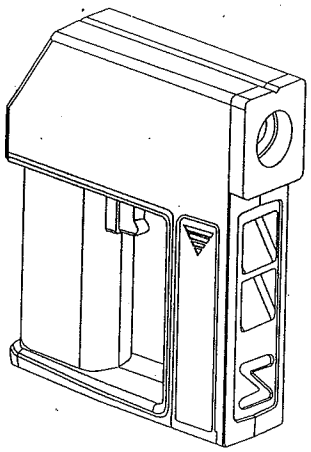
Raynger PM Plus Series

Operator's Manual



PM20:
Basic Model

■

PM30:
Standard Model

■

PM40:
Extended
Performance Model

■

PM50:
Data Logger Model

Raytek®

Noncontact Temperature Measurement

ISO 9001

LIMITED WARRANTY

Raytek warrants this product to be free from defects in material and workmanship under normal use and service for a period of one year from date of purchase, except as hereinafter provided. This warranty extends only to the originnal purchaser (a purchase from Raytek or Raytek's licensed distributors is an original purchase). This warranty shall not apply to fuses or batteries. Factory calibration is warranted for a period of one year. The warranty shall not apply to any product which has been subject to misuse, neglect, accident, or abnormal conditions of operation or storage. Should Raytek be unable to repair or replace the product within a reasonable amount of time, purchaser's exclusive remedy shall be a refund of the purchase price upon return of the product.

In the event of failure of a product covered by this warranty, Raytek will repair the instrument when it is returned by the purchaser, freight prepaid, to an authorized Service Facility within the applicable warranty period, provided Raytek's examination discloses to its satisfaction that the product was defective. Raytek may, at its option, replace the product in lieu of repair. With regard to any instrument returned within the applicable warranty period, repairs or replacement will be made without charge and with return freight paid by Raytek, unless the failure was caused by misuse, neglect, accident, or abnormal conditions of operation or storage, in which case repairs will be billed at a reasonable cost. In such cases, an estimate will be submitted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. RAYTEK SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES. WHETHER IN CONTRACT. TORT. OR OTHERWISE.

Raytek®

Noncontact Temperature Measurement

Worldwide
Raytek, Inc.
1201 Shaffer Raod, Box 1820
Santa Cruz, CA 95061-1820
Phone 408 458-1110
Fax 408 458 1239
800 227 8074 (U.S. & Canada)

Europe
Raytek GmbH
Berlin, Germany
Phone 49 30 478 0080
Fax 49 30 471 0251

Japan
Raytek Japan, Inc.
Tokyo, Japan
Phone 81 3 5976 1531
Fax 81 3 5976 1530

Brasil
Raytek do Brasil
Sorocaba, Brasil
Phone 0152 27 6556
Fax 0152 27 1091

United Kingdom
Raytek UK
Milton Keynes Bucks, UK
Phone 44 1908 630800
Fax 44 1908 630900

China
Raytek China Company
Beijing, China
Phone 86 10 6437 0284
Fax 86 10 6437 0285

55501 Rev N 6/96

CHAPTER 1: INTRODUCTION

Description and Models

Portable noncontact thermometers are rugged and easy-to-use tools, designed for predictive maintenance applications. They are valuable in monitoring operating temperatures of mechanical and electrical plant or production equipment without removing the equipment from service. They are also useful for measuring product temperatures during manufacturing, to spot problems before they reduce quality or cause production downtime.

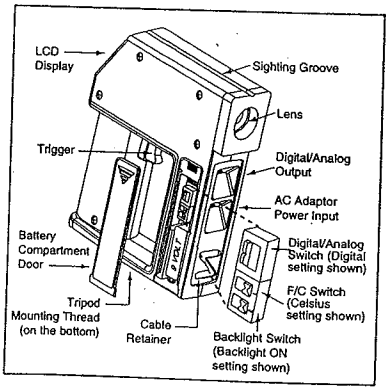
Four models are offered:

- Basic Model (BM) • Standard Model (SM)
- Extended Performance Model (EPM) • Data Logger Model (DLM)

All models are trigger-actuated. They consist of the following:

- Optical elements
- Infrared detector
- Circuit boards containing the necessary processing electronics
- LCD display with backlight
- Touch-sensitive membrane switch for operation
- 9V battery and compartment
- Laser sighting
- Power input jack for 110/220 VAC to 9VDC adapter accessory (except Basic Model)
- Signal output jack (analog 1mV per degree/ digital RS232) (except Basic Model)

Units are molded from high-strength, solvent-resistant plastic, with an environmentally-sealed optical system. A belt pouch is included for easy carrying at all times.



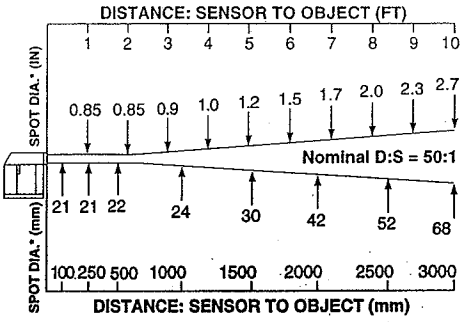
Note: The LCD backlight switch is factory set in the ON position. To use the unit in brightly lit environments, and to extend battery life, disable the backlight by moving the switch to the OFF position. (Battery life is reduced approximately 50% when using the backlight option, approximately 70% when using both backlight and laser.)

HOW THEY WORK

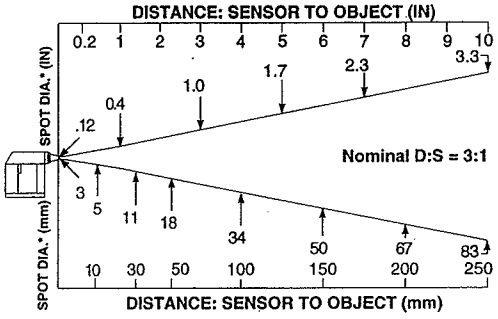
Objects having temperatures above absolute zero radiate infrared energy, which travels at the speed of light in all directions. An infrared thermometer's lens, pointed at an object, collects and focuses the energy onto an infrared detector. This produces a voltage signal directly proportional to the amount of energy received to the target temperature. The unit's microprocessor-based electronics manipulates this voltage signal and displays the temperature, and related computed values, such as maximum, minimum, and average temperatures, as well as the differences between them.

