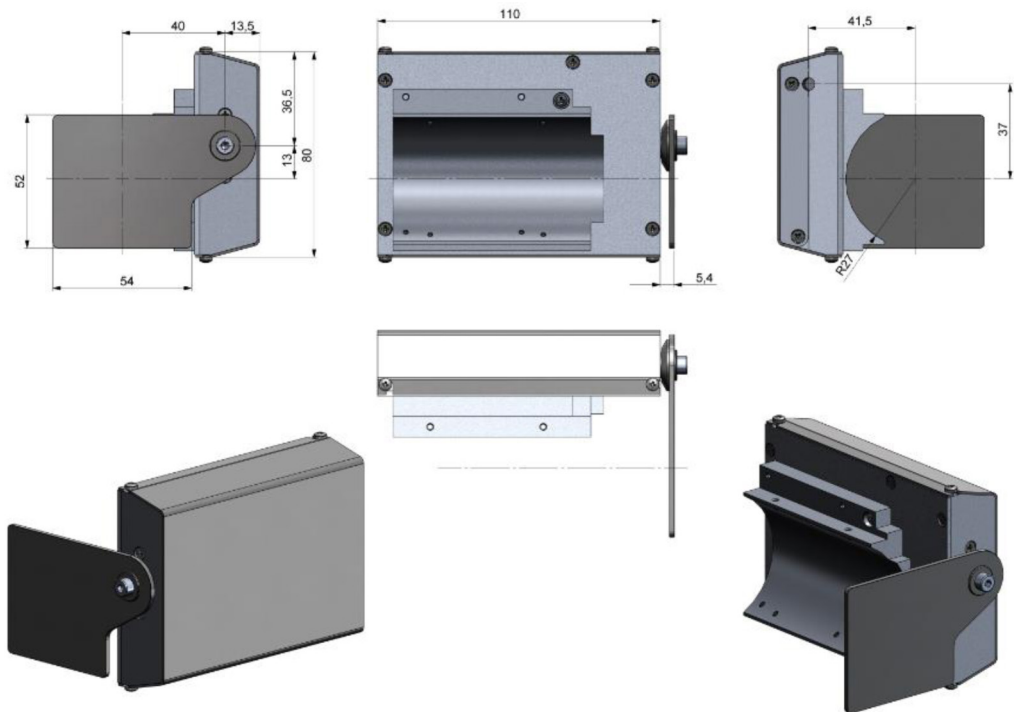


Fig. 48 Shutter TM-S-TIM8/40, dimensions in mm

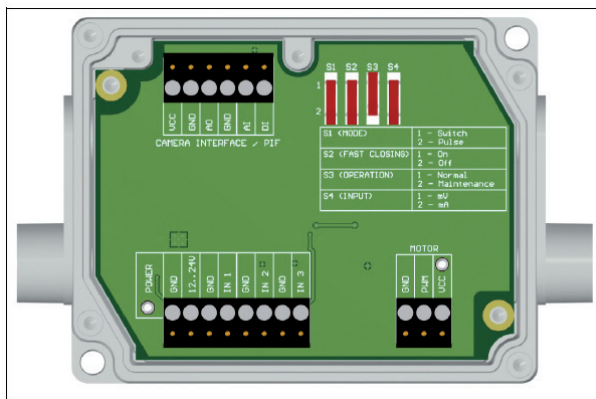


Fig. 49 Control box of shutter, dimensions, see Fig. 11

| | |
|--|---|
| Power supply | 12 - 24 V |
| Upper terminal screw | Connection for Process Interface (PIF) |
| Switch for different operation modes: | S1: Switching between switch operation and pulse operation S2: Activation/deactivation of fast-closing mode S3: Only for factory calibration (switch must be at normal) S4: Switching between mV or mA input |
| Lower screw terminal | Connection for power supply, inputs (Start/Stop signal) and motor |
| Inputs (Start/Stop signal, max. 24 V, input is active LOW (open input = HIGH)) | IN 1: Trigger input for normal operation (S1) |
| | IN 2: Currently no usage |
| | IN 3: Trigger input for fast-closing mode (S2) |

A 1.4 Combination of Air Purge, Water Cooling and Shutter

It is possible to combine all three components (air purge, water cooling and shutter) with each other. It should be noted that there are differences between the TIM 8 and TIM 40. Various mounting kits TM-WAKx-TIMxx are available in combination with water cooling. The mounting bracket is always required for the air purge TM-APLAB. For water cooling TM-W-TIM8/4, the mounting bracket is included and does not have to be ordered separately.

| Article number Combinations | TM-APL-TIM8/40 | TM-APLAB-TIM8/40 | TM-SAB-TIM8/40 | TM-S-TIM8/40 | TM-SW-TIM8/40 | TM-W-TIM8/40 | TM-WAK1-TIM8 | TM-WAK2-TIM8 | TM-WAK1-TIM40 | TM-WAK2-TIM40 |
|---|----------------|------------------|----------------|--------------|---------------|--------------|--------------|--------------|---------------|---------------|
| Air purge | ✓ | ✓ | | | | | | | | |
| Water cooling TIM 8 | | | | | | ✓ | ✓ | | | |
| Water cooling TIM 40 | | | | | | ✓ | | | ✓ | |
| Shutter | | | ✓ | ✓ | | | | | | |
| Air purge and water cooling TIM 8 | ✓ | | | | | ✓ | | ✓ | | |
| Air purge and water cooling TIM 40 | ✓ | | | | | ✓ | | | | ✓ |
| Air purge and shutter | ✓ | ✓ | | ✓ | | | | | | |
| Water cooling and shutter TIM 8 | | | | | ✓ | ✓ | ✓ | | | |
| Water cooling and shutter TIM 40 | | | | | ✓ | ✓ | | | ✓ | |
| Air purge, water cooling and shutter TIM 8 | ✓ | | | | ✓ | ✓ | | ✓ | | |
| Air purge, water cooling and shutter TIM 40 | ✓ | | | | ✓ | ✓ | | | | ✓ |

