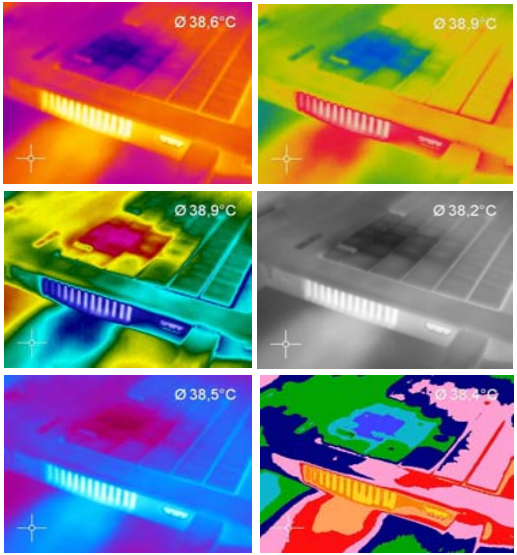
Infrared camera thermoIMAGER TIM



Operators manual

thermoIMAGER TIM 160 / 200 / 400 / 450

CE - Conformity

The product complies with the following standards:

EMC:	EN 61326-1:2006
	EN 61326-2-3: 2006
Safety regulations:	EN 61010-1: 2001
Laser protection:	EN 60825-1: 2007

The product accomplishes the requirements of the EMC Directive 2004/108/EC and of the low-voltage directive 2006/95/EC.

Note
Read the manual carefully before the initial start-up. The producer reserves the right to change the herein described specifications in case of technical advance of the product.

Warranty

Each single product passes through a quality process. Nevertheless, if failures occur, please contact the customer service at once. The warranty period covers 24 months starting on the delivery date. After the warranty is expired the manufacturer guarantees additional 6 months warranty for all repaired or substituted product components. Warranty does not apply to damages, which result from misuse or neglect. The warranty also expires if you open the product. The manufacturer is not liable for consequential damage. If a failure occurs during the warranty period the product will be replaced, calibrated or repaired without further charges. The freight costs will be paid by the sender. The manufacturer reserves the right to exchange components of the product instead of repairing it. If the failure results from misuse or neglect the use has to pay for the repair. In that case you ask for a cost estimate beforehand.

Content

1. Welcome!

Thank you for choosing the thermoIMAGER TIM!

The thermoIMAGER TIM calculates the surface temperature based on the emitted infrared energy of objects **[► Basics of Infrared Thermometry].** 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.

Please take care of the following notes:

Notes

- The thermoIMAGER TIM is a precise instrument and contains a sensitive infrared detector and a high-quality lens. The alignment of the camera to intensive energy sources (high power laser or reflexions of such equipment, e.g.) can have effect on the accuracy of the measurement or can cause an irreparable defect of the infrared detector.
- The mounting should be made only via the mounting threads or tripod connection the housing is providing.
- Avoid static electricity, arc welders, and induction heaters. Keep away from very strong EMF (electromagnetic fields).
- Avoid abrupt changes of the ambient temperature.
- In case of problems or questions which may arise when you use the infrared camera, please contact our service department.

2. Scope of Supply

2.1 Standard Version

- thermoIMAGER TIM 160, TIM 200, TIM 400 or TIM 450 incl. 1 lens
- USB cable (1 m[1]))
- Table tripod
- Process interface cable incl. terminal block (1 m)
- Software package TIM Connect
- Operators manual
- Aluminum case
- thermoIMAGER TIM 200 only: focusing tool for VIS camera

2.2 TIM Thermal Developer Kit

- thermoIMAGER TIM 160 or TIM 200
- 3 lenses (23 °, 6 ° and 48 °, incl. calibration certificate)
- USB cable (1 m[1)] and 10 m)
- Tripod (20 – 63 cm)
- Process interface cable incl. terminal block (1 m)
- Software package TIM Connect
- Operators manual
- Aluminum case
- thermoIMAGER TIM 200 only: focusing tool for VIS camera

[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. Maintenance

Lens cleaning

Blow off loose particles using clean compressed air. The lens surface can be cleaned with a soft, humid tissue moistened with water or a water based glass cleaner.

Hinweis
Never use cleaning compounds which contain solvents (neither for the lens nor for the housing).

4. Technical Datas

4.1 Factory Default Settings

The unit has the following presetting 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

4.2 General Specifications

Environmental rating	IP 65 (NEMA-4)
Ambient temperature	0 ... 50 °C
Storage temperature	-20 ... 70 °C
Relative humidity	10 ... 95 %, non condensing
Material (housing)	aluminum, anodized
Dimensions	TIM 160 / TIM 200: 45 x 45 x 62 - 65 mm^3 (depending on the lens)
	TIM 400 / TIM 450: 46 x 56 x 86 - 90 mm^3 (depending on the lens)
Weight (incl. lens)	TIM 160: 195 g, TIM 200: 215 g, TIM 400 / TIM 450: 320 g
Cable length (USB 2.0)	1 m (Standard), 5 m, 10 m, 20 m [1)]
Vibration	IEC 68-2-6: 3 G, 11 – 200 Hz, any axis
Shock	IEC 68-2-27: 50 G, 11 ms, any axis

[1)] Installation of 20 m cable in the ground is not allowed without protection by conduits, corrugated pipes, tubes or similar. If installed outside the cable must be protected as well (see aforementioned arrangements).

