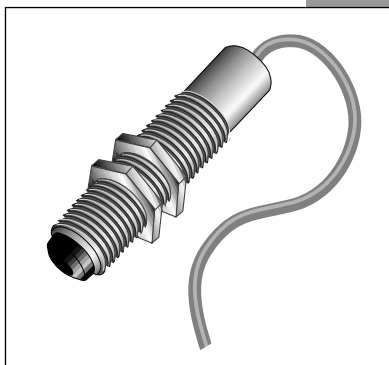


CI



THERMALERT® CI™

COMPACT INFRARED
SENSOR

OPERATOR'S GUIDE



Rev K
11/2009
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THERMALERT SERIES

THERMALERT CI

The Thermalert® CI™ Compact Infrared Sensor series of online instruments are noncontact infrared temperature measurement systems. They are designed to measure accurately and repeatably the amount of heat energy emitted from an object and to convert that energy into a measurable electrical signal.

Each model (see Table 1) comes with a 1 m (3 ft) cable and two mounting nuts and is designed for easy integration into standard 4-wire systems. There are J or K thermocouple output models or 10 mV/°C voltage output models if your application is susceptible to noise or requires a long cable run. The electronics are protected by a rugged NEMA 4 stainless steel housing.

Table 1: Models

Model	Output	Overall Temp. Range	Accuracy
CI1A	J Thermocouple	0 to 350°C (32 to 662°F)	0 to 1150°C (32 to 2400°F) larger of $\pm 2\%$ or $\pm 0.5^\circ\text{C}$ ($\pm 0.9^\circ\text{F}$)
CI2A	K Thermocouple		116 to 225°C (241 to 440°F) larger of $\pm 5\%$ or $\pm 6.0^\circ\text{C}$ ($\pm 10.8^\circ\text{F}$)
CI3A	Voltage		226 to 350°C (441 to 662°F) $> \pm 5\%$
CI1B	J Thermocouple	30 to 500°C (86 to 932°F)	100 to 500°C (212 to 932°F) larger of $\pm 2\%$ or $\pm 0.5^\circ\text{C}$ ($\pm 0.9^\circ\text{F}$)
CI2B	K Thermocouple		30 to 99°C (86 to 211°F) larger of $\pm 5\%$ or $\pm 6.0^\circ\text{C}$ ($\pm 10.8^\circ\text{F}$)
CI3B	Voltage		

TWO YEAR LIMITED WARRANTY

Raytek warrants this product to be free from defects in material and workmanship under normal use and service for a period of two years from date of purchase except as hereinafter provided. This warranty extends only to the original 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 covered product 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 a case, 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.

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ACCESSORIES

A full range of accessories for various applications and industrial environments are available (see Figure 1). Accessories may be ordered at any time and added on-site. Also available is a J- or K-type thermocouple connection kit and extension cables.

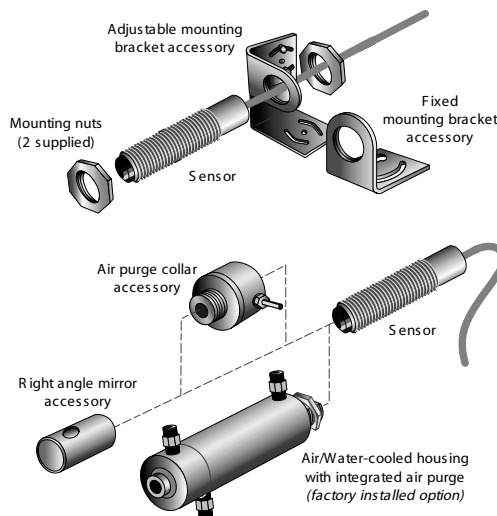


Figure 1: Accessories and Options

OPTIONS

Options for various applications and environments are available. **Options are factory installed and must be ordered with base model units.** These include the following:

- NIST traceable certification
- Air / Water-cooled housing (comes with integrated air purging and high temperature cable)
- High temperature cable—260°C (500°F) maximum ambient temperature (comes standard with air / water-cooled housing option)
- Longer 3 m (10 ft) standard cable

SPECIFICATIONS

Table 2 (below and continued on Page 4) lists the sensor's optical, thermal, operational, electrical, environmental, and physical specifications.