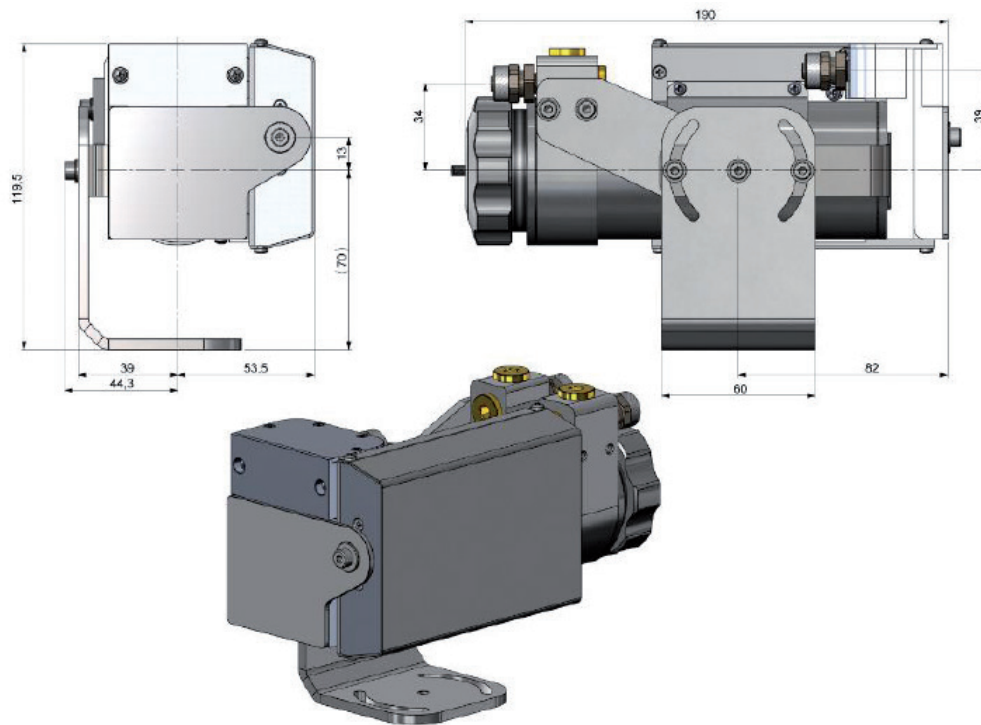


Fig. 50 Air purge TM-APL, water cooling TM-W-TIM8/40, shutter TM-SW-TIM8/40 and appropriate mounting kit TIM-WAKx-TIMxx, dimensions in mm

Components

- Air purge
- Water cooling
- Shutter
- Mounting kit

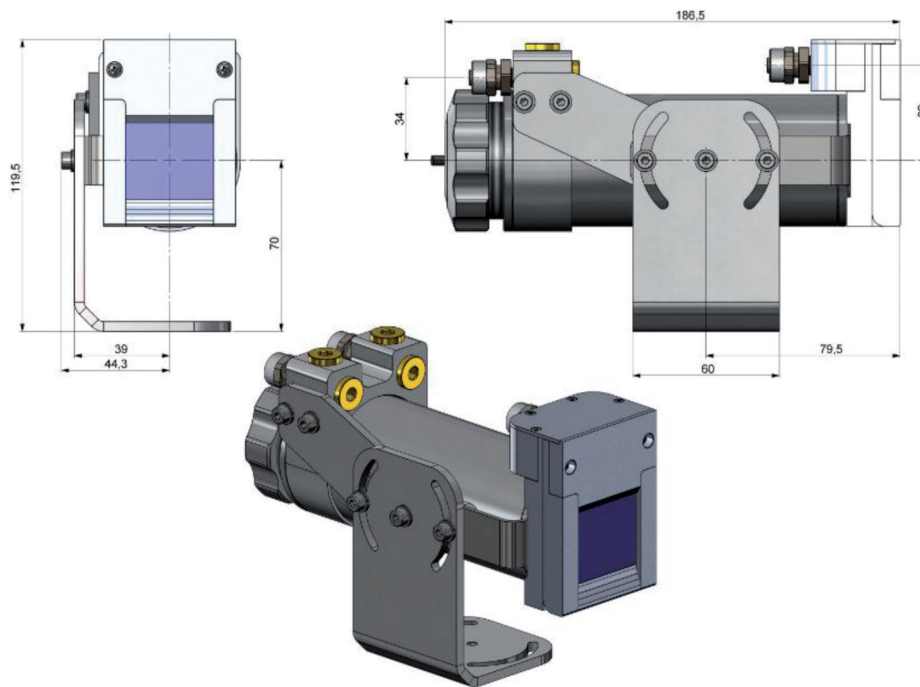


Fig. 51 Air purge TM-APL, water cooling TM-W-TIM8/40 and appropriate mounting kit TIM-WAKx-TIMxx, dimensions in mm

