MICRO-EPSILON

Instruction Manual

thermoIMAGER TIM

TIM 160
TIM 200
TIM 230
TIM 400
TIM 450
TIM G7
TIM 640
TIM M-1

Infrared camera

MICRO-EPSILON
MESSTECHNIK
GmbH & Co. KG
Königbacher Strasse 15

94496 Ortenburg / Germany

Tel. +49 (0) 8542 / 168-0
Fax +49 (0) 8542 / 168-90
e-mail info@micro-epsilon.de
www.micro-epsilon.com

Certified acc. to DIN EN ISO 9001: 2008

Contents

1. Safety

The handling of the system assumes knowledge of the instruction manual.

1.1 Symbols Used

The following symbols are used in the instruction manual.

⚠ CAUTION	Indicates a hazardous situation which, if not avoided, may result in minor or moderate injuries.
NOTICE	Indicates a situation which, if not avoided, may lead to property damage
➡	Indicates a user action.
i	Indicates a user tip.
`Measure`	Indicates a hardware or a button/menu in the software

1.2 Warnings

⚠ CAUTION

Connect the power supply and the display/output device in accordance with the safety regulations for electrical equipment.
> Danger of injury

> Damage to or destruction of the camera

NOTICE

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 shock and vibration to the camera.
> Damage to or destruction of the camera

The power supply 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

Do not mount the camera with external mounting devices (thread/ tripod connection).
> Damage to the camera (thread)

Protect the USB cable against damage.
> Failure of the camera

1.3 Notes on CE Identification

The following applies to the thermoIMAGER TIM:
- EU directive 2004/108/EC
- EU directive 2011/65/EC, “RoHS” category 9

Products which carry the CE mark satisfy the requirements of the quoted EU directives and the European standards (EN) listed therein. The EC declaration of conformity is kept available according to EC regulation, article 10 by the authorities responsible at

MICRO-EPSILON MESSTECHNIK
GmbH & Co. KG
Königbacher Straße 15
94496 Ortenburg / Germany

The system is designed for use in industry and laboratory and satisfies the requirements.

1.4 Proper 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 Chap. 10.
- The system may only be operated within the limits specified in the technical data, see Chap. 2..
- Use the system in such a way that in case of malfunctions or failure personnel or machinery are not endangered.
- Take additional precautions for safety and damage prevention for safety-related applications.

1.5 Proper Environment

- Protection class: IP 67 (NEMA-4)
- Operating temperature:
  - TIM 160/200/230/400/640: 0 ... 50 °C (+32 ... +122 °F)
  - TIM 450: 0 ... 70 °C (+32 ... +158 °F)
- Storage temperature:
  - TIM 160/200/230/400/640: -40 ... 70 °C (-40 ... +158 °F)
  - TIM 450: -40 ... 85 °C (-40 ...+185 °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 thermoIMAGER TIM calculates the surface temperature based on the emitted infrared energy of objects, see Chap. 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
TIM 160	IR	-20 to 900 °C 200 to 1500 °C (optional)	7.5 - 13 µm	120 Hz	Surface measurements in industrial application
TIM 200 / TIM 230	BI-SPEKTRAL	-20 to 900 °C 200 to 1500 °C (optional)	7.5 - 13 µm	128 Hz	Synchronous recording of VIS and IR videos and images
TIM 400 / TIM 450	IR	-20 to 900 °C 200 to 1500 °C (optional for TIM 400)	7.5 - 13 µm	80 Hz	Real-time thermographic images in high speed; Detection of smallest temperature differences (TIM 450)
TIM G7	IR	200 to 1500 °C	7.9 µm	80 Hz/ 27 Hz	Measurement of glass (with Line-Scanning mode)
TIM 640	IR	-20 to 900 °C	7.5 - 13 µm	32 Hz	Pin-sharp radiometric recordings in real time
TIM M-1	IR	450 to 1800 °C	0.92 - 1.1 µm	Bis 1 kHz	Measurement of metallic surfaces, graphite or ceramics with short wavelengths

2.3 General Specifications

Model TIM	160	200	230	400	450	G7	640	M-1
Protection class	IP 67 (NEMA-4) [1]							
Operating temperature	0 ... 50 °C (+32 ... +122 °F)				0 ... 70 °C (+32 ... +158 °F)		0 ... 50 °C (+32 ... +122 °F)	
Storage temperature	-40 ... 70 °C (-40 ... +158 °F)				-40 ... 85 °C (-40 ... +185 °F)		-40 ... 70 °C (-40 ... +158 °F)	
Relative humidity	10 ... 95 %, con condensing							
Material (housing)	Aluminum, anodized							
Dimensions	45 x 45 x 62 - 65 mm^3 (depending on the lens)			46 x 56 x 86 - 90 mm^3 (depending on the lens)				
Weight (inclusive lens)	195 g	215 g		320 g				
Cable length (USB)	1 m (standard), 5 m, 10 m, 20 m							
Vibration	IEC 68-2-6: (sinus shaped), see Chap. 2.4 IEC 60068-2-64 (broadband noise), see Chap. 2.4							
Shock	IEC 68-2-27: 25 g and 50 g, see Chap. 2.4							

1) Only with 5, 10, 20 m USB cable. The camera plug of USB cable (1 m) does not feature an IP 67 protection class.

2.4 Vibration / Shock

2.4.1 Used Standards

IEC EN 60068-1: 1988 + Corr. 1988 + A1: 1992	Environmental testing - Part 1: General and guidance
IEC 60068-2-6: 2007	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)
IEC 60068-2-27: 2008	Environmental testing - Part 2-27: Test Ea and guidance: Shock
IEC 60068-2-47: 2005	Environmental testing - Part 2-47: Mounting of specimens for vibration, impact and similar dynamic tests
IEC 60068-2-64: 2008	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 TIM	160	200	230	400	450	G7	640	M-1
Power supply	5 VDC (powered via USB 2.0 interface)							
Current draw	max. 500 mA							
Output Process Interface (PIF out)	0 - 10 V (T_{Obj}, T_{INT}, flag status or alarm status), see Chap. A 12							
Input Process Interface (PIF in)	0 - 10 V (Emissivity, ambient temperature, reference temperature, Flag control, triggered video or triggered snapshots), see Chap. A 12							
Digital input Process Interface	Flag control, triggered video, triggered snapshots							
Digital interface	USB 2.0							

2.6 Measurement Specification

Model TIM	160	200 [1]	230 [1]
Temperature range (scalable)	20 ... 100 °C; 0 ... 250 °C; 150 ... 900 °C; Option: 200 … 1500 °C		
Spectral range	7.5 - 13 µm		
Detector	UFPA, 160 x 120 Pixel@120 Hz	UFPA, 160 x 120 Pixel@128 Hz [3] 640 x 480 Pixel (visual camera)	
Lenses (FOV)	23 ° x 17 °; 6 ° x 5 °; 41 ° x 31 °; 72 ° x 52 °		
System accuracy [2]	±2°C or ±2 %		
Temperature resolution (NETD)	0.08 K with 23 °; 0.3 K with 6 °; 0.1 K with 41° and 72 °		
Warm-up time	10 min		
Emissivity	0.100 ... 1.100		
Software	TIMConnect		

1) For an ideal combination of IR and VIS image we recommend the 41° lens for TIM 200 and the 23° lens for TIM 230

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

3) The following options can be set: Option 1 (IR with 96 Hz at 160 x 120 px; VIS with 32 Hz at 640 x 480 px); option 2 (IR with 128 Hz at 160 x 120 px; VIS with 32 Hz at 596 x 447 px)

Model TIM	**400**	**450**	**G7**
Temperature ranges (scalable)	20 ... 100 °C; 0 ... 250 °C; 150 ... 900 °C; Option: 200 … 1500 °C	-20 ... 100 °C; 0 ... 250 °C; 150 ... 900 °C	200 ... 1500 °C
Spectral range	7.5 - 13 μm		7.9 μm
Detector	UFPA, 382 x 288 Pixel@80 Hz (switchable to 27 Hz)		
Lenses (FOV)	38 ° x 29 °; 62 ° x 49 °; 13 ° x 10 °; 80 ° x 56 °		38 ° x 29 °; 62 ° x 49 °; 80 ° x 56 °
System accuracy [2)]	±2 °C or ±2 %		
Temperature resolution (NETD)	0.08 K[1)] with 38 ° and 62 °; 0.1 K[1)] with 13 °	0.04 K[1)] with 38 ° and 62 °; 0.1 K[1)] with 13 °	130 mK (T_{obj} = 650 °C)
Warm-up time	10 min		
Emissivity	0.100 ... 1.100		
Software	TIMConnect		

1) Value is valid at 40 Hz and 25 °C room temperature.
2) At ambient temperature 23±5 °C; whichever is greater.

Model TIM	640	M-1
Temperature range (scalable)	20 ... 100 °C; 0 ... 250 °C; 150 ... 900 °C;	450 [3] … 1800 °C (32 Hz- and 27 Hz mode) 500 [3] … 1800 °C (80 Hz mode) 600 [3] … 1800 °C (1 kHz mode)
Spectral range	7.5 - 13 µm	0.92 - 1.1 µm
Detector	UFPA, 640 x 480 Pixel@32 Hz	UFPA, 764 x 480 Pixel@32 Hz 382 x 288 Pixel@80 Hz (switchable to 27 Hz) 72 x 56 Pixel@1 kHz
Lenses (FOV)	33° x 25 ° 60° x 45 ° 90° x 64 ° 15 ° x 11 °	FOV@382x288 px: 20 ° x 15 °, 13 ° x 10 °, 7 ° x 5 °, 4 ° x 3 ° FOV@764x480 px: 39 ° x 25 °, 26 ° x 16 °, 13 ° x 8 °, 9 ° x 5 °
System accuracy	±2 °C or ±2 % [2]	±2 % of reading (Object temperature $<$ 1500 °C)
Temperature resolution (NETD)	0.075 K[1] with 33 °	$<$ 1 K (700 °C), $<$ 2 K (1000 °C)
Warm-up time	10 min	
Emissivity	0.100 ... 1.100	
Software	TIMConnect	

1) Value is valid at 32 Hz and 25 °C room temperature.
2) At ambient temperature 23±5 °C; whichever is greater.
3) +75 °C start temperature for optics with focal length f = 50 mm and f = 75 mm

3. Delivery

3.1 Unpacking

3.1.1 Standard Version

1 thermoIMAGER TIM inclusive 1 lens

1 USB cable (1 m [1])

1 Table tripod

1 Process interface cable inclusive terminal block (1 m)

1 Software package TIM Connect

1 Instruction manual

1 Aluminum case

thermoIMAGER TIM 200 / TIM 230 only: Focusing tool for VIS camera

3.1.2 TIM Thermal Developer Kit

1 thermoIMAGER TIM 160 or TIM 200

3 lenses (23 °, 6 ° and 48 °, inclusive calibration certificate)

1 USB cable (1 m [1] and 10 m)

1 Tripod (20 - 63 cm)

1 Process interface cable inclusive terminal block (1 m)

1 Software package TIM Connect

1 Instruction manual

1 Aluminum case

thermoIMAGER TIM 200 / TIM 230 only: Focusing tool for VIS camera

➡ Check the delivery for completeness and shipping damage immediately after unpacking.