Table 2: Specifications

Optical Resolution	4:1 @ 90% energy
Spectral Response Range	7–18 μm
Thermal	
Measurement range	See Table 1
Detecting element	Thermopile
Accuracy	See Table 1
Repeatability	$\pm 1\%$ of reading
Temperature coefficient	0.2° C per °C (0.2° F per °F)
Operational	
Temperature resolution	< 0.5° C (1° F)
Emissivity	Fixed at 0.95
Response time	350 mSec (95% response)
Warm-up period	< 1 minute

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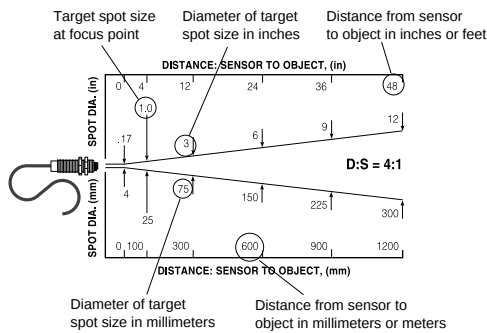
Table 2 (continued): Specifications

Electrical	
Power supply voltage	12 – 24 VDC @20 mA
Maximum current draw	≤ 10 mA
Ripple	$\leq 2.5\%$
Output impedance	50 ohms
Minimum load impedance	50K ohms
Outputs	J or K thermocouple, 10mV/°C Linear Voltage
Environmental	
Sensing head rating	IP 65, NEMA 4
EMI	
Conducted noise immunity	IEC 801-4, Level 1
Relative humidity	10 to 95%, non-condensing
Storage temp. range	-30 to 85° C (-22 to 185° F)
Thermal shock	Max error of 5° C (for $\Delta T=25^\circ$) stabilization time=20 mins.
Ambient operating range	0 to 70° C (32 to 160° F)
air cooling	0 to 94° C (32 to 200° F)
water cooling	0 to 105° C (32 to 220° F)
water cooling/high temp cable	0 to 260° C (32 to 500° F)
Physical	
Dimensions	19 mm dia x 87 mm L (0.75 in dia x 3.4 in L)
Weight	130 g (4.5 oz)
Material	Stainless steel
Cable—Standard	
Maximum ambient temperature	105° C (220° F)
Material (type & color)	PVC, grey
Cable length	1 m (3 ft)
Gauge	AWG 24 (J, K t/c cable) AWG 22 (10mV/°C cable)
Cable—High Temperature	
Maximum ambient temperature	260° C (500° F)
Material (type & color)	Teflon, black
Cable length	1 m (3 ft)
Gauge	AWG 24

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Optical Chart

Figure 2 shows you how to read the optical chart. The optical chart (Figure 3) indicates the nominal target spot diameter at any given distance from the sensing head and assumes 90% energy.



Focus Point D:S = Distance to spot divided by spot diameter at the focus point
Far Field D:S = Ratio at distances greater than 10x the focus distance

Figure 2: How to Read the Optical Chart

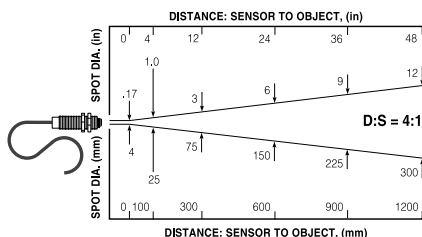


Figure 3: Optical Chart

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INSTALLATION

The installation process consists of the following:

- Preparation
- Mechanical Installation
- Electrical Installation

The most important part of the installation process is preparation. Please read the following section thoroughly before proceeding with the mechanical and electrical installations.

Preparation

Distance and Spot Size—The size of the area (spot size) you wish to measure determines the distance between the sensor and the target (see Figure 3 for distances and spot sizes). The spot size must not be larger than the target. Mount the sensor so the measured spot is the same or smaller than the target. Figure 4 is an overview of proper sensor placement.

