INSTALLATION AND OPERATION MANUAL

FOR

THE PYROSIGHT SERIES

Release 1

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CALEX TWO YEAR WARRANTY

Calex Electronics Limited warrants to the purchaser of each new temperature sensor that any part thereof that proves to be defective in material or workmanship within two (2) years from the date of shipment will be repaired or replaced at no charge. Calex requires that the instrument be returned to Calex with all freight charges prepaid. The repair or replacement work will be scheduled with the customer and return shipped by UPS ground. If the customer requests a premium delivery service, the customer will pay the difference between the ground and premium service.

If a performance problem should occur, contact our representative in your area or our office.

This warranty does not cover defects resulting from accident, alteration, improper use, or failure of the purchaser to follow normal operating procedures as outlined in the installation and operation manual. Calex will inspect each sensor returned to verify its proper use and the nature of the defect or damage reported.

THIS WARRANTY IS IN LIEU OF ANY WARRANTY OF MERCHANTABILITY AND OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, ALL OF THAT ARE HEREBY EXCLUDED. Calex Electronics Limited shall in no event be liable for any special, indirect, or consequential damages whatsoever, and neither assumes nor authorizes any person to assume for it any other obligation or liability.

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1.0 Introduction

For over fifty years, Calex has been in the business of improving process control and product quality through noncontact temperature measurement. Through our worldwide distribution network, we offer a comprehensive line of industrial temperature sensors as well as several innovative technologies for applications considered difficult to measure. With our extensive application experience that focuses on solving customer problems, we are also committed to providing the quality service and support that is essential for building long term customer partnerships.

We appreciate your commitment to purchase this Calex temperature sensor, and we are available to provide assistance and support with any installation or application issues. For specific questions or feedback, you can contact our local representative or our main office directly.

This manual provides a description of the installation and operation of the PyroSight Series sensors. It includes detailed information about

- the sensor specifications
- installation and operating procedures
- maintenance and calibration procedures

For more additional information about other Calex products, accessories, application information, or troubleshooting notes, please visit our web site at www.calex.co.uk

1.2 Overview of Infrared Temperature Sensors

Infrared temperature sensors measure the surface temperature of objects without contact. The sensors work based on the principle that the infrared energy emitted by an object is proportional to its temperature. Like a camera, the sensors use an optical system to collect the radiant energy emitted by the measured target. This energy is focused on an infrared detector that provides an output signal that varies with the intensity of the energy. This signal is then processed by the sensor electronics to provide the desired temperature output. This temperature output can be displayed on a digital meter, or it can be in the form of an output signal that varies linearly with temperature. These temperature output signals can be input into a computer, controller, recorder or other device for process monitoring and control.

1.1

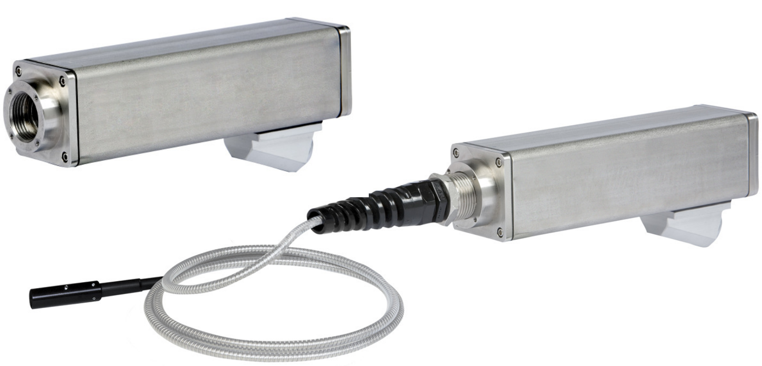


Figure 1 – From left to right; PyroSight, PyroSight F, and optional Interface Module

2.0 System Specifications

2.1 General Specifications

Table 1 provides a summary of the standard functions and specifications for the PyroSight Series sensors. All Calex sensors are precisely calibrated to standards that are compared daily against standards directly traceable to the National Institute of Standards and Technology (NIST) in accordance with Calex procedures and ANSI/NCSL Z540-1-1994.

PyroSight Series Specifications	
Type of Sighting	Line of Sight, Laser Aiming, or Fiber Optic with Aiming Light option
Temperature Limits	-50 to 4500°F (-45 to 2500°C). Field adjustable span in °F or °C.
Field of View	The FOV definition is 90% of the energy. Minimum Focus distance for PyroSight 20 is 10in(25cm) or 12in(30cm with Laser Aiming option and PyroSight 30 and SRU Min. Focus distance is 2in(5.1cm) . The actua working distance can be different but the Field of View of SingleWavelength Sensors must be filled with the target in to produce an accurate temperature measurement.
Spectral Response	Wavelengths vary by model. All PyroSight Series sensors are <u>SingleWavelength</u> infrared pyrometers.
Accuracy	0.25% to 1.0% of Reading or 2°C (varies by model)
Repeatability	Better than 1°C
Response Time	10ms for </= 2.2 micron models; 80ms for other models plus 100ms when optional Interface Module is used
CE Certification	EMI / RFI for heavy industry; LVD (Low Voltage Directive)
Ambient Temperature Limits	**Sensor Head:** 0 to 140°F (-17 to 60°C) **Interface Module:** 0 to 120°F (50°C) **Sensor w/ Water Cooling:** 200-350°F (95-175°C) (this varies with water rate and temperature) **Fiber Optic Assembly:** 400°F (200°C) max.
Input Power	**Stand-alone Sensor:** 24Vdc (300mA Max); **Interface Module:** 90-260Vac, 50/60Hz, 0.1A
Input and Output Signals	**Stand-Alone Sensor Configuration:** <u>**Analog Mode**</u> • 4-20 mA or 0-20 mA (1000ohm max. impedance) • Analog input to adjust Emissivity or Alarm Set Point • Select parameter, scale, & range of output & alarm • SPST Relay (2A at 24Vdc) <u>**Digital Mode**</u> • Bi-directional RS485 non-addressable • For connection to the Interface Module **System Configuration With a Sensor and Interface Module** **2 Programmable Analog Outputs** • 4-20 mA or 0-20 mA (1000ohm max. impedance. Shunt resistors produce voltage outputs.) • Select parameter, scale, and range **3 Analog Inputs** • Sample and Hold • External Peak Hold Reset • Analog input to adjust Emissivity & Alarm Set Point **Bi-directional Serial Communications** • RS232 and RS485 simultaneously **2 Programmable Alarms** • SPDT Relay (2A at 110Vac) • Select alarm parameter and set point **1 Programmable TTL Alarm** • TTL rating is 2 ma at 5Vdc • Select alarm parameter and set point
Programmable output and alarm parameters	Filtered Temperature, Unfiltered Temperature, and Ambient Temperature.
Signal Conditioning	Average Time, Out of Range, Peak Hold Delay, Emissivity
Status messages	Out of Range, Ambient Warning, Establishing Communications, and Aiming System Status (optional)
Diagnostics	System Test, Analog Output Tests, Alarm Tests, Menu Access/Security
User Interface	**Sensor:** 3 navigation buttons and a 2x8 LED Display **Interface Module:** 4 navigation buttons, a main display with 5 LEDs, and a 2x16 back lit LCD Display
Enclosure Rating	**Sensor:** NEMA 4X (IP65); options for NEMA7 or ATEX ExII2GEExdIIC – Stainless Steel Enclosure **Interface Module:** NEMA 12 front panel - Anodized Aluminum Housing
Dimensions	**Sensor NEMA4:** 7.9 x 2 x 3.1inches (201 x 51 x 80mm) ; plus Fiber Cable and Flange Mounts. **Sensor NEMA7 or ATEX:** 7.8inches (197mm) height; 5inches (127mm) diameter plus approximate minimum 12 inches(300mm) diameter clearance needed around base for Wiring and Fiber Cable entries. **Interface Module:** 7.0 x 3.78 x 3.78inches (178 x 96 x 96mm)
Weight	**Sensor NEMA4:** 2.8 lbs (1.25kg) + Options and Accessories **Sensor NEMA7 or ATEX:** 11 lbs (5kg) + Options and Accessories **Interface Module:** 2.2 lbs. (1kg)

Table 1 – PyroSight Series Sensor and Interface Module Specifications

2.2 FIELD OF VIEW SPECIFICATION

Figure 2 - Field of View Specification

2.3 Sensor Options and Accessories

Each sensor includes options and accessories that have been designed to simplify the sensor installation and operation or to provide additional protection for the sensor in hostile operating conditions. Table 2 provides a narrative description of each of these items, while appendix 6.3 includes dimensional drawings and assembly instructions, as required, for each component.

PYROSIGHT SERIES OPTIONS AND ACCESSORIES **Code**	**Description**
DISPLAY, SIGNAL CONDITIONING, AND POWER OPTIONS	
IM	**Interface Module** ¼ DIN for Panel Mounting or Bench Top use. ❑ Power Input: 90-260Vac 50-60Hz 0.1A ❑ Two Analog Outputs: (0)4-20mA ❑ Bi-directional RS232 and/or RS485 non-addressable (can be used simultaneously) ❑ Two SPDT Relays rated 2A @ 24VDC, and one TTL Alarm ❑ NEMA 12 Front Panel Refer to sections 3.2.2 and 3.4 for additional details.
nCF or nCM	**Sensor electrical cable**. Standard lengths available from 10ft (3m) to 1000ft (305m)
SENSOR INSTALLATION AND OPERATION ACCESSORIES	
LA	**Laser Aiming** option for **PyroSight 20** camera style sensors centers the red laser dot in the measurement area. Class II diode @ 670nm <2w output
AL	**Aiming Light** option for **PyroSight 30** and SRU fiber optic style sensors illuminates the measurement area and is used for fiber cable integrity checks. LED white light.
SB	S**wivel-mounting bracket** provides the ability to tilt and turn the alignment of the sensor.
FMxx	**Selection of Flange Mounts**
HOSTILE OPERATING ENVIRONMENT ACCESSORIES	
AP	The **air purge** option can be attached to the sensor's lens/window system to provide protection and improve measurement results with applications involving airborne contaminants.
WCAP	The **water cooling and air purge** option enables the use of water-cooling to maintain the sensor's ambient temperatures within specified limits. This option includes the air purge option described above. Water or vortex cooling (VCS) can be used with this option.
VCS	Vortex Cooling System – To be used in place of water with the water cooling air purge system
MF	Metric threads on Air and/or Water fittings; ¼" BSPT (R-1/4")
PACS	This **purge air control system** provides a regulator and air filter for the air purge system.

Table 2 – PyroSight Series Options and Accessories

3.0 Installation Procedures

3.1 Planning The Sensor Installation

For many applications, the proper installation planning and operating procedures can provide improved results with more accurate measurements, reduced maintenance requirements, and a longer operating life for the sensor.