Components

- Air purge
- Water cooling
- Mounting kit

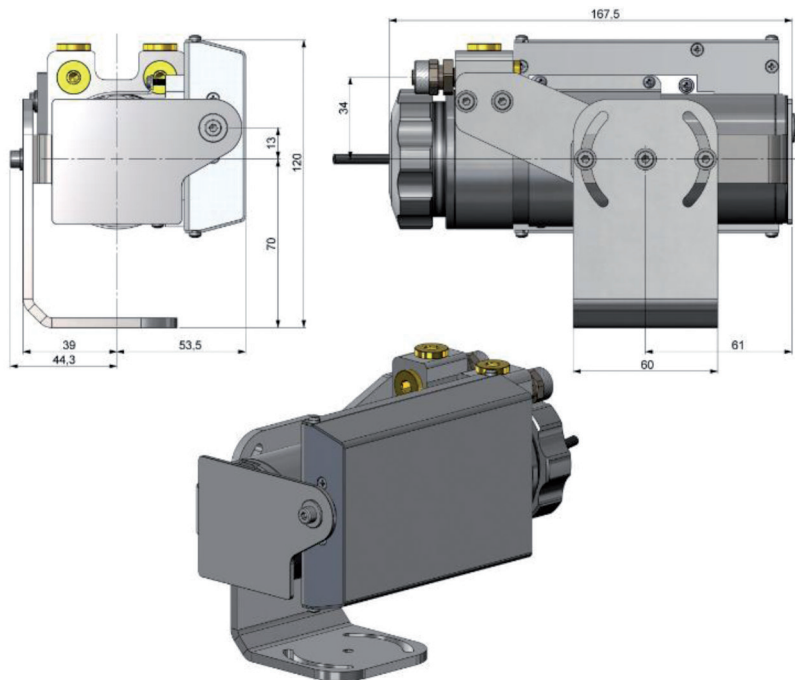


Fig. 52 Water cooling TM-W-TIM8/40L, shutter TM-SW-TIM8/40 and appropriate mounting kit TIM-WAKx-TIMxx, dimensions in mm

Components

- Water cooling
- Shutter
- Mounting kit

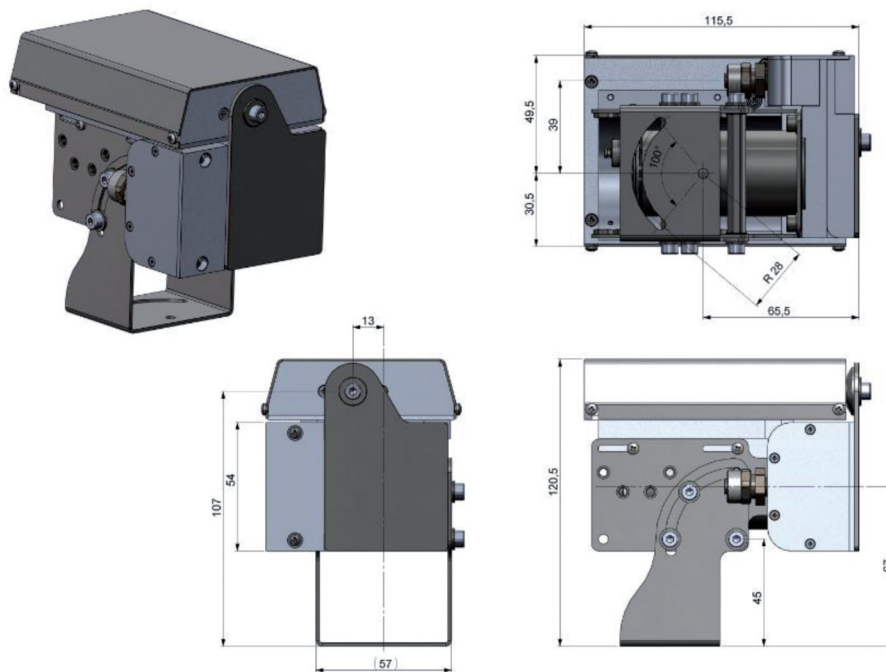


Fig. 53 Air purge TM-APL-TIM8/40 with mounting bracket TM-FB-TIM8/40 and shutter TM-S-TIM8/40, dimensions in mm

Components

- Air purge
- Mounting bracket
- Shutter

A 1.5 Outdoor Protective Housing

- i The infrared camera TIM can also be used for outdoor applications by using the outdoor protective housing TM-OPH24-TIM8/40. In addition, the industrial or stackable PIF TM-CJAPIF-TIM (thermoIMAGER TIM 40) or TM-PIFCx-TIM8 (thermoMETER TIM 8 / thermoIMAGER TIM 41) can be installed as an accessory without housing and a USB Server TM-USBSGB-TIM.



Fig. 54 Outdoor protective housing for TIM camera

A 1.6 Hardware and Software

| | | |
|----------------------|--|--|
| <p>TM-NETBox-TIM</p> | | <p>Miniature PC for standalone installation of TIM systems</p> |
| <p>TM-USBSII-TIM</p> | | <p>USB server for cable extension via Ethernet</p> |

A 2 Factory Settings

The devices have following presettings at time of delivery:

| | |
|----------------------------------|------------------------|
| Temperature range | -20 ... 100 °C |
| Emissivity | 1.000 |
| Process interface (PIF) | inactive |
| Interprocess Communication (IPC) | inactive |
| Measurement function | Rectangle measure area |

