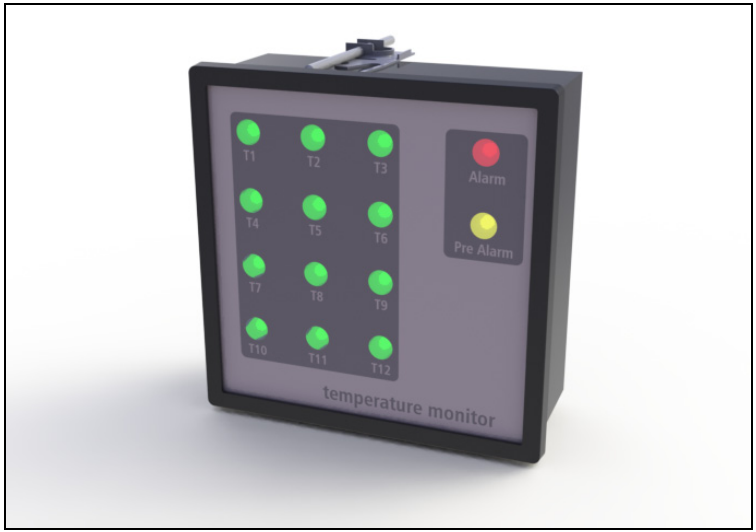
optris® TM

Temperature Monitor for Infrared Sensors



Operators manual

optris
infrared thermometers

CE-Conformity

The product complies with the following standards:

EMC:	EN 61326-1:2006 (Basic requirements)
	EN 61326-2-3:2006
Safety:	EN 61010-1:2001

The product accomplishes the requirements of the EMC Directive 2004/108/EG and of the Low Voltage Directive 2006/95/EG.

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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 user has to pay for the repair. In that case you may ask for a cost estimate beforehand.

Content

Description

The optris TM is a panel mount display for online temperature monitoring applications. The temperature monitor is designed for a connection of either 6, 9 or 12 optris CS sensors. The CS sensors calculate the surface temperature based on the emitted infrared energy of objects **[► Basics of Infrared Thermometry]**.
The monitor displays four different states of each sensor via LEDs (OK, sensor error, pre-alarm, alarm). In addition the pre-alarm and alarm of any of the connected sensors will be displayed separately and can also be transmitted via two relay outputs.

Scope of Supply

- TM incl. mounting accessories and operators manual

Maintenance

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

PLEASE NOTE: Never use cleaning compounds which contain solvents.

Cautions

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.
In case of problems or questions which may arise when you use the TM, please contact our service department.
References to other chapters are marked as [► ...].

Recommended default Settings for connected CS

For a usage of the TM system for online maintenance applications in electrical cabinets we recommend the following sensor settings. For different applications some parameters may need to be changed.
The descriptions are related to the setup tabs in the CompactConnect software:

OUT settings:	**3-state output**	
	Pre-alarm difference:	**2 °C**
	No alarm level:	**8 V**
	Pre-alarm level:	**5 V**
	Alarm level:	**0 V**
	Service voltage:	**10 V**
	mV output range:	**0-10 V according 0-100 °C (used for service mode only)**
IN/ OUT settings:	**Alarm output (open collector)**	
	Mode:	**normally closed**
	Temp code output:	**activated (for values above alarm level)**
	Range settings:	**0 °C = 0 %/ 100 °C = 100 %**
Status LED:	**Self diagnostic**	

Vcc adjust:	**Activated**	
	Output voltage range:	**0-10 V**
	Difference mode:	**activated**
	Vcc	**Alarm value (IN/ OUT pin)**
	11V	**40 °C**
	12 V	**45 °C**
	13 V	**50 °C**
	14 V	**55 °C**
	15 V	**60 °C**
	16 V	**65 °C**
	17 V	**70 °C**
	18 V	**75 °C**
	19 V	**80 °C**
	20 V	**not used by the temperature monitor**
General:	**Emissivity:**	**0,950**
	Transmission:	**1,000**
	Average time:	**0,20 s**
	Smart averaging:	**active**
	Averaging hysteresis:	**5°C**
	Ambient temp. source:	**internal (head)**
Signal processing:	**Hold mode:**	**off**

The above shown settings can be changed with the optional USB kit (USB adapter cable + software) which is available for the CS sensors.