4.3 Electrical Specifications

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)
Input Process Interface (PIF in)	0 - 10 V (Emissivity, ambient temperature, reference temperature, Flag control, triggered video or triggered snapshots)
Digital Input Process Interface	Flag control, triggered video or triggered snapshots)
Digital interface	USB 2.0 **[► Appendix F: PIF]**

4.4 Measurement Specifications

Temperature ranges	-20 ... 100 °C; 0 ... 250 °C; 150 ... 900 °C; Option 200 … 1500 °C [1]
Detector	TIM 160 / TIM 200: UFPA, 160 x 120 Pixel TIM 160 / TIM 200: UFPA, 382 x 288 Pixel
Spectral range	7.5 ... 13 µm
Lenses (FOV)	TIM 160 / TIM 200 [2]: 23 ° x 17 °; 6 ° x 5 °; 48 ° x 37 °; 80 ° x 60 ° TIM 400 / TIM 450: 30 ° x 23 °; 13 ° x 10 °
System accuracy [3]	±2 °C or ±2 %

[1] The additional measurement range of 200 … 1500 °C is not available for cameras thermoIMAGER TIM 400 / TIM 450 as well as for camera version TIM 160 / TIM 200 featuring 80 ° HFOV optic.
[2] For ideal combination of IR and VIS image the lenses of thermoIMAGER TIM 200 featuring 23 ° and 48 ° HFOV are recommended.
[3] At ambient temperature 23±5 °C; whichever is greater.

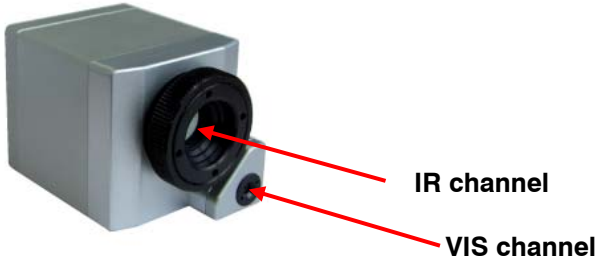
Technical Datas

Temperature resolution (NETD)	TIM 160 / TIM 200: 0.08 K with 23 °; 0.3 K with 6 °; 0.1 K with 48 ° and 80 ° TIM 400 [1]: 0.08 K with 30 °; 0.1 K with 13 ° TIM 450 [1]: 0.04 K with 30 °; 0.06 K with 13 °
Frame rate	TIM 160: 120 Hz; TIM 200: 128 Hz [2] TIM 400 /TIM 450: 80 Hz
Warm-up time	10 min
Emissivity	0.100 … 1.000 (adjustable via software)
Visual camera (TIM 200 only)	640 x 480 pixels, 32 Hz, 54 ° x 40 ° FOV [2]
Software	TIM Connect

[1] Value is valid at 40 Hz and 25 °C room temperature
[2] 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)

5. Optical Datas

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 (please see tables at the end of this section).



With the help of BI-SPECTRAL technology at thermoIMAGER TIM 200, a visual image (VIS) can be combined with a thermal image (IR). Both can be finally captured time synchronously:

Fig. 5.1: Focusing tool for VIS camera

Note

Please make sure that the focus of thermal channel and visual channel (thermoIMAGER TIM 200 only) is adjusted correctly. For the thermal camera please turn the lens, for focusing the visual camera please use the focusing tool supplied in the scope of delivery.

Optical Datas

TIM160/200 (160 x 120 px)	Focal length	Minimum distance	Distance to object [Measuring field in m, pixel in mm]												
				0.02	**0.1**	**0.2**	**0.3**	**0.5**	**1.2**	**2**	**4**	**6**	**10**	**30**	**100**
23 ° x 17 ° Standard	10 mm	0.02 m*	HFOV (m)	0.008	0.04	0.08	0.12	0.20	0.48	0.80	1.60	2.4	4.0	12.0	40.0
			VFOV (m)	0.006	0.03	0.06	0.09	0.15	0.36	0.60	1.20	1.8	3.0	9.0	30.0
			IFOV (mm)	0.050	0.25	0.50	0.75	1.25	3.00	5.00	10.00	15.0	25.0	75.0	250.0
Telephoto 6 ° x 5 °	35.5 mm	0.05 m	HFOV (m)					0.06	0.14	0.23	0.45	0.7	1.1	3.4	11.3
			VFOV (m)					0.04	0.10	0.17	0.34	0.5	0.8	2.5	8.5
			IFOV (mm)					0.35	0.85	1.41	2.82	4.2	7.0	21.1	70.4
48 ° x 37 ° Wide angle	4.5 mm	0.02 m*	HFOV (m)	0.018	0.09	0.18	0.27	0.44	1.07	1.78	3.56	5.3	8.9	26.7	88.9
			VFOV (m)	0.013	0.07	0.13	0.20	0.33	0.80	1.33	2.67	4.0	6.7	20.0	66.7
			IFOV (mm)	0.111	0.56	1.11	1.67	2.78	6.67	11.11	22.22	33.3	55.6	166.7	555.6
80 ° x 60 ° Wide angle	3.1 mm	0.1 m	HFOV (m)	0.026	0.13	0.26	0.39	0.65	1.55	2.58	5.16	7.7	12.9	38.7	129.0
			VFOV (m)	0.019	0.09	0.19	0.29	0.48	1.16	1.94	3.87	5.8	9.7	29.0	96.8
			IFOV (mm)	0.16	0.81	1.61	2.42	4.03	9.68	16.13	32.26	48.4	80.7	241.9	806.5

