FibreMini

Fibre Optic Pyrometer

Operator's Guide

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CALEX
ELECTRONICS LIMITED

FibreMini

The **FibreMini** is an infrared temperature sensor (pyrometer) with a fibre optic sensing head and separate electronics module.

The fibre optic sensing head withstands ambient temperatures of up to 200°C and contains no electronics, so it may be used in areas of strong electromagnetic interference.

Continuous laser sighting illuminates the position and size of the measurement spot while readings are being taken, without affecting the accuracy of the measurement.

A touch screen interface is built into the electronics module, with temperature display, sensor configuration, data logging to optional MicroSD Card, and configurable alarm relay outputs.

The sensor works by detecting the infrared radiation emitted from a surface as a result of its own temperature. The amount of radiation emitted is related to the temperature, and the sensor uses this relationship to provide an accurate temperature output.

FibreMini sensors are ideal for measuring the surface temperature of many reflective metals in high-temperature applications, including iron and steel, as well as non-reflective non-metals.

Specifications

Measurement Specifications

Temperature Range	MT models: 250°C to 1000°C HT models: 450°C to 2000°C
Max. Temperature Span for 4-20 mA Output (-CRT models)	Full temperature range (up to 1550°C)
Min. Temperature Span for 4-20 mA Output (-CRT models)	100°C
Output	4-20 mA or RS485 Modbus (Up to 247 sensors may be installed on a single Modbus network)
Field of View	Choice of wide-angle or narrow-angle optics (see Field of View Diagrams below)
Accuracy	±1% of reading
Repeatability	±0.5% of reading
Emissivity Setting	Adjustable, 0.10 to 1.00
Emissivity Setting Method	-BRT models: via RS485 Modbus -CRT and -BRT models: via touch screen
Response Time, t90	⩾240 ms (90% response)
Spectral Range	2.0 to 2.6 µm
Supply Voltage	24 V DC ± 5%

Max. Current Draw	100 mA
Max. Loop Impedance (-CRT models)	900 Ω (4-20 mA output)
Alarm Relays	2 x Single Pole Changeover alarm relays, rated 24 V DC, 1 A, isolated 500 V DC

Data Logging Specifications

Data Logging Interval	1 to 86,400 seconds (1 day)
MicroSD Card	Max. capacity: 32 GB (not included)
Internal Clock Battery	1 x BR 1225 3V (not included)
Variables Logged	Target temperature, electronics module temperature, max, min, average, emissivity setting, reflected energy compensation temperature, alarm events
File format	.csv
Configurable Parameters	Sample period, number of samples, scheduled start date and time

Touch Screen Interface Specifications

Touch Screen Display Format	2.83” (72 mm) resistive touch TFT, 320 x 240 pixels, backlit
Configurable Parameters	Temperature range, temperature units, emissivity setting, reflected energy compensation, alarms, signal processing, Modbus address (-BRT models), date and time, data logging
Temperature Units	°C or °F configurable
Temperature Resolution	0.1°
Alarm Configuration	Two alarms with adjustable level, individually configurable as HI or LO.
Signal Processing	Average, peak hold, valley hold, minimum, maximum

Mechanical Specifications

	Sensing Head	Electronics Module
Construction	Stainless Steel 316	Die Cast Aluminium
Major Dimensions	12 (dia.) x 48 (l) mm	98(w) x 64(h) x 36(d) mm
Mounting	M12 x 1.5 mm thread	Requires two M4 screws for wall mounting (see Installation)

Fibre Optic Cable Length (sensing head to electronics module)	3 m, 5 m or 10 m
Cable Connections	Removable screw terminal blocks (see "Connections") Conductor size: 28 AWG to 18 AWG
Output Cable Gland	Suitable for cable diameters 3.0 to 6.5 mm

