AST

CE

Accurate **S**ensors **T**echnologies

We measure accurate temperature in extreme conditions

AST T3-814

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

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

Chapter - 2
Introduction

AST T3-814 are specially designed highly accurate digital pyrometers to provide high performance and low maintenance of non contact temperature measurement in demanding industrial environment.

2.1 Product Key Features, Application and Range

The AST T3-814 pyrometers are especially designed for industrial purposes. They are suitable for high temperature measurement ranging from 0°C to 1000°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.

AST T3-814 both are having a fast response time of 60msec. The Pyrometer provided with Infralink (USB Interface) for communication between pyrometer & PC software Infrasoft. Response time, sub-range and peak picker selection are 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 micro controller. AST T3-814 work in 2-wire technology.

Features

- ✓ Two wire technology for easy electrical connection
- ✓ Wide temperature range 0°C....1000°C
- ✓ Spectral range 8....14 µm
- ✓ Laser Light for precison targeting of the measuring object
- ✓ 60 ms response time adjustable upto 10 sec
- ✓ Analog output 2 wire....4-20 mA (Isolated)
- ✓ Digital TTL output & Infrasoft software
- ✓ Small spot sizes
- ✓ Emissivity can be adjusted directly at device
- ✓ Accessories for mounting and cooling options

The applications in which AST pyrometers can be used are

- ✓ In glass hardening and bending
- ✓ Temperature measurement of float glass

Standard Item supplied with AST T3-814

- ✓ Pyrometer with 3 mtr. long connection cable
- ✓ Analog output 2 wire....4-20 mA
- ✓ Emissivity adjustable switch
- ✓ TTL output
- ✓ Calibration certificate, Operation manual

Optional

- ✓ Extra cable lengths
- ✓ Mechanical and Electrical Accessories
- ✓ USB Interface card & PC Software

2.2 Technical Specifications

Model	T3-814 PL
Temperature Range (Analog sub-range adjustable)	0°C....1000°C 75°C...1000°C
Spectral Range	8 µm...14 µm
Photodetector Type	Thermopile
Distance to Spot Size Ratio	50:1 100:1
Emissivity (ε)	0.1....1.0 adjustable
Response Time	60 msec adjustable upto 10sec
Accuracy	T < 200°C; ± 1.5% of measured value or 3°C whichever is greater T ≥ 200°C; ± 1% of measured value or 4°C whichever is greater (The instrument must be at constant ambient temperature for minimum 25-30 mins in power on condition)
Repeatability	0.3% of reading in °C + 1°C
Sighting Option	Laser Pilot Light (PL)
Analog Output	2 wire....4-20mA Linear Temperature Output Load : Max 500Ω at 24V DC, Max 200Ω at 18V DC
Digital Output	TTL
Operating Temp. Range	0°C.....70°C 0°C.....200°C (With water cooling jacket)
Storage Temp. Range	-20°C...70°C
Adjustable Parameters and Features via Software	Emissivity, Response Time, Analog Scale (Sub Range), Unit of Temperature (°C/°F), Peak Picker, Valley Picker
Power Supply	24 V DC (5 to 25 V DC for Laser Targeting light (I≤30 mA)
Power Consumption	For Laser Targeting Max 0.65 watt For Device Max 0.6 watt
Laser Power	<1 m watt
Protection Class	IP65
Housing	Stainless Steel
Operating Humidity	10-95%, Non-Condensing Conditions
Weight & Dimensions	250g Dia=Ø40mm; Length=113.5mm

Dimensions of Pyrometer (mm)

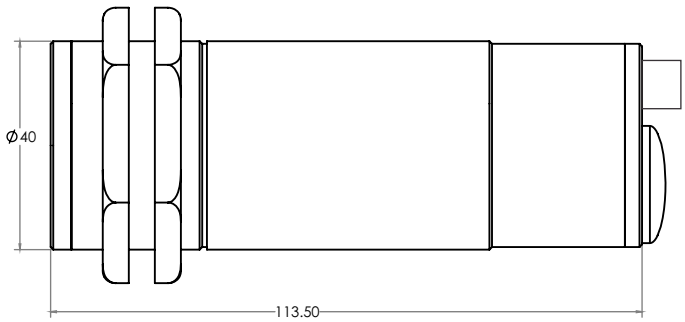
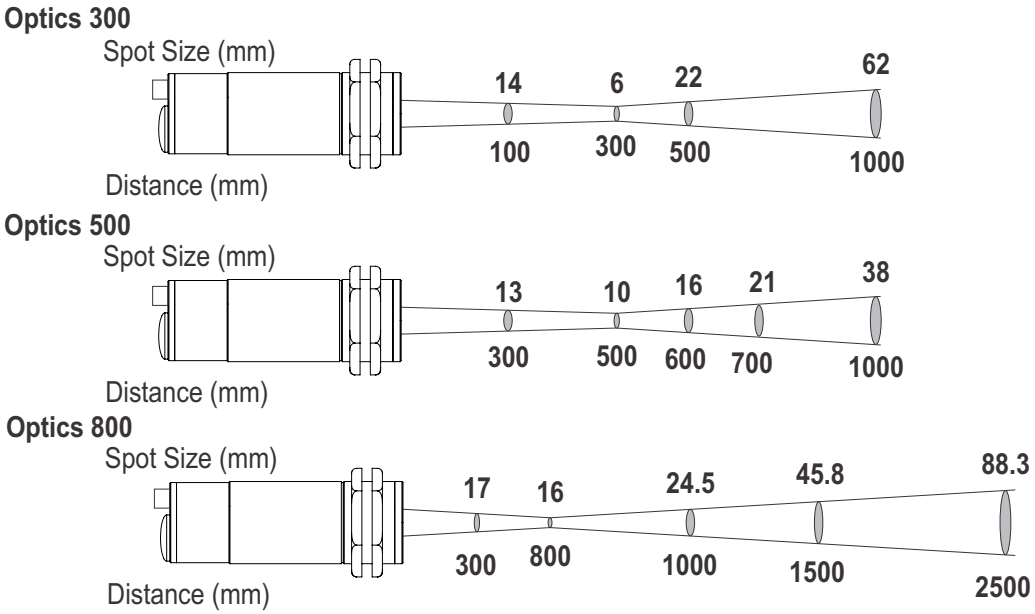


Fig. 1 Dimensions of pyrometer

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 is from the pyrometer, the larger the area that will be measured by the pyrometer. Depending on customer need, the pyrometer is designed with fixed optics.

Table 1 :Some fixed optics focus is as below



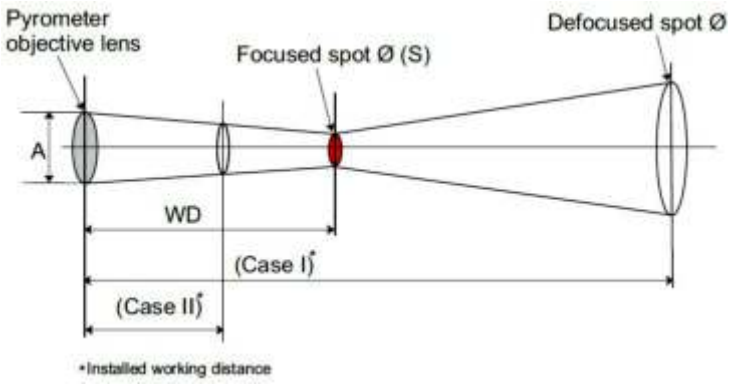


Fig. 2 Spot Size

* Manufactured working distance (WD) mentioned on the pyrometer.