TIM400/450 (382 x 288 px)	Focal length	Minimum distance	Distance to object [Measuring field in m, pixel in mm]												
				0.02	0.1	0.2	0.3	0.5	1.2	2	4	6	10	30	100
30 ° x 23 ° Standard	17 mm	0.2 m	HFOV (m)			0.11	0.17	0.28	0.67	1.12	1.60	3.4	5.6	16.9	56.2
			VFOV (m)			0.08	0.13	0.21	0.51	0,84	1.20	2.5	4.2	12.7	42.4
			IFOV (mm)			0.29	0.44	0.74	1.76	2.94	5.88	8.8	14.7	44.1	147.1
13 ° x 10 ° Telephoto	40 mm	0.5 m	HFOV (m)					0.12	0.29	0.48	0.96	1.5	2.4	7.2	23.9
			VFOV (m)					0.09	0.22	0.36	0.72	1.1	1.8	5.4	18.0
			IFOV (mm)					0.31	0.75	1.25	2.50	3.8	6.3	18.8	62.5

Table with examples showing what spot sizes and pixel sizes will be reached in which distance. For individual configuration there are different lenses available.
***Note:** The accuracy of measurement can be outside of the specifications for distances below 0.2 m.

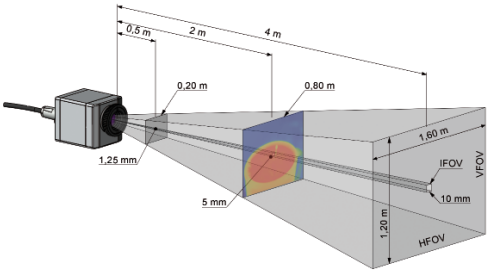


Fig. 5.2: Measurement field of the thermoIMAGER TIM representing the standard lens 23 ° x 17 °

6. 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).