Environmental Specifications

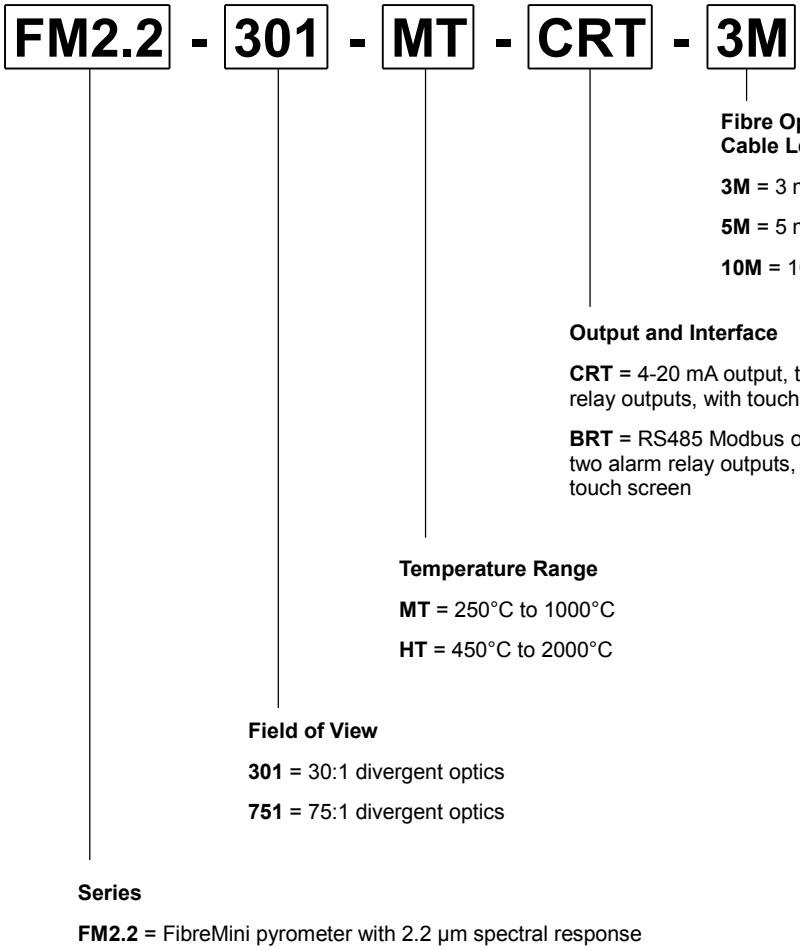
	Sensing Head	Electronics Module
Environmental Rating	IP65 (NEMA 4)	-
Ambient Temperature Range	0°C to 200°C	0°C to 60°C
Relative Humidity	Maximum 95% non-condensing	Maximum 95% non-condensing

This product is CE marked and RoHS compliant.

Electromagnetic Compatibility Standards

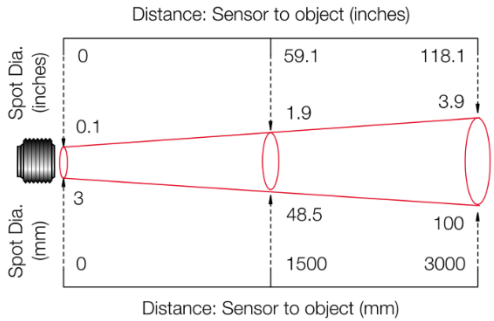
Conforms to EMC Directive EN61326-1:2006 (Electrical equipment for measurement, control and laboratory use – Industrial) as well as industrial standards for electromagnetic immunity and emissions.

Model Numbers

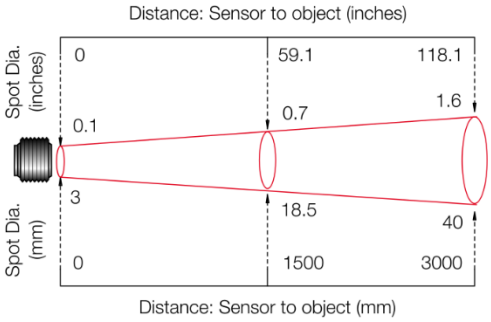


Field of View Diagrams

301 30:1 divergent optics



751 75:1 divergent optics



Diagrams show the diameter of the measured spot at each distance, for 90% energy.

The sensor will also measure at longer distances than the diagrams show.

Measurement accuracy is not affected by distance, however the measured spot size will be larger at longer distances.

