TEMPSENS

CE

Thermal & Cable Solutions

A250/A450 FO-PL BT

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

Index

1. **Chapter - 1** **1**
   General information

2. **Chapter - 2** **2**
   Introduction
   - 2.1 Product Key Features, Application and Range
   - 2.2 Technical specification
   - 2.3 Optics

3. **Chapter - 3** **5**
   Basics & Installation of Pyrometer
   - 3.1 Basics of Infrared temperature measurement of an object
   - 3.2 Installation
   - 3.3 Location Selection
   - 3.4 Mechanical Accessories
   - 3.5 Electrical Installation

4. **Chapter - 4** **13**
   Software installation
   - 4.1 Installation
   - 4.2 Parameters in main screen

5. **Chapter - 5** **24**
   Android Application Software
   - 5.1 Installation Process
   - 5.2 Communication
   - 5.3 Operation
   - 5.4 Datalogging & Online graph

6. **Chapter - 6** **28**
   Calculate Spot size

7. **Chapter - 7** **29**
   Maintenance

8. **Chapter - 8** **30**
   Serial communication protocol

9. **Appendix B** **35**

10. **Appendix C** **36**

Chapter - 1

General Information

Congratulations on choosing this high quality and highly efficient Tempsens pyrometer for non contact temperature measurement.

Please read this user manual carefully, step by step, including all notes of security, operation and maintenance before installing the pyrometer. This manual contains all the necessary instructions for set up and operation of the pyrometer. This section provides an overview about important safety regulations.

Some Important Safety Regulations Given Below

1. Safety Precaution

Each person working with pyrometer must read the user manual before operation. The pyrometer has only to be used for the purpose described in manual. The pyrometer works only with a potential free low voltage of range 24VDC. This voltage is not harmful for user. The pyrometer may contain harmful material and hence it should not be disposed of with normal waste.

2. Packaging and Storage

Always use a shock proof package for shipment of pyrometer. It should be sealed to protect it against humidity. Also protect the lens of pyrometer with cover. They should be stored at the temperature range from -20°c to 70°c.

3. Limit of Liability and Warranty

All general information and notes for handling, maintenance and cleaning of this instrument are offered according to the best of our knowledge and experience.

Tempsens reserves the right to revise this document and to make change from time to time in the content hereof without obligation to notify any person or persons of such revisions or changes

Tempsens instruments have a warranty of two year from the invoice date. This warranty covers manufacturing defects and faults which arise during operation only if they are the results of defects caused by Tempsens.

Tempsens does not accept liability for any damages or losses which might occur, including consequential damages and financial losses, as a result of use of the instrument.

4. Copyright

All rights reserved . this document may contain proprietary information and shall be respected as a proprietary document to Tempsens with permission for review and usage given only to the rightful owner of the instrument with which this document is associated.

Chapter - 2

Introduction

A250/A450 FO-PL BT is specially designed highly accurate digital single color pyrometer with fiber optic to provide high performance and low maintenance of non contact temperature measurement in demanding industrial environment. They are designed for areas with high ambient temperature (upto 250°C) without cooling or in areas where strong electromagnetic interference can influence correct measurement because the fiber & optical head do not contain any electronic part.

2.1 Product key features Working Principle, Range & Application

A250/A450 FO-PL BT are highly accurate pyrometers with fiber optics especially designed for rough industrial environment for temperature measurement of metals, ceramic or graphite. They are suitable for high temperature measurement ranging from 250°C to 2500°C.

These pyrometers have solid body in stainless steel housing which provides high operation safety even in rough industrial environment, and large variety of optics with fixed focus which can be easily used in all industrial areas. The radiation from hot object is focused on the detector by optics which then travel into mono fiber cable with flexible stainless steel protection tube and converted into electrical signals. This signal is then linearize and converted into standard analog & digital outputs.

A250/A450 FO-PL BT has a fast response time of 2msec. Pyrometer have RS-232, RS-485 outputs. Response time, emissivity, sub range and peak picker selection can be preset ex works or adjusted through available software.

According to application there are two optical heads small (head 1), big (head 2 & variable head).The heat radiation, enter from optical head, to the lens system & travel through mono glass fiber with flexible stainless steel protection tube where it is transmitted along optical fibre with the help of optical head. The optical head contains only the lens system, the electronic are located in the converter box, so the measurement is possible in atmospheric condition up to 250°C.

The pyrometer temperature measurement method utilizes the fact that objects emit thermal radiation in an amount that directly corresponds to their own temperature and surface emissivity.

Single Colour Mode : Single colour mode is best for measuring the temperature of target object in areas where no sighting obstacle is present between the target object and the pyrometer. Sighting obstacle can be any solid item, gaseous particles, smoke and dust etc. This mode is very useful where target object completely fills the spot size.

The applications in which Tempsens pyrometers can be used are:

- ✓ Induction heating
- ✓ Annealing
- ✓ Welding
- ✓ Forging
- ✓ Sintering
- ✓ Rolling mills
- ✓ Rotary kilns

Standard Item supplied with Tempsens A250/A450 FO-PL BT:

- ✓ Tempsens pyrometer
- ✓ Connection cable 12-core (length - 5 m)
- ✓ Digital cable 3-core (length - 1.5 m)
- ✓ Mono fiber optic cable (length - 2.5 m)
- ✓ Optical head
- ✓ Tempsens software CD
- ✓ Manual
- ✓ Certificate of calibration

2.2 Technical Specifications

Model	A250 FO-PL BT	A450 FO-PL BT
Measured Temperatures Range (Analog sub range adjustable)	250°C - 1800°C 300°C - 2500°C	600°C - 2500°C
Emissivity Range	0.1…..1.0 adjustable	
Spectral Range, µm	1.6µm	1.0µm
Photodetector Type	InGaAs	Si
Distance to Spot Size Ratio	100:1 OH(I) 200:1 OH(II) 200:1 OH(II) 200:1 OH(II) Variable	100:1 OH(I) 200:1 OH(II) 200:1 OH(II) - Variable
Response Time	2msec. Adjustable upto 10Sec.	
Accuracy	+/- 0.3% of the measured value + 1°C	
Repeatability	+/- 0.1% of the measured value + 1°C	
Analog Output	4 - 20mA or 0 - 20mA or 0 -10 V user selectable	
Digital Output	Bluetooth V2.0, RS-232 or RS-485/RTU Modbus Serial Interface (User selectable)	
Power Supply	12 C - 28 V DC with reverse voltage protection	
Power Consumption	Max. 2.5 Watt.	
Operating temp. range at fiber	Max.250°C at fiber optics cable and optical head, 0….70°C at pyrometer	
Fiber Optic	2.5meter standard (available 5, 10, 15, 20 meter on request)	
Sighting	Laser coliminated	
Isolation	Power supply and digital output and analog output are galvanically isolated against each other	
Operating humidity	10 - 95%, Non-Condensing Conditions	
Housing	Stainless steel, IP65 Ø49.5 mm; L=118mm;/0.6kg	

Dimensions

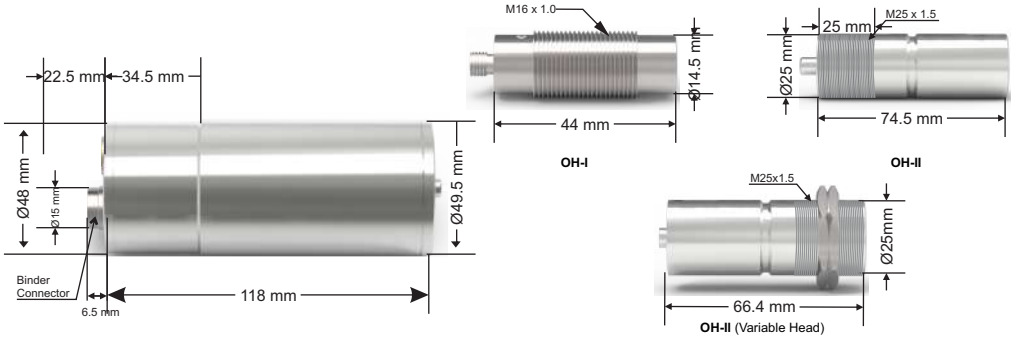


Fig. 1 Dimensions of Pyrometer

2.3 Fiber optics cable

The fibre optic cable has a small radius it can be "snaked" around and through machinery, walls and other obstacles. Cable can be changed if needed. Fibre optic cable with us can be supplied on request its details are given as in the description under. Longer fibre optic cable allows the pyrometer to be used away from the hostile environment.

The radiation, from object coming through optical head, is transported by the lens into the mono fiber cable with flexible stainless steel protection where it is transmitted to the converter. It can withstand ambient temperature upto 250°C without cooling because there is no electronic part.

Length : *2.5m scop of delivery; 5m, 7.5m, 10m, 15m, 30m on request*

Ambient temp. : *Max 250°C*

Fig. 2 Replacement fiber optic cable 2.5 M (Reference no: 5000-01)

2.4 Optics

Pyrometer receives heat radiation from the measured object, which is converted to an electrical signal after passing through the lens. The measured object can be at any distance from pyrometer however as far as the object from pyrometer the measured area (Spot size) will be larger.

Depending on the application the instrument will be delivered with a small or big optical head:

Type I - "Optical head-I" is suitable for use in confined spaces due to very small dimensions. The optics is adjusted to one of the measuring distances mentioned in following table.

Type II - This optical head is fixed adjusted optical head and is bigger in size than "optical head-I"

Type III - VariableWith variable optical head II [OH II - V] each working distance can be adjusted according to the pull out length as mentioned in the spot size table.

Fixed Optics		A250 FO-PL BT	A450 FO-PL BT
Optical Head	Working Distances (mm)	Spot Sizes(mm) 250°C - 1800°C 300°C - 2500°C	Spot Sizes(mm) 600°C - 2500°C
	120	1.2	1.2
	260	2.6	2.6
	700	7.0	7.0
Optical Head - I	Aperture (mm)	10.0 (250°C - 1800°C) 6.0 (300°C - 2500°C)	4.0
	90	0.5	0.5
	200	1.0	1.0
	600	3.0	3.0
	4500	23	23
Optical Head - II	Aperture (mm)	18.0 (250°C - 1800°C) 11.0 (300°C - 2500°C)	18.0

Variable Optics		Optical Head - II - V (Variable)									
Working Distance (mm)		0	250	300	400	600	800	1000	1500	2000	2500
Optical Head Length L (mm)		66.4	78.9	75.75	72.8	70.1	68.8	68.1	67.15	66.7	66.4
Optical Pullout P(mm)		0	12.5	9.35	6.4	3.7	2.4	1.7	0.75	0.3	0
Spot Size(mm) A250 FO PL	250°C - 1800°C	18	1.3	1.5	2	3	4	5	7.5	10	13
	300°C - 2500°C	11	1.3	1.5	2	3	4	5	7.5	10	13
Spot Size(mm) A450 FO PL	600 - 2500°C	10	1.3	1.5	2	3	4	5	7.5	10	13

Example of OH(II) - V

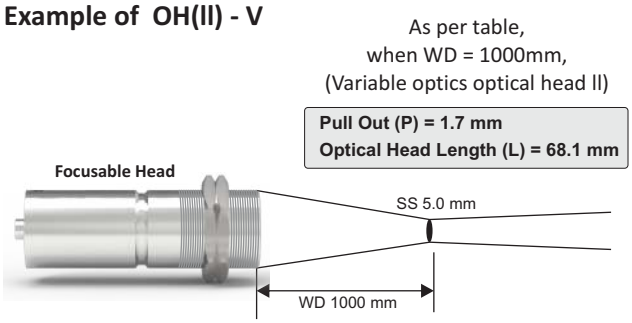


Fig. 3

If the pyrometer is not installed at manufactured working distance (WD) than the spot size at actual installed distance can be calculated. User can easily find out the spot size For example, if factory made working distance is 260mm & pyrometer is 250 FO-PL then spot size is 6.5mm for head-I (as given in above table). If user installed this pyrometer at 700mm then spot size is not 17.5mm (as given in table), user should have to calculate as given below method.

Case-I: If installed working distance is greater than manufactured working distance

$$\text{Installed Spot size} = \frac{\text{Installed working distance (Case I)}}{\text{WD}} \times (S + A) - A$$

Case-II: If installed working distance is smaller than manufactured working distance

$$\text{Installed Spot size} = \frac{\text{Installed working distance (Case II)}}{\text{WD}} \times (S - A) + A$$

Where : S= manufactured spot size of pyrometer(mm),
A = It shows the value oflens opening (aperture in mm)

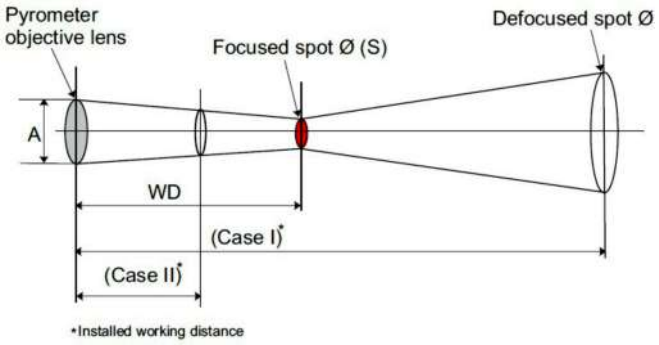


Fig 4 Spot Size

Chapter - 3

Basics & Installation of the Pyrometer

3.1 Basics of Infrared temperature measurement of an object

Each and every object emit definite amount of infrared radiation and its intensity varies according to the temperature of object. Wavelength of infrared radiation lies approximately between 0.7 to 1000 μm depending on the material and properties of object. Infrared radiations are sometimes also referred to as “heat radiations” depends mostly on the material. This material dependent constant value is known as “emissivity”, have a look at appendix B for emissivity values.

3.1.1 Emissivity (Ɛ)

Emissivity is the ratio of energy radiated from an object to the exterior and energy radiated from blackbody. The emissivity varies with the surface condition of the object and also with temperature variation and wavelength. If this value is not accurate, then the true temperature cannot be measured. In other words a variation or change in emissivity will cause a change in the measurement.

If the value of emissivity low, your measured results may contain some errors due to interfering infrared radiations form objects which are behind the target object like heating systems, fireclay brisk etc. Usually such type of problems occurs while measuring very thin materials like glass, plastic etc or some reflecting surface.

This error can be reduced if the sensor is shielded from reflecting radiation sources and also by properly, carefully installing the device.

By the application of Kirchhoff's law of thermal radiation “at thermal equilibrium, the emissivity of the body is equal to its absorptivity (α)”. So for perfect black body, Ɛ is 1 while any real object would have Ɛ less than 1. Also the transmissivity (τ) and reflectivity (ρ) is zero. The sum of absorptivity, reflectivity and transmissivity is always 1.

$$\alpha + \rho + \tau = 1$$

By emissivity factor materials can be categorized as

- ✓ Metals
- ✓ Non metals
- ✓ Transparent materials

3.1.2 Calculation of emissivity of target object

There are various methods to do so but one of most prominently used is Calculate the actual temperature of target object using a RTD, Thermocouple etc. Measure the object's temperature; and adjust emissivity settings unless correct temperature value is reached. Hence correct emissivity is measured of the target object.