A 3 Emissivity Table Metals

| Material | | Typical Emissivity | | | |
|----------|------------------|--------------------|-------------------|-------------------|----------------------|
| | | 1.0 μm | 1.6 μm | 5.1 μm | 8 - 14 μm |
| Aluminum | Non oxidized | 0.1 - 0.2 | 0.02 - 0.2 | 0.02 - 0.2 | 0.02 - 0.1 |
| | Polished | 0.1 - 0.2 | 0.02 - 0.1 | 0.02 - 0.1 | 0.02 - 0.1 |
| | Roughened | 0.2 - 0.8 | 0.2 - 0.6 | 0.1 - 0.4 | 0.1 - 0.3 |
| | Oxidized | 0.4 | 0.4 | 0.2 - 0.4 | 0.2 - 0.4 |
| Brass | Polished | 0.35 | 0.01 - 0.05 | 0.01 - 0.05 | 0.01 - 0.05 |
| | Roughened | 0.65 | 0.4 | 0.3 | 0.3 |
| | Oxidized | 0.6 | 0.6 | 0.5 | 0.5 |
| Copper | Polished | 0.05 | 0.03 | 0.03 | 0.03 |
| | Roughened | 0.05 - 0.2 | 0.05 - 0.2 | 0.05 - 0.15 | 0.05 - 0.1 |
| | Oxidized | 0.2 - 0.8 | 0.2 - 0.9 | 0.5 - 0.8 | 0.4 - 0.8 |
| Chrome | | 0.4 | 0.4 | 0.03 - 0.3 | 0.02 - 0.2 |
| Gold | | 0.3 | 0.01 - 0.1 | 0.01 - 0.1 | 0.01 - 0.1 |
| Haynes | Alloy | 0.5 - 0.9 | 0.6 - 0.9 | 0.3 - 0.8 | 0.3 - 0.8 |
| Inconel | Electro polished | 0.2 - 0.5 | 0.25 | 0.15 | 0.15 |
| | Sandblast | 0.3 - 0.4 | 0.3 - 0.6 | 0.3 - 0.6 | 0.3 - 0.6 |
| | Oxidized | 0.4 - 0.9 | 0.6 - 0.9 | 0.6 - 0.9 | 0.7 - 0.95 |

| Material | | Typical Emissivity | | | |
|---------------|---------------|--------------------|-------------------|-------------------|----------------------|
| | | 1.0 μm | 1.6 μm | 5.1 μm | 8 - 14 μm |
| Iron | Non oxidized | 0.35 | 0.1 - 0.3 | 0.05 - 0.25 | 0.05 - 0.2 |
| | Rusted | | 0.6 - 0.9 | 0.5 - 0.8 | 0.5 - 0.7 |
| | Oxidized | 0.7 - 0.9 | 0.5 - 0.9 | 0.6 - 0.9 | 0.5 - 0.9 |
| | Forget, blunt | 0.9 | 0.9 | 0.9 | 0.9 |
| | Molten | 0.35 | 0.4 - 0.6 | | |
| Iron, casted | Non oxidized | 0.35 | 0.3 | 0.25 | 0.2 |
| | Oxidized | 0.9 | 0.7 - 0.9 | 0.65 - 0.95 | 0.6 - 0.95 |
| Lead | Polished | 0.35 | 0.05 - 0.2 | 0.05 - 0.2 | 0.05 - 0.1 |
| | Roughened | 0.65 | 0.6 | 0.4 | 0.4 |
| | Oxidized | | 0.3 - 0.7 | 0.2 - 0.7 | 0.2 - 0.6 |
| Magnesium | | 0.3 - 0.8 | 0.05 - 0.3 | 0.03 - 0.15 | 0.02 - 0.1 |
| Mercury | | | 0.05 - 0.15 | 0.05 - 0.15 | 0.05 - 0.15 |
| Molybdenum | Non oxidized | 0.25 - 0.35 | 0.1 - 0.3 | 0.1 - 0.15 | 0.1 |
| | Oxidized | 0.5 - 0.9 | 0.4 - 0.9 | 0.3 - 0.7 | 0.2 - 0.6 |
| Monel (Ni-CU) | | 0.3 | 0.2 - 0.6 | 0.1 - 0.5 | 0.1 - 0.14 |
| Nickel | Electrolytic | 0.2 - 0.4 | 0.1 - 0.3 | 0.1 - 0.15 | 0.05 - 0.15 |
| | Oxidized | 0.8 - 0.9 | 0.4 - 0.7 | 0.3 - 0.6 | 0.2 - 0.5 |
| Platinum | Black | | 0.95 | 0.9 | 0.9 |
| Silver | | 0.04 | 0.02 | 0.02 | 0.02 |

| Material | | Typical Emissivity | | | |
|--------------------------|----------------|-------------------------------------|-------------------------------------|-------------------------------------|--|
| Spectral response | | 1.0 μm | 1.6 μm | 5.1 μm | 8 - 14 μm |
| Steel | Polished plate | 0.35 | 0.25 | 0.1 | 0.1 |
| | Rustless | 0.35 | 0.2 - 0.9 | 0.15 - 0.8 | 0.1 - 0.8 |
| | Heavy plate | | | 0.5 - 0.7 | 0.4 - 0.6 |
| | Cold-rolled | 0.8 - 0.9 | 0.8 - 0.9 | 0.8 - 0.9 | 0.7 - 0.9 |
| | Oxidized | 0.8 - 0.9 | 0.9 - 0.9 | 0.7 - 0.9 | 0.7 - 0.9 |
| Tin | Non oxidized | 0.25 | 0.1 - 0.3 | 0.05 | 0.05 |
| Titanium | Polished | 0.5 - 0.75 | 0.3 - 0.5 | 0.1 - 0.3 | 0.05 - 0.2 |
| | Oxidized | | 0.6 - 0.8 | 0.5 - 0.7 | 0.5 - 0.6 |
| Wolfram | Polished | 0.35 - 0.4 | 0.1 - 0.3 | 0.05 - 0.25 | 0.03 - 0.1 |
| Zinc | Polished | 0.5 | 0.05 | 0.03 | 0.02 |
| | Oxidized | 0.6 | 0.15 | 0.1 | 0.1 |

