TEMPSENS

CE

Thermal & Cable Solutions

EDGE MICRO

Non-contact Infrared Pyrometers

USER MANUAL

TEMPSENS INSTRUMENTS (INDIA) LIMITED

B-188, B-189, B-169 (Part), B-188A & F-188(E),
Road No 5, Mewar Industrial Area, Madri,
Udaipur, Rajasthan, India, PIN – 313003
Ph.:+91-9116554600, **Email:** info@tempsens.com

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Chapter - 1

General Information

We are pleased that you have chosen this high quality and highly efficient Tempsens pyrometer for non-contact temperature measurement.

Please read this manual carefully, step by step before performing any operation with the Pyrometer. It contains all the necessary instructions for set up and operation of the pyrometer. When operating the instrument, it is necessary to follow the general safety instructions.

1.1 Safety Measures

This section provides an overview about important safety regulations.

1.1.1 General

Each person working with the pyrometer must have read the user manual before operation. The Pyrometer has only to be used for the purpose described in the manual.

1.1.2 Maintenance and use of Pyrometer

Pyrometer can be operated by the qualified person who has got instructions from the supervisor. It is strongly prohibited to do technical modifications of the device without permission of the manufacturer.

1.1.3 Environmental Protection

The lens or its coating may contain harmful materials and hence it should not be disposed of with normal waste.

1.1.4 Packaging and storage

Always use a shock-proof package for shipment of the pyrometer. It should be sealed to protect it against humidity. Also protect the lens of the pyrometer with a cover. They should be stored at the temperature ranges from -40° to +85°C.

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Chapter - 2

Introduction

2.1 Functional principle

The sensors are non-contact infrared temperature measurement sensors. They measure the infrared radiation emitted by objects and calculate the surface temperature based on this.

The sensor housing is made of stainless steel (IP65). The controller is integrated in the cable.

→ *The sensors are sensitive optical systems. They should therefore only be fitted using the existing thread.*

Notice : *Avoid rough mechanical force on the sensor.*

► *Destruction of the sensor*

2.2 Sensor models

The sensors are available in the following versions:

Series	Model	Measuring range	Spectral range	Output	Optics
MICRO	M8-0-F15-S05-C05	-40 to 600 °C	8 to 14 µm	4...20mA/0 ... 5 V (freely scalable within the measuring range)	15:1
	M8-0-F15-S3-C05				
	M8-0-F15-S3-C3				
	M8-0-F15-S6-C05				
	M8-0-F15-S6-C3				
	M8-0-F15-S15-C05				

Tab. 2.1: Sensor models

Chapter - 3

Technical Specifications

Model			Micro
Optical resolution			15:1
Measuring range[1]			-40 °C up to 600 °C (1100 °C)
Spectral range			8 to 14 µm
System accuracy[2]			±1.0 % or ±1.0 °C
Repeatability[2]			±0.5 % or ±0.5 °C
Temperature resolution (NETD)[3]			50 mK
Response time[4]			20 ms
Emissivity			0.100 to 1.100
Transmittance			0.100 to 1.100
Signal processing			Intelligent averaging, Min/Max, Hold function with threshold/hysteresis (adjustable via software)
Supply voltage			5 ... 30 VDC
Max. current consumption			⩽ 4 mA (voltage output) / ⩽ 20 mA (2-wire current output)
Digital interface			3.3V-LVTTL or TTL to USB Converter
Analog output[5]			4 ... 20 mA (two-wire current output) / 0 ... 5 V; 0 ... 10 V (voltage output) freely scalable within the measuring range
Switching output			Open collector for alarm; 500 mA
Connection			Integrated cable with open ends (ferrules); standard length 0.5 m sensor and connection cable; optional sensor cable with 3 m, 6 m or 15 m and connection cable with 3 m available
Mounting	Sensor		Direct fastening via integrated M12x1 thread or fastening using the hexagon nut included in the scope of delivery
Temp. range	Sensor	Storage	-40 ... 85 °C
		Operation	-20 ... 120 °C
	Controller	Storage	-40 ... 85 °C
		Operation	-20 ... 80 °C
Humidity			10 % RH ... 95 % RH (non-condensing)
Shock (DIN EN 60068-2-27)			50g, 11 ms, each axis
Vibration (DIN EN 60068-2-6)			3g / 11 ... 200 Hz, each axis
Protection class (DIN EN 60529)	Sensor		IP65
	Controller[7]		IP65
Material	Sensor		Stainless steel (1.4404)
Weight			approx. 20 g(sensor only)
Control and indicator elements[6]			Sensor configuration optionally possible via InfraSoft

[1] Measuring range can optionally be extended to 1100 °C
[2] At ambient temperature of 24±2 °C; whichever is greater (ε=1)
[3] With a time constant of 200 ms and an object temperature of 200 °C
[4] 0 - 90 % energy; adjustable via software
[5] Preconfigured for current or voltage on delivery; switchable via InfraSoft (requires USB converter); voltage scaling depending on the supply voltage
[6] Access with InfraSoft requires USB converter (see accessories)

Chapter - 4

Standard Item Supplied

4.1 Unpacking, included in delivery

- 1 Sensor
- 1 Mounting nut
- 1 Blue protective cap
- 1 Setup guide

► *Carefully remove the components of the measuring system from the packaging and ensure that the goods are forwarded in such a way that no damage can occur.*

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

► *If there is damage or parts are missing, immediately contact the manufacturer or supplier.*

Optional accessories are listed in the appendix.

Chapter - 5

Optical Tables

The following optical tables show the diameter of the measurement spot dependent on the measurement distance. The measurement spot size refers to 90% of the radiation energy. The distance is measured from the front edge of the sensor / CF lens.

→ *The size of the object to be measured and the optical resolution of the IR thermometer determine the maximum distance between sensor and object. To avoid measuring errors, the measuring object should completely fill the field of vision of the sensor's optical system. This means, the measurement spot must always be at least as large as or smaller than the measuring object.*

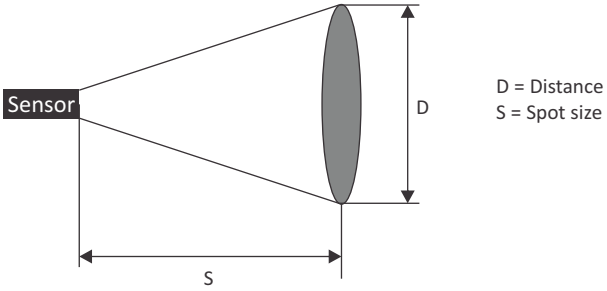


Fig. 5.1: Optical diagram

5.1 Optical specifications

Standard Focus (in mm)								
SF 15	15:1	6.5	11.5	14	18	23.5	29.5	35.5
Distance		0	100	200	300	400	500	600