➡ In case of damage or missing parts, please contact the manufacturer or supplier.

1) The camera plug of USB cable (1 m) does not feature an IP 67 protection class. For industrial applications there are cables with IP 67 available, starting at 5 m.

3.2 Storage

- Storage temperature:
  - TIM 160/200/230/400/640: -40 ... 70 °C (-40 ... +158 °F)
  - TIM 450: -40 ...85 °C (-40 ... +185 °F)
- Relative humidity: 10 ... 95 %, non-condensing

4. Optical Charts

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. 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 Chap. Fig. 5.

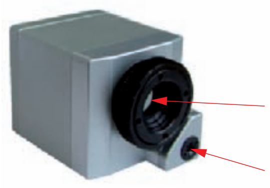


Fig. 1 thermoIMAGER TIM 200 / TIM 230 with VIS channel

Fig. 2 Focusing tool for VIS camera

The thermoIMAGER TIM 200 has also a visual camera (BI-SPECTRAL technology) with a 54 ° x 40 ° - lens (TIM 230 with 30 ° x 23 ° lens). A visual image (VIS) can be combined with a thermal image (IR). Both can be finally captured time synchronously:

i Please make sure that the focus of thermal channel and visual channel (thermoIMAGER TIM 200 / TIM 230 only) is adjusted correctly. For focusing the thermal camera turn the lens in right direction for close and to the left for infinite, see Fig. 2, as well as focusing the visual camera with the focusing tool supplied in the scope of delivery, see Fig. 2

➡ For focusing the thermal camera please turn the lens.

➡ For focusing the visual camera please use the focusing tool, see Fig. 2, supplied in the scope of delivery, see Chap. 3.1.1, see Chap. 3.1.2.

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 contains an algorithm which corrects this distortion.

TIM 160/200 (160 x 120 px)	Focal length	Minimum distance [1]	Distance to object (Measuring field in m, pixel in mm)												
				0,02	**0,1**	**0,2**	**0,3**	**0,5**	**1**	**2**	**4**	**6**	**10**	**30**	**100**
23 ° x 17 ° Standard	10 mm	0.2 m	HFOV (m)	0.012	0.043	0.08	0.12	0.21	0.41	0.81	1.62	2.44	4.1	12.2	40.6
			VFOV (m)	0.009	0.032	0.06	0.09	0.15	0.30	0.60	1.21	1.81	3.0	9.0	30.1
			IFOV (mm)	0.1	0.3	0.5	0.8	1.3	2.5	5.0	9.9	14.9	24.8	74.4	248.0
6 ° x 5 ° Telephoto	35.5 mm	0.5 m	HFOV (m)					0.06	0.11	0.23	0.45	0.68	1.1	3.4	11.3
			VFOV (m)					0.04	0.09	0.17	0.34	0.51	0.8	2.5	8.5
			IFOV (mm)					0.4	0.7	1.4	2.8	4.2	7.0	21.1	70.4
48 ° x 37 ° White angle	4.5 mm	0.2 m	HFOV (m)	0.022	0.082	0.16	0.23	0.38	0.76	1.51	3.00	4.50	7.5	22.5	74.9
			VFOV (m)	0.016	0.059	0.11	0.17	0.28	0.55	1.10	2.19	3.28	5.5	16.4	54.5
			IFOV (mm)	0.1	0.4	0.9	1.3	2.2	4.4	8.8	17.5	26.3	43.9	131.6	438.6

HFOV: 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.

TIM 160/200 (160 x 120 px)	Focal length	Minimalum distance [1]	Distance to object (Measuring field in m, pixel in mm)												
				0.02	**0.1**	**0.2**	**0.3**	**0.5**	**1**	**2**	**4**	**6**	**10**	**30**	**100**
72 ° x 52 ° White angle	3,3 mm	0,2 m	HFOV (m)	0.039	0.152	0.29	0.43	0.72	1.42	2.84	5.665	8.49	14.1	42.4	141.4
			VFOV (m)	0.027	0.106	0.20	0.30	0.50	0.99	1.98	3.95	5.92	9.9	29.6	98.6
			IFOV (mm)	0.2	0.8	1.5	2.3	3.8	7.5	15	30.0	45.0	75.1	225.2	750.8

Fig. 3 Table with examples (TIM 160 / 200) showing what spot sizes and pixel sizes will be reached in which distance

HFOV: 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.

TIM 400/450 (160 x 120 px)	Focal length	Minimum distance [1]	Distance to object (Measuring field in m, pixel in mm)												
				0.02	**0.1**	**0.2**	**0.3**	**0.5**	**1**	**2**	**4**	**6**	**10**	**30**	**100**
38 ° x 29 ° Standard	17 mm	0.2 m	HFOV (m)	0.024	0.079	0.15	0.21	0.35	0.70	1.39	2.76	4.14	6.9	20.7	68.9
			VFOV (m)	0.018	0.060	0.11	0.16	0.26	0.52	1.04	2.07	3.11	5.2	15.5	51.7
			IFOV (mm)	0.1	0.2	0.4	0.5	0.9	1.7	3.4	6.7	10.0	16.7	50.0	166.7
13 ° x 10 ° Telephoto	41 mm	0.5 m	HFOV (m)					0.12	0.23	0.47	0.94	1.40	2.3	7.0	23.4
			VFOV (m)					0.09	0.17	0.35	0.70	1.05	1.7	5.2	17.5
			IFOV (mm)					0.3	0.6	1.2	2.5	3.7	6.1	18.4	61.2
62 ° x 49 ° White angle	8 mm	0.5 m	HFOV (m)	0.040	0.136	0.26	0.38	0.62	1.22	2.42	4.83	7.23	12.0	36.1	120.3
			VFOV (m)	0.030	0.103	0.19	0.28	0.47	0.92	1.83	3.65	5.47	9.1	27.3	90.9
			IFOV (mm)	0.1	0.2	0.5	0.7	1.2	2.29	4.56	9.11	13.65	22.7	68.2	227.3

HFOV: 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.

TIM 400/450 (160 x 120 px)	**Focal length**	**Minimum distance [1]**	**Distance to object (Measuring field in m, pixel in mm)**											
				0.02	**0.1**	**0.2**	**0.3**	**0.5**	**1**	**2**	**4**	**6**	**10**	**30**	**100**
80 ° x 56 ° Standard	7.7 mm	0,2 m	HFOV (m)		0.182	0.35	0.84	0.84	1.65	3.29	6.55	9.82	16.4	49.0	163.4
			VFOV (m)		0.119	0.23	0.55	0.54	1.08	2.14	4.28	6.41	10.7	32.0	106.6
			IFOV (mm)		0.3	0.7	1.6	1.6	3.3	6.5	13.0	19.5	32.5	97.4	324.7

Fig. 4 Table with examples (TIM 400 / 450) showing what spot sizes and pixel sizes will be reached in which distance

HFOV: 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.

TIM 640 (640 x 480 px)	Focal length	Minimum distance [1]	Distance to object (Measuring field in m, pixel in mm)											
				0.1	0.2	0.3	0.5	1	2	4	6	10	30	100
33 ° x 25 ° Standard	18.7 mm	0.2 m	HFOV (m)	0.068	0.13	0.19	0.31	0.60	1.20	2.38	3.57	5.9	17.8	59.3
			VFOV (m)	0.051	0.09	0.14	0.23	0.45	0.89	1.77	2.65	4.4	13.2	44.2
			IFOV (mm)	0.1	0.2	0.3	0.5	0.9	1.8	3.6	5.5	9.1	27.3	90.9
15 ° x 11 ° Telephoto	41.5 mm	0.5 m	HFOV (m)				0.13	0.26	0.52	1.05	1.57	2.6	7.8	26.1
			VFOV (m)				0.10	0.20	0.39	0.79	1.18	2.0	5.9	19.6
			IFOV (mm)				0.2	0.4	0.8	1.6	2.5	4.1	12.3	41.0
60 x 45 ° White angle	10.5 mm	0.2 m	HFOV (m)	0.128	0.25	0.36	0.59	1.17	2.32	4.63	6.94	11.6	34.6	115.4
			VFOV (m)	0.091	0.18	0.26	0.42	0.83	1.66	3.31	4.96	8.3	24.7	82.4
			IFOV (mm)	0.2	0.3	0.5	0.8	1.6	3.2	6.5	9.7	16.2	48.6	161.9

HFOV: 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.

TIM 640 (640 x 480 px)	**Focal length**	**Minimum distance [1]**	**Distance to object (Measuring field in m, pixel in mm)**											
				0.1	0.2	0.3	0.5	1	2	4	6	10	30	100
90 x 64 ° Super wide angle lens	7.7 mm	0.2 m	HFOV (m)	0.220	0.43	0.63	1.03	2.03	4.04	8.06	12.07	20.1	60.3	200.8
			VFOV (m)	0.138	0.27	0.39	0.64	1.27	2.53	5.05	7.57	12.6	37.8	125.9
			IFOV (m)	0.2	0.4	0.70	1.1	2.2	4.4	8.8	13.2	22.1	66.2	220.8

Fig. 5 Table with examples (TIM 640) showing what spot sizes and pixel sizes will be reached in which distance

HFOV: 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.