3.2 Installation

3.2.1 Mechanical installation of pyrometer

After all preparations are completed you can install pyrometer. Installation of pyrometer depends on the type of bracket you are using and the type of surface.

3.2.2 Distance of pyrometer from object

The desired spot size on the target will determine the maximum measurement distance and the focal length of the optical module. To avoid wrong readings the spot size of target must contain entire field view of the pyrometer. The pyrometer must be mounted so the entire field of view is the same or smaller than the desired target size. This is indicated in the below diagram.

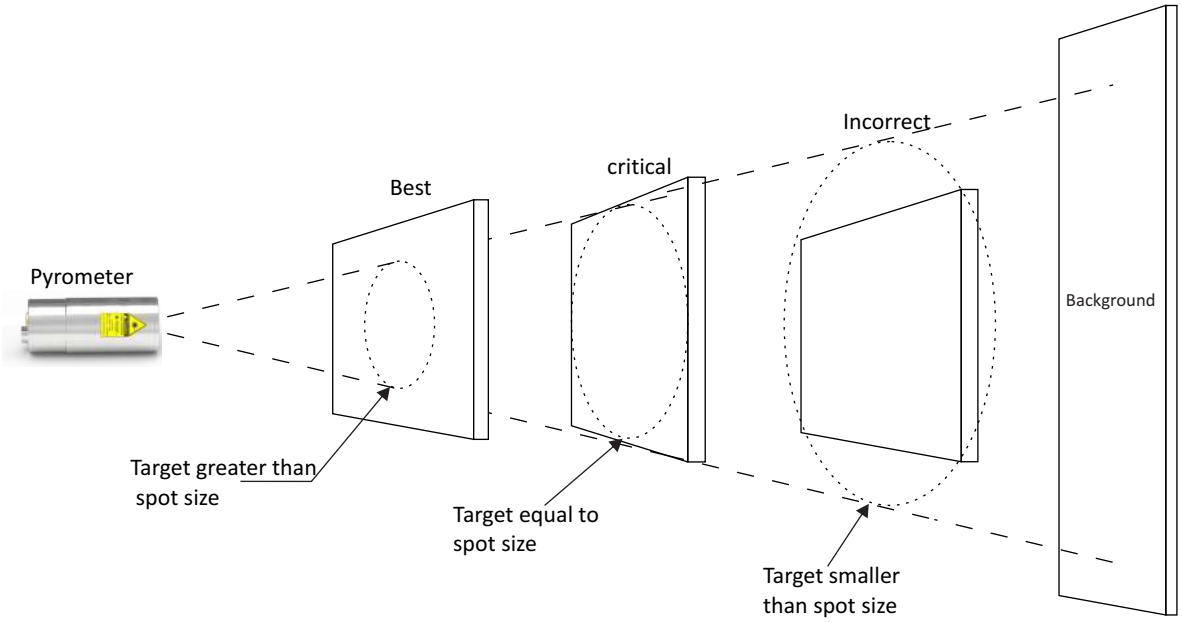


Fig.3 Proper mounting of pyrometer

3.2.3 Viewing Angles

The pyrometer can be placed at any angle from the target object up to 30°.indicated in the below diagram.

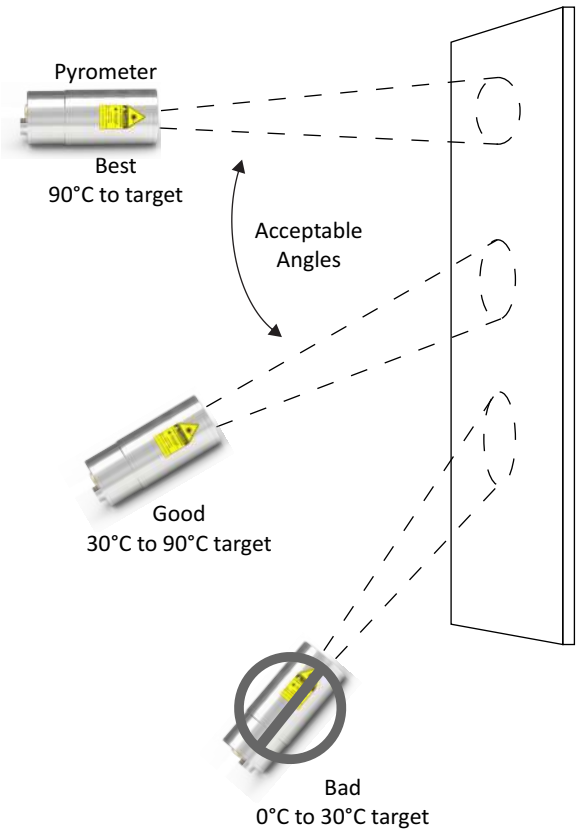


Fig. 4 Pyrometer Acceptable Viewing angles

3.3 Location selection

Qualified operating personnel should do the installation. Location should be good enough so that pyrometer should get continuous infrared radiation.

Pyrometer distance from object is according to below points:-

1. Pyrometer spot size should be small than object size.(read 3.2.2 & 3.2.3)
2. Know your pyrometer spot size according to point 2.3.
3. Pyrometer ambient temperature should be within 0° to 70°C (read 3.3.3).

3.3.1 Correct Positioning of the pyrometer

With pilot light (PL)

A laser targeting light will help to correct the position of the pyrometer. It is recommended that laser should be switched off while measurement. It will increase the life of laser. To avoid measuring errors caused by a too big spot size the pyrometer must be fixed in the correct measuring distance, so that the object under measurement fills the spot size.

Note: *The laser spot (PL) is only for indication of measuring spot, not exactly shows the measuring area.*

3.3.2 Mounting of pyrometer

To install the pyrometer at the place of measurement a mounting support is supplied as an accessory, after losing the clamp screws, it can be fastened correctly.

3.3.3 Ambient temperature

The allowed operation temperature for the pyrometer is 0°C to 70°C. Therefore if pyrometer is to be used above 70°C upto 200°C water cooling jacket with built in air purge unit is used otherwise it may damage the pyrometer. The ambient temperature is dependent on the temperature and flow rate of cooling water. Details of water cooling jacket& air purge are given in point 3.4.1.

3.3.4 Atmospheric conditions

The pyrometer cannot receive the full infrared energy for the measurement if atmospheric conditions like smoke, dust or steam are present and hence it result in measuring error. An air purge unit can be helpful to avoid contamination such as dust and humidity on the lens. The air supplied should be at normal temperature with oil & moisture free. The air purge generates an air stream shaped like a cone and blows particles from the lens area.

3.4 Mechanical accessories

3.4.1 Air Purge

This accessory is used to keep dust, moisture, airborne particle and vapours away from the lens head so that correct sighting of target object can be done. (for mechanical drawing refer Appendix C.)

Fig. 7 Air Purge Unit for Optical Head-I
(Reference No: 8200-02)

Fig. 8 Air Purge Unit-Optical Head-II
(Reference No: 8200-01)

3.4.2 Adjustable mounting stand

This adjustable mounting stand will provide appropriate movement to the pyrometer. (for mechanical drawing refer Appendix C.)

Fig. 9 Adjustable Mounting for Optical Head-I
(Reference No: 8200-04)

Fig. 10 Adjustable Mounting for Optical Head-II
(Reference no: 8200-03)

3.4.3 Combination of Accessories

Fig. 11 Adjustable Mounting for Optical Head-I + Air Purge Unit + Optical Head l (Reference No: 8200-04 + 8200-02 + 1100-01)

Fig. 12 Adjustable Mounting for Optical Head-ll + Air Puge Unit + Optical Head ll (Reference No: 8200-03 + 8200-01 + 1100-02)

Fig. 13 Adjustable Mounting for Optical Variable Head + Air Purge Unit + Optical variable Head (Reference No: 8200-03 + 8200-01 + 1100-03)

3.5 Electrical Installation

3.5.1 Power Supply

The input power supply is 110/230v AC check the polarity before connecting the device.

Device has following specifications

Power supply I/P : 100 - 240VAC, 0.35A
50/60 Hz
Power supply O/P : +24V DC(well stabilized ripple max 50mV), 0.625A

Fig. 14 12-Core Cable (Reference no: 7002-02)

Fig. 15 Power Supply Unit (Reference no: 9000-02)

3.5.2 Connector pin assignment on the back of the pyrometer

For connecting pyrometer with computer via connector pin (on the back of pyrometer) connection diagram is shown as under .Different colors and their indication is also shown in the table 2. So connections need to be done according to color, indication, used for particular purpose as in the table2.

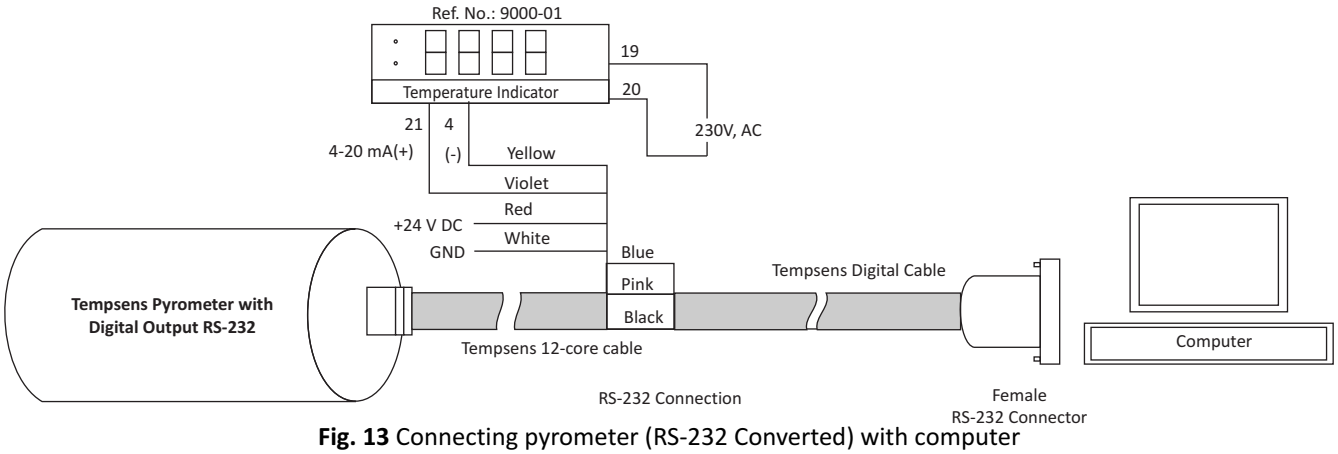


Fig. 13 Connecting pyrometer (RS-232 Converted) with computer

Table 2 : Color code & Pin specification for pyrometer connections

Pin	Colour	Indication	Used for
A	Red	+ 24 V DC In	Power supply
G	White	Ground	
C	Blue	TxD (RS-232) / D- (RS-485)	RS-232/ RS-485 communication
D	Pink	RxD (RS-232) / D+ (RS-485)	
F	Black	RS-232 communication	
H	Yellow	(-) 4-20mA / 0-20mA	Analog current output
M	Violet	(+) 4-20mA / 0-20mA	
J	Brown	Short / Open both wires for laser ON/OFF	Laser ON/OFF
K	Green		
H	Yellow	- (0-10V)	Analog voltage output
B	Grey	+ (0-10V)	
E	Blue-Yellow	-mA	For External Emissivity setting
L	Red-Grey	+mA	

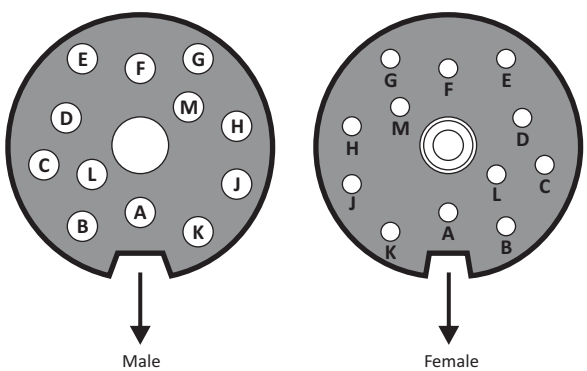


Fig. 14 12-pin Binder connector

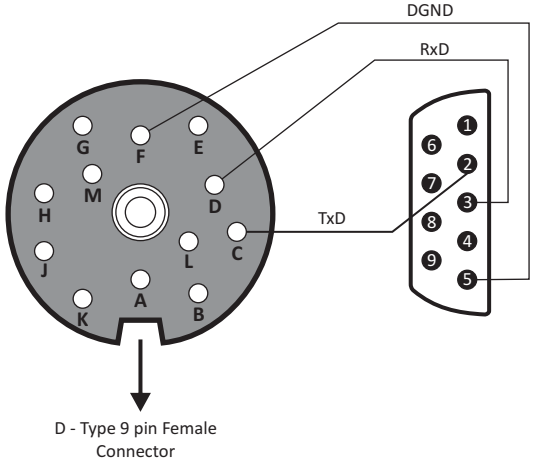


Fig. 15 RS-232 communication connection

3.5.3 Power ON Pyrometer

1. Connect the 12-core cable (Supplied with pyrometer) with pyrometer 12-pin binder connector given at the back side of pyrometer.
2. Connect the 12-core cable supply wire with +24V DC as given in table above.
3. Connect remaining wires as per your requirement (details given in table above).
4. Provide insulation for not used end points of 12-core cable.
5. Now, the pyrometer can be switch ON.

3.5.4 Converter RS-232 ↔ RS-485

Fig. 16 Converter RS-232 ↔ RS-485
(Reference no: 9000-03)

The pyrometer can communicate with PC using RS-232 or RS-485. RS-232 is used only for short distances.

RS-485 is well suited for long distance transmission. Standard on PC is RS-232, so a converter is used which converts RS-485 to RS-232.