While measurement of a target's surface temperature is the primary concern, other factors with the process and the environment must be considered when planning the installation of a sensor. As is illustrated in Figure 3, these issues include:

- the characteristics of the measured target
- the sensor alignment or field of view (FOV)
- the existence of intervening media
- the existence of background or surrounding influences

The basic steps to install a sensor are:

1. Mount the sensor in a location to properly view the target (section 3.2.1).
2. Mount the optional interface module for easy viewing and operation of the sensor (section 3.2.2).
3. Connect the sensor power and interconnect cables. The system will power on once the proper connections are established (section 3.4).
4. Review and adjust the sensor settings in order to optimize the performance for the application. For most applications, no adjustments are required (see section 4.0).

Calex offers many options and accessories that can simplify this process and enhance the durability of the system for extreme operating conditions (see our web site for more details).

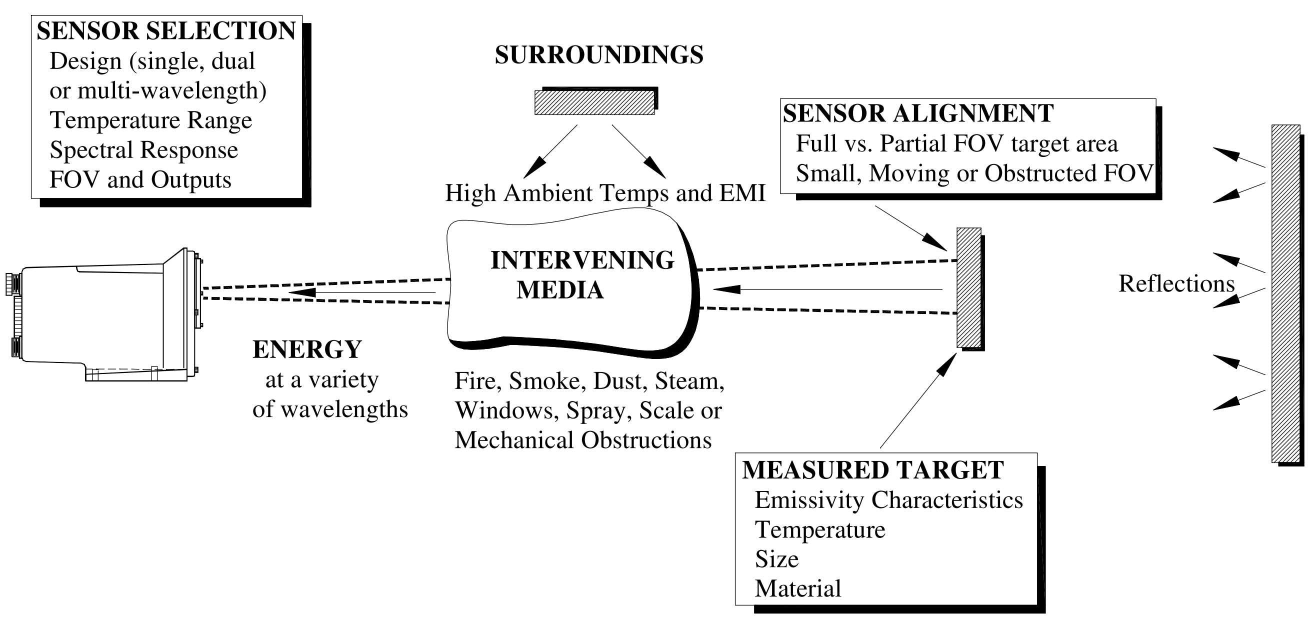


Figure 3 – Overview of Application Issues

3.2 Mechanical Installation

3.2.1 Mounting the Sensor

Because the sensor measures temperature by collecting infrared energy emitted from a specified target area, it is very important that the sensor is properly installed and aligned to the target. An appropriate location of the sensor:

- provides a direct view of the measured target
- is out of the way of plant personnel, moving equipment, and maintenance access panels
- minimizes the sensor's exposure to severe ambient temperature conditions
- minimizes the interference of outside influences like background reflections or intervening media such as oil, smoke, water, or dust that can build up on the lens or dilute the energy signal

As figure 4 illustrates, the sensor enclosure includes 4 tapped mounting holes and a ¾ inch female pipe thread on the front of the sensor. See section 2.4 for additional installation accessories that can enhance the mounting capabilities of the sensor.

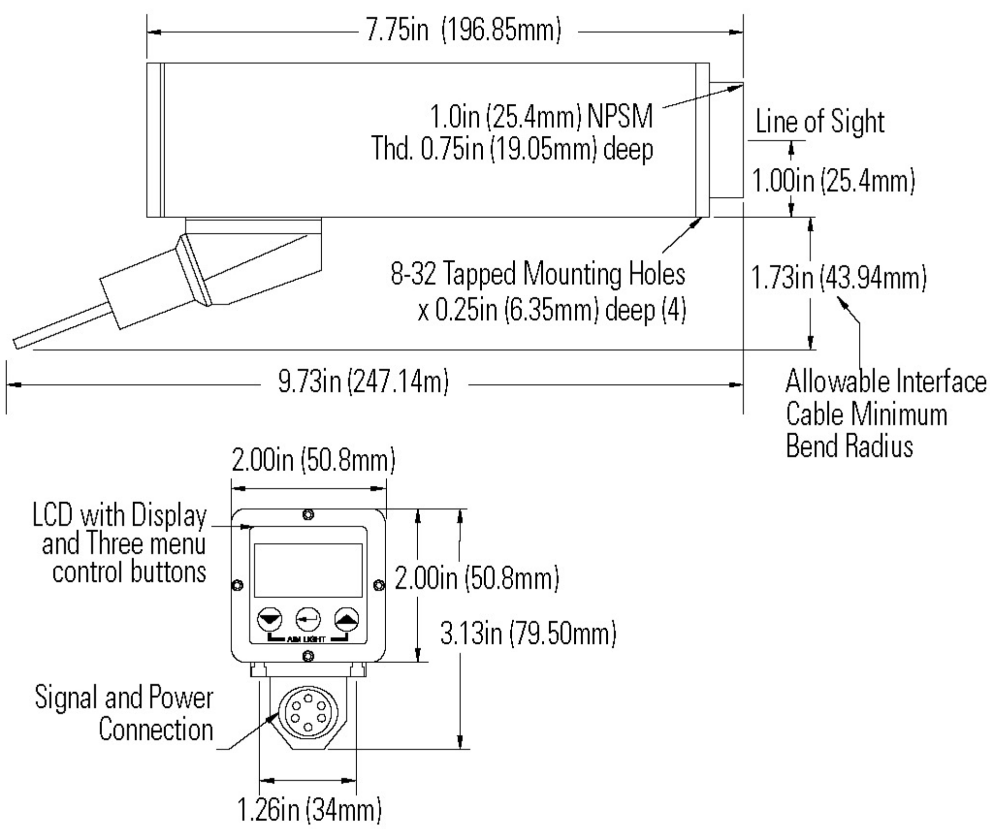


Figure 4 – PyroSight Camera Style Dimensions

3.2.2 Mounting the Optional Interface Module

The remote interface module may be placed on a counter or mounted to a panel. The module is standard 1/4 DIN dimensions with a NEMA12 front panel rating.

For installations on a counter, the rear connections of the module must be protected from dust and moisture. For installations in a panel, air circulation must be adequate to maintain proper ambient temperature limits of less than 120°F (50°C).

To mount the interface module (figure 5) to a panel:

1. Prepare a square 3.63 inches (92cm) panel cutout. If more than one display is being installed, allow 1 inch (2.5cm) between cutouts.
2. Remove the top and bottom mounting bars using the setscrews located on the rear panel as well as the rubber feet on the bottom of the enclosure.
3. Slide the interface module, terminal end first, into the front of the mounting panel.
4. Return the mounting bars into their original locations.
5. Tighten the mounting bars against the panel using the rear set screws.

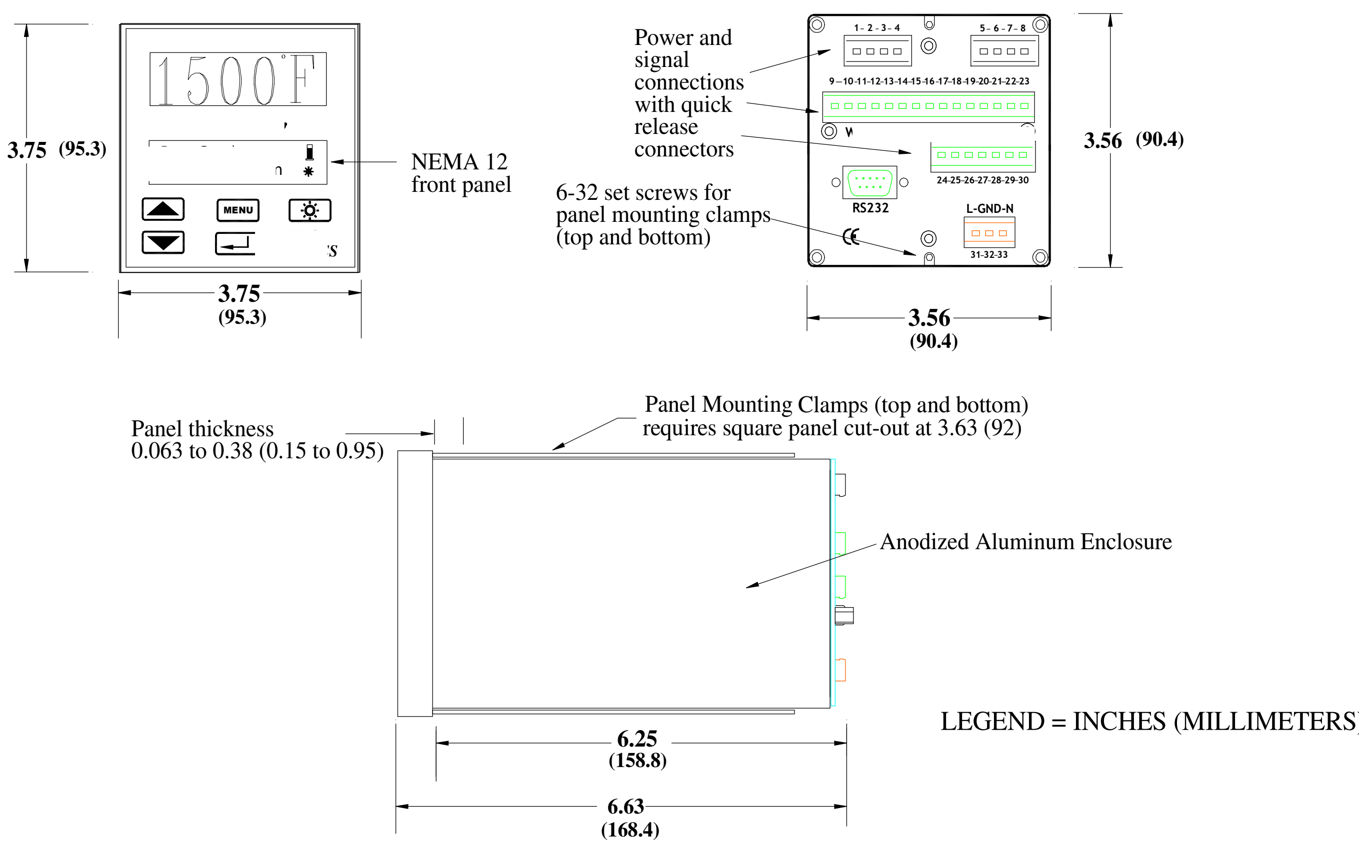


Figure 5 – Interface Module Dimensions

3.2.3 Connecting the Water Cooling Option for High Ambient Conditions

Depending on the application environment and the location of the sensor, it is often common for the sensor enclosure to be exposed to high ambient temperatures either from the radiant energy of a near by high temperature target or from the high temperature of the general operating environment. For these situations, a Water Cooling (WC) or Water Cooling/Air Purge (WCAP) option is available to cool the sensor enclosure to within acceptable limits (see section 2.1).

