



Accurate Sensors Technologies

We measure accurate temperature in extreme conditions

AST SRU FO

Non-contact Infrared Pyrometers

USER MANUAL



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Chapter - 1

General Information

Congratulations on choosing this high quality and highly efficient AST 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.

AST 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. AST 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 AST.

AST 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

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Chapter - 2

Introduction

The SRU - FO is a two channel model for measurement of refractory temperature Refractory or Wall, gas temperature and smart hybrid temperature. It is highly accurate digital Fibre Optic industrial IR Pyrometers, for non contact temperature measurement in demanding applications. Infrared Thermometry Fibre Optic Pyrometers are widely used in high ambient temperature applications without cooling and also in processes involving digital interferences. With very fast response time of 2ms to 10 sec.

2.1 Product Key Features, Application and Range

They are suitable for high temperature measurement ranging from 350°C to 2000°C.

These pyrometers have OLED display which shows temperature for Refractory, Gas Temperatures and smart hybrid temperature and provides menu selection via parameterization keys. AST SRU-FO have fast response time of 2msec. The RS-485 for long distance communication between pyrometer & PC software Infracore. Response time, emissivity, transmissivity, sub-range and peak picker selection can be preset ex-works or adjustable through available software.

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.

The pyrometer sensor detects the amount of infrared radiation emitted by the measured object (target). The infrared signal is analyzed and the temperature it represents is analyzed by built-in microprocessor. AST SRU-FO work in 4-wire technology.

The applications in which AST pyrometers can be used are

- Sulphur Recovery Units
- Thermal Oxidizer Monitoring
- Petrochemical emission
- Other High Temperature
- Monitoring Furnaces

Standard Item supplied with AST SRU FO

- AST pyrometer
- Connection cable 12-core (length - 5 m)
- Fiber Optic Cable 2.5 meter (length 5mtr., 10mtr. Optional)
- AST software CD
- Manual
- Certificate of calibration
- Explosion-Proof Certification II 2G Ex db IIB +H2 T4, IECEx, ATEX, FM (US and CDN)
- CE Certifications (EMI/RFI)

2.2 Technical Specifications

Model	AST SRU FO
Temperature Range (Analog sub-range adjustable)	350°C. 2000°C (Refractory) 350°C. 2000°C (Gas) 350°C. 2000°C (Smart Hybrid)
Distance to Spot Size Ratio	100:1 (OH-II)
Emissivity (ε)	0.1....1.0 adjustable
Transmissivity	0.1....1.0 adjustable
Response Time	2 msec adjustable upto 10 sec
Accuracy	± 0.3% of the measured value + 1°C
Repeatability	0.1% of reading in °C + 1°C
Analog Output	2 analog outputs, 0-20mA/4-20mA, for two separate channel
Digital Output	RS-485 (Isolated)
Relay Output	2 Relay output with hysteresis 60V DC / 42V AC RMS, 0.4A
Operating Temp. Range	0°C.....70°C
Storage Temp. Range	-20°C...70°C
Adjustable Parameters and Features via Software/ Keypad	Emissivity, Transmissivity, Response Time, Clear Time(Peak Picker), Analog Output, Analog Scale (Sub Range), Unit Of Temperature(°C/°F), Record feature, Match Temperature etc.
Power Supply	12V to 28V DC with reverse voltage protection
Power Consumption	Max 2.5 watt
Protection Class	Explosion Proof
Housing	Di-Cast Aluminium
Isolation	Power supply, Digital output and Analog output are galvanically isolated against each other
Operating Humidity	10-95%, Non-Condensing Conditions
Weight & Dimensions	Length: 133mm x 156.60mm

Dimensions

OH2

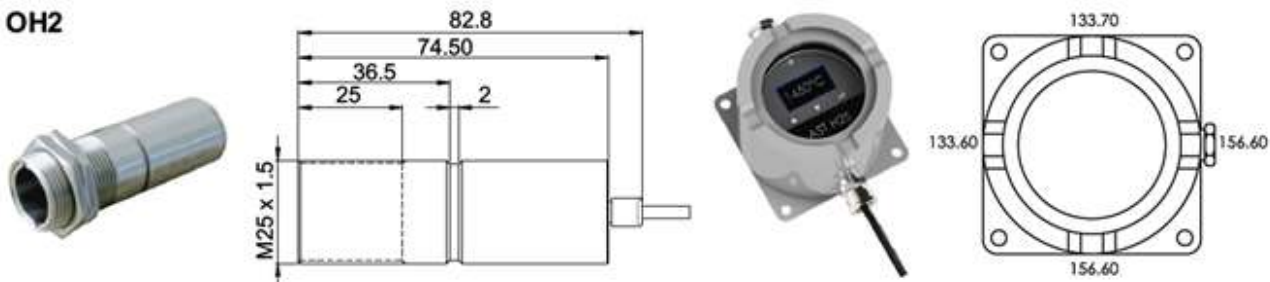


Fig. 1 AST SRU- FO

2.3 Optics

The pyrometer measure temperature by receiving heat radiation from the object whose temperature has to be measured. This heat radiation is passed through the lens sensor and then converted to an electrical signal. The farther the measured object from the pyrometer, the larger the area that will be measured.