Emissivity Adjustment

The default emissivity setting is 0.95. This may be adjusted via the touch screen interface:

Settings → Emissivity & Compensation

Enter the emissivity of the target surface here. For more information on how to find the target emissivity, contact Calex.

Reflected Energy Compensation

Settings → Emissivity & Compensation

Some of the infrared energy detected by an infrared temperature sensor is not emitted by the target, but is a reflection of its surroundings.

To ensure an accurate reading, the sensor needs to know the temperature of the source of that reflected energy. In most applications, the surfaces that surround the target have the same temperature as the sensor itself (e.g. the sensor and target are in the same room). The sensor automatically compensates for the reflected energy, so this setting is not required and should be switched off.

However, in some applications, the source of the reflected energy (the surroundings of the target) is much hotter or colder than the sensor itself. In these cases, Reflected Energy Compensation should be enabled and set to the temperature of the surroundings of the target.

For example: if the target is inside a furnace and the sensor is outside, the reflected energy is coming from the inner walls of the furnace. Enter the furnace temperature into “Reflected Temperature” and select “Enable Reflected Energy Compensation”.

For assistance, contact Calex.

Alarm Outputs

The sensor has two alarm relay outputs, rated 24 V DC, 1 A. They are individually configurable via the touch screen interface.

Each alarm can be configured as Low or High, with set point and hysteresis.

For more information, see “Alarms”.

Touch Screen Interface

The backlit touch screen interface provides a large, bright display of the measured temperature, two alarm relay outputs, and options for full configuration of the sensor.

Using the Touch Screen Interface

Main Screen (Temperature View)

Displays a large indication of the measured temperature. The background turns bright red when an alarm is activated.

MicroSD Card Status

This icon is displayed when a MicroSD card is inserted, and flashes when data logging is in progress.

Scheduled Logging

This icon is displayed when scheduled data logging is enabled and has yet to begin.

Temperature Units °C and °F

Press “°C” to switch to °F and vice versa. The units are changed throughout the interface.

Display Options

Press the measured temperature to select which reading is shown:

Average Temperature: The measured temperature with averaging, but without hold processing.

Hold Temperature: The measured temperature, with averaging **and** hold processing.

Unfiltered Temperature: The unprocessed measured temperature.

Sighting On/Off

Switches the laser sighting light on or off. The light does not affect the measurement accuracy.

Start/Stop Logging

Manually begins or ends data logging (requires MicroSD Card, available separately).

If Scheduled Start is enabled in Settings > Data Logging, then logging cannot be started manually.

To manually start logging, you must first disable Scheduled Start.

Acknowledge Alarms

Switches the relay outputs for triggered alarms to their normal, untriggered state. The background of the Temperature View and Graph screen will stay red, and the alarms will not be triggered again until they are reset (see “Alarms” below). Alarms can be acknowledged while the display is locked.

<table>
<tr>
<td> 
  </td>
<td>Lock/Unlock

Prevents settings being changed via a four-digit numerical code.

To unlock the sensor, enter the password and press the Unlock icon.

The default password is 1234.

 
Change Password

Enter, confirm and save a new four-digit code.</td>
</tr>
<tr>
<td>  </td>
<td>Graph

Displays the recent history of the Filtered Temperature and the Sensor Temperature. To scroll backwards and forwards in time, touch the graph and drag it. The graph stores the most recent 24 hours of temperature data.

 
Reset Graph

Clears and restarts the graph.

 
Return to Scrolling View

Returns the graph to the real-time scrolling view, showing the most recent measurements.</td>
</tr>
<tr>
<td>  </td>
<td>Settings

Access the configuration parameters. Press Apply  to save the settings, or Exit  to leave the screen without saving.</td>
</tr>
</table>

Settings

	**Emissivity & Compensation** Adjust the emissivity setting and reflected energy compensation options.
	**4-20 mA Output (-CRT models)** Set the temperature range limits for the linear 4-20 mA analogue output.
	**RS485 Modbus Output (-BRT models)** Set the Modbus address.
	**Date & Time** Change the date and time for data logging purposes. The clock is reset when the power is switched off, unless a battery is fitted.
	**Data Logging** Configure the storage of temperature data and alarm events. A MicroSD Card (optional) must be inserted to use these features.
	**Alarms** Configure the settings for Alarm 1 and Alarm 2 individually.
	**Output Processing** Configure averaging and peak or valley hold processing.