Some objects reflect infrared energy as well as emit it. Shiny or highly polished surfaces reflect energy, whereas dull ones do not. A factor called emissivity accounts for the actual reflected energy. You can set emissivity values anywhere from 0.1 to 1.0 (see Chapter 2: Operation). For most applications an emissivity setting of .95, which describes a target having a small amount of reflection (5%), is sufficient. For areas where surrounding (ambient) temperature are higher than the target (which has an emissivity less than 1.0), Ambient Temperature Compensation (TAM Mode) allows for compensation of reflected energy.

Optical Chart for Basic, Standard, Extended Performance and Data Logger Models



Optical Chart for Close Focus Model



Nominal spot diameter at 90% energy.

SPECIFICATIONS

Temperature Range: -18 to 870°C (0 to 1600°F)

Emissivity: Fixed .95 (BM)
0.10 to 1.0 Digitally adjustable (SM, EPM, DLM)

	BM	SM	EPM	DLM
Temperature Measurement:				
Current, MAX	•	•	•	•
MIN, DIF, AVG			•	•
Recall of Last Reading		•	•	•
Stores 64 Points in Memory				•
HI/LO Audible and Visual Alarm:			•	•
Ambient Temperature Compensation (TAM):				•
Locking Trigger:			•	•
DC Power Input:		•	•	•
Laser Sighting (L3): meets FDA Class IIIa, (L2): meets IEC Class 2 & FDA Class II	•	•	•	•
Options (must be pre-ordered):				
Tenth Degree Display Resolution (TR)*:	•	•	•	•
Close Focus (CF): 3.1 mm (0.12 in) spot diameter @ cone tip – maximum temperature for cone tip: 82°C (180°F)	•	•	•	•
Sub Zero (SZ): -46 to 400°C (-50 to 750°F)	•	•	•	•
N.I.S.T. calibration certification	•	•	•	•
Intrinsic Safety (IS):	•	•	•	•

Option offers Tenth degree display, not Tenth degree output resolution

SPECIFICATIONS

Data Output:	RS232C or 1mV per degree (°C or °F), except Basic Model
Accuracy:	± 1% of Reading, or ± 1.0°C (1.5°F) whichever is greater, at 23 ± 5°C (73± 9°F) ambient operating temperature
Repeatability:	± 0.5% of Reading or ± 0.5°C (±1°F) whichever is greater
Spectral Response:	8 to 14 microns, thermopile detector
Response Time (95% response):	350 mSec
Temperature Display:	°C or °F (selectable), 4 digit backlit LCD
Display Resolution:	1°C or °F (0.1°C or °F in AVG mode or all modes with TR option)
Ambient Operating Range:	0 to 50°C (32 to 120°F)
Relative Humidity:	10 to 95% RH noncondensing, @ up to 30°C (86°F)
Storage Temperature:	-20 to 50°C (-4 to 120°F) without battery
Power:	9 VDC alkaline battery
Dimensions (L x W x H):	140 x 44 x 178 mm (5.5 x 1.75 x 7 in)
Weight:	0.6 kg (1 lb., 4 oz.)
Tripod Mount:	1/4 inch - 20 UNC
Accessories	
AC Adapter:	9 VDC output at 100 mAmp, tip positive (except Basic Model)
Output Cables:	1.5 m (60 in) analog, printer, computer (except Basic Model)
Printer and Cable:	Thermal-type with internal battery or AC adaptor, 241 x 163 x 58 mm (9.5 x 6.4 x 2.3 in), 1.0 kg (2.0 lbs)
Spreadsheet Software and Graphing/Table Software:	Writes to floppy disks for data transfer to spreadsheets or ASCII files. Software also logs up to 5,000 points, and presents data in graphs or tables. Computer cable included.

CHAPTER 2: OPERATION

COMMON FEATURES OF OPERATION – ALL MODELS

• POWER SUPPLY – Power is provided by a 9V battery located inside the compartment in the front of the unit. 9 VDC adapters are available for either 110 or 220 VAC. 220 VAC adapter must meet DIN 0551 requirements when used with IEC Class 2 laser sighted models. The 9 VDC output of the adapter should be inserted into the lower input jack (marked DC ▲) on the front of the unit (not available on Basic Model).

NOTE: Power consumption will be less when the unit is set in the digital output position. It is recommended to leave the switch in this position at all times, except when the analog output is being used. Battery life is approximately 25 hours with backlight OFF and laser OFF, 12 hours with backlight ON and laser OFF, 10 hours with backlight OFF and laser ON, and 3 hours with backlight ON and laser ON.

• TAKING A MEASUREMENT – All units are activated by pulling and holding the trigger and pointing at the target to be measured. A reading will appear on the display. If the error code 8888 shows, that means the target temperature is over or under temperature range. The trigger can be locked ON if desired.

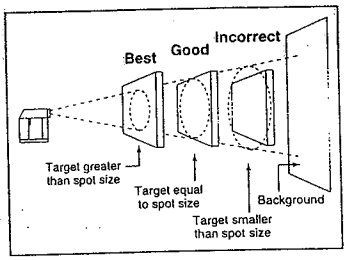
• CELSIUS/FAHRENHEIT SWITCH – Temperature can be displayed in Celsius or Fahrenheit. A switch in the battery compartment can be used to select one or the other.

• DISPLAY – Temperature information and parametric settings are shown on the Liquid Crystal Display (LCD). The low battery icon ( ) is displayed when the battery power is low. Displayed information will still be correct even if the low battery icon ( ) is activated. The LCD has a switchable backlight feature which permits viewing in dimly lit areas.