The PyroSight Series sensors include the ability to measure their own ambient temperature. This measured parameter is used to trigger an internal ambient status message when the sensor goes above its ambient limit. It can also be configured for use with the outputs and alarms for external monitoring of the ambient conditions.

The optional WC plate is attached to the bottom of the sensor and includes two additional fittings that are used to circulate water through the plate to cool the sensor (see Figure 6). For the best results, the water source temperature should be less than 75°F (24°C), and the water flow rate should range between **1 to 5 gallons (4-20 liters) per HOUR**. A sensor using the WCAP option can operate in **ambient temperatures ranging from 200-300°F (95-150°C)** depending on the water temperature and flow rate. In addition to the water cooling function, the WCAP option includes an air purge assembly that is used to limit the formation of condensation on the cooled protective window, as well as to clear contaminants from the lens.

Other options to consider for a sensor exposed to high ambient temperatures are:

1. Different sensor optics that permit the sensor to be installed further away in a cooler location.

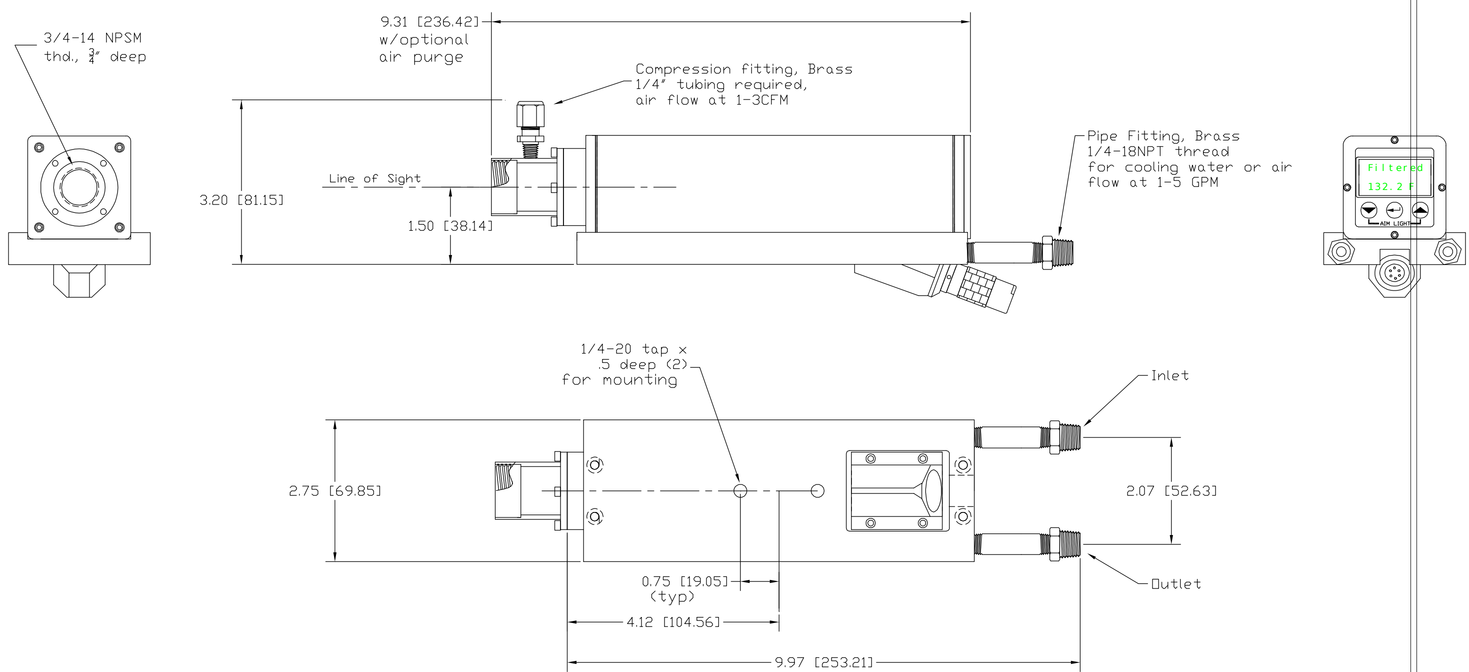
2. A radiation shield (RS) is available from Calex to shield the sensor enclosure from the radiant energy of a high temperature target.

3. Fiber optic sensors (PyroSight 30 or SRU) use a fiber cable and lens assembly with an ambient limit of 400°F (200°C) to focus on the measured target. This enables the more sensitive sensor electronics to be installed in a protected, remote location away from the high temperatures.

4. For moderate ambient conditions, a vortex cooling system (VCS) (see section 2.4) can be used in place of water to cool the sensor through the water cooling system.

3.2.4 Connecting the Air Purge Option for Applications with Airborne Contaminants

An air purge (AP) option can be attached to the sensor's lens/window system to provide protection and improved measurement results with applications involving airborne contaminants. The aluminum tube air purge assembly includes an air flow fitting for the circulation of clean, dry air (or an inert gas, like nitrogen) into the air purge assembly and across the lens/window system (see Figure 6). **If plant air is used for the air purge, it should be cleaned with a filter system.** Unfiltered plant air is typically too dirty and only contributes to the problems of a dirty window and additional sensor maintenance. Calex has an optional **Purge Air Control System (PACS)** that provides a regulator and air filter for the air purge system.



Dimensions: inches (mm)

Figure 6 – Water Cooling and Air Purge Options

3.3 Aligning the Sensor to the Target

3.3.1 Guidelines for Typical Installations

Calex temperature sensors use a fixed optical system to 'focus' on the desired target area. The energy collected by the sensor within this target area is the basis for calculating the measured target's temperature. As illustrated in Figure 7, the sensor's Field of View (FOV) is a cone shaped optical pattern that is defined by the **diameter of the target area (d)** and **the working distance (D)** of the sensor to the measured target. Section 2.2 provides the field of view curve that defines the measured target diameter at all working distances for the sensor purchased.

The PyroSight Series sensors require a manual line of sight alignment of the sensor to the target (unless the unit includes the built in laser aiming or aiming light option). It is also possible to verify the proper alignment of the senor by adjusting the alignment of the sensor until the proper temperature is measured. This means that:

1. The measured target area fills the sensor's FOV target area.
2. The sensor should have a clear line of sight without any obstructions or intervening media within the sensor's FOV. This is particularly important when viewing through a window, sight hole, or sight tube.
3.
4. The viewing angle from the normal of the target should be no greater than 45° when measuring a smooth or shiny surface This reduces the potential of viewing reflected energy that effects the sensor's accuracy. For non-reflective targets (emissivity greater than 0.3), a sensor can be aligned at a 75° angle from the normal.

For applications involving precision alignment or difficult to view targets, these alignment issues require careful consideration during the installation and on-going operation of the sensor to insure optimal measurement results. The next three sections provide guidelines for applications involving more complex alignment requirements.

If the standard mounting features do not enable the proper mounting and alignment of the sensor, section 2.4 provides a summary of additional mounting accessories.

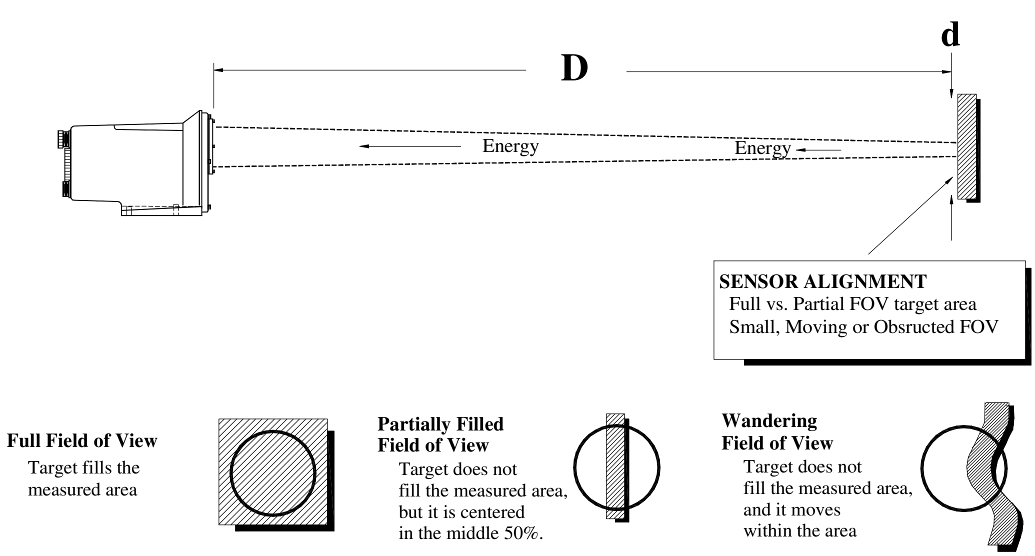


Figure 7 – Full vs Partial Filled Field of View

3.3.2 Guidelines for Precise Alignment

There are several reasons a measured object may not fill a sensor's FOV (see figure 7).

1. The target may be too small.
2. The target may be moving within the process and within the FOV.
3. There may be objects that obstruct the sensor's ability to view the entire measured surface.

All three of these factors must be addressed when selecting and installing a single wavelength sensor.

There are several options available to help improve the alignment of the sensor.

1. Using the sensor's FOV curve provided in Section 2.2, it may be possible to adjust the location of the sensor relative to the target in order to obtain the minimum sensor target diameter.

2. It may be possible to re-focus the sensor or consider an alternative smaller spot optics system.

3. A laser aiming option can be considered to make it easier to verify the sensor's alignment to insure a full FOV.

4. For applications where the measured surface only 'partially' fills the sensor's FOV target area, it is possible to use a dual or multi wavelength sensor because they measure the hottest temperature in the FOV target area.

3.3.3 Guidelines for Viewing through Windows or Sight Holes

For some applications, like a process in a vacuum or in an inert atmosphere, a sensor is required to measure through a viewing window. In order to achieve accurate and repeatable temperature measurement results, it is important to know the material of the window, and it's effect on the transmission of the energy signal. Depending on the sensor involved, the window material and thickness may dilute the energy signal at a particular energy wavelength. Suitable window materials and sensor selections are listed in Table 3.

As with any installation, proper sensor alignment is important with these applications to make sure the sensor has a clear view of the target. Of particular concern with a viewing window, sight hole, or sight tube is that the hole diameter is large enough to allow the sensor's field of view (FOV) to clear the hole or window and view the target.

As long as the measured target fills the sensor's FOV, it is possible to adjust the sensor's calibration in order to accurately compensate for a variance in the energy transmission levels created by the viewing window.