If the pyrometer is not installed at manufactured working distance (WD) then spot size at actual installed distance should be calculated. For example, if factory made working distance is 500 mm & pyrometer is AST T3-814PL (0 - 1000°C) then spot size is 5mm (as given in table). If user installed this pyrometer at 1000mm then spot size is not 10mm (as given in table), user should have to calculate it by below given 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 of lens opening (aperture in mm)

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 8.0µm 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. 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.

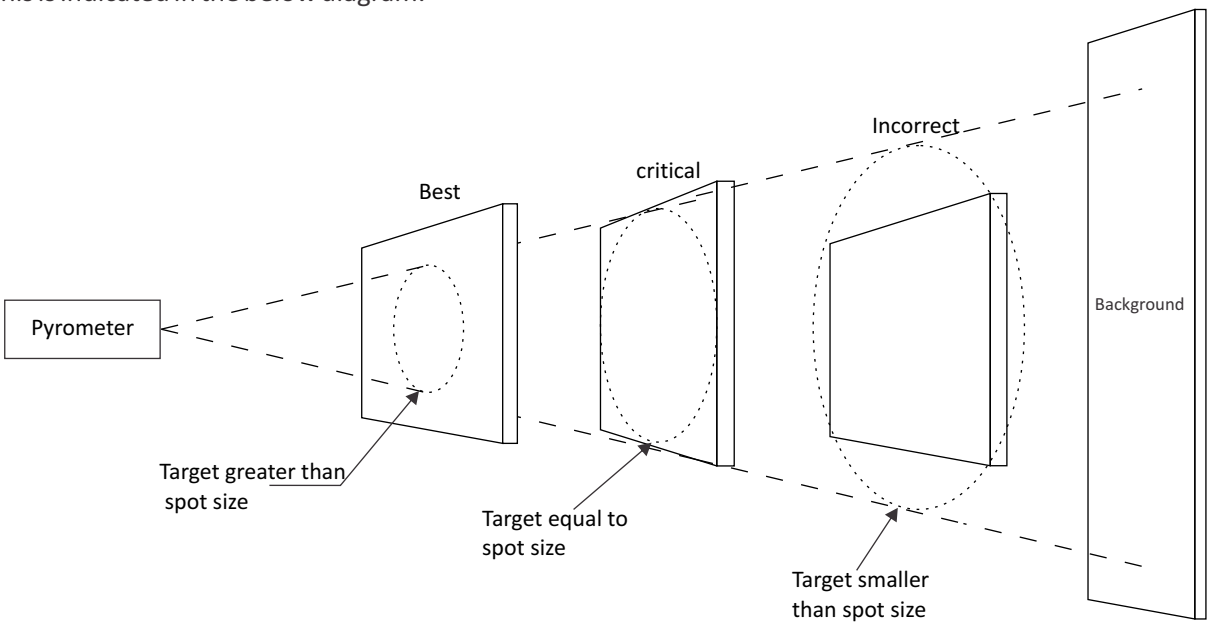


Fig.3 Proper mounting of pyrometer

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.

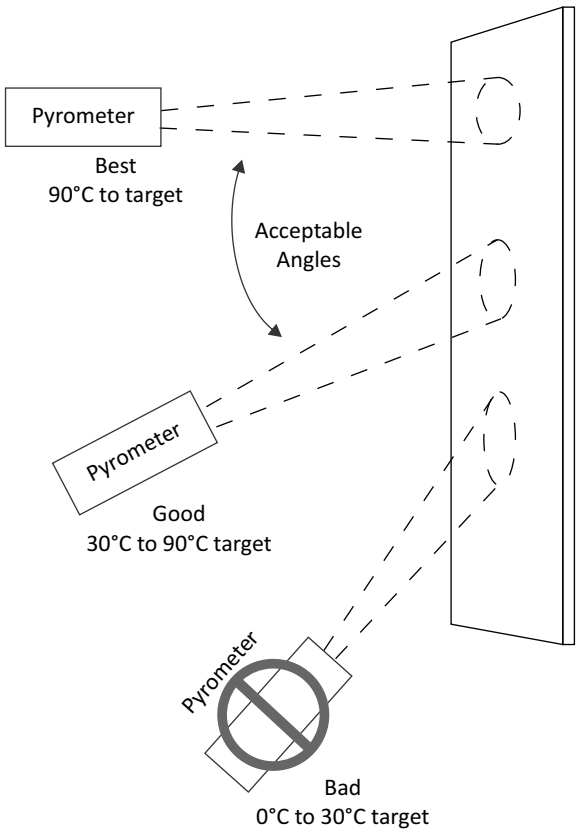


Fig. 4 Pyrometer Acceptable Viewing angles

3.3 Location Selection

Qualified operating 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.(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 mounted 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 Water Cooling Jacket

This accessory is very important in order to use pyrometer at higher temperature. A normal pyrometer can withstand a temperature of 0-70°C. For higher temperature applications the device must be used with water cooling jacket upto 200°C.(for mechanical drawing refer Appendix C.)

- Water pressure : < 10 bar
- Air pressure : < 0.5 bar
- Air consumption : 2...3 m³/h
- Ambient temperature : < 200°C
- Metal : Stainless steel
- Weight : 2.75 Kg

Fig. 5 Water Cooling Jacket (air purge, mounting clamp, water jacket combo) (Reference no: 8700-02 (for PL)

3.4.2 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.)

- Air pressure : < 0.5 bar
- Air consumption : 2...3 m³/h
- Metal : SS-304
- Weight : 0.15 Kg
- Dry, clean air (Oil and dust free)

Fig. 6 Air Purge Unit (Reference no: 8700-01)

3.4.3 Adjustable mounting stand

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

- Metal : Stainless Steel
- Weight : 0.9 Kg

Fig. 7 Adjustable Mounting Stand (Reference no: 8000-07)

3.4.4 Mounting Clamp

Mounting clamp can be used to hold the pyrometer.(for mechanical drawing refer Appendix C.) Fig. 8.

- Metal : Stainless Steel
- Weight : 0.45 Kg

Fig. 8 Mounting Clamp (Reference no: 8500-04)

3.4.5 Aluminum Jacket

- Metal : Aluminium
- Weight : 0.2 Kg

Fig. 9 Aluminum jacket (Reference no: 8700-01)

3.4.6 Combination of Accessories

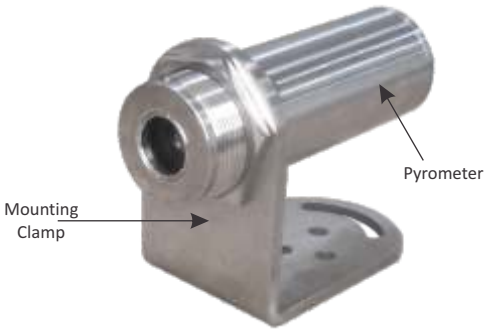


Fig. 10 Mounting Clamp + Pyrometer
(Reference no: 8500-04)

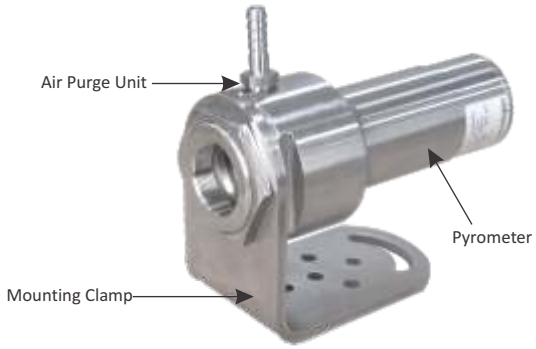


Fig. 11 Air purge unit + Mounting Clamp + Pyrometer
(Reference no: 8700-01 + 8500-04)