Table 1 : Some fixed optics focus is as below

AST SRU FO	
Working Distances WD (mm)	Spot Size (mm) 350°C - 2000°C
600	6.0
1000	10.0
2000	20.0
4500	45.0
Aperture (mm)	18.0



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 14 μm depending on the material and properties of object. Infrared radiations are sometimes also referred to as “heat radiations” depends mostly on the material.

3.1.1 Emissivity (ϵ)

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 from objects which are behind the target object like heating systems, fireclay brick 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, ϵ is 1 while any real object would have ϵ less than 1. Also the transmissivity (τ) and reflectivity (ρ) is zero. The sum of absorptivity, reflectivity and transmissivity is always 1.

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

Transmissivity :

It is a measure of how much of the radiation passes through the object . It can compensate for signal loss due to external windows. Each of these parameters is a number that ranges from 0 to 1, and for any given wavelength (λ), $\alpha + \rho + \tau = 1$. Objects may have different values of each of these parameters at different wavelengths

By emissivity factor materials can be categorized as

- Metals
- Non metals
- Transparent materials

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 by pyrometer and adjust emissivity settings in pyrometer 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.

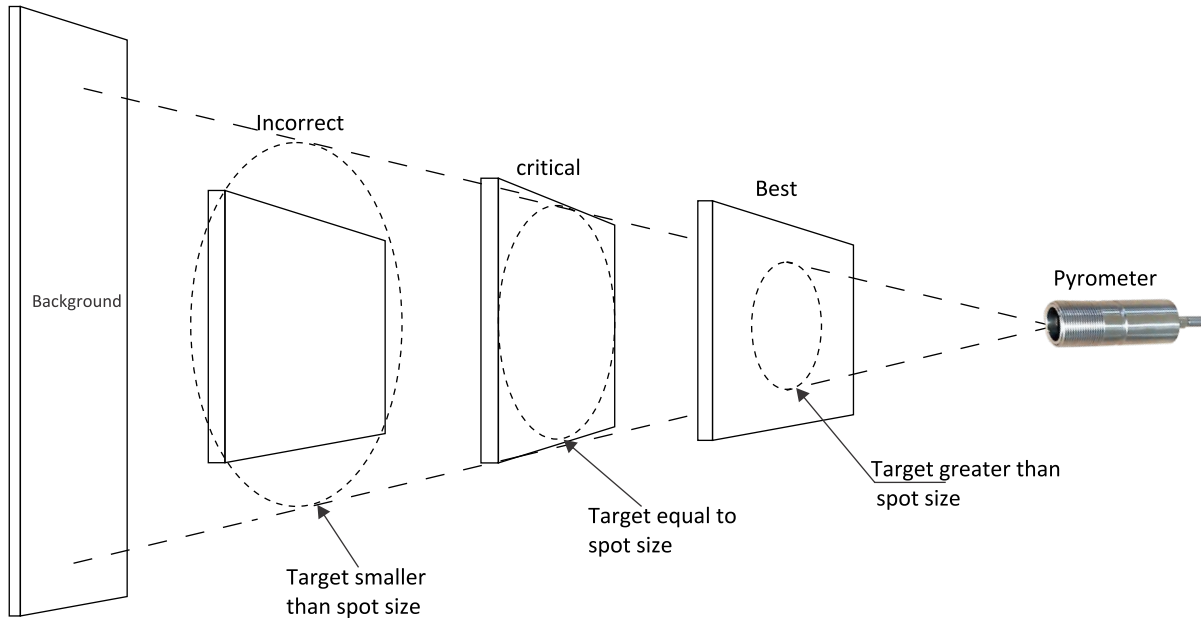


Fig.3 Proper mounting of pyrometer

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.