Using the Emissivity adjustment, it is a straightforward process to adjust for any constant offset. The procedure is to:

1. Sight the instrument on a heat **source at or near the top of the sensor's range** (or at the top of the temperature range for the application) and record the temperature value.

2. Insert the window, or a piece of the window material, between the instrument and the heat source. Any effects caused by the window transmission will be revealed by a change in the temperature value.

3. Adjust the emissivity parameter until the same temperature value without the window is achieved. An increase to the emissivity value will lower the sensor's temperature, while a decrease will raise the sensor's temperature.

4. Verify the repeatability of the results.

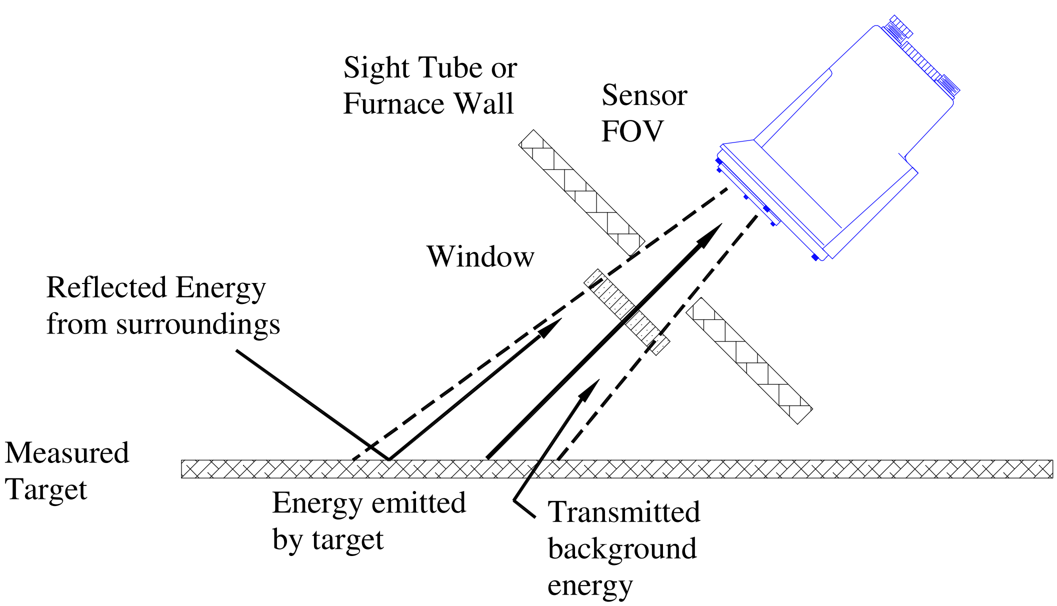


Figure 8 – Sensor Alignment Guidelines

VIEWING WINDOW SELECTION GUIDE							
Approximate Spectral Region (µm)	**Sensor Selection**	**AVAILABLE WINDOWS**					
		Pyrex	**Water-free Quartz GE #125**	**Sapphire**	**Zinc Selenide, Zinc Sulfide**	**Calcium Fluoride**	**Germanium (AR coated)**
0.8	G1, 21, 31, 41, 51, 81, 91, 110, 210	Suitable x=0.92	Suggested x=0.94	Suitable x=0.85	Suitable x=0.70	Suitable x=0.94	No
2.4	G2, 22, 32 42, 52, 82, 92, 120, 220	No	Suggested x=0.94	Suitable x=0.85	Suitable x=0.70	Suitable x=0.94	No
3.4	43	No	Suggested x=0.94	Suggested x=0.88	Suitable x=0.70	Suitable x=0.94	No
3.8	G4, 24, 44	No	No	Suggested x=0.88	Suitable x=0.70	Suitable x=0.94	No
5.1	G5, 25, 45	No	No	Suitable x=0.88	Suitable x=0.70	Suggested x=0.94	Suitable x=0.97
8.0	G8, 28, 48	No	No	No	Suggested x=0.70	Suggested x=0.94	Suggested x=0.97
8-14	G9, 29, 49	No	No	No	Suggested x=0.70	No	Suggested x=0.97
Suggested cleaning material		Alcohol, window cleaner	Alcohol, window cleaner	Alcohol, window cleaner	Alcohol	Alcohol	Alcohol

Table 3 – Viewing Window Selection Guide

Notes:

1. x = Emissivity compensation factor for 0.125" (3.2mm) thick optical quality window

3.3.4 Guidelines for Applications Involving Reflected or Transmitted Energy

An infrared temperature sensor measures the temperature of a target surface based on the energy emitted by that surface within the sensor's field of view (FOV). In order to achieve accurate results, it is important that the sensor is properly aligned to only measure energy that is 'emitted' from the target. Inaccurate or inconsistent results may occur when **a sensor measures background energy emitted by a hotter object that is combined with the true target energy** (see Figure 8). Potential applications with this problem involve:

1. Transparent, small, or moving targets where an energy source behind the target **transmits** background energy through the target or within the measured target area.

2. Shiny targets that can result in **reflections** of background energy sources off of the surface of the target.

In industrial environments, these potential background energy sources include furnace walls, heating elements, incandescent lights, or even the sun. Some guidelines to eliminate potential errors from the transmitted or reflected energy are:

1. Re-align the sensor at an angle that avoids this background energy.

2. Eliminate or shade the background energy from the target. This can be accomplished by placing a shield between the background energy source and the target, such as a polycarbon (plexiglass) cover that filters out the infrared energy from an incandescent light. A sight tube for the sensor that extends very near the measured target area can also help to block out reflections. If a sight tube is used, it is best to have internal threads inside the tube to eliminate any reflections from coming up the tube to the sensor.

If the problems persist, contact Calex to discuss other options and accessories that may be available to help eliminate the problem.

3.4 Electrical Installation For The Sensor, Interface Module, and Power Supply

When power is properly applied to the stand-alone sensor or the interface module, the system displays illuminate. The power requirements are 24Vdc (300mA) for the **stand-alone** sensor and 90 to 260Vac for the **interface module** (the interface module provides the power to the sensor). An optional external AC power supply (PSD) is available for the stand-alone sensor.

The sensor head is setup in either an **'analog'** or **'digital'** mode depending on the installation requirements. A factory menu option is used to change the sensor between the 'analog' and 'digital' configurations (figure 9).

The sensor's **analog mode** is used with a Calex supplied PID Controller or any customer supplied device with an analog input (see Table 4).

The sensor's **digital mode** is used to provide a bi-direction non-addressable RS485 connection directly from the sensor (see Table 4). In addition, the digital mode is used for connecting to **Interface Module** which offers a variety of output, alarm, and programming options (see Table 5 and Figure 10).

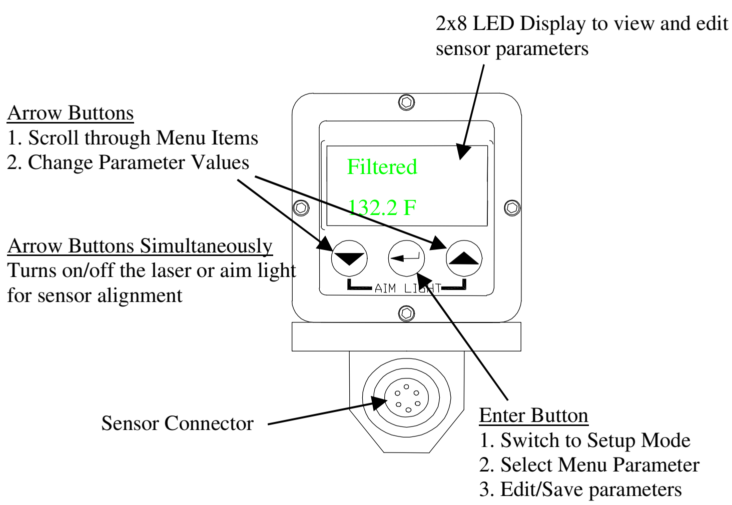
All PyroSight sensors use Belden Cable #83606, or equivalent. This cable has six 20 AWG (0.812mm) conductors with an overall braided shield and a Teflon jacket. Custom cable lengths are available.

If high-level EMI (greater than 9 volts/meter) or specific frequencies exist, then visit Calex's web site for a detailed procedure to eliminate the potential for interference from high levels of EMI.

PyroSight Series Wiring Diagram				
Power Supply Terminal (1)	**Sensor Connector Pin Letter**	**Cable Color**	**ANALOG MODE** For Stand Alone Configuration or a sensor with a PID Controller	**DIGITAL MODE** For Stand Alone Digital Sensor or a System Configuration with a Remote Interface Module **(IM)**
7	1	Red	+24Vdc / 300mA Max	+24Vdc / 300mA Max (Connect to Terminal 30 on IM)
6	2	White	24Vdc Return (circuit common)	24Vdc Return (circuit common) (Connect to Terminal 29 on IM)
3	3	Green	Analog Output (0-20mA or 4-20mA)	RS485 Full Duplex Receive + (Connect to Terminal 26 on IM)
2	4	Black	Current Ground	RS485 Full Duplex Receive - (Connect to Terminal 25 on IM)
4	5	Blue	Relay Normally Open (NO) (2)	RS485 Full Duplex Transmit + (Connect to Terminal 28 on IM)
3	6	Orange	Relay Common (C)	RS485 Full Duplex Transmit - (Connect to Terminal 27 on IM)
1	Shield	Clear	Earth Ground	Earth Ground (Shield) (Connect to Terminal 24 on IM)

1. This option is for stand-alone sensors only.
2. Can be changed in the field to normally closed (NC). SPST Relay is rated 2A at 24Vdc.
3. An internal jumper can be used to change Pin 5 to a 4-20ma input.