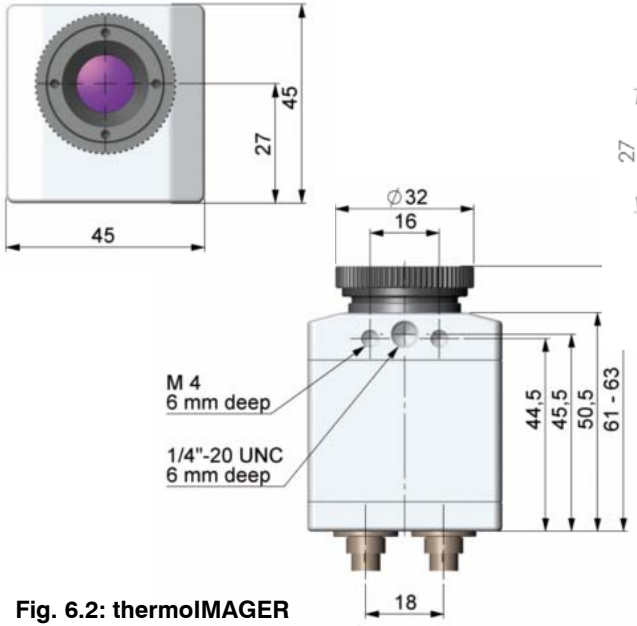


Fig. 6.2: thermoIMAGER TIM 160, dimensions in mm

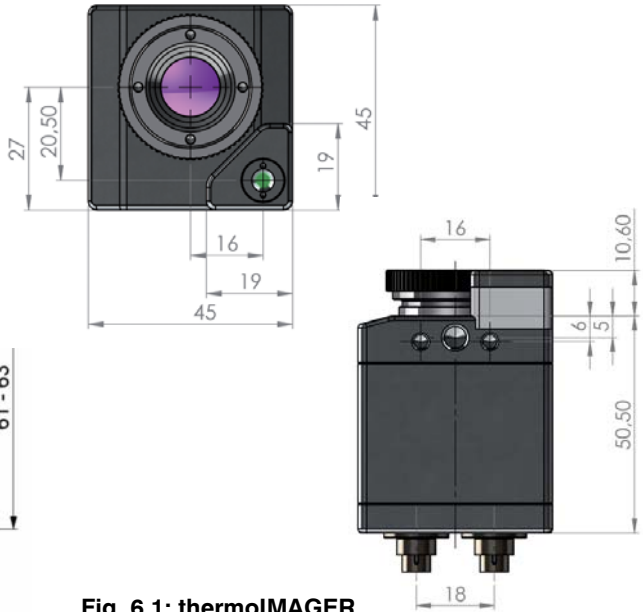
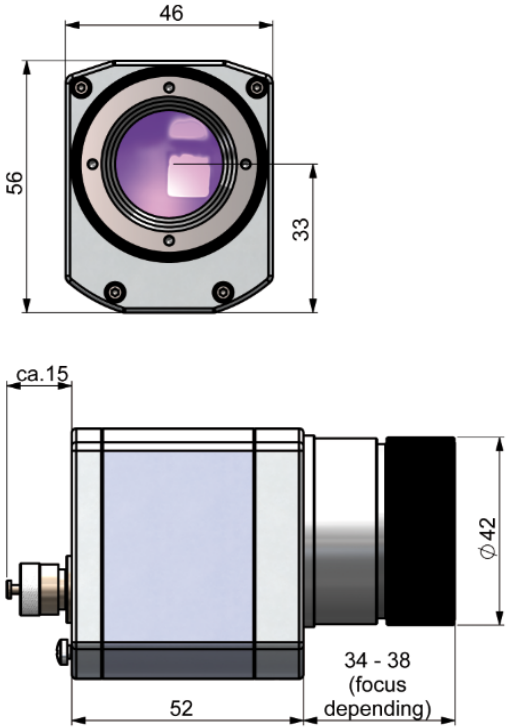


Fig. 6.1: thermoIMAGER TIM 200, dimensions in mm



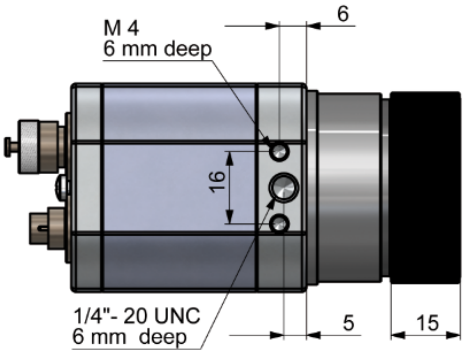


Fig. 6.3: thermoIMAGER TIM 400 / TIM 450, dimensions in mm

6.1 Mounting Accessories (Optional)

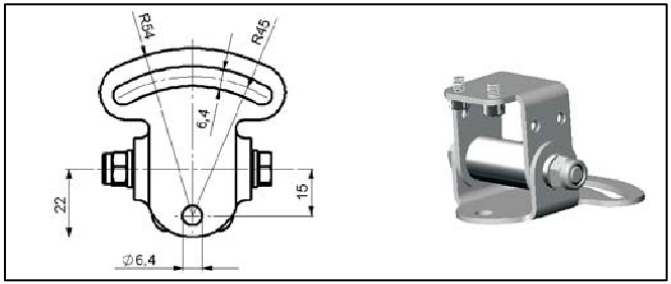


Fig. 6.4: Mounting base, stainless steel, adjustable in 2 axes
Product code: TM-MB-TIM

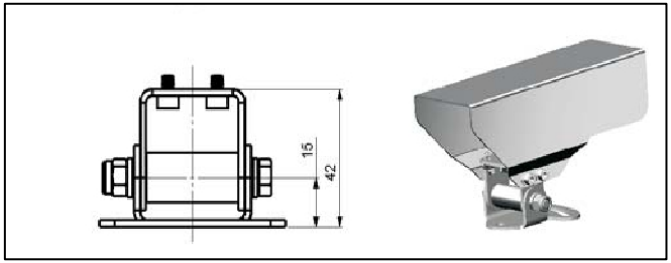


Fig. 6.5: Protective housing, stainless steel, incl. mounting base
Product code: TM-PH-TIM

6.2 High Temperature Accessories (Optional for TIM 160 only)

The thermoIMAGER TIM can be used at ambient temperature up to 50 °C.
At higher temperatures (up to 240 °C) the cooling jacket should be used.