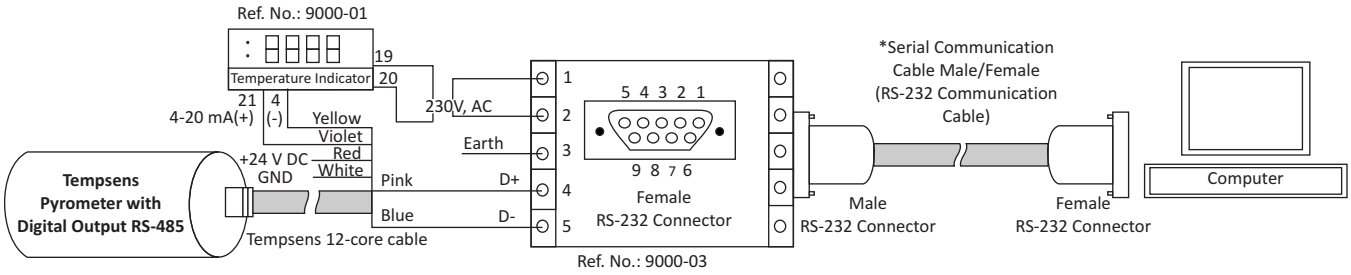


Fig. 17 RS-485 to RS-232 Connection

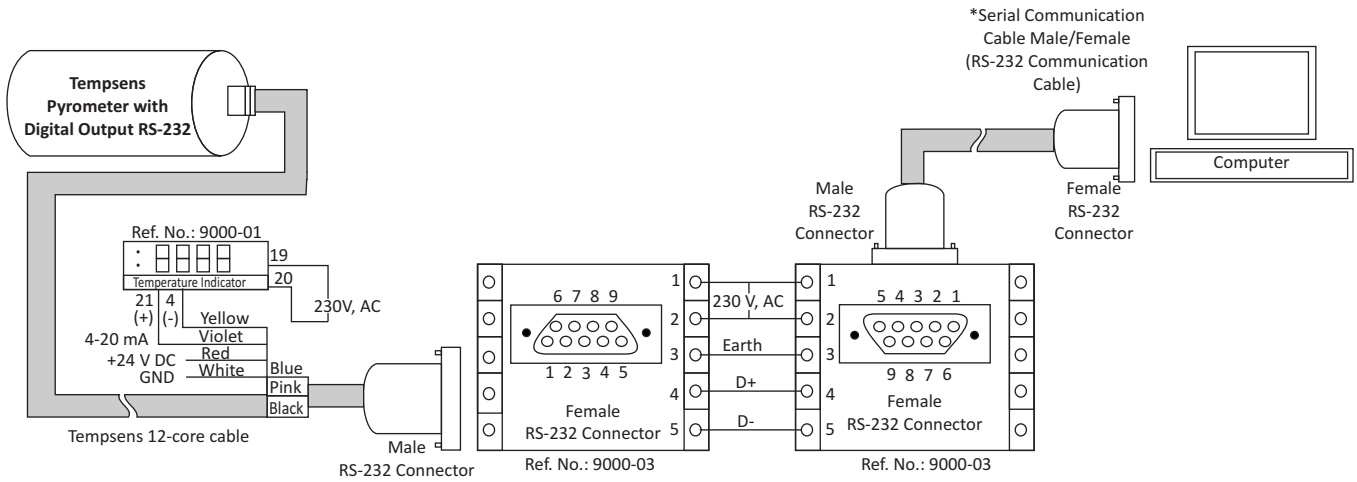


Fig. 18 RS-232 to RS-485 to RS-232 Connection

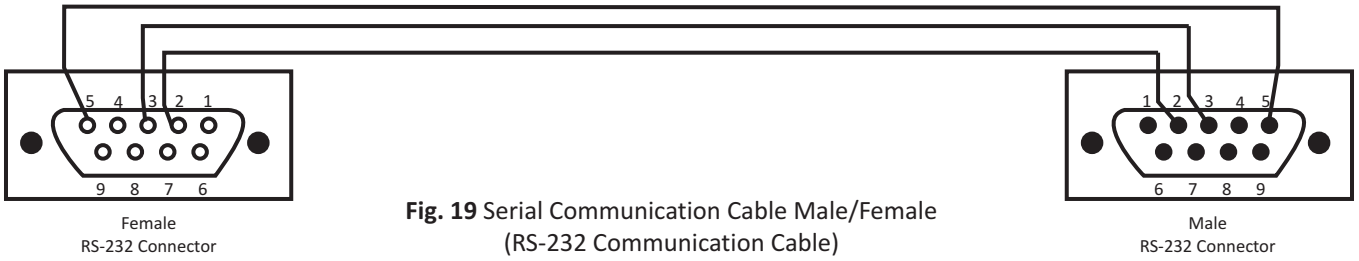
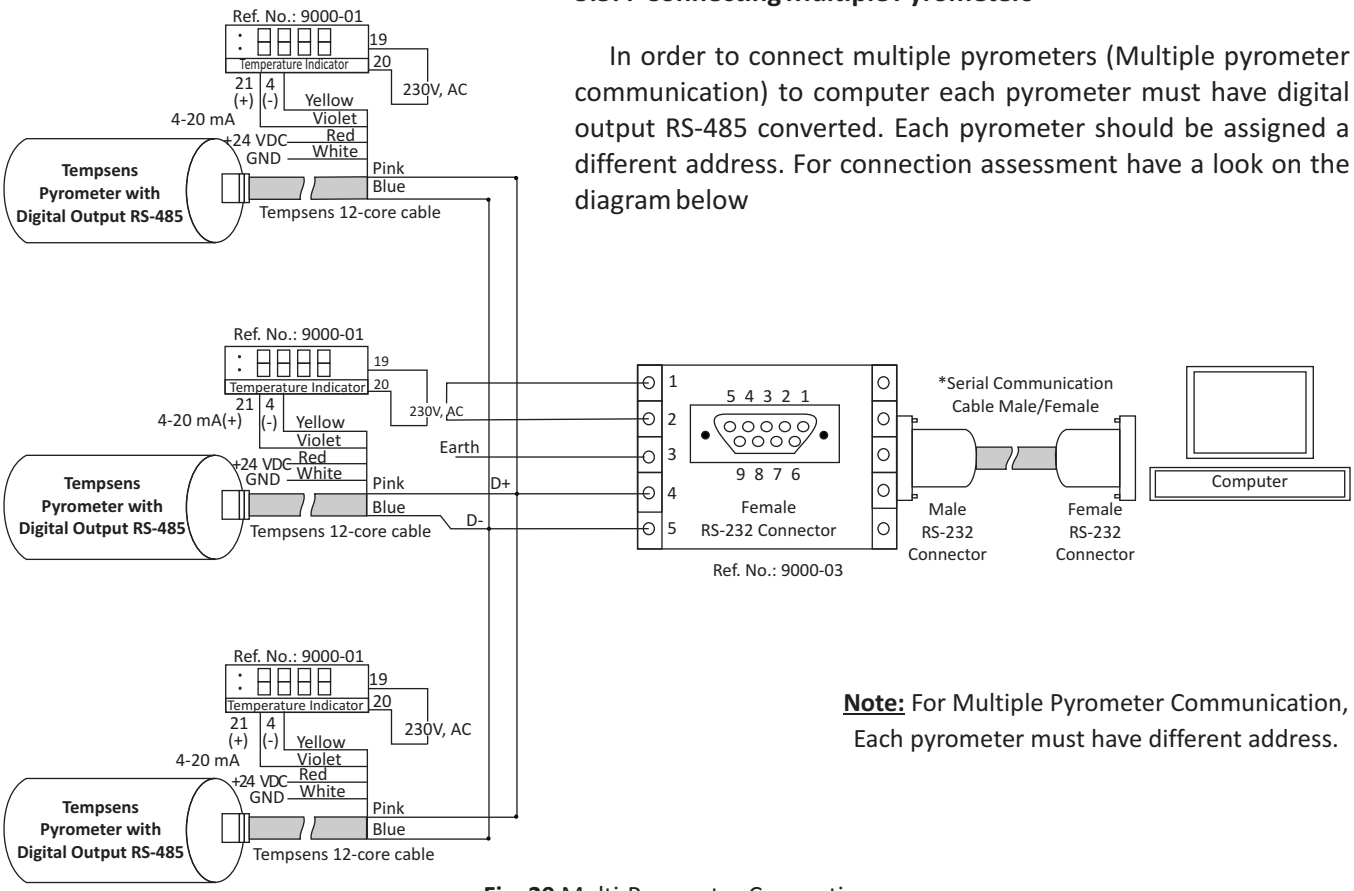


Fig. 19 Serial Communication Cable Male/Female
(RS-232 Communication Cable)

3.5.4 Connecting Multiple Pyrometers

In order to connect multiple pyrometers (Multiple pyrometer communication) to computer each pyrometer must have digital output RS-485 converted. Each pyrometer should be assigned a different address. For connection assessment have a look on the diagram below



Note: For Multiple Pyrometer Communication, Each pyrometer must have different address.

Fig. 20 Multi-Pyrometer Connection

Fig. 21 Temperature Indicator
(Reference no: 9000-01)

Fig. 22 Display & Parameterizer P-120
(Reference no: 9001-01)

3.5.5 Display Instrument

To display the measured temperature 7 segment digital indicator is used. Device has following specifications:

Power supply I/P	:	100 to 240 V, AC/DC
Analog I/P	:	4….20 mA/0...20mA/0...10V
Retransmission	:	4….20 mA/0...20mA/0...10V
Power supply O/P	:	24V, DC
Display	:	4 Digits
Alarm	:	2

3.5.6 Display & Parameterizer

P-120 is a high precision LED indicator for non contact temperature measurement. With indication of measured temperature user can easily parameterize a connected Tempsens digital pyrometer without any PC.

Device has following specification:

Power supply	:	100 – 240V, AC or 24V, DC
DC analog O/P	:	0-20 mA or 4-20 mA
Digital interface	:	RS-232 or RS-485
Pilot light	:	Pilot light On/Off with keys

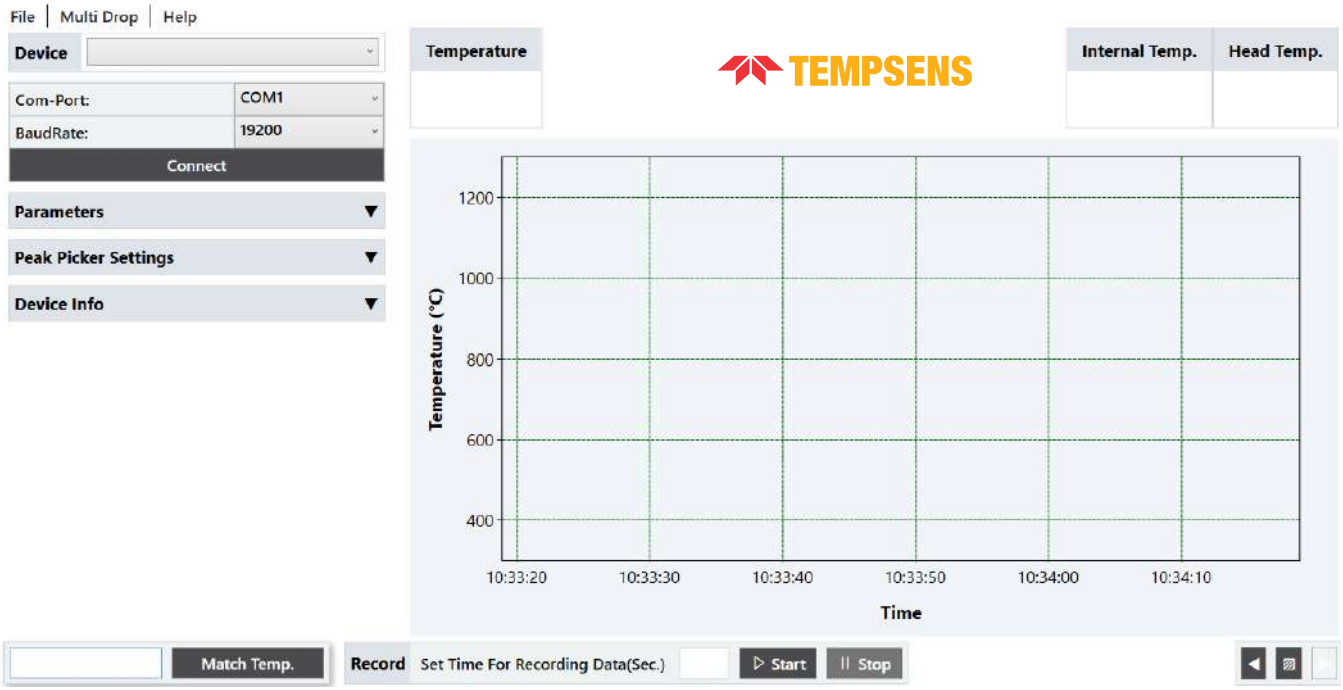
Chapter - 4

Software Installation

The provided Tempsens software “InfraSoft” offers digital PC interface RS-232 & RS-485. Using this software we can set all the parameters like response time, analog scale, emissivity, clear time, communication mode. This software provide all necessary information about pyrometer.

4.1 Installation

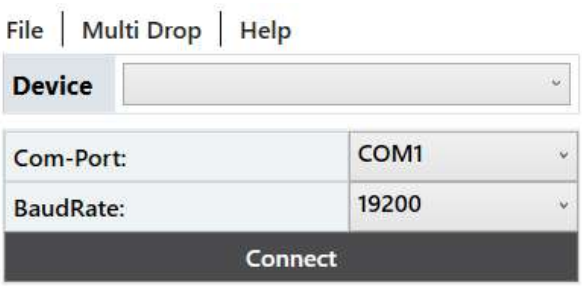
Install the pyrometer software using the installation guide file on CD ROM & restart your PC as per guidelines provided for installation. After installation of the software; Double click the application. It will open the screen of software.



4.2 Parameters in main screen

4.2.1 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 & BaudRate Then click on CONNECT Button.



For communication of multiple pyrometers, select different com port and address.

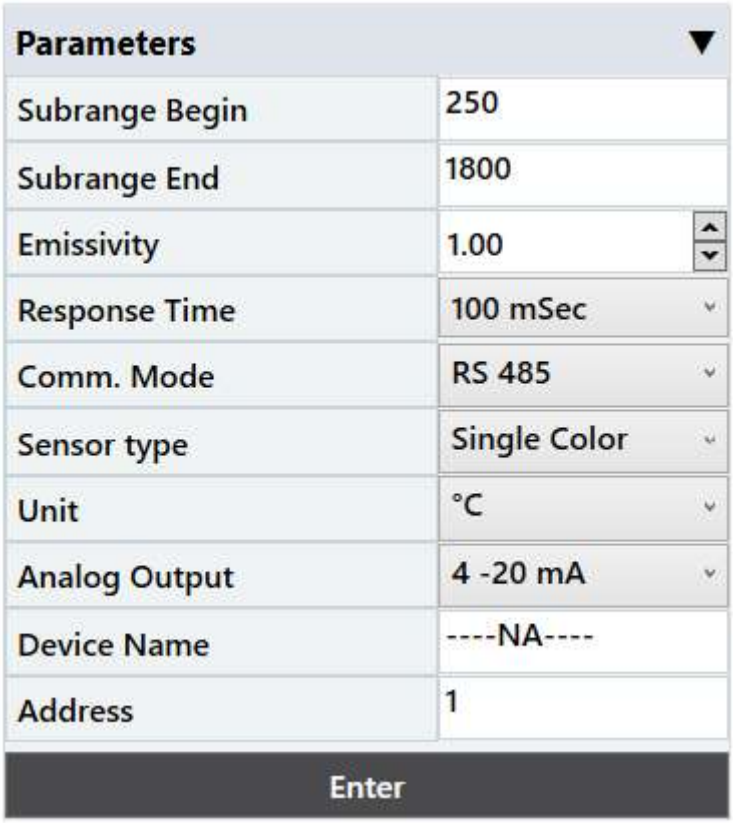
4.2.2 Temperature

It shows the temperature measured by the pyrometer

4.2.3 Parameter Setting

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

Note : Hit '**Enter**' Button on any transferrable value.