Close Focus (when using the screwable CF lens, in mm)								
CF 15	15:1	6.5	3.7	0.8	4.4	8.1	11.8	15.4
Distance		0	5	10	15	20	25	30

= smallest spot size / focal point (mm)

The ratio D:S (example 15:1, see table) describes the ratio Distance (distance from the front edge of the sensor to the measuring object) to Spot size (measurement spot size)

Chapter - 6

Installation and assembly

6.1 Mechanical installation

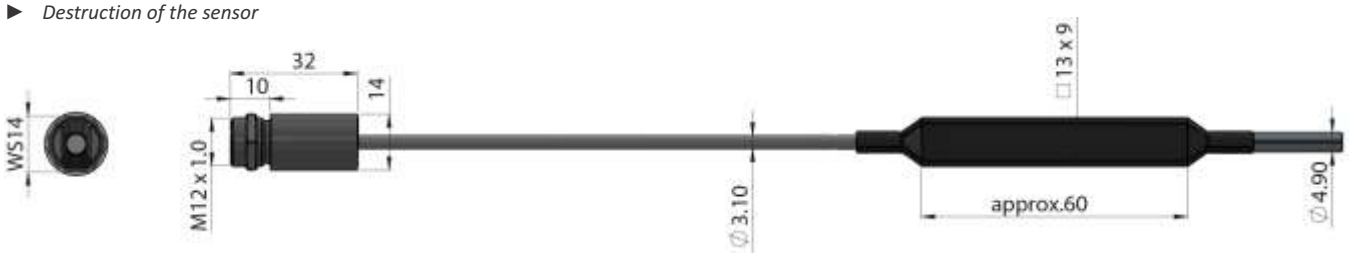
The sensors have a metric M12x1-thread and can be attached to available mounting equipment either directly via this sensor thread or by means of the nuts included.

Various mounting brackets and fixtures are available as accessories.

→Mount the sensor via the provided thread.

Notice : *Avoid rough mechanical force on the sensor.*

► *Destruction of the sensor*



*all dimensions in mm

Fig. 6.1: Dimensional drawing Edge Lite, dimensions in mm (inches, rounded off)

6.2 Electrical connections

6.2.1 General

→ *Use a power supply unit with a stabilized output voltage of 5 ... 30 VDC, which supplies a minimum current of 50 mA. Residual ripple should be no more than 200 mV. Power the sensor either via USB or externally with a power supply unit, but not at the same time to prevent damage to a connected USB device.*

→ *The shield of the sensor must be grounded, as the shield and GND are separated.*

6.2.2 Pin assignment

The following table shows the color assignment and signal assignment of the connection cable

Color	Signal	Description
Red	V_{CC}	Power supply
Green	V_{OUT}	Analog output Voltage
Black	GND	Ground
Yellow	Tx	Digital interface Output
Orange	Rx	Digital interface Input
Brown	OC	Open-collector output
Shield		Black cable with larger cross-section

Tab. 6.1: Pin assignment

Note : To obtain stable temperature measurements, the shield wire should be connected to the GND wire.

► The minimum bending radius of the connection cable is 40 mm (static). Dynamic movement is not permitted.

6.2.3 Analog output

6.2.3.1 Description

The sensor has the following preset analog outputs, which can be set using the InfraSoft software:

- Voltage output
- Current output as two-wire sensor

→The digital interface is an LVTTL interface with a 3.3 V signal level.

Notice : *Avoid using higher signal voltages.*

► *Damage to the input or output*

6.2.3.2 Voltage output

The sensor has a voltage output at the V_{OUT} port. The shield of the sensor is separated from the GND connection.

→The output impedance must be ⩾ 10 kΩ. It is necessary that the shield is connected to ground or GND.

Notice : *Avoid a residual ripple of > 200 mV on the power supply unit used.*

► *Damage to or destruction of the controller*

Fig. 6.2: Terminal assignment voltage output (mV)

6.2.3.3 Current output as 2-wire sensor

The sensor has a two-wire current output. The two wires are responsible for both the supply and the transmission of the measurement signal.

→The maximum loop impedance is 1000 Ω.

The shield of the sensor is separated from the GND connection.

Fig. 6.3: Pin assignment current output as two-wire sensor

6.2.4 Maximum loop resistance

The maximum impedance of the current loop depends on the level of the supply voltage

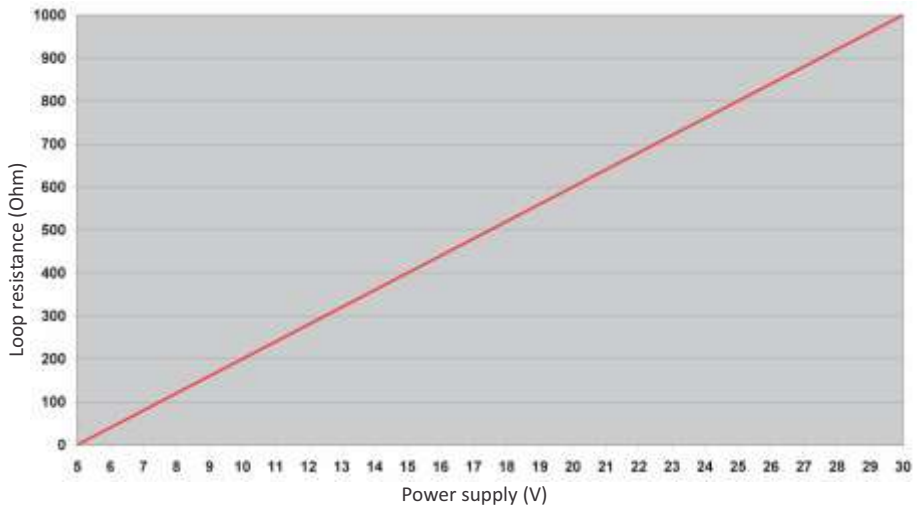


Fig. 6.4: Edge Micro Maximum loop resistance

6.2.5 Digital output

For digital communication, use the optionally available TTL to USB Converter and the InfraSoft software

→Connect the wire of the USB adapter indicated below to the wire of the same color of the sensor cable using a terminal block.

The sensor supports two communication protocols for digital communication:

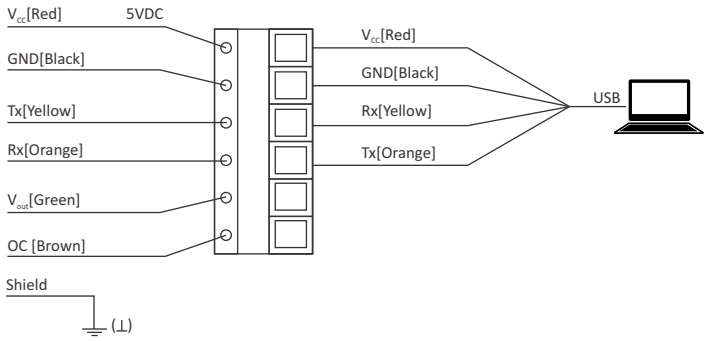


Fig. 6.5: Pin assignment digital output

6.2.6 Combination of analog output and digital output

The sensors can communicate digitally and be used as an analog device (current or voltage) at the same time.