Fig. 6.6: Cooling jacket for thermoIMAGER TIM
Product code: TM-J-TIM

Fig. 6.7: Mounting bracket for cooling jacket, adjustable in two axes
Product code: TM-JAB-TIM

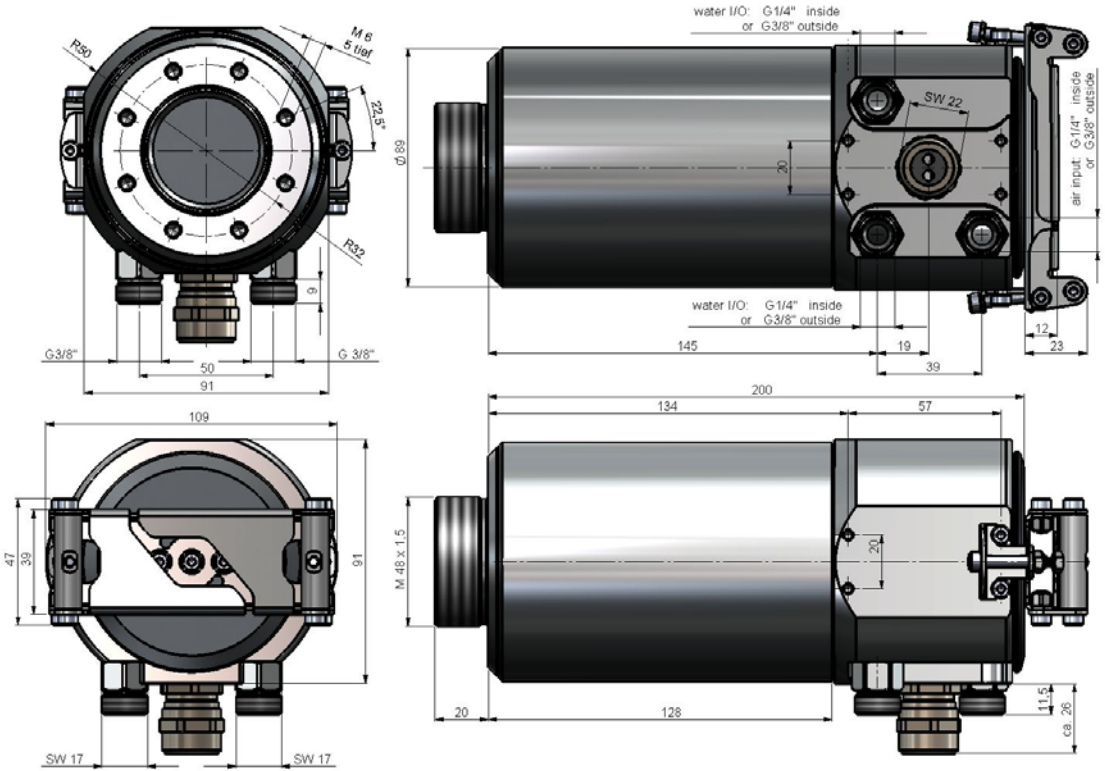


Fig. 6.8: Cooling jacket dimensions

7. Electrical Installation

At the back side of the thermoIMAGER TIM you will find two connector plugs. Please connect the supplied USB cable with the right plug. The left connector plug is only used for the process interface.

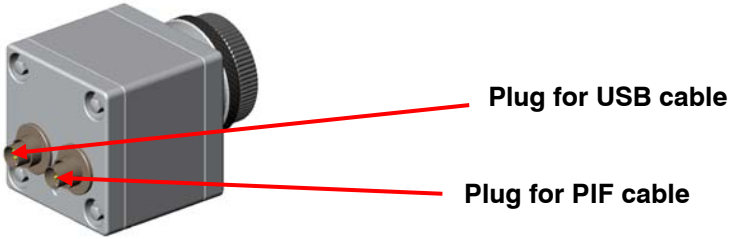


Fig. 7.1: Backside of camera with connectors

7.1 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 (PIF in) and Digital Input (Dig In) in order to control the camera or as an Analog Output (PIF out) in order to control the process. The signal level is always 0 – 10 V.

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

The process interface can be activated choosing the following options:

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

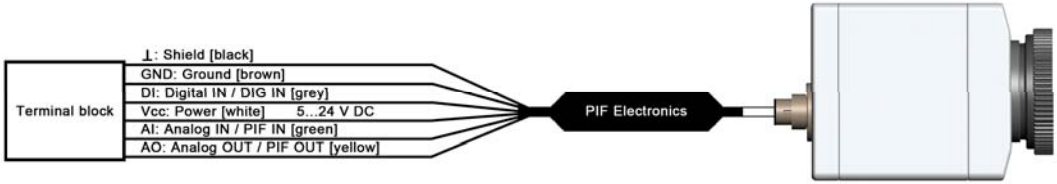


Fig. 7.2: Configuration Process Interface (PIF)

7.2 Industrial Process Interface (Optional)

For electrical installation, an industrial process interface with 500 VAC_{RMS} isolation voltage between TIM and process is available (connection box with IP 65, 5 m high temp. cable for camera connection, terminal for process integration).

