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CALEX
ELECTRONICS LIMITED

innovative **infrared temperature sensors**
low-noise industrial **power supplies**



catalogue

The background of the entire page is a photograph of an industrial facility. It features a complex network of large, silver-colored metal pipes that run horizontally and vertically. Some pipes are wrapped in white insulation. In the background, there are metal walkways with grates and various industrial components like valves and flanges. The lighting is bright, creating strong highlights and shadows on the metallic surfaces.

















WELCOME TO CALEX

Since 1973, Calex Electronics Ltd has been providing high quality, cost effective temperature measurement and power conversion solutions for industries worldwide. Our in-house design and manufacturing is focused on non-contact infrared temperature sensors and AC/DC power supplies.

We also offer a wide range of complementary products including thermocouples, resistance thermometers, indicators, controllers, SCADA systems, calibrators and DC/DC converters.

Calex Electronics Ltd is ISO 9001 and ISO 14001 certified.

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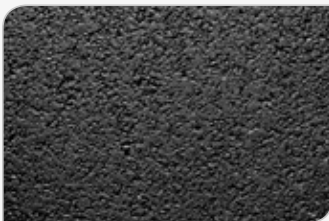


choosing a sensor

INTRODUCTION

The sensor detects the infrared radiation emitted by an area of the target surface, and converts this into a useful temperature measurement. There are 3 main factors affecting the accuracy of the measurement:

Type of Material

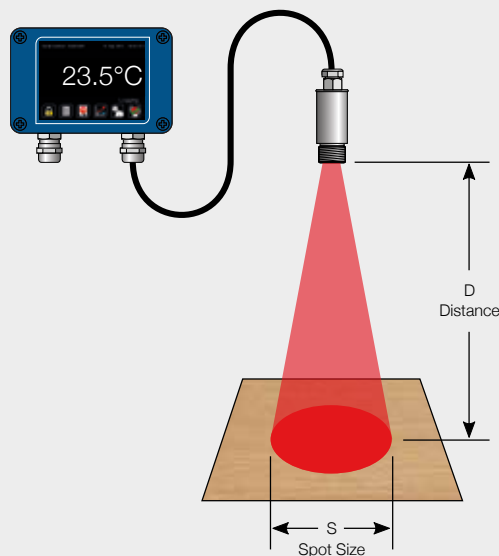


Most non-reflective materials, such as paper, cardboard, asphalt, food, plastics, rubber and painted surfaces are easy to measure with a general-purpose, long-wavelength sensor.



Some materials, such as reflective metals, may require a specialised short-wavelength sensor for accurate results.

Target Size and Distance



The sensor measures the average temperature within an area on the target surface. The size of this area depends on the sensor's optics.

A choice of optics is available for most sensors. The size of the target and the measurement distance determine which optics should be chosen.

For each choice of optics, the spot size at any given distance can be determined using the D:S (Distance to Spot Size) ratio.

Ambient Conditions



In normal room-temperature conditions, a simple, uncooled sensor may be used. For hotter environments, high-ambient-temperature models, or models with air or water cooling, are available.



Obstructions such as dust, steam and smoke can affect the reading, and specialised sensors are available for accurate readings in very damp or dirty conditions. However if the air looks clear, then it should be easy to get good results with a general-purpose sensor.

PyroNFC

Smartphone Configurable Infrared Temperature Sensor



- Non-contact industrial temperature sensor
- Fully configurable via smartphone app
- Voltage output (linear with temperature) and open collector alarm output. Both can be used simultaneously
- Measures from 0°C to 1000°C, accurately and consistently
- Extremely small, with side-entry cable: ideal for mounting in tight spaces
- Fast response time: 125 ms
- Low cost, high performance
- Operates in ambient temperatures up to 80°C without cooling
- Form factor optimised for brake testing applications, plus many others

APP FEATURES



- Continuously read temperature from PyroNFC sensors
- Instantly configure PyroNFC sensors without powering them
- Simply touch the sensor with the device to communicate
- Compatible with NFC-equipped Android devices
- Get the app free from Google Play Store (search for "PyroNFC")

GENERAL SPECIFICATIONS

Temperature Range

0 to 1000°C

Outputs

2 outputs, configurable via NFC:
0-5 V DC or 0-10 V DC output, linear with measured temperature, rescalable, and:
Open collector alarm output with temperature threshold and hysteresis

Field of View

15:1 (see OPTICS)

Accuracy

± 1.5% of reading or ± 1.5°C, whichever is greater

Repeatability

± 0.5% of reading or ± 0.5°C, whichever is greater

Response Time, t_{90}

125 ms

Configuration

Via Android app using NFC-equipped device (e.g. smartphone or tablet)

Emissivity

Adjustable via app

Emissivity Setting Range

0.2 to 1.0

Max Temperature Span (Linear Output)

1000°C

Min Temperature Span (Linear Output)

100°C

Spectral Range

8-14 μm

Max. Supply Voltage

28 V DC

Min. Supply Voltage (at Sensor)

12 V DC (for 10 V output)

6 V DC (for 5 V output)

Max Current Draw

7 mA

ENVIRONMENTAL

Environmental Rating

IP65

Ambient Temperature Range

0°C to 80°C

Relative Humidity

95% max. non-condensing

CONFORMITY

Electromagnetic Compatibility (EMC)

EN61326-1, EN61326-2-3 (Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements - Industrial)

RoHS Compliant

Yes

APP

Configurable Parameters

Temperature range

Linear voltage output type and scale

Alarm output threshold and hysteresis

Emissivity setting

Reflected temperature

Temperature Units

°C / °F

Signal Processing

Averaging Period (0.125 to 60 seconds)

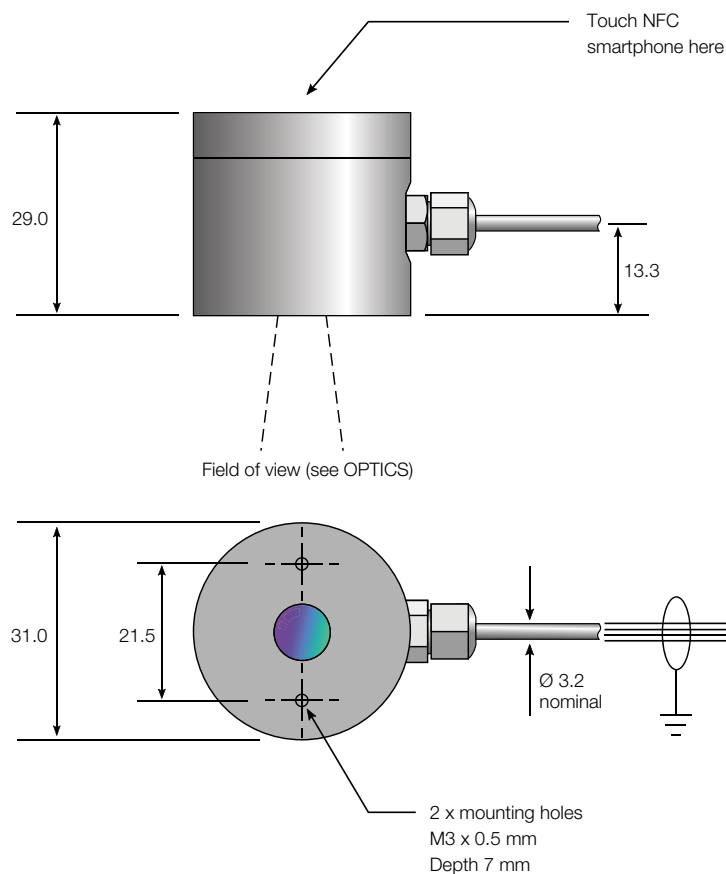
Peak / Valley Hold

Hold Period (0.125 to 1200 seconds)

Real Time Temperature Reading

Hold NFC device against sensor for continuous in-app temperature updates

DIMENSIONS AND CONNECTIONS



MECHANICAL SPECIFICATIONS

Construction

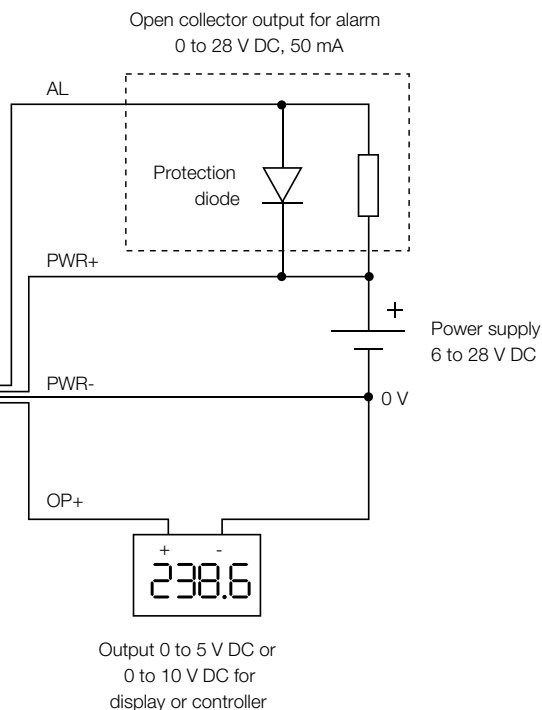
Black anodised aluminium and ABS

Cable Length

1 metre standard (longer lengths available to order)

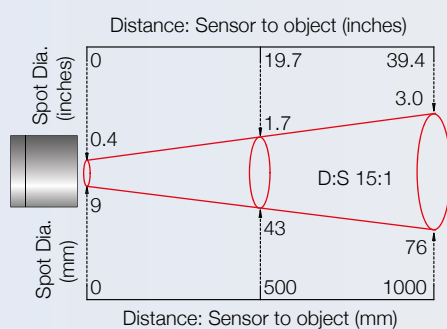
Weight with 1 Metre Cable

65 g



OPTICS

Diameter of target spot measured versus distance from sensing head (90% energy)



MODEL NUMBERS



PN

151

Optics
151 = 15:1 divergent optics

Series

PN = PyroNFC infrared temperature sensor with 0-5 / 0-10 V DC output, open collector alarm output, NFC wireless communications and 1 metre cable

ACCESSORIES

Fixed mounting bracket **FBN**

Adjustable mounting bracket **ABN**

Air purge collar **APN**

3-point UKAS traceable calibration certificate **CALCERTA**

Extended cable (30 m max) **PNCE**

PyroCouple, PyroEpsilon, PyroBus

Compact Non-Contact Temperature Sensors



shown actual size

- Temperature range: -20°C to 500°C
- Choice of precision optics for large or small targets at short or long distances
- Fast response with high stability
- Stainless steel housing, sealed to IP65
- Quick and easy installation
- Wide range of accessories

The Calnex Compact Series is a range of high quality, low cost non-contact sensors that measure the temperature of inaccessible or moving objects and materials. They measure temperatures from -20°C to 500°C, accurately and consistently, with an outstanding response time of 240 ms. All models conform to industrial EMC standards.



PyroCouple with indicator

The **PyroCouple** is a simple infrared temperature sensor with a choice of analogue outputs. No complicated setup is required - just connect a temperature indicator and power supply, and instantly start taking measurements.

- Suitable for non-contact temperature measurement on most non-reflective non-metal surfaces, such as paper, thick plastics, asphalt, painted surfaces, food, rubber and organic materials, among many others.
- Choice of analogue outputs for measured temperature:
Two-wire 4-20 mA,
Four-wire 0-50 mV,
Four-wire Type K, J or T thermocouple
- Additional 4-20 mA sensor body temperature output on the power supply loop of four-wire models: indicates the air temperature around the sensor and helps prevent overheating or overcooling



PyroEpsilon with PyroTune emissivity adjuster

The **PyroEpsilon** is a simple sensor with an adjustable emissivity setting. It is ideal if the target is partially reflective.

- Two-wire 4-20 mA output
- Emissivity adjustment via a separate two-wire 4-20 mA input
- Adjust the emissivity continuously during the process using a variable 4-20 mA source
- Set the emissivity manually with the PyroTune emissivity adjuster
- If you are not sure the emissivity of the target is high, choose the PyroEpsilon instead of the PyroCouple.



PyroBus sensors with PM180 touch screen display

The **PyroBus** is a networkable, fully configurable sensor with RS485 Modbus RTU communications.

- Up to 247 sensors may be connected to a single network.
- Adjustable emissivity setting for use on a wide range of materials
- Averaging function to smooth the temperature output
- Peak and valley hold processing for measuring individual objects on a conveyor
- Reflected energy compensation for accurately measuring the temperature of objects in ovens or chillers, from outside
- Maximum, minimum and instantaneous temperature readings
- Optional 6-channel touch screen terminal for local display, configuration and data logging
- Connect sensors and 6-channel terminals directly to an existing RS485 Modbus system

GENERAL SPECIFICATIONS - SENSORS

Output (PyroCouple)

PyroCouple Output Option (see Model Numbers)	Target Temperature Output	Sensor Temperature Output
-0	4-20 mA	Not available
-1	0-50 mV	4-20 mA
-2	Type T thermocouple	4-20 mA
-3	Type J thermocouple	4-20 mA
-4	Type K thermocouple	4-20 mA
-5	0-50 mV (very low current draw: 3.2 mA)	Not available

	PyroCouple	PyroEpsilon	PyroBus
Output	See Above	Two-wire 4-20 mA	RS485 Modbus RTU
Temperature Range	LT = -20 to +100 °C MT = 0 to 250 °C HT = 0 to 500 °C		-20 to 500°C
Accuracy	±1% of reading or ±1°C whichever is greater		
Repeatability	± 0.5% of reading or ± 0.5°C whichever is greater		
Emissivity Setting	Fixed at 0.95	Variable 0.2 to 1.0 via continuous 4-20 mA input	Adjustable 0.2 to 1.0 via RS485 Modbus
Response Time, t_{90}	240 ms (90% response)		
Spectral Range	8 to 14 μ m		
Supply Voltage	24 V DC (28 V DC max.)		12 V DC (13 V DC max.)
Min. Sensor Voltage	6 V DC		
Max. Loop Impedance	900 Ω (4-20 mA output)		-
Output Impedance	56 Ω (voltage/thermocouple output)	-	
Input Impedance	-	50 Ω	-
Current Draw	20 mA max. (PyroCouple -5 models: 3.2 mA @ 24 V DC)		50 mA max
Baud Rate	-		9600 baud*
Format	-		8 data bits, no parity, 1 stop bit *

* Other configurations available upon request

MECHANICAL

Construction	Stainless Steel
Dimensions	18 mm diameter x 103 mm long
Thread Mounting	M16 x 1 mm pitch
Cable Length	1m (longer lengths available to order)
Weight with Cable	95 g

ENVIRONMENTAL

Environmental Rating	IP65
Ambient Temperature Range	0°C to 70°C
Relative Humidity	95% max. non-condensing

GENERAL SPECIFICATIONS - PYROTUNE

Output	4-20 mA for emissivity adjustment of PyroEpsilon sensor
Supply Voltage	24 V DC (13 V to 28 V DC)
Display Format	3.5 digit LCD
Display Units	Emissivity (0.2 to 1.0) or current (4 - 20 mA)
Adjustment	Push-buttons (raise/lower/set)

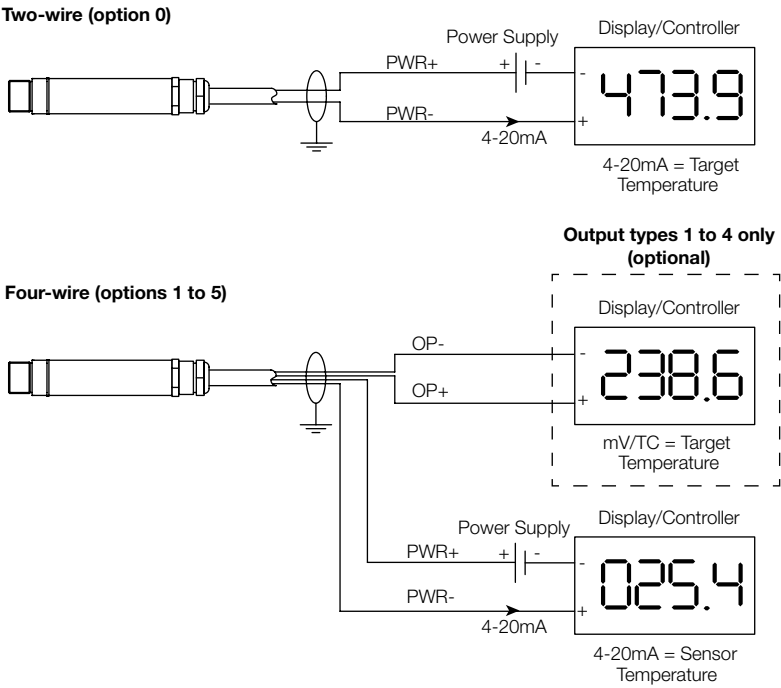
MECHANICAL

Construction	Polycarbonate with gasket, transparent lid (PC) and quick release screws
Mounting	Surface
Dimensions	65 mm tall x 50 mm wide x 35 mm deep
Weight	72 g

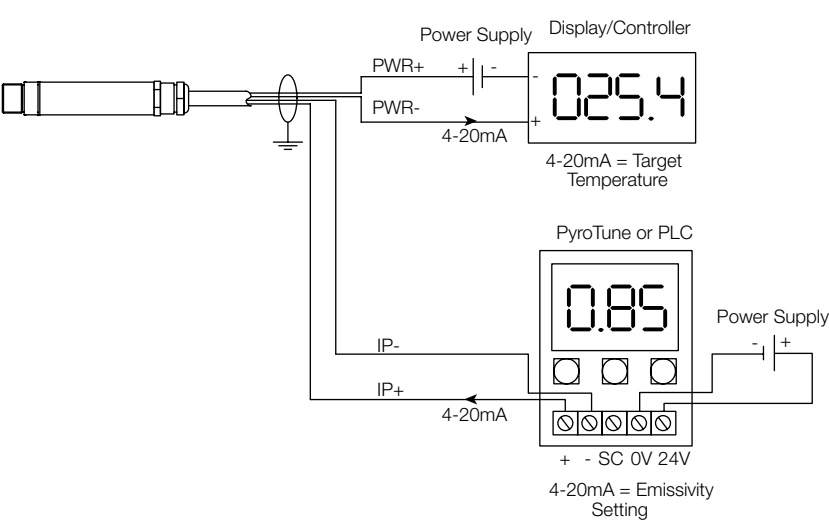
ENVIRONMENTAL

Environmental Rating	IP65
Ambient Temperature Range	0°C to 70°C
Relative Humidity	95% max. non-condensing