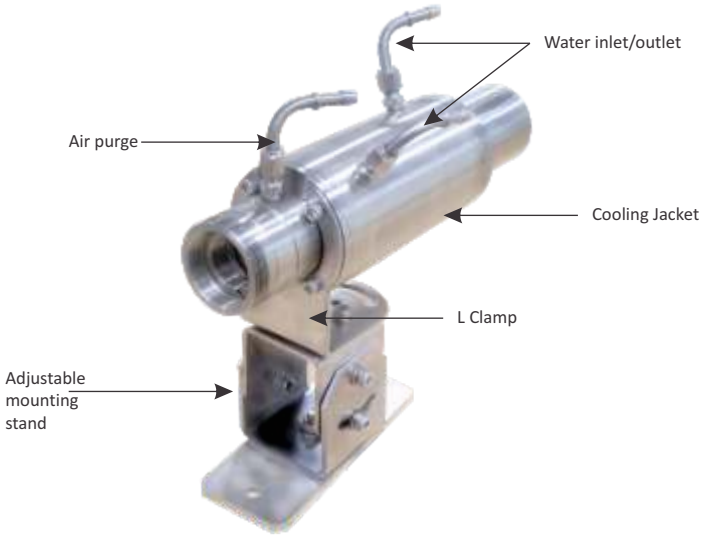


Fig. 12 Adjustable Mounting Stand + L Clamp + Water cooling jacket with air purge
(Reference no: 8000-02 or 8000-06 + 8700-02)

3.5 Electrical Installation

3.5.1 Power Supply

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

Device has following specifications

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

Fig. 13 Power Supply Unit
(Reference no: 9000-02)

3.5.2 Temperature Indicator

Fig. 14 Temperature Indicator
(Reference no: 9000-01)

3.5.3 Wire connections of Pyrometer

Following diagram & table shows proper wiring connection.

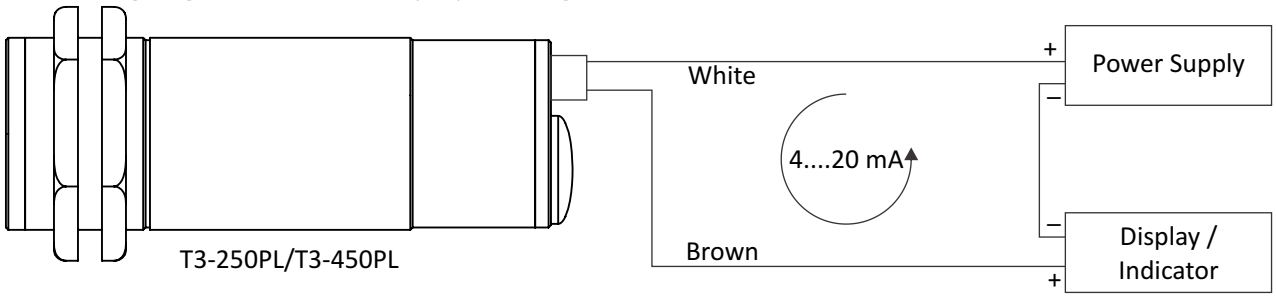


Fig. 15 Connecting pyrometer with supply and display / indicator

Table 2 : Color code

COLOR	INDICATION	DESCRIPTION
White	+24 VDC	Power Supply
Brown	Ground (Power Supply)	
Black	Shield	
Orange	TXD	TTL Communication
Red	RXD	
Blue	Ground (Communication)	
Green	+5 VDC to +25 VDC	Laser ON /OFF
Yellow	Ground (Laser)	

Note : Each Ground is Different, Don't Make Common

3.5.4 Seven Pin Binder Connector

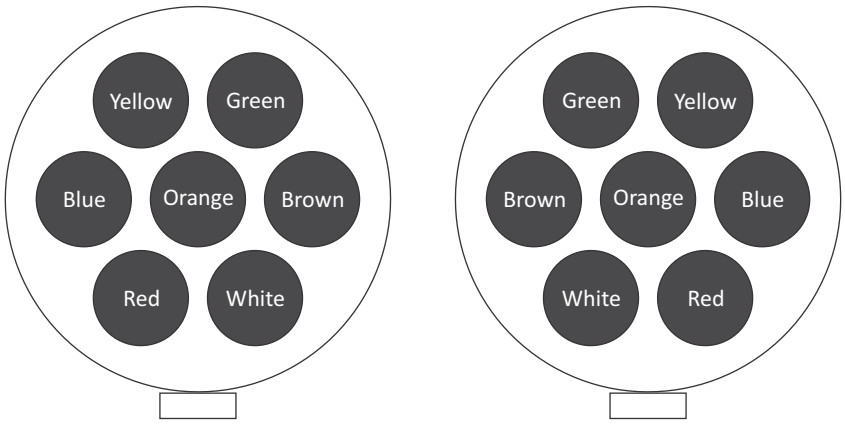


Fig. 16 Seven Pin Binder Connector

3.5.5 Power ON Pyrometer

1. Connect the 7-core (7 core + Shield(Black)) cable connector (Supplied with pyrometer) with pyrometer 7-pin binder connector given at the back side of pyrometer.
2. Connect the 7-core (7 core + Shield(Black)) 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 7-core (7 core + Shield(Black)) cable.
5. Now, the pyrometer can be switch ON.

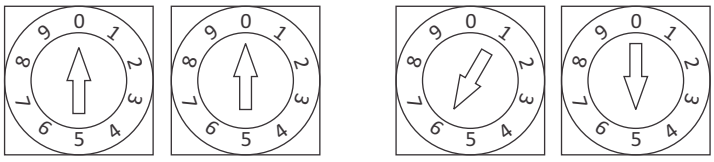
3.5.6 Emissivity Settings of Pyrometer

The exact emissivity should be known to measure accurate temperature of the object. The emissivity is the ratio between the level of radiation from an object and level of radiation from a black body at the same temperature. Different material have different emissivity ranging from 0.01 to 1.00(or 0% to 100%). Material which reflect more radiation have a lower emissivity and if the material is acting like a black body than the value of emissivity will be Ɛ = 1.00 means the material absorb all the incoming radiations.

Factory Settings:

Ɛ = 1.00 (Switch Setting :00)

Example to set emissivity on signal processor
adjust the emissivity Ɛ, by both switches as shown in the example. Emissivity can be adjusted between 0.01 & 1.00 in increments of 0.01.



Ɛ = 1.00 or 100% Ɛ = 0.65 or 65%

Note : The settings 00 read as Ɛ=1.00 or 100%.

3.5.7 InfraLink USB Interface (With PC software)

Fig. 17 Infralink USB interface
(Reference no: 9000-07)

The pyrometer can communicate with PC using Infralink USB interface.

3.5.8 Connecting Pyrometer with PC

In order to connect pyrometers with computer orange wire should be connected to 2nd pin, red wire to 3rd pin and blue wire to 4th pin of infralink USB interface.