Technical Data

General Specifications

Environmental rating	IP5X (front side only)
Ambient temperature	-20...65 °C
Storage temperature	-40...65 °C
Material (box)	MBS plastics
Dimensions	146 x 146 x 63 mm (without mounting clamps)
Weight	420 g

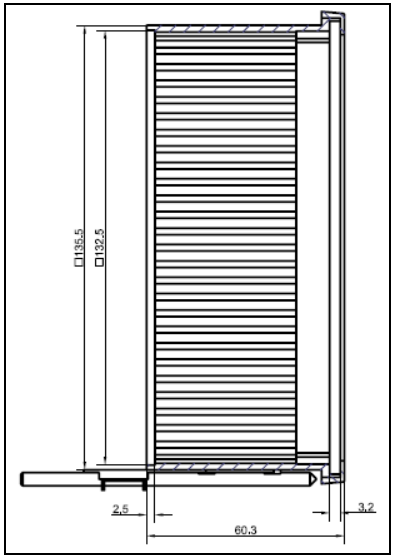
Electrical Specifications

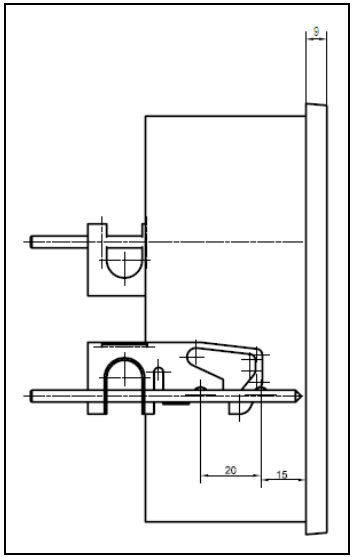
Power supply	24 VDC ± 20 %
Current draw	200 mA (without connected relays)
Outputs	2 x 24 V DC/ 1 A for connection of relays (pre-alarm; alarm)

Installation

Mechanical Installation

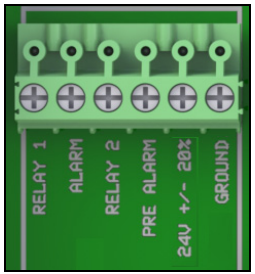
The **TM** is incorporated in a standard panel mount display designed for front door mounting in electrical cabinets. The size of the notch which needs to be made into the front door of the cabinet must have the size of **135,5 mm x 135,5 mm**.
To fix the display in the front door please use the supplied two mounting clamps.