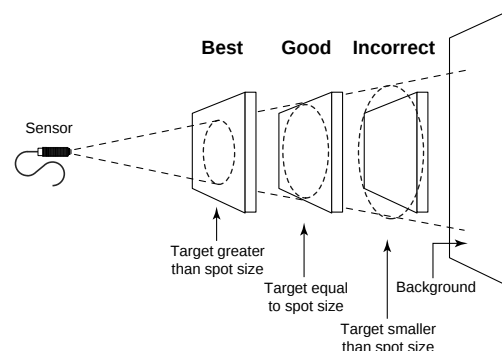


Figure 4: Proper Sensor Placement

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Ambient Temperature—The sensing head is designed to operate in ambient temperatures from 0 to 70°C (32 to 160°F). For ambient temperatures above 70°C (160°F), a factory installed air / water-cooled housing option is available that allows operation in ambient conditions up to 260°C (500°F) with water cooling. The air / water-cooled housing option comes with a high-temperature cable and integrated air purging.

Atmospheric Quality—Smoke, fumes, dust, and other contaminants can coat the lens and cause erroneous temperature readings. We recommend using the air purge collar accessory in these types of environments to keep the lens clean. (The air / water-cooled housing comes with integrated air purging.)

Electrical Interference—To minimize electrical or electromagnetic interference or “noise,” mount the sensor away from motors producing large step load changes.

Wiring—Before installing, be sure to check the distance between the sensor and the monitoring / controlling device. If necessary, extension cables are available as accessories.

Power—Have available a 12–24 VDC, 10 mA, power supply.

Mechanical Installation

All sensors come with a 1 m (3 ft) cable and 2 mounting nuts. You can mount the sensor in brackets or cutouts of your own design, or you can use the fixed and adjustable mounting bracket accessories. Figures 5 through 7 show the mounting bracket accessories' and sensor's dimensions.