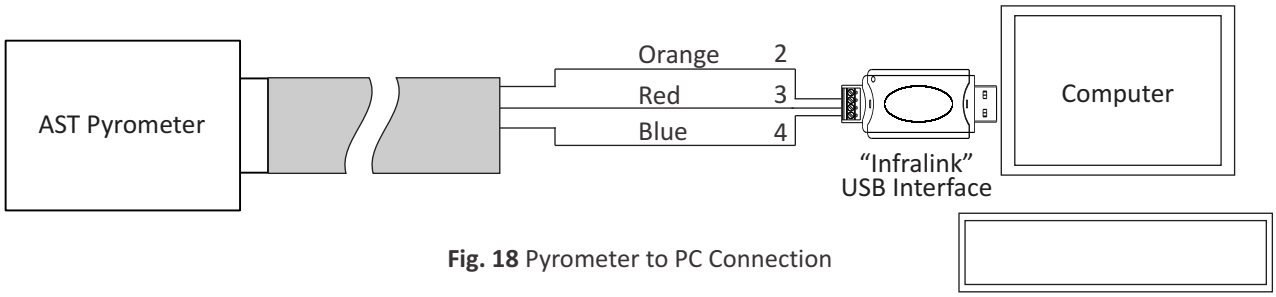


Fig. 18 Pyrometer to PC Connection

Fig. 19 Temperature Indicator
(Reference no: 9000-01)

3.5.9 Display Instrument

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

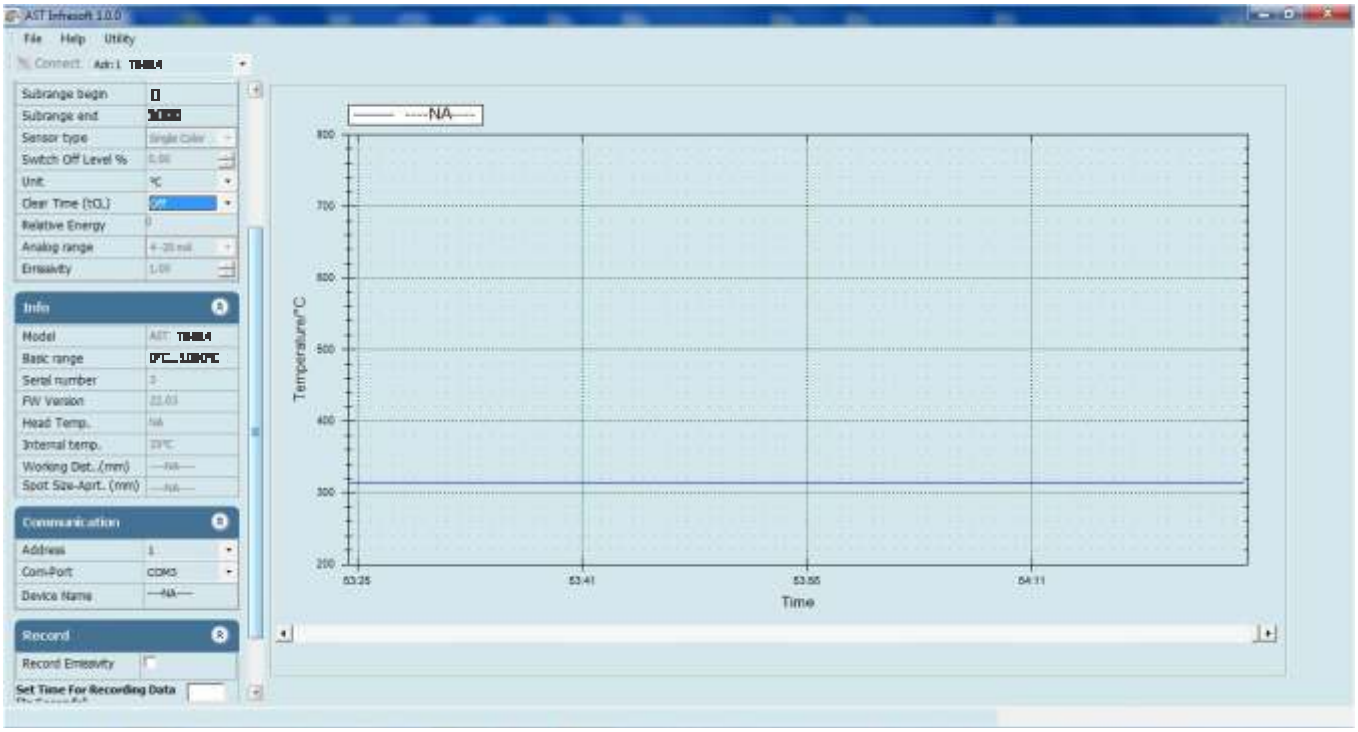
Power supply I/P	:	100 to 240 V, AC/DC
Analog I/P	:	4....20 mA
Retransmission	:	4....20 mA
Power supply O/P	:	24V, DC
Display	:	4 Digits
Alarm	:	2

Chapter - 4
Software Installation

Using AST software(Infrasoft) user can set all the parameters like response time, clear time, communication mode. This software provide all necessary information about pyrometer.

4.1 Installation

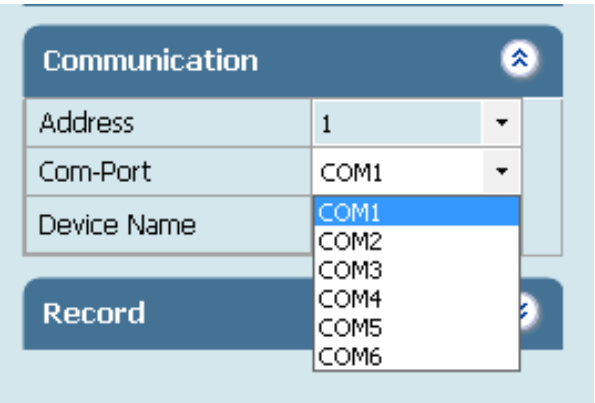
Install the pyrometer software using the installation guide file on CD ROM & restart your PC as per guidelines provided for installation. After installation of the software; Double click the application. It will open the screen of software.



4.2 Parameters in main screen

4.2.1 Communication

Communication between the AST pyrometer and the software is implemented via a infralink USB interface. 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.



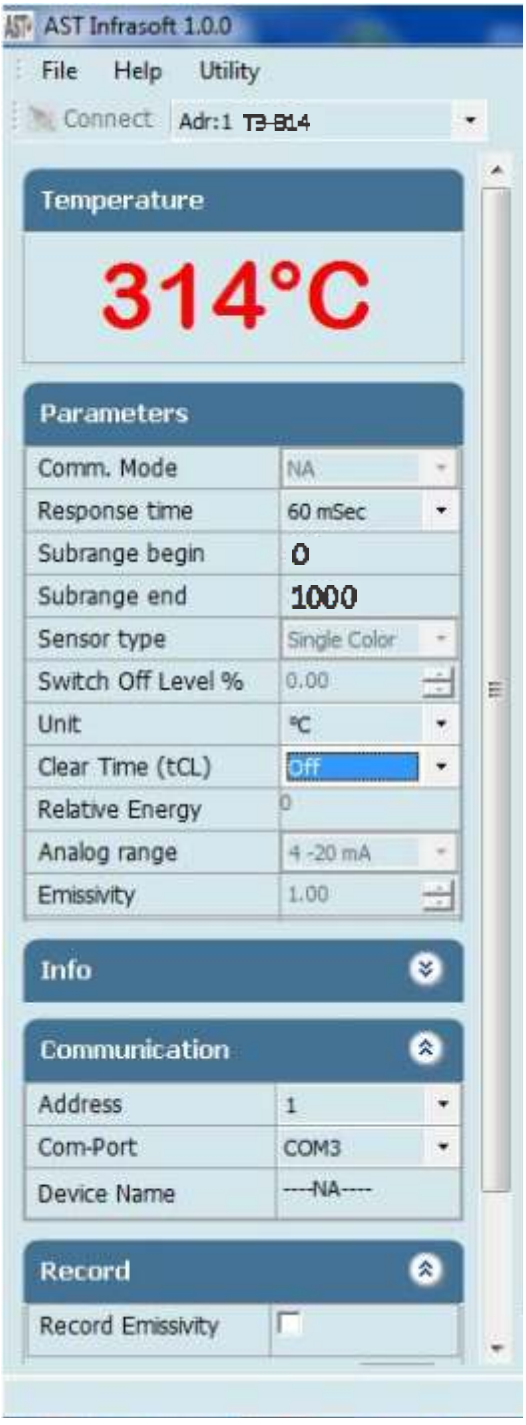
For communication of multiple pyrometers, select different com port and address.