• LOCKING THE TRIGGER – The trigger can be electronically locked by pressing the LOCK button while holding the trigger. The lock icon ( ) will appear on the display, and the trigger can be released (except Basic Model).

• UNLOCKING THE TRIGGER – Simply press the LOCK button again. The lock icon ( ) will disappear from the display and the measurement will stop.

• TARGET SIZE AND FIELD-OF-VIEW – When measuring the absolute temperature of an object, be sure that the object fill the entire field-of-view. The distance from the object affects the size of the spot measured. When measuring relative temperatures, the objects need not fill the field-of-view if they are the same size and at the same distance.



• MEMORY RECALL – All measurement values are stored in memory, even after the unit has been turned off. They are available to be recalled as long as the battery has not been disconnected or lost power. Pressing RECALL or MODE in the Basic, Standard and Extended Performance Models, displays last values for about 10 seconds (30 seconds for Data Logger Model). In the DL Model, pressing the MODE button while in the LOG mode displays the stored value.

• TEMPERATURE OUTPUTS – Analog and digital electrical outputs of current temperature are available from the upper jack in the front (except Basic Model). Either analog or digital may be selected through the use of a switch inside the battery compartment.

Analog : 1 mV per degree (°C or °F) – Digital : RS232C

• TRIPOD-MOUNT THREAD – A standard tripod thread (1/4"-20 UNC) is provided in the bottom for fixed measurements. (See Measurement Techniques.)

• ENVIRONMENTAL – All units can be used accurately and without damage in any environment from 0 to 50°C (32 to 120°F). The maximum temperature the housing can withstand is 95°C (200°F).

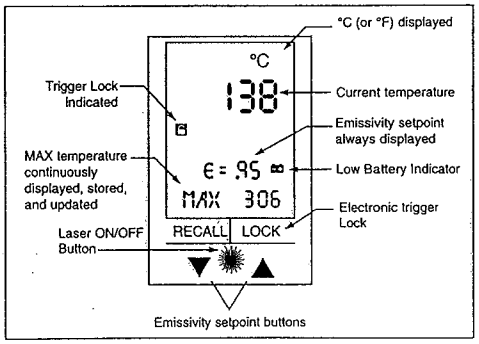
• THERMAL SHOCK – If the instrument is moved from a location that has a sharply different temperature, or is subject to a sudden large ambient temperature change, it should be allowed to thermally stabilize for 30 minutes before use. If the unit is not thermally stabilized, temperature readings will be inaccurate, although no damage to the unit will occur.

OPERATION OF BASIC AND STANDARD MODELS

(for other models, skip this section)

1. Aim the unit at the object; pull and hold the trigger.
2. Both the current and maximum temperature will be displayed and updated four times per second. To lock the trigger, press LOCK while holding in the trigger (except Basic Model).
3. Set emissivity, if necessary. (See Appendices A and B, and also "How They Work".) The emissivity is set by pressing either arrow, which is active only if the trigger is held or locked (except Basic Model).
4. To stop measuring, release the trigger, or press LOCK again, if the trigger was locked (except Basic Model).
5. The last value and maximum can be displayed at any time by pressing RECALL, and will remain for about 10 seconds (except Basic Model).
6. Each pull of the trigger erases the previous readings and starts a new measurement.

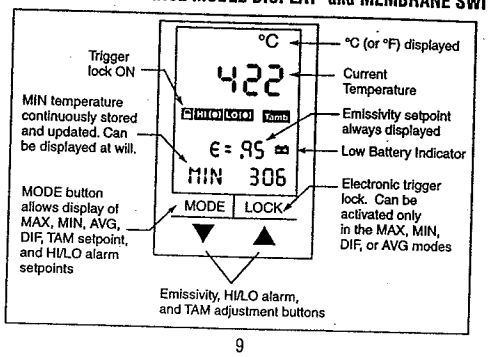
BASIC and STANDARD MODEL DISPLAY and MEMBRANE SWITCH



OPERATION OF EXTENDED PERFORMANCE MODEL

1. Aim the unit at the object; pull and hold the trigger.
2. Current temperature is always displayed and continuously updated. In addition, one of seven mode values is displayed:
   - Computed Values (continuously updated):
     MAX - maximum temperature recorded during current measurement
     MIN - minimum temperature recorded during current measurement
     DIF - difference between MAX and MIN
     AVG - average temperature for entire measurement
   - Setpoint Values:
     HAL - High Alarm • LAL - Low Alarm
     T Ambient - Ambient Temperature Compensation
3. Any one of the four computed values or three setpoints can be displayed by successively pressing the MODE button. HAL, LAL and T Ambient modes are used to display the setpoint, change the setpoint, and activate or deactivate each respective function during measurement.
4. To lock the trigger, press LOCK while holding in the trigger. The unit must be in MAX, MIN, DIF, or AVG modes.

EXTENDED PERFORMANCE MODEL DISPLAY and MEMBRANE SWITCH



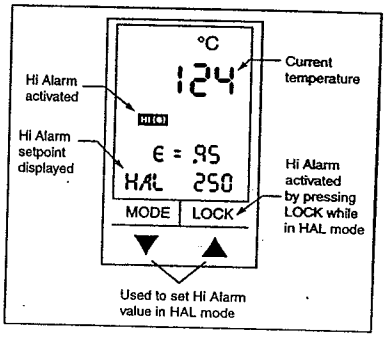
5. Set emissivity if necessary. (See Appendices A and B, and also "How They Work".) The emissivity is set by operating the arrows on the switch, which are active only if the trigger is held or locked. Also, the mode selected must be MAX, MIN, AVG, or DIF.
6. To stop measuring, release the trigger. Or press LOCK again if the trigger was locked.
7. All computed values are retained in memory for a given measurement and are available to be recalled at any time after the measurement has ended.