In this case, power can be supplied via the USB interface (5 V).

The sensor can communicate in parallel in all operating modes (current or voltage output). The analog measurement signal can then be accessed either at the analog voltage output or in the supply voltage (current output as 2-wire sensor).

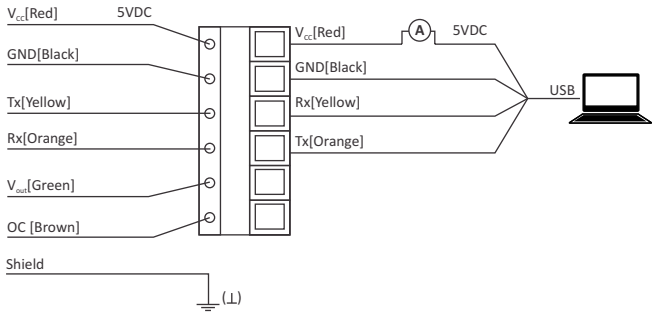


Fig. 6.6: Edge Micro Pin assignment analog (current) and digital

6.2.7 Open Collector Output

The sensors can communicate digitally and be used as an analog device (current or voltage) at the same time.

In this case, power can be supplied via the USB interface (5 V).

The sensor can communicate in parallel in all operating modes (current or voltage output). The analog measurement signal can then be accessed either at the analog voltage output or in the supply voltage (current output as 2-wire sensor).

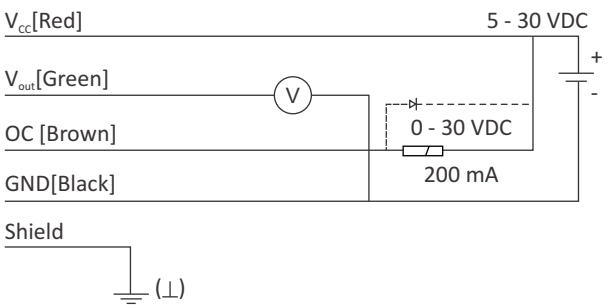


Fig. 6.7: Pin assignment of open-collector output

Notice : *If a relay is used, a freewheeling or protective diode must be installed.*

► *Damage to the output*

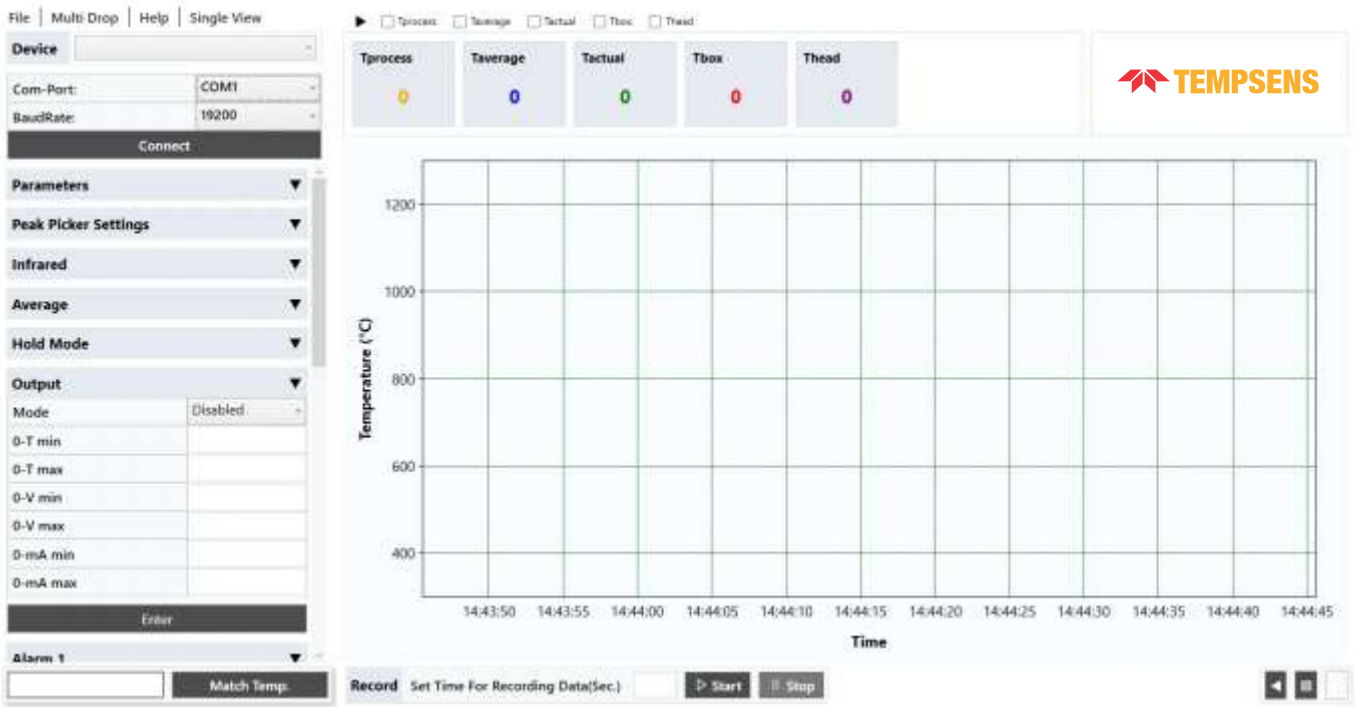
Chapter - 7

Software Installation

The provided Tempsens software “InfraSoft” offers digital PC interface RS-485 to USB and TTL to USB converter. Using this software, we can set all the parameters mode. This software provides all necessary information about pyrometer.

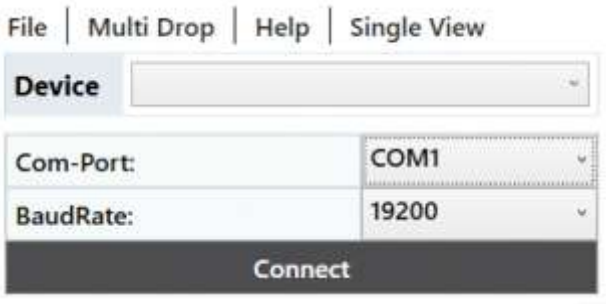
7.1 Installation

Install the pyrometer software using the installation guide file on Pen Drive & restart your PC as per guidelines provided for installation. After installation of the software; Double click the application. It will open the screen of software.