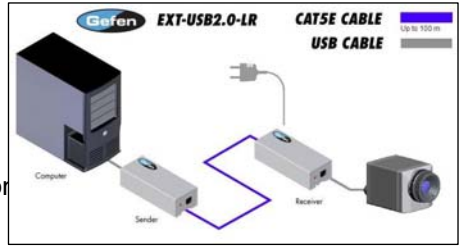
[► Appendix F: PIF]

Fig. 7.3: Connection box of industrial process interface TM-PIF500V-TIM

7.3 USB Cable Extensions

Some applications for the thermoIMAGER TIM are requiring a cable length above 20 m which cannot fulfilled with the standard USB cables. After extensive test runs MICRO-EPSILON recommends the following USB cable extensions:

1. USB extension up to 100 m via CAT5 Ethernet cable:
Gefen EXT-USB2.0-LR; part number: EXT-USB2.0-LR
Please note: local power supply on TIM side (receiver) is needed.



2. USB extension up to 500 m via multimode fiber optics
Icron 2224; part number: 00-00261/ USB Ranger 2224 -EU
Please note: MICRO-EPSILON recommends both the power supply on remote unit (PI side) as well as on local unit (PC side)
Gefen EXT-USB-400FON; part number: EXT-USB-400FON
Please note: power supply on TIM side (receiver) is needed.

3. USB extension up to 10 km via single-mode fiber optics
Icron 2244; part number: 00-00265 USB Ranger 2244 - EU
Please note: MICRO-EPSILON recommends both the power supply on remote unit (TIM side) as well as on local unit (PC side).

8. Initial Start-up

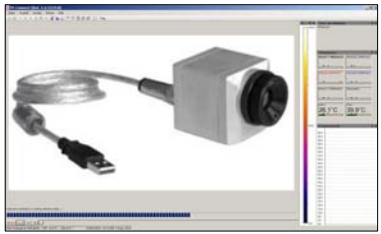
Please install at first the software TIM Connect from the CD.

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

Now you can connect the infrared imager into an USB port (USB 2.0) of your PC.

Note
If connecting the imager and the computer please plug at first the USB cable into the camera and then into the computer.
If disconnecting the imager and the computer please remove at first the USB cable from the computer and then from the camera.

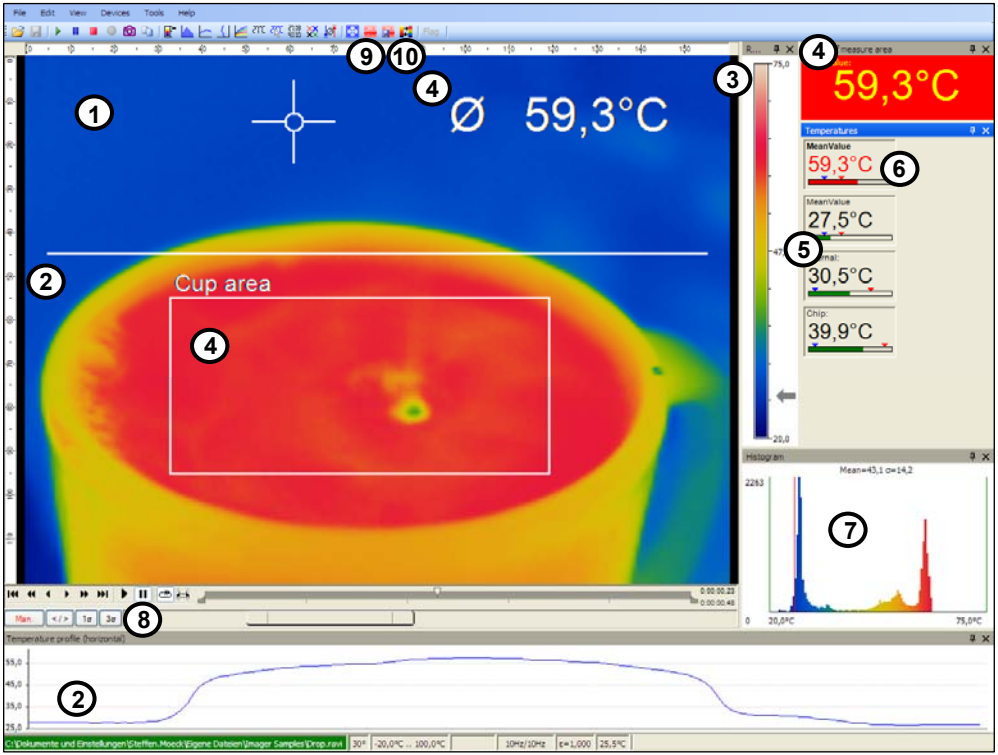
After the software has been started, you should see the live image from the camera inside a window on your PC screen.



Note
At first start of software you will be asked to install the calibration data of camera (supplied on the CD).

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

9. Software TIM Connect



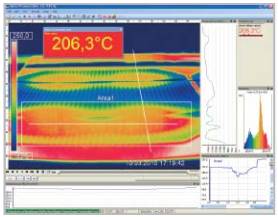
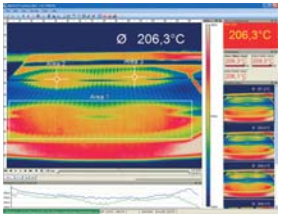
Note
Further information regarding software installation as well as software features you will find in the manual supplied on the CD.