Pressing MODE will recall the values last displayed for about 10 seconds. To recall other computed values, press MODE again. Each time MODE is pressed, the display will change, and 10 seconds will be added to the display time.

- Setting Temperature Alarms

1. Operate MODE button until HAL is displayed.
2. Set the high alarm value by using the s or t arrows. Arrows are active only if trigger is held or locked.
3. Activate the mode by pressing LOCK. The high alarm icon (HI(O)) will appear on the display, indicating that the mode has been activated.
4. Measure temperature using normal procedures. An audible alarm will sound and the high alarm icon on the display will blink any time the measured temperature exceeds the alarm setpoint.

HIGH ALARM DISPLAY



5. To turn off the alarm, operate the MODE button until HAL is displayed. Then press LOCK. The high alarm icon (HI(O)) will disappear, indicating that the alarm has been turned off. *NOTE: Low Alarm is used in the same way.*

MODE	DISPLAY SHOWS	PRESSING MODE	PRESSING LOCK	PRESSING ▲▼
MAX	Current Temp. MAX Temp.	Goes to MIN	Locks trigger when pressed while trigger is held. Unlocks trigger if already locked.	Sets emissivity
MIN	Current Temp. MIN Temp.	Goes to DIF		Sets emissivity
DIF	Current Temp. DIF Temp.	Goes to AVG		Sets emissivity
AVG	Current Temp. AVG Temp.	Goes to HAL		Sets emissivity
HAL	Current Temp High Alarm Temp. Setting	Goes to LAL	Activates/Displays Hi Alarm. Press again to deactivate.	Sets High Alarm value
LAL	Current Temp. Low Alarm Temp. Setting	Goes to TAM	Activates/Displays Low Alarm. Press again to deactivate.	Sets Low Alarm value
TAM	Current Temp. AMBIENT Temp. Setting	Goes to MAX	Activates/Displays TAM compensation mode. Press again to deactivate.	Sets TAM value

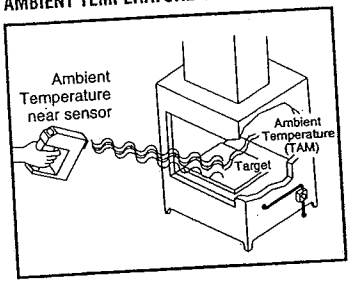
USING THE AMBIENT TEMPERATURE COMPENSATION (TAM) MODE

Targets which have low emissivities will reflect energy from their surrounding environments. This is added to their own emitted energy. If the temperature of the surrounding environment is the same value as the internal temperature of the unit, there is no need to input this value as it is automatically and continually measured. However, in some industrial situations the surrounding environment (machines, furnaces, or other heat sources) has a value much higher than that of the unit's internal temperature. Table 1 "Effect of TAM on Accuracy" illustrates these effects on measurement accuracy, with and without use of the Ambient Temperature Compensation mode.

Ambient Temperature Compensation mode should be used whenever all of the following are true:

- Target has a low emissivity
- Temperatures of objects facing target are much hotter than temperature of the unit
- Increased measurement accuracy is required

AMBIENT TEMPERATURE COMPENSATION



• TO SET AND ACTIVATE TAM MODE:

1. Set the emissivity to 1.0
2. Operate MODE button to display AVG.
3. Pan the unit across the object's field-of-view (objects and surfaces surrounding the target) several times. Read the average temperature value. This is the value you should enter as the reflected ambient temperature in Step 5 below.
4. Operate the MODE button until the "TAM" is displayed.
5. Set ambient temperature value, using the ▲▼ arrows.

6. Activate the mode by pressing LOCK. The Tamb icon (Tamb) will appear in the right middle of the display, indicating that the mode has been activated.
7. The unit is now ready to use with normal procedures. Reset the emissivity to the proper value for the object being measured. The current temperature and all computed values, as well as the analog and digital electrical outputs, will be based upon the compensated measurement.
8. Press LOCK to deactivate TAM mode. The Tamb icon will disappear, indicating that the mode has been deactivated. The value will be saved until the battery is disconnected or the C/F switch is operated.

TAM MODE DISPLAY

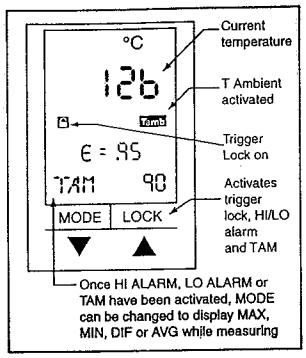


Table 1: Effect of TAM on Accuracy

Actual Target Temp		Emissivity	Reflected Temp		Indicated Temp w/o TAM		Indicated Temp w/TAM	
°C	°F		°C	°F	°C	°F	°C	°F
100	200	0.8	25	80	100	200	100	200
100	200	0.8	40	100	102	203	100	200
100	200	0.8	150	300	120	250	100	200
100	200	0.6	150	300	160	321	100	200

NOTE: Internal Temperature of IR Thermometer assumed to be 25°C (80°F).

Explanation:

1. No error if IR thermometer internal temperature and ambient temperature near target are the same.
2. Error of 1.5°C (3°F) when ambient near target is 10°C (20°F) higher than ambient of thermometer.
3. Increasing error with increasing difference between target and sensor ambient temperatures.
4. Increasing error with decreasing emissivity

OPERATION OF DATA LOGGER MODEL (DLM)

The DLM performs all the functions of the Extended Performance Model (EPM) in addition to providing Data Logger functions. This section covers only the additional features of the DLM. The Data Logger function is entered by continuous pressing of the MODE button until LOG is seen in the lower left corner of the display. Once in the LOG mode, it is possible to store up to 64 temperatures within the DLM memory. In addition, it is possible to set a specific emissivity and High Alarm value for each of the 64 LOG locations. The default values are E=0.95 and HAL=871°C (1600°F), not activated.