Emissivity & Compensation Settings

Emissivity Setting

Enter the emissivity of the target surface. The emissivity setting should match the target emissivity for maximum accuracy.

Enable Reflected Energy Compensation

Select to enable Reflected Energy Compensation, which improves the measurement accuracy if there is significant reflected energy, for example when measuring an object inside a furnace with the sensor positioned outside.

In most applications, this setting should be disabled.

For more information, see the “Reflected Energy Compensation” section of this guide.

Reflected Temperature

If reflected energy compensation is required, enter the temperature of the surroundings of the target here.

4 to 20 mA Output (-CRT models)

Temperature at 4 mA

The lower temperature range limit.

Temperature at 20 mA

The upper temperature range limit.

Please note:

The difference between the temperatures at 4 mA and at 20 mA must be at least 100°C. The temperature at 20 mA must be greater than the temperature at 4 mA.

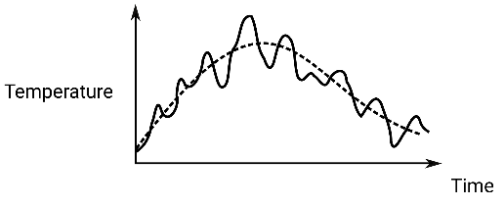
Modbus Address (-BRT models)

The Modbus address of the sensor is displayed. Enter a new address, then press Apply to save it to the sensor. Cycle the power to use the new address.

Minimum: 1. Maximum: 247.

Output Processing

Averaging Period



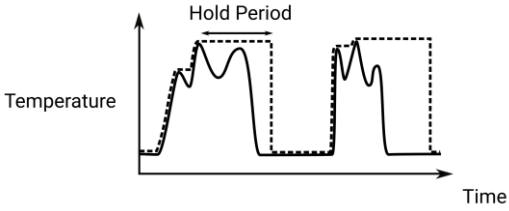
Select the required averaging period to smooth the output and slow down the sensor's response time.

Note: averaging prevents the sensor from following rapid temperature changes.

Hold Mode

With Peak or Valley Hold, the sensor will continue to display or output a peak or valley in the measured temperature for a certain time. This feature is ideal for monitoring the temperature of individual objects on a conveyor, and for ignoring unwanted low readings, such as when a rotating stirring arm in a container of liquid passes the sensor.

Peak



The output returns to the measured temperature after the Hold Period.

Valley

Valley Hold operates in the same way as Peak Hold, except the sensor holds the lowest temperature measured during the Hold Period.

Off

Disables hold processing.

Hold Period

The peak hold period.

Alarms

The settings for the Alarm 1 and Alarm 2 relay outputs are configured individually.

Manually Reset Alarms

If an alarm has been triggered, this allows both alarms to be triggered again. Alarms will not be triggered again until they are reset, either automatically or manually.

Alarm 1 and Alarm 2

Alarm Set Point

The temperature at which the alarm is triggered. Minimum: 200°C. Maximum: 2000°C.

Hysteresis

The temperature difference between the Alarm Set Point and the reset temperature. Hysteresis is only used when Automatic Reset is enabled. Please see the diagrams below for more information.

Minimum: 0°C (hysteresis disabled). Maximum: 2000°C.

Filtered Temperature or Sensor Temperature (Alarm 2 only)

Select the temperature monitored by Alarm 2.

Alarm Type

High

The alarm is triggered when the temperature rises above the Alarm Set Point.

Low

The alarm is triggered when the temperature drops below the Alarm Set Point.

Off

The alarm is disabled.