(A)Emissivity settings The emissivity can be set by clicking on "Parameters" and select or type in the desired emissivity directly in the description field. The emissivity value will be transferred to pyrometer by hitting the "Enter " button.

(B)Response time The desired response time can be chosen in the panel Parameter by clicking the appropriate list box (as per the values available in the drop box of response time). This parameter is use to set the analog response time of pyrometer.

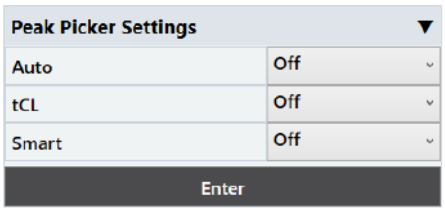
(C)Sub Range User can change the sub range of pyrometer in the panel Parameter. Sub range must be within the basic range of pyrometer, the minimum span between higher & lower range is 51. Analog output will be automatically set according to the sub-range by hitting "Enter" button.

(D)Sensor Type It shows pyrometer sensor type. User can change sensor type from two color to single color and vice versa (only applicable with two color pyrometer).

(E)Switch off level% (for two color pyrometer) The switch of level is the function that is used to avoid measurement errors caused by signals, which are too low. Although factory default is set to 15 %, the switch off limit can be adjusted between 2 and 50%.

(F)Unit User can change the measuring unit of temperature from "Centigrade" to "Fahrenheit" and vice versa.

(G) Peak Picker Setting Three Pickers are available in Pickers setting menu (Auto, tCL, Smart) & user can switch on any as per requirement, one at a time.



(G1) Auto "Auto" mode is used for discontinuous measuring task, such as object being transported on a conveyer belt in such a case the maximum value for each object has to be indicated. when the object passes the measuring beam of the pyrometer, the maximum value is stored until a new hot object appears in the measuring beam. The temperature which has to be recognized as "hot" is defined by the low limit of the adjusted sub range. The stored maximum value will be deleted when the temperature of the new hot object exceeds the low limit "from" of the sub range by at least

1°C. If a lower limit is not entered, the maximum value storage will be deleted whenever the low level of the full measuring has been exceeded.

(G2) Clear time (tCL) If the peak picker is switched on, the highest last temperature value will always be displayed and stored. As such, it may be beneficial to periodically clear and reset the stored values in order to obtain new temperature readings.

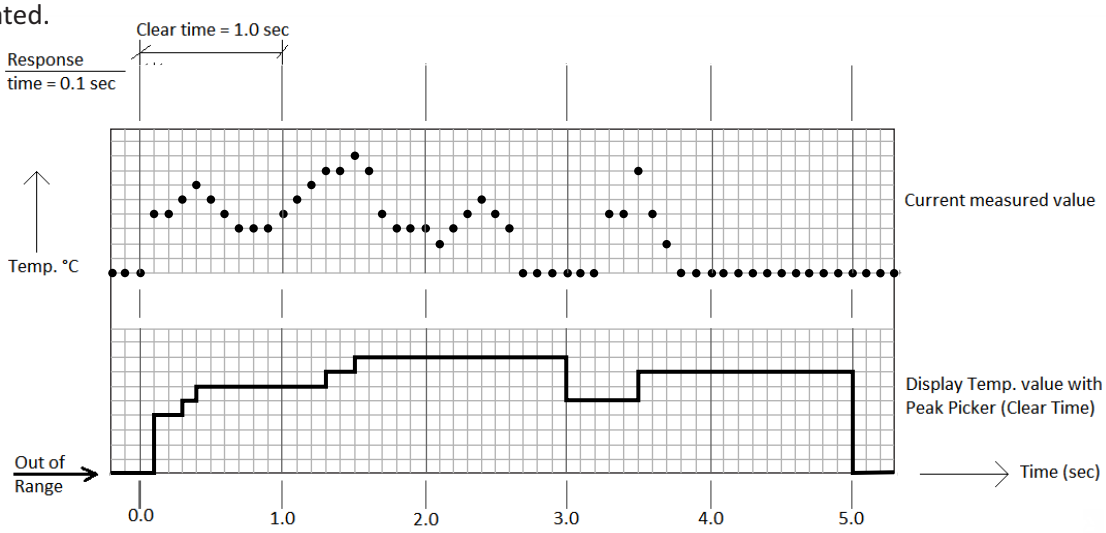
Example : If we set the tCl a s "6 sec" the highest last temperature value will be display for 6.0 sec to 12 sec then it capture next pick.

The following setting are possible :

OFF : At clear time "OFF" the maximum value storage is switched off and only momentary values are measured.

tCL (10msec...25sec) : Clear Time tCL can be set between 10msec and 25sec. When set, estimates the maximum values and holds it in two buffer memory. After the entered time, the storage will be deleted.

Clear Time feature is particularly useful when object temperature is not uniform across its dimension or the pyrometer is not constantly viewing an object to be measured. The peak picker works on two buffer memory to find maximum value over a defined interval. With the first memory, the highest measured value is held and is deleted alternately in the time interval set (clear time). The other memory retains the maximum value throughout the next time interval. The disadvantages of fluctuations in the display with the clock frequency are thereby eliminated.



Note:

The maximum value storage coincides with adjustments made to response time. Therefore:

(I) Clear time<= the adjusted response time is useless

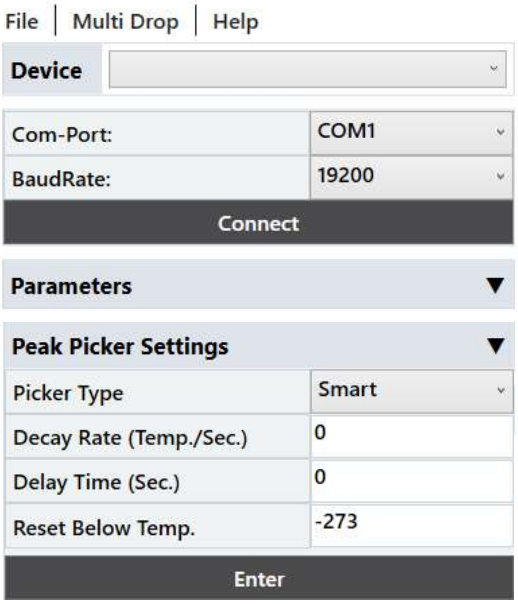
(ii) Clear times must be at least 5 times longer than the response time.

(iii) Only maxima with full maximum value can be recorded, which appear at least 5 times longer than response time.

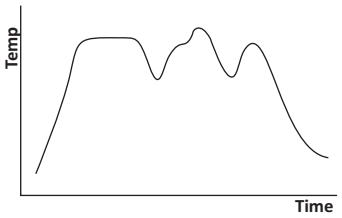
(G3) Smart If the smart picker is switched on, the highest last temperature value will always be displayed and stored. This feature is particularly useful when object temperature is not uniform across its dimension or the pyrometer is not constantly viewing an object to be measured.

Smart Picker Functions

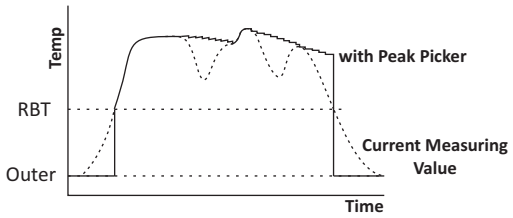
Smart picker can be turn ON & OFF by using the software. When Peak picker is ON, the peak picker menu is enabled for setting of the parameters like decay rate function, reset below temperature and peak picker delay.



(I)Decay rate The Decay rate range is 0.00 to 166.66°C/sec. or 0.00 to 300°F/sec. depending upon °F/°C unit's selection. The slowest Decay rate is 0 degrees per sec. This feature helps to eliminate erratic measurements and allows the peaked value to decay down to lower process temperature values as they occur. Decay rate is set to retain peak measured temperature value and ignore momentary decreases in measured temperature.

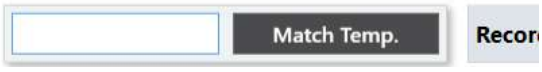


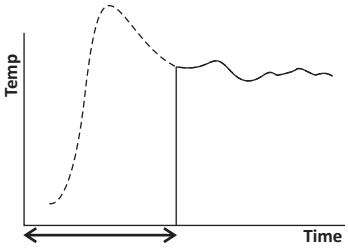
Without RBT



RBT with Decay Rate

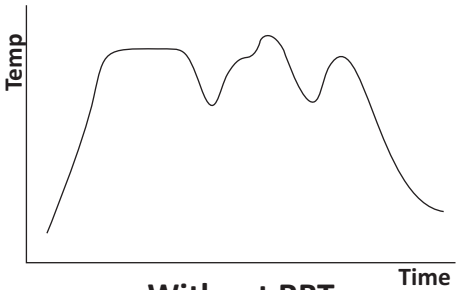
(II)Delay Time This function set the delay time in sec. before peak picker function starts. The delay time is selectable in the range 0.02 to 10.00 sec. Zero (0) turns delay time OFF. This function is used to delay the start of peaking action for upto 10 sec. following the detection of leading edge of a new target.



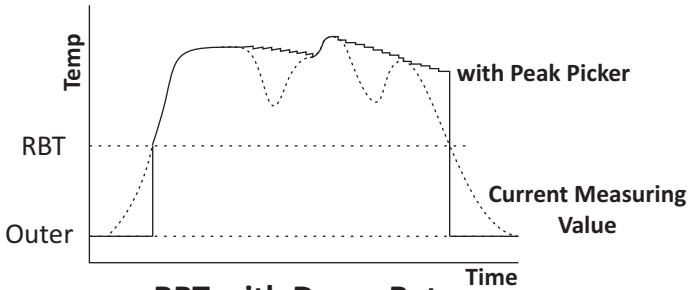


Delay Time (sec.)

(III) Reset Below Temperature(RBT) The user can set RBT within the limit of pyrometer sub range. This function sets the temperature above which peak picker action starts. When the target temperature matches or is below the selected value, the sensor indicates temperature without picking action.



Without RBT



RBT with Decay Rate

(H)Relative energy(for two color pyrometer) The relative energy shows a signal weakening which can be caused by contaminations of the optics or a viewing window or by dust in the field of view or a too small measuring object. Relative energy shows the measured intensity compared to the intensity, a black body radiation source would have at a determined ratio temperature of the pyrometer.

(I)Analog Range User can select the analog range from the option 4-20mA, 0-20 mA & 0-10V.

(J)Comm. Mode User can select the communication mode as per requirement [RS-232 / RS-485].

Note: For connection diagram from RS-232 to RS-485 & RS-485 to RS-232 *Refer Page No:-9*

To view parameters of multiple devices select the pyrometer name from the drop down list that appears at the top of the screen.

4.2.4 Device information

Pyrometer specific information will be displayed in the Info Panel

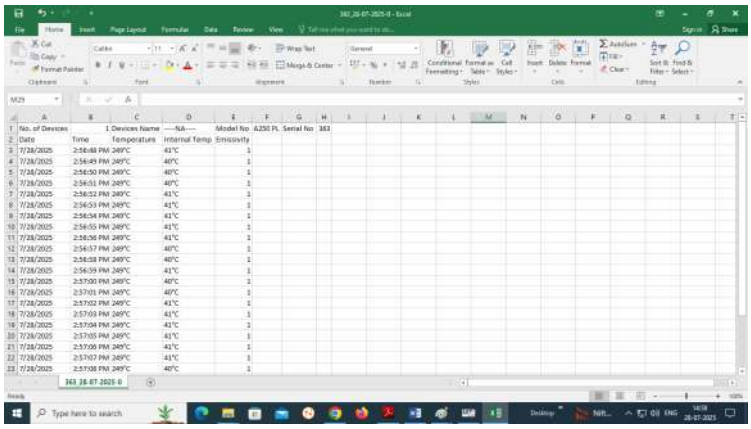
This screen shows the Model, basic range, serial number, version, working distance, spot size-apperture.

Device Info	
Model	AST A250 PL
Basic range	250°C...1800°C
Serial number	363
FW version	11.39
Working Dist(mm)	500
Spot Size-Aprt(mm)	5-11

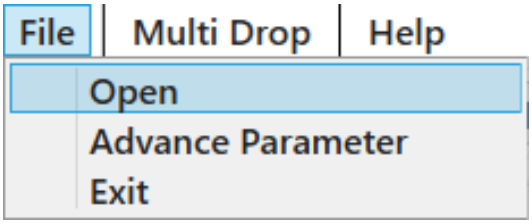
4.2.5 Record

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

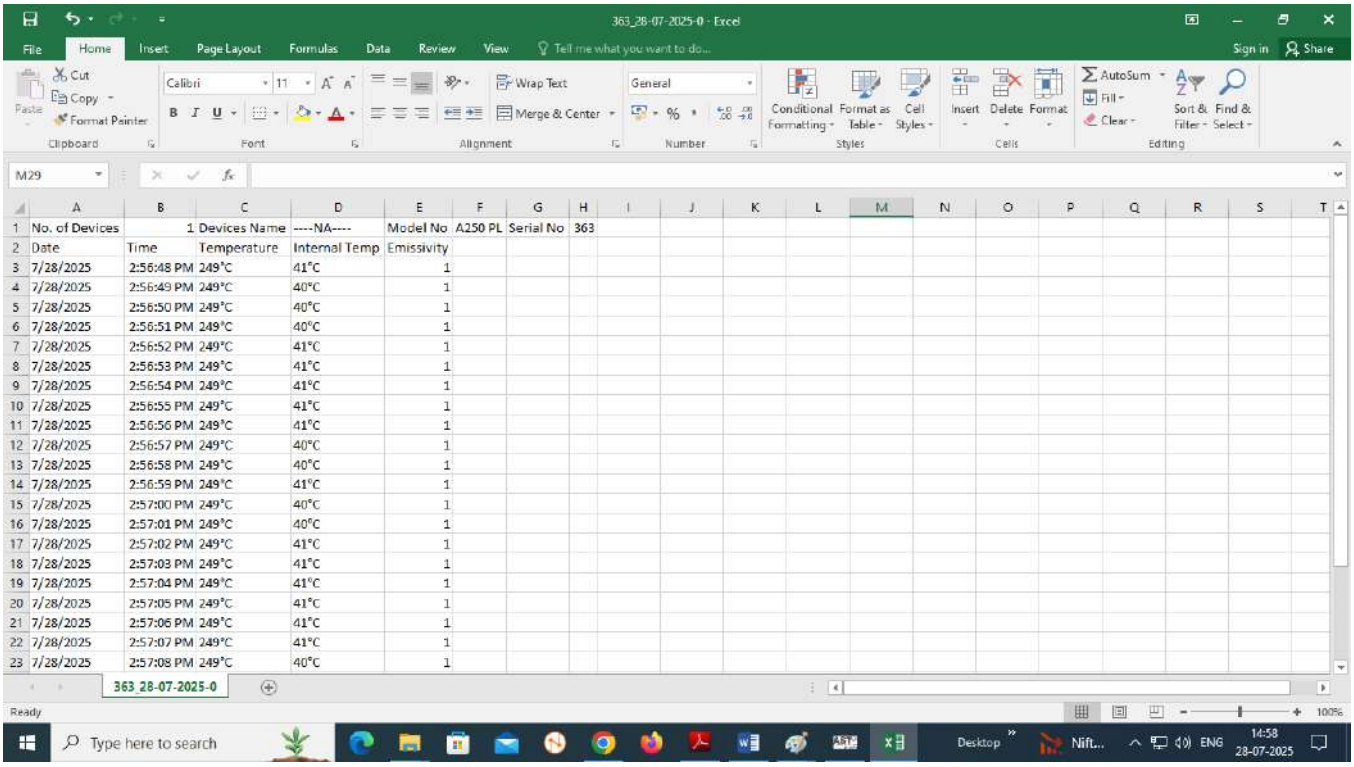
Record will be saved as ***.csv*** format and the name of file will be user define.