- **STORING TEMPERATURES**

1. Press MODE button to enter LOG mode. LOG will be seen on display.
   NOTE: If trigger is to be locked in the LOG mode, this must be done before entering the LOG mode (in MAX, MIN, DIF or AVG modes.)
2. Choose LOG location by pressing the ▲ or ▼ buttons. LOG location is shown on the lower right corner of the display.
3. Press STO to store the current temperature value while trigger is pulled or in locked position. A "beep" will be heard.

- RECALLING STORED TEMPERATURES

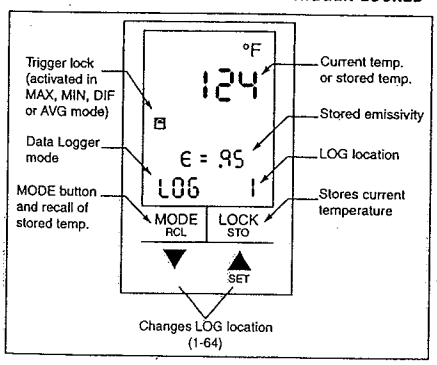
1. To recall stored values, press RCL while display is OFF. Do not pull trigger.
2. Press MODE until LOG is seen on display.
3. Choose LOG location by pressing s or t buttons. Stored value will be seen on main temperature display.

1. *°C/°F indication will not be flashing in RCL mode.*
2. *Pressing STO or adjusting any value will erase any stored value while in LOG or SET-EMS (emissivity) modes.*

- NOTES

1. *Stored values are held in memory regardless of whether display is ON or OFF, or if the battery is discharged or not. The memory will not be erased even when the battery is changed.*
2. *The stored values may be recalled at any time the display is OFF and the unit has been left in or is put into the LOG mode.*
3. *When using RCL in the LOG mode, the display will stay activated for thirty seconds after any button has been pressed. If the display goes out, simply press RCL again and the unit will continue from the location when it went out.*
4. *Switching from °C to °F or vice versa will erase the stored readings held in memory.*

DLM DISPLAY IN LOG MODE WITH TRIGGER LOCKED



MODE	DISPLAY SHOWS	PRESSING MODE	PRESSING LOCK	PRESSING ▲▼
MAX	Current Temp. MAX Temp.	Goes to MIN	Locks trigger when pressed while trigger is held. Unlocks trigger if already locked.	Sets emissivity
MIN	Current Temp. MIN Temp.	Goes to DIF		Sets emissivity
DIF	Current Temp. DIF Temp.	Goes to AVG		Sets emissivity
AVG	Current Temp. AVG Temp.	Goes to HAL		Sets emissivity
HAL	Current Temp High Alarm Temp. Setting	Goes to LAL	Activates/Displays Hi Alarm. Press again to deactivate.	Sets High Alarm value
LAL	Current Temp. Low Alarm Temp. Setting	Goes to TAM	Activates/Displays Low Alarm. Press again to deactivate.	Sets Low Alarm value
TAM	Current Temp. AMBIENT Temp. Setting	Goes to LOG	Activates/Displays TAM compensation mode. Press again to deactivate.	Sets TAM value
LOG	Current or Stored Temp. LOG Location	Goes to MAX	Stores Current Temp. while trigger is pulled or activated	Sets LOG location (1-64)

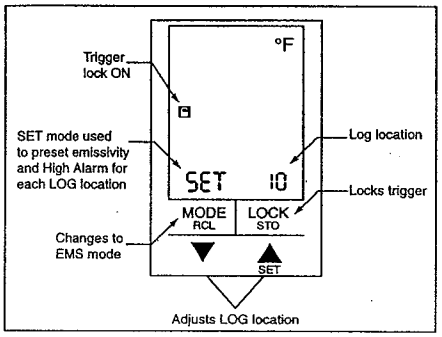
• SETTING EMISSIVITY AND HIGH ALARM

CAUTION: Any adjustment of emissivity in SET mode will erase any stored value in the indicated location. Adjusting the High Alarm will have no effect on the stored value.

1. Press MODE button to enter LOG mode. Allow display to go out.
2. Press and hold the ▲ (SET) button first and then pull the trigger. SET will be seen on the display. Stop holding the SET button.
3. Press LOCK to lock the trigger. Release trigger.
4. Choose the LOG location for which the emissivity or high alarm level is to be set by adjusting the ▲ or ▼ buttons.
5. Press MODE button once to enter EMS (emissivity adjust) mode or twice to enter HAL (High Alarm adjust) mode.
6. Press the ▲ or ▼ buttons to obtain the desired setting in either the EMS or HAL modes.
7. If HAL is to be activated, press the LOCK button. (The emissivity value is automatically activated.)
8. Press MODE to return to SET position. Press ▲ or ▼ buttons to set another location or press LOCK to turn unit off.

NOTE: Pulling trigger will now return unit to LOG mode.

DLM DISPLAY IN SET MODE

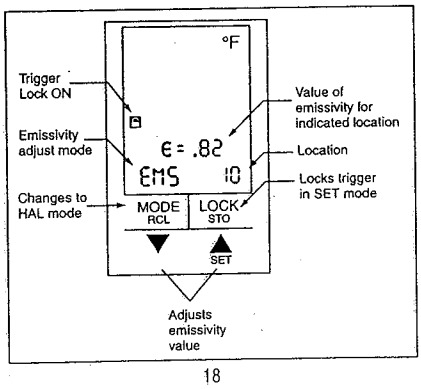


SET MODE OPERATIONAL FLOW CHART

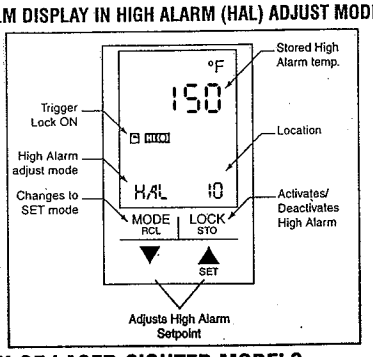
MODE	DISPLAY SHOWS	PRESSING MODE	PRESSING LOCK ▲	PRESSING ▲▼
LOG	(Allow display to go blank)	Press and hold SET and then pull trigger While holding trigger, press LOCK		
SET	LOG location number	Goes to EMS*	Locks/Unlocks trigger	Sets new LOG location (1-64)
EMS	Emissivity value	Goes to HAL*	Locks/Unlocks trigger	Sets new emissivity value
HAL	High Alarm value and Hi Alarm icon	Goes to SET	Activates/ Deactivates Hi Alarm	Sets new High Alarm value

*Goes to LOG by unlocking trigger

DLM DISPLAY IN EMISSIVITY (EMS) ADJUST MODE



DLM DISPLAY IN HIGH ALARM (HAL) ADJUST MODE



OPERATION OF LASER-SIGHTED MODELS

Laser target sighting is factory installed for all models described in this manual.