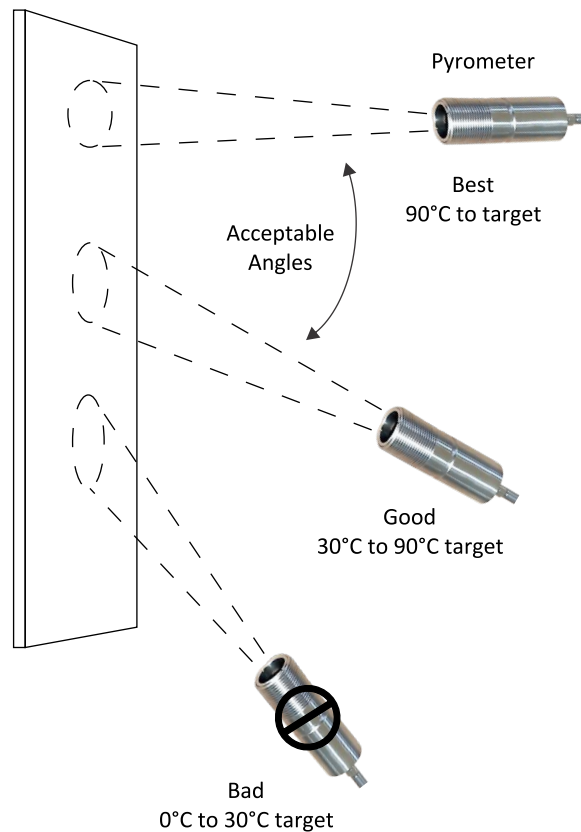


Fig. 4 Pyrometer Acceptable Viewing angles

3.2.4 Location selection

Qualified operating person 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.
2. Know your pyrometer spot size according to point 2.3.
3. Pyrometer ambient temperature should be within 0°C to 70°C.

3.2.5 Ambient temperature

The allowed operation temperature for the pyrometer is 0°C to 70°C.

3.3 Electrical Installation

3.3.1 Power Supply

24V DC (well stabilized ripple max 50mV).The input power supply is 110/230v AC check the polarity before connecting the device.



Fig. 11 12-Core Cable
(Reference no: 7002-02)



Fig. 12 Power Supply Unit
(Reference no: 9000-02)

Device has following specifications

Power supply I/P : 100 - 240VAC, 0.35A
50/60 Hz
Power supply O/P : +24V DC, 0.625A

3.3.2 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.

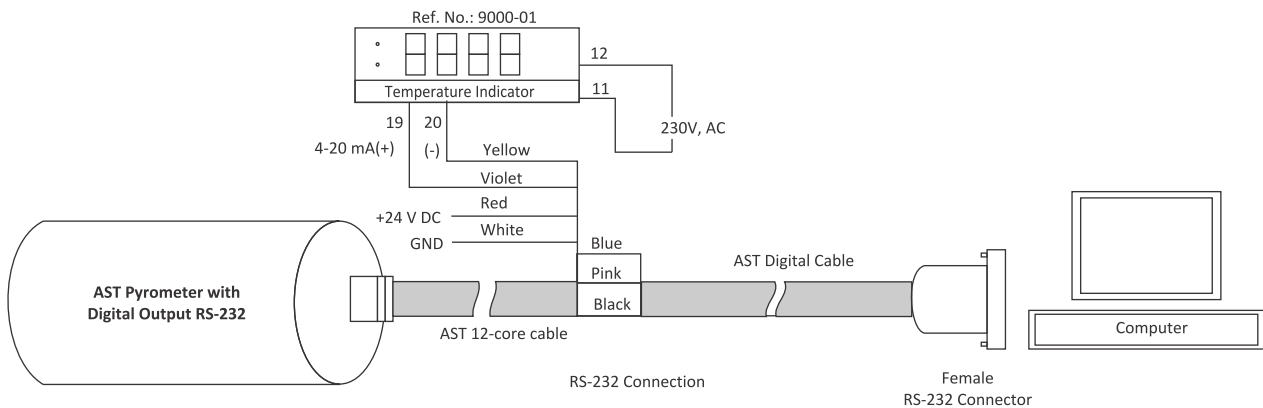


Fig. 13 Connecting pyrometer (RS-232 Converted) with computer

Table 2 : Color code & Pin specification for pyrometer connections

Colour	Indication	Used for
Red	24 V DC	Power supply
White	Ground	
Blue	D- (RS-485)	RS-485 communication
Pink	D+ (RS-485)	
Black	Relay 1- NO	Relay Terminal 1
Grey	Relay 1-CO	
Blue-Yellow	Relay 2-NO	Relay Terminal 2
Red-Grey	Relay 2-CO	
Violet	(-) 4-20mA / 0-20mA	Analog current output 1
Yellow	(+) 4-20mA / 0-20mA	
Brown	(-) 4-20mA / 0-20mA	Analog current output 2
Green	(+) 4-20mA / 0-20mA	