Table 4 – PyroSight Series Wiring Diagram



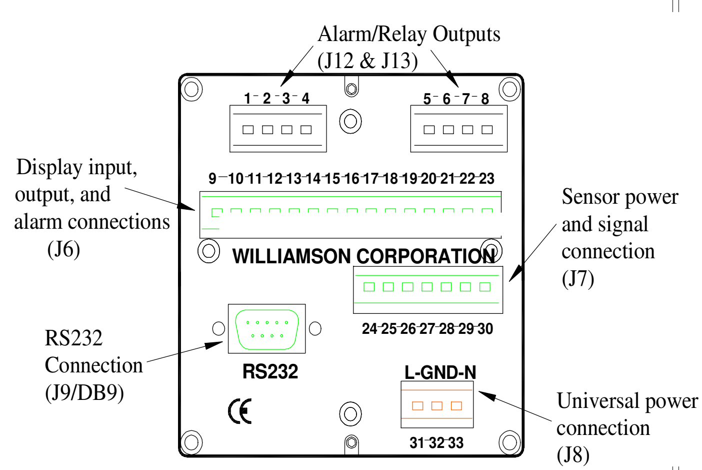


Figure 9 – Analog/Digital Setting for Sensor Interface Module (Adjust in Menu System)

Figure 10 - Layout of Rear Panel Connections

ID	FUNCTION			NOTES
J12	**ALARM / RELAY OUTPUT 1 (Black Connector)**			Interface Module Relays Two (2) SPDT : 2A at 110Vac Relay Activation Time: 15 ms max Reset Time: 5 ms max Select alarm parameter for Filtered Temp, Out of Range, or Ambient Temp,
1	Normally Closed (N.C.)			
2	Common (C.)			
3	Common (C.)			
4	Normally Open (N.O.)			
J13	**ALARM / RELAY OUTPUT 2 (Black Connector)**			
5	Normally Closed (N.C.)			
6	Common (C.)			
7	Common (C.)			
8	Normally Open (N.O.)			
J6	**DISPLAY INPUT, OUTPUT, & ALARM FUNCTIONS (Green Connector)**			
9	Analog Input			Adjusts: Emissivity setting or Alarm Set Point. Can select input of 4-20mA or 0-20mA. Can convert to a voltage scale by using a shunt resistor (max 1000 ohms).
10	Circuit Common			Select output parameter for Filtered Temp, Unfiltered Temp or Ambient Temp. Select output scale of 4-20mA or 0-20mA. Generate a voltage output by using a shunt resistor (max 1000 ohms).
11	Analog Output 2			
12	Circuit Common			
13	Analog Output 1			
14	Circuit Common			
15	TTL Alarm Output			TTL output rating is 2mA at 5Vdc (same parameters as Alarm 1 and Alarm 2)
16	Circuit Common			
17	Adjustable Peak Hold Reset			Provides an instantaneous reset of the peak hold (must have peak hold enabled)
18	Circuit Common			
19	Display Sample and Hold			Freezes the main display temperature value, but not the sensor outputs.
20	RS485 Full Duplex Receive -			The RS485 connection offers full duplexed (not multi-drop), bi-directional communication with a computer (via hyper terminal), a data logging system, or another sensor. The communication protocol is ASCII request-response (See Section 4.5.3), and the line format is 38400 baud, no parity, 8 data bits, 1 stop bit (not currently adjustable).The estimated distance limit is 4000 feet (1200m).
21	R485 Full Duplex Receive +			
22	RS485 Full Duplex Transmit -			
23	RS485 Full Duplex Transmit +			
J7	**SENSOR CONNECTION (Green Connector)**			
	Interface Module	**Wire**	**Sensor**	
24	Earth Ground (shield)	Clear	Shield	Isolated from circuit common
25	RS485 Full Duplex Receive -	Black	4	Standard connection for all sensor communications (same connection for single, dual, and multi wavelength sensors). Estimated distance limit of 4000 feet.
26	RS485 Full Duplex Receive +	Green	3	
27	RS485 Full Duplex Transmit -	Orange	6	
28	RS485 Full Duplex Transmit +	Blue	5	
29	24Vdc Return (circuit common)	White	2	Sensor Power
30	+24Vdc	Red	1	
J8	**AC POWER LINE IN (Green Connector)**			
31	AC IN Hot (L)			Isolated from circuit common. Input power 90-260Vac 50/60Hz (0.1 Amps)
32	AC IN Earth Ground			
33	AC IN Neutral (N)			
J9	**RS232 CONNECTION (DB9 Connector - Female)**			
DB9	(1) N.C.			The RS232 connection offers bi directional communication with a computer (via hyper terminal), a data logging system, or another sensor. The communication protocol is ASCII request-response (See Section 4.5.3), and the line format is 38400 baud, no parity, 8 data bits, 1 stop bit (not currently adjustable). It requires a standard **straight-through serial cable** with DB9 male and Female connectors (wired as DTE). The estimated distance limit of the cable is 50 feet. The AUTO ON Command generates the following output (see Section 4.5.3): Unfiltered Temp, Filtered Temp, Temp Status, Ambient Temp, Amb Status, Cell Strength
	(2) PC RS232 TX			
	(3) PC RS232 RX			
	(4) N.C.			
	(5) Circuit Common			
	(6) N.C.			
	(7) PC RS232 CTS			
	(8) PC RS232 RTS			
	(9) N.C.			

Table 5 - Interface Module Wiring Connections and Specifications

4.0 Configure and Operate the System

4.1 The PyroSight Series Menu System

4.1.1 Overview of the Menu System

The PyroSight Series menu system is designed to simplify the sensor setup and operation for standard applications, as well as enable easy access to the system's programming and diagnostics capabilities for advanced requirements. Some important highlights about this menu system are:

- The **Interface Module can be interchanged** with different PyroSight or PRO Series sensors to simplify installation, maintenance, and calibration procedures. The sensor is designed to automatically update the interface module with its configuration information. This simplifies the setup of spare sensors or modules as well as enables the testing of sensors without its respective module. The interface modules can be interchanged within common families of sensors as follows:

> **IMPORTANT:** When interchanging Interface Modules configured with different temperature ranges, it is necessary to manually reset the analog output scales by pressing 'reset defaults' under the 'Configure I/O' menu group. This will update the Interface Module's analog output to agree with the different sensor.

4.1.2

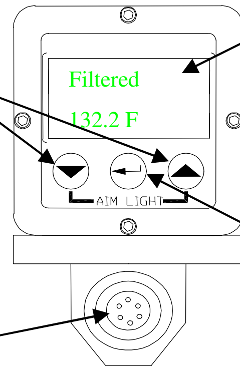
4.1.3 Operator Interface

Each PyroSight Series sensor is available in a stand-alone or a system configuration. Figure 13 illustrates the operator interface that is provided with each of these options.

With the **stand-alone sensor configuration,** it is possible to setup the unit in either an analog or a digital mode by simply changing a menu item in the system (see section 3.4). The **analog mode** offers connections for one analog output, one contact relay alarm or an analog input for remote adjustments of the emissivity setting or an alarm set point. The **digital mode** offers a bi-directional RS485 connection. With both of these stand-alone configurations, the menu adjustments are made using the three buttons and the display on the sensor.

With the **system configuration, the interface module** offers an advanced user interface, additional input, output, and alarm functions, as well as a universal power supply. The user can install this module in a remote location away from the sensor for convenient access. When the sensor is setup in a system configuration, the operator can only change sensor settings from the interface module. For startup and troubleshooting purposes, the functional display on the back of the sensor still provides access to view parameters, but it is not possible to change the system settings from the sensor's integrated display when an interface module is connected.

STAND ALONE SENSOR



PROGRAMMABLE INTERFACE MODULE

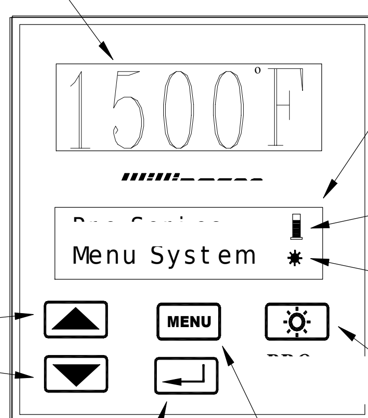


Figure 11 – Sensor and Interface Module Layouts

4.1.4 Navigating The Menu System

For most applications, the factory default settings are sufficient for out of the box ‘Aim and Read’ operation. If adjustments are required, the text-based menu is accessible from the stand-alone sensor or the interface module (see Figure 12).

The menu is organized into two modes for easy viewing and editing of all parameters:

- The **display mode** provides **view-only access** to most sensor parameters.
- The **setup mode** provides **view-and-edit access** to all sensor parameters. Figure 14 provides a description of the entire menu system organization.

The ‘menu button’ on the interface module is used to switch between the display mode and the setup mode. The arrow and enter buttons are used to navigate through the menu and to edit parameters. Due to space limitations, the ‘menu button’ is not included in the stand-alone sensor. **To generate the menu button functions on the stand alone sensor, press the enter button.** The setup mode includes a timeout function to return the system back to the display mode when none of the buttons have been pressed for 15 minutes.

4.1.5

4.1.6 Editing Parameters in the Setup Mode

Follow these steps to change/edit a sensor parameter:

1. Press the **menu/enter button** to enter into the **setup mode** from the **display mode**.

2. Press the **arrow buttons** to scroll to the desired group menu (i.e. signal conditioning, configure I/O, etc.).

3. Press the **enter button** to access the group menu.

4. Press the **arrow buttons** to scroll to the desired item.

5. Press the **enter button** to enable the edit mode for the selected menu item. With the interface module, the angled brackets ‘< >’ disappear, and the ‘E’ icon and parameter value will blink. With the sensor, once the enter button is pressed the parameter value will blink.

6. Press one of the **arrow buttons** to scroll through the pre-defined menu options or to increase or decrease the parameter value. **Press and hold** the **arrow button** to accelerate the rate of change.

7. Once the final value is selected, press the **enter button** to ‘save’ the value and end the editing process. Note that the sensor output signal is not affected by the adjustment until the enter button has been pressed to save the new value. If the menu button is pressed before the change is entered, then the change is not saved and the original value is retained.

8. With the interface module, press the menu button once to return to the main menu and edit other parameters, or return to the display mode from the group menu by pressing the menu button twice. To navigate to other parameters with the sensor based menu system, scroll through the menu items with the arrow buttons until you get to ‘Return to Main Menu’ or ‘Return to Display Mode’, then press the

enter button to select the desired
navigation function.

NAVIGATION FUNCTIONS			
Button	**DISPLAY MODE (3) (View Only)**	**SETUP MODE (View and Edit)** **Main Menu**	**Group Menus**
MENU (1)	Switch to the main menu in setup mode	Return to the display mode.	Return to the main menu in the setup mode.
▲ ▼	Scroll through the sensor parameters on the LCD functional display.	Scroll through the main menu parameter groups.	Scroll through group parameters. During editing, changes parameter values.
↵	Press and hold the enter button to change the parameter shown on the main LED display.	Select the menu item.	If an 'E' icon is displayed, then the enter button activates the editing process and saves the new value.
¤ (4)	Turns the optional aiming system on/off.	No Function	No Function

DISPLAY MODE (		
Main Display (LED)	• Target Temperature	
Functional Display (Back-Lit LCD)	• Ambient Temperature • Filtered Temperature • Unfiltered Temperature • Average Time • Peak Hold Delay • Emissivity (1λ)	• A • M • S • S • S • F • **M**
Status Messages	• Out of Range • Ambient Warning	• **E** • L

SETUP MODE	MAIN MENU				
	SIGNAL CONDITIONING	**CONFIGURE I/O (Inputs & Outputs)**	**CONFIGURE ALARMS**	**DIAGNOSTICS**	**SYSTEM SPECIFICATION**
	GROUP MENUS (2)				

	• Average Time
	• Advanced Filter
	  • Continuous Average
	  • Peak Hold Time Reset
	  • Peak Hold Temp Reset
	  • Valley Hold Time Reset
	  • Valley Hold Temp Reset
	• Temp Scale (°F / °C)
	• Emissivity (1λ)
	• Reset Group Defaults
	• Rtrn to Main Menu
	• Rtrn to Display Mode
		• **Input Parameter**
		• **Input Scale**
		• Output 1 Parameter
		• Output 1 Scale
		• 0 / 4mA Temp (O1)
		• 20mA Temp (O1)
		• **Output 2 Parameter**
		• **Output 2 Scale**
		• **0 / 4mA Temp (O2)**
		• **20mA Temp (O2)**
		• **PC Serial Port**
		• Reset Group Defaults
		• Rtrn to Main Menu
			• Alarm 1 Parameter
			• Alarm 1 Set Point
			• Relay Logic (stand alone)
			• **Alarm 2 Parameter**
			• **Alarm 2 Set Point**
			• **TTL Alarm Parameter**
			• **TTL Alarm Logic**
			• **TTL Alarm Set Point**
			• Reset Group Defaults
			• Rtrn to Main Menu
			• Rtrn to Display Mode
				• Output 1 Test
				• **Output 2 Test**
				• **TTL Test**
				• **Alarm 1 Test**
				• **Alarm 2 Test**
				• Menu Access
				• Reset Group Defaults
				• Rtrn to Main Menu
				• Rtrn to Display Mode
					• Sensor Type
					• Model Number
					• Sensor S/N
					• Spec. Bottom Temp
					• Spec. Top Temp
					• Field of View
					• Manufactured Date
					• Last Calibration Date
					• Next Calibration Date
					• Warranty Exp. Date
					• Sensor Firmware
					• **Module S/N**
					• **Module Firmware**

NOTES:

1. On the stand alone sensors, press the enter button to switch to the setup mode and select the 'Rtrn to Main Menu' or 'Rtrn to Display Mode' parameters to navigate the menu system

2. <u>**The bold items**</u> <u>are only available with an Interface Module</u>. When an interface module is connected to a sensor, only the display mode is accessible from the back of the sensor.