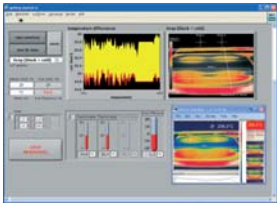
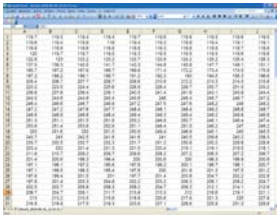
Fig. 9.1: Example of software layout

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 Basic Features of Software TIM Connect

LabVIEW Microsoft Windows XP Windows Vista Windows 7	**Extensive infrared camera software** • No additional costs • 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

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.

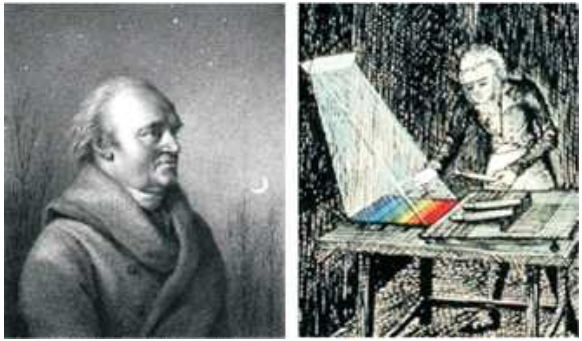


Fig. 10.1: William Herschel (1738 – 1822)

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”.

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 enclosed table emissivity).

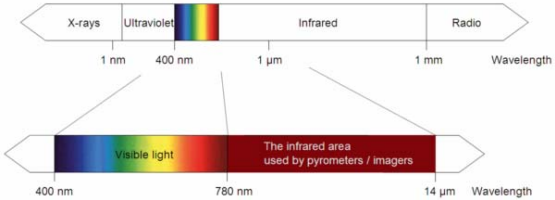
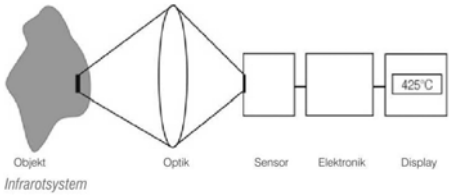


Fig. 10.2: The electromagnetic spectrum and the area used for temperature measurement

Infrared thermometers are optoelectronic sensors. They calculate the surface temperature on the basis of the emitted infrared radiation from an object. The most important feature of infrared thermometers is that they enable the user to measure objects contactless. Consequently, these products help to measure the temperature of inaccessible or moving objects without difficulties. Infrared thermometers basically consist of the following components:

- lens
- spectral filter
- detector
- electronics (amplifier/ linearization/ signal processing)

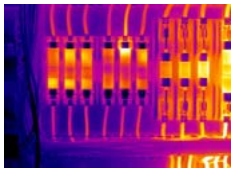


The specifications of the lens decisively determine the optical path of the infrared thermometer, which is characterized by the ratio **D**istance to **S**pot size. The spectral filter selects the wavelength range, which is relevant for the temperature measurement. The detector in cooperation with the processing electronics transforms the emitted infrared radiation into electrical signals.

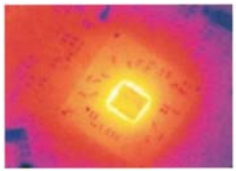
The advantages of non-contact temperature measurement are clear - it supports:

- 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

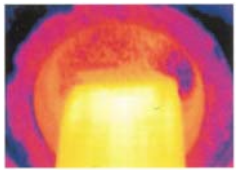
Application examples:



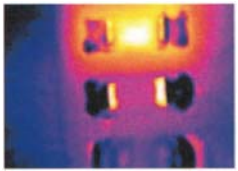
Monitoring of electronic cabinets



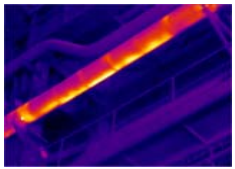
F&E of electronics



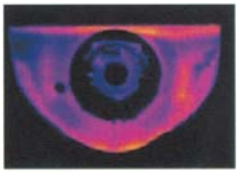
Process control extruding plastic parts



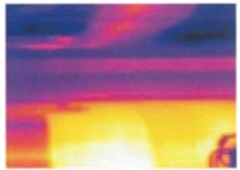
F&E of electronic parts



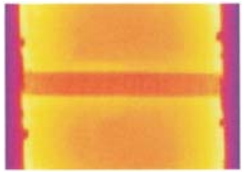
Monitoring of cables



F&E of mechanical parts



Process control at calendering



Process control manufacturing solar modules

11. Emissivity

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.