3.3.3 Power ON Pyrometer

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

3.3.4 Display Instrument

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



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

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

Chapter - 4

Setting at the instrument

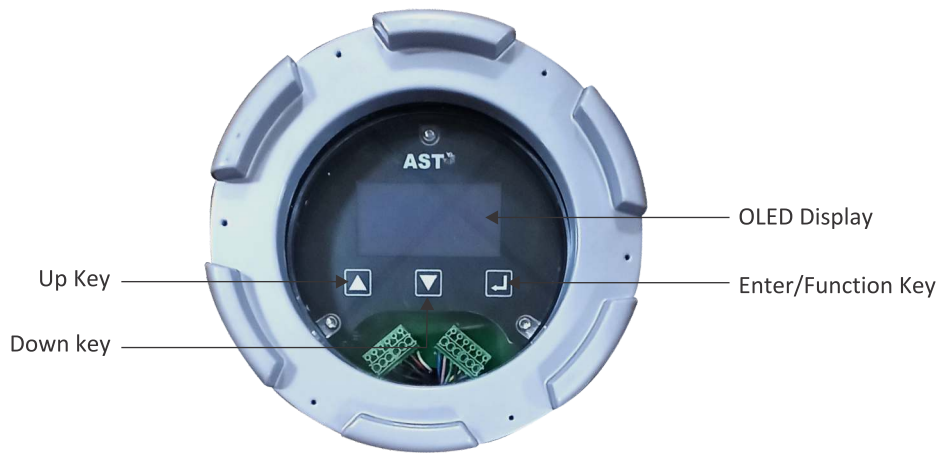


Fig. 27 Display

User can power up the unit by using connection cable at 24V DC input. After power up sensor starts an initializing routine for some seconds. After this the object temperature is shown in the OLED display.

4.1 Operation

The programming keys FUNC, UP and DOWN enable the user to set the device on-site. Normally, OLED shows temperature of any selected mode, also temperature of any two selected mode can be displayed at a time. To view parameter of Refractory or Wall (WT), Gas(GT) and Smart Hybrid Mode(AT) FUNC key is pressed. It will display the selected mode, switching between any mode is done by UP and DOWN key. To enter press the FUNC key repeatedly and to change values of parameters UP & DOWN keys are used. After changing values in any parameter by UP & DOWN key finally FUNC key should be pressed to save that value in device. Temperature selection for particular mode i.e. Refractory or Wall (WT), Gas(GT) and Smart Hybrid(AT) is done by pressing UP and DOWN key together. Press FUNC key to enter in temperature selection, choose on and off using UP and DOWN key. Now, to switch between temperature modes use UP and DOWN key. Press the FUNC key to save the selection. If FUNC key is not pressed after changing parameter value than device will automatically take the old value & device will start showing temperature. If any key is not pressed for more than 5 sec. than device will automatically shows the temperature.

4.2 Key Description

Up Key :This key changes the options to the next available value in the upward order.

Down Key :This key changes the options to the next available value in the downward order.

Enter/Function Key :This key is used for various function selection.

1. Target temperature is above the analog high range of pyrometer or target temperature is below the analog low range of pyrometer
2. Internal temperature is above ambient temperature high range of pyrometer(70°C) or internal temperature is below ambient temperature low range of pyrometer(0°C).

4.3 Adjustable Parameters

OLED Display	Parameters	Description
EMISSIVITY	Emissivity	By pressing function key emissivity will be shown. It is the relationship between the emissions of a real object and the emission of a black body radiation source at the same temperature. For a correct measurement it is necessary to adjust emissivity. Emissivity depends on the surface condition of the material, the spectral range of the pyrometer and the measuring temperature. Different material has different emissivity ranging from 0.1 to 1.0. User can change emissivity by up/down key on the instrument.
TRANSMITY	Transmissivity	By pressing function key transmissivity will be shown. It can compensate for signal loss due to external windows. For a correct measurement it is necessary to adjust transmissivity. Transmissivity depends on the spectral range of the pyrometer and the measuring temperature. Different material has different transmissivity ranging from 0.1 to 1.0. User can change transmissivity by up/down key on the instrument.
RESPONSE TIME	Response Time	The response time can be set from 2 msec to 10sec. (Applicable for all Modes)
ANA. LOW	Ana. Sub range Lo	Analog sub-range is adjustable within the basic range, user can set lower analog sub-range here. (Applicable for all Modes)
ANA. HIGH	Ana. Sub range HI	User can set the analog sub-range higher value here. Minimum span between lower & higher value is 51°C (Applicable for all Modes)
ANA. O/P1 ANA. O/P2 ANA. O/P	Analog Output	User can select the output from 4...20mA or 0...20mA (Applicable for all Modes)
SET PNT.1 SET PNT.2 SET POINT	Set Point	Instrument is equipped with a relay contact controlled by the measuring signal. The turn on temperature of relay is adjusted within the measuring range. The relay contact is "OPEN" below the adjusted value, it is "CLOSE" above it. (Applicable for all Modes)
HYST.1 HYST.2 HYSTERESIS	Hysteresis (Hyst.)	The relay contact close when temperature exceeds the set point. It opens only if the temperature falls below a value which consists of set point and the adjusted hysteresis. It can be adjusted from 2° to 20°C. (Applicable for all Modes) Example : if set point value is 900°C and Hysteresis set to 10. Then relay operation as below mentioned: 1. Relay contact OPEN below 910°C temperature. 2. Relay contact CLOSE above 910°C temperature. Once relay contact CLOSED than relay contact is OPEN's when temperature falls below 890°C