7.2.1 Communication

Communication between the Tempsens pyrometer and the software is implemented via a cable connected between the pyrometer and the PC serial port. This enables the acquisition and recording of data, as well as the transfer of commands from the software application to the Tempsens pyrometer. Communication can be done by selecting correct COM Port. Then click on CONNECT Button



7.3 Temperature

It shows the temperature measured by the pyrometer

7.4 Parameter Setting

All user selectable device parameters can be set by using the software in the Panel "Parameter".

Note: Press "**Enter**" button on any transferrable value

(A) Infrared Settings In the side menu under Infrared Settings, you can also change the Emissivity and Transmissivity set in the Settings. The Emissivity (epsilon) is a material constant that describes the ability of a body to emit infrared energy. The Transmissivity or transmittance compensates for the signal loss if a protective window or an additional lens is mounted between the sensor and the measuring object.

(B) Averaging Depending on the selected function, an arithmetic mean value is calculated with the separately set time constant.When using the Normal mode, an arithmetic mean value is calculated.An intelligent algorithm is activated when Hysteresis mode is used. Rapid temperature rises are passed directly to the signal output if the set averaging hysteresis is exceeded, so that dynamic events can be recorded despite averaging.

Intelligent averaging with Hysteresis

Averaging is generally used to smooth signal curves. This function can be optimally adapted to the respective application using the adjustable Averaging Time parameter. One disadvantage of averaging is that rapid temperature rises caused by dynamic events are subject to the same averaging time and are therefore only available at the signal output with a time delay. The intelligent averaging function (Hysteresis) eliminates this disadvantage by passing rapid temperature rises directly to the signal output without averaging.

(C) Hold Mode: Activating Hold Mode activates one of the following arithmetic algorithms:

Valley Search :

In this mode, the sensor waits for rising signals. When the signal rises, the algorithm holds the previous signal level for the specified hold time. The definition of the algorithm corresponds to the maximum search (inverted).

Peak Search :

In this mode, the sensor waits for descending signals. If the signal drops, the algorithm holds the previous signal peak for the specified hold time.

A.Valley Search :

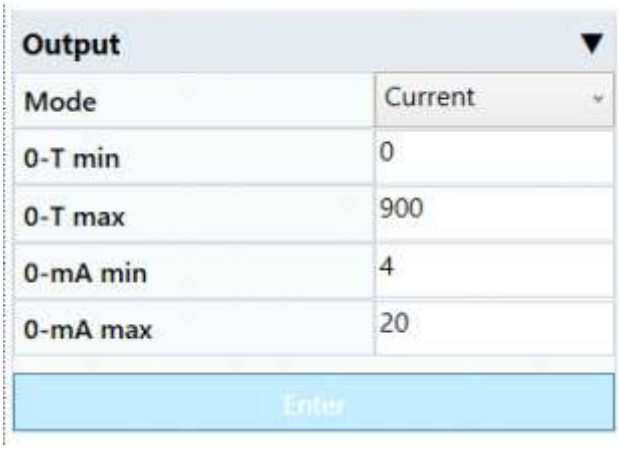
This mode is the reverse function of the extended maximum search. The sensor waits for local minima. Minimum values that are higher than their predecessors are only adopted if the temperature previously exceeded the threshold value. If Hysteresis is activated, a minimum value must also increase by the value of the hysteresis before the algorithm accepts the value as the new minimum value.

A.Peak Search :

In this mode, the sensor waits for local peak values. Peak values that are lower than their predecessors are only accepted if the temperature has fallen below the threshold value. If Hysteresis is activated, a peak value must also decrease by the value of the hysteresis before the algorithm accepts it as the new peak value.

(D) Output Setting : The Output Mode settings enables to activate the analog output Voltage Output or the Current Output.If Disabled is selected, all available analog outputs are switched off.

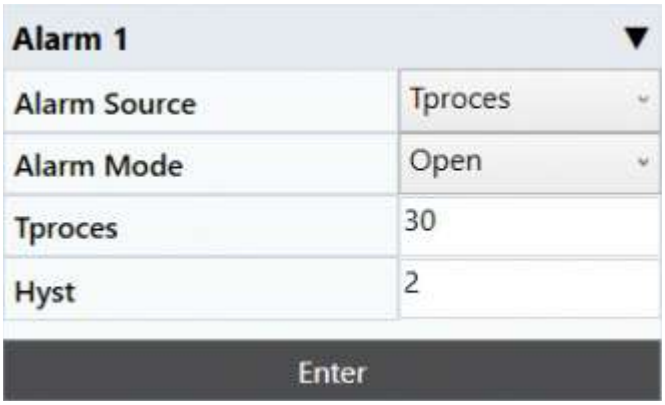
The upper and lower limits for the output scaling of the analog output and the upper and lower temperature limits for the scaling are defined via the Advanced entry.

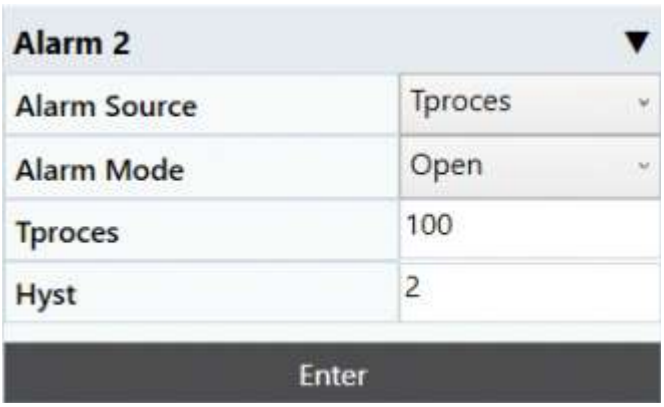


(E) Alarm Settings : The Alarm Source is used to set the function of the alarm channel. The other entries are used to define the alarm source (temperature value) for the alarm output. The temperature determines when the alarm is triggered and the alarm relay changes its switching state. Off deactivates the alarm output.