Reset

Automatic

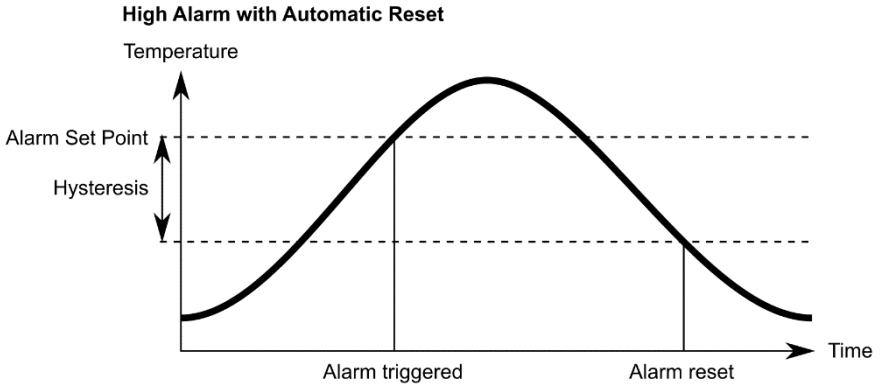
The alarm is acknowledged and reset automatically when the temperature reaches the reset temperature (see Hysteresis). It can also be acknowledged or reset manually.

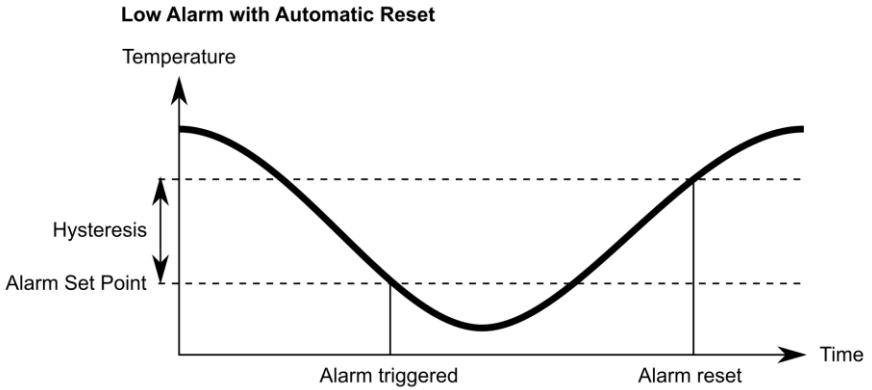
Manual

The alarm is acknowledged by pressing on the Temperature View or List View, and reset by pressing on the Alarms screen.

Alarms

Alarm Operation with Hysteresis and Automatic Reset





Data Logging

	**Data Logging Settings** **Sample period** The time, in seconds, between samples. **Number of samples** The number of samples the unit will collect before logging stops. Enter “0” to log data continuously until manually stopped. **Enable Scheduled Start** The sensor begins logging at the Date and Time specified. Logging can also be started and stopped manually. **Date and Time** The date and time for scheduled logging to start.
	**Alarm Logging Settings** Alarm events can be logged to the MicroSD Card. Alarm log files and settings are independent from Data Logging. **Log Trigger Time** The time that an alarm is triggered will be logged. **Log While Triggered** Data logging will start when an alarm is triggered. 1 sample is logged per second. Logging stops when both alarms are reset. **Log Acknowledge Time** The time that the alarm is acknowledged will be logged. **Log Reset Time** The time that the alarm is reset will be logged.

Data Logging

The sensor can be used as a standalone data logger.

Data is stored on a MicroSD card in .csv format and can be viewed and edited easily using spreadsheet software. The MicroSD card is available as an optional accessory, with an SD Card adapter to transfer data to a PC.

With a 2 GB card, the user can store 28.4 million readings, which is almost 1 year’s worth of data at 1 sample per second. Larger cards provide more storage.

The MicroSD card slot and battery holder are located on the touch screen circuit board in the lid of the electronics module. Readings are time and date stamped using the unit’s internal clock. The clock is reset when the power is disconnected, or it will continue if the optional battery is fitted.

Using the Sensor as a Data Logger

1. Insert a MicroSD card into the holder on the circuit board inside the lid of the electronics module.

2. To retain the date and time when the unit is switched off, fit a battery to the holder on the circuit board inside the lid.

3. Replace the lid and connect the sensor power supply.

4. To set the number of samples to be logged, the time period between samples, and, if required, to schedule data logging to automatically start, press  to access the Settings menu, then press  to access the Data Logging options.