OLED Display	Parameters	Description
PICKER (i)AUTO (ii)CLEAR TIME	Peak Picker	<p>The peak picker can be switched ON & OFF by using up down key. If the peak 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.</p> <p>Definition of auto and TCL to be copied from other manual.</p>
UNIT	Temp. Unit	User can select °C or °F unit.
ADDRESS	Sensor Address	For communicating with pyrometer via software users have to give an address. The address may be 1 to 255.
INT. TEMP	Internal Temperature	It shows the internal temperature of pyrometer.
OLED OFF	OLED OFF Time	<p>The User can set OLED OFF time from 1 min. to 30 min. or continue ON. If user select OFF time as 1 min., then OLED display will turn ON till 1 min. and after 1 min. OLED display will turn OFF(Only OLED display will turn OFF, Pyrometer is ON.)</p> <p>By pressing any key, OLED will resume again with display. If user select continue ON option, then OLED display is continues.</p>

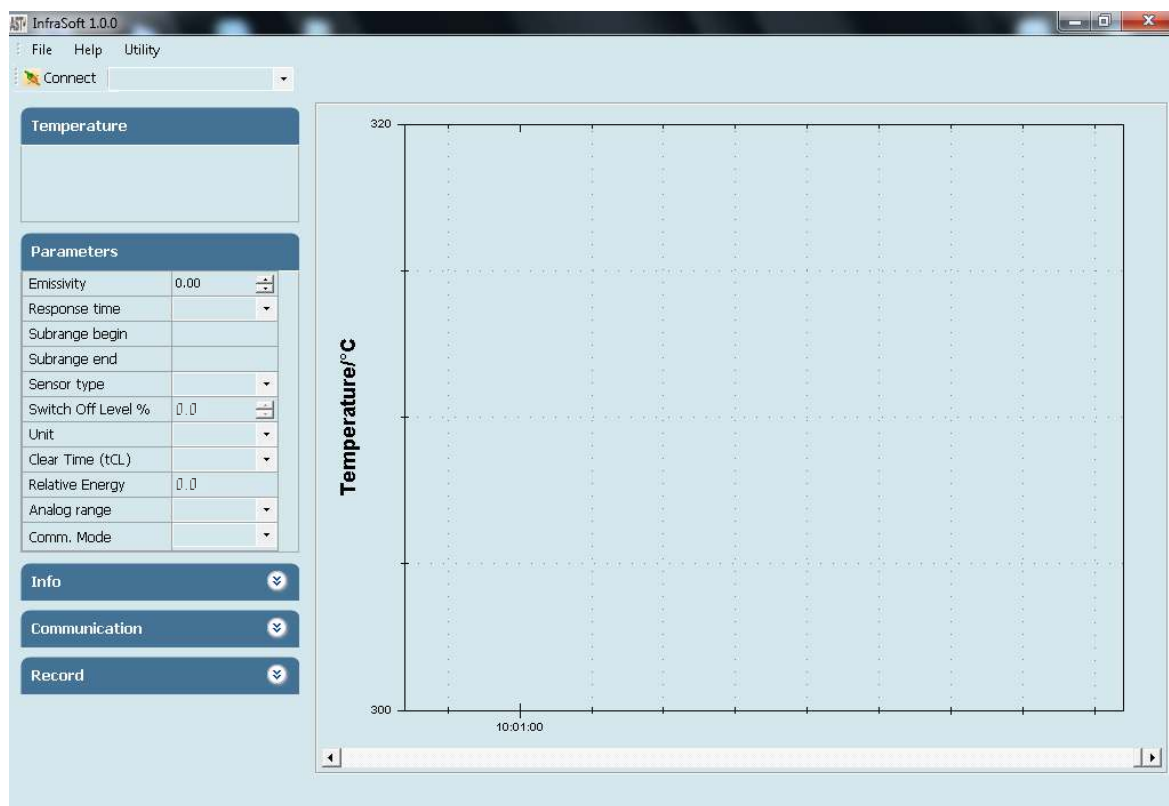
Chapter - 5

Software Installation

AST infrasoft 1.0.1 provides facility to set all the parameters like response time, analog scale, emissivity, transmissivity, clear time, communication mode. This software provide all necessary information about pyrometer.

5.1 Installation

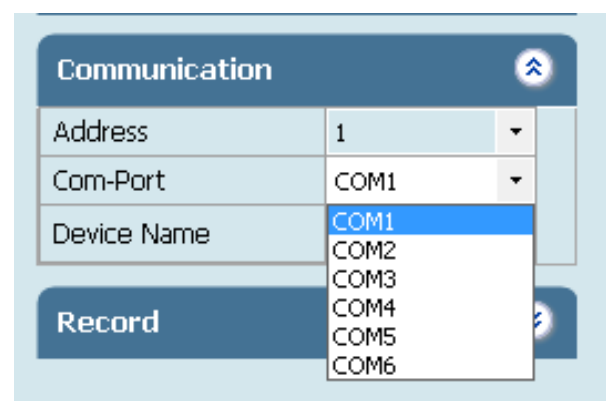
Install the pyrometer software using the installation guide file on CD ROM & restart your PC as per guidelines provided for installation. After installation of the software; Double click the application. It will open the screen of software.