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"



(A) 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 from 60msec. to 10sec.). This parameter is use to set the analog response time of pyrometer.

(B) 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.

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

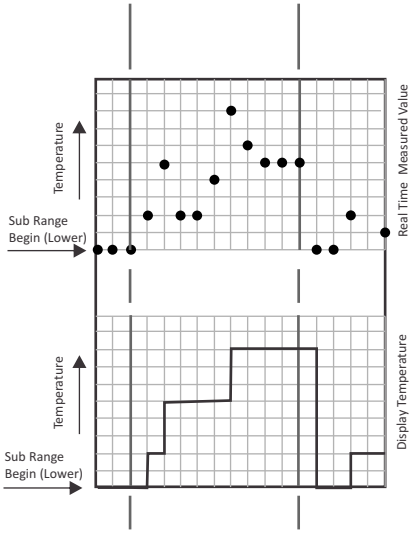
(D)Clear time (tCL) This feature is particularly useful when object temperature is not uniform across its dimension or the pyrometer is not constantly viewing an object to be measured. There are three options available in this function :

1. OFF
2. Peak
3. Valley

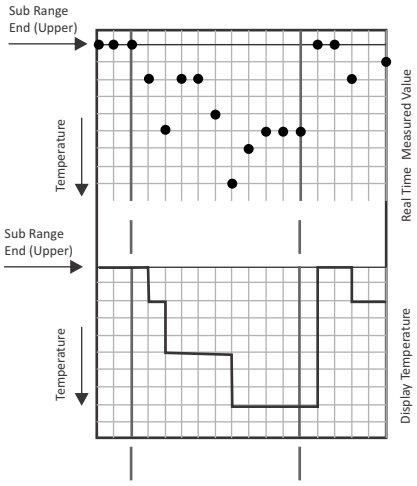
OFF : At clear time “OFF” the maximum value storage is switched off and only real time values are measured.

Peak-Picker:

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 & it will reset whenever the pyrometer goes outer(below sub range begin(lower)) the measuring range of temperature.



Valley : This function works similar to peak picker, except that it will search the signal for a minimum value & it will reset whenever the pyrometer goes outer(above sub range end(upper)) the measuring range of temperature.



(E) Emissivity settings This parameter is not adjustable by software. This can be manually adjusted in device itself by using rotary switches as per requirement. For manual settings of emissivity of device refer section 3.5.5. The emissivity value which is manually set by rotary switches will be shown in software.

4.2.4 Device information

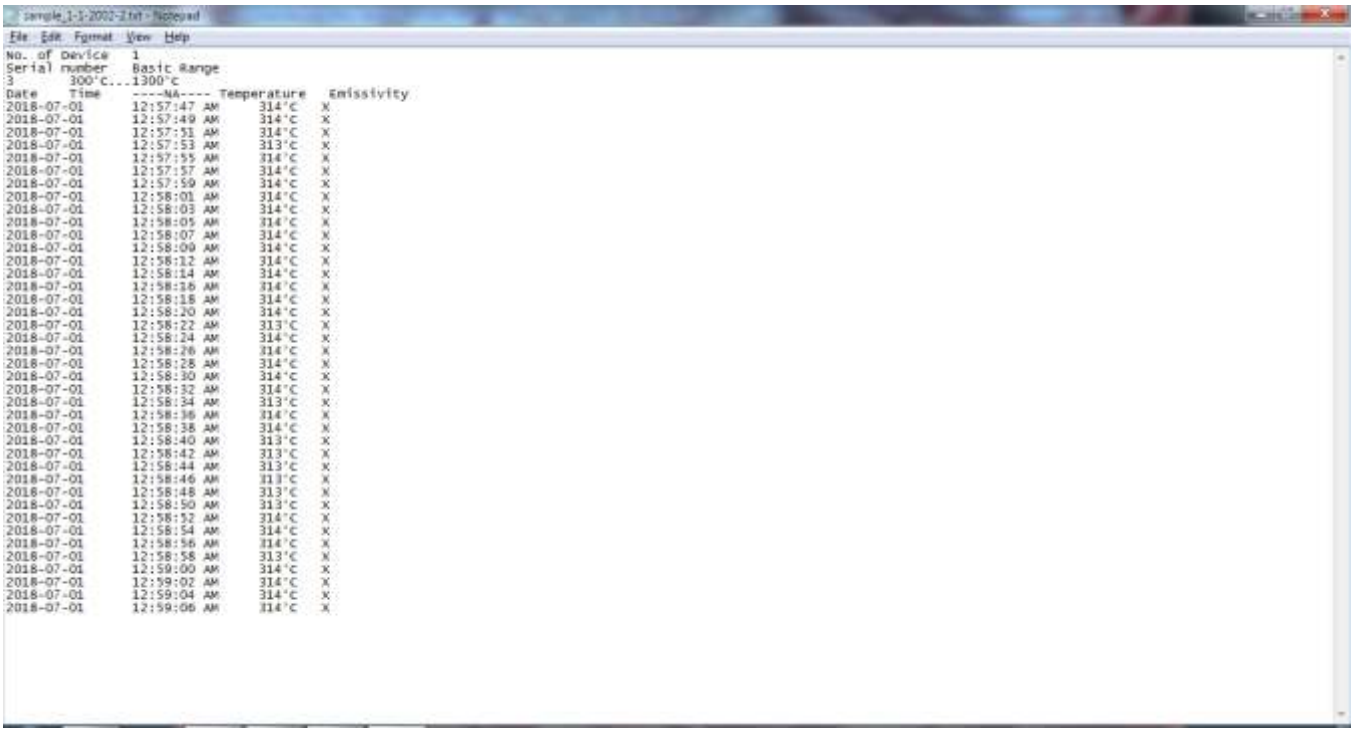
Pyrometer specific information will be displayed in the Info Panel

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

4.2.5 Record

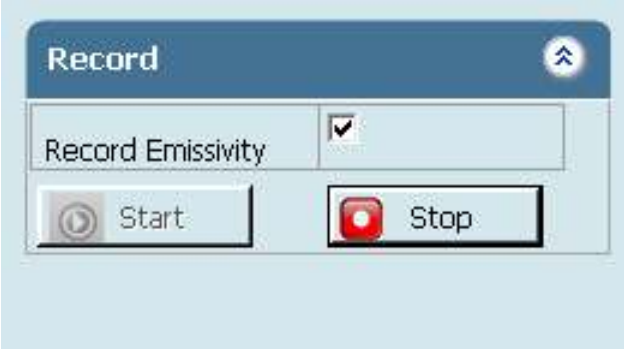
Record is for continuous data logging. It records the measured temperature, emissivity with current date & time.To start data logging click on start button. If user wants to record emissivity, click on record emissivity button. After Clicking Start button window appears where user can specify the file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