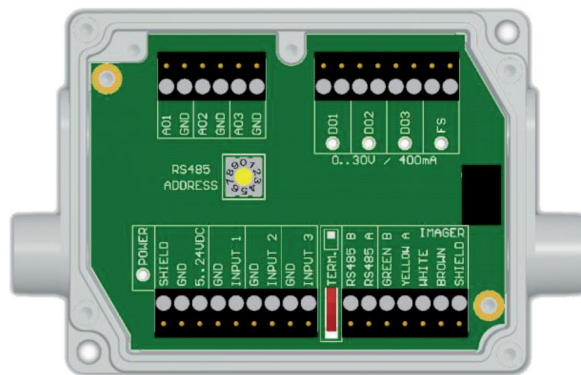
A 4 Emissivity Table Non Metals

| Material | Typical Emissivity | | | |
|----------------------------|--------------------|-------------------|-------------------|----------------------|
| | 1.0 μm | 2.3 μm | 5.1 μm | 8 - 14 μm |
| Asbest | 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 - 0.9 |
| Carborundum | 0.4 | 0.8 - 0.95 | 0.8 - 0.95 | 0.95 |
| Cement | 0.65 | 0.9 | 0.9 | 0.95 |
| Ceramic | 0.65 | 0.9 | 0.9 | 0.95 |
| Glass | Plate | 0.2 | 0.98 | 0.85 |
| | Melt | 0.4 - 0.9 | 0.9 | |
| Grit | | | 0.95 | 0.95 |
| Gypsum | | | 0.4 - 0.97 | 0.8 - 0.95 |
| Ice | | | | 0.98 |
| Limestone | | | 0.4 - 0.98 | 0.98 |
| Paint | Non 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 |

| Material | Typical Emissivity | | | |
|--------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--|
| Spectral response | 1.0 μm | 2.3 μm | 5.1 μm | 8 - 14 μm |
| Sand | | | 0.9 | 0.95 |
| Snow | | | | 0.9 |
| Soil | | | | 0.9 - 0.98 |
| Textiles | | | 0.95 | 0.95 |
| Water | | | | 0.93 |
| Wood | Natural | | 0.9 - 0.95 | 0.9 - 0.95 |

A 5 Industrial Process Interface for thermoMETER TIM 8 (Optional)

For use in industrial environment the industrial process interface with 500 V AC_{RMS} isolation voltage between thermoMETER TIM 8 and process is available (connection box with IP65, 5 m, 10 m or 20 m standard or high temperature cable for camera connection, terminal block for process integration), [see A 12](#).



| Color | Assignment |
|--------|------------|
| Green | RS485 B |
| Yellow | RS485 A |
| White | 12 V |
| Brown | GND |
| Shield | GND |

Fig. 55 Connections of the industrial Process Interfaces for thermoMETER TIM 8

The industrial process interface provides the following inputs and outputs:

| Designation | Description | max. range ¹ / status |
|-------------|---|---|
| INPUT 1/2/3 | Analog- or digital input 1, 2, 3 | 0 - 10 V ² |
| AO 1/2/3 | Analog output 1, 2 and 3 Alarm output 1, 2 and 3 | 0 - 10 V 0/4 - 20 mA |
| DO 1/2/3 | Relais output 1, 2 and 3 ³ | open/ closed (red LED on)/ 0 ... 30 V, 400 mA |
| FS | Fail-safe-relay | open/ closed (green LED on)/ 0 ... 30 V, 400 mA |

I The industrial PIF has a maximum of 3 analog outputs. To use more outputs, you can cascade up to three PIFs, allowing you to use up to 9 analog or alarm outputs in total.

- 1) Depending on supply voltage; for 0 - 10 V on the AO the PIF has to be powered with min. 12 V.
- 2) The AI is designed for max. 24 V, the voltage level above 10 V is not interpreted.
- 3) Active if AO1, 2 or 3 is/ are programmed as alarm output.