5.2 Parameters in main screen

5.2.1 Communication

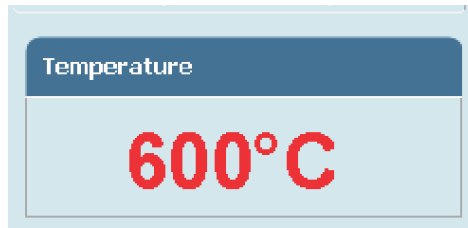
Communication between the AST pyrometer and the software is implemented via a cable connected between the pyrometer and the PC serial port. This enables the acquisition and recording of data, as well as the transfer of commands from the software application to the AST pyrometer. Communication can be done by clicking on "Communication panel" and select correct COM Port address where pyrometer is connected. Also user has to select address of the pyrometer(Example: Default 01/ printed on the pyrometer sticker). Then click on CONNECT Button.



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

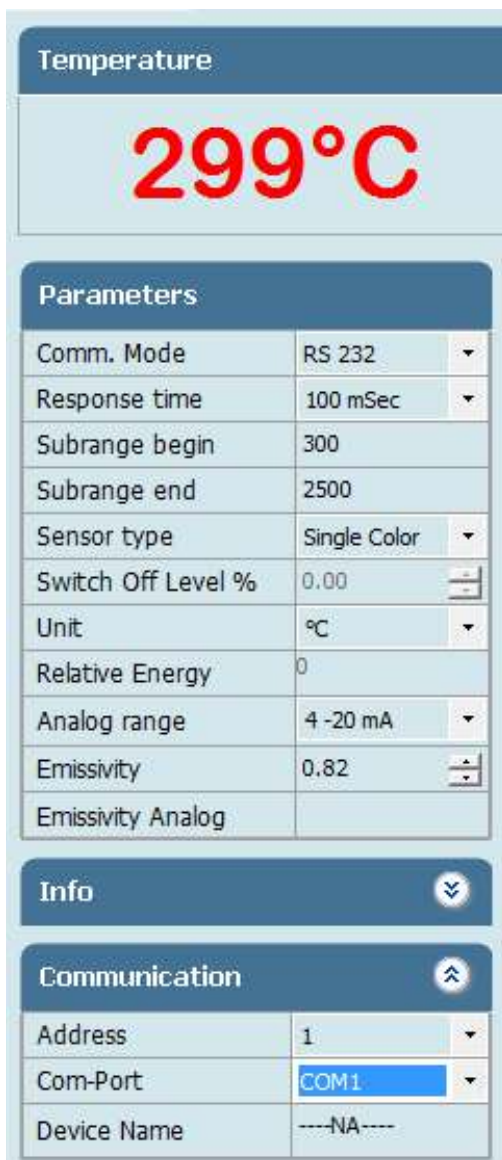
5.2.2 Temperature

It shows the temperature measured by the pyrometer



5.2.3 Parameter Setting

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



(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 "TAB " 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 "TAB" button.

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

(E) Peak PickerPicker If the peak 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.

Peak picker can be turn ON & OFF by using the software.

(E1) 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.

(E2) 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.

(E3) Analog Range User can select the analog range from the option 4-20mA, 0-20 mA.

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

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.

5.2.4 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-aperture.

Info	
Model	AST A250 TL
Basic range	300°C ...1300°C
Serial number	849
FW Version	11.25
Head Temp.	0°C
Internal temp.	30°C
Working Dist. (mm)	300
Spot Size-Aprt. (mm)	2-5

5.2.5 Record

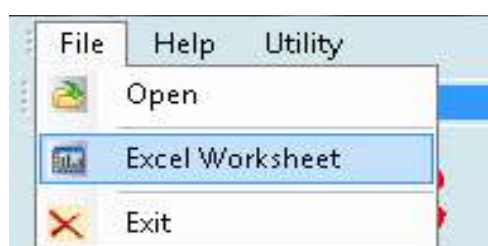
Record is for continuous data logging. It records the measured temperature, emissivity with current date & time. To start data logging click on start button. If user wants to record emissivity, click on record emissivity button. After Clicking Start button window appears where user can specify the file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