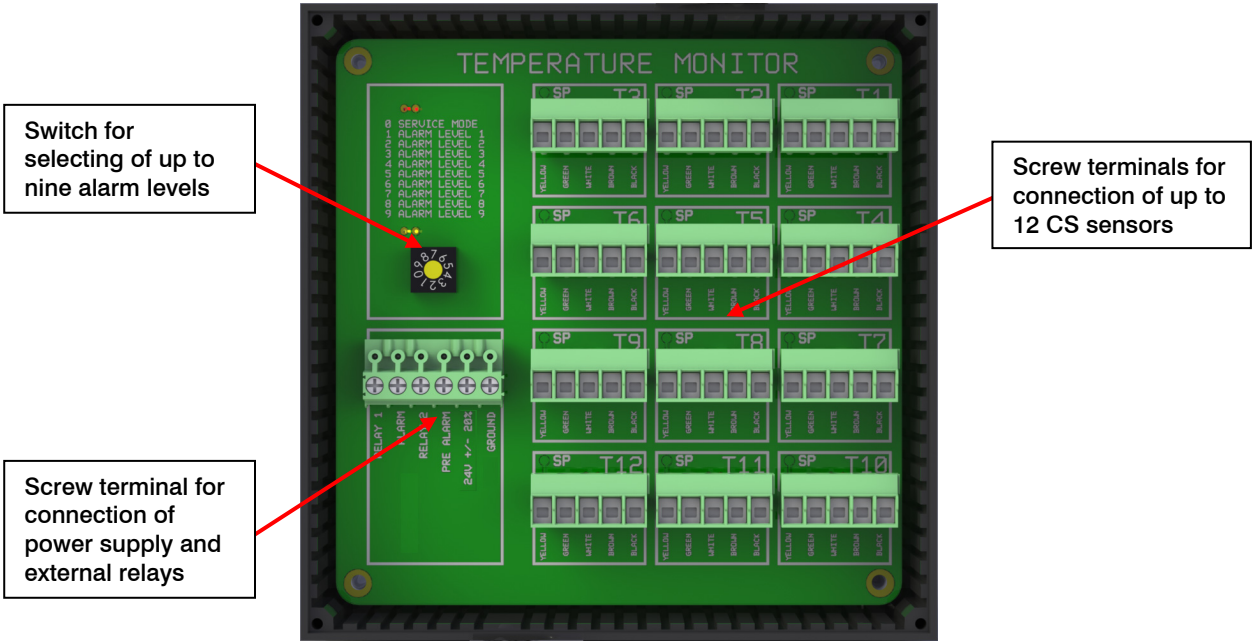


Electrical Installation

On the backside of the TM you will find 12 screw terminals for the CS sensors. On the left side (seen from the backside) there is a screw terminal for connecting of the power supply **[24 V DC ± 20 %]**. In addition you will find two 24 V output terminals which can be used for connection of external relays (pre-alarm and alarm output). All screw terminals can be removed for an easier installation of the cables.

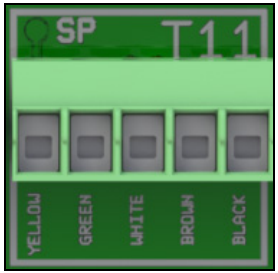


Backside of TM with connection terminals



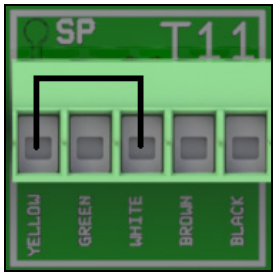
Connection of the CS sensors

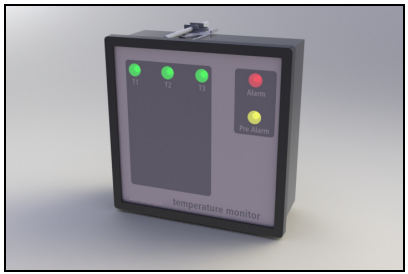
Up to 12 CS sensors can be connected to the TM (T1 – T12).



Wire colors of CS sensors	
OUT	yellow
IN/ OUT	green
Power	white
GND	brown
Shield	black

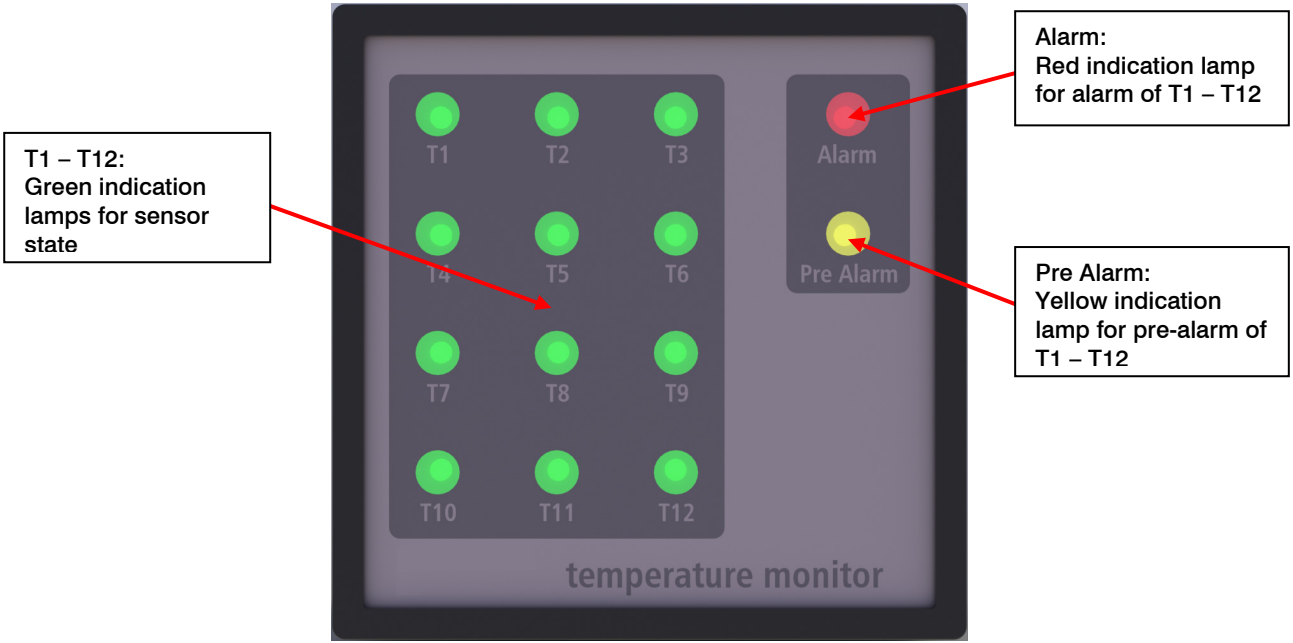
If you need less than 12 sensors you can also connect only 9 or 6 sensors. In this case you will need to jumper the white and yellow on the none connected terminals. For the front side the supplied grey labels can cover the none used sensor indication lamps.