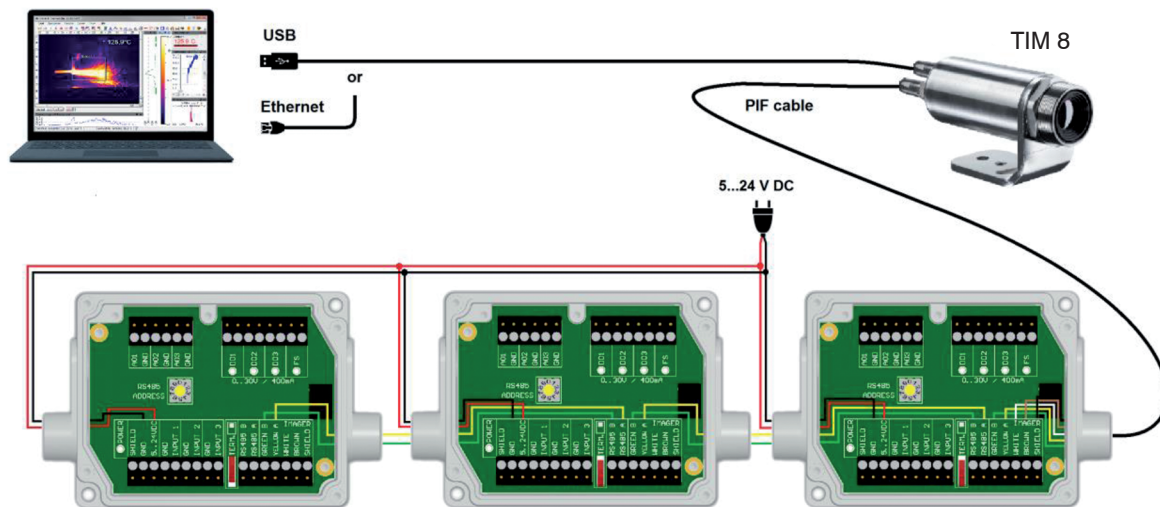


Fig. 56 Connection of 3 industrial PIFs via RS485

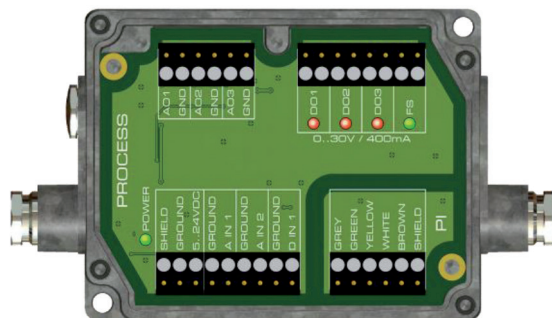
- Each stackable industrial PIF must have its own RS485 address. The address must be set directly on the board and in the software. For the PIF which is the furthest away the 120R switch (TERM.- Termination) has to be set.
- The RS485 interface is defined for a length of 500 m.

The process interface has an integrated fail-safe mode. This allows to control conditions like interruption of cables, shut-down of the software etc. and to give out these conditions as an alarm.

| Controlled conditions on camera and software | Standard Process interface TM-PIF-TIM8 | Industrial Process interface TM-PIFCBx-TIM8 |
|--|---|--|
| Interruption USB cable to camera | ✓ | ✓ |
| Interruption data cable camera - PIF | ✓ | ✓ |
| Interruption power supply PIF | ✓ | ✓ |
| Shut-down of TIM Connect software | ✓ | ✓ |
| Crash of TIM Connect software | - | ✓ |
| Fail-Safe-Output | 0 V at analog output (AO) | Open contact (fail-safe-relay)/ green LED off |

A 6 Industrial Process Interface for thermoIMAGER TIM 40 (Optional)

For use in industrial environment the industrial process interface with 500 V AC_{RMS} isolation voltage between thermoIMAGER TIM 40 and process is available (connection box with IP 65, 5 m, 10 m or 20 m standard or high temperature cable for camera connection, terminal block for process integration, [see A 12](#)).



| Pin assignment | |
|----------------|------------------------|
| Color | Designation |
| Grey | Interrupt |
| Green | SCL (I ² C) |
| Yellow | SCL (I ² C) |
| White | 3.3 V |
| Brown | GND |
| Shield | GND |

Fig. 57 Connections of the industrial Process Interfaces for thermoIMAGER TIM 40

The industrial process interface provides the following inputs and outputs:

| Designation | Description | max. range ¹⁾ / status |
|--------------------|---|---|
| A IN 1 / 2 | Analog input 1 and 2 | 0 - 10 V ²⁾ |
| D IN 1 | Digital input (Low-active = 0...0.6 V) | 24 V |
| AO 1 / 2 / 3 | Analog output 1, 2 and 3 Alarm output 1, 2 and 3 | 0/4 - 20 mA 0/4 - 20 mA |
| DO 1 / 2 / 3 | Relay output 1, 2 and 3 ³⁾ | open/ closed (red LED on)/ 0 ... 30 V, 400 mA |
| FS | Fail-safe-relay | open/ closed (green LED on)/ 0 ... 30 V, 400 mA |

1) Depending on supply voltage; for 0 - 20 mA on the AO the PIF has to be powered with min. 5 V < (1.5 + working resistance * 0.021) < 24 V. Working resistance = Load bzw. Measuring resistance;

Example: $R_{\text{Load}} = 500 \text{ Ohm} \rightarrow U_{\text{min}} = 1.5 + 500 * 0.021 = 12 \text{ V}$,

$R_{\text{Load}} = 100 \text{ Ohm} \rightarrow U_{\text{min}} = 1.5 + 100 * 0.021 = 3.6 \text{ V} \rightarrow \text{min. } 5 \text{ V}$

2) The AI is designed for max. 24 V, the voltage level above 10 V is not interpreted.

3) Active if AO1, 2 or 3 is/ are programmed as alarm output.

i The alarm output can be configured as a threshold between 0 - 4 mA for no alarm and between 10 - 20 mA as alarm. For values outside the respective range, the relay does not switch on the DO.

The process interface has an integrated fail-safe mode. This allows to control conditions like interruption of cables, shut-down of the software etc. and to give out these conditions as an alarm. The time constant of the fail-safe is 1.5 seconds.

| Controlled conditions on camera and software | Standard Process interface | Industrial Process interface TM-PIFCxx-TIM |
|--|----------------------------|---|
| Interruption USB cable to camera | ✓ | ✓ |
| Interruption data cable camera - PIF | ✓ | ✓ |
| Interruption power supply PIF | ✓ | ✓ |
| Shut-down of TIM Connect software | ✓ | ✓ |
| Crash of TIM Connect software | - | ✓ |
| Fail-Safe-Output | 0 V at analog output (AO) | Open contact (fail-safe-relay)/ green LED off |