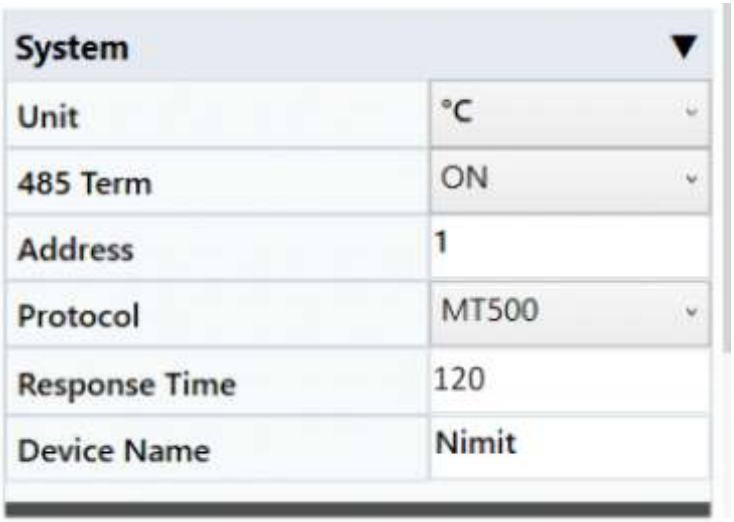
Alarm 1 / Alarm 2	Alarm source	TProc / TAvg / TAct / TBox / THead / Differenz /TAct / THead	
	Alarm Mode	Activate Alarm	Normal Open
			Normal Closed

If you check Advanced, you can activate the alarm directly and set the Alarm Switching Temperature and the Alarm Hysteresis.





(F) System : User can change the measuring unit of temperature from “Centigrade” to “Fahrenheit” and vice versa. The device address can be selected from 1 to 126 but we are giving the default address 1. The user can give the device name based on the application and requirement.



7.5 Device Information

Pyrometer specific information will be displayed in the Info Panel.

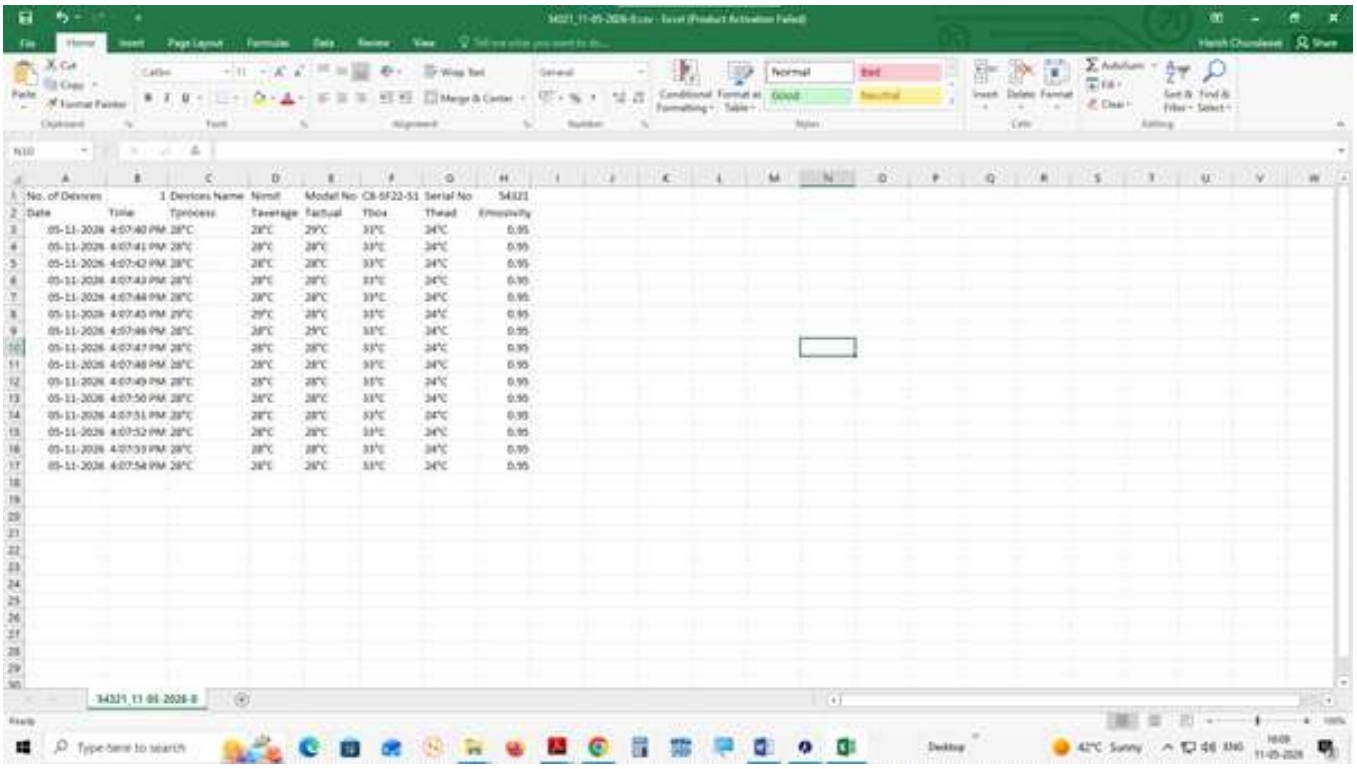
This screen shows the Model, basic range, serial number, version, Head temperature, internal temperature, working distance, spot size-apperture.

Device Info	
Model	C8-0-F22-S1
Basic range	-50°C...900°C
Serial number	54321
FW version	48.00
Working Dist(mm)	1000
Spot Size-Aprt(mm)	22-1

7.6 Record

Record is for continuous data logging. It records the measured temperature, emissivity with current date & time. To start data logging click on start button. If user wants to record emissivity, click on record emissivity button. After Clicking Start button window appears where user can specify the file name & location.

Record will be saved as .txt format and the name of file will be user define.



To record emissivity, click on Record Emissivity button.

7.7 Software Parameters

Display	Selection	Fine selection	Value range (adjustable)	Explanation
Infrared	Epsilon		[0.9 - 1.10]	Setting the emissivity. The emissivity (ε - epsilon) is a material constant that describes the ability of a body to emit infrared energy.
	Transm.		[0.9 - 1.10]	Setting the transmittance. If a protective window or additional lens is mounted between the sensor and the measuring object, the resulting signal loss can be compensated for with this entry.
Average	Avg.Time		[0.10 - 999.95s]	This entry defines the time constant for averaging. The signal is smoothed using an arithmetic algorithm.
	Avg.Mode			Depending on the selection, an arithmetic mean value is calculated with the separately set time constant.
			Normal	Arithmetic averaging
			Smart	Intelligent averaging: Fast temperature increases are passed directly to the signal output and fast, dynamic events can be recorded despite averaging
Holdmode	Off			Off deactivates the extended signal processing func tions. The advanced functions are activated via the other entries.
	Peak	H.P.Time	[0.1 - 999.9s]	The Peak Hold function is used to search for the maximum value. The respective signal maximum is held for the set time. After the hold time has elapsed, the signal drops to the second highest value or de creases by 1/8 of the difference between the previous maximum value and the minimum value during the hold time. This value is in turn held for the set time. The signal then falls with a slow time constant and fol lows the course of the object temperature.
	Valley	H.P.Time	[0.1 - 999.9s]	Valley Hold is used to search for the minimum val ue. The respective signal minimum is held for the set time. This algorithm is the inverse of that for the maxi mum search.
	A.Peak	Tresh.	[-50-600°C] SF02 / SF15 or [-50-900°C] SF22	In the extended maximum search, this algorithm searches for local maximum values. Maximum values that are lower than their predecessors are only ac cepted if the temperature had previously fallen below the threshold value. If hysteresis is set, a maximum value must also have dropped by the hysteresis value before it is accepted as the new maximum.
		Hyst.	[0.0 - 600°C]	
	A.Valley	Tresh.	[-50-600°C] SF02 / SF15 or [-50-900°C] SF22	In the extended minimum search, this algorithm searches for local minimum values. Minimum values that are greater than their predecessors are only ac cepted if the temperature previously exceeded the threshold value. If hysteresis is set, a minimum value must also have risen by the value of the hysteresis before it is accepted as the new minimum.
		Hyst.	[-50 - 900°C] [0.0 - 600°C]	