LASER SAFETY

Laser radiation may be harmful to the human eye.

WARNING:

- Avoid direct exposure of human eyes to laser light. Eye damage can result.
- Never point the unit at another person. • Keep out of the reach of children.
- Avoid indirect exposure via reflective materials such as glass and mirrors.

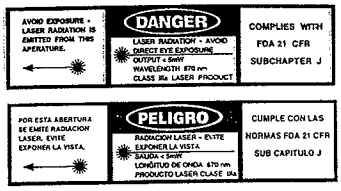
Laser Specifications

Two different laser power levels are available for this product. Please refer to the label diagrams and the label on your unit to determine which one you have.

Category:	FDA Class IIIa	FDA Class II and IEC Class 2
Type:	Gallium Arsenide	Gallium Arsenide
Wavelength:	670 nm	670 nm
Power:	< 5 milliwatt	< 1 milliwatt
Operating Range:	up to 30 m (100 ft) (depending on ambient light level)	up to 15 m (50 ft)

Caution: Use of controls or adjustments, or performance of procedures other than those specified herein, may result in hazardous laser radiation exposure.

CLASS IIIa (FDA) LASER LABELS

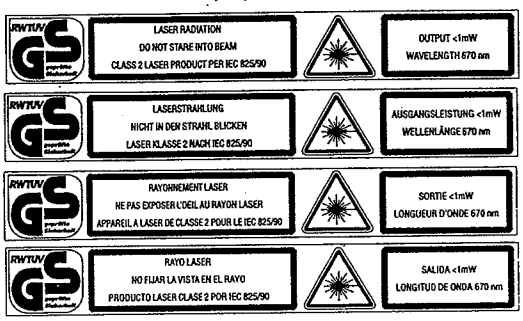


CLASS 3a (JIS) LASER LABEL

CLASS 2 (JIS) LASER LABEL

CLASS II (FDA) LASER LABEL

CLASS 2 (IEC) LASER LABELS



Laser sighting is extremely useful for accurate aiming of the IR thermometer at small or distant targets. It does not indicate the size of the spot being measured, only the center. To find the size of the spot being measured, see Optical Charts.

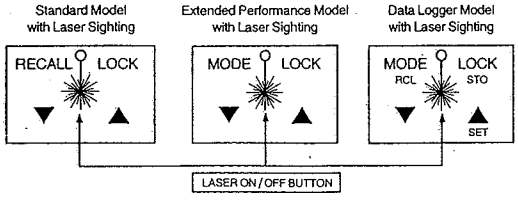
Laser sighting is provided by a rugged and compact solid-state device mounted inside the unit. It is aligned with the thermometer's lens to provide accurate, non-parallax sighting of the targets that you want to measure.

A two-step procedure is required to activate the laser. This is a safety feature designed to prevent the user from activating the laser accidentally or leaving it ON after the temperature measurement has been made.

TO OPERATE THE LASER: (see diagrams)

1. To enable the laser circuit, pull and hold trigger, and press the "starburst" button in the center of the switch panel. The red LED above the starburst will light. The laser is now enabled, and will be activated any time the trigger is pulled. When the trigger is released, the laser is deactivated.
2. Pull and hold trigger and point the unit at the target to be measured. The laser will produce a red dot on the target, pinpointing the center of the spot being measured by the unit. (see Optical Charts)
3. To disable the laser circuit, pull and hold trigger, and again press the starburst button. The red LED will go off. Temperature measurement can be carried on per usual procedures.

NOTE: The laser may be used all of the time if necessary. However, it is recommended that the laser be disabled when not needed in order to extend battery life and for greater safety.



Data Outputs

Data outputs on the Standard, Extended Performance, and Data Logger Models provide a direct interface to chart recorders, printers and PC compatible computers. See Measurement Techniques for some examples.

All models (except Basic Model) are equipped with an output jack which is capable of providing analog and digital signals representing temperature. This is the upper jack in the front of the unit which accepts a 3.5 mm stereo plug.

- Digital: RS232C Format of Digital Output:
  8 data bits 1 stop bit no parity
  300 BAUD ASCII output
- Analog: 1 mV/° (C or F)

Either format may be selected using the switch inside the battery compartment.

The output represents the current temperature of the target being measured, regardless of the mode used. If TAM compensation is activated, the output will be representative of the compensated temperature values.

TRANSMITTED INFORMATION

Four important pieces of information are continually transmitted via the RS232 interface:

1. Current temperature - resolution is 1° (C or F) even for models with TR option.
2. Emissivity Setting.
3. Mode and current mode value.
4. Time elapsed since triggering of unit or Data Logger location (DL model).

The values are updated and sent once per second. The frame consists of 29 characters, and is terminated by a carriage return. The following is an example of the ASCII data "frame" which they are sent in:

T0126C_E095_MAX_0150_00:05:10

Measurement Techniques

All models can be used in any one of five basic ways:

1. Spot measurement
2. Differential measurement
3. Static surface scan
4. Moving surface scan
5. Fixed point monitoring over time

The EP and DL models maximum, minimum, difference, averaging and alarm functions are helpful for these varied types of measurement.