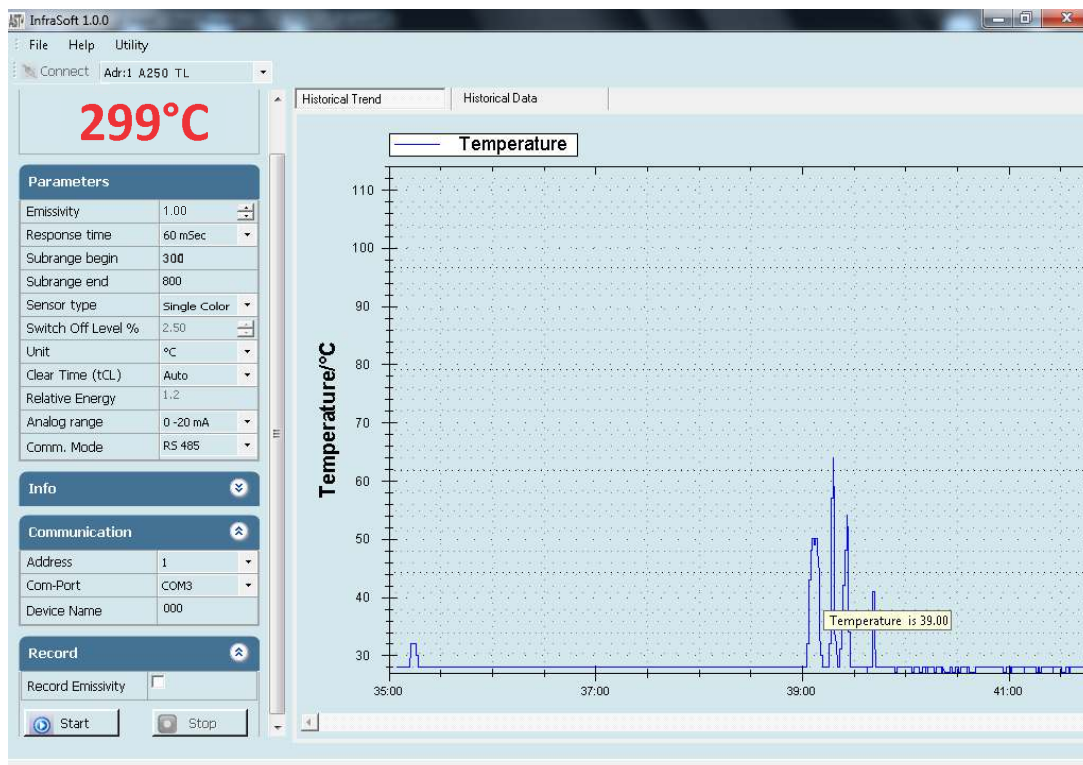
If user wants file in Spreadsheet format, user can export by choosing Excel Spreadsheet in file menu.