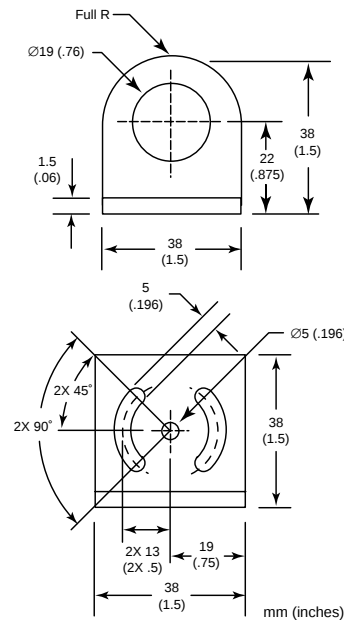


Figure 5: Fixed Mounting Bracket

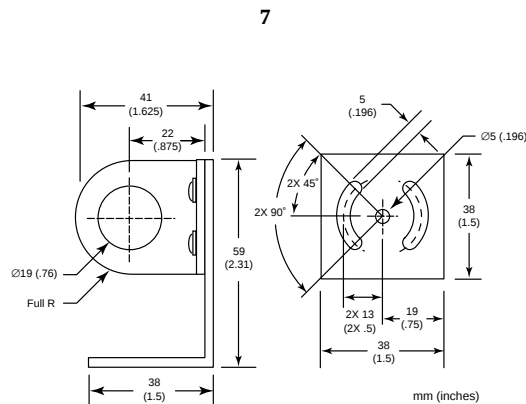


Figure 6: Adjustable Mounting Bracket

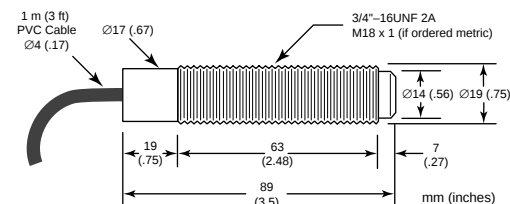


Figure 7: Sensor

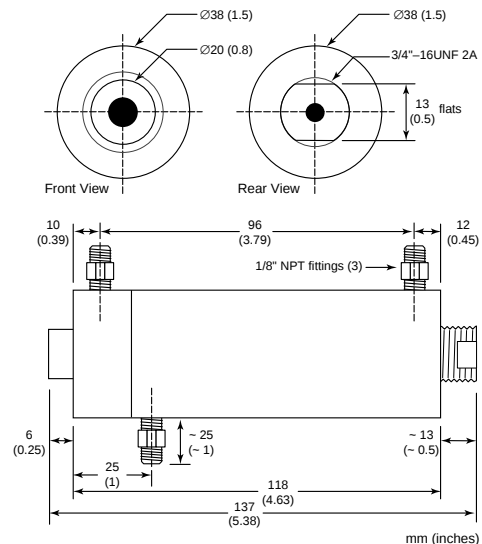


Figure 8: Air / Water-cooled Housing

Air Purge Collar—The air purge collar accessory (Figure 9) is used to keep dust, moisture, and other contaminants away from the lens. It must be screwed in fully. Air flows into the 10/32" fitting and out the front aperture. Clean or "instrument" air is recommended. *The air purge collar accessory is not needed with the air/water-cooled housing.*

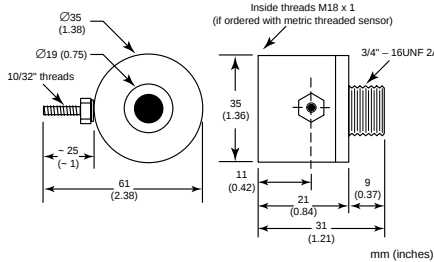


Figure 9: Air Purge Collar

Table 3: Recommended Water and Air

Recommended	
Cooling water supply	
Temperature	15–30° C (60–86° F)
Flow rate	1.89 liters per min (0.5 gpm)
Pressure drop (across unit only)	< 0.69 bar (10 psi)
Cooling air supply	
Temperature	< 30° C (< 86° F)
Flow rate	70.8 liters per minute (2.5 SCFM)
Pressure drop (across unit only)	< 0.34 bar (5 psi)
Air purge air supply	
Temperature	< 30° C (< 86° F)
Flow rate	11.33 liters per minute (0.4 SCFM)
Pressure drop (across unit only)	< 0.34 bar (5 psi)

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Electrical Installation

Sensor to Electronics Cable—The sensor to electronics cable is a 1m (3 ft), 4-wire, PVC cable. One end is attached, at the factory, to the sensor head. The other end has two pairs of wires and a bare shield (ground) wire (see Figure 11).

The unlabeled pair of wires is for connecting to a controller or chart recorder or for attaching to a thermocouple plug (for connecting to a thermocouple meter). **DO NOT CONNECT TO A POWER SOURCE.**

The second pair of wires, with the label, is for connecting to a power source.

WARNING

Incorrect wiring will cause severe, permanent damage to the sensor.

Pay close attention to the wiring diagram in Figure 11, and match your sensor to the appropriate output type in Table 4 or 5. Wire accordingly.

DO NOT CONFUSE OUTPUT WIRES WITH POWER SUPPLY WIRES.

Right Angle Mirror—The right angle mirror accessory (Figure 10) allows a perpendicular view of a target. It may be used when space is limited or when you need to avoid excessive radiation to the sensor. This can be mounted either on the end of the sensor or on the air purge collar, but not on the air / water-cooled housing.

Note: When using the right angle mirror, a small amount of energy emitted by the source is lost, which results in a lower than actual temperature reading. To compute the corrected temperature, use this formula:

$$T = 1.035T_m - .035T_{amb}$$

where T=corrected temperature, T_m=temperature reading with mirror, and T_{amb}=ambient temperature. All temperatures are in either °C or °F.

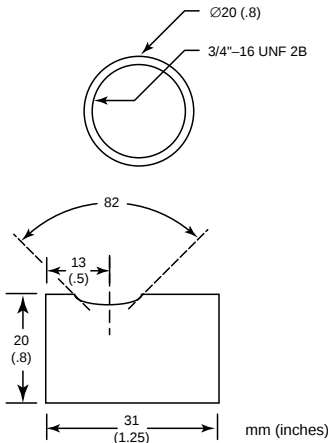


Figure 10: Right Angle Mirror

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Wiring—Wire the electronics cable using Figure 11 and Table 4 or 5 (for high temp cables) as a guide. **USE ONLY THE OUTPUT TYPE OF YOUR SENSOR. WIRING TO THE WRONG OUTPUT WILL DAMAGE THE SENSOR.** Note in Figure 11 that the numbers refer to the wire numbers in Table 4 or 5, which shows proper wiring connections based on insulation color coding.