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

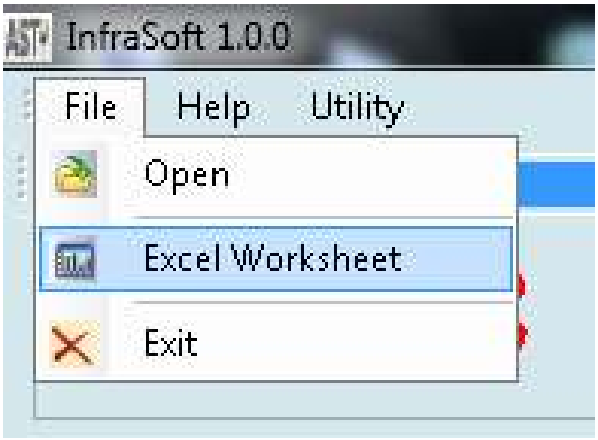


```
File  Edit  Format  View  Help
No. of Device    1
Serial number    Basic Range
3        300°C...1300°C
Date     Time      -----NA---- Temperature   Emissivity
2018-07-01       12:57:47 AM      314°C    X
2018-07-01       12:57:49 AM      314°C    X
2018-07-01       12:57:51 AM      314°C    X
2018-07-01       12:57:53 AM      313°C    X
2018-07-01       12:57:55 AM      314°C    X
2018-07-01       12:57:57 AM      314°C    X
2018-07-01       12:57:59 AM      314°C    X
2018-07-01       12:58:01 AM      314°C    X
2018-07-01       12:58:03 AM      314°C    X
2018-07-01       12:58:05 AM      314°C    X
2018-07-01       12:58:07 AM      314°C    X
2018-07-01       12:58:09 AM      314°C    X
2018-07-01       12:58:12 AM      314°C    X
2018-07-01       12:58:14 AM      314°C    X
2018-07-01       12:58:16 AM      314°C    X
2018-07-01       12:58:18 AM      314°C    X
2018-07-01       12:58:20 AM      314°C    X
2018-07-01       12:58:22 AM      313°C    X
2018-07-01       12:58:24 AM      314°C    X
2018-07-01       12:58:26 AM      314°C    X
2018-07-01       12:58:28 AM      314°C    X
2018-07-01       12:58:30 AM      314°C    X
2018-07-01       12:58:32 AM      314°C    X
2018-07-01       12:58:34 AM      313°C    X
2018-07-01       12:58:36 AM      314°C    X
2018-07-01       12:58:38 AM      314°C    X
2018-07-01       12:58:40 AM      313°C    X
2018-07-01       12:58:42 AM      313°C    X
2018-07-01       12:58:44 AM      313°C    X
2018-07-01       12:58:46 AM      313°C    X
2018-07-01       12:58:48 AM      313°C    X
2018-07-01       12:58:50 AM      313°C    X
2018-07-01       12:58:52 AM      314°C    X
2018-07-01       12:58:54 AM      314°C    X
2018-07-01       12:58:56 AM      314°C    X
2018-07-01       12:58:58 AM      313°C    X
2018-07-01       12:59:00 AM      314°C    X
2018-07-01       12:59:02 AM      314°C    X
2018-07-01       12:59:04 AM      314°C    X
2018-07-01       12:59:06 AM      314°C    X
```

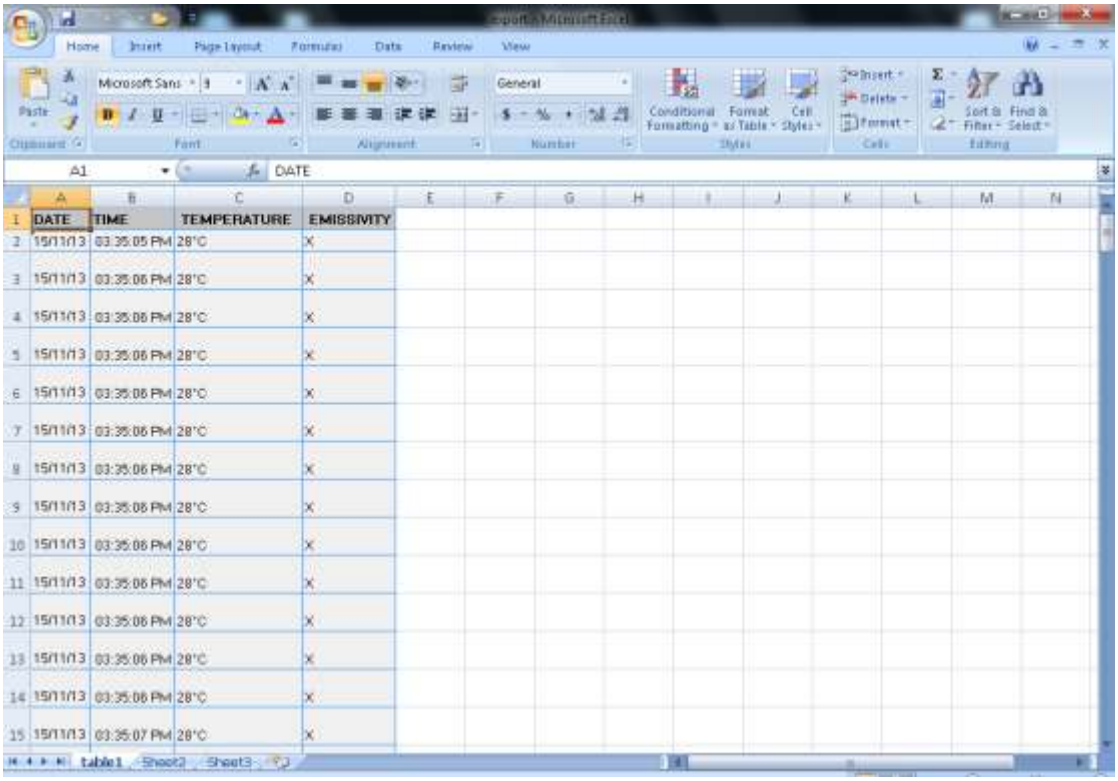
To record emissivity, click on ***Record Emissivity*** button.



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



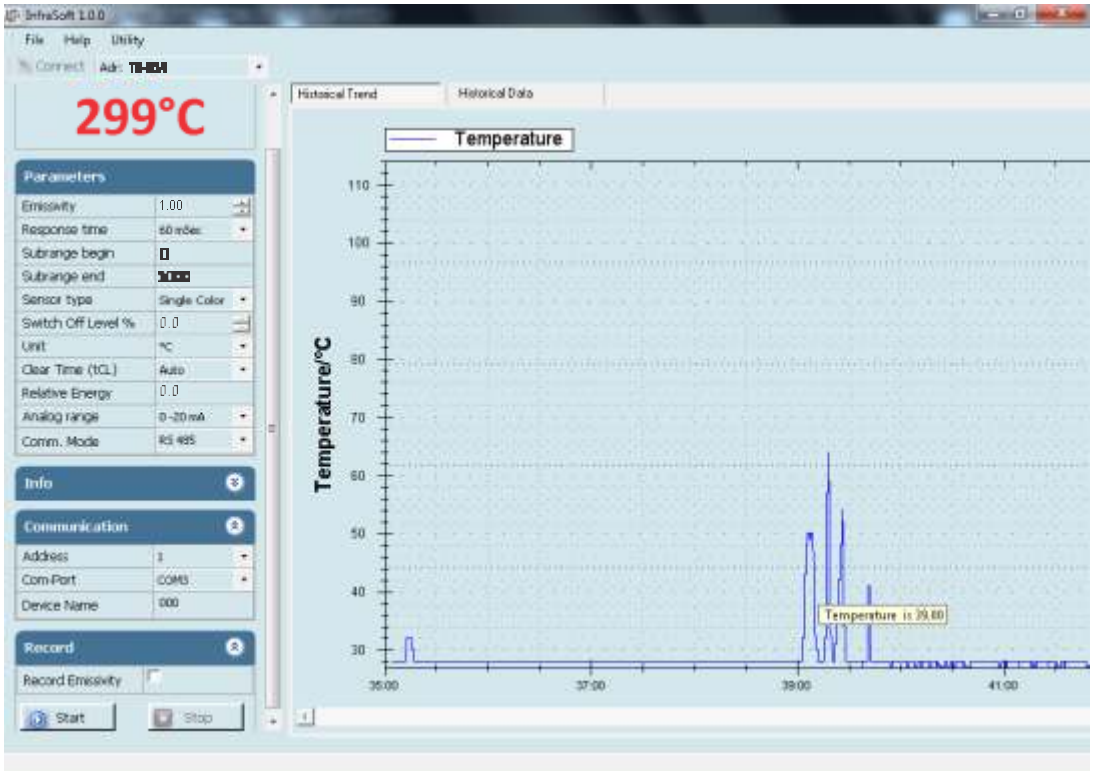
File will be stored in ***.xls*** format named as “export”. This “export.xls” file will be saved where the software is installed.