TIM M-1 (382 x 288 px)	**Focal length**	**Minimum distance** [1]	**Distance to object (Measuring field in m, pixel in mm)**											
				0,1	**0.2**	**0.3**	**0.5**	**1**	**2**	**4**	**6**	**10**	**30**	**100**
f = 16 mm	16 mm	0.2 m	HFOV (m)		0.07	0.11	0.18	0.36	0.72	1.43	2.15	3.6	10.7	35.8
			VFOV (m)		0.05	0.08	0.14	0.27	0.54	1.08	1.62	2.7	8.1	27.0
			IFOV (mm)		0.2	0.3	0.5	0.9	1.9	3.8	5.6	9.4	28.1	93.8
f = 25 mm	25 mm	1.5 m	HFOV (m)	0.023	0.05	0.07	0.11	0.23	0.46	0.92	1.38	2.3	6.9	22.9
			VFOV (m)	0.017	0.03	0.05	0.09	0.17	0.35	0.69	1.04	1.7	5.2	17.3
			IFOV (mm)	0.1	0.1	0.2	0.3	0.6	1.2	2.4	3.6	6.0	18.0	60.0
f = 50 mm	50 mm	1.5 m	HFOV (m)				0.06	0.11	0.23	0.46	0.69	1.1	3.4	11.5
			VFOV (m)				0.04	0.09	0.17	0.35	0.52	0.9	2.6	8.6
			IFOV (mm)				0.2	0.3	0.60	1.2	1.8	3.0	9.0	30.0

HFOV: 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.

TIM M-1 (382 x 288 px)	Focal length	Minimum distance [1]	Distance to object (Measuring field in m, pixel in mm)											
					0.2	**0.3**	**0.5**	**1**	**2**	**4**	**6**	**10**	**30**	**100**
f = 75	75 mm	2.0 m	HFOV (m)					0.08	0.15	0.31	0.46	0.8	2.3	7.6
			VFOV (m)					0.06	0.12	0.23	0.35	0.6	1.7	5.8
			IFOV (mm)					0.2	0.4	0.8	1.2	2.0	6.0	20.0

Fig. 6 Table with examples (TIM M-1) showing what spot sizes and pixel sizes will be reached in which distance

HFOV: 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.

TIM M-1 VGA resolution (764 x 480 px)	**Focal length**	**Minimum distance** [1]	**Distance to object (Measuring field in m, pixel in mm)**											
				0.1	**0.2**	**0.3**	**0.5**	**1**	**2**	**4**	**6**	**10**	**30**	**100**
f = 16 mm	16 mm	0.2 m	HFOV (m)		0.14	0.21	0.36	0.72	1.43	2.87	4.3	7.2	21.5	71.6
			VFOV (m)		0.09	0.14	0.23	0.45	0.90	1.8	2.7	4.5	13.5	45
			IFOV (mm)		0.2	0.3	0.5	0.9	1.9	3.8	5.6	9.4	28.1	93.8
f = 25 mm	25 mm	1.5 m	HFOV (m)	0.046	0.09	0.14	0.23	0.46	0.92	1.83	2.75	4.6	13.8	45.8
			VFOV (m)	0.029	0.06	0.09	0.14	0.29	0.58	1.15	1.73	2.9	8.6	28.8
			IFOV (mm)	0.1	0.1	0.2	0.3	0.6	1.2	2.4	3.6	6.0	18.0	60.0
f = 50	50 mm	1.5 m	HFOV (m)				0.11	0.23	0.46	0.92	1.38	2.3	6.9	22.9
			VFOV (m)				0.07	0.14	0.29	0.58	0.86	1.4	4.3	14.4
			IFOV (mm)				0.2	0.3	0.6	1.2	1.8	3.0	9.0	30.0

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.

TIM M-1 VGA resolution (764 x 480 px)	Focal lenght	Minimum distance [1]	Distance to object (Measuring field in m, pixel in mm)											
				0.1	0.2	0.3	0.5	1	2	4	6	10	30	100
f = 75	75 mm	2.0 m	HFOV (m)					0.15	0.31	0.61	0.92	1.5	4,6	15,3
			VFOV (m)					0.10	0.19	0.38	0.58	1.0	2.9	9.6
			IFOV (mm)					0.2	0.4	0.8	1.2	2.0	6.0	20.0

Fig. 7 Table with examples (TIM M-1 / VGA resolution) showing what spot sizes and pixel sizes will be reached in which distance

HFOV: 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.

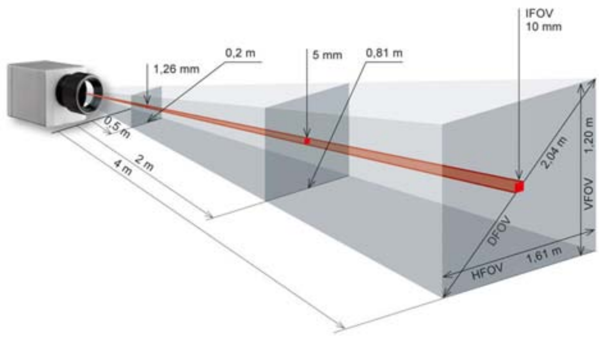


Fig. 8 Measurement field of the thermoIMAGER TIM representing the standard lens 23 ° x 17 °

Dimensions in mm, not to scale

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 (not shown in the drawing above, see Fig. 8)

5. Mechanical Installation

The thermoIMAGER TIM is equipped with two metric M4 thread holes on the bottom side (6 mm depth) and can be installed either directly via these threads or with help of the tripod mount (also on bottom side).