Display	Selection	Fine selection	Value range (adjustable)	Explanation
Output	Disabled			The Disabled setting deactivates all analog outputs.
	Voltage	0-T.min	[-50-600°C] SF02 / SF15 or [-50- 900°C] SF22	Setting the upper and lower temperature limit for scaling the analog output.
		0-T.max	[-50-600°C] SF02 / SF15 or [-50- 900°C] SF22	
		0-V.min	[0 - 10V]	Setting the upper and lower limit for the output scaling of the voltage output.
		0-V.max	[0 - 10V]	
	Current	0-T.min	[-50-600°C] SF02 / SF15 or [-50- 900°C] SF22	Setting the upper and lower temperature limit for scaling the analog output.
		0-T.max	[-50-600°C] SF02 / SF15 or [-50- 900°C] SF22	
		0-mA.min	[0 - 20mA]	Setting the upper and lower limit for the output scaling of the current output.
		0-mA.max	[0 - 20mA]	
Alarm 1	Alarm 1	Off		Off deactivates alarm output 1. The other entries are used to define the alarm source for alarm output 1. The temperature determines when the alarm is trig gered and the alarm relay 1 changes its switching state.
		TProces	[-50-600°C] SF02 / SF15 or [-50- 900°C] SF22	Setting the temperature and the alarm source [TProces] Process temperature = temperature value with signal processing functions
		TAverag		Setting the temperature and the alarm source [TAverag] Averaged temperature = temperature val ue with averaging function
		TActual		Setting the temperature and the alarm source [TActual] Raw temperature value = temperature value without signal processing functions
		TBox		Setting the temperature and the alarm source Controller temperature
		THead		Setting the temperature and the alarm source Sensor head temperature
		Diffmod		Setting the temperature and the alarm source Differential temperature between TActual - THead
Alarm 2	Alarm 2	Off		Off deactivates alarm output 2. The other entries are used to define the alarm source for alarm output 2. The temperature determines when the alarm is trig gered and the alarm relay 2 changes its switching state.
		Tproces	[-50-600°C] SF02 / SF15 or [-50- 900°C] SF22	Setting the temperature and the alarm source [TProces] Process temperature = temperature value with signal processing functions
		Taverag		Setting the temperature and the alarm source TAverag Averaged temperature = temperature value with averaging function

Display	Selection	Fine selection	Value range (adjustable)	Explanation
Alarm 2	Alarm 2	Tactual		Setting the temperature and the alarm source [TActual] Raw temperature value = temperature value without signal processing functions
		Tbox		Setting the temperature and the alarm source Controller temperature
		Thead		Setting the temperature and the alarm source Sensor head temperature
		Diffmod		Setting the temperature and the alarm source Differential temperature between TActual - THead
Aiming	Off			No alignment aid
	Valley			Optical alignment aid via the LCD backlight to find the position with the lowest temperature
	Peak			Optical alignment aid via the LCD backlight to find the position with the highest temperature
	Laser	ON / OFF		Activation of the power supply for an optional laser sighting
System	FactRes.	Apply		This entry is used to reset the sensor to the factory parameters.
		No		There is no action.
	Baud rate	19200		19200
	T. Unit	°C / °F	[°C / °F]	Setting the temperature unit for the display and data output. You can choose between °C and °F.
	485 Term	ON/OFF	[ON/OFF]	Activation or deactivation of the integrated 120 Ohm terminating resistor of the RS485 interface
	485 Adr.		1 - 126	Setting the RS485 bus address via which the sensor can be addressed on an RS485 bus. The preset bus address is 126, which is the usual standard address for Tempsens sensors.
	Protocol	MT		Tempsens's MT500

Chapter - 8

Principle of infrared temperature measurement

Depending on the temperature, every body 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.

The wavelength range of this so-called "thermal radiation" used for infrared measurement technology is between approx.

1 µm and 20 µm. The intensity of the emitted radiation depends on the material.

The material-dependent constant is referred to as emissivity (ε - epsilon) and is known for most substances, see Chap.

11.4, see Chap. 11.5. Infrared pyrometers are optoelectronic sensors. They detect the infrared radiation emitted by a

body and calculate the surface temperature based on this. Probably the most important feature of infrared pyrometers is the non-contact measurement technique, which allows the temperature of difficult-to-access or moving objects to be determined. Infrared pyrometers essentially consist of the following components:

- Lens
- Spectral filter
- Detector
- Controller

The properties of the lens largely determine the beam path of the infrared thermometer, which is characterized by the ratio of distance- to-spot-size. The filter is used to select the wavelength range that is relevant for the temperature meas urement. Together with the controller, the detector converts the intensity of the emitted infrared radiation into electrical signals.

Chapter - 9

Emissivity

9.1 Definition

The intensity of the infrared heat radiation emitted by each body depends on both the temperature and the radiation prop erties of the material to be examined. The emissivity (ε - epsilon) is the corresponding material constant that describes the ability of a body to emit infrared energy. It can be between 0% and 100%. An ideally radiating body, a so-called "black body", has an emissivity of 1, while the emissivity of a gold mirror, for example, is < 0.1.

If the emissivity is set too high, the infrared thermometer determines a lower temperature than the real temperature, pro vided that the object being measured is warmer than the surroundings. With a low emissivity (reflective surfaces), there is a risk that interfering infrared radiation from background objects (flames, heating systems, fireclay, etc.) will distort the measurement result. To minimize the measurement error in this case, the device should be handled very carefully and shielded from reflective radiation sources.