Operation

After you have installed the monitor and made all necessary connections you can switch on the power.
On the front side of the TM the following indicators are located:



The indication lamps (green) of the sensors T1 – T12 can show the following conditions:

Always On	**Object temperature OK**
Always Off	**Sensor error**
Slow flashing	**Pre-alarm**
Temp Code flashing	**Alarm**

The CS sensors are programmed to work with the over-temperature of the spots they are monitoring (difference between object- and ambient temperature) **[►Recommended default Settings for connected CS].**
Working with over-temperature is recommended for temperature monitoring applications in electrical cabinets. It can be changed to object temperature by using the optional USB programming kit.

Sensor error

The CS sensors have a built-in self diagnostic feature. In case of a sensor error or a disconnected sensor or broken cable the according lamp will indicate this status.

Pre-Alarm

The pre-alarm difference is set to 2 °C. If the over-temperature reaches a value which is 2 °C below the alarm level the pre-alarm will be initiated by the TM.
In case of a **pre-alarm** of at least one of the sensors T1 – T12 the **yellow pre-alarm indication lamp** will be on in addition.
In case of an **alarm** of at least one of the sensors T1 – T12 the **red alarm indication lamp** will be on in addition.

Temp Code flashing

In case of an **alarm** the corresponding indication lamp will flash the measured object temperature according to the temperature code. The range is set to 0 °C to 99 °C.
The two digits of the object temperature will be indicated as follows:

Long flashing indicates the first digit	**x**x
Short flashing indicates the second digit	x**x**
10-times long flashing indicates a zero for the first digit	**0**x
10-times short flashing indicates a zero for the second digit	x**0**

Examples

87 °C

8-times long flashing indicates	**8**7 and afterwards
7-times short flashing indicates	8**7**

31 °C

3-times long flashing indicates	**3**1 and afterwards
1-time short flashing indicates	3**1**

8 °C

10-times long flashing indicates	**0**8 and afterwards
8-times short flashing indicates	0**8**

20 °C

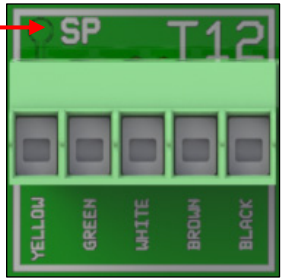
2-times long flashing indicates	**2**0 and afterwards
10-times short flashing indicates	2**0**

Change of Alarm levels

On the backside of the TM a rotary switch with positions 0...9 is located. By changing the position of the switch between 1 and 9 the alarm levels of all connected CS sensors will be changed simultaneously according to the preset values under Vcc adjust **[►Recommended default Settings for connected CS].**

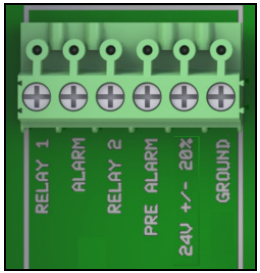
Position 0 activates the service mode. If selected, all connected CS sensors are working in analog mode and the current object temperature can be checked with a volt meter on each separate service point **[SP]**.
The recommended preset output range of the CS sensors is:
0-100 °C → 0-10 V

Service point for direct measurement of the analog output signal



Relay Outputs

The TM provides two relay outputs, each with **24 V DC/ 1A**.
Any **alarm** will activate **relay 1**, any **pre-alarm** will activate **relay 2**.