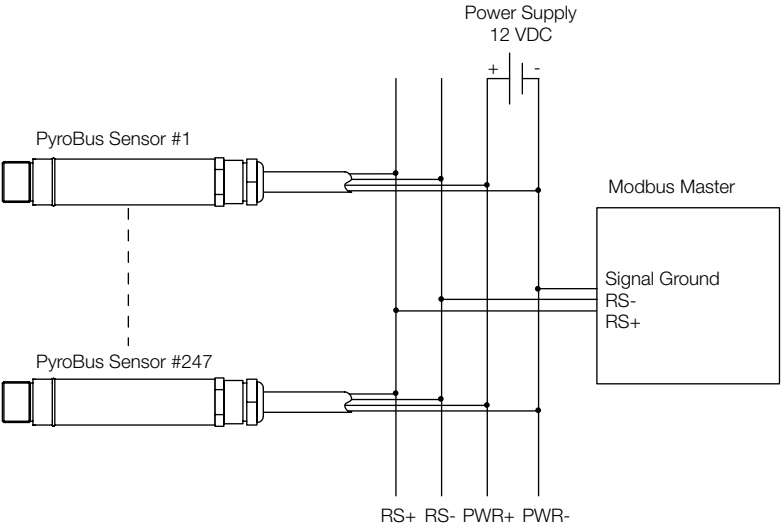
PYROCOUPLE



PYROEPSILON

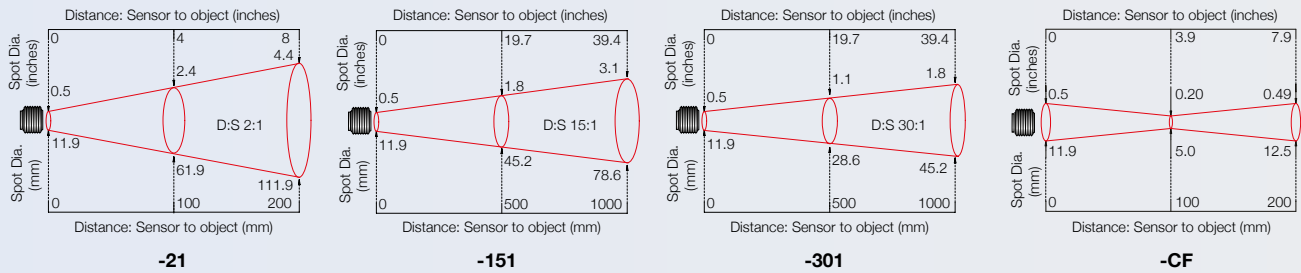


PYROBUS



OPTICS

Diameter of target spot measured versus distance from sensing head (90% energy)



ACCESSORIES



Fixed mounting bracket **FBS**



Air purge collar for 2:1 optics **APSW**
or for all other optics (shown above) **APSN**



Laser sighting tool **LSTS**



Adjustable mounting bracket **ABS**



Air or water cooled jacket with air purge collar **WJ**
(see Model Numbers)



Dual laser sighting bracket, adjustable **DLSBAS**
or fixed **DLSBFS**



PyroTune emissivity adjuster **PT**
(for PyroEpsilon only)



6-channel touch screen interface for temperature display, configuration and data logging (PyroBus only) **PM180**



Protective plastic window with stainless steel holder **PWS**
(PyroEpsilon and PyroBus only)

MODEL NUMBERS



PC **151** **MT** **0** **WJ**

Cooling
(blank) = Sensor without cooling
WJ = Air/water cooled jacket with air purge collar

Output option (PyroCouple only)

0 = 2 wire, 4-20mA
1 = 4-wire, 0-50mV (target temp.), 4-20mA (sensor temp.)
2 = 4-wire, T Thermocouple (target temp.), 4-20mA (sensor temp.)
3 = 4-wire, J Thermocouple (target temp.), 4-20mA (sensor temp.)
4 = 4-wire, K Thermocouple (target temp.), 4-20mA (sensor temp.)
5 = 4-wire, 0-50 mV (target temp.), very low current draw

e.g. Model PC151HT-4 has a type K thermocouple output representing target temperatures of 0°C to 500°C plus a 4-20 mA output proportional to internal sensor temperature. For simplicity, the sensor temperature range is always set the same as the target temperature range

Temperature range (PyroCouple and PyroEpsilon only)

LT = -20 to +100 °C
MT = 0 to 250 °C
HT = 0 to 500 °C (not normally available on PC21 models)

Field of view

21 = 2:1 divergent optics
151 = 15:1 divergent optics
301 = 30:1 divergent optics
CF = Close-focus optics (focal spot size 5 mm at 100mm distance)

Series

PC = PyroCouple: fixed emissivity, choice of analogue outputs
PE = PyroEpsilon: adjustable emissivity, 4-20 mA output
PB = PyroBus: fully configurable, RS485 Modbus communications

Example Model Numbers: PC151MT-0, PE151MT, PB151

PyroMini

Miniature Infrared Temperature Sensors with Optional Touch Screen Interface



FEATURES (ALL MODELS)

- Miniature sensing head and configurable electronics module
- Touch screen (optional) for temperature indication and configuration
- Screen turns bright red in alarm condition for maximum visibility
- Adjustable emissivity setting on all models
- Data logging to MicroSD Card (optional) on touch screen models
- 4 to 20 mA or RS485 Modbus outputs
- Alarm relay outputs rated 24 V DC (optional) - no need for separate trip amplifier
- Maximum, minimum, average and instantaneous readings, peak or valley hold, reflected energy compensation

PYROMINI GENERAL PURPOSE

- High-ambient sensing heads (optional) withstand up to 120°C or 180°C without cooling
- Suitable for a wide range of target materials such as paper, plastics, food, painted surfaces, coated metal and many more
- Resistant to interference from movement of sensing head cable (-JA, -HA models) - ideal for mounting on robot arms
- Temperature ranges from -20°C to 1000°C

PYROMINI 2.2 HIGH TEMPERATURE

- Short-wavelength measurement for improved accuracy on reflective targets such as steel rollers and many other metal surfaces
- Temperature ranges from 100°C to 2000°C
- Choice of optics, including narrow options for long-distance measurements of very hot objects

GENERAL SPECIFICATIONS

	PyroMini General Purpose	PyroMini 2.2 High Temperature
Temperature Range	Choice of ranges from -20°C to 2000°C (see Model Numbers on page 3)	
Output	4 to 20 mA or RS485 Modbus (up to 247 sensors may be installed on each Modbus network)	
Alarm Relays (-CRT and -BRT models)	2 x Single Pole Changeover alarm relays rated 24 V DC, 1 A, isolated 500 V DC	
Accuracy	± 1°C or 1% of reading, whichever is greater	± 2°C or 1% of reading, whichever is greater
Repeatability	± 0.5°C or 0.5%, whichever is greater	
Field of View	Choice of optics (see Model Numbers on page 3)	
Emissivity Setting Range	0.20 to 1.00	0.10 to 1.00
Emissivity Setting Method	-CRT and -BRT models: via touch screen -BB and -BRT models: via RS485 -CB models: via two rotary switches in electronics box	
Response Time, t90	≥240 ms (90% response)	
Spectral Range	8 to 14 µm	2.0 to 2.6 µm
Supply Voltage	24 V DC ± 5%	
Maximum Current Draw	100 mA	
Maximum Loop Impedance	CB and -CRT models: 900 Ω (4 to 20 mA output)	
Max Temp Span (-CRT models)	Full temperature range	
Min Temp Span (-CRT models)	100°C	

Cable Length (sensing head to electronics module)

1 m (standard), up to 30 m (optional)

Weight with 1 m Cable

390 g (approx)

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

	Sensing Head	Electronics Module (without screen)	Electronics Module (with touch screen)
Environmental Rating	IP65 (NEMA 4)	IP65 (NEMA 4)	-
Ambient Temperature Range	See below *	0°C to 60°C	0°C to 60°C
Relative Humidity	Maximum 95% non-condensing	Maximum 95% non-condensing	Maximum 95% non-condensing
RoHS Compliant	Yes	Yes	Yes

*Ambient Temperature Range (Sensing Head)

PyroMini: Ranges from 0°C to 180°C, depending on model (see Model Numbers on page 3)

PyroMini 2.2: 0°C to 70°C

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.

MECHANICAL

	Sensing Head	Electronics Module
Construction	Stainless Steel 316	Cast aluminium
Dimensions	Ø 18 x 45 mm (see diagram)	98(w) x 64(h) x 36(d) mm
Mounting	M16 x 1 mm thread	Two M4 screw holes for wall mounting (see diagram)

TOUCH SCREEN (-CRT AND -BRT MODELS)

The optional backlit touch screen interface mounted in the lid of the electronics module provides a large, bright display of the measured temperature, as well as controls allowing full configuration of the sensor. The graph view shows the history of the measured temperature.

In alarm conditions, the display changes colour to provide an immediate and obvious alarm indication. Alarm modes and levels can be configured via the touch screen.

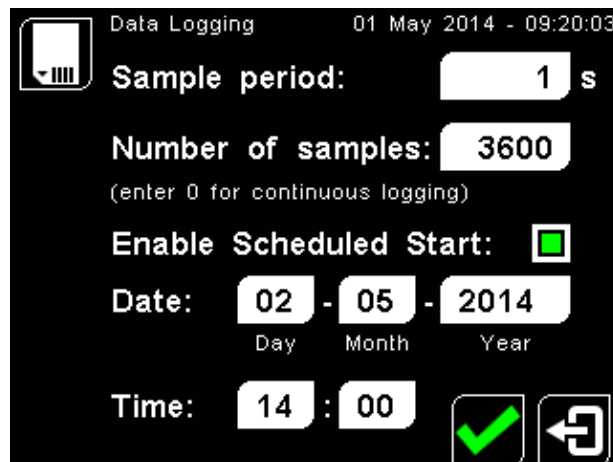
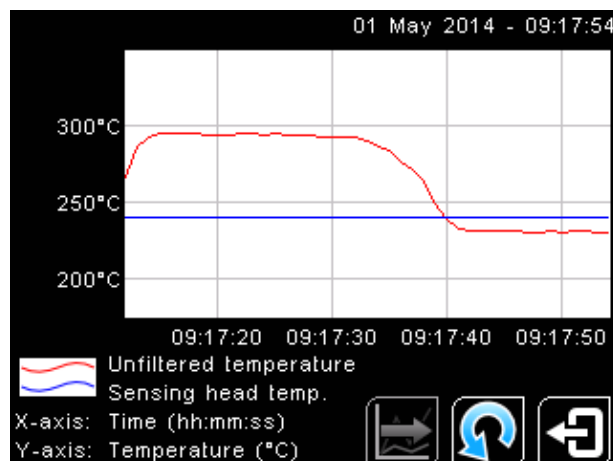
TOUCH SCREEN SPECIFICATIONS

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. Alarm 2 can be set to target temperature or sensing head internal temperature
Signal Processing	Average, peak hold, valley hold, minimum, maximum

EXAMPLE SCREENSHOTS



Screen shown with red background to indicate alarm condition



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, sensing head 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

DATA LOGGING (-CRT AND -BRT MODELS)

The PyroMini can be used as a standalone data logger.

PyroMini models -CRT and -BRT include a MicroSD card slot for data logging, which can be configured via the touch screen interface. The user can select the sample rate and the number of samples to be taken and schedule the data logging to start at a certain time.

With a 2 GB card, the user can store 28.4 million readings, which provides almost 1 year's worth of data at the fastest possible sample rate of 1 per second.

Data is stored on the MicroSD card in .csv format and can be viewed and edited easily using spreadsheet software. Alarm events can also be logged to the MicroSD Card.

A MicroSD card with SD card adapter is available as an optional accessory.

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

MODEL NUMBERS

Series	Sensing Head Operating Temperature Range (General Purpose only)	Field of View	Measurement Temperature Range	Output and Interface
PM (PyroMini - General Purpose)	MA	21 151 301 CF	LT MT HT XT	CB
			CT	CRT BB BRT
	HA JA	201	HT XT	CB
			CT	CRT BB BRT

PM2.2 (PyroMini 2.2 - High Temperature)	-	151	PT	CB
		251		CRT
		751	MT	BB
		CF	HT	BRT

SENSING HEAD OPERATING TEMPERATURE RANGE
(General Purpose models only)

- MA 0°C to 60°C
- JA 0°C to 120°C
- HA 0°C to 180°C

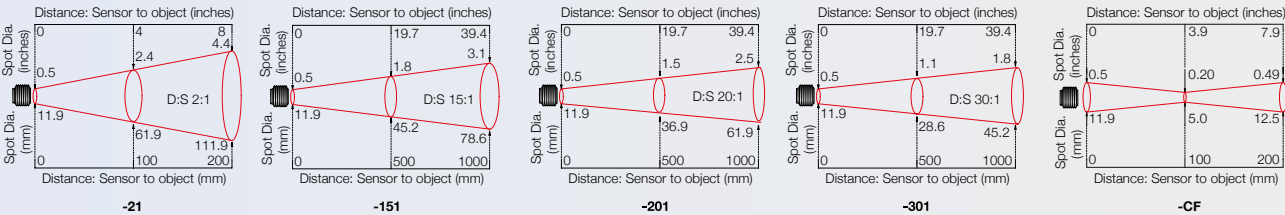
The sensing head on -JA and -HA models is able to withstand ambient temperatures of up to 120°C (-JA) and 180°C (-HA) without cooling. Both models are available with 20:1 optics.

There is no need to supply cooling air or water, and the miniature sensing head is much smaller than bulky, cooled sensors.

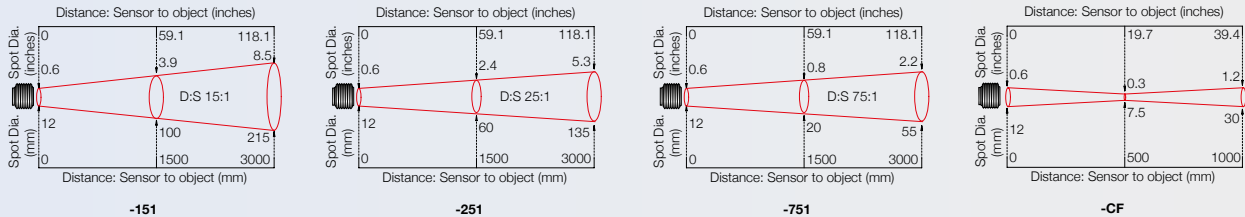


FIELD OF VIEW (PyroMini - General Purpose)

Diameter of target spot measured versus distance from sensing head - 90% energy

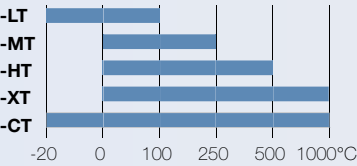


FIELD OF VIEW (PyroMini 2.2 - Short Wavelength)

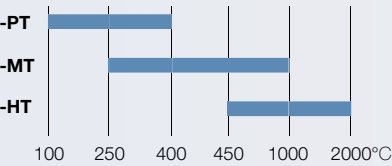


MEASUREMENT TEMPERATURE RANGE (°C)

PyroMini (General Purpose)



PyroMini 2.2 (High Temperature)



- CB models: Fixed 4 to 20 mA output scale (e.g. -XT: 0°C @ 4 mA, 1000°C @ 20 mA)
- CRT models: 4 to 20 mA output is configurable within this range
- BRT and -BB models: Digital output, full temperature range

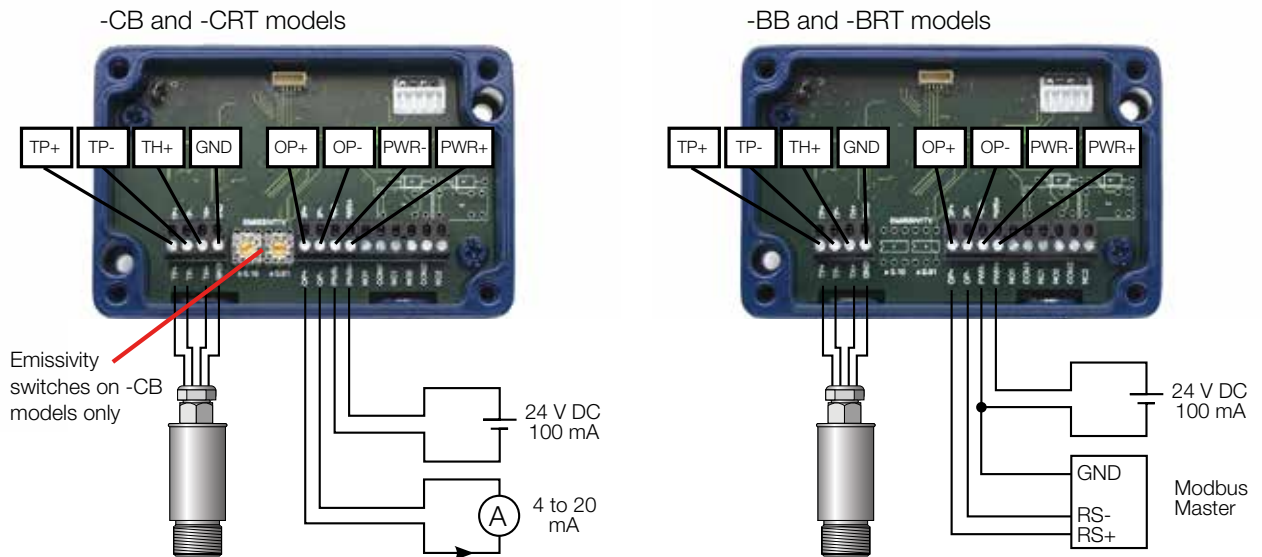
OUTPUT AND INTERFACE

- CB 4 to 20 mA output, no screen
- CRT 4 to 20 mA output and two alarm relay outputs, with touch screen
- BB RS485 Modbus output, no screen
- BRT RS485 Modbus output and two alarm relay outputs, with touch screen