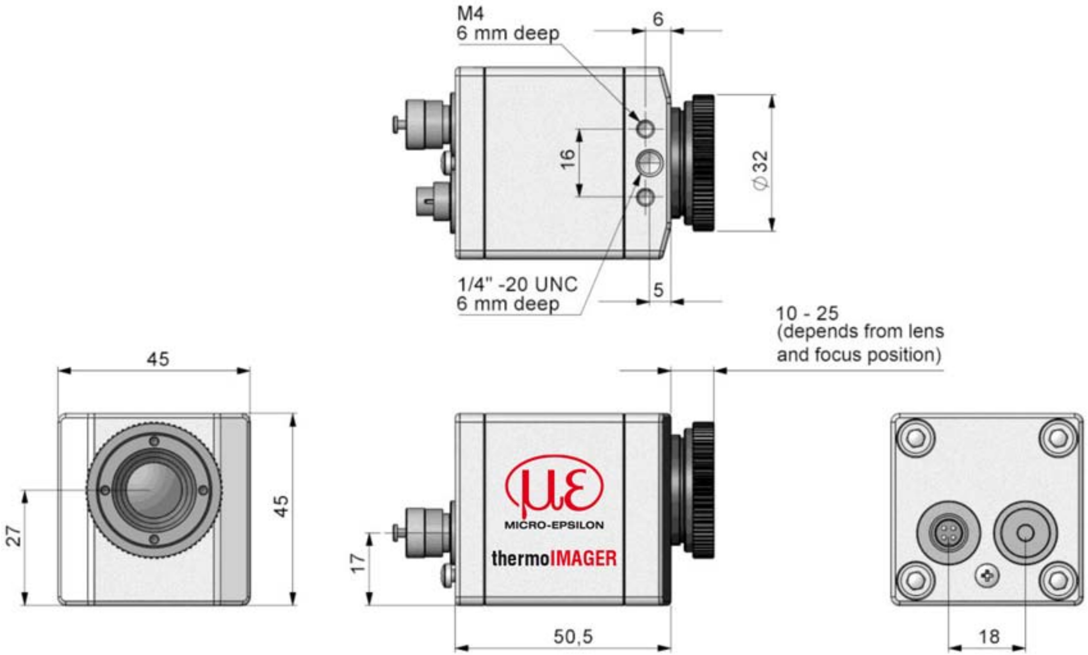


Fig. 9 Dimensional drawing TIM 160, dimensions in mm, not to scale

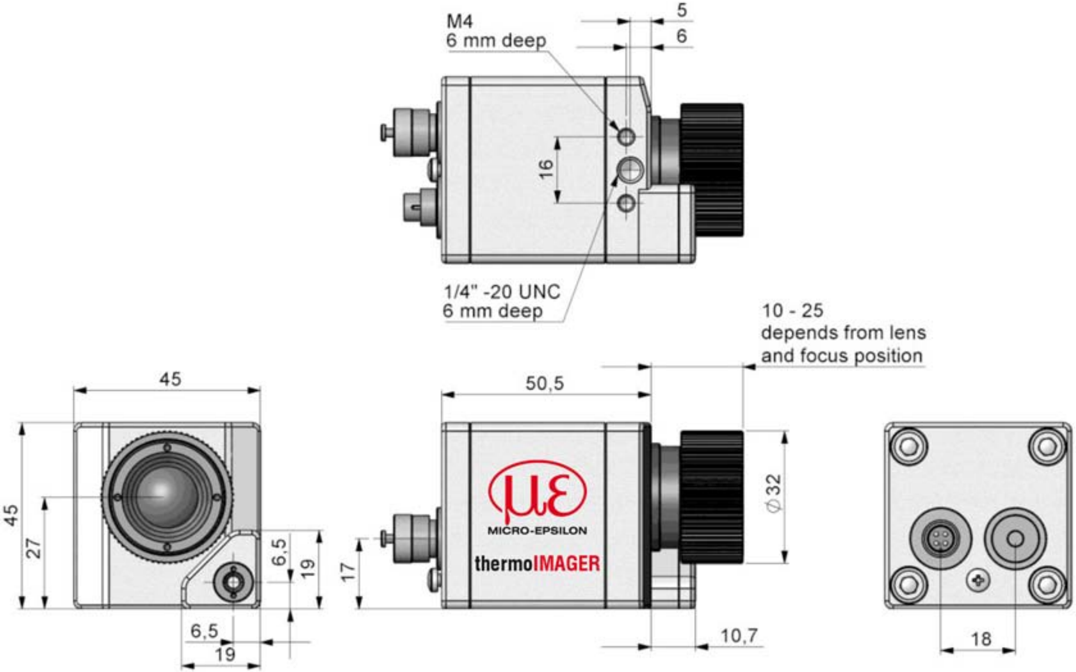


Fig. 10 Dimensional drawing TIM 200 / 230, dimensions in mm, not to scale

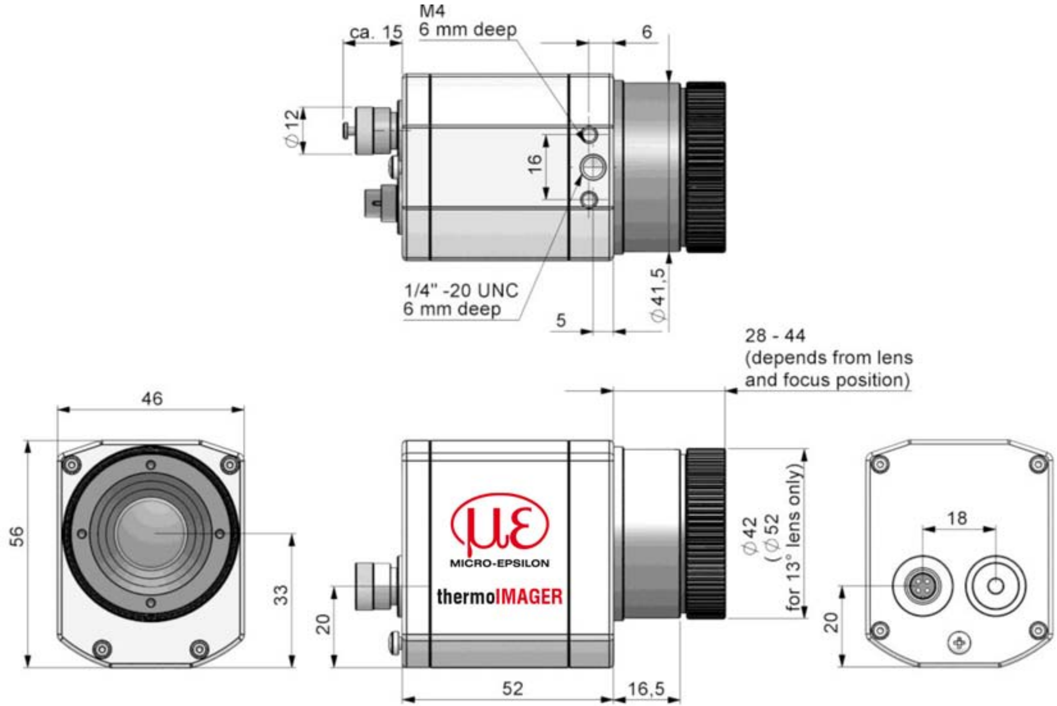


Fig. 11 Dimensional drawing TIM 400 / 450 / G7 / 640, dimensions in mm, not to scale

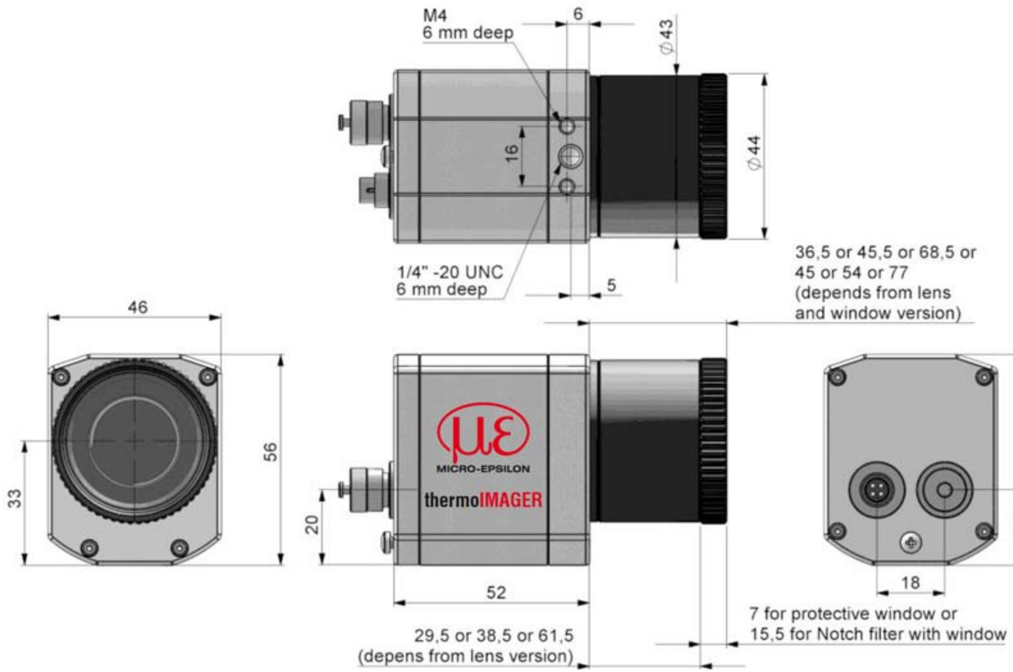


Fig. 12 Dimensional drawing TIM M1, dimensions in mm, not to scale

A mounting base, stainless steel and a protective housing, stainless steel, inclusive mounting base are available as optional accessories, see Chap. A 1.

The infrared camera thermoIMAGER TIM can be used at ambient temperature up to 50 °C.

At higher ambient temperatures (up to 240 °C) the cooling jacket, see Chap. Fig. 13, should be used. This is optionally available for the thermoIMAGER TIM 160 and the TIM 4x0, see Chap. A 1, see Chap. A 2.

For even higher ambient temperatures (up to 315 °C) the CoolingJacket Advanced is provided, see Chap. A 1, see Chap. A 3.

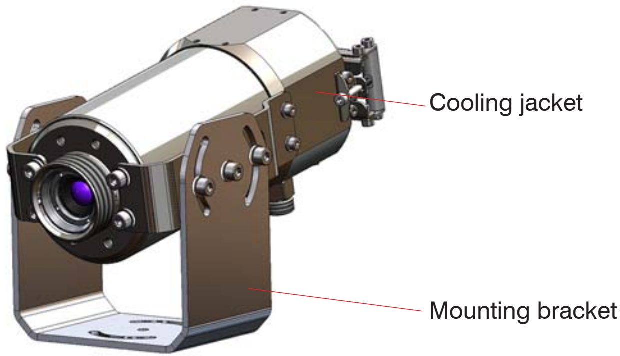


Fig. 13 Combination cooling jacket with mounting bracket

6. Electrical Installation

At the back side of the thermoIMAGER TIM you will find two connector plugs.

➡ Please connect the supplied USB cable with the left plug.

The right connector plug is only used for the process interface.

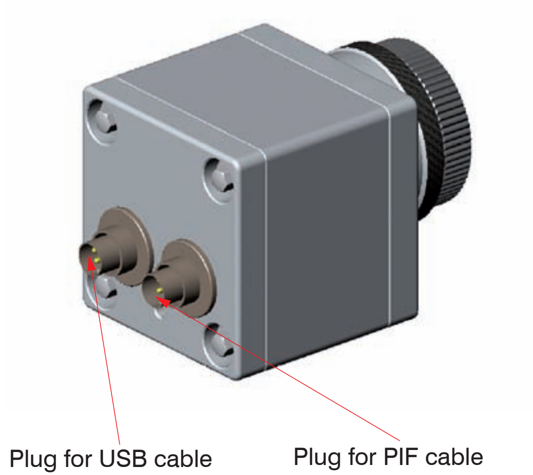
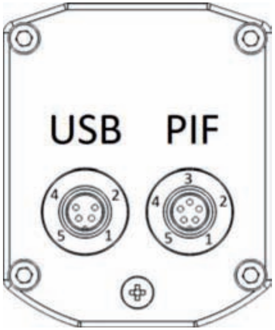


Fig. 14 Rear side of camera with connectors

6.1 PIN Assignment of Connectors

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



View on connector side

Fig. 15 Pin assignment of rear side of camera

⚠ CAUTION

In case of working with a direct PIF connection the input of the PIF is not protected!
A voltage > 3 V on the INT pin will destroy the device!

In case you would like to connect the process interface of the camera directly to external hardware [1] (without using the supplied PIF cable) you should activate the field “Support proprietary PIF cable” in the menu `Tools/ Configuration/ Device (PIF)` in the TIM Connect software.

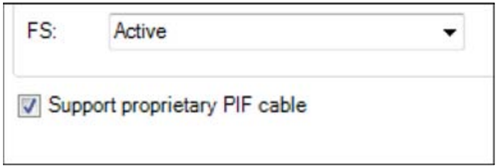


Fig. 16 Screen Support proprietary PIF cable

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

6.2 Process Interface

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.

NOTICE

Please make sure that the process interface (electronics within cable as well as industrial interface) is powered separately (5 - 24 VDC).

> With no external power supply the PIF will not work

The process interface can be activated choosing the following options:

Analog Input (AI):	Emissivity, ambient temperature, reference temperature, flag control, triggered re cording, triggered snapshots, triggered line scanner, uncommitted value
Analog Output (AO):	Main area temperature, internal temperature, flag status, alarm, fail-safe
Digital Input (DI):	Flag control, triggered recording, triggered snapshots, triggered line scanner

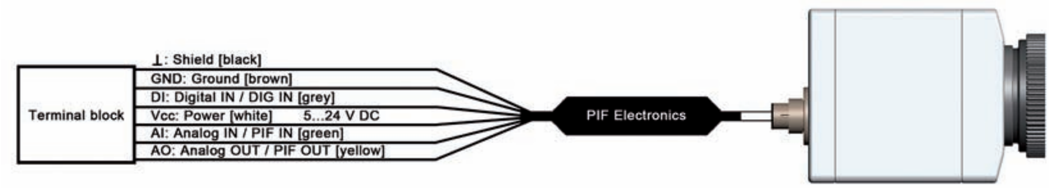


Fig. 17 Configuration process interface (PIF)

The standard process interface offers the following inputs and outputs:

Designation	**Description**	**max. range [1/] status**
AI	Analog input	0 - 10 V
DI	Digital input	24 V
AO	Analog output	0 - 10 V
	Alarm output	0/ 10 V

The voltage levels for the DI are: LOW = 0 ... 0.6 V / HIGH = 2 ... 24 V.

6.3 Industrial Process Interface (Optional)

For use in industrial environment an industrial process interface with 500 VAC_{RMS} isolation voltage between TIM and process is available (connection box with IP 65, 5 m, 10 m or 20 m standard or high temp cable for camera connection, terminal for process integration), see Chap. A 7 (Industrial Process Interface).

6.4 USB Cable Extensions

The maximum USB cable length is 20 m. For greater distances between TIM and computer or for stand-alone solutions you should use the optional TIM NetBox or the USB-Server Industry Isochron, see Chap. A 1, see Chap. A 8.

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

7. Commissioning

➡ Please install at first the software TIM Connect from the delivered CD.

i Further information regarding software installation as well as software features you will find in the instruction manual supplied on the CD.

➡ 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. 18.

Fig. 18 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 supplied CD.

The sharpness of the image can be adjusted by turning the exterior lens ring at the camera.

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 water based glass cleaner.