A 7 Examples for a Fail-Safe Monitoring with a PLC

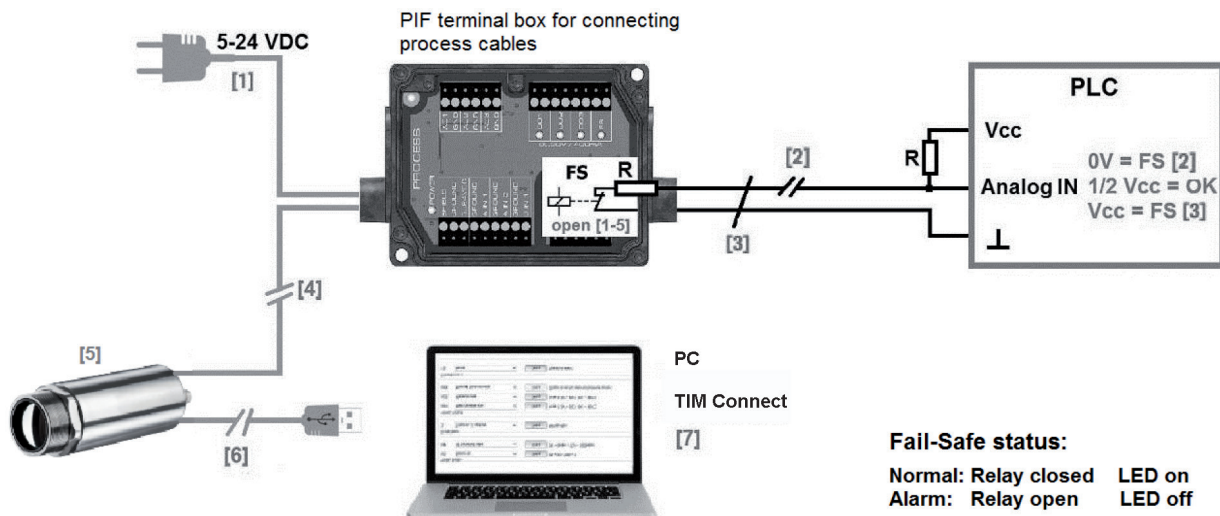


Fig. 58 Fail-Safe monitoring states

| | | | |
|-----|--------------------------------|-----|--|
| [1] | Breakdown of PIF power supply | [4] | Malfunction of camera |
| [2] | Cable break of fail-safe cable | [5] | Breakdown of TIM power supply/ Interruption of USB cable |
| [3] | Interruption of cable TIM-PIF | [6] | Malfunction of TIM Connect software |

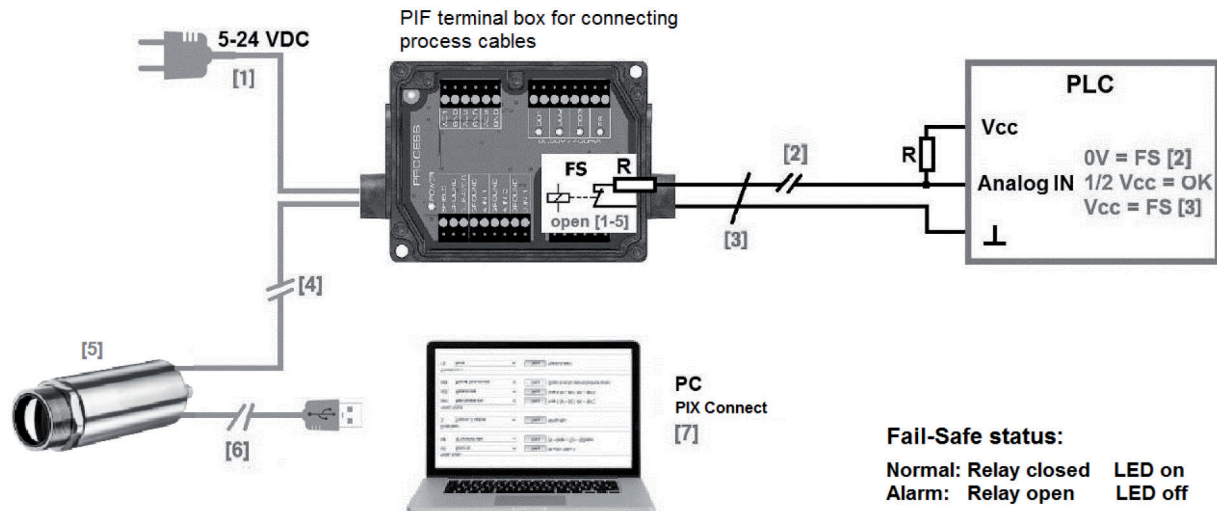


Fig. 59 Fail-Safe monitoring states

| | | | |
|-----|----------------------------------|-----|--|
| [1] | Breakdown of PIF power supply | [5] | Malfunction of TIM |
| [2] | Cable break of fail-safe cable | [6] | Breakdown of TIM power supply/ Interruption of USB cable |
| [3] | Short circuit of fail-safe cable | [7] | Malfunction of TIM Connect software |
| [4] | Interruption of cable TIM-PIF | | |

A 8 USB Cable Extension for thermoIMAGER TIM 40

The maximum USB cable length is 20 m. For greater distances between thermoIMAGER TIM 40 and computer or for stand-alone solutions the optional USB Server Gigabit is provided:

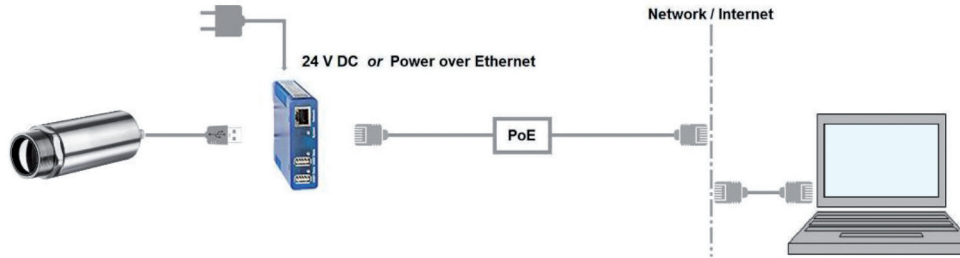


Fig. 60 USB-Server Gigabit

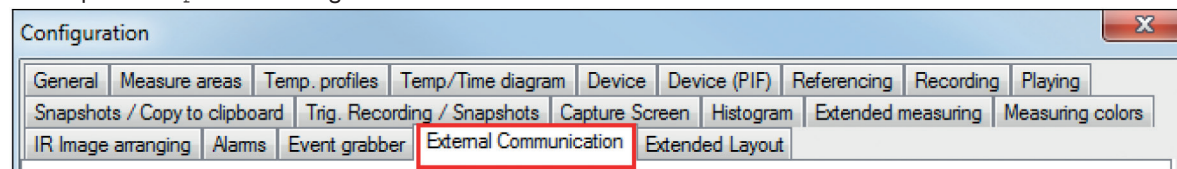
A 9 A Quick Start for Serial Communication