- For spot measurement (motor bearings, engine exhaust manifolds, etc.), simply aim the sensor at the desired target and pull the trigger.
- To measure the temperature differential between two spots, aim at the first spot, pull the trigger, take the first reading, and release the trigger. Then aim at the second spot, pull the trigger for that reading, and release. The EP and DL Models will automatically store the difference between the two (DIF).
- To measure temperature across a static surface, aim the sensor at a starting point and "sweep" it across the surface.
- For moving surfaces, aim the sensor at a fixed point and measure temperature as the material moves past. Or, continually scan across the material as it moves past.
- Some applications may require monitoring target temperature over time. With its data outputs, these sensors are well-suited for this purpose. Set the unit on a tripod and aim at the target. Connect the data output to a printer, strip-chart recorder, X-Y plotter, or computer to achieve unattended monitoring.

The Data Logger model is particularly useful for predictive maintenance applications.

TER 3: USER MAINTENANCE

BATTERIES

To open the battery compartment, press gently on the textured arrowhead to release the catch, and slide the door in the direction of the arrowhead. Lift straight up. Unsnap the battery connector. Replace the battery with a standard 9-Volt alkaline. Replace door by setting it over the compartment approximately 12 mm (1/2 in) from the top. Press gently down and forward on the arrowhead until the cover snaps into place.

LASER MAINTENANCE

If the laser does not operate properly, call your infrared thermometer supplier. DO NOT open the instrument's main housing.

LENS CLEANING

Although all lenses are quite durable, care should be taken when cleaning them to prevent scratching. Use the following procedures:

1. Blow off loose particles with clean air
2. Gently brush off remaining particles with a soft camel-hair brush or clean remainder of contaminants with water and a soft cloth. Use gentle pressure.
3. For fingerprints or other grease, apply a few drops of denatured alcohol, ethanol, or Kodak lens cleaner to a soft, clean cloth.

   Wipe the lens gently until you see colors on the surface, then allow to air dry. Do not wipe the surface dry, as this may scratch it. Do not apply drops of liquid directly to the lens or it may be damaged.
4. If silicones (used in hand creams) get on the lens, gently wipe the surface with Hexane. Allow to air-dry.

Caution: Do not use any ammonia or cleaners with ammonia on the lens, as damage may result.

CASE CLEANING

To clean the exterior housing, simply use soap and water or a mild commercial cleaner. Wipe with a damp sponge or soft rag. Use a soft rag to gently wipe the display.

APPENDIX A: EMISSIVITY TABLE

This table is provided only as a guideline for estimating the emissivity of various common materials. Actual emissivity, especially of metals, can vary greatly depending on surface finish, oxidation, or the presence of contaminants. Also, emissivity of IR radiation for some materials varies with wavelength and temperature. Follow the procedures in Appendix B for determining exact emissivities for most applications.

Metals

Material	Emissivity	Material	Emissivity
Aluminium		Lead	
Unoxidized	.02-.10	Polished	.05-.10
Oxidized	.20-.40	Roughened	.40
Alloy A3003		Oxidized	.20-.60
Oxidized	.30	Steel	
Roughened	.10-.30	Cold-Rolled	.70-.90
Polished	.02-.10	Ground Sheet	.40-.60
Brass		Polished Sheet	.10
Polished	.01-.05	Molten	—
Burnished	.30	Oxidized	.1-.8
Oxidized	.50	Stainless	.05
Carbon		Tungsten	
Unoxidized	.80-.90	Polished	.03-.1
Graphite	.70-.80	Zinc	
		Oxidized	.1
		Polished	.02

Non-Metals

Material	Emissivity	Material	Emissivity
Asbestos	.95	Ice Bath	.95
Asphalt	.95	Limestone	.98
Basalt	.7	Paint (non-Al.)	.9-.95
Carborundum	.9	Paper (any color)	.95
Ceramic	.95	Plastic (opaque	.95
Clay	.95	over 20 mils)	
Concrete	.95	Rubber	.95
Cloth	.95	Sand	.9
Glass - Plate	.85	Snow	.9
Gravel	.95	Soil	.9-.98
Gypsum	.8-.95	Water	.93
Ice	.98	Wood, natural	.9-.95

APPENDIX B:
DETERMINATION OF AN UNKNOWN EMISSIVITY

The emissivity of most organic materials (e.g. cloth, wood, plastics, most paints) equals approximately .95. Metals with polished surfaces can have emissivities which are very low. Appendix A lists typical values of emissivity for some common materials. If the emissivity of a material is questionable, determine its value by using one of the following methods:

METHOD A

1. Heat a sample of the material on a hotplate to a known temperature as measured with a calibrated, precision sensor. The surroundings should be at ambient temperature, except for the hotplate.
2. Measure the surface temperature of the sample with the infrared thermometer. Press the emissivity adjustment arrows up or down during the measurement until the display indicates the sample's actual temperature. Note and record the corresponding emissivity value as shown on the display. Use this value whenever the same material is measured again.

METHOD B

1. For temperatures up to approximately 260°C (500°F), place a piece of common masking tape on the object to be measured.
2. Allow sufficient time for the masking tape to reach thermal equilibrium with the object.
3. With emissivity set to .95, measure and note the temperature of the masking tape. This process establishes the actual temperature of the object.
4. Proceed as in step 2 in METHOD A, above.

METHOD C

1. For very high temperatures and if practical, drill a hole approximately 35 mm (1.5 in) in diameter and approximately 100 mm (4 in) deep in a sample of the object. This hole will act as a blackbody with emissivity of approximately .97.
2. Set emissivity to .97 and measure the temperature of the blackbody hole.
3. Proceed as in step 2 in METHOD A, above.

METHOD D

1. When a portion of a material sample can be coated, paint it with a flat black paint (such as engine manifold paint), 'mold release', or spray-on baking soda deodorant. These materials exhibit an emissivity of approximately .95.
2. Set emissivity to .95 and measure the temperature of the coated portion of the material sample. The result is the correct object temperature.
3. Proceed as in step 2 in METHOD A, above.