NOTICE

Never use cleaning compounds which contain solvents (neither for the lens nor for the housing).
> Destruction of the sensor and/or the controller

9. Software TIM Connect

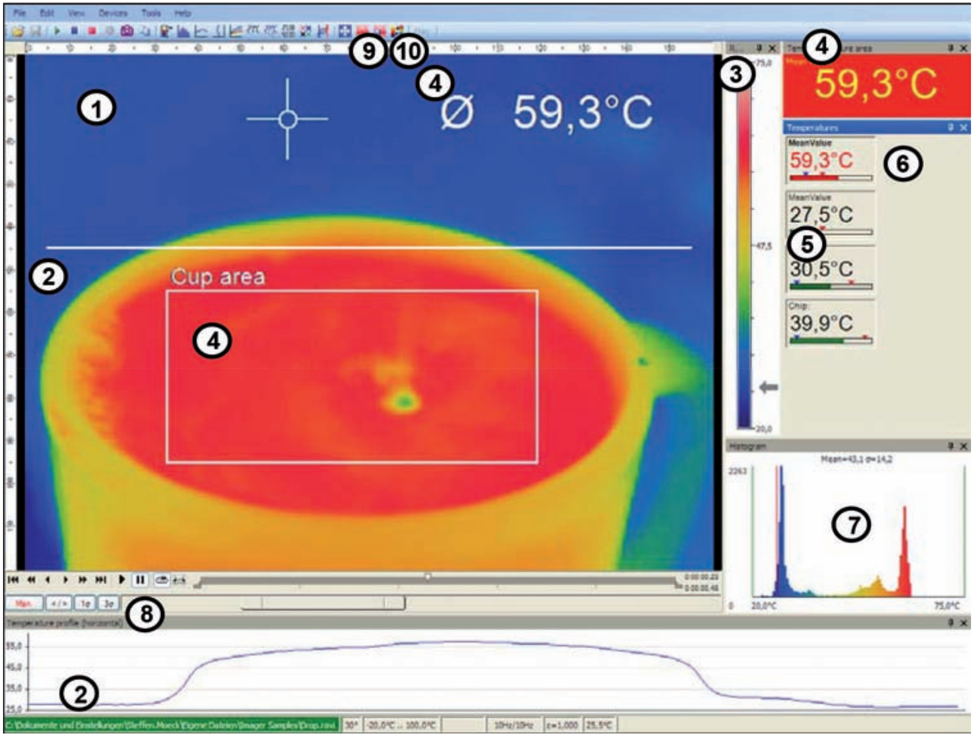


Fig. 19 Example window

i Further information regarding software installation as well as software features you will find in the manual supplied on the CD.

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	Reference bar: Shows the scaling of temperature within the color palette.
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	Control displays: Displays all temperature values in the defined measure areas like Cold Spots, Hot Spots, temperature at cursor, internal temperature and chip temperature.
6	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 temperature above the high alarm value) and to blue (when temperature below the low alarm value).
7	Histogram: Shows the statistic distribution of single temperature values.
8	Automatic / manual scaling of the palette (displayed temperature range): Man., </> (min, max), 1 σ: 1 Sigma, 3 σ: 3 Sigma
9	Icon for quick access to Image Subtraction function.
10	Icon enabling switching between color palettes.

Further details to the software are in the enclosed CD.

9.1 Installation and Initial Start-up

i Uninstall previous versions of the PI Connect before installing the new software. To this use the `Uninstall` icon in the start menu.
All drivers are booted via Windows OS automatically. A driver installation is not necessary.
By default the program starts automatically in English.

➡ Insert the installation CD into the according drive on your computer. If the `autorun option` is activated the installation wizard will start automatically.

➡ Otherwise start `setup.exe` from the CD-ROM. 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 > TIMConnect.`

➡ 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.

➡ Start the software now.

At the initial start the software asks for the calibrations files which are available via internet or on the CD.

➡ Install the calibration files at first start of the software.

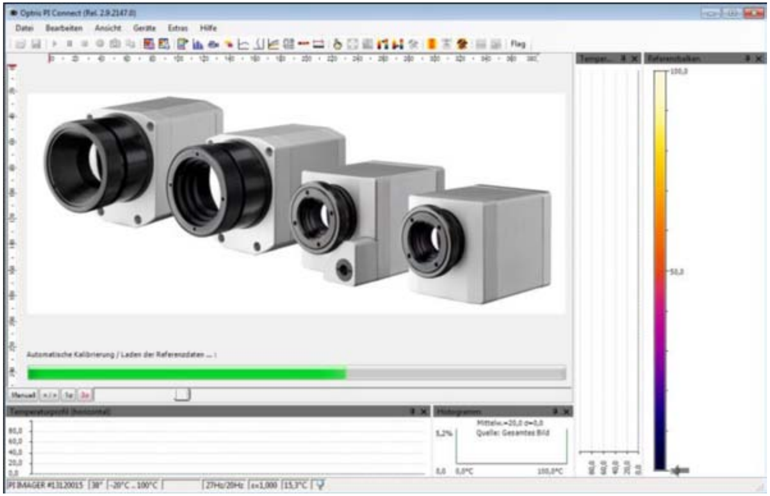
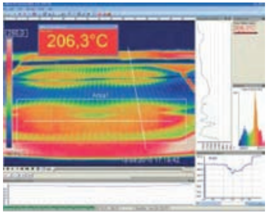
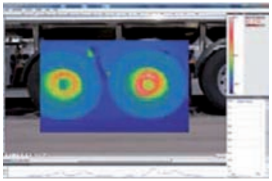


Fig. 20 calibration data transfer

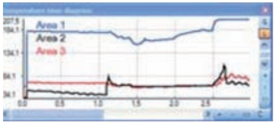
After the calibration files have been installed the live image from the camera is shown inside a window on your PC screen.

- Choose the desired language in the menu `Tools > Language`.
- Adjust the focus of the image by turning the exterior lens ring at the camera.

9.2 Basic Features of Software TIM Connect

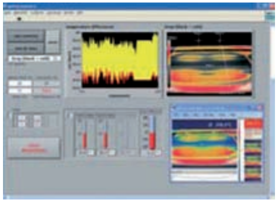
Extensive infrared camera software	
	- No restrictions in licensing - Modern software with intuitive user interface - Remote control of camera via software - Display of multiple camera images in different windows - Compatible with Windows XP, Vista and 7 and LabVIEW
High level of individualization for 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 - BI-SPECTRAL video analysis (IR and VIS) in order to highlight critical temperatures - Adjustment of recording frequency to reduce data volume - Display of snapshot history for immediate analysis

Extensive online and offline data analysis



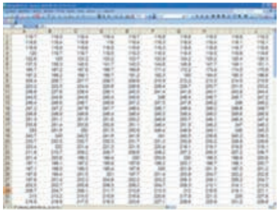
- Analysis supported by measurement fields, hot and cold spot searching, image subtraction
- Real time temperature information within main window as digital or graphic display (line profile, temperature time diagram)
- Slow motion repeat of radiometric files and analysis without camera being connected
- 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
- BI-SPECTRAL process monitoring (IR and VIS) for easy orientation at point of measurement
- 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



- 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”.

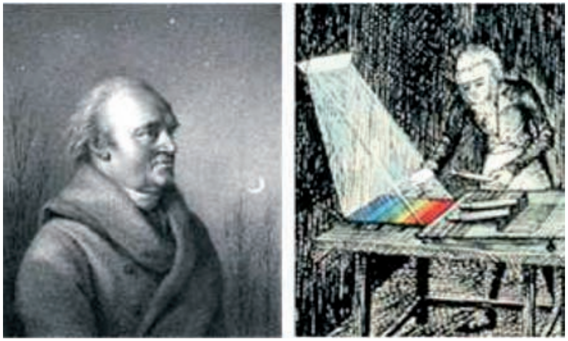


Fig. 21 William Herschel (1738 – 1822)

For the measurement of “thermal radiation” infrared thermometry uses a wave-length ranging between 1 µ and 20 µm.

The intensity of the emitted radiation depends on the material. This material contingent constant is described with the help of the emissivity which is a known value for most materials, see Chap. 11., see Chap. 12.

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)

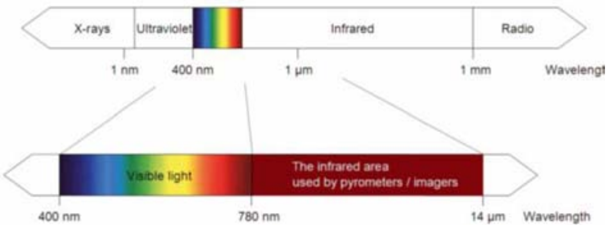
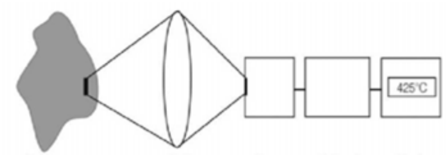


Fig. 22 The electromagnetic spectrum and the area used for temperature measurement

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. 23 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

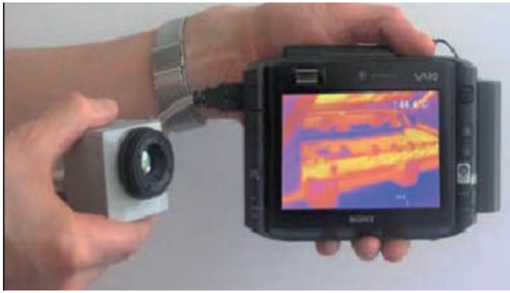
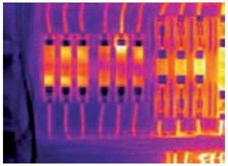
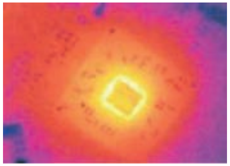


Fig. 24 TIM with tablet PC

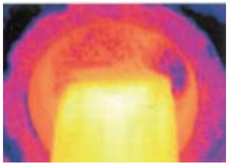
10.2 Application Examples



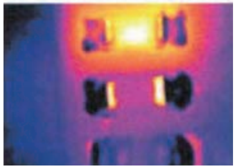
Monitoring of electronic cabinets



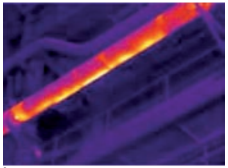
Electronic development



Process control extruding plastic parts

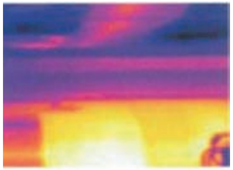


Development of electronic components

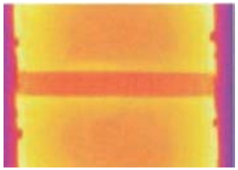


Monitoring of cables

Development of mechanical parts



Process control at calendering



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.