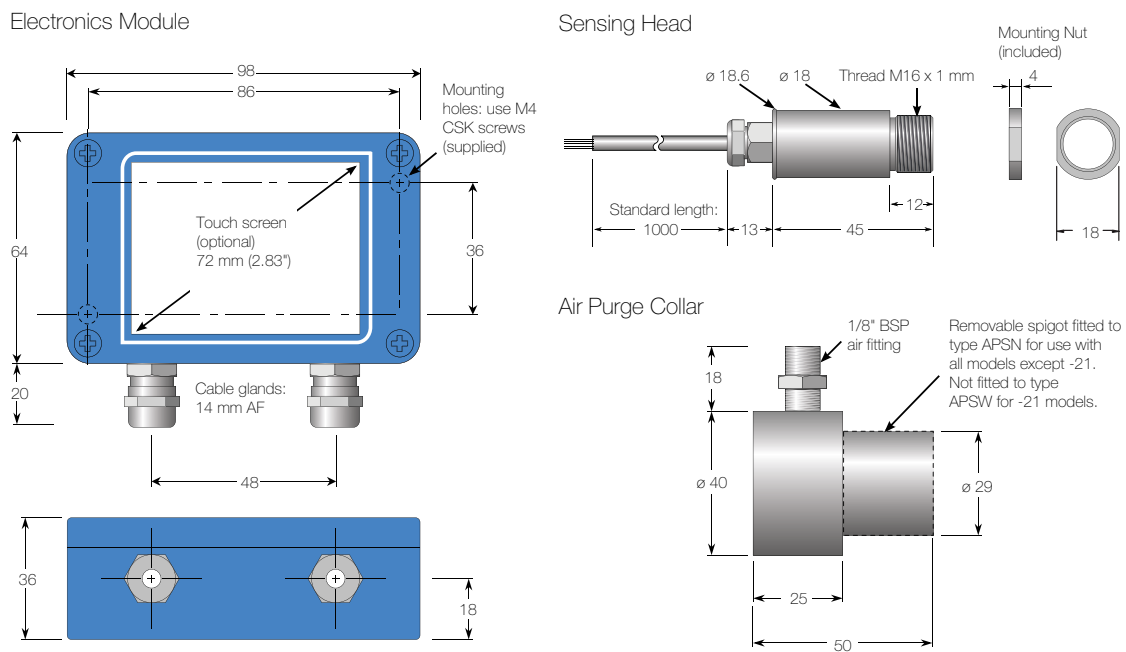
EXAMPLE: PM-MA-301-CT-BRT

Series	Sensing Head Operating Temperature	Optics	Temperature Range	Output and Interface
PM PyroMini	-MA 0°C to 60°C	-301 30:1 divergent	-CT Digital output, -20 to 1000 °C	-BRT RS485 Modbus output and two alarm relay outputs, with touch screen

CONNECTIONS



DIMENSIONS AND ACCESSORIES



All dimensions in mm

ACCESSORIES ALSO AVAILABLE

- MicroSD Card with SD Card adapter: stores logged data (-CRT and -BRT models) **MSD**
- Extended cable between sensing head and electronics module (PyroMini -MA models) **PMCE**, (PyroMini -HA and -JA models) **PMCEHT**, (PyroMini 2.2 models) **PM2.2CE**
- Calibration certificate **CALCERTA**
- Laser sighting tool **LSTS**
- Mounting bracket, Adjustable **ABS**, Fixed **FBS**
- Dual Laser Sighting Bracket, Adjustable **DLSBAS**, Fixed **DLSBFS**
- 6-channel Modbus temperature indicator with data logging **PM180**



PyroUSB

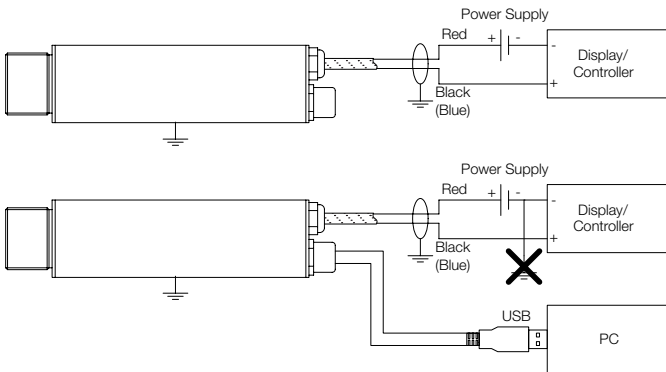
USB Configurable Infrared Temperature Sensors with mA Output



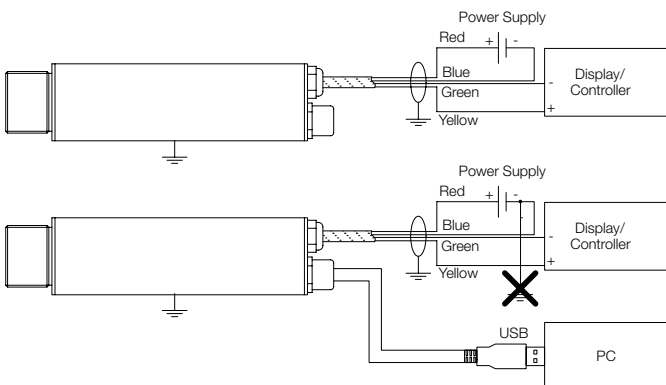
General purpose model shown, with two-wire 4-20 mA output

- Fast, accurate non-contact temperature measurement
- General purpose models suitable for most non-metals
- Short wavelength models suitable for reflective targets such as steel rollers and other metal surfaces, even at low temperatures
- Configurable temperature range, emissivity setting etc. via USB using the included cable and software
- Features max, min, average and instantaneous readings; peak or valley hold; reflected energy compensation
- OPC Server capabilities
- Temperature ranges from -40 to 2000°C
- Stainless steel housing, sealed to IP65
- Choice of optics
- 4 to 20 mA output
- Quick and easy installation
- Wide range of accessories

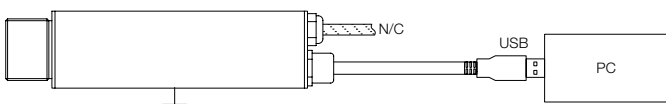
PYROUSB (GENERAL PURPOSE) MODELS:



PYROUSB 2.2 (HIGH TEMPERATURE) MODELS:



ALL MODELS:



Note: The sensor must be grounded at only one point, either the cable shield or the sensor housing.

The PyroUSB Series measures temperatures from -40°C to 2000°C accurately and consistently, with an outstanding response time as low as 240 ms. The selectable 0 to 20 mA or 4 to 20 mA output is compatible with almost any indicator, controller, recorder or data logger, without the need for special interfacing or signal conditioning.

A choice of measurement wavelengths is available to suit a range of applications.

PyroUSB (general purpose) models can measure from -40°C to 1000°C . They are suitable for measuring high-emissivity materials such as paper, thick plastics, food, pharmaceuticals, rubber, asphalt and painted surfaces.

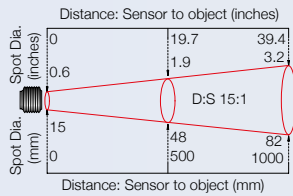
PyroUSB 2.2 (high temperature) models can measure from 45°C to 2000°C . They provide a more accurate reading than general-purpose sensors when measuring reflective surfaces including many metals. They are also capable of measuring temperatures through glass.

All PyroUSB Series sensors are fully configurable from a PC using the CalxSoft software and USB cable supplied. This user-friendly software enables the user to set the temperature range and emissivity, compensate for reflected energy, apply filtering, select max, min, average or instantaneous readings, and configure peak or valley hold processing. These features can also be monitored and adjusted by an OPC Client. Other features include data acquisition, alarms and a scrolling graphical display.

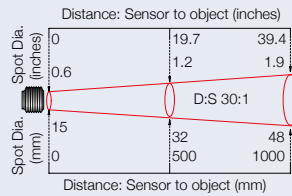
The sensor will operate with either the 4 to 20 mA cable connected, the USB cable connected, or both. The USB cable has an IP65 connector at the sensor end. An IP65 cap protects the sensor when the USB cable is not connected.

OPTICS Diameter of target spot measured versus distance from sensing head (90% energy)

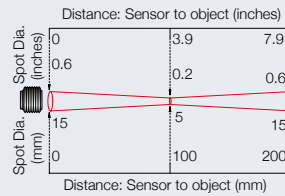
PyroUSB (general purpose models):



PU151

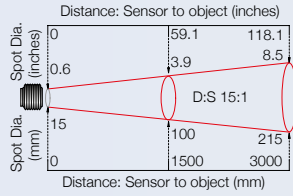


PU301

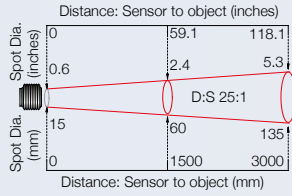


PUCF

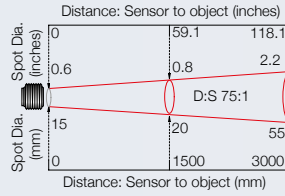
PyroUSB 2.2 (high temperature models):



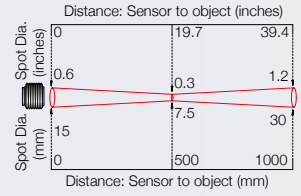
PU151-2.2



PU251-2.2



PU751-2.2



PUCF-2.2

GENERAL SPECIFICATIONS

	PyroUSB General Purpose	PyroUSB 2.2 High Temperature
Temperature Range	Choice of ranges from -40°C to 1000°C	Choice of ranges from 45°C* to 2000°C (see Minimum Measurable Temperature and Model Numbers)
Field-of-View	Choice of optics (see Optics and Model Numbers)	
Output	4 to 20 mA (linear with temperature)	Selectable 4 to 20 mA or 0 to 20 mA (linear with temperature)
Configuration	Via PC port conforming to USB 2.0	
Accuracy *	±1°C or ±1% of reading, whichever is greater	±2°C or ±1% of reading, whichever is greater
Repeatability *	±0.5% of reading or ±0.5°C, whichever is greater	
Emissivity Setting	0.1 to 1.0	
Response Time, t90	≥240 ms (90% response)	
Spectral Range	8 to 14 μm	2.0 to 2.6 μm
Supply Voltage	24 V DC (26 V DC max)	
Sensor Voltage	6 V DC min	11 V DC min
Max Loop Impedance	900 Ω @ 24 V DC	
Maximum Span	Full temperature range	
Minimum Span	100°C	

* Object temperature > T_{min} (see graph of Minimum Measurable Temperature)

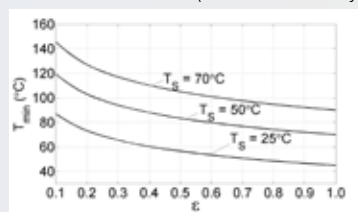
MECHANICAL

Construction	Stainless Steel
Dimensions	Ø 25 mm x 106.5 mm
Thread mounting	M20 x 1 mm pitch
Weight with Output Cable	175 g
Output Cable Length	1 m (longer cable to order)
USB Cable Length	1 m

ENVIRONMENTAL

Environmental Rating	IP65
Ambient Temperature	0°C to 70°C (cooling available for higher temperatures)
Relative Humidity	95% max. non-condensing

MINIMUM MEASURABLE TEMPERATURE (PU151LT2.2 only)



ACCESSORIES



ACCESSORIES ALSO AVAILABLE

- Fixed mounting bracket **FBL**
- Extended analogue output cable (30 m max):
 - for PyroUSB (general purpose) models without cooling **PUCF**
 - for PyroUSB (general purpose) WJ models **PUCFHT**
 - for PyroUSB 2.2 (High Temperature) models **PU2.2CE**
- Protective plastic window with stainless steel holder for PyroUSB (general purpose) models **PWL**
- Dual laser sighting bracket:
 - fixed **DLSBFL**
 - adjustable **DLSBAL**
- 3-point calibration certificate **CALCERTA**

MODEL NUMBERS - General Purpose

PUxxx xx	
Cooling	
(blank) =	Sensor without cooling
WJ =	Air/water cooled jacket with air purge collar
Field of view	
151 =	15:1 divergent optics
301 =	30:1 divergent optics
CF =	Close-focus optics (focal spot size 5 mm at 100 mm distance)

MODEL NUMBERS - High Temperature

PUxxx xx 2.2 xx	
Cooling	
(blank) =	Uncooled sensor
WJ =	Air/water cooled jacket with air purge collar
Temperature range	
LT =	45 to 300 °C (model PU151LT2.2 only)
PT =	100 to 400 °C (model PU151PT2.2 only)
MT =	250 to 1000 °C
HT =	450 to 2000 °C
Field of view	
151 =	15:1 divergent optics (model PU151LT or PT)
251 =	25:1 divergent optics (model PU251MT or HT)
751 =	75:1 divergent optics (model PU751MT or HT)
CF =	Close-focus optics (focal spot size 7.5 mm at 500 mm distance) (model PUCFMT or HT)

PyroMiniUSB

USB Infrared Temperature Sensor for Benchtop, Laboratory and Education



- Miniature non-contact temperature sensor with USB communications
- Measures from -20°C to 1000°C
- USB cable and PC software included for data logging and configuration
- Open Modbus protocol - use your own software to communicate with the sensor

SPECIFICATIONS

Temperature Range	-20°C to 1000°C
Interface	USB
Accuracy	±1% of reading or ±1°C whichever is greater
Repeatability	± 0.5% of reading or ± 0.5°C whichever is greater
Emissivity Setting	0.2 to 1.0
Response Time, t_{90}	125 ms (90% response)
Spectral Range	8 to 14 μ m
Supply Voltage	5 V DC (provided by USB)
Supply Current	50 mA max.

VIRTUAL COM PORT

Baud Rate	9600 baud *
Format	8 data bits, no parity, 1 stop bit *
Protocol	Modbus over Serial Line

* Other configurations available upon request

CONFIGURATION

Configuration Method	Via USB using included CalexConfig software or Modbus
Configurable Parameters	Emissivity Setting, Averaging, Reflected Energy Compensation

MECHANICAL

Construction	Stainless Steel
Dimensions	18 mm diameter x 45 mm long
Thread Mounting	M16 x 1 mm pitch
Cable Length	1.5 m
Weight with Cable	85 g

ENVIRONMENTAL

Environmental Rating	IP65
Ambient Temperature	0°C to 75°C
Relative Humidity	95% max. non-condensing

CONFORMITY

RoHS Compliant	Yes
Electromagnetic Compatibility	EN61326-1, EN61326-2-3 (Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements - Industrial)

The PyroMiniUSB is a miniature infrared sensor that measures the surface temperature of a solid or liquid without contact. It can measure non-metal surfaces between -20°C and 1000°C, with a response time of just 125 ms.

Materials including paper, thick plastics, rubber, food and organic materials, as well as painted metals and most dirty, rusty or oily surfaces, are measured accurately, safely and cleanly.

A choice of optics is available to measure small or large targets at distances ranging from a few millimetres up to tens of metres.

It has a rugged stainless steel housing, sealed to IP65, and is built to withstand ambient temperatures of up to 75°C.

COMPACT

The sensor is just 45 mm long (plus cable gland), so it can fit into very small spaces. The USB interface is built into the sensor, so there is no need for additional bulky interface modules.

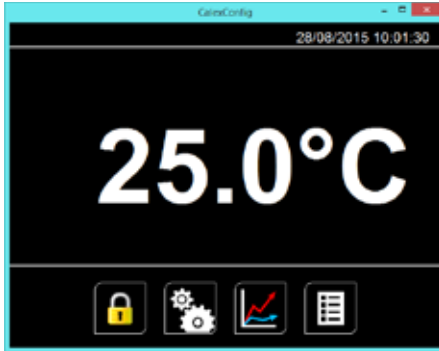
BENCHTOP AND LABORATORY

With the precision and robustness of our industrial pyrometers, and the plug-and-play convenience of USB, the PyroMiniUSB is the ideal benchtop temperature sensor for testing and experimentation.

EDUCATION

The PyroMiniUSB is ideal for teaching science concepts such as emissivity, reflectivity, thermal conductivity, energy transfer, insulation and internal energy.