If user wants to open the file they open it in file menu by file name and location.

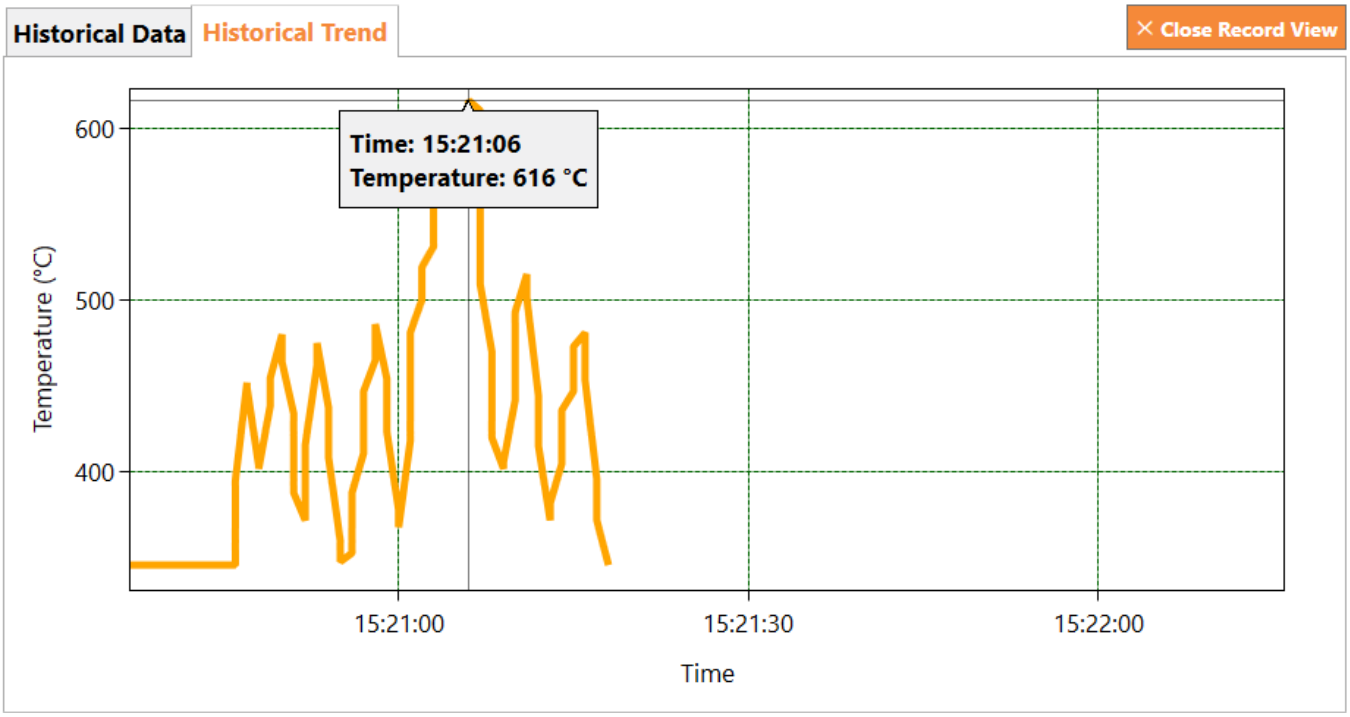


File will be stored in ***.csv*** format.

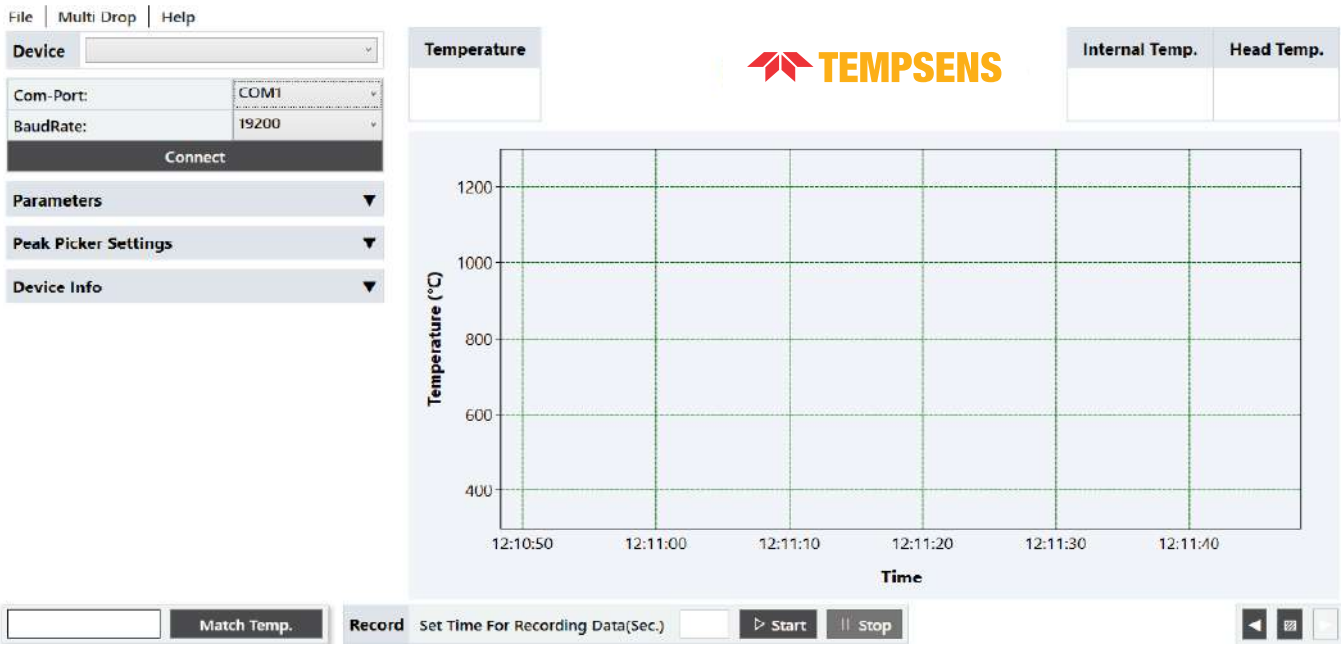


	A	B	C	D	E	F	G	H
1	No. of Devices	1	Devices Name	----NA----	Model No	A250 PL	Serial No	363
2	Date	Time	Temperature	Internal Temp	Emissivity			
3	7/28/2025	2:56:48 PM	249°C	41°C	1			
4	7/28/2025	2:56:49 PM	249°C	40°C	1			
5	7/28/2025	2:56:50 PM	249°C	40°C	1			
6	7/28/2025	2:56:51 PM	249°C	40°C	1			
7	7/28/2025	2:56:52 PM	249°C	41°C	1			
8	7/28/2025	2:56:53 PM	249°C	41°C	1			
9	7/28/2025	2:56:54 PM	249°C	41°C	1			
10	7/28/2025	2:56:55 PM	249°C	41°C	1			
11	7/28/2025	2:56:56 PM	249°C	41°C	1			
12	7/28/2025	2:56:57 PM	249°C	40°C	1			
13	7/28/2025	2:56:58 PM	249°C	40°C	1			
14	7/28/2025	2:56:59 PM	249°C	41°C	1			
15	7/28/2025	2:57:00 PM	249°C	40°C	1			
16	7/28/2025	2:57:01 PM	249°C	40°C	1			
17	7/28/2025	2:57:02 PM	249°C	41°C	1			
18	7/28/2025	2:57:03 PM	249°C	41°C	1			
19	7/28/2025	2:57:04 PM	249°C	41°C	1			
20	7/28/2025	2:57:05 PM	249°C	41°C	1			
21	7/28/2025	2:57:06 PM	249°C	41°C	1			
22	7/28/2025	2:57:07 PM	249°C	41°C	1			
23	7/28/2025	2:57:08 PM	249°C	40°C	1			

To see previous record open the file by clicking on menu ***File*** ⟶ ***open.***
Screen containing historical trend & historical data will appear.

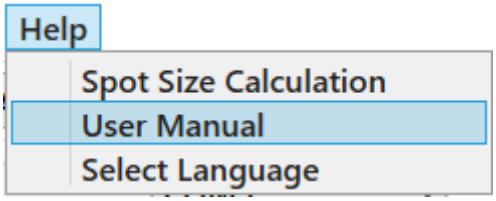


Temperature graph of connected pyrometer is displayed on right side of the screen. This shows the measured temperature corresponding to the time.



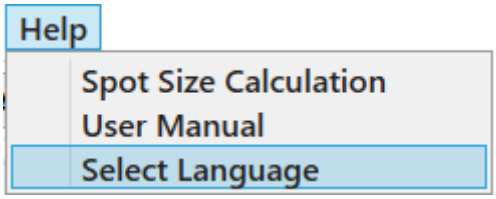
4.2.6 User Manual

If User wants to open the Product Manual then select help Menu and Open it, provided that PC should be online Mod.



4.2.7 Software Language

If User wants to Change Software Language, they open it in help menu and change it.



4.2.8 Match Temperature feature allows users to align the measured temperature with a master temperature by adjusting the emissivity accordingly.

How It Works:

- When matching the temperature, the Emissivity Type must be set to Software.
- Enter the Master Temperature (the reference temperature measured by another device) in the input box.
- Press the "ENTER" key to submit and apply the setting
- The pyrometer will then start reading the temperature the same as the master temperature.

Note :
If the Master Temperature exceeds the allowed limit (i.e., the calculated emissivity falls out of range), an alert message will be displayed: “Emissivity cannot be less than or greater than the allowed limit."

4.2.9 Modbus RTU Protocol

Modbus RTU (Remote Terminal Unit) is a communication protocol commonly used in industrial automation systems to facilitate communication between electronic devices, typically over serial communication lines like RS-**485.**

Features:

1. Serial Communication: Modbus RTU typically uses RS-485 as the physical layer for communication, but it can also run over other serial protocols.

2. Frame Structure in Modbus RTU: Modbus RTU uses a binary format for data transmission, which is compact and efficient. Each frame includes:

Field	Size	Description
Slave Address	1 byte	Address of the slave device (1–247).
Function Code	1 byte	Specifies the type of operation (e.g., read/write).
Data	Variable	Contains request or response parameters (registers, coils, etc.).
CRC (Error Check)	2 bytes	Cyclic Redundancy Check for error detection.

1. Master-Slave Architecture: In a Modbus RTU network, there is typically one master device that controls one or more slave devices (e.g., sensors, actuators, or other programmable devices). The master initiates the communication and requests data from or sends commands to the slave devices.

2. Function Codes: Common function codes used in Modbus RTU include:

- Read Holding Registers (FC03): Read analog values.
- Write Single Register (FC06): Write a value to a single analog output.

3. Communication Protocol: The master sends a request to the slave device, which responds with the requested data or an error code. The slave address, function code, and data are part of the request and response messages.

4. Error Checking: The CRC is used for error detection. If a message is corrupted during transmission, the receiving device can detect this and request the message to be sent again.

5. Data Representation: Modbus RTU typically represents data in a 16-bit register format. Each register can hold two bytes of data, and values may need to be interpreted according to the device's specifications.

Examples:

I. Query example to read temperature

Example	Byte	Description	No. of bytes
01	-	Slave Address	1
03	-	Function Code	1
00	High	Starting Register	2
00	Low		
00	High	No. of words to be read	2
01	Low		
84	High	Error Check(CRC)	2
0A	Low		

To read temperature, the following request should be generated: 01 03 00 00 00 01 84 0A, where

Byte 1 **'01'** is slave address
Byte 2 **'03'** is Function Code
Byte 3-4 **'0000'** is the starting address to read from
Byte 6-7 **'0001'** are number of items to read
Byte 8-9 **'840A'** is CRC

II. Response example: 01 03 02 01 D8 B9 8E

Example	Byte	Description	No. of bytes
01	-	Slave Address	1
03	-	Function Code	1
02	High	Byte count	1
01	Low	Requested Data	2
D8	High		
84	High	Error Check(CRC)	2
0A	Low		

Sensor response is, 01 03 02 01 D8 B9 8E, where
Byte 1 **'01'** is slave address
Byte 2 **'03'** is Function Code
Byte 3 **'02'** is byte count
Byte 4-5 is real temperature in HEX code **'01D8'** (472°K =01D8H)
Byte 6-7 **'840A'** is CRC

III. Write example: For example to change parameter to a analog range to TA max to 2773 °K or 2550 °C the following request will be generated :01 06 01 01 0A D5 E9 FC.

Example	Byte	Description	No. of bytes
01	-	Slave Address	1
06	-	Function Code	1
01	High	Starting Register	2
01	Low		
0A	High	Data to be written	2
D5	Low		
E9	High	Error Check(CRC)	2
FC	Low		

Byte 1 '**01'** is slave address
Byte 2 **'06'** is Function Code
Byte 3-4 **'0101'** is starting address to write to
Byte 5-6 is TA max in HEX code **'0AD5'** (2773°K=0AD5H)
Byte 7-8 is **'E9FC'** is check sum

Response example in case of Modbus RTU: 01 06 01 01 0A D5 E9 FC (same command frame will echo back) & at the 0101 starting register 0AD5 (2773K) will be write.

IV. Error Codes in Modbus RTU: The CRC is used for error detection. If a message is corrupted during transmission, the receiving device can detect this and request the message to be sent again.