3. The 'filling thermometer icon' in the upper right corner of the functional display indicates that the system is in the display mode (it disappears in the setup mode).

4. While in the display mode, simultaneously select the two arrow buttons to turn on/off the laser or aim light function.

5. Contact Calex for the commands required to access the field calibration functions in the Factory Options menu group. See section 5.1 for complete calibration instructions.

Figure 12 – PyroSight Series Menu System Overview

4.2 System Status Messages

The table below describes the system status messages and their associated conditions. There is no reset requirement for any of these status messages. If the condition reverts back to a normal state, then the status message is no longer displayed.

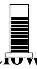
STATUS MESSAGES				
Status	**Condition**	**LED Display**	**Functional LCD Display**	**Analog Output**
	As verification that the system is running properly, a **thermometer icon** is continuously refilling in the upper right corner of the functional display of the interface module while the system is in the **display mode**. In the **setup mode** this icon disappears.	No Change	No Change	No Change
Below Temperature Range (1)	The target temperature is below the sensor's range of measurement.	'LO'	'Below Range'	0 or 4mA
Above Temperature Range (1)	The target temperature is above the sensor's range of measurement.	'HI'	'Above Range'	20mA
Ambient Warning	Sensor's measured ambient temperature is above its limit. To access and use the menu system, press any button on the interface module to temporarily clear this message. The message will continue to re-appear until the sensor's ambient temperature goes back in range.	No Change	'Ambient Warning'	No Change
Establishing Comminations	This message is displayed as the communications between the sensor and interface module are established. If this message stays on for longer than 2 minutes, then there is a problem with the communications between the sensor and the interface module. See section 5.2.3 for a detailed troubleshooting procedure.	Dashes on LEDs	'Establishing Communications'	0 or 4mA
Menu Lockout Enabled	This feature prevents inadvertent access to the menu system. It is **enabled** and **disabled** using the **menu access** item in the **diagnostics** menu group. With the 'delay' setting, the operator must press and hold the menu button for 7 seconds to get into the menu system. During the first 5 seconds of the 7-second delay the 'menu lockout message' is displayed.	No Change	Menu Lockout Enabled	No Change

Table 6 – System Status Messages

NOTES:

1. If the sensor's temperature range is configured to a narrower custom range by using the Configure I/O menu group, **then the out of range status message is still triggered by the factory specified temperature range.**

4.3 Signal Conditioning Functions

4.3.1 Overview

In the factory, Calex temperature sensors are calibrated to a temperature standard known as a blackbody calibration source. In addition, all of the sensor parameters are set to default values that are appropriate for most applications. Some applications may require minor signal conditioning adjustments in order to provide optimal performance for an application (see Table 7).

SIGNAL CONDITIONING GROUP MENU Menu Item (w/ Default Value)	Parameter Range / Options
Average Time <2.0> sec	Disabled, 0.2 to 24.0 sec
Out of Range <Clear Buffer>	Clear Buffer Save Buffer
Peak Hold Delay <Disabled>	Disabled, 0.1 to 360.0 sec
Temperature Scale <Fahrenheit>	Fahrenheit Celsius
Emissivity <+1.000>	0.010 to 1.500

Table 7 – Signal Conditioning Group Menu

4.3.2 Averaging Time

The **Averaging Time** function is a running average of the measurements made by the sensor. It is used to dampen process noise or sensor interference. The sensor responds to temperature changes the **fastest** when the averaging time is disabled, and it responds to changes the **slowest** when the time is set to the highest value of 24 seconds.

In order to calculate this running average, the sensor's measurements are stored in a 'buffer'. The number of measurements stored in the buffer is defined by the specified averaging time. Every time the sensor completes a new measurement (10 - 85ms depending on the model), it adds the new number to the buffer.

The averaging time is typically set to the smallest value (least dampening) that provides a steady, noise-free temperature measurement for the application. The amount of averaging required will vary with the sensor model and the application requirements. Refer to section 2.1 for specific update and response time values.

4.3.3

4.3.4 Out of Range

The **Out of Range** parameter defines what happens to the measurements stored in the averaging 'buffer' whenever the sensor goes 'out of range'. Out of range conditions occur when:

- The sensor is viewing a target temperature that is below or above range.

Based on the selection for the out of range parameter (Table 7), the sensor either **clears** the measurements from the buffer or **saves** the measurements in the buffer during an out of range condition. Figures 13 and 14 illustrate the different responses for each setting when the sensor comes back in range and starts a new measurement.

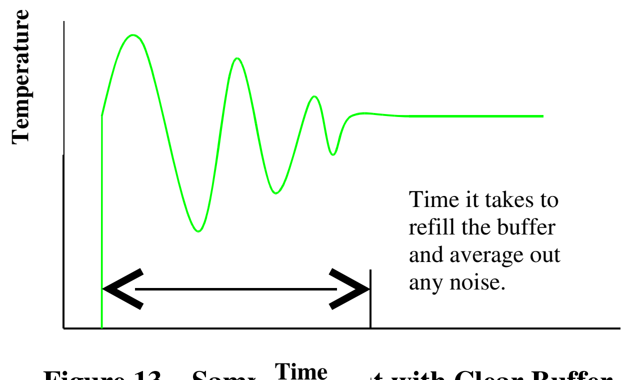


Figure 13 – Sample Output with Clear Buffer

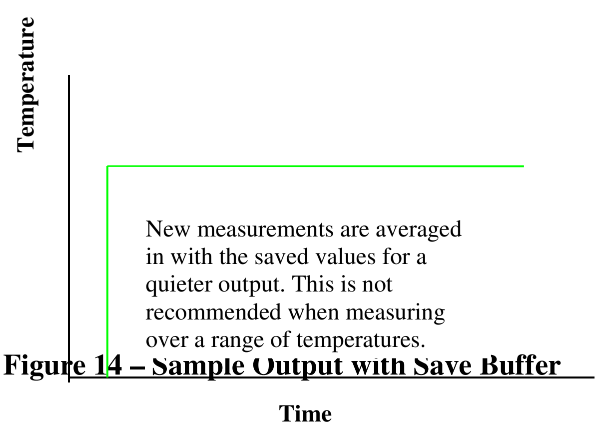


Figure 14 – Sample Output with Save Buffer

The following guidelines can help to select the proper setting for the out of range parameter:

- The **clear buffer** setting is recommended for a process where the sensor tracks temperatures over a range of values, or the objective is to obtain a unique measurement for each individual part in an intermittent process.

- The **save buffer** setting is recommended when measuring a reasonably consistent temperature at a specific point in a process, or when the objective is to obtain a quieter output signal that can be used to track the temperature trend for a series of intermittent parts.

4.3.5 Peak Hold Delay

The peak hold function enables the displayed and output temperature values to:

- increase continuously as the temperature rises
- hold at a peak value for a specified period of time as the target temperature decreases (see figure 15).

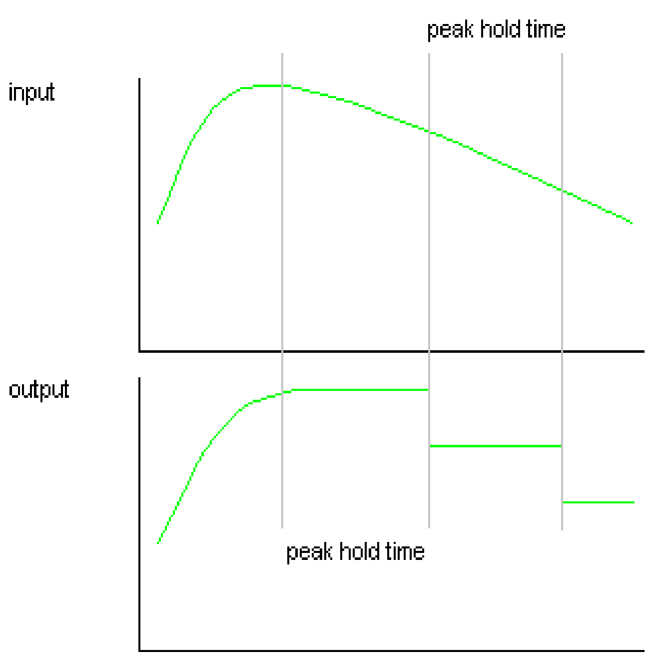


Figure 15 – Sample Peak Hold Output

The hold time is set by the peak hold delay parameter. When the time period is up, the peak is reset to a new value based on the current target temperature. If the target temperature goes out of range before the time period expires, then the hold time is reset to enable one complete hold period for the current held temperature before the out of range status message is displayed.

The peak hold function is often used to hold a measured value when the target is intermittently obstructed from the sensor's view by a colder object. Common intermittent obstructions include heavy smoke, moving apertures or arms, moving targets, seams, or intermittent targets. To establish the proper setting for a specific application, adjust the peak hold time delay until the maximum temperature is maintained while still enabling sufficient time to reset for the application monitoring and control requirements.

4.3.6 External Peak Hold Reset

To enable **external adjustments to the peak hold function**, interface module offers an external peak hold reset function. This function is used to reset the sensor readings via an external signal. To use the external reset function:

1. Enable the peak hold delay parameter in the menu system to a delay time that is longer than required.
2. Short the respective connections on the interface module (pins 17 and 18) to **instantaneously** reset the peak temperature value. Note that an extended short does not provide an extended live reading.