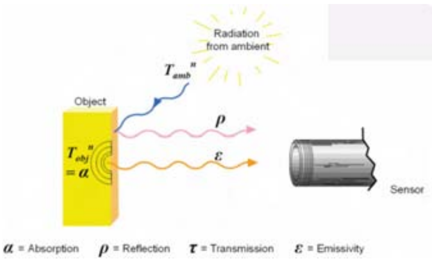


Fig. 25 Capability of an object to emit radiation

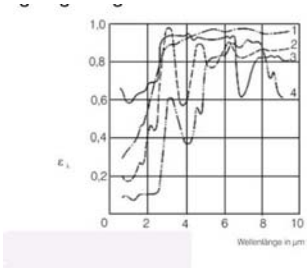


Fig. 26 Spectral emissivity of some materials [1]

1) 1 = Enamel, 2 = Plaster, 3 = Concrete, 4 = Chamotte

11.2 Determination of Unknown Emissivity

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.

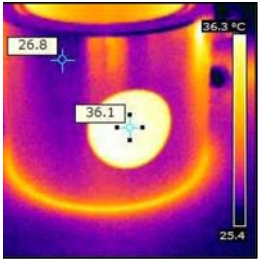


Fig. 27 Plastic sticker at metal surface

➡ 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. 28 Shiny metal surface

Fig. 29 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 Chap. A 5, see Chap. A 6. 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)

12. Warranty

All components of the device have been checked and tested for perfect function in the factory. In the unlikely event that errors should occur despite our thorough quality control, this should be reported immediately to MICRO-EPSILON.

The warranty period lasts 12 months following the day of shipment. Defective parts, except wear parts, will be repaired or replaced free of charge within this period if you return the device free of cost to MICRO-EPSILON. This warranty does not apply to damage resulting from abuse of the equipment and devices, from forceful handling or installation of the devices or from repair or modifications performed by third parties.

No other claims, except as warranted, are accepted. The terms of the purchasing contract apply in full. MICRO-EPSILON will specifically not be responsible for eventual consequential damages. MICRO-EPSILON always strives to supply the customers with the finest and most advanced equipment. Development and refinement is therefore performed continuously and the right to design changes without prior notice is accordingly reserved.

For translations in other languages, the data and statements in the German language operation manual are to be taken as authoritative.

13. Service, Repair

In the event of a defect on the camera, the table tripod or the cables please send us the affected parts for repair or exchange.

In the case of faults the cause of which is not clearly identifiable, the entire measuring system must be sent back to:

MICRO-EPSILON MESSTECHNIK
GmbH & Co. KG
Königbacher Str. 15
94496 Ortenburg / Germany
Tel. +49 (0) 8542 / 168-0
Fax +49 (0) 8542 / 168-90
info@micro-epsilon.de
www.micro-epsilon.com

For customers in USA applies:

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

MICRO-EPSILON USA
8120 Brownleigh Dr.
Raleigh, NC 27617 /USA
Tel. +1 919 / 787-9707
Fax +1 919 / 787-9706
me-usa@micro-epsilon.com
www.micro-epsilon.com

For customers in Canada or South America applies:

Please contact your local distributor.

14. Decommissioning, Disposal

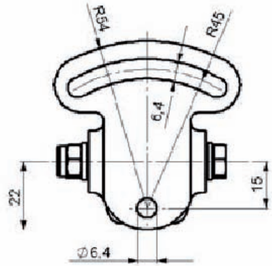
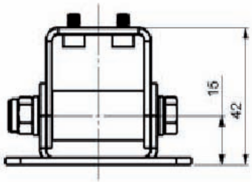
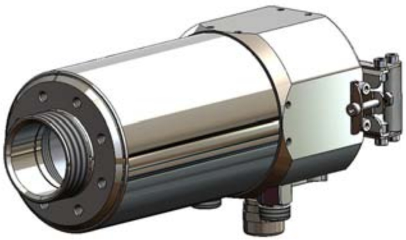
➡ Disconnect all cables from the thermoIMAGER TIM camera.

Incorrect disposal may cause harm to the environment.

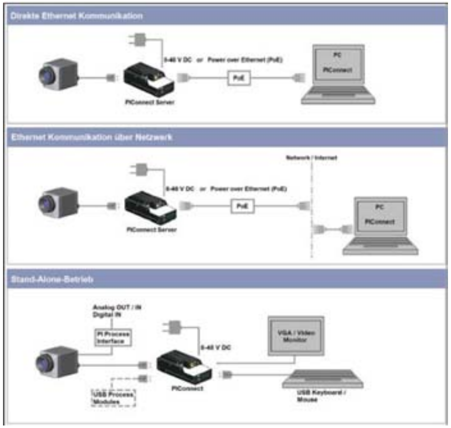
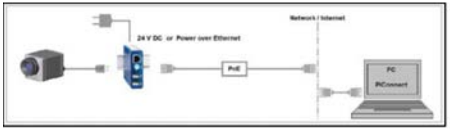
➡ Dispose of the device, its components and accessories, as well as the packaging materials in compliance with the applicable country-specific waste treatment and disposal regulations of the region of use.

Appendix

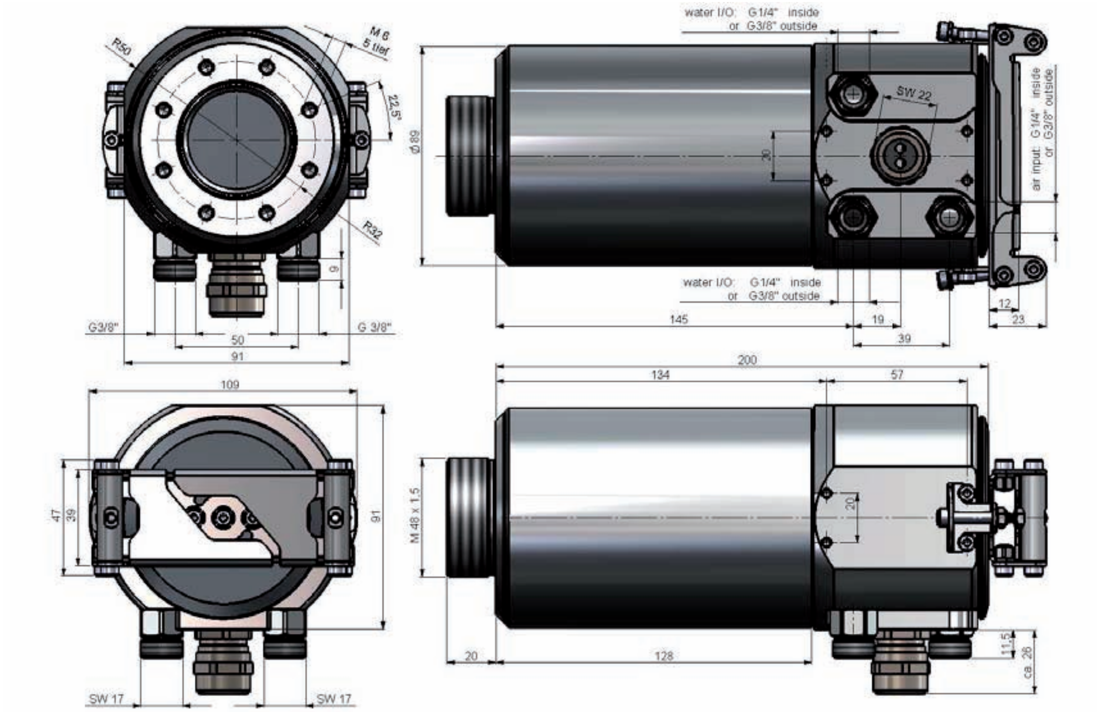
A 1 Accessories

TM-MB-TIM	 	Mounting base, adjustable in two axes
TM-PH-TIM	 	Protective housing, stainless steel, inclusive mounting base
TM-J-TIM TM-Jxx-TIM		Cooling jacket for the thermoIMAGER TIM 160 and TIM 4x0; dimensions, see Chap. A 2

Dimensions in mm (inches), not to scale

TM-JAB-TIM		Mounting bracket for cooling jacket, adjustable in two axes; for the thermoIMAGER TIM 160 and TIM 4x0
TM-CJAxxxx	Further information on request, see Chap. 13. Dimensional drawing, see Chap. A 3	Cooling Jacket Advanced
TM-NETBox-TIM		Miniature PC for stand-alone installation of TIM systems
TM-USBSII-TIM		USB server for cable extension via Ethernet

A 2 Dimensions Cooling Jacket

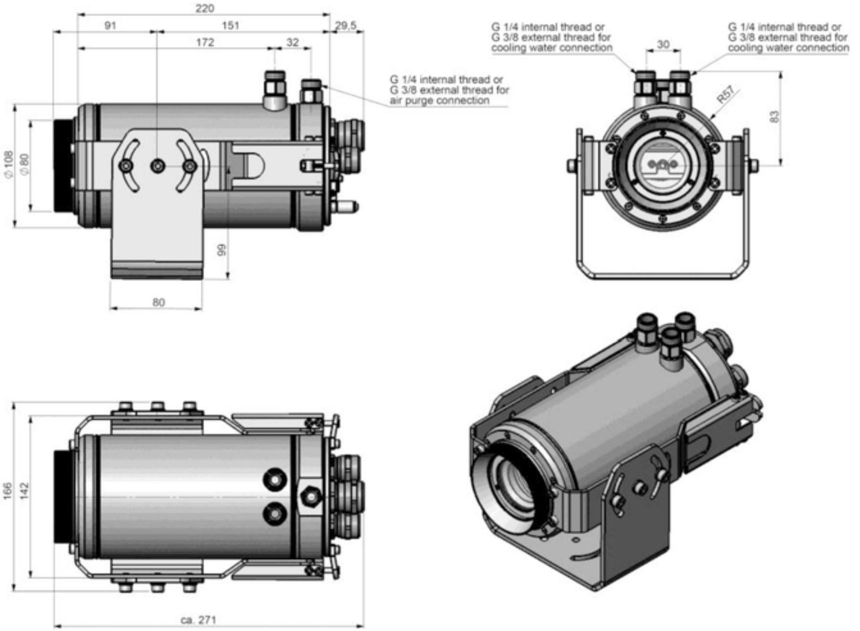


Dimensions in mm, not to scale

A 3 Dimensions Cooling Jacket Advanced

The CoolingJacket Advanced is available as a standard version and as an extended version.