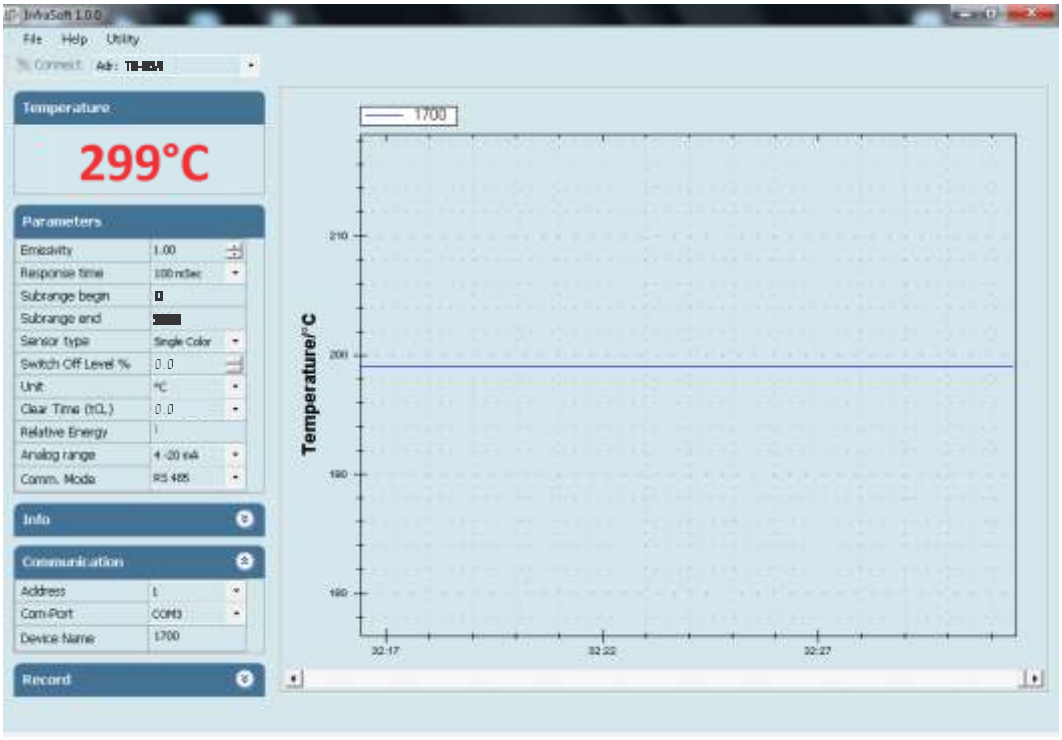


	DATE	TIME	TEMPERATURE	EMISSIVITY
2	15/11/13	03:35:05 PM	28°C	X
3	15/11/13	03:35:06 PM	28°C	X
4	15/11/13	03:35:06 PM	28°C	X
5	15/11/13	03:35:06 PM	28°C	X
6	15/11/13	03:35:06 PM	28°C	X
7	15/11/13	03:35:06 PM	28°C	X
8	15/11/13	03:35:06 PM	28°C	X
9	15/11/13	03:35:06 PM	28°C	X
10	15/11/13	03:35:06 PM	28°C	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.***

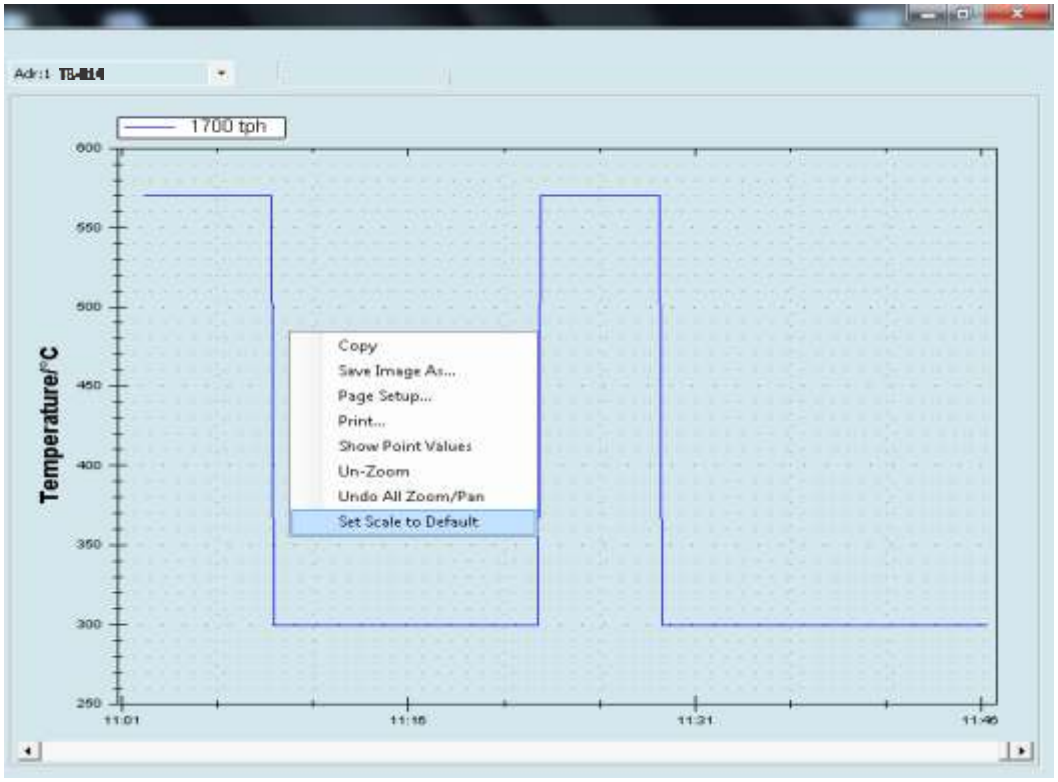
Screen containing historical trend & historical data will appear.