4.3.7 Sample and Hold

The sample and hold function provides the ability to freeze the current measured temperature value on the interface module’s main display. This function is enabled by shorting terminals 18 and 19 on the rear panel of the interface module (see section 3.4). The display holds the value as long as the terminals are shorted. Once the short is removed, the display resumes real-time operation. **This feature has no influence on the analog or digital output signals, and it is only available with the optional interface module.**

4.3.8 Temperature Scale (°F or °C)

Every temperature-based parameter in the system is converted between the Fahrenheit and Celsius temperature scales by making this one adjustment in the menu system. This includes changes to the following parameters:

- measured temperature (filtered & unfiltered)
- measured ambient temperature
- sensor's specified temperature range
- configured temperature range for each output
- set point values for each of the alarms

4.3.9 Emissivity Adjustment

Calex's infrared temperature sensors are calibrated at the factory to provide an accurate temperature reading under ideal emissivity conditions using a blackbody temperature source. For each application, the sensor must be adjusted to the emissivity characteristics of the measured process in order to provide accurate and optimized temperature measurement results. All PyroSight Series sensors include a emissivity adjustment range of 0.010 to 1.500.

Unless otherwise specified, the sensors are calibrated under blackbody conditions with the emissivity setting at 1.000. An emissivity adjustment from 1.000 to a lower value will cause the sensor temperature reading to increase, while an emissivity adjustment of a lower value to a higher value will cause the sensor temperature reading to decrease. When the emissivity setting is greater than 1.000, it is intended to compensate for constant reflection that can not be eliminated from the process. When viewing a target other than a blackbody or when viewing through an infrared window, a lower emissivity adjustment may be required.

To prepare a sensor for an application, adjust the emissivity setting until the sensor provides an accurate temperature measurement as compared to a reference temperature measurement or a known temperature value for the process. **In order to optimize the accuracy of the adjustment across the entire range of the sensor, it is important to make the field calibration adjustment as close to the top end of the sensor's temperature range as possible (or at the top of the temperature range for the application).** If a benchmark temperature is not available, it is also possible to adjust the emissivity setting to a known or estimated emissivity value for the material being measured.

Lastly, if the emissivity value is not set with precise accuracy, the sensor still provides repeatable, but not accurate, temperature measurements. For many process monitoring and control applications, it is often the repeatability of the measurements that is critical as opposed to the absolute accuracy.

4.4 Configure Inputs, Outputs, and Alarms

4.4.1 Programming the Analog Input

The analog input function enables a remote adjustment of the **Emissivity** or the **Alarm 1 Temperature Set Point** via a remote analog source. This function is available with the sensor and the optional interface module.

Using the **configure I/O** group menu, it is a simple four step process to configure the input function:

1. Connect the wires from the analog source (mA or V) to pins 9 and 10 on the rear panel of the interface module, or pins 4 and 5 on the stand alone sensor.

2. Select one of the **input parameters**. The default setting for the input parameter is disabled.

Parameter	Range	Resolution
Emissivity	0.0 to +1.500	0.002
Alarm 1 Temperature Set Point	The factory specified temperature range of the sensor	1 to 5 ° (varies by model)

Table 8 – Input Parameters

For the range of the alarm 1 temperature parameter, verify the temperature range specification on the cover of the manual or in the specifications menu group of the sensor.

3. Select the **analog input scale** of 0-20mA for 972 bits of resolution, or 4-20mA for 777 bits of resolution. It is also possible to drive the input function with a voltage source by installing a resistor in series with the (+) input on Pin 9. For example, with the 0-20mA output, a 237.5 ohm resistor will provide a 0 to 10V input. The minimum current for this connection is 30mA.

4. Verify that the input signal is scaled properly. To view the 'live' value of the input signal, switch the interface module back to the display mode, and use the arrow buttons to scroll to and read the value of the input parameter.

- External Emissivity (overrides internal setting)
- External Alarm 1 Temp (overrides Alarm 1 Temperature Set Point)

These input parameters only appear in the display mode when they are enabled, and once enabled, they override the respective function from the internal menu system.

A fixed average is applied to the input signal to provide a stable input value for the sensor. Thus, it can take a few seconds to settle on a new value when the input signal is changed.

4.4.2 Programming The Analog Outputs

A unique feature of the PyroSight Series is that each sensor includes several measured parameters that can be used for advanced process monitoring and control. By using the menu system, it is easy to configure any one of the system outputs to use any one of the sensor's measured parameters (Table 9).

Each of the linear analog output signals are scaled to the factory specified temperature range of the sensor. This means that the 0 or 4mA signal corresponds to the bottom end of the sensor's temperature scale, and the 20mA output signal corresponds to the top end of the sensor's temperature scale with a linear relationship in between.

Expressed mathematically, the output signal to temperature scale relationship is as follows:

4-20mA: $T = ((Out–4) / 16) \times (T_{Top}-T_{Bottom}) + T_{Bottom}$

0-20mA: $T = (Out/ 20) \times (T_{Top}-T_{Bottom}) + T_{Bottom}$

Using this approach, it is possible to create an output to temperature curve or to calculate a few discrete temperature points that are critical to the process.

PROGRAMMABLE OUTPUT AND ALARM PARAMETERS Parameter	Default Range	Adjustable Range	Description
Filtered Temperature	Specified Range of the Sensor	Yes	The measured target temperature with all of the signal conditioning filters applied. This parameter should be used for process control.
Unfiltered Temperature	Specified Range of the Sensor	Yes	The measured target temperature with no signal conditioning filters applied. It can be viewed simultaneously with the filtered temperature to better understand the measurement conditions without disrupting the process control temperature values.
Ambient Temperature	0 to 200°F (-17 to 93°C)	No	The ambient temperature inside the sensor is measured to verify that the sensor is within its specified ambient operating limits. A status message is displayed when ambient limits are exceeded.

Table 9 – Output and Alarm Parameters

Using the **configure I/O** group menu, it is a simple 3 step process to configure the analog outputs.

1. Selected the output parameter
2. Select the output scale (0-20mA or 4-20mA)
3. If required, adjust the temperature range of the output. It is not possible to adjust the range of the other output parameters.

This procedure can be used to change the sensor output to a **'custom temperature range'** within the **'factory specified temperature range'** or to change the output to a parameter other than temperature.

The analog output scales can be used with a shunt resistor to drive various voltage outputs (see table 10). The level of accuracy of the voltage output will vary directly with the accuracy of the shunt resistor. The maximum load on the analog outputs is 1000 ohms.

Convert the 0-20mA Output to a Voltage Output	Required Shunt Resistor Value
0 to 100mV	5 ohms
0 to 1V	50 ohms
0 to 5 V	250 ohms
0 to 10 V	500 ohms
0 to 20 V	1000 ohms

Table 10 – Shut Resistor Values For Voltage Outputs

4.4.3 Programming The Alarms

Using the **configure alarms** group menu, it is a simple two step process to configure the alarms to use any of the sensor's measured parameters (Table 11).

1. select the alarm parameter
2. adjust the alarm set point value

The factory default values for all the alarms are disabled. The stand alone sensor offers one contact relay alarm when it is setup in the analog mode, while the interface module includes one TTL alarm and two contact relay alarms.

The rating for each alarm is as follows:

- **Relay Alarms:** 2 amps at 110Vac, , Relay Activation Time: 15 ms max, Reset Time: 5 ms max
- **TTL Alarms:** 2mA at 5Vdc

Table 11 provides a description of the alarm conditions for each parameter, while section 3.4 provides additional details about the wiring connections for each alarm.

SENSOR AND INTERFACE MODULE ALARMS					
				Relay Alarms (3)	
Alarm Parameter	**Range Of Set Point**	**Condition (Default Value)**	**TTL Logic Normal (2)**	**Normally Open**	**Normally Closed**
Power Off or Disabled	None	None	0 Volts	Open	Closed
Filtered Temp	Range of Sensor	Measured Temp >Temp Set Point Measured Temp < Temp Set Point (Default Value is the Specified Bottom End Temperature)	0 Volts 5 Volts	Open Closed	Closed Open
Out of Range (1)	None	Spec. Bottom Temp < Measured Temp < Spec. Top Temp Spec. Bottom Temp > Measured Temp > Spec. Top Temp	0 Volts 5 Volts	Open Closed	Closed Open
Ambient Warning	0 - 200°F (-17 - 93°C)	Measured Ambient Temp < Ambient Temp Set Point Measured Ambient Temp > Ambient Temp Set Point (Default value is the Sensor's Ambient Limit)	0 Volts 5 Volts	Open Closed	Closed Open

Table 11 – Alarm Specifications

Some important notes about the operation of the alarms are as follows:

1. If the sensor's analog outputs are configured to a narrower, customized temperature range, the out of range alarm for temperature is still triggered by the factory specified temperature range.
2.
3. Depending on the application requirements, the 'TTL alarm logic' can be adjusted to a 'normal' or 'reversed' logic setting in the Configure Alarms menu group.
4. To enable complete flexibility with setting up the contact relay alarms, the wiring connections are provided for both normally open and normally closed.

4.5 System Diagnostics

The following diagnostics are included with each system to assist with the setup and troubleshooting procedures.

SYSTEM DIAGNOSTICS GROUP MENU

Menu Item (w/ Default Value)	Parameter Options/ Range	Description
Output 1 Test <Disabled>	Disable 4mA 12mA 20mA	This feature allows the operator to verify the proper calibration and operation of the data acquisition equipment. This feature injects a specified current value onto the output terminals. While running this diagnostic, the measured target temperature is still presented on the interface module displays. To eliminate the possibility of leaving the fixed output enabled, the system automatically disables this function as the operator leaves this menu item.
Output 2 Test <Disabled>		
TTL Test <Disabled>	Disabled TTL ON TTL OFF	The alarm output tests are used to verify the proper operation of the alarm.
Alarm 1 Test <Disabled>	Disabled ALARM ON ALARM OFF	
Alarm 2 Test <Disabled>		
Menu Access <Immediate>	Immediate Delayed	This feature prevents inadvertent access to the sensor menu system, and it is enabled and disabled using the **'menu access'** item in the **'diagnostics'** menu group (see figure 14). When this item is set to 'delay', the operator is required to press and hold the menu button for 7 seconds in order to get into the menu system. During the first 5 seconds of this 7-second delay the lockout message is displayed.

Table 12 – Diagnostics Group Menu

4.6 Optional Laser Aiming System

An optional built-in laser-aiming feature is available with the PyroSight 20 camera style sensors. The laser aiming should be selected when proper sensor alignment must be quickly verified at a glance.

The laser used in the sensors is a Class II Laser product according to CDRH standards. The wavelength is 650 nm and the peak power rating is 1mW. For sensors that include a laser option, a label with the exact laser classification is placed on the top of the sensor enclosure.

The safety precautions for using the laser option are:

1. Since a laser beam can be damaging to the eyes, DO NOT look into the laser aperture when the laser is in operation. A general guideline for Class II lasers is that the visible output is at a level that enables the defensive reaction of the human body to prevent injury. An icon appears on the interface module display when the laser is ON (Figure 19).
2. Be aware that laser light can also be dangerous when reflected off a mirror-like surface.
3. For further safety information regarding lasers, refer to ANSI-Z1 36.1 STANDARD FOR THE SAFE USE OF LASERS, available from the Laser Institute of America, phone 407/380-1553.
4. CAUTION: Use of controls, adjustments or performance procedures other than those intended may result in hazardous laser light exposure.