9.2 Determination of an unknown emissivity

- The current temperature of the measuring object can be determined using a thermocouple, contact sensor or similar. The temperature can then be measured with the infrared temperature sensor. The emissivity can be changed until the displayed measurement value matches the actual temperature.
- For temperature measurements up to 380 °C, it is possible to attach a special plastic sticker to the measured object.
  - → Set the emissivity to 0.95 and measure the temperature of the sticker.
  - → Then determine the temperature of a directly adjacent surface on the measuring object and set the emissivity so that the value corresponds to the previously measured temperature of the plastic sticker.
- Apply matt black paint to part of the surface of the object to be measured.
  - → Set the emissivity of your infrared thermometer to 0.98 and measure the temperature of the black-colored surface.
  - → Then determine the temperature of a directly adjacent surface and change the emissivity setting until the measured temperature corresponds to that of the colored area.

► *With all three methods, the object must have a different temperature from the room temperature.*

9.3 Characteristic emissivities

If you do not wish to use any of the methods described above to determine your emissivity, you can use guide values from the following emissivity tables.

► *Please note that the tables only show average values.*

The actual emissivity of a material is influenced by the following factors, among others:

- Temperature
- Measuring angle
- Geometry of the surface (plane, convex, concave)
- Thickness of material
- Structure of the surface (polished, oxidized, rough, sandblasted)
- Spectral range of the measurement
- Transmission properties (e.g. with thin film)

9.4 Emissivity table for metals

Material		Typical emissivity			
Spectral sensitivity		1.0 µm	1.6 µm	5.1 µm	8 - 14 µm
Aluminum	Not oxidized	0.1 ... 0.2	0.02 ... 0.2	0.02 ... 0.2	0.02 ... 0.1
	Polished	0.1 ... 0.2	0.02 ... 0.1	0.02 ... 0.1	0.02 ... 0.1
	Roughened	0.2 ... 0.8	0.2 ... 0.6	0.1 ... 0.4	0.1 ... 0.3
	Oxidized	0.4	0.4	0.2 ... 0.4	0.2 ... 0.4
Lead	Polished	0.35	0.05 ... 0.2	0.05 ... 0.2	0.05 ... 0.1
	Roughened	0.65	0.6	0.4	0.4
	Oxidized		0.3 ... 0.7	0.2 ... 0.7	0.2 ... 0.6
Chrome	0.4	0.4	0.03 ... 0.3	0.02 ... 0.2	
Iron	Not oxidized	0.35	0.1 ... 0.3	0.05 ... 0.25	0.05 ... 0.2
	Rusted		0.6 ... 0.9	0.5 ... 0.8	0.5 ... 0.7
	Oxidized	0.7 ... 0.9	0.5 ... 0.9	0.6 ... 0.9	0.5 ... 0.9
	Forged, blunt	0.9	0.9	0.9	0.9
	Molten	0.35	0.4 ... 0.6		
Iron, cast	Not oxidized	0.35	0.3	0.25	0.2
	Oxidized	0.9	0.7 ... 0.9	0.65 ... 0.95	0.6 ... 0.95
Gold	0.3	0.01 ... 0.1	0.01 ... 0.1	0.01 ... 0.1	
Haynes	Alloy	0.5 ... 0.9	0.6 ... 0.9	0.3 ... 0.8	0.3 ... 0.8
Inconel	Electropolished	0.2 ... 0.5	0.25	0.15	0.15
	Sandblasted	0.3 ... 0.4	0.3 ... 0.6	0.3 ... 0.6	0.3 ... 0.6
	Oxidized	0.4 ... 0.9	0.6 ... 0.9	0.6 ... 0.9	0.7 ... 0.95
Copper	Polished	0.05	0.03	0.03	0.03
	Roughened	0.05 ... 0.2	0.05 ... 0.2	0.05 ... 0.15	0.05 ... 0.1
	Oxidized	0.2 ... 0.8	0.2 ... 0.9	0.5 ... 0.8	0.4 ... 0.8
Magnesium	0.3 ... 0.8	0.05 ... 0.3	0.03 ... 015	0.02 ... 0.1	
Brass	Polished	0.35	0.01 ... 0.5	0.01 ... 0.5	0.01 ... 0.5
	Harshened	0.65	0.4	0.3	0.3
	Oxidized	0.6	0.6	0.5	0.1
Molybdenum	Not oxidized	0.25 ... 0.35	0.1 ... 0.3	0.1 ... 0.15	0.1
		0.5 ... 0.9	0.4 ... 0.9	0.3 ... 0.7	0.2 ... 0.6
Monel (Ni-Cu)	0.3	0.2 ... 0.6	0.1 ... 0.5	0.1 ... 0.14	
Nickel	Electrolytic	0.2 ... 0.4	0.1 ... 0.3	0.1 ... 0.15	0.05 ... 0.15
	Oxidized	0.8 ... 0.9	0.4 ... 0.7	0.3 ... 0.6	0.2 ... 0.5
Platinum	Black		0.95	0.9	0.9
Mercury		0.05 ... 0.15	0.05 ... 0.15	0.05 ... 0.15	
Silver	0.04	0.02	0.02	0.02	

Material	Typical emissivity				
Steel	Polished pitch	0.35	0.25	0.1	0.1
	Stainless	0.35	0.2 ... 0.9	0.15 ... 0.8	0.1 ... 0.8
	Heavy plates			0.5 ... 0.7	0.4 ... 0.6
	Cold-milled	0.8 ... 0.9	0.8 ... 0.9	0.8 ... 0.9	0.8 ... 0.9
	Oxidized	0.8 ... 0.9	0.8 ... 0.9	0.7 ... 0.9	0.7 ... 0.9
Titanium	Polished	0.5 ... 0.75	0.3 ... 0.5	0.1 ... 0.3	0.05 ... 0.2
	Oxidized		0.6 ... 0.8	0.5 ... 0.7	0.5 ... 0.6
Tungsten	Polished	0.35 ... 0.4	0.1 ... 0.3	0.05 ... 0.25	0.03 ... 0.1
Zinc	Polished	0.5	0.05	0.03	0.02
	Oxidized	0.6	0.15	0.1	0.1
Tin	Not oxidized	0.25	0.1 ... 0.3	0.05	0.05

9.5 Emissivity table for non-metals

Material		Typical emissivity			
Spectral sensitivity		1.0 µm	2.3 µm	5.1 µm	8 - 14 µm
Asbestos		0.9	0.8	0.9	0.95
Asphalt				0.95	0.95
Basalt				0.7	0.7
Concrete		0.65	0.9	0.9	0.95
Ice					0.98
Soil					0.9 ... 0.98
Color	Not alkaline				0.9 ... 0.98
Gypsum				0.4 ... 0.97	0.8 ... 0.95
Glass	Washer		0.2	0.98	0.85
	Melting material		0.4 ... 0.9	0.9	
Rubber				0.9	0.95
Wood	Natural			0.9 ... 0.95	0.9 ... 0.95
Limestone				0.4 ... 0.98	0.98
Carborundum			0.95	0.9	0.9
Ceramics		0.4	0.8 ... 0.95	0.8 ... 0.95	0.95
Gravel				0.95	0.95
Carbon	Not oxidized		0.8 ... 0.9	0.8 ... 0.9	0.8 ... 0.9
	Graphite		0.8 ... 0.9	0.7 ... 0.9	0.7 ... 0.9
Plastics > 50 µm	Opaque			0.95	0.95
Paper	Any color			0.95	0.95
Sand				0.9	0.9
Snow					0.9
Textiles				0.95	0.95
Water					0.93

Chapter - 10

Disclaimer

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

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

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

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

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

Chapter - 11

Service, repair

If the measuring system is defect, please send in the affected parts for repair or replacement.