Response example for error frame in case of Modbus RTU: 01 83 06 C3 02 00

Example	Byte	Description	No. of bytes
01	-	Slave Address	1
83	-	0x80+Function Code	1
06	-	Exception Code	1
C1	Low	CRC	2
32	High		
00		NULL	1

Byte 1 **'01**' is slave address
Byte 2 **'0x83'** is 0x80 + Function Code
Byte 3 Exception code refer' Exception Codes Error Description'
Byte 4-5 **'C1 22'** is CRC
Byte 6 NULL

- **Exception Codes Error Description:**

Code	Description
0x01	Illegal Function Code
0x02	Illegal Data Address
0x05	Parameter limit exceed Error
0x06	CRC Error

- **Address allocation of Commands:**

S no.	Data	Comments	Address Allocation
1.	Real Temperature, °K	Real calculated object temperature.	0000
2.	Status Code	As shown in Table 5.2.2.1 (below).	0001
3.	Internal temperature, °K	Internal temperature inside of device case.	0006
4.	Head temperature, °K	Temperature inside optical head. Multiplied by 10.	0007
5.	T max, °K	Max. (basic) temperature measurement range of pyrometer in °K	00FF
6.	T min, °K	Min (basic) temperature measurement range of pyrometer in °K	0100
7.	TA max, °K	Upper analog scale value	0101
8.	TA min, °K	Lower analog scale value.	0102
9.	Tau	Parameter to set response time. (0-10000ms)	0104
10.	°C / °F Flag	Flag is used to instruct SW to show temperature either in Centigrade or Fahrenheit scale. (0 or 1)	01FE
11.	Emissivity	Emissivity parameter multiplied by 1000. Parameterization for single color sensors.	03FC
12.	Sensor model number (10byte)	10 byte 'AST250C', if less than 10 byte pad with space at end	0DF2
13.	Laser Control	Updated hardware from August, 2010 allos laser turn on/off under sensor SW control.	0EF1
14.	Output mA range control	· Set to '0000': 4 to 20 mA (Default), · Set to '0001': 0 to 20 mA,	0EF2
15.	Software version no.	Embedded Software version number of device	12ED
16.	Sensor type	Sensor type: · '0001': Single color pyrometer · '0002': Two color pyrometer · '0003': Thermopile If needed more sensor type can be added,	12EE
17.	Sensor Serial number (6 byte)	6 byte in hex '000155', if less than 6 byte pad with '0' at start. Only 0 to 9 allowed.	13EC
18.	Set Point for alarm1	Hex value in °K (must be within Tmax and Tmin)	16E9
19.	Hysteresis	Hex value, '0000' to '0014' in °C or °F	17E8
20.	Device Name String	Max. 10 byte 'Hot End ', if less than 10 byte pad with space	1CE3
21.	Spot Size-Aperture (mm)	Max. 10 byte '99999-9999', if less than 10 byte pad with space	1CE4
22.	Smart Picker ON/OFF	'0000': OFF '0001': ON	02FD

S no.	Data	Comments	Address Allocation
23.	Pick picker Auto / TCL	Auto / TCL OFF : ‘0' Auto ON : ‘1' TCL ON : ‘(2 - 12)’	0300
24.	Decay Rate	Decay Rate: 0.0 to 166.66 C / 0.0 to 300.0 F	0107
25.	Delay Time	Delay Time : 0.02 to 10 Sec	0108
26.	RSBT: Reset below temp.	Temp range between Analog range(RBT)	0109
27.	Communication type selection ***once switched need to restart the pyrometer	· Set to '0000': RS485/MT500 · Set to '0001': Modbus-RTU	0302

Chapter - 5

Android Application Software

5.1 Installation Process

Tempsens provides "**infrasmart .apk**" for android phone. This apk is in software CD.

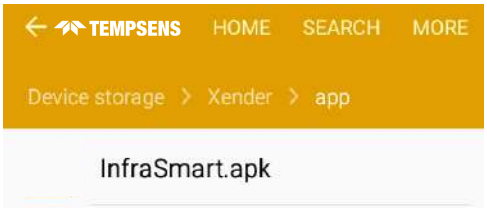
Special Note: - This apk is compatible with android version 4.0 and above

Following are the predefined steps to install apk in a mobile.

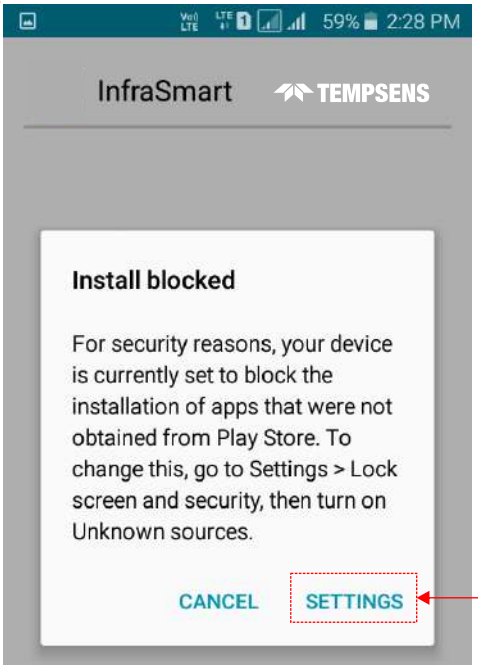
(i) Copy apk file from CD in a mobile.

(ii) Click on "**infrasmart .apk**" (Fig. 5.1)

(iii) Next screen will be as shown below, click on settings (Fig. 5.2)



(**Fig.** 5.1)

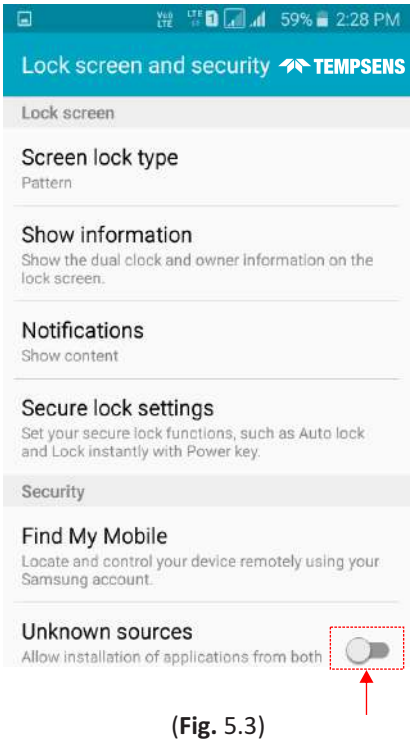


(**Fig.** 5.2)

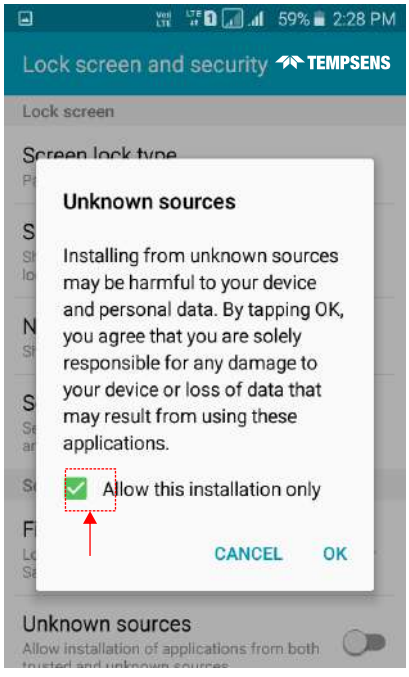
(IV) "On" unknown sources, Pop up window will appear as below. (Fig. 5.3)

Tick mark on "Allow this installation only "check box (indicated by arrow in below screen) and then click "OK". (Fig. 5.4)

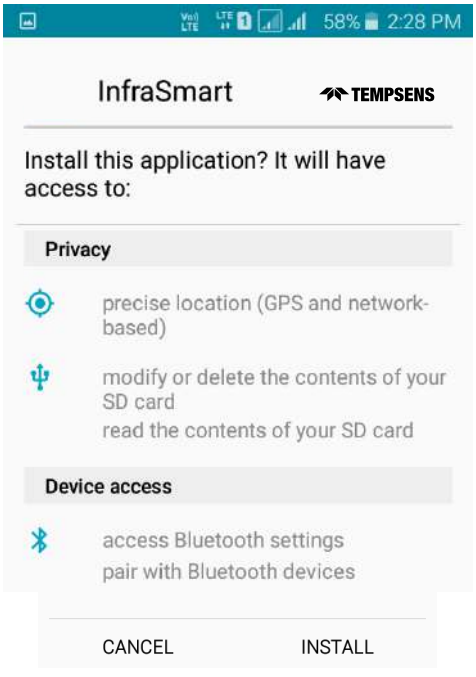
(V) Next click on Install tab (Fig. 5.5)



(**Fig.** 5.3)



(**Fig.** 5.4)

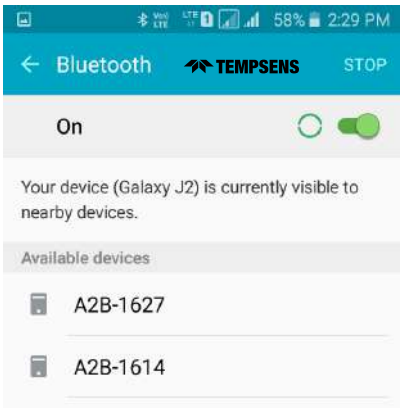


(**Fig.** 5.5)

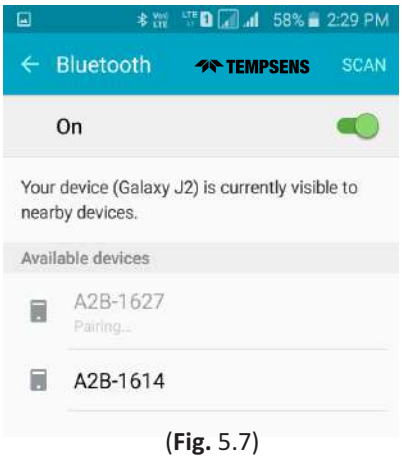
5.2 Communication

After installation, switch on Bluetooth of mobile. Scan for available devices. (Fig. 5.6)
Select the device name from list for pairing. (Fig. 5.7)

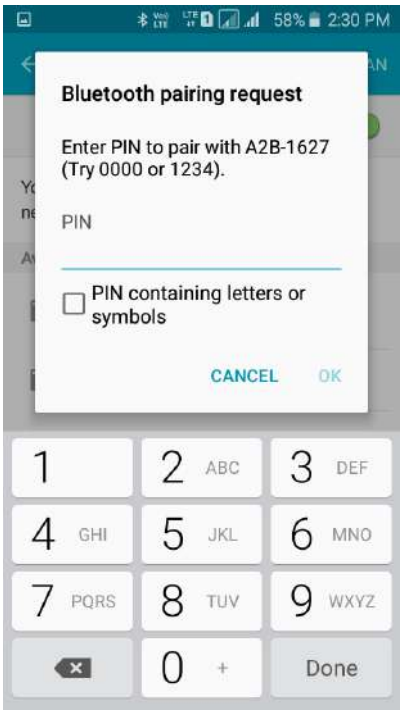
For pairing user need to enter pin no. Pin no will be reverse of last four digit of device name.(For eg:- if device name is A2B-1627 then pin will be 7261). (Fig. 5.8)



(**Fig**. 5.6)



(**Fig.** 5.7)



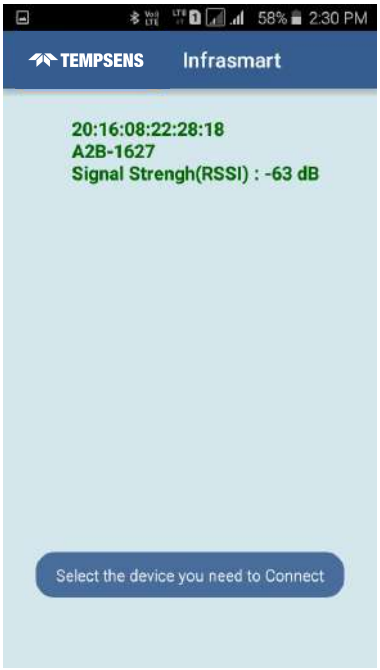
(**Fig.** 5.8)

Note: - Pairing require only one time until and unless it is not unpaired.

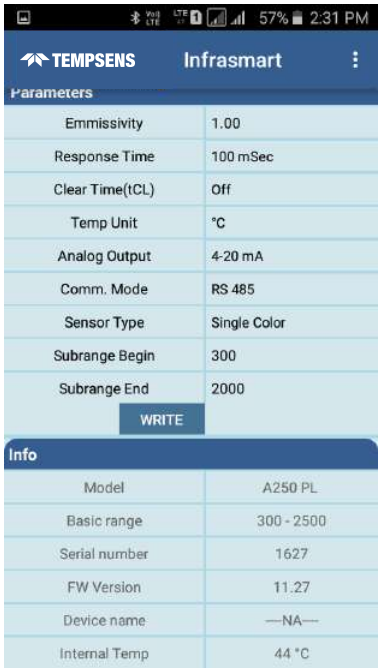
5.3 Operation

Open the Infrasmart application. Screen will appear as below, it will show all the devices which are paired. Select the device you need to connect. (Fig. 5.9)

Next screen will show all parameters of connected pyrometer. (Fig. 5.10)



(**Fig.** 5.9)



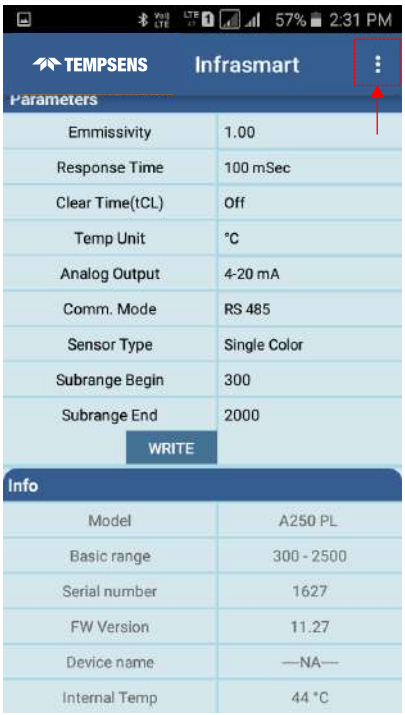
(**Fig.** 5.10)

Note: - Don't click any where on screen until all data is loaded.