5. To save data logging settings, press 

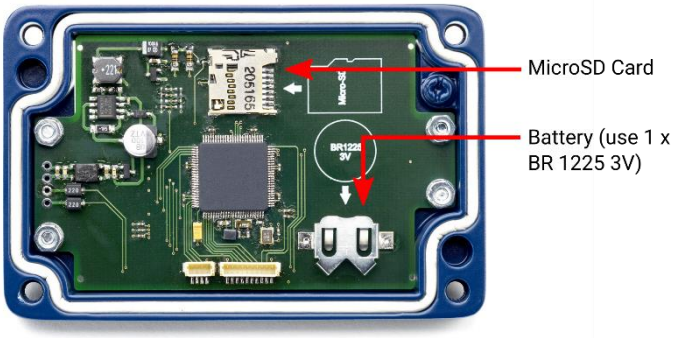
6. To manually start data logging, press  on the Temperature View.

7. While logging is in progress, the logging icon  flashes on the Temperature View.

8. To stop data logging, press 

9. To transfer data to a computer, remove the MicroSD Card from the unit, insert the card into the SD Card adapter (supplied with the MicroSD Card, accessory model MSD) and insert the adapter into an SD Card reader.

Installation of MicroSD Card and Battery



The MicroSD Card and battery slots are located on the touch screen circuit board. Unscrew the lid of the electronics module to access them.

The battery is optional. With a battery fitted, the internal clock will continue to run when the power is off. Without a battery, the unit will request the date and time each time the power is cycled.

All other settings are stored in permanent memory and will be preserved when it is switched

off, regardless of whether a battery is fitted.

Data Log Files

Data is saved to the MicroSD Card in .csv format. This file format can be opened or imported by spreadsheet software such as Microsoft Excel.

A new folder is created on the MicroSD Card for each day that data is logged.

A new log file is created every time logging is started. The start time is used as the file name.

Accessories

A range of accessories to suit different applications and industrial environments is available. These may be ordered at any time and added on-site. The following accessories are available from Calex:

Fixed mounting bracket

Adjustable mounting bracket

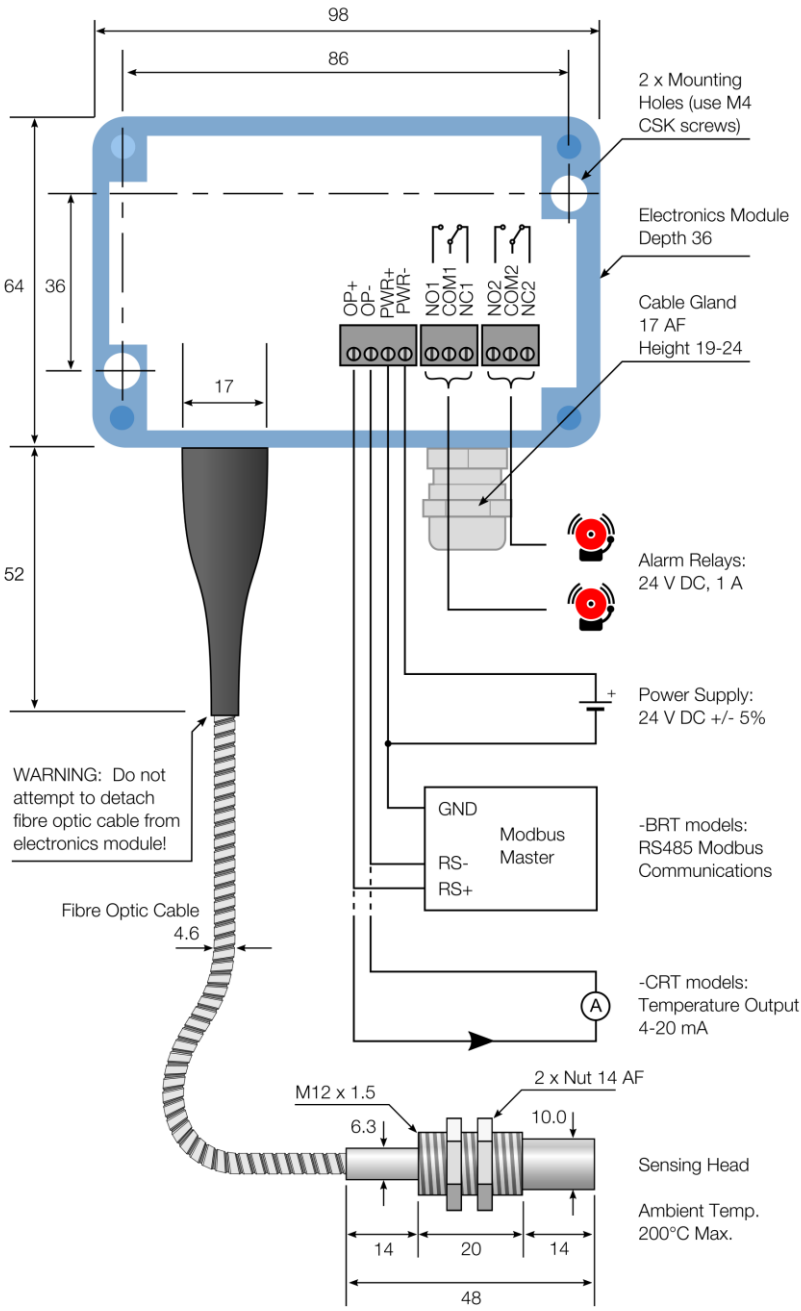
Air purge collar: The air purge collar is used to keep dust, fumes, moisture, and other contaminants away from the lens. It must be screwed fully onto the sensing head. Air flow should be 5 to 15 l/min. Clean or ‘instrument’ air is recommended.