SOFTWARE: CALEXCONFIG



- Temperature display
- Graph of measured temperature and sensor temperature
- Sensor configuration
- Data logging to an Excel-compatible file
- Connect multiple sensors to the same software
- Simple, touch-friendly interface
- Software included with every sensor
- Free to download from the Calnex website
- Or use the provided Modbus details to connect the sensor to your own software

ACCESSORIES



Adjustable mounting bracket **ABS**

Fixed mounting bracket **FBS**

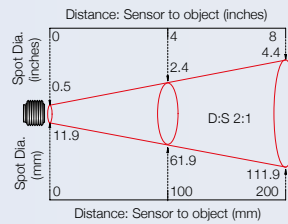
Calibration certificate **CALCERTA**

Laser sighting tool **LSTS**

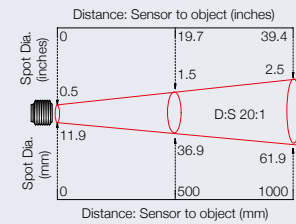
Fixed or Adjustable mounting bracket with continuous laser sighting **DLSBFS / DLSBAS**

OPTICS

Diameter of target spot measured versus distance from sensing head (90% energy)

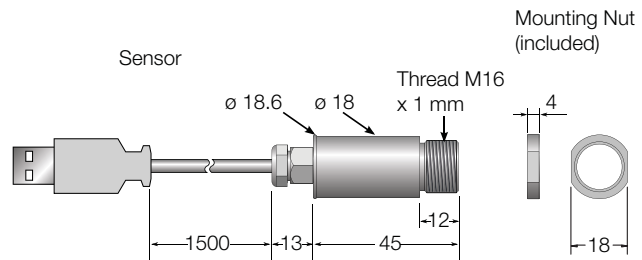


PMU21

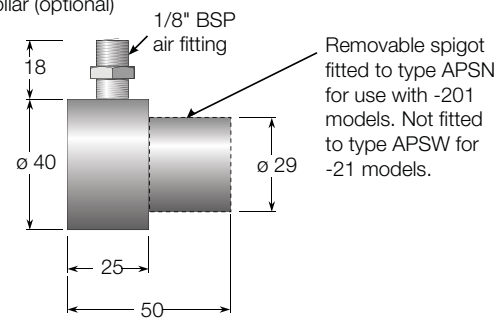


PMU201

MAJOR DIMENSIONS



Air Purge Collar (optional)



All dimensions in mm

MODEL NUMBERS



PMU

201

Field of view

21 = 2:1 divergent optics

201 = 20:1 divergent optics

Series

PMU = PyroMiniUSB sensor

PyroCube

IR Temperature Sensor with Fast Response Time, Small Measured Spot and Continuous LED Sighting



- Response time 0.001 seconds (-F models) - the fastest in the world
- Measures from 0°C to 500°C
- Ideal for small targets - measurement area as small as 1.6 mm diameter
- Continuous LED sighting on all models - shows the position and size of the measurement spot while readings are being taken
- Multilingual touch screen interface (optional) for temperature display, data logging, sensor configuration and alarms
- Measures surface temperature of paper, thick plastics, food, rubber, electronic components, cable, ceramics, textiles, painted surfaces and some metals, as well as many other materials

PYROCUBE SENSOR SPECIFICATIONS

MEASUREMENT

Temperature range

0°C to 500°C

Response time (95% of step change)

-S models: 10 ms to 5 s

-F models: 1 ms to 5 s

Adjustable via averaging function

Target sighting

Red LED built-in as standard on all models.

Indicates the measured spot size. Switchable on/off*

Measurement accuracy†

-S models: $\pm 3^\circ\text{C}$ or 1%, whichever is greater

-F models: $\pm 3.5^\circ\text{C}$ or 1%, whichever is greater

Repeatability†

-S models: $\pm 0.5^\circ\text{C}$

-F models: $\pm 1^\circ\text{C}$

Resolution†

-S models: $< 0.5^\circ\text{C}$

-F models: $< 1.5^\circ\text{C}$ (0 to 50°C); $< 0.7^\circ\text{C}$ (above 50°C)

Emissivity setting

Adjustable 0.3 to 1.0 via RS232C or optional touch screen interface

Field of view

See OPTICS on page 2

ELECTRICAL

Outputs

1 analogue output and 1 alarm output

Analogue output

4-20 mA (set by default), 0-20 mA, mV/°C or voltage‡, selectable via RS232C or optional touch screen interface.

Alarm output

1 open drain alarm output, rated 27 V DC, 0.2 A *

Supply voltage

5 to 27 V DC, 100 mA max

Digital communications

RS232C Modbus RTU, non isolated

MECHANICAL

Weight (without cable)

85 g

ENVIRONMENTAL

Environmental rating

IP67

Operating ambient temperature

0°C to 50°C

Storage temperature

-15°C to 70°C

Operating ambient humidity

30% to 85% RH non condensing

DISPLAY

Optional PM030 touch screen terminal for indication, configuration, data logging and alarm outputs

* LED SIGHTING AND ALARMS

Sensor Only

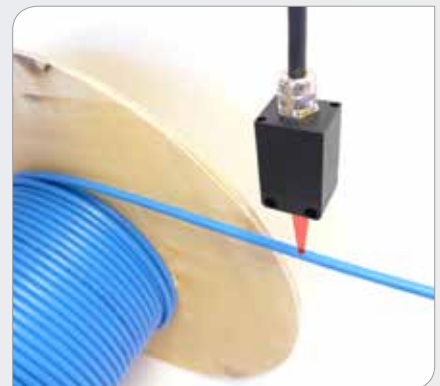
These functions are selectable via RS232C and share a common connection, which is configurable either as an input to switch the LED sighting on/off, or an open drain alarm output, but not both at once.

Sensor with PM030

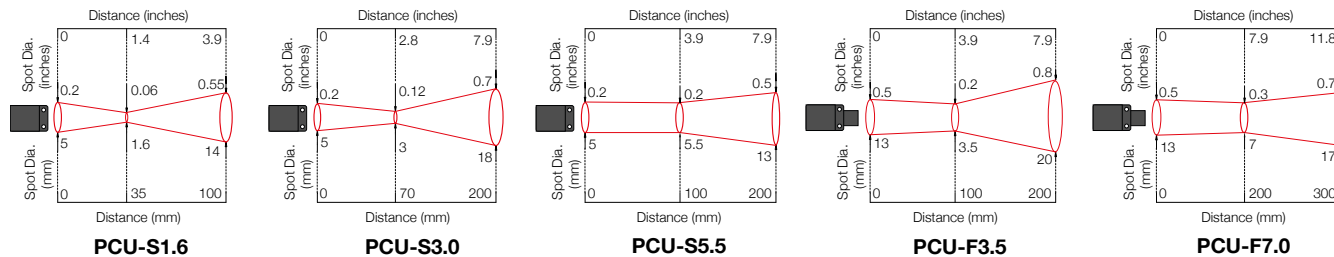
These functions may be configured via the PM030 interface. Two alarm relay outputs are provided in place of the open drain output.

† Ambient temperature $23 \pm 5^\circ\text{C}$, emissivity 1.0, averaging time 50 ms

‡ Voltage can be 0-1, 0-5, or 0-10 V DC, depending on model (see Model Numbers).



OPTICS



Accuracy specifications are valid up to the maximum distances shown

PM030 TOUCH SCREEN INTERFACE

- Optional wall-mounted display, data logging, configuration and alarm unit for PyroCube sensor
- Read the temperature**
The large, bright backlit temperature display is visible from a distance and turns red in an alarm condition.
- Record the temperature history**
See a graph of the measured temperature, and log more than a year of data to a single MicroSD Card. The data is stored in a simple text format that can be imported easily into Excel.
- Configure the sensor**
All the sensor's configuration settings can be adjusted via the intuitive touch screen interface.
- Trigger temperature alarms**
Two alarms are individually configurable as high, low, band or error. The screen turns bright red to signal an alarm condition, and the built-in 24 V, 1 A relay outputs can be connected directly to alarm sounders and beacons.
- Accurate measurements, even with reflections of hot objects**
Place the sensor outside an oven or furnace and accurately measure the temperature of objects inside by using the Reflected Energy Compensation feature.

PM030 SPECIFICATIONS

Display Format

2.83" (72 mm) resistive touch TFT, 320x240 pixels, backlit

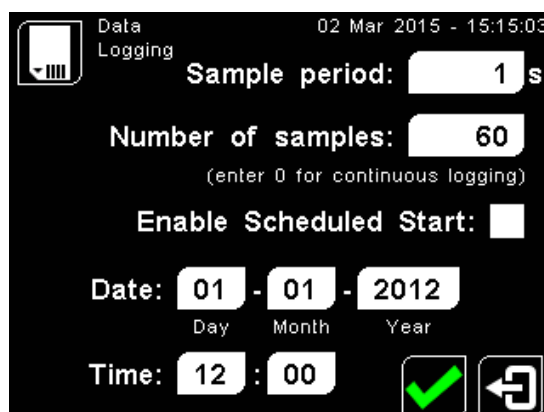
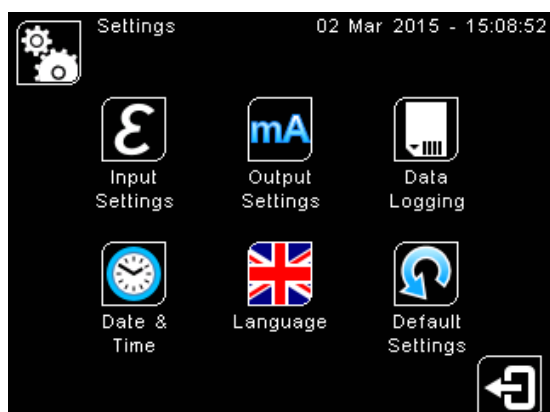
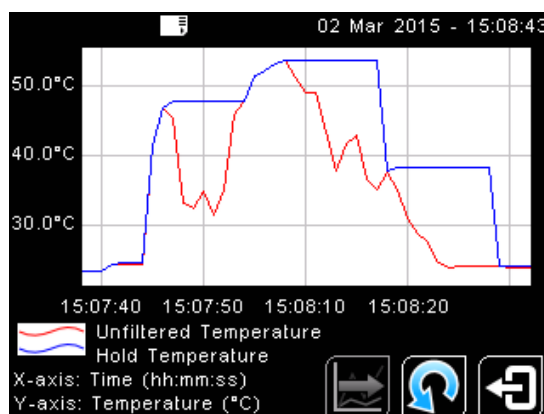
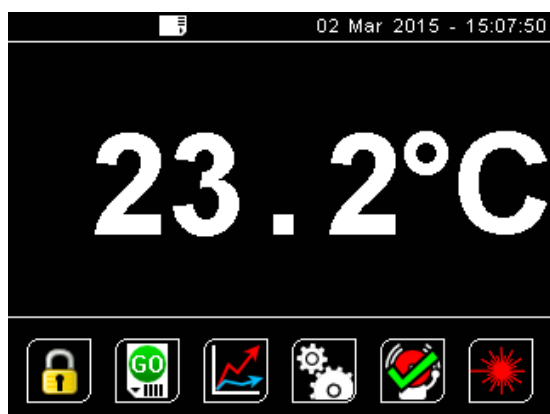
Configurable Parameters

Language (English, Chinese, Japanese)
Temperature units °C/°F
Displayed temperature
LED sighting on/off
Password
Date & time (for data logging time stamps)
Peak hold period, decay level
Averaging period
Correction (gain/offset)
Emissivity setting (with teach function)
Reflected energy compensation (with teach function)
Output type
Output temperature range
Polarity on error
Alarm mode, levels, hysteresis

Outputs (from touch screen module)

Retransmitted analogue output from sensor, plus 2 relays, rated 24 V DC, 1 A

Output Type	Effective Minimum Output	Output Accuracy (additional to Measurement Accuracy)
0 to 1 V DC	30 mV	±1.5 mV
mV/°C	30 mV	±1.5 mV
0 to 20 mA	0.2 mA	±0.02 mA
4 to 20 mA	4.0 mA	±0.02 mA

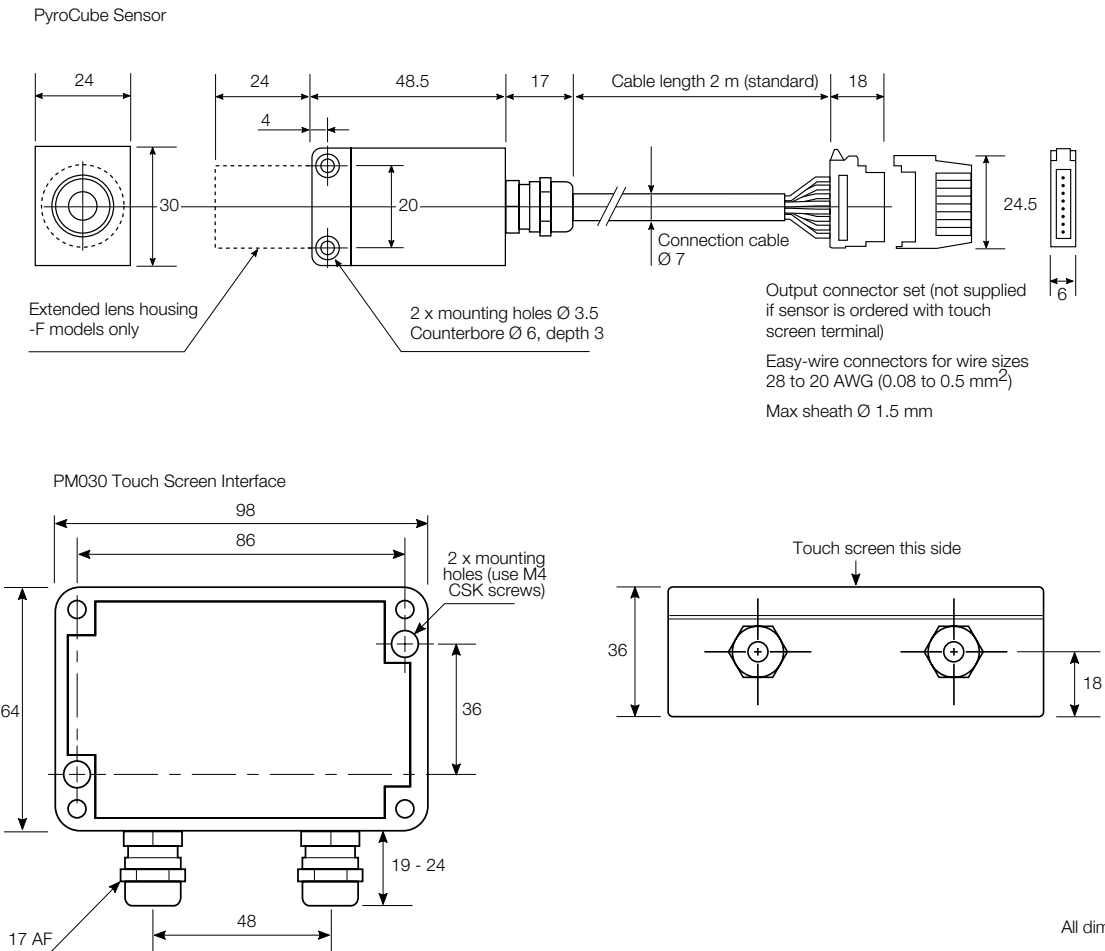


PM030 DATA LOGGING SPECIFICATIONS

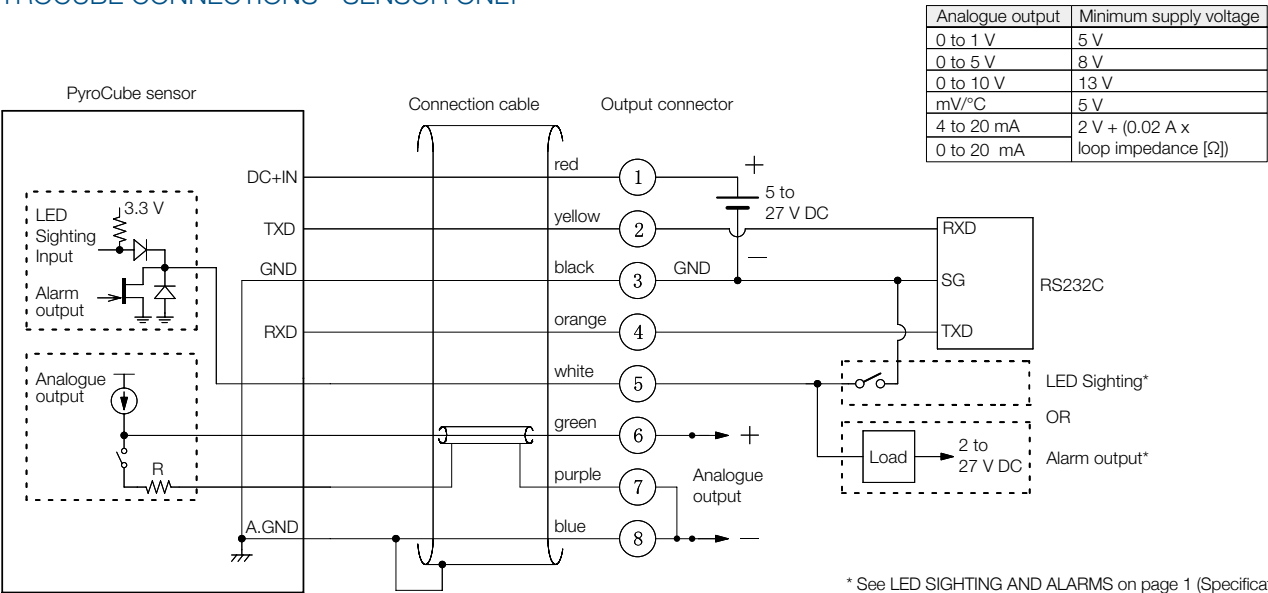
Storage	MicroSD Card (optional), max. 32 GB, equal to 16 years of data at the fastest sample rate of 1 per second
Sample Interval	1 second to 1 day (configurable)
Internal Clock Battery	1 x BR 1225, 3 V (not included)
Variables Logged	Instantaneous measured temperature, hold temperature, alarm events

Configurable Parameters	Data logging: Sample period Number of samples Scheduled start
	Alarm logging: Log times when triggered, acknowledged, reset Log data while triggered

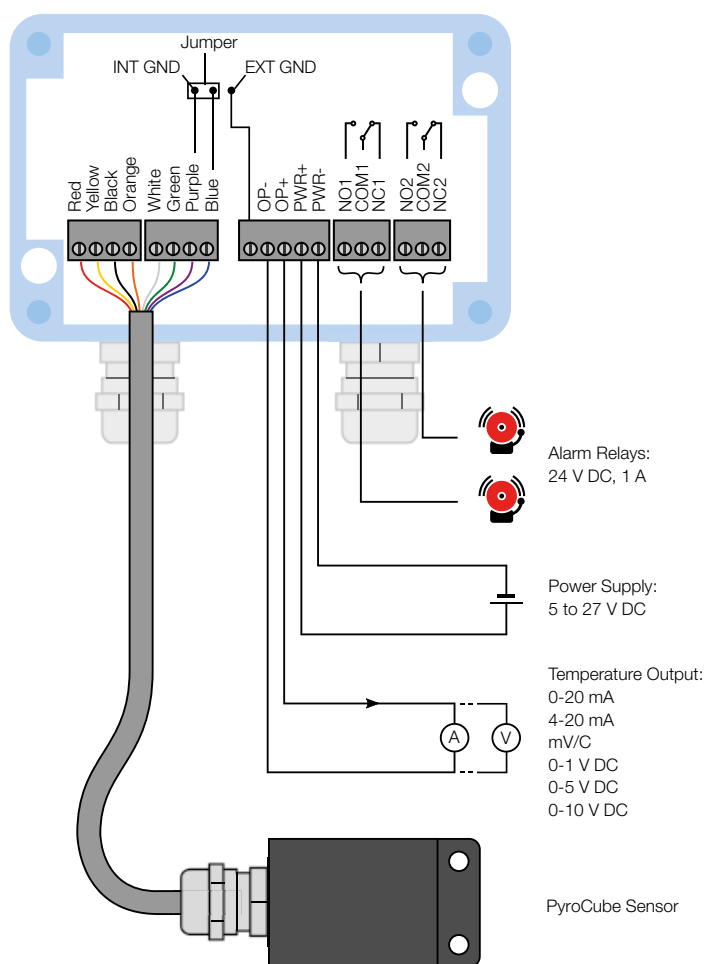
DIMENSIONS



PYROCUBE CONNECTIONS - SENSOR ONLY



PM030 CONNECTIONS



ACCESSORIES



FBC Mounting bracket



PWC Protective lens cover



APC Air purge collar



ADP Airless dust protector



RAM Right angled mirror



WCJ Water Cooling Jacket



PCMCE5 5 m extension cable with connectors

MODEL NUMBERS



PCU - **S1.6** - **2M** - **1V**

Voltage output option

1V = 0 to 1 V DC

5V = 0 to 5 V DC

10V = 0 to 10 V DC

Note: All models also have 0-20 mA, 4-20 mA, and mV/°C outputs as standard.