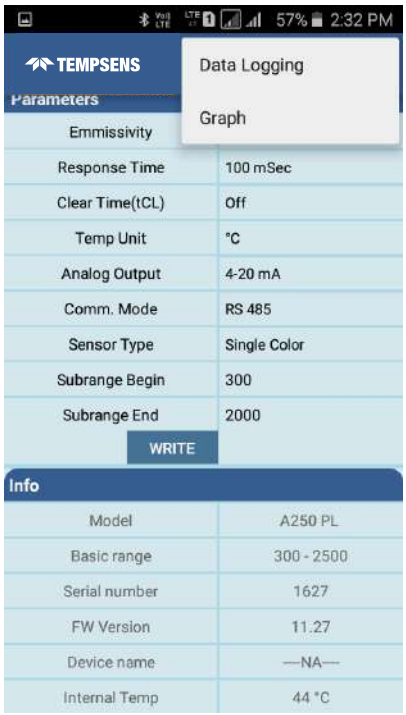
For parameter setting refer Page no 12 (4.2.3)

5.4 Data logging & Online graph

For data logging user need to click on dots which is at the right side as shown by arrow in below screen (Fig. 5.11) Next screen will be (Fig. 5.12)

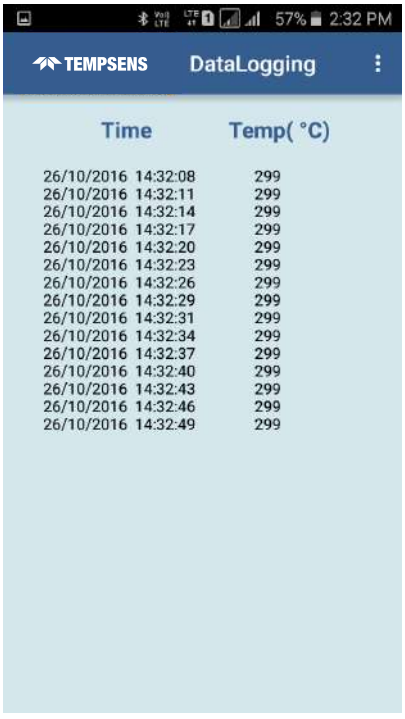


(**Fig.** 5.11)



(**Fig.** 5.12)

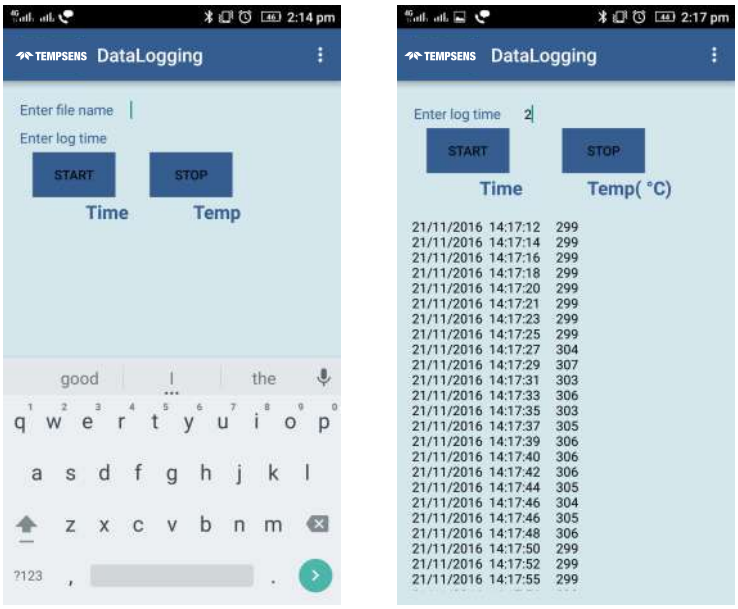
For data logging click on data logging & to view online graph user can click on Graph(Fig. 5.13 & 5.14)



(**Fig.** 5.13)

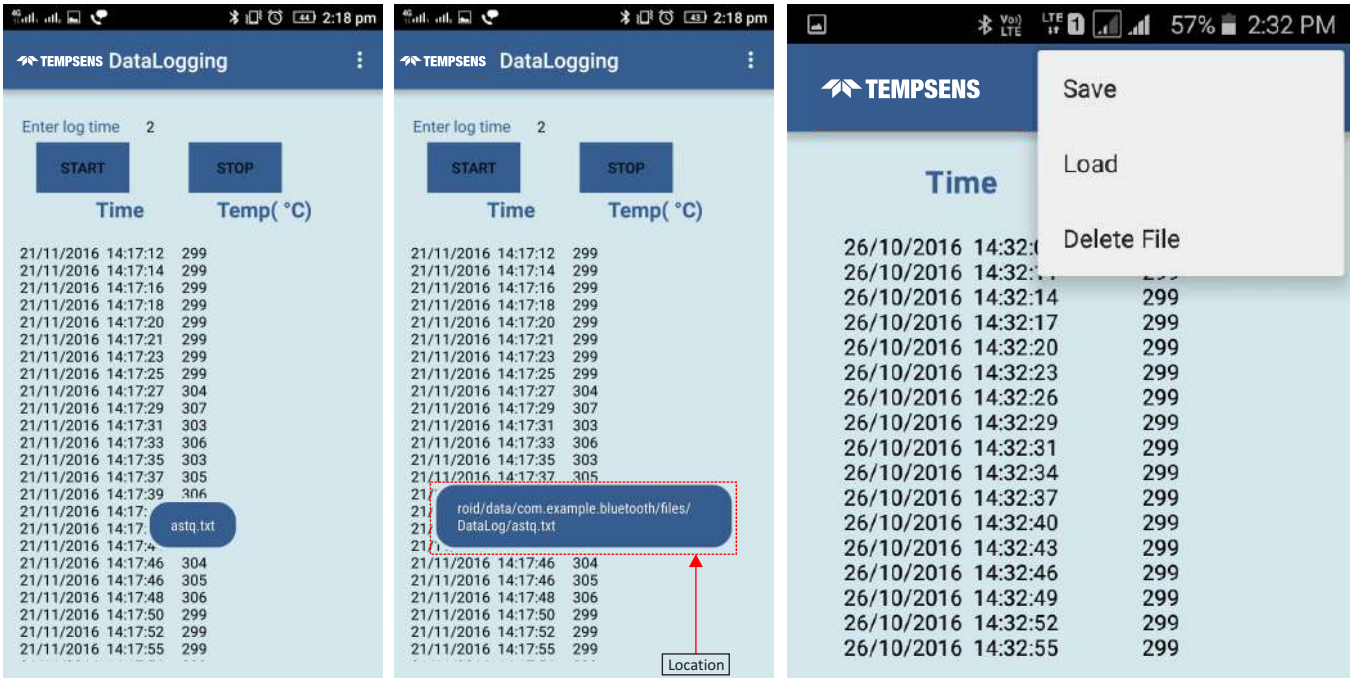
(**Fig.** 5.14)

To Start data logging, Enter file name & log time then click on start tab.



Note : If file name or log time is not enter within 5 sec then time out error will appear.

To save data logging click on save button.
Location where file is saved will be shown on data logging screen as shown(Fig. 5.15).



(**Fig.** 5.15)

To load file user need to enter file name

Basic Information Of Bluetooth

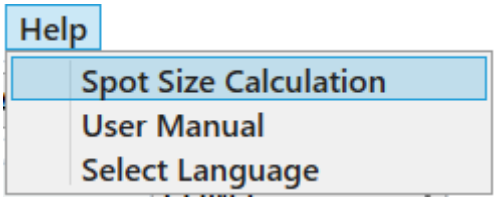
- Bluetooth Communication range is up to 5 meter in the line of site condition. Line of sight is a type of propagation that can transmit & receive data only where transmit & receive stations are in view of each other without any sort of an obstacle between them.
- Pyrometer works as a slave and mobile works as master.
- Pyrometer Bluetooth pair with multiple devices but can communicate with only single device at a time.

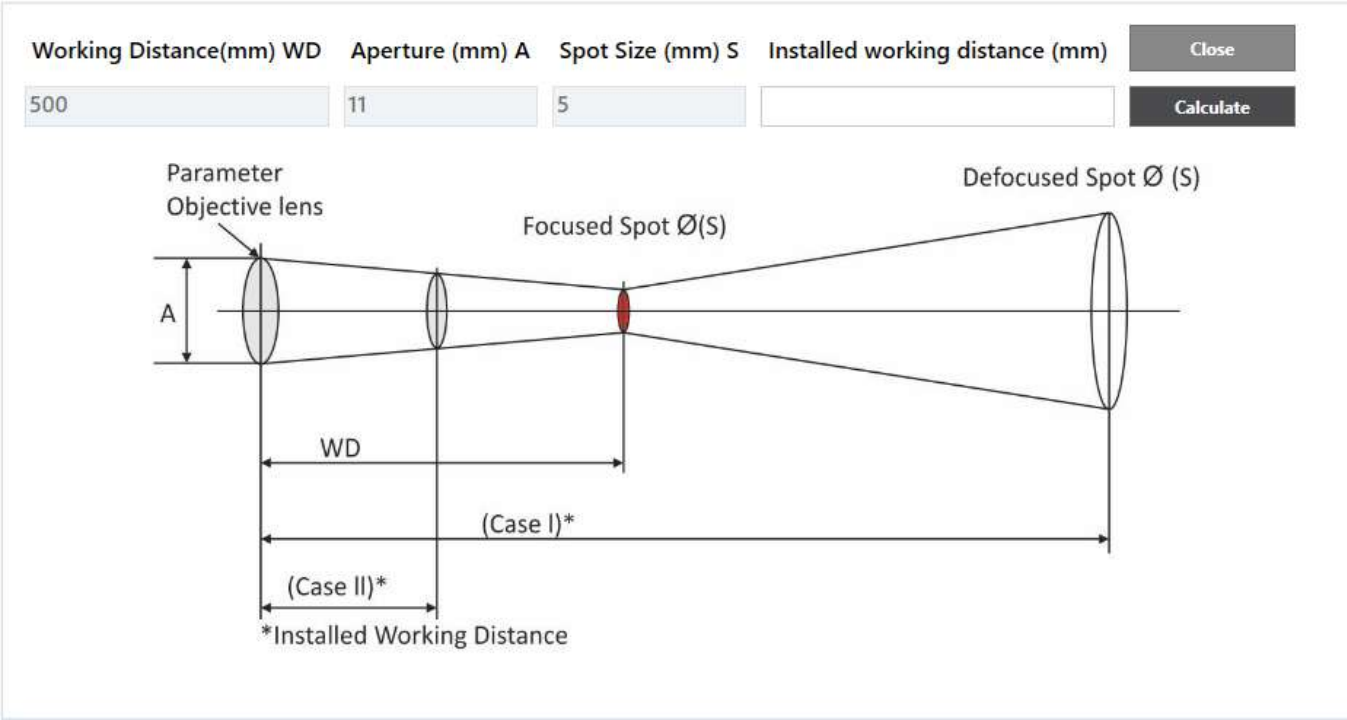
Chapter - 6

Calculate Spot Size

To calculate Spot Size click on help menu ⟶ ***Calculate Spot Size***

This option is used to calculate the spot size at installed working distance of the Pyrometer. When you click on calculate spot size the new window will open.





WD = Manufactured working distance in (mm).

A = It shows the value of lens opening (Aperture in mm)

S = Manufactured spot size of the pyrometer (mm)

User has to enter the value of WD, A, S, of the installed pyrometer (These values are given in section – 2.3). Now, putting the value of "Installed working distance" it will show the value of "Installed spot size".

Chapter - 7

Maintenance

In case of any queries, questions regarding repair, solutions to problems, calibration and assistance you may contact our sales representatives. Most of problems can be solved telephonically.

7.1 Cleaning Lens

The lens should be kept clean all the time as it aims at center of target object. When cleaning lens care should be taken and it can be done as follows :

- Firstly blow off lightly loose particles with “canned air” which is used for cleaning computer equipment or a small bellows squeeze (used for cleaning lenses).
- Now brush out gently remaining particles with a soft hair brush, a soft lens tissue can also be used.
- At last clean remaining particles “dirt” using a cotton or soft lens tissue dampened in distilled water. Do not scratch the surface.

In case of finger prints or any other grease material uses any of the following removing elements:

- Kodak lens cleaner
- Ethanol
- Denatured alcohol

Gently wipe with a soft, clean cloth after application of any of the above elements and wipe until you are able to see colours on the surface, then allow to air dry.

Do not wipe the surface dry, as this may result in scratches on the surface.

Note: Do not use any cleaners containing ammonia or simple ammonia to wash or clean the optical lens of pyrometer as this may permanently damage the surface of lens.

Chapter - 8

Serial communication protocol-MT500

This protocol is developed to use in the half duplex addressable communication mode. Master device should periodically issue requests to each Slave device. The request contains an address of polling “Slave” device. Slave device reply only on the requests issued by Master. Each Slave has its own address to recognize the issued request. Tempsens sensors always operate as Slave devices. Using RS485 serial communication option allows connecting more than one sensor to Master device. Tempsens sensors always perform delay of 5 ms before sending an answer on Master request to meet RS485 hardware requirement.

MT500_Tempsens protocol uses only RD (Batch Read) and WD (Batch Write) commands. Sending other MT500 protocol commands causes sensor to consider it as error condition and answer with unknown command reply. Symbols enclosed within apostrophes (‘symbol’) means ASCII representation of the symbols. String enclosed with quotation mark (“string”) means ASCII representation of the string (ended by ‘\0’). Data format is: 8 data bit, 1 stop bit, No parity, baud-rate 19200.

Description	Address	Items	Parameters
Emissivity	'0400'	'01'	Object emissivity multiplied by 1000. Refer user manual for adjustable range.
Emissivity slope	'0401'	'01'	Emissivity slope parameter multiplied by 1000. Refer user manual for adjustable range.
Response time (τ)	'0105'	'01'	Parameter specifies analog and serial output response time. See Table 1.
Upper basic range	'0100'	'01'	Upper measurement range limit in °K (read only)
Lower basic range	'0101'	'01'	Lower measurement range limit in °K (read only)
Analog output type	'0F01'	'01'	'0000': 4 to 20 mA (Default); '0001': 0 to 20 mA, '0002': 0 to 10 Volt; '0003': K type TC; '0004': J type TC
Upper sub range	'0102'	'01'	Upper analog scale value in °K
Lower sub range	'0103'	'01'	Lower analog scale value in °K
Station number	'0200'	'01'	Adjustable between '0001' to '0255'
Temperature unit	'0201'	'01'	Flag is used to instruct PC SW to show temperature '0000': Centigrade (Default); '0001': Fahrenheit
Switch off level	'0107'	'01'	Parameter multiplied by 10. Adjusted between 0 and 100%, Default set to 15%.
Sensor mode	'0204'	'01'	'0000' = Single color; '0001' = Two color This parameter is useless for single color sensors.
Internal temperature	'0006'	'01'	Temperature inside device case in °C (read only)
Head temperature	'0007'	'01'	Temperature inside optical head m°C(only for E –series pyrometers) (read only)
Clear time(tCL)	'0303'	'01'	Adjustable between 0 to 12, Default 0, 0=OFF, 1=Auto. 2-12 = 10msec to 25sec [refer to page-13(clear time)]
Laser control	'0F00'	'01'	'0000': LASER OFF; '0001': LASER ON (Default)
Communication type selection	'0F03'	'01'	'0000':RS-485;, '0001': RS-232 (Default)
Set point	'1700'	'01'	Set point for relay actuation (only for E –series pyrometers)
Hysteresis	'1800'	'01'	Hysteresis value relay actuation
LCD back light control	'1801'	'01'	'0000': BL OFF; '0001': BL ON(Default) (Only for E-series pyrometers)
Device name	‘1D00'	‘01'	10 Bytes “Hot end “, if less then 10 bytes pad with space at end.
Working distance (mm)	‘1D01'	‘01'	10 Bytes “1000 “, if less then 10 bytes pad with space at end.
Spot size-apperture (mm)	‘1D02'	‘01'	10 Bytes “1000-6000” if less then 10 bytes pad with space at end. ‘-’ sign between spot size and apperture is compulsory
Relative energy (read only)	‘0002'	‘01'	Relative energy multiply by 1000 for 2 color pyrometers only

Device model number (read only)	'0E00'	'01'	10 bytes “Pyro450C “', if less than 10 byte pad with space at end
Firmware version	'1300'	'01'	Firmware version number of device (read only)
Sensor serial number (read only)	'1400'	'01'	6 bytes in hex, if less than 6 bytes pad with '0' at start. Only numbers allowed.
Device type (read only)	'1301'	'01'	'0001': Single color; '0002' : Two color '0003': Thermopile; '0004' : Reserved
Real temperature and status code (read only)	'0000'	'02'	Calculated object temperature in °K and status of sensor (As shown in Appendix A). First process status code then real temperature.