MicroSD Card: Stores logged data. Includes SD Card adapter.

Options

An optional Calibration Certificate is available if ordered at the same time as the sensor. This UKAS traceable certificate shows the measured temperature at three points across the sensor's temperature range. Contact Calex for details.

Installation



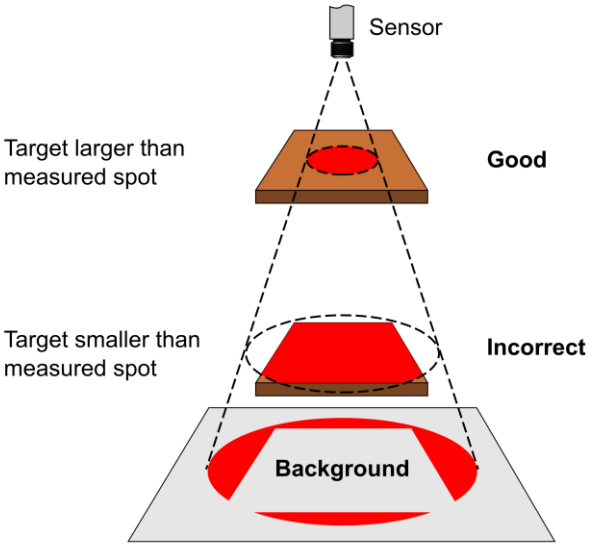
The installation process consists of the following stages:

- **Preparation**
- **Mechanical installation**
- **Electrical installation**

Please read the following sections thoroughly before proceeding with the installation.

Preparation

Distance and Spot Size



The size of the area (spot size) to be measured determines the distance between the sensor and the target. The spot size must not be larger than the target. Choose a suitable mounting distance so that the measured spot size is smaller than the target.

Reflections

The sensor must be installed in a location where energy from lamps, heaters and sunlight cannot be reflected from the target into the lens. This is especially important for low-temperature targets. Using shields may help in this respect. For further information and assistance, contact Calex.

Ambient Temperature

The sensing head may be used between 0°C and 200°C ambient temperature.

The electronics module may be used between 0°C and 60°C ambient temperature. Ensure the temperature of the electronics module remains stable, and allow 20 minutes for the unit to adjust to large changes in ambient temperature.

Atmospheric Quality

Smoke, fumes, dust or steam can contaminate the lens and cause errors in temperature measurement.

In these types of environment, the amount of contaminant should be minimised, and the air purge collar should be used to help keep the lens clean.