Cable length

2M = 2 metres

5M = 5 metres

10M = 10 metres

Response time and optics

S1.6 = 10 ms response, 1.6 mm spot at 35 mm distance

S3.0 = 10 ms response, 3.0 mm spot at 70 mm distance

S5.5 = 10 ms response, 5.5 mm spot at 120 mm distance

F3.5 = 1 ms response, 3.5 mm spot at 100 mm distance

F7.0 = 1 ms response, 7.0 mm spot at 200 mm distance

Series

PCU = PyroCube sensor



PM030

Touch screen interface module for PyroCube sensor

FibreMini

Fibre Optic Infrared Temperature Sensor for Harsh Applications



- Temperature ranges from 250°C to 2000°C
- Miniature sensing head withstands 200°C ambient temperature
- Short measurement wavelength for improved accuracy on metals
- No electronics in the sensing head - ideal for use near induction heaters and strong electromagnetic fields
- Touch screen display with configuration and data logging
- Choice of analogue or digital output
- Alarm relays on all models
- Advanced signal processing functions
- Built-in laser sighting, simultaneous with measurement

GENERAL SPECIFICATIONS

Temperature Range
MT models: 250°C to 1000°C
HT models: 450°C to 2000°C

Maximum Temperature Span (-CRT models)
Full temperature range (up to 1550°C)

Minimum Temperature Span (-CRT models)
100°C

Output
4 to 20 mA or RS485 Modbus (up to 247 sensors may be installed on a single Modbus network)

Field of View
Choice of optics (see Optics)

Accuracy
±1% of reading

Repeatability
±0.5% of reading

Emissivity Setting Range
0.10 to 1.00

Emissivity Setting Method
-BRT models: via RS485
-CRT and -BRT models: via touch screen

Response Time, t_{90}
≥240 ms (90% response)

Spectral Range
2.0 to 2.6 μ m

Supply Voltage
24 V DC ± 5%

Maximum Current Draw
100 mA

Maximum Loop Impedance
-CRT models: 900 Ω (4 to 20 mA output)

Alarm Relays
2 x Single Pole Changeover alarm relays rated 24 V DC, 1 A, isolated 500 V DC

MECHANICAL

	Sensing head	Electronics Module
Construction	Stainless Steel 316	Cast aluminium
Dimensions	Ø 12 x 48 mm (see diagram)	98(w) x 64(h) x 36(d) mm
Mounting	M12 x 1.5 mm thread	Two M4 screw holes for wall mounting (see diagram)

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

	Sensing head	Electronics Module (without touch screen)	Electronics Module (with touch screen)
Environmental Rating	IP65 (NEMA 4)	IP65 (NEMA 4)	
Ambient Temperature Range	0°C to 200°C	0°C to 60°C	0°C to 60°C
Relative Humidity	Maximum 95% non-condensing	Maximum 95% non-condensing	Maximum 95% non-condensing
CE Marked	Yes	Yes	Yes
RoHS Compliant	Yes	Yes	Yes

ELECTROMAGNETIC COMPATIBILITY STANDARDS:
EN61326-1, EN61326-2-3 (Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements - Industrial)

TOUCH SCREEN

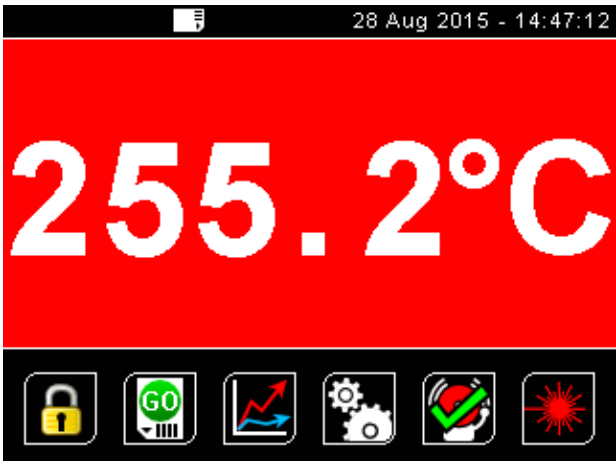
The backlit touch screen interface mounted in the lid of the electronics module provides a large, bright display of the measured temperature, as well as controls allowing full configuration of the sensor. The graph view shows the history of the measured temperature.

In alarm conditions, the display turns bright red to provide an immediate and obvious alarm indication. Alarm modes and levels can be configured via the touch screen.

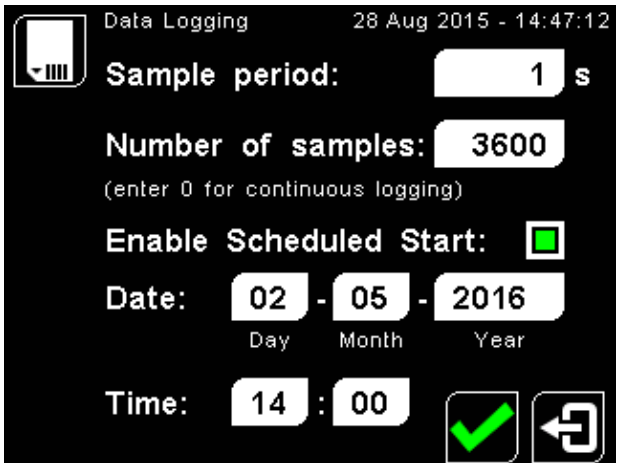
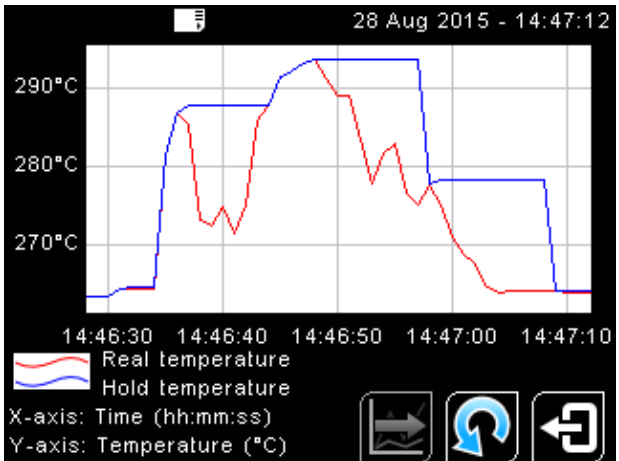
TOUCH SCREEN SPECIFICATIONS

Touch Screen Display Format	2.83" (72 mm) resistive touch TFT, 320 x 240 pixels, backlit
Configurable Parameters	Temperature range (-CRT models), 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. Alarm 2 can be set to target temperature or sensing head internal temperature
Signal Processing	Average, peak hold, valley hold, minimum, maximum

EXAMPLE SCREENSHOTS



Screen shown with red background to indicate alarm condition



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

DATA LOGGING (-CRT AND -BRT MODELS)

The FibreMini can be used as a standalone data logger.

All models include a MicroSD card slot for data logging, which can be configured via the touch screen interface. The user can select the sample rate and the number of samples to be taken and schedule the data logging to start at a certain time.

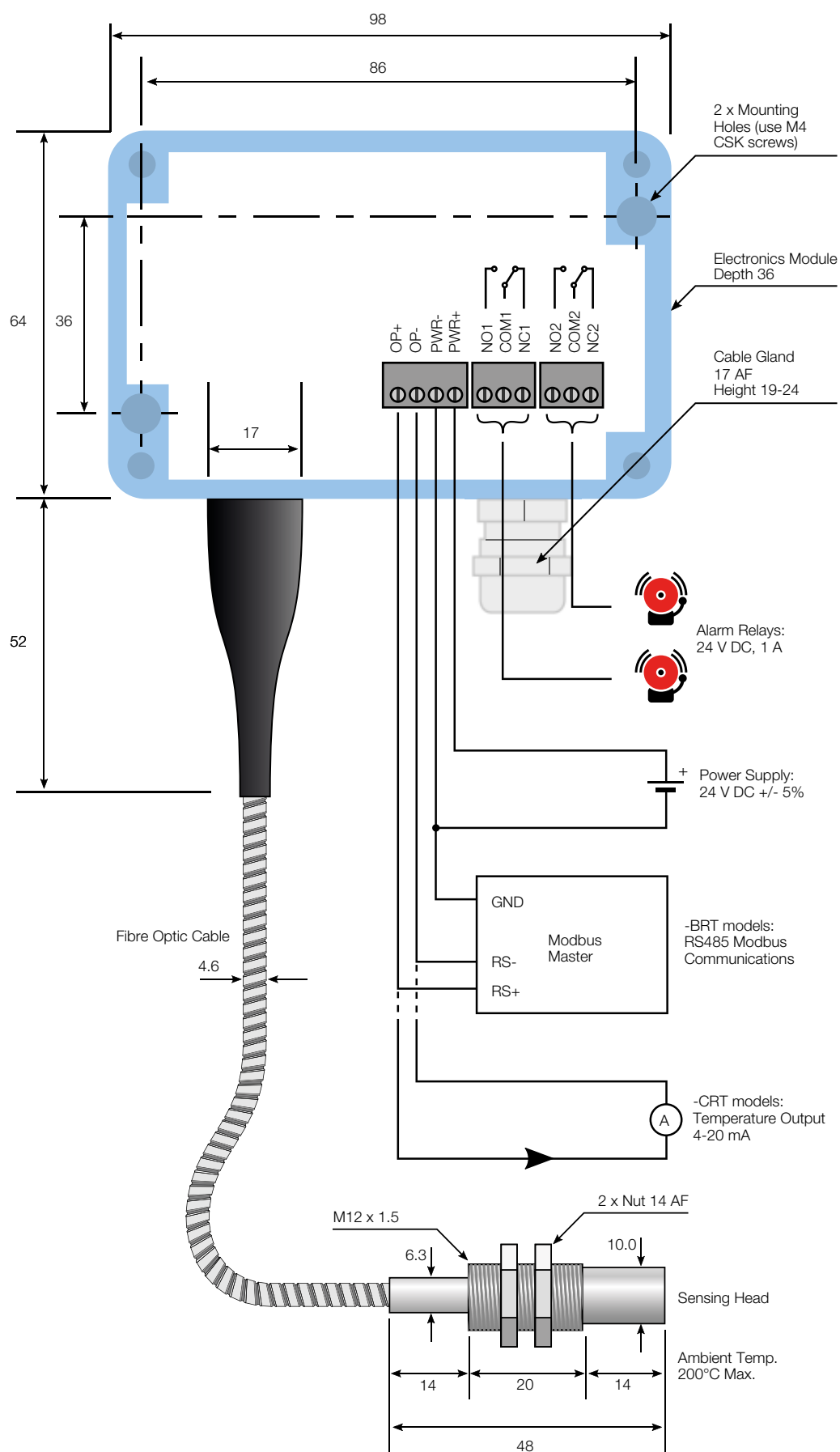
With a MicroSD card larger than 2 GB, years of data can be stored, even at the fastest possible sample rate of 1 per second.

Data is stored in .csv format and can be viewed and edited easily using spreadsheet software. Alarm events can also be logged to the MicroSD Card.

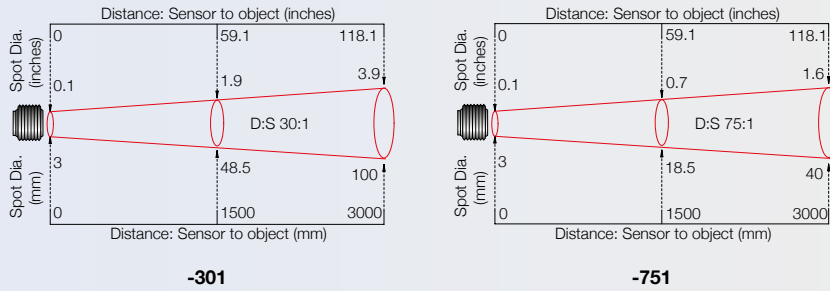
A MicroSD card with SD card adapter is available as an optional accessory.

The MicroSD card slot and battery holder are located inside the electronics module. Readings are time and date stamped using the sensor's internal clock. The clock is reset when the power is disconnected, or it will continue if the optional battery is fitted.

CONNECTIONS AND DIMENSIONS

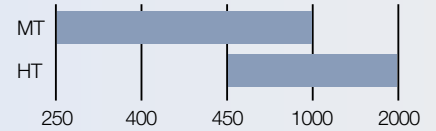


FIELD OF VIEW



Diameter of target spot measured versus distance from sensing head - 90% energy

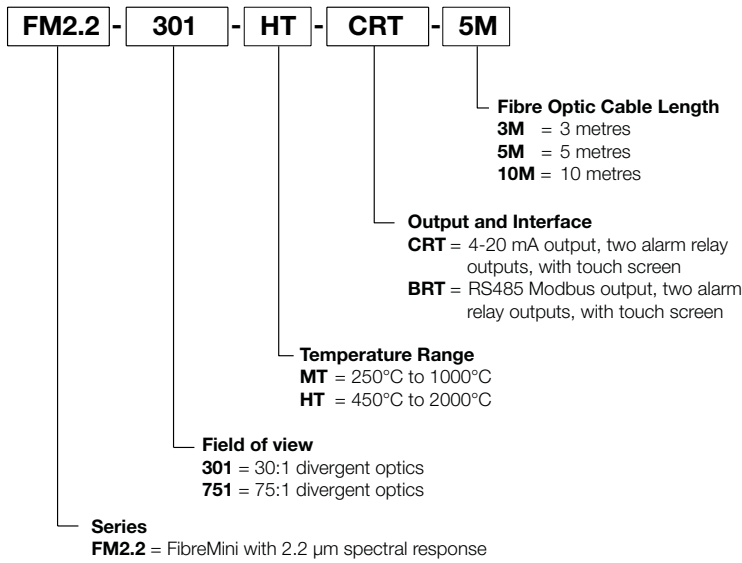
MEASUREMENT TEMPERATURE RANGE (°C)



-CRT models: 4 to 20 mA output is configurable within this range

-BRT models: Digital output, full temperature range

MODEL NUMBERS



ACCESSORIES ALSO AVAILABLE

- MSD** MicroSD Card with SD Card adapter: stores logged data
- CALCERTA** Calibration certificate
- ABF** Adjustable mounting bracket
- FBF** Fixed mounting bracket
- APF** Air purge collar
- PM180** 6-channel Modbus temperature indicator with touch screen interface and data logging



- Suitable for hazardous areas, Zone 0, 1 and 2 (gas), and Zone 20, 21 and 22 (dust), with a suitable Intrinsically Safe isolator
- Temperature range: -20°C to 1000°C
- Two wire, 4-20 mA output
- Rescalable output and adjustable emissivity setting via optional USB adapter
- Fast response time and high stability
- Stainless steel 316 housing - ideal for offshore applications
- IP65 sealed
- Supplied with up to 25 m cable

GENERAL SPECIFICATIONS

Temperature range	See table of Model Numbers
Maximum Temperature Span	1000°C
Minimum Temperature Span	100°C
Output	4 to 20 mA
Field of View	See table of Model Numbers
Accuracy	± 1°C or 1%, whichever is greater
Repeatability	± 0.5°C or 0.5%, whichever is greater
Emissivity Setting Range	0.20 to 1.00 (pre-set to 0.95)
Emissivity Setting Method	User configurable via USB interface
Response Time, t_{90}	240 ms (90% response)
Spectral Range	8 to 14 μ m
Supply Voltage	12 to 24 V DC \pm 5%
Maximum Current Draw	25 mA
Maximum Loop Impedance	See Application Guide (available separately)

MECHANICAL

Construction	Stainless Steel 316
Major Dimensions	Ø 20 x length 150 mm (see Dimensions)
Mounting	M20 x 1.5 mm thread, length 46 mm, supplied with two mounting nuts
Cable Length	5 m, 10 m or 25 m as standard (custom lengths also available)
Weight with 5 m Cable	475 g

ENVIRONMENTAL

Environmental Rating	IP65 (NEMA 4)
Ambient Temperature Range	0°C to 70°C (Operating range)
Relative Humidity	Max. 95% non-condensing
CE Marked	Yes
RoHS Compliant	Yes

HAZARDOUS AREA CLASSIFICATION

The ExTemp is ATEX, IECEx and TIIS certified.