APPENDIX C:
OPERATION IN INTRINSICALLY SAFE ENVIRONMENTS

Intrinsic safety is a technique for preventing explosions in hazardous areas. It achieves safety by limiting the energy available during normal operation, or during certain foreseeable fault conditions, to levels that are insufficient to cause ignition of explosive atmospheres. Explosions can be sparked by the presence of gases, dusts, grains, and fibers.

All models are offered with a Factory Mutual Intrinsically Safe rating as an option (must be pre-ordered). These models have a special Intrinsic Safety Label attached.

FM
Intrinsic Safety

Rating in USA and Canada: Class 1, Division 1, Groups A, B, C, D. IEC Group rating: Group I and Groups II A, II B, II C.

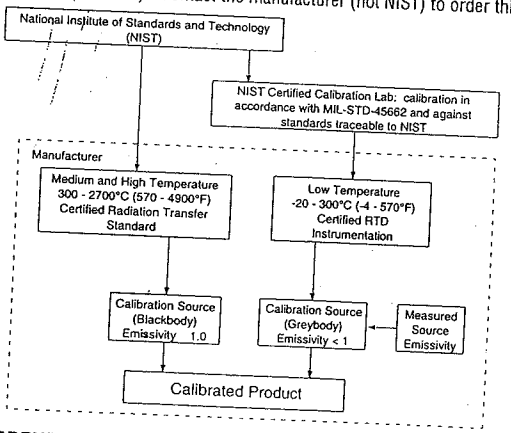
Caution: The 1 mV/degree or RS232 outputs, or AC adaptor cannot be used in the Intrinsically Safe (IS) area.

Note: The Data Logger model can store up to 64 readings in the "IS" area, and download the 64 readings using the outputs outside the "IS" area.

APPENDIX D: TRACEABILITY OF CALIBRATION

The temperature sources (blackbodies) used to calibrate this instrument are traceable to the U.S. National Institute of Standards and Technology (NIST). The calibration sources for this instrument were certified by a NIST certified calibration laboratory and are traceable to NIST primary standards. The certificate describes the equipment used for calibration and any corresponding NIST

report numbers. In addition, the certificate lists test accuracy data and the next calibration date. NIST certificates are available as an option (must be ordered with the instrument). Contact the manufacturer (not NIST) to order this option.



APPENDIX E: CE CERTIFICATION

CE

This instrument conforms to the following standards:

- EN50081-1:1992, Electromagnetic Emissions
- EN50082-1:1992, Electromagnetic Susceptibility

Tests were conducted using a frequency range of 27–500 MHz with the instrument in three orientations. The average error for the three orientations is –2.9° C at 3 v/m throughout the spectrum. However, at approximately 470 MHz at 3 v/m, the instrument may not meet its stated accuracy.

QUICK REFERENCE CARD

Operating Instructions

Basic, Standard, Extended Performance and Data Logger Models:

- Trigger may be locked by pressing LOCK while holding trigger. To unlock, press LOCK again.
- To recall last values ***after*** the unit has been turned off, press RECALL on Standard Model or MODE on Extended Performance Model.
- Each pull of the trigger erases the previous measurement and begins a new one.
- Battery Replacement: 9V Alkaline.

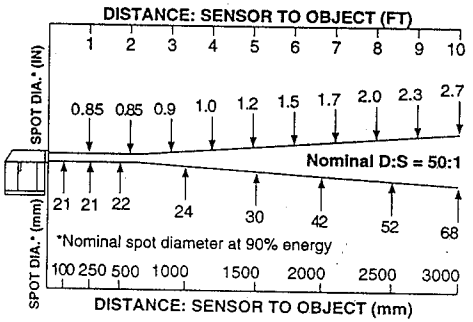
Extended Performance Model Operation Flowchart:

MODE	DISPLAY SHOWS	PRESSING MODE	PRESSING LOCK	PRESSING ▲ ▼
MAX	Current Temp. MAX Temp.	Goes to MIN		Sets emissivity
MIN	Current Temp. MIN Temp.	Goes to DIF	Locks trigger when pressed while trigger held. Unlocks trigger if already locked.	Sets emissivity
DIF	Current Temp. DIF Temp.	Goes to AVG		Sets emissivity
AVG	Current Temp. AVG Temp.	Goes to HAL		Sets emissivity
HAL	Current Temp. High Alarm Temp. Setting	Goes to LAL	Activates/Displays Hi Alarm. Press again to deactivate.	Sets High Alarm value
LAL	Current Temp. Low Alarm Temp. Setting	Goes to TAM	Activates/Displays Low Alarm. Press again to deactivate.	Sets Low Alarm value
TAM	Current Temp. AMBIENT Temp Setting	Goes to LOG	Activates/Displays TAM compensation. Press again to deactivate.	Sets TAM value
LOG	Current or stored temp. LOG location	Goes to MAX	Stores current Temp. while trigger is pulled or activated	Sets LOG location (1-64)

QUICK REFERENCE CARD

Measured Spot Diameter At Various Working Distances

Basic, Standard, Extended Performance and Data Logger Models:



METRIC		U.S. STANDARD	
Target Distance	Spot Diameter	Target Distance	Spot Diameter
250 mm	21 mm	1 ft	0.85 in
500 mm	22 mm	2 ft	0.85 in
1000 mm	24 mm	3 ft	0.9 in
1200 mm	25 mm	4 ft	1.0 in
1500 mm	30 mm	5 ft	1.2 in
1800 mm	38 mm	6 ft	1.5 in
2000 mm	42 mm	7 ft	1.7 in
2500 mm	52 mm	8 ft	2.0 in
2700 mm	58 mm	9 ft	2.3 in
3000 mm	68 mm	10 ft	2.7 in
> 3000 mm	S = D/26	> 100 ft.	S = D/26

D = distance (mm or ft) S = spot diameter (mm or in)

Rev F 12/94