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

TEMPSENS INSTRUMENTS (INDIA) LIMITED
B-188, B-189, B-169 (Part), B-188A & F-188(E),
Road No 5, Mewar Industrial Area, Madri,
Udaipur, Rajasthan, India, PIN – 313003
Ph.:+91-9116554600, Email: info@tempsens.com

Chapter - 12

Decommissioning, disposal

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

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

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

Chapter - 13
Optional accessories

13.1 Mounting accessories

TM-FB	Mounting bracket	2970753
TM-TA	Pipe adapter	2970756
TM-T40	Reflection protection tube, length 40 mm; M12x1 external thread	2970757
TM-T88	Reflection protection tube, length 88 mm; M12x1 external thread	2970758
TM-T20	Reflection protection tube, length 20 mm; M12x1 external thread	2970759
TM-CF	Close Focus lens	2970763
TM-PW	Protective window	2970764
TM-MI	Right angle mirror	2970769
TM-MF-UC	Mounting fork	2970751
TM-AB-UC	Mounting bracket, adjustable in 2 axes	2970754
TM-MB-UC	Mounting bolt with M12x1 thread and nut	2970755
TM-MH-UC	Massive housing made from stainless steel	2970760
TM-FBMH-UC	Mounting bracket for solid housing	2970761
TM-DIN-UC	Rail mount adapter	2970750

13.2 Air Purge Units

Notice : *Avoid both deposit (dust, particles) and smoke, steam and high air humidity (condensation) on the lens.*

► *Erroneous measurements*

These effects are avoided or reduced by using an air purge collar.

→ *Make sure you use oil-free, technically clean air.*

The required air volume (approx. 2 ... 10 l/min.) depends on the application and the conditions at the installation site

TM-AP	Air purge collar	2970767
TM-APL	Air purge collar with laminar air flow and air outlet offset by 90° to the measuring object	2970752
TM-AP8	Air purge collar with 8 mm hose connection	2970768
TM-APMH-UC	Air purge collar made from stainless steel for solid housing	2970762

There is an air outlet on the side of the laminar air purge collar. This prevents the measuring object from cooling down at small measuring distances.

13.3 Protective window

A protective window is available to protect the sensor lens. It has the same mechanical dimensions as the CF lens and is available in the following variants:

When using the protective window (average values), the following transmission values must be set as a guide value:

Model	Transmittance
SF15	0.83

Tab. 14.1 : Protective window model and transmission values
The optionally available USB adapter is required to change the transmission value.

13.4 CF ancillary lens

The CF ancillary lens enables the measurement of tiny objects. The minimum measurement spot depends on the sensor used.

The distance is measured from the front edge of the CF lens holder. The ancillary lens is mounted by screwing it on the sensor up to the stop.

When using the CF ancillary lens (average values), the following transmission values must be set as a guide value:

Model	Transmittance
SF15	0.85

Tab. 14.2: Model ancillary lens and transmission values

13.6 TTL to USB Converter

TM-USBA	TTL to USB converter	2970770

Chapter - 14

Factory settings

The sensors have the following default settings on delivery:

Temperature Range	0.....+600°C
Output Voltage	0...6V/4...20mA
Emissivity	0.95
Transmittance	1.000
Averaging Time (Normal & Hysteresis)	0.2 s
Averaging Hysteresis (Hysteresis)	2°C
Source of Ambient Temperature	Internal (sensor temperature)
Signal Processing	Hold Mode : Disabled
Calibration	Tweak Gain 1.000/Tweak Offset 0.00°C
Failsafe	Disabled

The factory settings can be changed using the optional USB adapter and the InfraSoft.

Intelligent averaging (Hysteresis) is a dynamic adaptation of the averaging to steep signal edges. Activation/deactivation is only possible via the Infrasoft Software.

Information

Maintenance

The pyrometer has no internal parts, which have to be cleaned. The lens can be cleaned with compressed air, which is dry and free of oil. If the protection glass requires more thorough cleaning, use a soft, dry cloth such as that used to clean camera lenses.

Packing instructions

To transport or store the instrument, please use the original box or a box padded with sufficient shock absorbing material. For storage in humid areas or shipment overseas, the device should be placed in welded foil (ideally along with silicone gel) to protect it from humidity.

Software warranty

The windows compatible software was thoroughly tested on a wide range of windows operating systems. Nevertheless, there is always a possibility that windows or PC configuration or some other unforeseen condition exists that would cause the software not to run smoothly. The manufacturer assumes no responsibility or liability and will not guarantee the performance of the software. Liability regarding any direct or indirect damage caused by this software is excluded.

Limit of liability

Tempsens not liable for any damages that arise from the use of any examples or processes mentioned in this manual.

Specifications are subject to change without notice

ABOUT US

Tempsens Instruments (India) Limited

Tempsens Instruments (India) Limited is a part of Pyrotech Group which was established by four technocrats in 1976 at Udaipur, with their first product as Thermocouples and RTDs. Today 'Tempsens' is one of the largest manufacturers of Temperature Sensors in India.

Tempsens Instruments (India) Limited U #II was started in 2009 to produce cables with high standard of manufacturing process conforming to national & international specifications. We manufacturer wide range of cables for Temperature sensors and Instrumentation in various insulations as PTFE, FEP/PFA, Kapton, Silicon, Fiber Glass, Ceramic Fiber, Refrasil/Nextel, PVC etc. in variety of configurations. These cables are available in temperature range -60°C to 1200°C.

All our products are manufactured under strict ISO-9001 quality management system. We also provide Calibration Certificates with all cables. We stock most types of cables which enable us for fast delivery of goods. Our engineering staff are capable to custom design solutions for all applications for customers.

We are dedicated to provide the highest quality products that meet our customer's specifications for various applications.

We continuously focus on improving our manufacturing processes and competitiveness in the industry

TEMPSENS

www.tempsens.com

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B-188, B-189, B-169 (Part), B-188A & F-188(E),
Road No 5, Mewar Industrial Area, Madri,
Udaipur, Rajasthan, India, PIN – 313003
Ph.:+91-9116554600, **Email:** info@tempsens.com