ATEX Classification	Ex II 1GD
IECEx Classification (Gas)	Ex ia IIC T4 Ga
IECEx Classification (Dust)	Ex ia IIC T135°C IP65 Da
Ambient Temperature Rating	-20°C \leq Ta \leq 70°C
Maximum DC Input Voltage	Ui = 28 V
Maximum Input Current	Ii = 93 mA
Maximum Input Power	Pi = 650 mW
Maximum Internal Capacitance	Ci = 8 nF
Maximum Internal Inductance	Li = 0 mH
ATEX Certificate Number	CML 14ATEX2079
IECEx Certificate Number	IECEx CML 14.0032
TIIS Certificate Number	TC21097

MODEL NUMBERS

EX

FFF

TT

C

LL

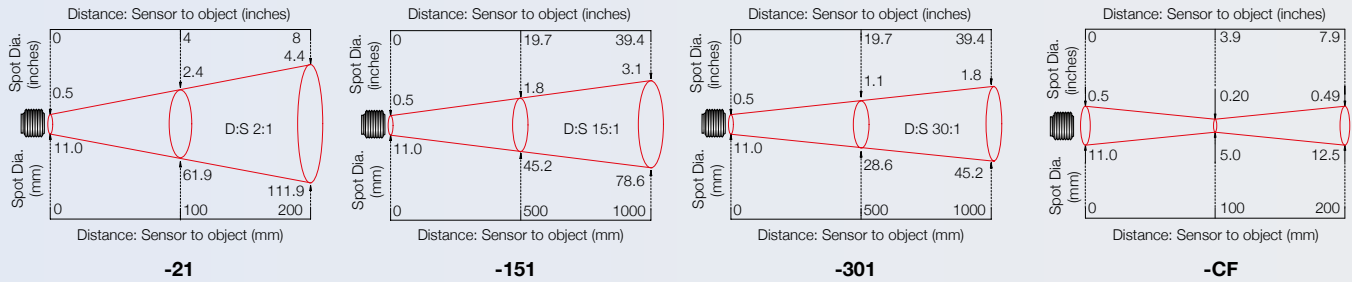
Cable Length
5 = 5 m
10 = 10 m
25 = 25 m
Custom lengths also available

User Configurable
C = Configurable via optional USB adapter

Temperature Range
LT = -20°C to 100°C
MT = 0°C to 250°C
HT = 0°C to 500°C
XT = 0°C to 1000°C
ST = Special temperature range
Temperature range may be re-scaled between limits -20°C and 1000°C via optional USB adapter and software

Field of view
21 = 2:1 divergent optics
151 = 15:1 divergent optics
301 = 30:1 divergent optics
CF = Close focus optics (Spot Ø 5 mm at distance 100 mm)

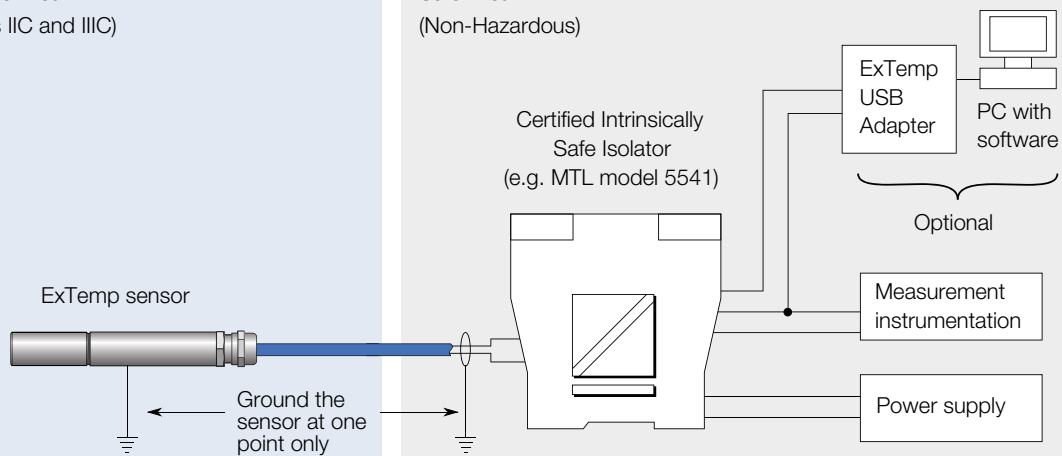
DIAMETER OF TARGET SPOT MEASURED VERSUS DISTANCE FROM SENSING HEAD



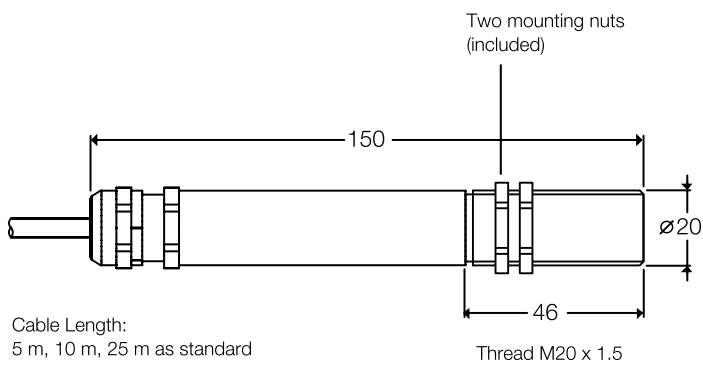
CONNECTIONS

Hazardous Area
(All Zones IIC and IIIC)

Safe Area
(Non-Hazardous)



DIMENSIONS (mm)



Cable Length:
5 m, 10 m, 25 m as standard
Custom lengths also available
User may extend cable subject to safety requirements

CONFIGURATION

The ExTemp sensor may be connected to a PC via the optional USB adapter and included Windows software.

Configurable settings include the emissivity setting, 4-20 mA temperature range, averaging, peak and valley hold processing and reflected energy compensation.



ACCESSORIES

FBL	Fixed mounting bracket (1-axis rotation)
ABL	Adjustable mounting bracket (2-axis rotation)
APMW	Air purge collar (for 2:1 optics)
APMN	Air purge collar (for all other optics)
CALCERTA	Calibration certificate, 3 temperature points, UKAS traceable
LCT	USB adapter and configuration software

Protective Windows

for Infrared Temperature Sensors

IR Viewport Windows



- Mount the window in a flange on your process
- Protect the sensor from high pressure, high temperature or vacuum
- Choice of materials to suit a range of sensors and applications
- Wide range of standard sizes, or custom-made to suit your requirements

Calex provides IR-transmissive windows in a choice of sizes. Windows are commonly circular, however other shapes are available, and we can provide windows manufactured to suit your requirements.

The material should be chosen to suit the type of sensor and the conditions in the process, such as the pressure and temperature. Short-wavelength sensors, such as the PyroUSB 2.2, PyroMini 2.2 and FibreMini, can view through glass, quartz and calcium fluoride. Other materials, such as zinc selenide and germanium, are required for use with long-wavelength (8 to 14 µm) sensors.

The sensor must have an adjustable emissivity setting to compensate for the small percentage of infrared energy lost to reflection and absorption by the window. Use this formula to ensure maximum accuracy.

Emissivity setting =
actual emissivity of target x transmission of window

MATERIALS

Window Material	Transmission Range	Transmission (approx.)	Maximum Temperature
Zinc selenide (ZnSe)	4 to 14 µm	72%	250°C
Germanium (Ge)	2 to 14 µm	46% uncoated (around 90% if anti-reflective coated)	70°C
Calcium fluoride (CaF2)	0.2 to 7 µm	94%	1200°C
Sapphire (Al2O3)	0.2 to 4.5 µm	85%	2000°C
Quartz Crystal (SiO2)	0.4 to 3 µm	92%	490°C

ORDERING

These windows are inexpensive compared with the cost of replacing the lens of an infrared temperature sensor. Contact Calex for a quotation, or for assistance on choosing a suitable window.

Protective Plastic Window -

ideal for the food and pharmaceutical industries



The protective plastic window models PWS and PWL are designed to help protect the germanium lens of Calex infrared temperature sensors from mechanical damage, and to help retain fragments of the lens if it is damaged.

To use the window, simply screw the stainless steel window holder onto the front of the sensor, tighten with a spanner, adjust the emissivity setting using the formula below, and begin taking measurements.

Emissivity setting = actual emissivity of target x 0.768

SPECIFICATIONS

Model	PWS	PWL
Mounting	M16 x 1 mm	M20 x 1 mm
Compatible With	PyroEpsilon, PyroBus, PyroMini*, PyroMiniBus, PyroMiniUSB	PyroUSB*
Transmission (8 to 14 µm)	76.8%	76.8%
Ambient Temperature Range	0°C to 100°C**	0°C to 100°C**
Window material	IR-transmissive plastic	IR-transmissive plastic
Holder material	Stainless steel	Stainless steel

* Not compatible with PyroUSB 2.2 or PyroMini 2.2 models

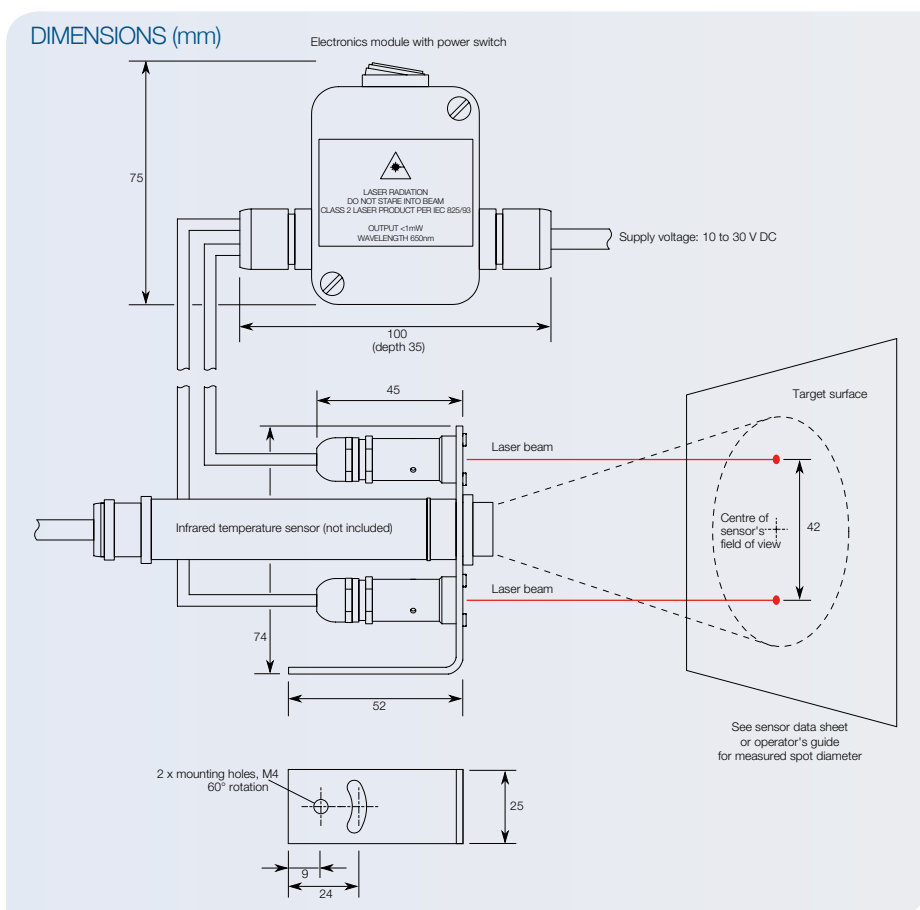
** Do not exceed the ambient temperature limits of the sensor.

DLSB

Dual Laser Sighting Bracket



- Mounting bracket for Calex infrared temperature sensors
- Two parallel lasers indicate the centre of the measured spot
- Allows continuous targeting while taking measurements
- IP65 sealed
- Remote on/off switch



GENERAL SPECIFICATIONS

Supply voltage

10 to 30 V DC

Max current draw

100 mA

Electrical connection

Removable screw terminals

Power cable type

Use two-core cable with outer diameter 4.5 to 10 mm

Connection cable (lasers to electronics module)

Two cables, length 1 m as standard (longer cable available to order)

Construction

Bracket & laser housing: Stainless steel

Electronics module: Polycarbonate

Separation of laser dots

42 mm (calibrated at 1.5 m distance)

Dimensions (electronics module)

With glands & switch: 100 (w) x 75 (h) x 35 (d) mm

Box only: 50 (w) x 65 (h) x 35 (d) mm

Dimensions (bracket)

25 (w) x 74 (h) x 52 (d) mm

Weight (without sensor)

202 g

Environmental Rating

IP65

Relative humidity

95% max. non-condensing

Operating temperature range

-10°C to +60°C

OPTIONS

- Extended cable for all models (30 m max)

ORDERING INFORMATION

Description	Compatibility	Type	Model number
Dual Laser Sighting Bracket	Sensors with 16 mm mounting thread (e.g. PyroCouple, PyroMini, PyroBus, PyroEpsilon)	Fixed (1-axis rotation)	DLSBFS
		Adjustable (2-axis rotation)	DLSBAS
	Sensors with 20 mm mounting thread (e.g. PyroUSB)	Fixed (1-axis rotation)	DLSBFL
		Adjustable (2-axis rotation)	DLSBAL

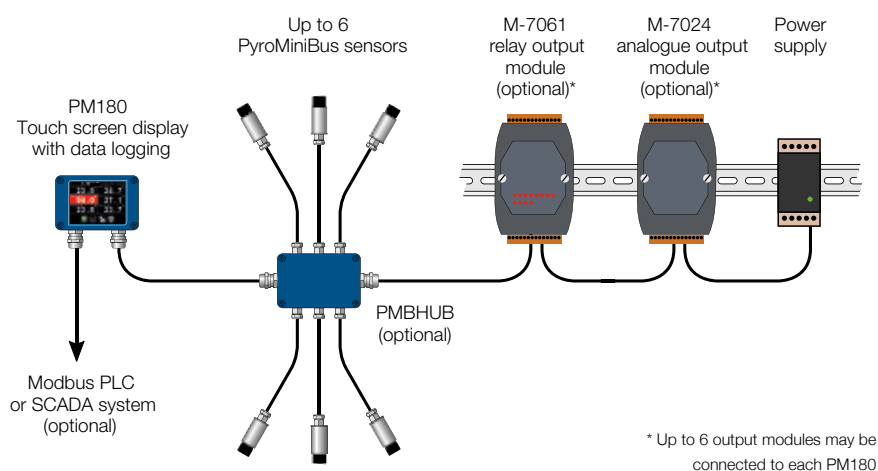
PyroMiniBus

Multi-Channel Infrared Temperature Monitoring System



- Miniature non-contact temperature sensors with RS485 Modbus communications
- Touch screen terminal for configuration, display, alarms and data logging
- Low-cost standalone 6-channel system
- Build larger systems using the PM180's isolated Modbus Master and Slave interfaces
- Analogue and alarm relay outputs via optional modules
- Conforms to industrial EMC standards

PM180 AS MODBUS MASTER



The PyroMiniBus is an industrial infrared temperature monitoring system, with miniature sensing heads and optional display modules.

PyroMiniBus sensors are designed to measure the surface temperature of non-reflective materials in industrial applications, from -20°C to 1000°C . They are sealed to IP65, built from 316 stainless steel, and fully tested to industrial EMC standards.

They can measure food, paper, thick plastics, asphalt, paint, bulk materials and organic materials, as well as most dirty, rusty or oily surfaces.

ROBUST

PyroMiniBus sensors have an operating temperature rating of up to 120°C with no need for cooling.

COMPACT

The sensors measure just 45 mm long (plus cable gland), so they can fit into the smallest of spaces.

CONFIGURABLE

Up to 6 sensors can be connected to the optional PM180 interface module, which provides temperature display, configuration, and high-capacity data logging to a MicroSD Card. Analogue and relay outputs are available via separate DIN rail mounted modules.

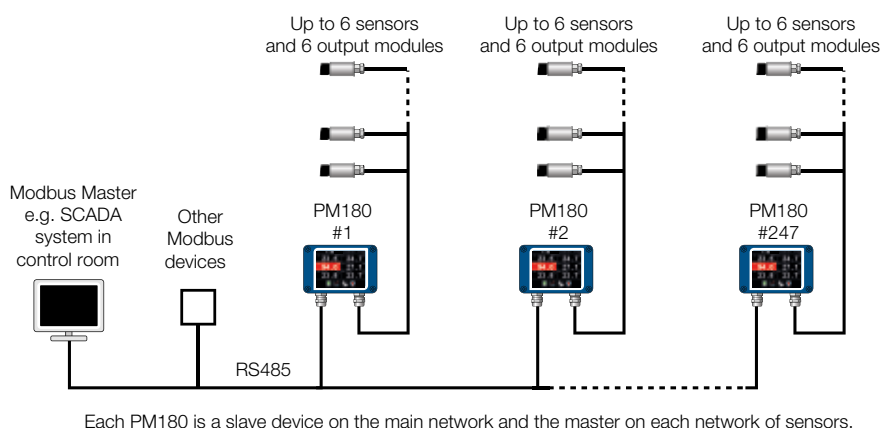
LOW COST

With up to 6 sensors connected to one PM180, the PyroMiniBus is an ideal low-cost non-contact temperature measurement system.