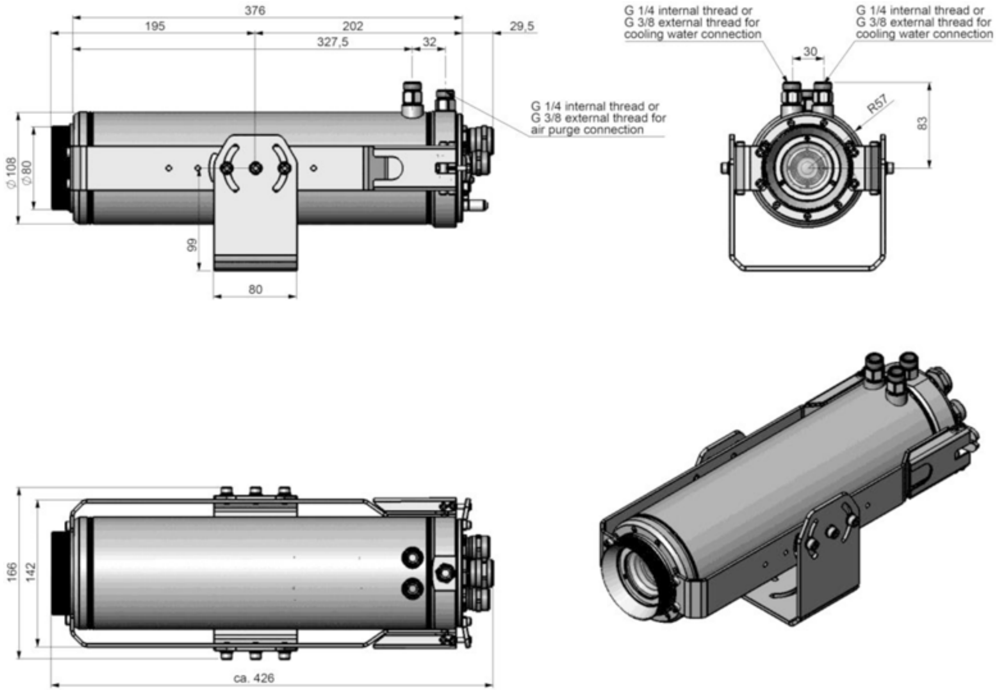
A 3.1 Standard Version



Dimensions in mm, not to scale

A 3.2 Extended Version

The Extended Version is provided for applications of the TIM series with the TIM Netbox and industrial PIF or the USB Server Gigabit and industrial PIF. Both TIM Netbox and industrial PIF or USB Server Gigabit and industrial PIF can be integrated in the CoolingJacket.



Dimensions in mm, not to scale

A 4 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 5 Emissivity Table Metals

i Please note that these are only approximate values, which were taken from various sources.

Material		Typical emissivity
Aluminum	Non oxidized	0.02 - 0.1
	Polished	0.02 - 0.1
	Roughened	0.1 - 0.3
	Oxidized	0.2 - 0.4
Brass	Polished	0.01 - .05
	Roughened	0.3
	Oxidized	0.5
Copper	Polished	0.03
	Roughened	0.05 - 0.1
	Oxidized	0.4 - 0.8
Chrome		0.02 - 0.2
Gold		0.01 - 0.1
Haynes	Alloy	0.3 - 0.8
Inconel	Electro polished	0.15
	Sandblast	0.3 - 0.6
	Oxidized	0.7 - 0.95

Material		Typical emissivity
Iron	Non oxidized	0.05 - 0.2
	Rusted	0.5 -0.7
	Oxidized	0.5 - 0.9
	Forget, blunt	0.9
Iron, casted	Non oxidized	0.2
	Oxidized	0.6 - 0.95
Lead	Polished	0.05 - 0.1
	Roughened	0.4
	Oxidized	0.2 - 0.6
Magnesium		0.02 - 0.1
Mercury		0.05 - 0.15
Molybdenum	Non oxidized	0.1
	Oxidized	0.2 - 0.6
Monel (Ni-CU)		0.1 - 0.14
Nickel	Electrolytic	0.05 - 0.15
	Oxidized	0.2 - 0.5
Platinum	Black	0.9
Silver		0.02

Material		Typical emissivity
Steel	Polished plate	0.1
	Rustless	0.1 - 0.8
	Heavy plate	0.4 - 0.6
	Cold-rolled	0.7 - 0.9
	Oxidized	0.7 - 0.9
Tin	Non oxidized	0.05
Titanium	Polished	0.05 - 0.2
	Oxidized	0.5 - 0.6
Wolfram	Polished	0.03 - 0.1
Zinc	Polished	0.02
	Oxidized	0.1

A 6 Emissivity Table Non Metals

Please note that these are only approximate values which were taken from various sources.

Material		Typical emissivity
Asbestos		0.95
Asphalt		0.95
Basalt		0.7
Carbon	Non oxidized	0.8 - 0.9
	Graphite	0.7 - 0.8
Carborundum		0.9
Cement		0.95
Glass		0.85
Grit		0.95
Gypsum		0.9 - 0.95
Ice		0.98
Limestone		0.98
Paint	Non alcaline	0.9 - 0.95
Paper	Any color	0.95
Plastic > 50 μm	Non transparent	0.95
Rubber		0.95
Sand		0.9
Snow		0.9

Material		Typical emissivity
Soil		0.9 - 0.98
Textiles		0.95
Water		0.93
Wood	Natural	0.9 - 0.95

A 7 Industrial Process Interface (Optional)

For use in industrial environment an industrial process interface with 500 VAC_{RMS} isolation voltage between TIM and process is available (connection box with IP 65, 5 m, 10 m or 20 m standard or high temp cable for camera connection, terminal for process integration).

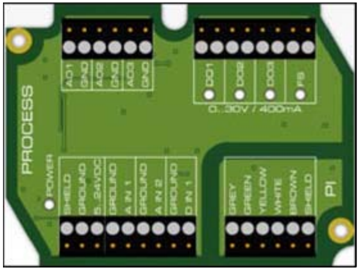


Fig. 30 Connections of the industrial process interface

Color	Designation
Gray	Interrupt
Green	SCL (I^2C)
Yellow	SDA (I^2C)
White	3,3 V
Brown	GND
Shield	GND

Fig. 31 Pin assignment connection cable industrial PIF

The industrial process interface offers the following inputs and outputs:

Designation	Description	max. range [1] / status
A IN 1 / 2	Analog input 1 und 2	0 - 10 V
D IN 1	Digital input	24 V
AO1 / 2 / 3	Analog output 1, 2 and 3	0 - 10 V
	Alarm output 1, 2 and 3	0 / 10 V
DO1 / 2 / 3	Relay output 1, 2 and 3 [2]	open/ closed (red LED on) / 0 ... 30 V, 400 mA
FS	Fail-safe relay	open/ closed (green LED on) / 0 ... 30 V, 400 mA

The voltage levels for the DI are: LOW = 0 ... 0.6 V /HIGH = 2 ... 24 V.

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-TIM	Industrial process interface TM-PIF500V2-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 [1]	-	√
Fail-safe output	0 V at analog output (AO)	Open contact (Fail-safe relay)/ green LED off

1) Depending on supply voltage; for 0 - 10 V on the AO the PIF has to be powered with min. 12 V.
2) Active if AO1, 2 or 3 is/ are programmed as alarm output.

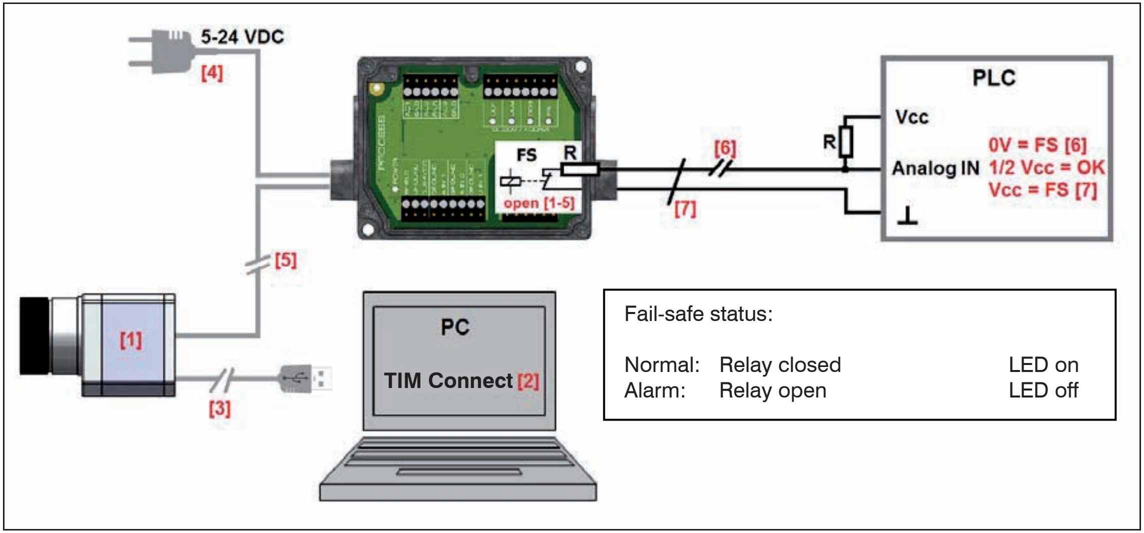


Fig. 32 Example 2 for a fail-safe monitoring of the TIM with a PLC

Fail-safe monitoring states, see Fig. 32

[1] Malfunction of TIM

[2] Malfunction of TIM Connect software

[3] Breakdown of TIM power supply/ Interruption of USB cable

[4] Breakdown of PIF power supply

[5] Interruption of cable TIM-PIF

[6] Cable break of fail-safe cable

[7] Short circuit of fail-safe cable

A 8 USB Cable Extensions

The maximum USB cable length is 20 m. For greater distances between TIM and computer or for standalone solutions you should use the optional TIM NetBox or the USB-Server Industry Isochron:

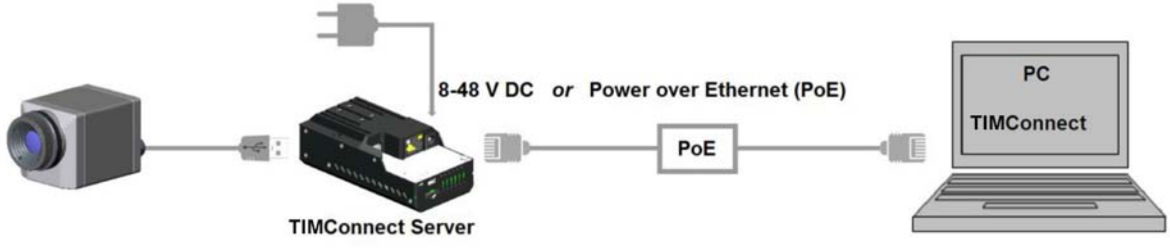


Fig. 33 Ethernet direct communication with TIM Netbox

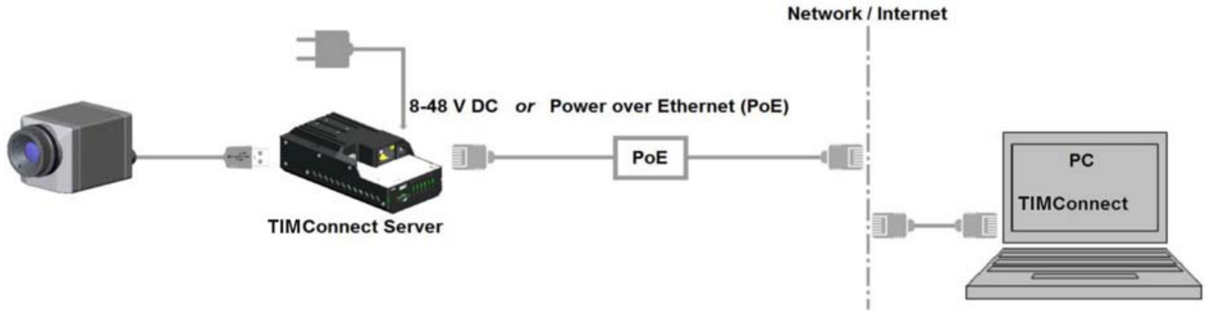


Fig. 34 Ethernet network communication with TIM Netbox

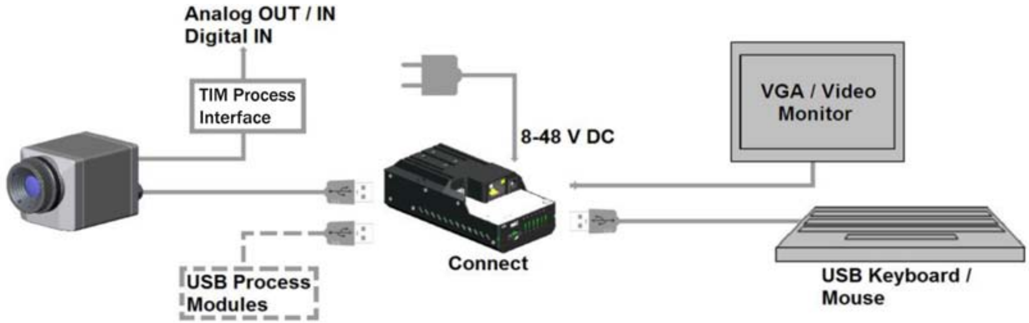


Fig. 35 Stand-Alone operation with TIM Netbox

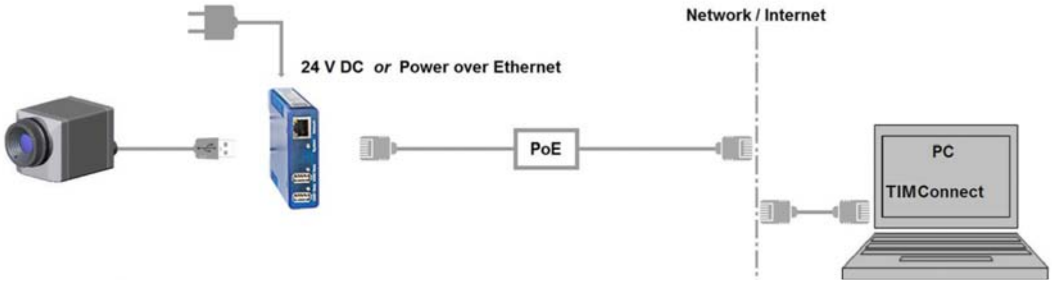


Fig. 36 USB Server Gigabit

A 9 A Brief Overview to Serial Communication

A 9.1 Introduction

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

A 9.2 Setup of the Interface

➡ To enable the software for the serial communication open the Options dialog and enter the tab `Extended Communication`.

➡ Choose the mode `Comport` and select the port you want to use.

➡ Also 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). This is mostly used on other communication devices too. The other station must support 8 bit data.

➡ Now you have to connect the computer with your other communication device.

➡ If this is a computer too you will have to use a null modem cable.

A 9.3 Command List

i You will find the command list on the CD provided and in the TIM Connect software (`Help > SDK`). Each command must end with a `CR / LF` (0x0D, 0x0A).

A 10 A Brief Overview to DLL Communication (IPC)

The communication to the process imager device is handled by the thermoIMAGER TIM Connect software (Imager.exe) only. This communication is made possible by a dll library (imager IPC2.DLL). The DLL can be dynamically linked into the secondary application, or it can be done static by a lib file too.

Both components are designed for Windows XP/Vista/7 only. The application must support call-back functions.

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

i The description of the init procedure as well as the necessary command list you will find on the CD provided and in the TIM Connect Software (`Help > SDK`).

A 11 thermoIMAGER TIM Connect Resource Translator

A 11.1 Introduction

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. If you want to learn more about the internationalization topics please consult Microsoft's developer documentation

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

If needed the localization process can be very detailed. Also the resizing of buttons or other visible resources and the support of right-to-left languages is supported. This can be a huge effort and should be done by experts who have the appropriate tools. 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.

i You will find a detailed tutorial on the CD provided.

A 12 Process Interface

A 12.1 Analog Output

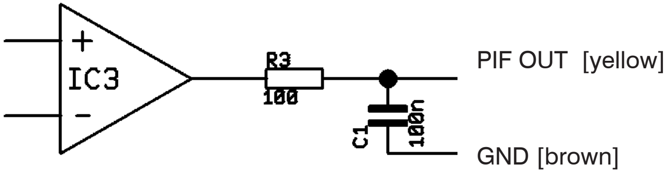


Fig. 37 Analog output

For voltage measurements the minimum load impedance should be 10 KOhm.

The analog output can be used as a digital output. The voltage for `no alarm` and `alarm on` can be set within the software. The analog output (0 … 10 V) has a 100 Ohm resistor in raw. With a maximum current of 10 mA the voltage drop is 1 V.

Having an alarm LED with a forward voltage of 2 V the analog output value for `alarm on` should be 3 V as maximum.

A 12.2 Digital Input

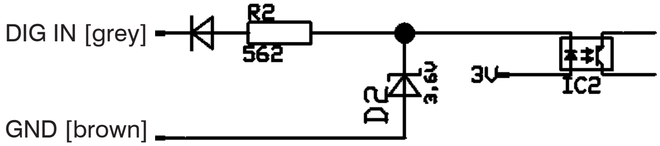


Fig. 38 Digital input

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

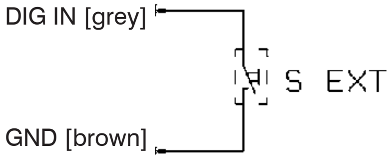


Fig. 39 Diagram 2 - Digital input

A 12.3 Analog Input

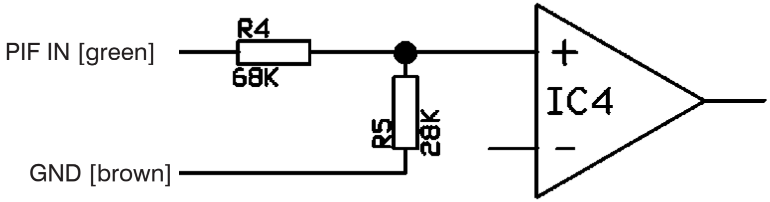


Fig. 40 Analog input

Useful voltage range: 0 ... 10 V

For voltage measurements the minimum load impedance should be 10 KOhm.

A 12.4 Relay Output on Industrial Interface [TM-PIF500V2-TIM]

The analog output has to be set to `Alarm`.

The voltage level for AO1 - AO3 can be set in the software:

- no alarm: 0 V
- Alarm: 2 – 10 V

REL1-3 (D01-D03): Umax = 30 VDC
Imax = 400 mA

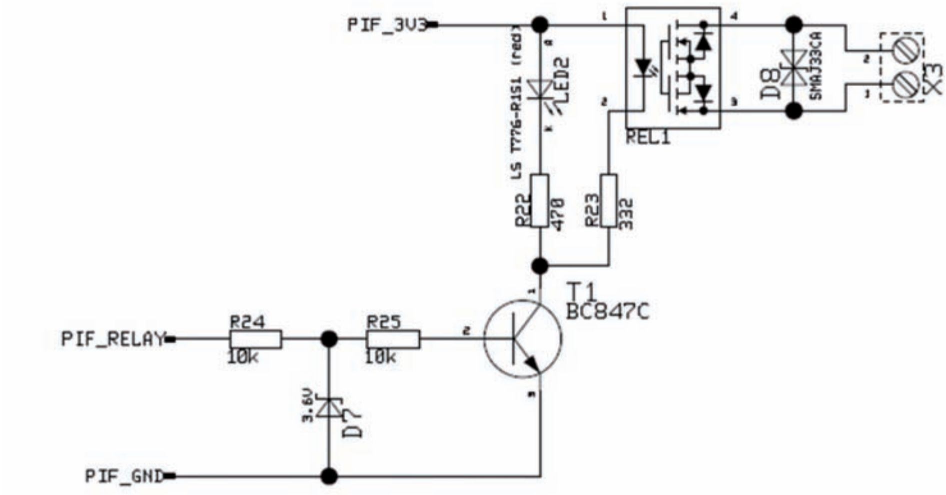


Fig. 41 Relay output

MICRO-EPSILON

MICRO-EPSILON MESSTECHNIK GmbH & Co. KG
Königbacher Str. 15 · 94496 Ortenburg / Germany
Tel. +49 (0) 8542 / 168-0 · Fax +49 (0) 8542 / 168-90
info@micro-epsilon.de · www.micro-epsilon.com

X9751206-E041046HDR