Some important features about the laser are:

- The laser image may be switched on and off using the laser-aiming button located on the interface module (or the optional button on the back of the sensor).
- The laser image does not interfere with normal sensor operation, and it may be left "on" continuously.
- The laser is centered in the sensor's target area at all working distances.
- The laser is capable of illuminating targets over 100 feet (30m) away.
- The red laser image is less effective on glowing targets, but it has demonstrated the ability to assist with glowing targets heated to as high as 1400°F (760°C).
- The ambient limit of the laser is 140°F (60°C). However, the expected life of the laser is reduced when operated at temperatures above 110°F (40°C). For these higher ambient conditions, it is recommended that the water-cooling option be added to the system to extend the life of the laser.

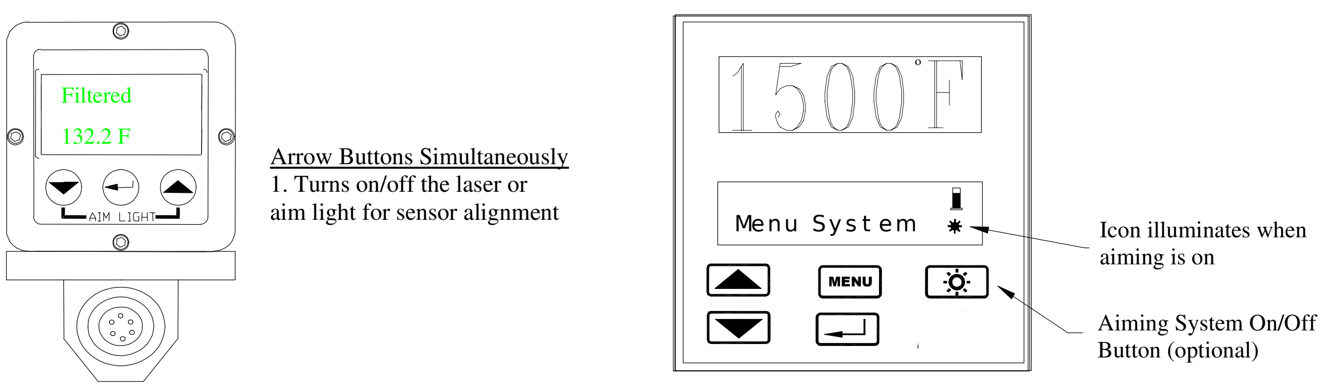


Figure 16 – Aiming System On/Off Button

5.0 Calibration, Maintenance and Service

5.1 Calibration Procedures

Under reasonable operating conditions, most Calex temperature sensors will remain within specification for many years. However, as with any instrumentation, the possibility of drift or a malfunction is not negligible. Therefore, calibration verification every 1 to 5 years is recommended. More frequent calibration verification may be appropriate as circumstances dictate. If it is determined that the sensor should be re-calibrated, then the sensor should be returned to Calex, or re-calibrated in the field with the appropriate blackbody temperature calibration facilities.

To assist with the calibration process, contact Calex for details about purchasing blackbody calibration systems, or a spare interface module to be used in a calibration facility. Section 4.2.1 describes how the interface modules can be interchanged with different sensors to simplify the calibration of multiple sensors and to eliminate the need of taking the interface modules out of operation whenever a sensor is checked or calibrated.

All PyroSight Series sensors include the ability to implement a 2 point (offset and gain) calibration adjustment to the factory calibration. The parameters required to make this adjustment are included in the Factory Options menu group (see Table 13). **Contact Calex to obtain the special commands that are required to access the Factory Options menu group.**

FACTORY OPTIONS MENU GROUP **Menu Item** **(w/ Default Value)**	**Parameter** **Range / Options**
Field Cal <Disabled>	Disabled Enabled
BB Ref Bot <Spec Bot Temp>	0 to 9000°F
Measured Bot <Spec Bot Temp>	0 to 9000°F
BB Ref Top <Spec Top Temp>	0 to 9000°F
Measured Top <Spec Top Temp>	0 to 9000°F

Table 13 – Field Calibration Parameters

> **WARNING:** Do not use the Reset Group Defaults menu item in the FACTORY OPTIONS. This will reset critical sensor parameters and will require the sensor be sent back to Calex for re-calibration.

To complete the calibration process, follow these steps:

1. Access the **Factory Options** menu group. Other than the first 5 parameters in this menu group, it is important to maintain all of the other factory settings. In addition, **it is important NOT to use the reset defaults menu function in the Factory Options menu group,** otherwise the sensor will need to be returned to Calex for re-calibration.

2. Set the reference temperature sources at or close to the top and bottom temperatures of the sensor's specified temperature range. Refer to the **cover of the manual** or the **Specifications** menu group in the sensor menu to determine the specific temperature range of the sensor purchased. For example, if the sensor's specified temperature range is 1600-3200°F, then set one reference source to 1600°F and the other reference source to 3200°F.

3. Switch to the **Setup Mode** of the menu system by pressing the menu button (see section 4.2 for details on navigating the menu system). Verify or change the values of the following parameters:

- In the **Signal Conditioning** menu group, set the **Emissivty** to '1.000'
- In the **Signal Conditioning** menu group, set the **Averaging Time** to '5.0' seconds

4. Using the menu button, return to the display mode of the menu system (should see a refilling thermometer in the upper right corner of the LCD display).

5. Locate the sensor at a distance 6-12in (15-30cm) from the **bottom end temperature source** and verify that the sensor is properly aligned so that the sensor's FOV target area is completely filled by the blackbody heat source.

6. Once the alignment has been verified, record the following temperature values that will be entered into the sensor later:

- **BB Ref Bot:** This is the temperature of the blackbody reference source at or near the bottom end of the sensor's temperature range.
- **Measured Bot:** This is the temperature measured by the sensor on this reference source.

7. Repeat step 5 for the blackbody reference source that is at or near the top end of the sensor's temperature range.

8. Once the alignment has been verified, record the following temperature values that will be entered into the sensor later:

- **BB Ref Top:** This is the temperature of the blackbody reference source at or near the top end of the sensor's temperature range.
- **Measured Top:** This is the temperature measured by the sensor on this reference source.

1.

9. Access the factory menu options (contact Calex for access code) and enter the recorded calibration data by editing the following parameters:

- **Field Cal** to enabled
- **BB Ref Bot, Measured Bot, BB Ref Top,** and **Measured Top** to the recorded values.

10. **IMPORTANT STEP**: Power the system off and on to enable the changes to the calibration.

11. Verify the accuracy of the calibration by repeating steps 5, 6, 7, and 8.

12. Upon completion of the calibration adjustments, the sensor settings should be reviewed and verified for the proper settings. For calibration with a stand-alone sensor, it is also important to screw the sensor's rear cover securely back into place.

13. This calibration process can be repeated as many times as required, and it is always possible to return the system back to its original factory calibration by simply changing the **Field Cal** parameter to **disabled** and cycling the system power on and off.

5.2 System Maintenance and Troubleshooting

5.2.1 General Maintenance

Calex sensors are factory calibrated to customer specifications and no field calibration is required. Routine maintenance requires the protection of the instrument against harmful environmental conditions and excessive ambient exposure. To simplify installations and to provide additional protection from harsh operating conditions, Calex offers many unique options and accessories that can be used to improve sensor performance, minimize maintenance requirements and extend the life of the sensor. Consult the installation and operation sections of this manual to identify all of the options available, or call Calex or its local representative for additional information.

Specific maintenance tasks that should be considered are:

Cleaning the Lens/Window: Dust and dirt on the window will reduce the transmission of energy to the sensor and possibly cause erroneous temperature readings. Clean the window periodically by wiping the window with a lens tissue or a clean, soft, lint free cloth or cotton swab. Using a water/alcohol mixture, gently wipe the entire exposed surface of the window and avoid "scrubbing" as this can cause scratches. Dry the window with a clean dry soft cloth and inspect the window to make sure that it is clean. Repeat the procedure if necessary. The frequency of cleaning the window will depend on the environment at the point of installation. An air purge option is available to reduce the necessity of frequent cleaning in dusty, dirty areas (**note:** with air purge systems make sure the circulating air is clean and not dirty. Often times dirty plant air in an air purge contributes to the buildup of dirt on the window).

Checking Environmental Conditions: Calex sensors have been designed to operate in heavy industrial environments, however, ambient temperature extremes beyond the sensor specifications (see section 2.2) will cause improper temperature indications and/or damage to the instrument. Periodically check to make sure the instrument is not being subjected to temperatures beyond these extremes. If water-cooling is used, insure cooling water is flowing at the recommended rate and temperature through the cooling device (see section 3.2.3).

Sensor Alignment: When any work has been done with or around the sensor, it is important to verify that the sensor is still properly aligned to the measured target. Refer to section 3.3 for details.

5.2.2 General Troubleshooting Guidelines

If trouble is encountered in obtaining temperature readings after installation of the system, review the troubleshooting guidelines in table 14. If further assistance is required, contact Calex or your local Calex Representative. To call Calex from within the United States, use our Toll Free number (800) 300-8367 and ask for application engineering assistance or repair assistance (have the sensor model and serial number information available). For calls from outside the United States, call (978) 369-9607, or send an email to info@calex.co.uk.

TROUBLESHOOTING GUIDELINES TO VERIFY PROPER SENSOR PERFORMANCE

SYMPTOM	POSSIBLE CAUSE/RECOMMENDED ACTION
No temperature is indicated.	1. Verify the **proper power** is applied to the system (the displays should be lit). 2. Verify the **proper wiring** connections for the power and the output signals. 3. Verify the **cable connection** of the sensor to the display has not been crimped or damaged (if included). 4. Verify the sensor is properly **aligned** to the measured target (see section 3.3). 5. Verify that the sensor is not being operated at **extreme ambient temperatures**. See section 2.1. 6. Verify that none of the system components has been dropped or damaged.
The incorrect temperature is indicated.	1. Verify that the **output devices are properly calibrated** to the sensor's linear output signal, and verify the configured output settings (see section 4.5.1). 2. Verify the sensor is properly **aligned** to the measured target (see section 3.3). 3. Verify that the sensor's **lens/window is clean**. 4. Verify that the sensor is not being operated at **extreme ambient temperatures**. See section 2.1. 5. Verify that the sensor measurements are not being effected by **electro-magnetic interference.** A test is to turn on/off the potential sources of EMI and track the sensor results. 6. Verify that the sensor is **properly set to compensate for emissivity** issues. 7. Verify that the sensor is not receiving input energy from **reflections** off the target surface or **transmissions** from behind the target (see section 3.3.4). 8. Verify that the reference/benchmark temperature is correct.
Inconsistent sensor operation with a known stable target temperature.	1. Check for **loose, intermittent electrical connections**. 2. If the potential for EMI exists, then verify the **proper sensor grounding**. 3. Verify that the sensor measurements are not being effected by **electro-magnetic interference.** A test is to turn on/off the potential sources of EMI and track the sensor results. 4. Verify that the sensor is not being operated at **extreme ambient temperatures**. See section 2.1. 5. Verify that there is not any **intermittent interference** to the measured energy signal from the target. This could include intervening media such as heavy smoke or dust, reflections, or a moving target.

Table 14 – Troubleshooting Guidelines