NETWORKABLE

To measure more than 6 locations, PyroMiniBus sensors and PM180 sub-networks may be connected to an RS485 Modbus SCADA system or PLC. It is possible to measure the temperature of hundreds or thousands of locations on the same network.

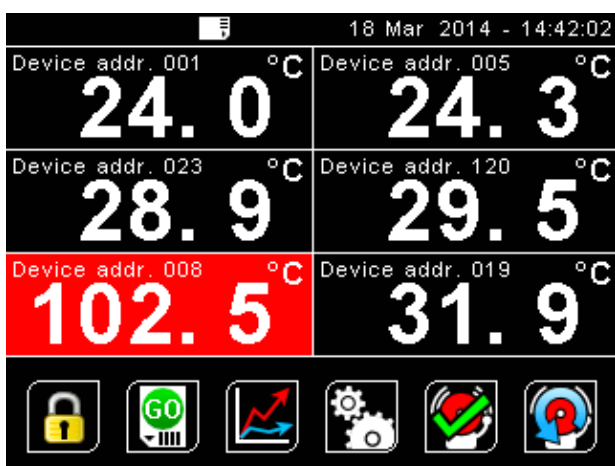
PM180 AS MODBUS SLAVE





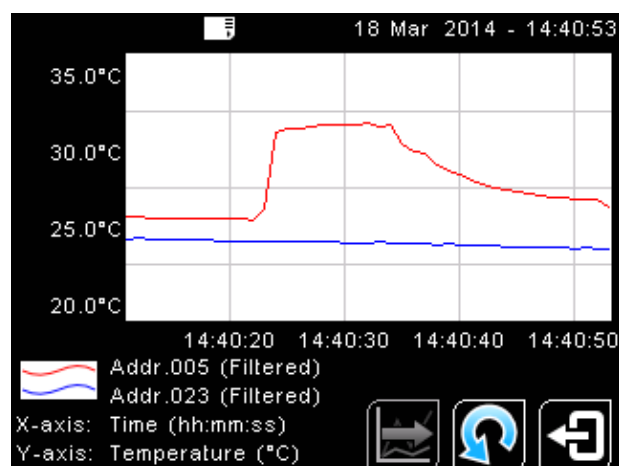
PM180 6-CHANNEL TOUCH SCREEN TERMINAL

- Configure, display and log data and alarms from up to 6 sensors per terminal unit, simultaneously or individually
- Operates as Modbus master and Modbus slave
- High capacity data logging to MicroSD Card
- Bright touch screen with backlight
- Analogue and relay outputs via optional ICP DAS modules
- 2-channel scrolling temperature chart



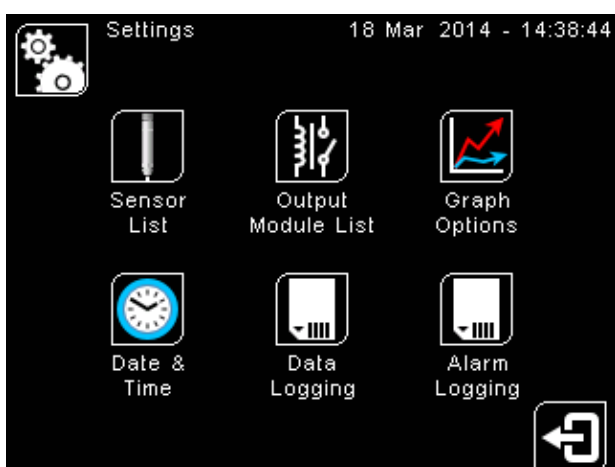
Intuitive touch screen interface

Display and configure all 6 channels individually or simultaneously. The display for each channel turns red in an alarm condition



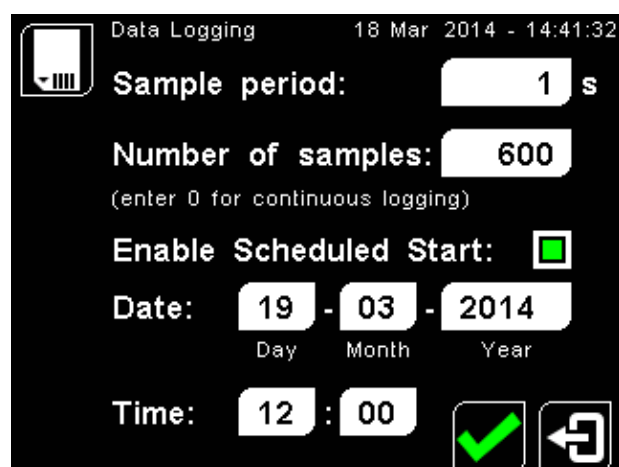
Temperature chart

Display temperature data from two channels in a scrolling graph



Password-protected settings

Configure options for each sensor and the PM180 itself via the touch screen interface



Data logging

Schedule a start time, or start and stop logging at the touch of an icon. Temperature data and alarm events may be logged to a MicroSD Card (not supplied)



PYROMINIBUS SENSOR SPECIFICATION

Temperature Range

-20°C to 1000°C

Interface

RS485 Modbus RTU

Accuracy

±1% of reading or ±1°C whichever is greater

Repeatability

± 0.5% of reading or ± 0.5°C whichever is greater

Emissivity Setting

0.2 to 1.0

Response Time, t_{90}

125 ms (90% response)

Spectral Range8 to 14 μ m**Supply Voltage**

6 to 28 V DC

Supply Current

50 mA max.

Baud Rate

9600 baud *

Format

8 data bits, no parity, 1 stop bit *

* Other configurations available upon request

CONFIGURATION

Configuration Method

Via PM180 touch screen, or directly via RS485 Modbus

Configurable Parameters

Emissivity Setting, Averaging, Reflected Energy Compensation

MECHANICAL

Construction

Stainless Steel

Dimensions

18 mm diameter x 45 mm long

Thread Mounting

M16 x 1 mm pitch

Cable Length

1m (longer lengths available to order)

Weight with Cable

85 g

ENVIRONMENTAL

Environmental Rating

IP65

Ambient Temperature

0°C to 120°C

Relative Humidity

95% max. non-condensing

CONFORMITY

See PM180 Specification (right)



PM180 SPECIFICATION

Compatible Sensor Types

PyroMiniBus (all models), PyroBus (all models), PyroMini (-BB and -BRT models)

Display

2.83" (72 mm) resistive touch TFT, 320 x 240 pixels, backlight

Supply Voltage

10 to 30 V DC

Maximum Current Draw

100 mA

Configurable Parameters (global)

Temperature units, date and time, data logging, graph channels, alarm logging

Configurable Parameters (per channel)

Signal processing, emissivity setting, reflected energy compensation, alarms, Modbus address

Alarm Configuration

12 alarms (2 per sensor) with adjustable level, individually configurable as HI or LO.

Temperature Units

°C or °F selectable

Temperature Resolution

0.1°

Signal Processing

Averaging with configurable period

Display Sample Period

120 ms per sensor (720 ms in total for 6 sensors)

DATA LOGGING

Logging Interval

1 to 86,400 seconds (1 day)

MicroSD Card

Max. capacity: 32 GB (not included - stores years of logged data)

Internal Clock Battery

1 x BR 1225 3V (not included)

Variables Logged

Target temperature, sensing head temperature, alarm events

File Format

.csv (can be imported to Excel)

Configurable Parameters

Sample period, number of samples, scheduled start date and time

MECHANICAL

Construction

Die Cast Aluminium

Electrical Connections

Removable screw terminals, 28 AWG to 18 AWG

Dimensions

98(w) x 64(h) x 36(d) mm excluding cable glands

Weight

280 g

ENVIRONMENTAL

Environmental Rating

IP65

Ambient Temperature Range

0°C to 60°C

Relative Humidity

Maximum 95%, non-condensing

CONFORMITY

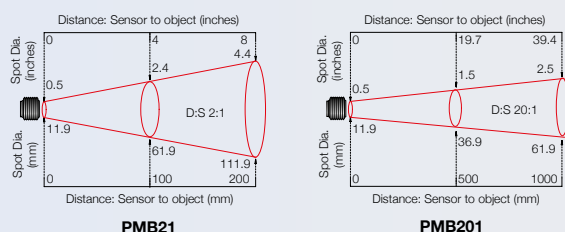
RoHS Compliant

Yes

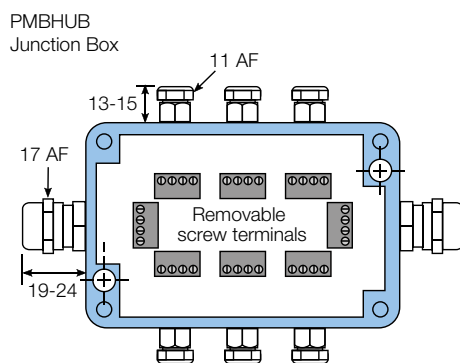
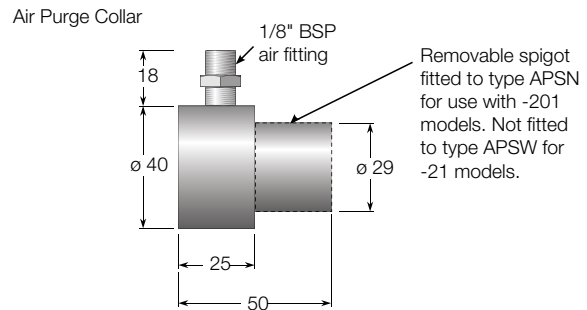
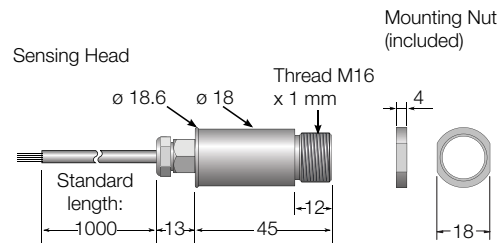
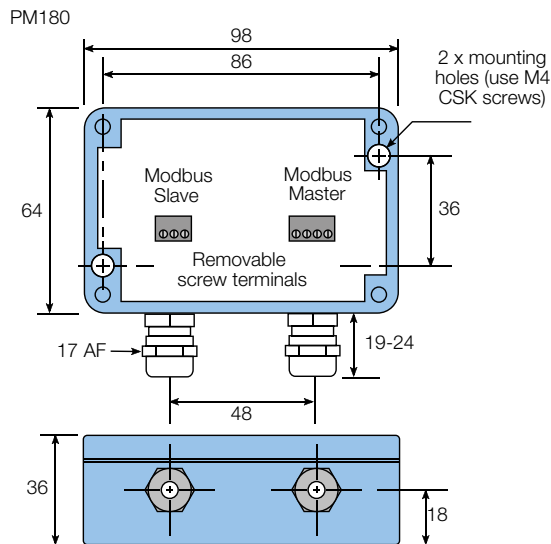
Electromagnetic CompatibilityEN61326-1, EN61326-2-3 (Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements - **Industrial**)

OPTICS

Diameter of target spot measured versus distance from sensing head (90% energy)



MAJOR DIMENSIONS



All dimensions in mm

PMBHUB SPECIFICATIONS

Construction

Die Cast Aluminium

Electrical Connections

Removable screw terminals, 28 AWG to 18 AWG

Weight

250 g

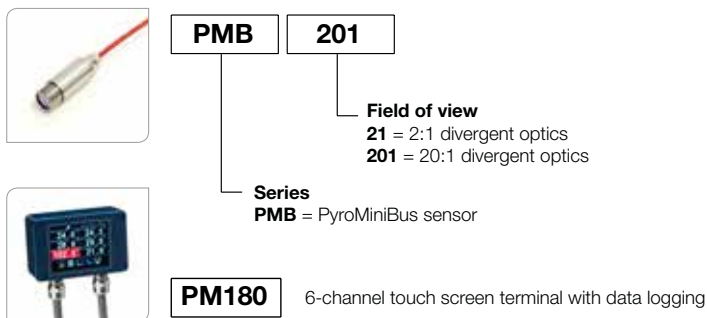
Environmental Rating

IP65

Enclosure Dimensions

Same as PM180

MODEL NUMBERS



SENSOR ACCESSORIES

IP65 junction box for 6 sensors **PMBHUB**

Adjustable mounting bracket **ABS**

Fixed mounting bracket **FBS**

Extended cable **PMBCE**

Calibration certificate **CALCERTA**

Laser sighting tool **LSTS**

Fixed or Adjustable mounting bracket with continuous laser sighting **DLSBFS / DLSBAS**

PM180 ACCESSORIES

International AC mains power supply for PM180

PM180MA

MicroSD Card for PM180 data logging **MSD**

12-channel Modbus relay output module **M-7061**

4-channel Modbus voltage or current analogue output module **M-7024**



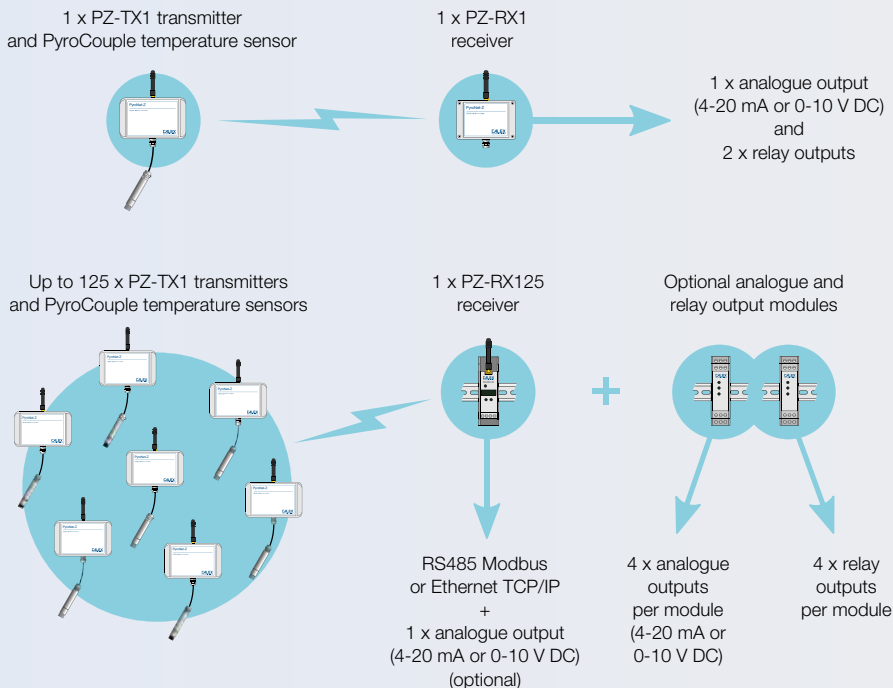
PyroNet Z

Wireless Non-Contact Temperature Measurement System



- Battery-powered wireless transmitter for PyroCouple infrared temperature sensor
- Choice of 1-channel or 125-channel wireless receivers
- Analogue outputs, alarm relays, and digital communications
- Replace expensive cable runs, and install temperature sensors where cabling is impossible

SYSTEM DIAGRAM



Temperature Sensor

The temperature of a surface is measured using a PyroCouple non-contact infrared sensor with a 0-50 mV output. Materials including paper, thick plastics, painted surfaces, food, asphalt and organic materials are measured easily and instantaneously.

Wireless Transmitter

The battery-powered PZ-TX1 transmitter periodically takes a measured temperature reading from the PyroCouple temperature sensor and sends it wirelessly to a PyroNet-Z receiver. It is supplied in a compact wall-mounted enclosure.

Wireless Receivers

A choice of single-channel or multi-channel receivers is available.

• Single Channel

The wall-mounted PZ-RX1 receives the wireless signal from one PZ-TX1 transmitter. It provides one analogue output and two relay outputs.

• Multi Channel

The PZ-RX125 is a DIN rail mounted unit with digital communications via RS485 or Ethernet. Its 125 channels may be individually assigned to wireless transmitters or outputs. Optional analogue and relay output modules may be added using the included clip-on bus connector.






• Multi-Channel Output Modules

These optional DIN rail mounted units clip onto the PZ-RX125 via the included bus connector and provide 4 analogue or relay outputs.

SPECIFICATIONS

For sensor specifications, see PyroCouple data sheet.