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

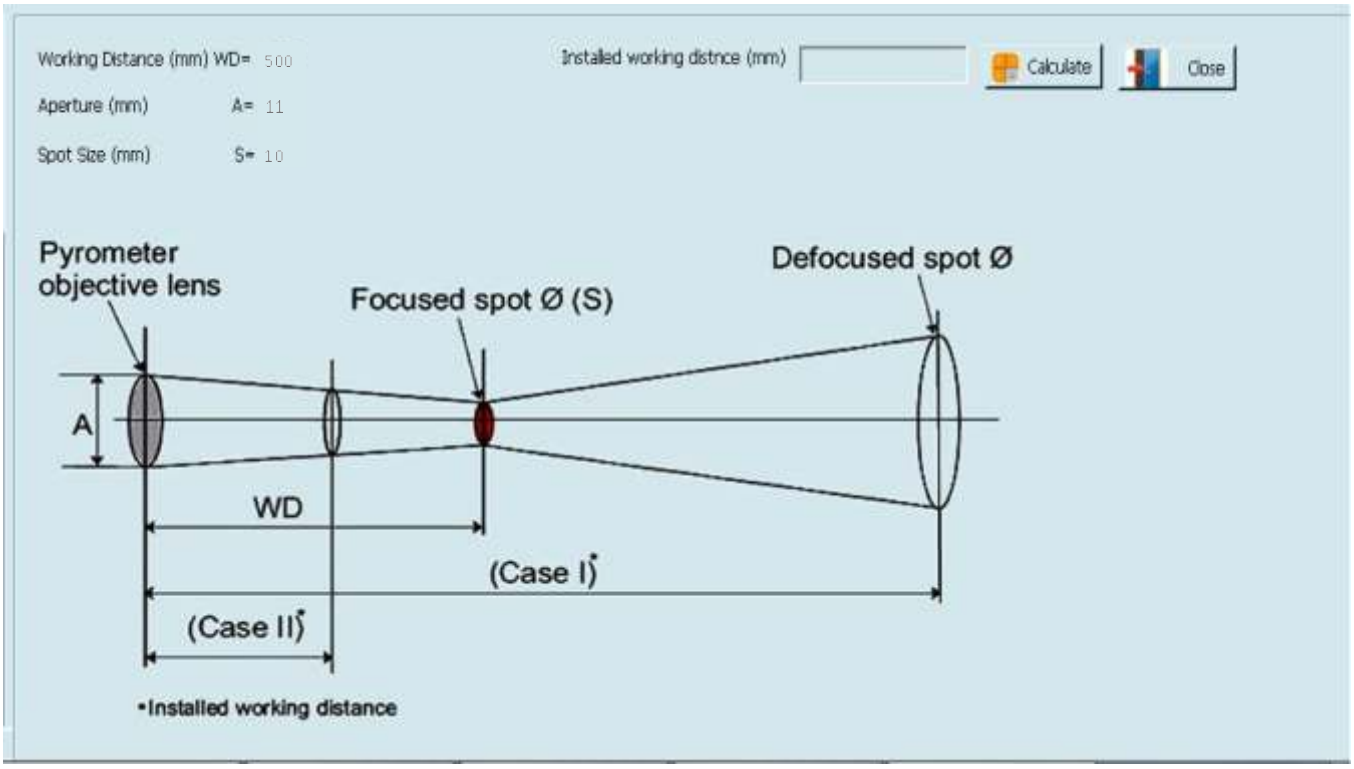
Note:
After connecting the pyrometer right click on the graph screen and choose "Set to default" option from pop-up menu.



Chapter - 5
Calculate Spot Size

To calculate Spot Size click on ***Utility*** ⟶ ***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 - 6
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.

6.1 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 - 7

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. AST sensors always operate as Slave devices. Using RS485 serial communication option allows connecting more than one sensor to Master device. AST sensors always perform delay of 5 ms before sending an answer on Master request to meet RS485 hardware requirement.

MT500_AST 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 “AST450C “', 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, technical@accuratesensors.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

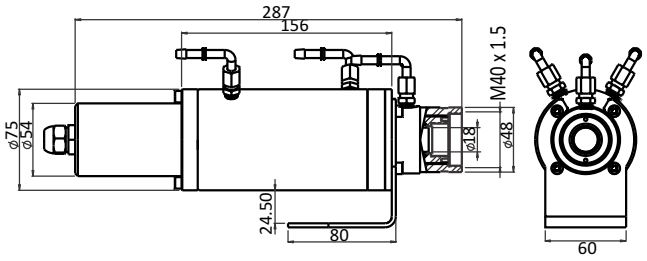
Material	Emissivity*
Aluminum, polished	0.05
Aluminum, rough surface	0.07
Aluminum, strongly oxidized	0.25
Asbestos board	0.96
Asbestos fabric	0.78
Asbestos paper	0.94
Asbestos slate	0.96
Brass, dull, tarnished	0.22
Brass, polished	0.03
Brick, common	0.85
Brick, glazed, rough	0.85
Brick, refractory, 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	

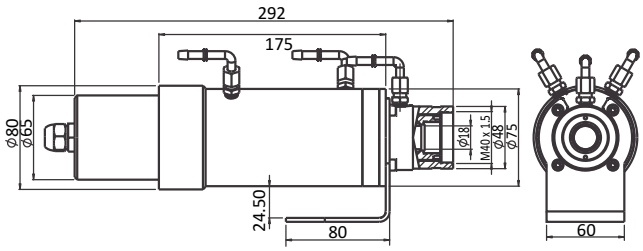
Appendix C

Mechanical Drawings

1. Water Cooling Jacket

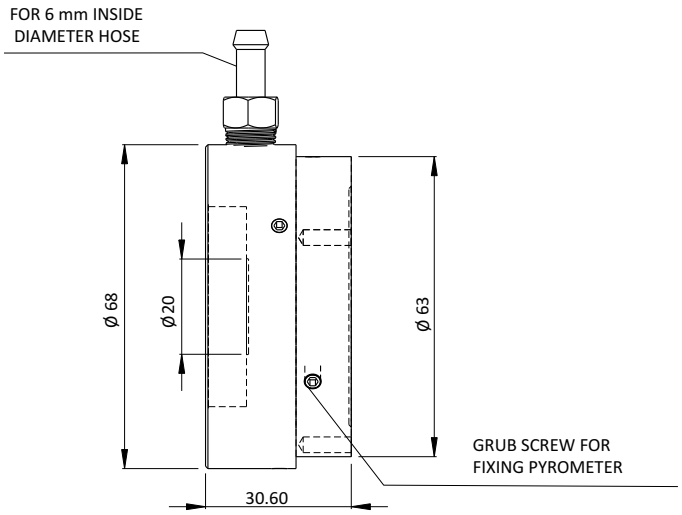


Water Cooling Jacket with Adjustable Flange PL
(Reference no: 8000-02)



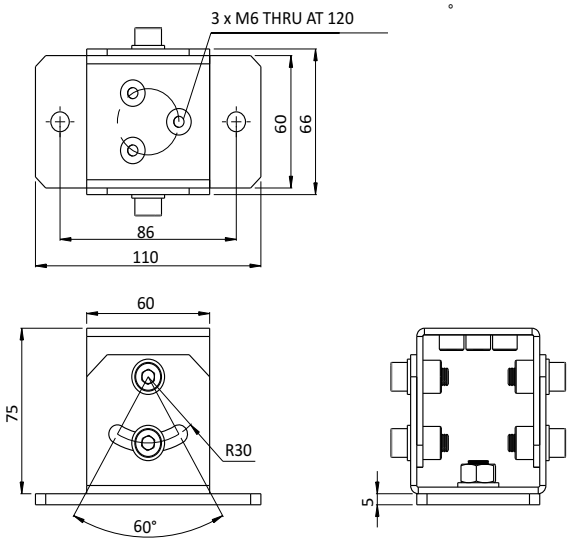
Water Cooling Jacket with Adjustable Flange TL
(Reference no: 8000-06)

2. Air Purge Unit



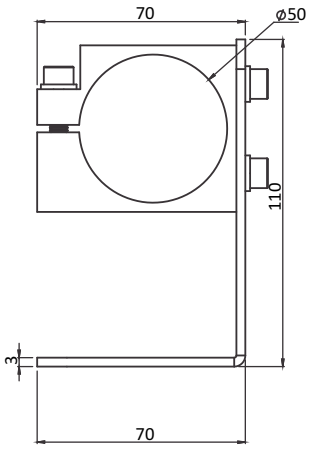
Air Purge Unit
(Reference no: 8000-04)

3. 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

AST T3-814 PL 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 bought 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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