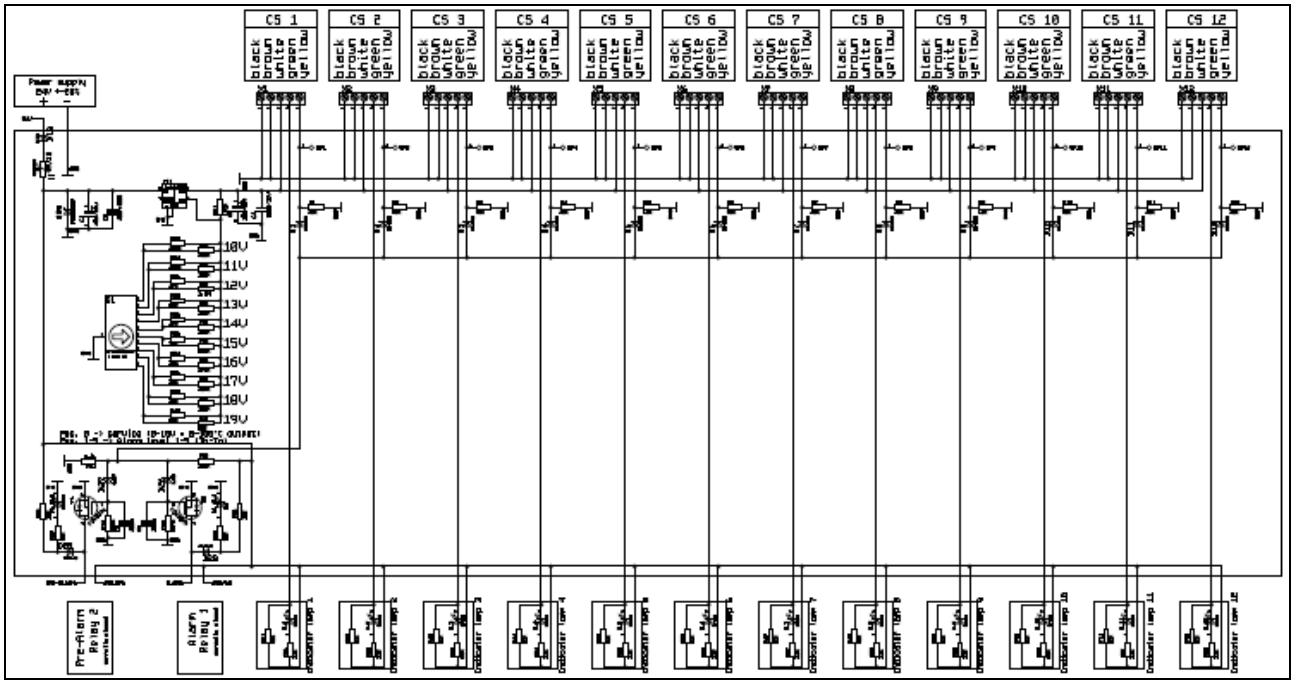


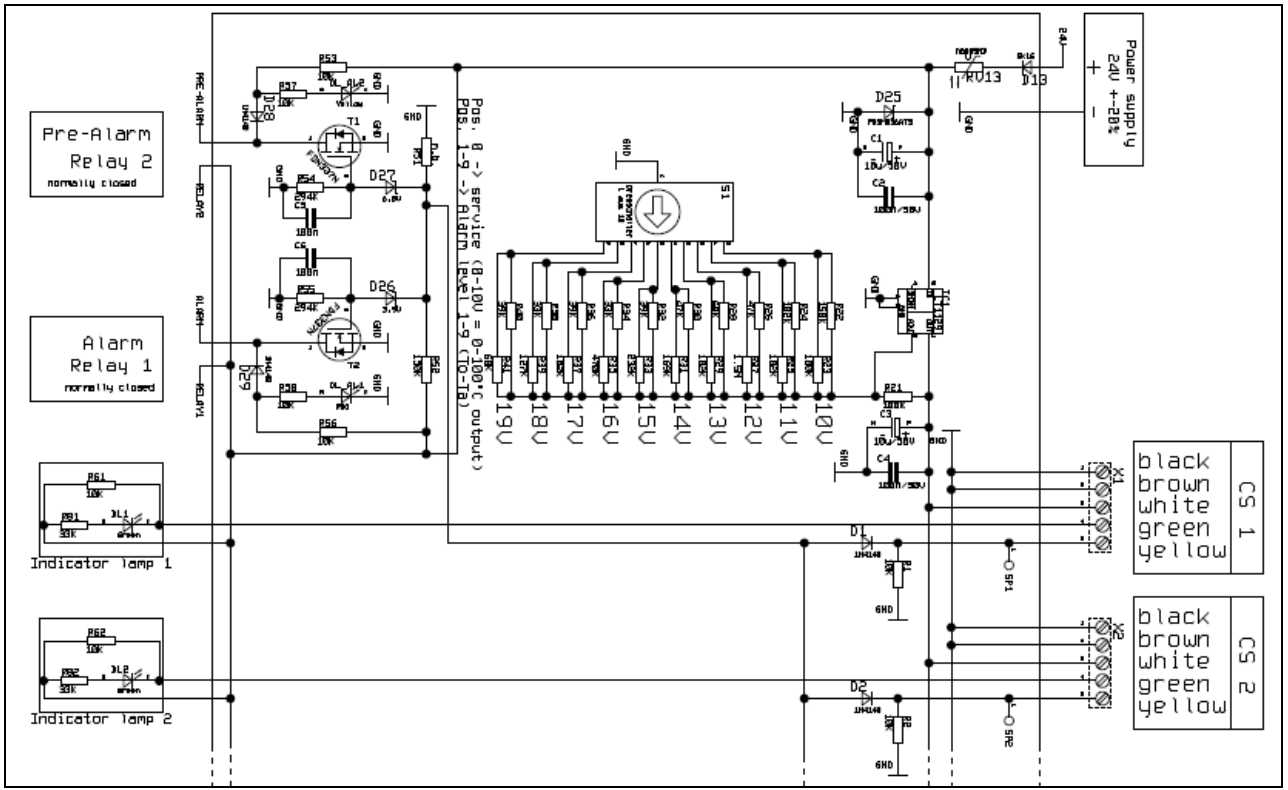
NOTE: In order to generate a high level of safety with the TM system the relay outputs are following a "wrong positive" concept:

No alarm/ **no** pre-alarm: 24 V **ON** at relay output
Alarm/ pre-alarm: 24 V **OFF** at relay output

Therefore also a system error which might cause a defective 24 V supply at the relay output will cause an alarm.

Wiring diagram




Pre-Alarm
Relay 2
normally closed
Alarm
Relay 1
normally closed
Indicator lamp 1
Indicator lamp 2
Power supply
24V +-20%
Pos. 0 -> service (0-10V = 0-100°C output)
Pos. 1-9 -> Alarm level 1-9 (TO-TB)
19V
18V
17V
16V
15V
14V
13V
12V
11V
10V
black
brown
white
green
yellow
CS 1
black
brown
white
green
yellow
CS 2

Basics of Infrared Thermometry

Depending on the temperature each object emits a certain amount of infrared radiation. A change in the temperature of the object is accompanied by a change in the intensity of the radiation. For the measurement of "thermal radiation" infrared thermometry uses a wave-length ranging between 1 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).

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

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

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

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.

Determination of unknown Emissivities

- ► First, determine the actual temperature of the measuring object with a thermocouple or contact sensor. Second, measure the temperature with the infrared thermometer and modify the emissivity until the displayed result corresponds to the actual temperature.
- ► If you monitor temperatures of up to 380°C you may place a special plastic sticker (emissivity dots – part number: ACLSED) onto the measuring object, which covers it completely. Now set the emissivity to 0,95 and take the temperature of the sticker. Afterwards, determine the temperature of the adjacent area on the measuring object and adjust the emissivity according to the value of the temperature of the sticker.

► Cove a part of the surface of the measuring object with a black, flat paint with an emissivity of 0,98. Adjust the emissivity of your infrared thermometer to 0,98 and take the temperature of the colored surface. Afterwards, determine the temperature of a directly adjacent area and modify the emissivity until the measured value corresponds to the temperature of the colored surface.

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	0,01-0,05
	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