A 9.1 Introduction

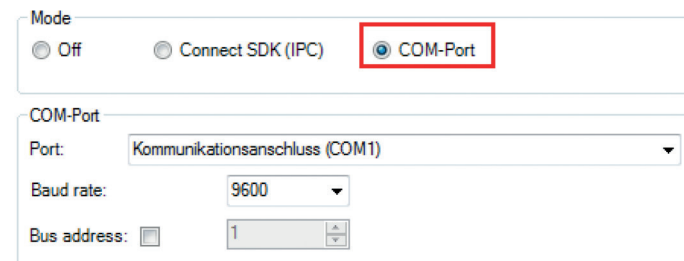
One of the features of the thermoIMAGER TIM Connect software contains the possibility to communicate via a serial COM-PORT interface. This can be a physical COM-PORT or a Virtual COM-PORT (VCP). It must be available on the computer where the TIM connect software is installed.

A 9.2 Setup of the Interface

➤ Open the **Options** dialog and enter the tab **External Communication** to enable the software for the serial communication.



➤ Select the mode **Com-Port** and choose the appropriate port.



➤ Select the baud rate that matches the baud rate of the other communication device.

The other interface parameters are 8 data bits, no parity and one stop bit (8N1). These parameters are used in many other communication devices too. The other station must support 8 bit data.

➤ Connect the computer with the communication device. If this is a computer too, use a null modem cable.

A 9.3 Command List

i The command list is provided on the USB stick and the TIM Connect software (**Help > SDK**).
Every command must expire with **CR / LF (0x0D, 0x0A)**.

A 10 A Brief Overview to DLL Communication (IPC)

i The description of the initialization procedure as well as the necessary command list is provided on the delivered USB stick and in the TIM Connect software under `Help > SDK`.

2 SDK packages are available. These can be found on the delivered USB stick:

- Connect SDK: requires the TIM Connect software
- Direct SDK: no TIM Connect software required, supports Linux and Windows

The communication to the process imager device is handled by the TIM Connect software (`Imager.exe`) only. A dynamic link library (`ImagerIPC2.dll`) provides the interprocess communication (IPC) for other attached processes. The DLL can be dynamically linked into the secondary application. Or it can be done static by a lib file too. Both `Imager.exe` and `ImagerIPC2.dll` are designed for Windows Vista/ 7/ 8/ 10 only. The application must support call-back functions and polling mode.

The `ImagerIPC2.dll` will export a bunch of functions that are responsible for initiating the communication, retrieving data and setting some control parameters.

The main difference to the former Version 1 (`ImagerIPC.dll`) is the support of more than one TIM cameras via multiple instances of TIM Connect.

A 11 thermoIMAGER TIM Connect Resource Translator

i A detailed tutorial is provided on the USB stick.

thermoIMAGER TIM Connect is a .Net Application. Therefore it is ready for localization. Localization as a Microsoft idiom means the complete adaption of resources to a given culture. Learn more about the internationalization topics consult Microsoft's developer documentation on

<http://msdn.microsoft.com/en-us/goglobal/bb688096.aspx>.

If desired the localization process can be illustrated in detail. Also, the resizing of buttons or other visible resources and the support of right-to-left languages is supported. Experts who have the appropriate tools should handle it. To limit this effort and to enable anybody to translate the resources of the TIM Connect application Micro-Epsilon has developed the small tool `Resource Translator`.

This tool helps to translate any visible text within the thermoIMAGER TIM Connect application.

A 12 Process Interface for thermoIMAGER TIM 40

A 12.1 Analog Output

The maximum load impedance is 500 Ohm.

The analog output can be used as a digital output too. The current value for `no alarm` and `alarm on` is set within the software.

A 12.2 Digital Input

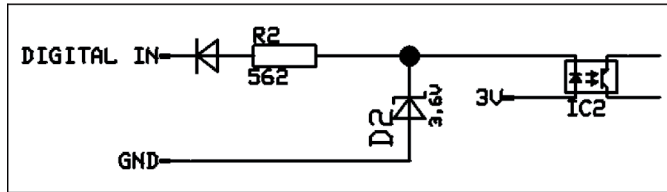


Fig. 61 Digital input

The digital input can be activated with a switch to the TIM GND or with a Low level CMOS/TTL signal:

- Low level 0 ... 0.6 V
- High level 2 ... 24 V

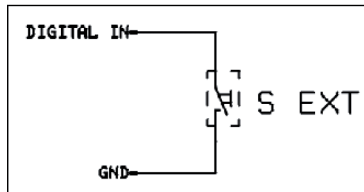


Fig. 62 Button example

A 12.3 Analog Input

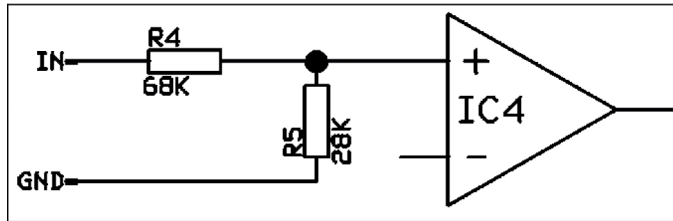


Fig. 63 Analog input

Useful voltage range: 0 ... 10 V



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