Electrical Interference

The sensor is tested to industrial standards for electromagnetic compatibility (EMC). To minimise electromagnetic interference or ‘noise’, the electronics module should be mounted away from motors, generators and such like.

The fibre optic sensing head of this pyrometer contains no electronics and may be mounted where electromagnetic interference prevents the other types of sensor from working properly.

Power Supply

The required supply voltage is 24 V DC. Ensure the power supply is of the correct voltage and is capable of providing an output current of at least 100 mA.

Mechanical Installation

Affix the sensing head to its mounting. The sensor can be mounted on brackets of your own design, or you can use the mounting bracket accessory.

- Switch on the laser sighting to illuminate the measured spot, and adjust the angle of the sensor to aim it.
- Ensure the target is larger than the illuminated spot. If not, adjust the measurement distance for a smaller spot size.

Note: The sensor housing must be connected to earth at one point, either the sensing head, the electronics module, or the output cable shield termination. To avoid ground loops, please ensure the sensor is grounded at only one of these points.

Electrical Installation

Check the distance between the sensing head and the electronics module, and between the electronics module and the instrumentation. If necessary, the sensor can be ordered with a longer fibre optic cable between the sensing head and the electronics module.

The cable from the electronics module should have an outer diameter between 3.0 and 6.5 mm, with conductors of size 28 to 18 AWG.

The terminal blocks may be removed from the electronics module for easy wiring.

IMPORTANT: Ensure wiring is correct before switching the power on. Always switch off the power before connecting or disconnecting the sensor.

Do not disconnect the touch screen circuit board from the main circuit board while the power is on.

Wiring (-BRT models)

When connecting several sensors in a single Modbus network, all of the sensors should be connected via a junction box to a single network bus cable, running from the furthest sensor to the Modbus Master.

Up to 247 sensors may be connected to a single Modbus network. Each sensor must have a unique Modbus address. Sensors are normally shipped with Modbus address 1. This may be changed using the touch screen interface or via Modbus.

To help prevent data reflections, please ensure the cable between each sensor and the main network bus is as short as possible. The network bus should be terminated with a resistor of 120Ω between the RS+ and RS- wires. The PWR- wire of the bus should be connected to the signal ground of the Modbus Master.

Operation

Once the sensor is in position and the appropriate power, air and cable connections are secure, the system is ready for continuous operation by completing the following simple steps:

1. Turn on the sensor power supply
2. Turn on the connected instrumentation
3. Read, monitor or log the temperature

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 stabilise before taking or recording measurements.
- The electronics module should be positioned away from sources of electromagnetic interference. However, the sensing head may be positioned in areas of high electromagnetic interference.
- Wires must be connected only to the appropriate terminals.
- Do not attempt to open the black cover on the sensor inside the electronics module. Doing so will void the warranty.

Viewing through a window

The sensor is capable of measuring the temperature of a target through a window made of a suitable material transmissive to infrared radiation at 2.0 to 2.6 microns. The emissivity setting of the sensor should be adjusted to compensate for the presence of the window. Please contact Calex for more information on using the sensor with a window.

Maintenance

Our customer service representatives are available for application assistance, calibration, repair, and solutions to specific problems. Contact our Service Department before returning any equipment.

In many cases, problems can be solved over the telephone. If the sensor is not performing as it should, try to match the symptom below to the problem. If the table does not help, call Calex for further advice.

Troubleshooting

Symptom	Probable Cause	Solution
No output	No power to sensor	Check power supply
Erroneous temperature	Incorrect wire connection	Check connections
Erroneous temperature	Faulty sensor cable	Verify cable continuity
Erroneous temperature	Field of view obstruction	Remove obstruction

Lens cleaning

The lens must be kept clean and dry for maximum accuracy. Check the condition of the lens regularly.

If the lens has become dirty, the measurement accuracy will be affected. Blow off loose particles (if not using the air purge accessory) with an air “puffer”.

Password

The default password is 1234. The password may be changed via the interface.

Guarantee

Calex guarantees each instrument it manufactures to be free from defect in material and workmanship under normal use and service for the period of two years from the date of purchase. This guarantee extends only to the original buyer according to Calex Terms and Conditions of Sale.