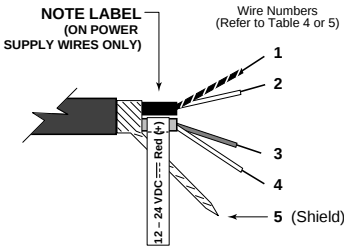


Figure 11: Wiring Configuration

Table 4: Standard Cable Wiring

Output	Label	Wire Number	Wire Color	Function
J-type Thermocouple	Output	1	White	Signal + (Iron)
		2	Red (white stripe)	Signal – (Constantan)
	Power Supply	3	Red (yellow stripe)	Power Supply +
		4	Yellow	Power Supply –
	–	5	Bare	Shield Ground
K-type Thermocouple	Output	1	Yellow	Signal + (Chromel)
		2	Red (yellow stripe)	Signal – (Alumel)
	Power Supply	3	Red (white stripe)	Power Supply +
		4	White	Power Supply –
	–	5	Bare	Shield Ground
10mV/°C Voltage	Output	1	White	Signal +
		2	Green	Signal Ground
	Power Supply	3	Red	Power Supply +
		4	Black	Power Supply –
	–	5	Bare	Shield Ground

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Table 5: High Temperature Cable Wiring

Output	Label	Wire Number	Wire Color	Function
J-type Thermocouple	Output	1	White	Signal + (Iron)
		2	Red (white stripe)	Signal $\bar{\Delta}$ (Constantan)
	Power Supply	3	Red	Power Supply +
		4	Yellow	Power Supply $\bar{\Delta}$
	$\bar{\Delta}$	5	Bare	Shield Ground
K-type Thermocouple	Output	1	Yellow	Signal + (Chromel)
		2	Red	Signal $\bar{\Delta}$ (Alumel)
	Power Supply	3	Red (white stripe)	Power Supply +
		4	White	Power Supply $\bar{\Delta}$
	$\bar{\Delta}$	5	Bare	Shield Ground
10mV/°C Voltage	Output	1	Red	Signal +
		2	Yellow	Signal Ground
	Power Supply	3	Red (white stripe)	Power Supply +
		4	White	Power Supply $\bar{\Delta}$
	$\bar{\Delta}$	5	Bare	Shield Ground

Extension Cables—Extension cables are available as accessories. Also available is a thermocouple connection kit.

IMPORTANT

Be aware of the following when using the sensor:

If the sensor is exposed to significant changes in ambient temperature (hot to cold or cold to hot), allow 20 minutes for the temperature to stabilize before taking or recording measurements.

Do not operate the sensor near large electrical or magnetic fields (e.g., around arc welders or induction heaters). Electro-Magnetic Interference (EMI) can cause measurement errors.

Connectors or wires must be connected only to the appropriate input jacks or terminals.

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Table 6: Troubleshooting

Symptom	Probable Cause	Solution
No output	No power to sensor	Check the power supply
Erroneous Temp.	Incorrect wire connection	Check wire color codes and reconnect
Erroneous Temp.	Faulty sensor cable	Verify cable continuity
Erroneous Temp.	Field of view obstruction	Remove obstruction

Lens Cleaning—Keep the lens clean at all times. Blow off loose particles (if not using the air purge accessory) with clean compressed air, then carefully wipe surface with moist cotton swab (water or water-based glass cleaner). DO NOT use solvents.

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OPERATION

Once the sensor is in position and you have made sure that the appropriate power, air, water, and cable connections are secure, the system is ready for continuous operation.

To operate, complete the following simple steps:

1. Turn on the power supply.
2. Turn on the meter, chart recorder, or controller.
3. Read/ monitor the temperature.

WARNING

If using the air/water-cooled housing, do not leave it in a heated environment with the coolant turned off. Damage to the sensor and to the housing can occur.

MAINTENANCE AND TROUBLESHOOTING

If your sensor is not performing as it should, try to match the symptom in Table 6 to its probable cause. If the table does not help, call us at one of the phone numbers listed on the last page.

Our customer service representatives are always at your disposal for application assistance, calibration, repair, and solutions to specific questions or problems. Contact our Service Department before returning any equipment to us. In many cases, problems can be solved over the telephone.

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