Batch Read (RD)command

Byte 1	Bytes 2,3	Bytes 4, 5	Bytes 6-9	Bytes 10, 11	Byte 12	Bytes 13, 14
1 Byte	2 Bytes	2 Bytes	4 Bytes	2 Bytes	1 Byte	2 Bytes
STX	Station ID	RD	Address	Items	ETX	Checksum

Byte 1: Always STX (0x02)
Bytes 2, 3: The Station Number of the device to read from (2 Hex digits)
Bytes 4, 5: The command to execute (RD)
Bytes 6-9: This is the starting address to read from. Must be 4 bytes long
Bytes 10, 11: This is the number of addresses (items) to read. Must be 2 bytes long
Byte 12: Always ETX (0x03)
Bytes 13, 14: The checksum is the lowest 8 bits of the sum of bytes 2 through 12

Example : Read two parameters starting from address 0000, from the station number 10 (0AH). This will read addresses 0000 and 0001.

Byte 1	Bytes 2, 3	Bytes 4, 5	Bytes 6-9	Bytes 10, 11	Byte 12	Byte 13, 14
STX	0A	RD	0000	02	ETX	2E
0x02	0x30, 0x41	0x52, 0x44	0x30,0x30,0x30,0x30	0x30, 0x32	0x03	0x32, 0x43,

Checksum is calculated as the lowest 8 bits of the sum of the Hex codes for bytes 2 to 12.
Example : 70ARD 000002[1] +0x30 +0x41 + 0x52 + 0x44 + 0x30 + 0x30 + 0x30 + 0x30 + 0x30 + 0x32 + 3(ETX) = 22C → Checksum is 2C lower byte of the result.

Reply
The reply length is L = (N * 4) + 8, Where N = the number of requested Items.
If the command is successful, the reply length will be at least 12 bytes. It consists of the STX, followed by four bytes for each requested item, then the ETX and Checksum.

Byte 1	Bytes 2, 3	Bytes 4, 5	Bytes 6-9	Bytes 10-13	Byte L-2	Byte L-1, L
STX	Station	RD	Data 1	Data N	ETX	Checksum

Reply to above command if address '0000' contains value 1497 and address '0001' contains value 0000.

Byte 1	Bytes 2, 3	Bytes 4, 5	Bytes 6-9	Bytes 10-13	Byte 14	Byte 15-16
STX	0A	RD	059D	0000	ETX	AC
0x02	0x30, 0x41	0x52, 0x44	0x30,0x35,0x39,0x44	0x30, 0x30, 0x30, 0x30	0x03	0x41, 0x43

in the event of an error, the reply is

Byte 1	Byte 2, 3	Byte 4, 5	Byte 6
NAK	0A	'R', 'D'	01 (Error Code)
0x15	0x30, 0x41	0x52, 0x44	0x30, 0x31

Batch Write (WD) command

Byte 1	Bytes 2, 3	Bytes 4, 5	Bytes 6-9	Bytes 10, 11	Bytes 12-15	Bytes (L-6) - (L-3)	Byte L-2	Byte L-1, L
STX	Station ID	WD	Address	No. of Items	Data 1	Data N	ETX	Checksum

Byte 1	Bytes 2, 3	Bytes 4, 5	Bytes 6-9	Bytes 10, 11	Bytes 12-15	Byte 16	Byte 17,18
STX	0A	WD	0400	01	03E8	ETX	74
0x02	0x30, 0x41	0x57, 0x44	0x30, 0x34, 0x30, 0x30	0x30, 0x31, 0x30, 0x30	0x30, 0x33, 0x45, 0x38	0x03	0x37, 0x34

Reply

If the command is successful, the reply is

Byte 1	Byte 2, 3	Byte 4, 5
ACK	0A	'W', 'D'
0x06	0x30, 0x41	0x57, 0x44

In the event of an error, the reply is

Byte 1	Byte 2, 3	Byte 4, 5	Byte 6
NAK	0A	'W', 'D'	01 (Error Code)
0x15	0x30, 0x41	0x57, 0x44	0x30, 0x31

Error Codes

Error Code	Description	Comments
'1'	Invalid check sum	See how to calculate a check sum
'2'	Unknown command	Protocol uses only RD (Batch Read) and WD (Batch Write) commands
'3'	Data length error	Number of items in WD (Batch Write) command doesn't match number of data bytes
'4'	ETX not found	ETX (0x03) not present in command
'5'	Illegal Address	number of items in a request is set to 0; memory segment number in a request is out of 0-25; Wrong command value, No data at requested address;
'6'	More items requested	More than 99 items were requested in command
'7'	Unsuccessful write	It informs Master that it should repeat WD command

Table 1

Tau (τ)	Analog Response Time, ms	Serial Response Time, ms
1	2	20
3	6	50
5	10	100
10	20	200
30	60	300
50	100	500
100	200	1000
300	600	2000
500	1000	3000
1000	2000	4000
3000	6000	5000
5000	10000	10000

Appendix A

DATA	Comments
Status code	'0000' : No error '0001' : Signal is lower than sensor sensitivity '0002' : Out of range due to T brightness minimum '0003' : Too low energy '0004' : Signal is higher than sensor sensitivity '0006' : Sharp brightness jump '0007' : Non stable object measurement '0011' : Internal temperature warning '0013' : Thermopile ambient temperature too low '0014' : Thermopile ambient temperature too high '0015' : Pyrometer in testing mode '0016' : Pilot light ON '0017' : Measurement below lower basic range '0018' : Measurement exceeds upper basic range '0019' : Pyrometer in warm up period

Broadcast Message

WD (Batch Write) command with Station ID of 0 is considered as broadcast message. Sensors process this command regardless of their Station Number and do not issue replies.

It is useful when master issues a request to change the same parameters of more than one Slave devices.

For more information write us at, info@tempsens.com

Appendix B

Typical emissivity values for various materials available:

All the emissivity values shown in the table are only approximate, as it depends various parameters and it may affect the emissivity of a material. These parameters are as under:

1. Temperature
2. Thickness of material
3. Angle of measurement
4. Spectral range of measurement
5. Geometry
6. Surface quality (polished, rough , oxidized, sandblasted)
7. Transmission

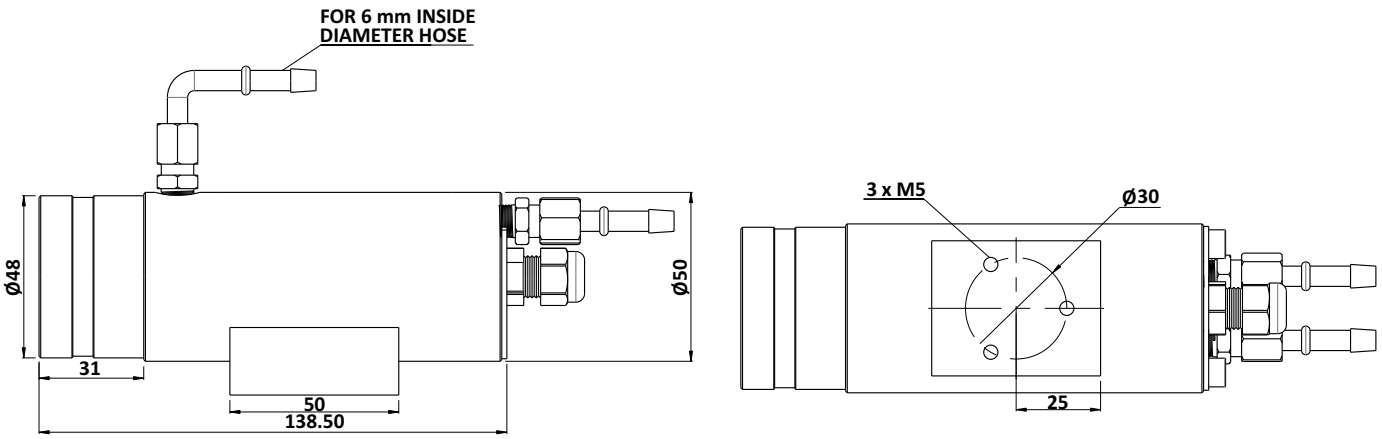
Material	Emissivity*
Aluminum, polished	0.05
Aluminum, rough surface	0.07
Aluminum, strongly oxidized	0.25
Asbestos board	0.96
Asbestos fabric	0.78
Asbestos paper	0.94
Asbestos slate	0.96
Brass, dull, tarnished	0.22
Brass, polished	0.03
Brick, common	0.85
Brick, glazed, rough	0.85
Brick, refractory, rough	0.94
Bronze, porous, rough	0.55
Bronze, polished	0.10
Carbon, purified	0.80
Cast iron, rough casting	0.81
Cast iron, polished	0.21
Charcoal, powdered	0.96
Chromium, polished	0.10
Clay, fired	0.91
Concrete	0.54
Copper, polished,	0.01
Copper, commercial burnished	0.07
Copper, oxidized	0.65
Copper, oxidized to black	0.88
Electrical tape, black plastic	0.95
Enamel **	0.90
Formica	0.93
Frozen soil	0.93
Glass	0.92
Glass, frosted	0.96
Gold, polished	0.02
Ice	0.97
Iron, hot rolled	0.77
Iron, oxidized	0.74
Iron, sheet galvanized, burnished	0.23
Iron, sheet, galvanized, oxidized	0.28
Iron, shiny, etched	0.16

Material	Emissivity*
Iron, wrought, polished	0.28
Lacquer, Bakelite	0.93
Lacquer, black, dull	0.97
Lacquer, black, shiny	0.87
Lacquer, white	0.87
Lampblack	0.96
Lead, gray	0.28
Lead, oxidized	0.63
Lead, red, powdered	0.93
Lead, shiny	0.08
Mercury, pure	0.10
Nickel, on cast iron	0.05
Nickel, pure polished	0.05
Paint, silver finish**	0.31
Paint, oil, average	0.94
Paper, black, shiny	0.90
Paper, black, dull	0.94
Paper, white	0.90
Platinum, pure, polished	0.08
Porcelain, glazed	0.92
Quartz	0.93
Rubber	0.93
Shellac, black, dull	0.91
Shellac, black, shiny	0.82
Snow	0.80
Steel, galvanized	0.28
Steel, oxidized strongly	0.88
Steel, rolled freshly	0.24
Steel, rough surface	0.96
Steel, rusty red	0.69
Steel, sheet, nickelplated	0.11
Steel, sheet, rolled	0.56
Tar paper	0.92
Tin, burnished	0.05
Tungsten	0.05
Water	0.98
Zinc, sheet	

Appendix C

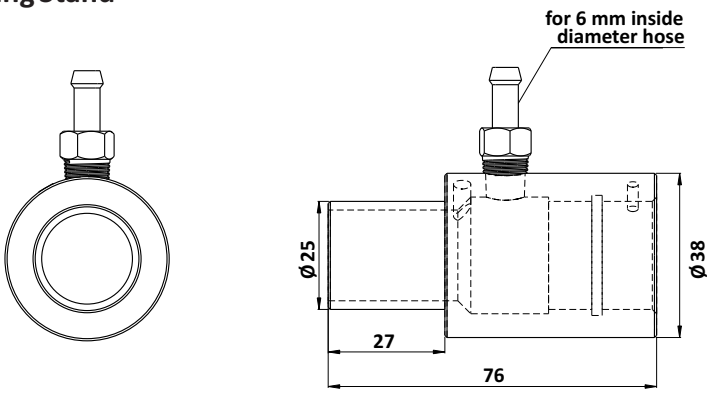
Mechanical Drawings

1. Water Cooling Jacket



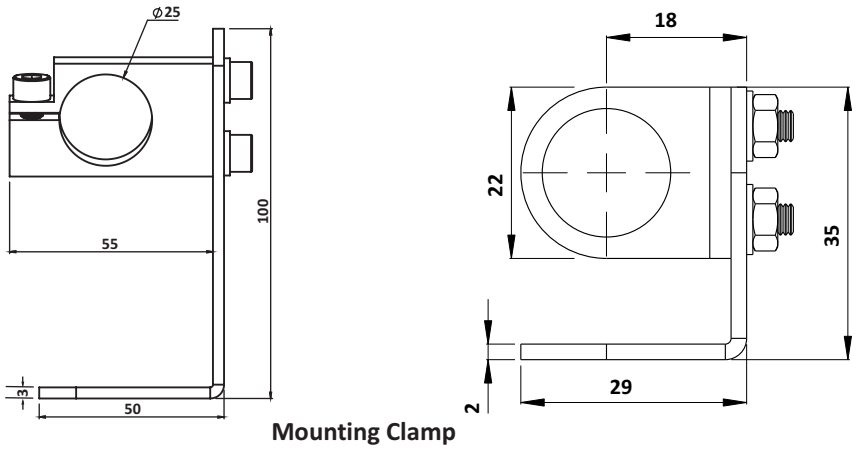
Adjustable Mounting Stand
(Reference no: 8000-07)

2. Adjustable Mounting Stand



Adjustable Mounting Stand
(Reference no: 8000-07)

3. Mounting Clamp



Mounting Clamp
(Reference no: 8000-05)

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.

Warranty

A250/A450 FO PL BT instruments have a warranty of two years from the invoice date. This warranty covers manufacturing defects. User-induced faults are not covered under this warranty.

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

Copyright: © 2009, Tempsens. All rights reserved.

This document may contain proprietary information and shall be respected as a proprietary document to Tempsens with permission for review and usage given only to the rightful owner of the equipment with which this document is associated.

Tempsens reserves the right to make changes, without further notice, to any products herein to improve reliability, function, or design. Tempsens does not assume any liability arising out of the application or use of any product described herein, neither does it convey any license under its patent rights nor the rights of others.

Copyright: © 2009

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

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