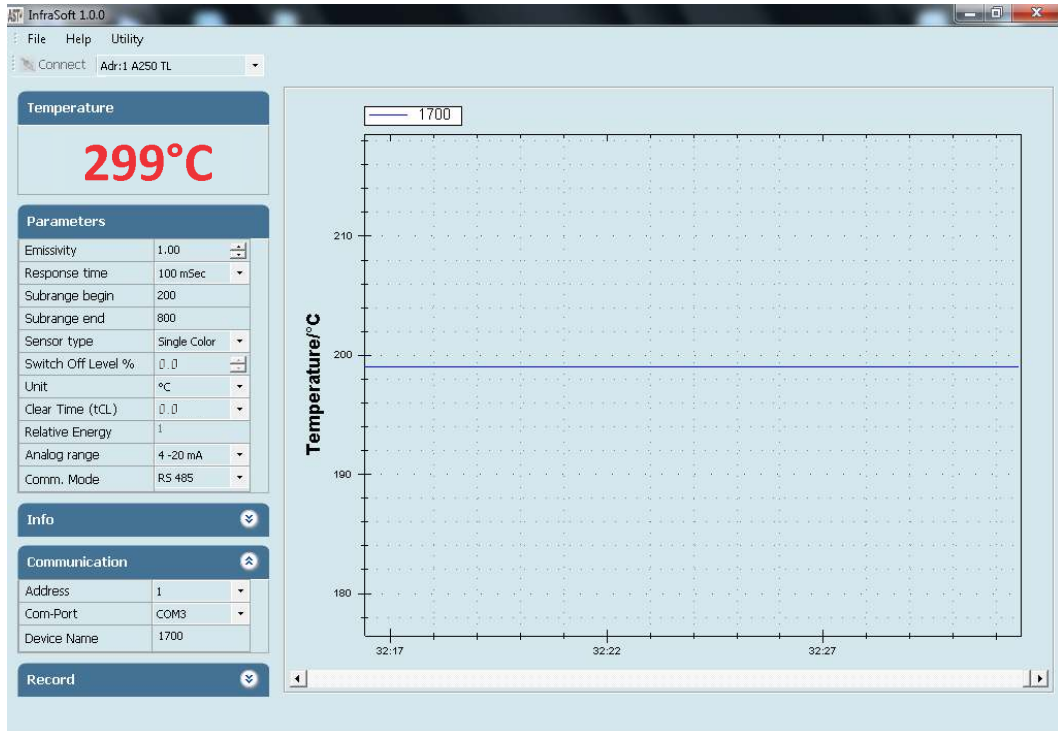


File will be stored in **.xls** format named as “export”. This “export.xls” file will be saved where the software is installed.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	DATE	TIME	TEMPERATURE	EMISSIVITY										
2	15/11/13	03:35:05 PM	28°C	X										
3	15/11/13	03:35:06 PM	28°C	X										
4	15/11/13	03:35:06 PM	28°C	X										
5	15/11/13	03:35:06 PM	28°C	X										
6	15/11/13	03:35:06 PM	28°C	X										
7	15/11/13	03:35:06 PM	28°C	X										
8	15/11/13	03:35:06 PM	28°C	X										
9	15/11/13	03:35:06 PM	28°C	X										
10	15/11/13	03:35:06 PM	28°C	X										
11	15/11/13	03:35:06 PM	28°C	X										
12	15/11/13	03:35:06 PM	28°C	X										
13	15/11/13	03:35:06 PM	28°C	X										
14	15/11/13	03:35:06 PM	28°C	X										
15	15/11/13	03:35:07 PM	28°C	X										

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

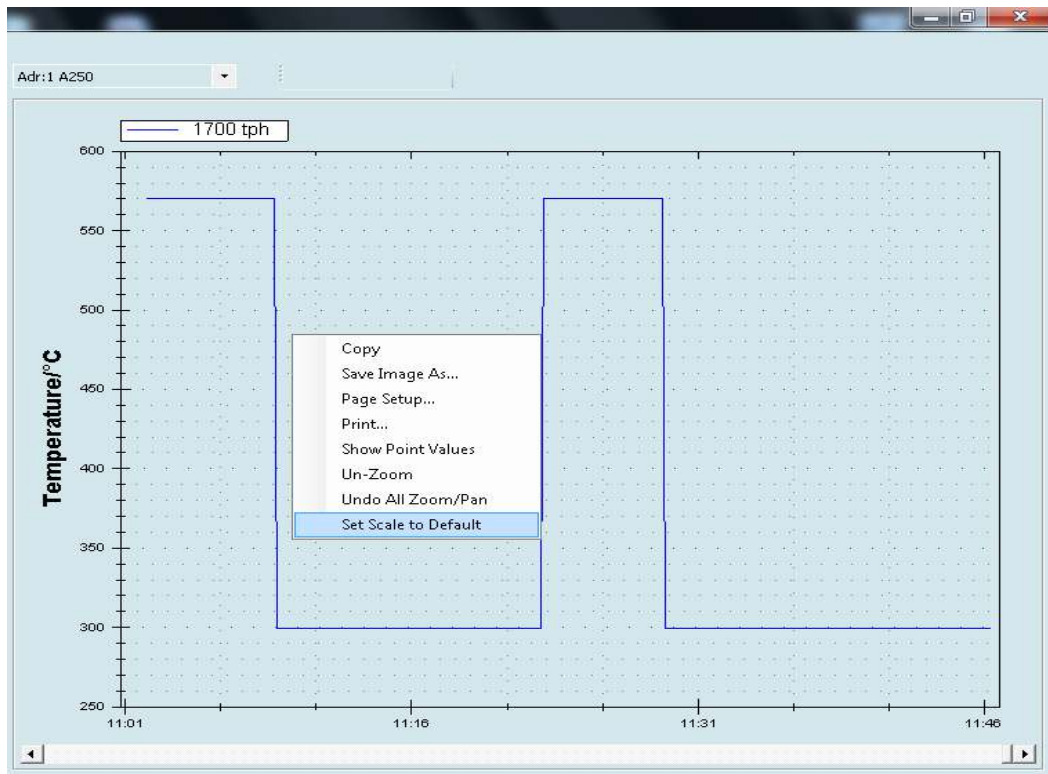




Temperature graph of connected pyrometer is displayed on right side of the screen. This shows the measured temperature corresponding to the time.

Note:

After connecting the pyrometer right click on the graph screen and choose "Set to default" option from pop-up menu.



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

SRU FO 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

AST 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

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ABOUT US

AST - Accurate Sensors Technologies

Accurate Sensors Technologies along with 3T - True Temperature Technologies established in 1994 focusing on the development and commercialization of non-contact temperature measurement technologies.

Based on these technologies, AST/3T has brought to the market a line of pyrometers for the remote measurement of target temperatures using no physical contact. AST/3T pyrometers use a totally new approach for remote temperature measurement achieving high accuracy.

The following products are available from AST/3T

- ❖ Single color pyrometer
- ❖ Ratio (2 color) pyrometer
- ❖ Fiber optics with single color and two color pyrometer
- ❖ Multi wavelength pyrometer specially for Aluminum & other Non - ferrous application
- ❖ Black Body calibration sources
- ❖ Special system for automatic Isothermal Extrusion (MOMAS)
- ❖ Parameter setting Devices



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