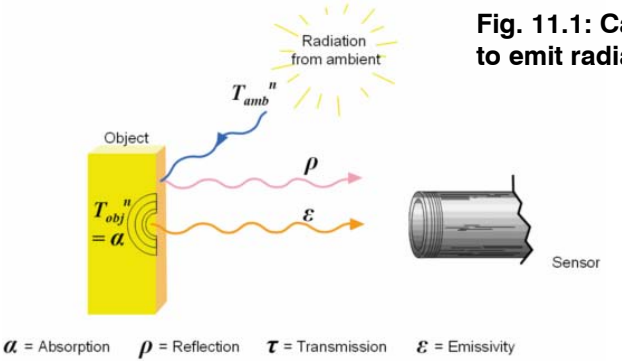


Fig. 11.1: Capability of an object to emit radiation

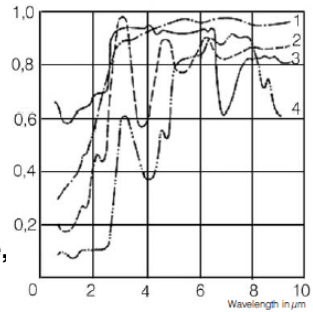


Fig. 11.2: Spectral emissivity of some materials: 1 Enamel, 2 Plaster, 3 Concrete, 4 Chamotte

11.1 Determination of Unknown Emissivities

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

► If you monitor temperatures of up to 380 °C you may place a special plastic sticker (emissivity dots – part number: TM-ED-LS) onto the measuring object, which covers it completely. Now set the emissivity to 0.95 and take the temperature of the sticker. Afterwards, determine the temperature of the adjacent area on the measuring object and adjust the emissivity according to the value of the temperature of the sticker.

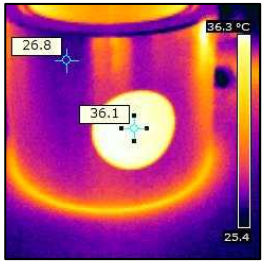


Fig. 11.3: Plastic sticker at metal surface

► 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. 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.

Fig. 11.4: Shiny metal surface

Fig. 11.5: Blackened metal surface

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

11.2 Characteristic Emissivities

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

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

Appendix A – Emissivity Table Metals

Material		typical Emissivity
Aluminium	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
Iron	non oxidized	0.05-0.2
	rusted	0.5-0.7
	oxidized	0.5-0.9
	forged, blunt	0.9
Iron, casted	non oxidized	0.2
	oxidized	0.6-0.95
Lead	polished	0.05-0.1

Material		typical Emissivity
Lead	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
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

Appendix B – Emissivity Table Non Metals

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
Ceramic		0.95
Concrete		0.95
Glass		0.85
Grit		0.95
Gypsum		0.8-0.95
Ice		0.98
Limestone		0.98
Paint	non alkaline	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
Soil		0.9-0.98
Textiles		0.95
Water		0.93
Wood	natural	0.9-0.95

Appendix C – A Brief Overview to Serial Communication

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.

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.

Command list

You will find the command list on the CD provided.

Appendix D – 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 Imager.exe and ImagerIPC.dll 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.

Note
The description of the init procedure as well as the necessary command list you will find on the CD provided.

Appendix E – thermoIMAGER TIM Connect Resource Translator

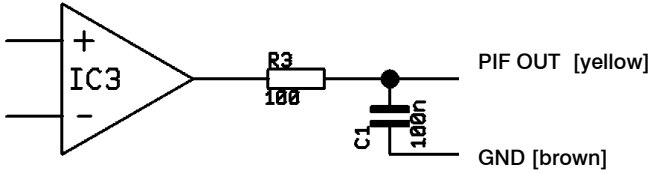
Introduction

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 (e.g.: 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.

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

Appendix F – Process Interface

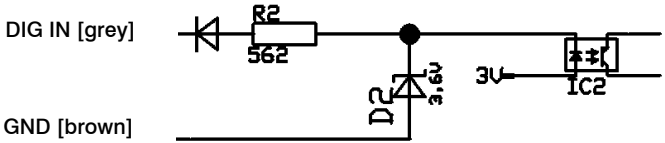
Analog Output:



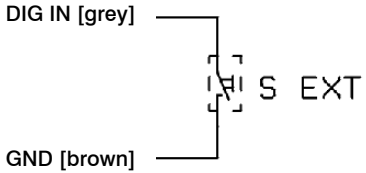
For voltage measurements the minimum load impedance should be 10 KOhm.

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:

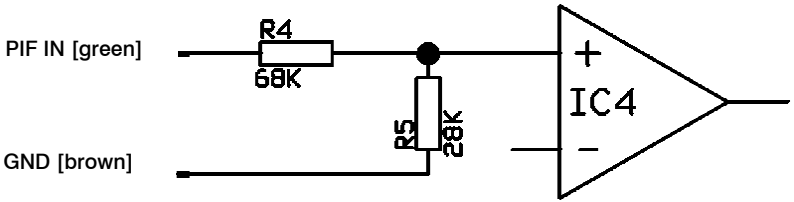
Digital Input:



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



Analog Input:



Useful voltage range: 0 … 10 V

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