GENERAL

Model	Transmitter	Receivers		Output Modules for PZ-RX125	
	PZ-TX1 1 channel	PZ-RX1 1 channel	PZ-RX125 125 channel	PZ-OP4A Analogue outputs (4 channels)	PZ-OP4R Relay outputs (4 channels)
					
	Models shown include optional 5 dBi antenna				

Inputs	1 x PyroCouple with output option 5 (0 to 50 mV).	Wireless signal from 1 x PZ-TX1	Wireless signal from up to 125 x PZ-TX1	Digital communications with PZ-RX125 via clip-on DIN rail bus connector	
Outputs and Communications	Wireless transmission only	1 analogue output (selectable 4-20 mA or 0-10 V DC), and 2 relay outputs rated 3 A @ 240 V AC	Choice of RS485 Modbus RTU, Ethernet TCP/IP or Ethernet Modbus TCP; Optional 1-channel 4-20 mA (built-in); Optional output modules (see right)	4 outputs, selectable 4-20 mA, 0-10 V DC, or mA sink via switches	4 SPDT relay outputs, rated 3 A @ 240 V AC

Accuracy (total non-linearity)	Better than +/- 0.05%				-
Sample rate	Selectable 10 s, 30 s, 1 min, 1 hour, via switches. Custom sample rates available; contact Calex.	-	-	-	-
Diagnostics	-	-	Via display	-	-
Display	-	-	Built-in 4-character LED display for temperature indication and configuration	-	4 LED indicators for relay on/off status
Configurable Parameters (via switches inside enclosure)	Network code (A-H), channel number, sample period	Network code (A-H), no-signal alarm time, relay operation mode (no-signal alarm or setpoint), analogue output type (voltage/current)	Display scaling, analogue output scaling and type (models with built-in analogue output), Modbus protocol RTU/TCP (Ethernet models), Modbus slave address, baud rate, port settings, timeout	Individually selectable current or voltage output, output scaling	Alarm temperature setpoint, hysteresis, high/low alarm function, error or timeout alarm function
Relay (alarm) set points	-	Selectable 25% or 75% of input range as standard. Alternative setpoints may be factory-set.	See PZ-OP4R	-	Fully configurable via PZ-RX125
Mounting	Wall mounted		DIN Rail TS35. Wall-mount enclosure available (contact Calex)	DIN Rail TS35	DIN Rail TS35






ELECTRICAL

Power supply	3 x 3.6 V lithium batteries (1 for transmitter, 2 for sensor)	24 V DC	16 to 30 V DC	12 to 36 V DC. Powered via clip-on DIN rail mounted bus connector	
Battery life	Typically > 1 year	-	-	-	-
Max current draw	40 mA (during transmission)	180 mA	120 mA	90 mA continuous (260 mA on startup)	
Input connection	Screw terminals	-	-	Clip-on DIN rail mounted bus connector	
Power connection	-	Screw terminals	Screw terminals	Clip-on DIN rail mounted bus connector	
Output connection	-	Screw terminals	Analogue output and RS485 interface: Screw terminals Ethernet interface: RJ45 socket	Screw terminals	
Conductor size (for screw terminals)	0.5 to 4.0 mm				
Tested Surge Voltage	-	2.5 kV for 50 μs			
Tested Transient Voltage	-	10 kV/μs			
Isolation (power supply - output)	-	-	1 kV		

SPECIFICATIONS

For sensor specifications, see PyroCouple data sheet.

GENERAL

Model	Transmitter	Receivers		Output Modules for PZ-RX125	
	PZ-TX1 1 channel	PZ-RX1 1 channel	PZ-RX125 125 channel	PZ-OP4A Analogue outputs (4 channels)	PZ-OP4R Relay outputs (4 channels)
					
	Models shown include optional 5 dBi antenna				

ENVIRONMENTAL

Environmental rating	IP67	IP67	Designed for mounting in a cabinet with suitable environmental protection. IP67 enclosure available - contact Calnex		
Dimensions	160 (w) x 90 (h) x 50 (d) mm	120 (w) x 80 (h) x 55 (d) mm	114.5 (d) x 99 (h) x 22.5 (w) mm	114.5 (d) x 99 (h) x 17.5 (w) mm	114.5 (d) x 99 (h) x 17.5 (w) mm
Operating Temperature	-20°C to 55°C	0°C to 55°C			
Relative Humidity	0% to 90%				

WIRELESS COMMUNICATIONS

Output power	20 dBm		-	-
Antenna	2 dBi antenna with SMA connector fitted as standard. Higher-gain antenna available (see Accessories). Antenna may be mounted remotely via extension cable.		-	-
Approvals & Conformity	CE Marked; conforms to FCC part 15, IC Canada RSS 210e, ETSI EN 300-328, Japan ARIB STD-T66		CE Marked	

CONNECTIONS

Screw terminal number					
1	PWR- (PyroCouple model -5)	Power supply +24 V DC	Power supply 0 V	Output 1: mA/V +	Relay 1 NO
2	Not connected	Power supply 0 V	Power supply 16-32 V DC	Output 1: mA/V - (mA sink +)	Relay 1 NC
3	PWR+ (PyroCouple model -5)	mA sink +		Output 2: mA/V +	Relay 2 NO
4	OP+ (PyroCouple model -5)	mA sink -		Output 2: mA/V - (mA sink +)	Relay 2 NC
5	OP- (PyroCouple model -5)	Output mA/V +		Output 3: mA/V +	Relay 3 NO
6		Output mA/V -		Output 3: mA/V - (mA sink +)	Relay 3 NC
7		Relay 1 Common	RS485 Signal Ground (B models)	Output 4: mA/V +	Relay 4 NO
8		Relay 1 Normally Open	RS485 B - (B models)	Output 4: mA/V - (mA sink +)	Relay 4 NC
9		Relay 1 Normally Closed	RS485 A + (B models)	Output 1: mA sink -	Relay 1 COM
10		Relay 2 Common	mA/V Output - (A models)	Output 2: mA sink -	Relay 2 COM
11		Relay 2 Normally Open		Output 3: mA sink -	Relay 3 COM
12		Relay 2 Normally Closed	mA/V Output + (A models)	Output 4: mA sink -	Relay 4 COM
Other			RJ45 Socket (E models)		

ORDERING



PZ-TX1 Wireless transmitter for 1 x PyroCouple infrared temperature sensor with output option 5, in IP67 wall mount enclosure, fitted with 2 dBi antenna

Sensor not included - see PyroCouple data sheet for ordering information



PZ-RX1 Single channel wireless receiver for 1 x PZ-TX1, with 1 x 4-20 mA output, in IP67 wall mount enclosure, fitted with 2 dBi antenna

Note: Up to PZ-RX1/transmitter pairs may be used on the same site.
If more sensors or outputs are required, use the PZ-RX125.



125 channel receiver, DIN rail mounted, fitted with 2 dBi antenna:

PZ-RX125-B - with RS485 Modbus RTU communications only

PZ-RX125-B-A - with RS485 Modbus RTU communications and 1 x built-in analogue output

PZ-RX125-E - with Ethernet communications only

PZ-RX125-E-A - with Ethernet communications and 1 x built-in analogue output

OPTIONS AND ACCESSORIES



PZ-OP4A DIN rail mounted output module for PZ-RX125, with 4 x individually selectable 4-20 mA or 0-10 V outputs

PZ-OP4R DIN rail mounted output module for PZ-RX125, with 4 x relay outputs



PZ-ANT5 Optional high-gain indoor antenna with SMA connector for PyroNet Z wireless receivers and transmitters, 5 dBi

Outdoor antenna options are also available. Contact Caalex for details.

PZ-ANTCE Optional extension cable for antenna (e.g. for mounting the antenna on the outside of a metal cabinet)

PZ-BATT Replacement battery for PZ-TX1 (3 batteries required per transmitter)

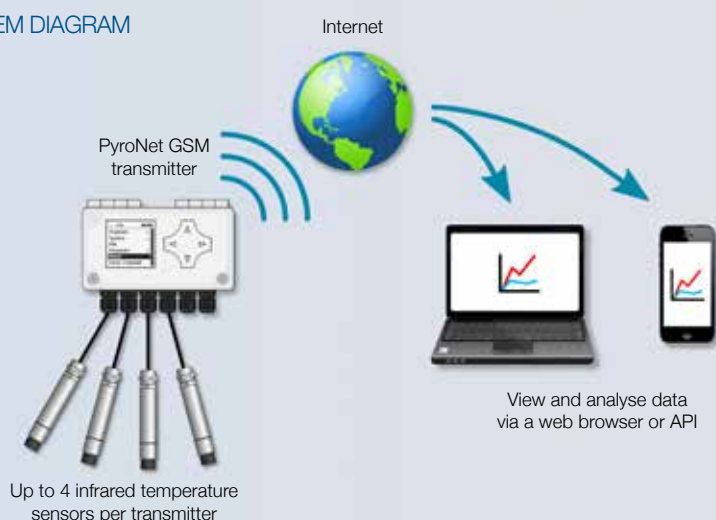
PyroNet GSM

Remote Sensor Telemetry System



- Monitor temperatures from anywhere in the world
- Unit transmits measurement data to the internet via cell phone network
- Up to 4 sensor inputs per unit
- View, analyse and download data via the hosted web interface

SYSTEM DIAGRAM



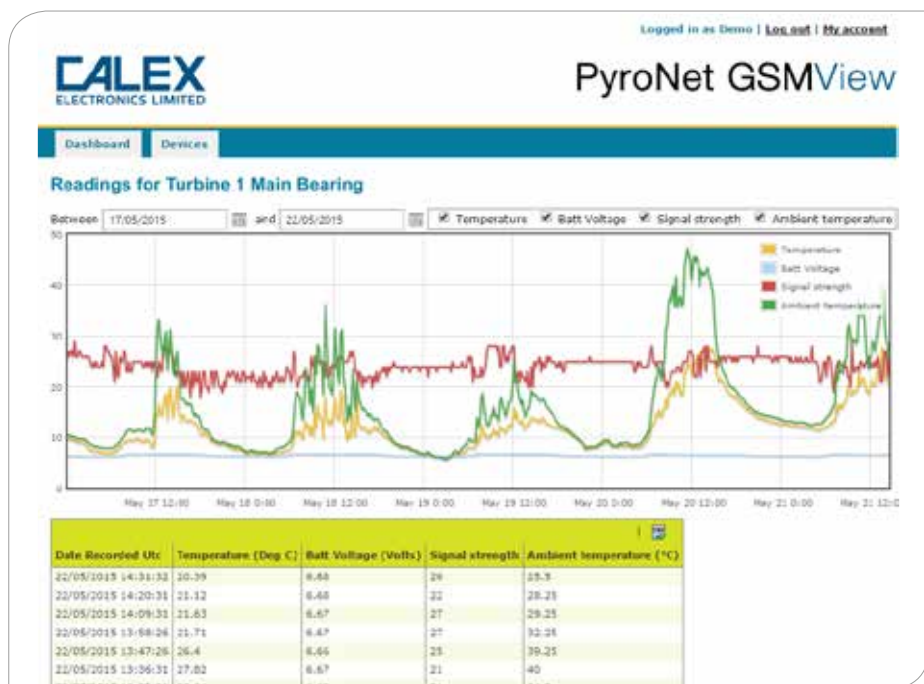
The PyroNet GSM telemetry module transmits readings from up to 4 devices with analogue output, such as the PyroCouple and PyroMini infrared temperature sensors.

Measurements are taken at regular intervals and transmitted to the internet via the GSM cellular phone network, using the PyroNet GSM's built-in SIM card.

Our hosted web interface, PyroNet GSMView, allows you to access and analyse data anywhere in the world via the internet.

A choice of battery-powered, solar-powered or 6-24 V DC-powered versions is available for indoor or outdoor use - contact Calex for advice.

Optional relay outputs rated 30 V DC, 2 A are available for connection directly to alarm hardware.



PyroNet GSMView

- View and export data via a web browser
- Configure the PyroNet GSM unit remotely
- API included for third-party data export
- See configurable graphs
- Send alarms via email

PyroNet GSMView is a web-based interface for data acquisition and analysis. Your data is hosted securely on the PyroNet GSMView servers and access is included as standard in your monthly subscription.

You can export measurement data to be used in a spreadsheet, and configure the system to send email or SMS alarms, for temperature alerts or loss of communication (for example, due to power failure).

GENERAL SPECIFICATIONS

Inputs

4 x analogue inputs, selectable 0-20 mA, 4-20 mA, 0-5 V, 0-10 V or digital ON/OFF

Optional plug-in board with 5 x digital or pulse inputs - contact Calex.

Compatible with

PyroCouple, PyroMini, PyroUSB, or any other sensor with analogue voltage or current output

Input resolution

10 bit (1024 increments) over 10 volts

Accuracy

0.25%

Sample rate

Configurable depending on data subscription (typically 1 transmission per 10 minutes, or 1 transmission per hour)

Outputs

-R models: 2 relay outputs rated 30 V DC, 2 A

Display

40 x 40 mm, 128 x 128 pixel resolution, backlit

Programming interface

USB port for configuration and firmware updates

Firmware updates

Via USB or GSM network

Warranty

2 years

ELECTRICAL

Input connector

Removable screw terminals, pitch 3.81 mm. 4 x 3-pin connectors for sensors, 1 x 2-pin connector for power

Power supply

3.9 V battery (-B models) or 6-24 V DC, 0.5 A (-DC models)

Output power to sensors

3.9 V (unregulated), 5 V or 21.6 V

Output current to sensors

31.25 mA max.

ENVIRONMENTAL

Environmental rating

IP67

Dimensions

138 x 76 x 68 mm (excluding cable glands)

TELECOMMUNICATIONS

Approvals & Conformity

Conforms with R&TTE Directive; GE, GCF, FCC, PTCRB, IC, ANATEL approved

Modem type

Quad-band GSM & GPRS 850/900/1800/1900 Mhz

Output power

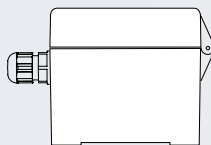
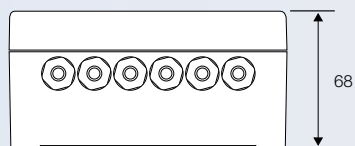
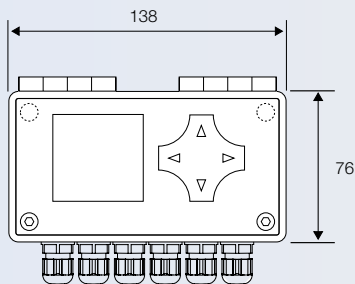
Class 4 (2 W) 850/900 MHz

Class 1 (1 W) 1800/1900 MHz

Antenna

Internal antenna built in as standard. Optional external antenna via SMA connector

DIMENSIONS (mm)



ORDERING

PyroNet GSM telemetry transmitter with 4 analogue inputs, IP67 weatherproof enclosure, built-in display, GSM modem for GPRS or SMS communications and internal antenna



PGSM - XX - X

Relay Outputs
(blank) = No relay outputs
R = 2 relay outputs rated 30 V DC, 2 A

Power Supply

DC = 6-24 V DC
B = Internal 3.9 V battery
S = Solar panel, backup battery and regulator

OPTIONS AND ACCESSORIES

PGANT External antenna with connection kit

PGBAT Battery, 3.9 V, 16 Ah, non-rechargeable, with built-in secondary cell. For PGSM-B models.

Monthly Subscriptions

Subscriptions include a SIM card, access to PyroNet GSMView, and a daily allowance of 24 transmissions (1 per hour) or 144 transmissions (1 every 10 minutes) as standard. Other options are available.

Optionally, alarm events may be transmitted by SMS and email.

Contact Calex to discuss your requirements.

PyroPen

Handheld Infrared Thermometer



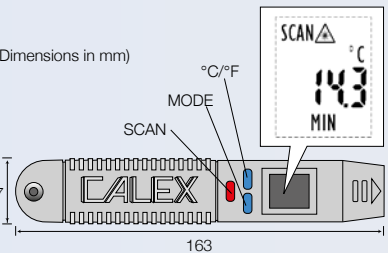
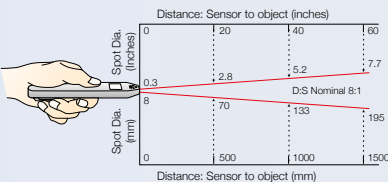
- Conveniently clips into your pocket just like a pen
- Unique ultra compact design
- Wide temperature range
- High accuracy and repeatability
- Fast response
- Displays maximum, minimum, average and current temperatures
- Narrow field of view
- Optional laser sighting
- Optional USB data logging & data acquisition

GENERAL SPECIFICATIONS

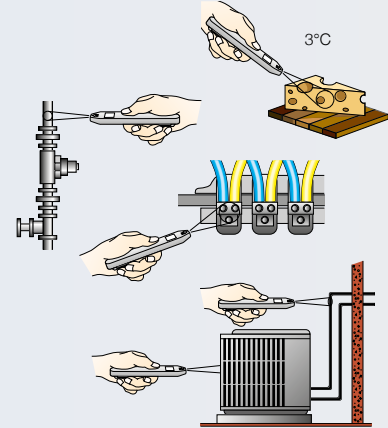
Temperature Range	-20°C to +500°C
Accuracy	+/-1% of reading or +/-1°C whichever is greater
Repeatability	+/-0.5% of reading or +/-0.5°C whichever is greater
Response Time, t ₉₀	500 ms (90% response)
Spectral Range	8 to 14µm
Ambient Temp Range	0°C to +50°C
Housing	Pen style
Display	3.5 digit LCD
Power	2 x AAA batteries
Reading	°C or °F SCAN/HOLD/LOCK/MAX/MIN/AVG
Display Resolution	0.1°
Field-of-view	8:1
Relative Humidity	10 to 95% non-condensing
Dimensions	163 mm x 27 mm x 16 mm

	PyroPen E	PyroPen L	PyroPen U
Emissivity	Fixed at 0.95	Adjustable 0.3 to 1.0	Adjustable 0.3 to 1.0
Sighting	None	Laser	Laser
Data Logging	None	None	100 memory locations
Data Acquisition	None	None	Via USB cable and CalexSoft software supplied
Weight	50g	60g	60g

TARGET SIGHTING AND SPOT SIZES



APPLICATIONS



Designed to be simple, safe and convenient to use. The ultra compact PyroPen has been specifically designed to fit into your pocket, just like a pen, so that you can carry it with you anywhere you go.

You simply aim, press the SCAN button and read the temperature immediately. No fuss. No need to focus and no special training.

The non-contact nature of the measurement means that you can take the temperature of moving, rotating, inaccessible or hazardous objects. This makes the PyroPen particularly useful for test, inspection and maintenance applications in industries such as food & beverage, automotive, plastics & rubber, textiles, paper & packaging, chemicals & pharmaceuticals, HVAC, electrical, asphaltting, plus many others.

The PyroPen L has all the features of the PyroPen E, plus laser sighting for small or distant targets and adjustable emissivity.

The PyroPen U has all the features of the PyroPen L, plus a built-in memory for logging up to 100 temperatures and the ability to perform PC based data acquisition via USB. It is supplied complete with USB interface cable and CalexSoft software disk.

High performance, low cost. The Calex design team have taken advantage of the latest technology, not only to provide an ultra slim design but to incorporate reliability with high accuracy.

Advanced manufacturing techniques are used to ensure that the PyroPen meets the highest quality standards at low cost.

Each PyroPen comes with additional functions such as maximum, minimum and average temperature measurements. The PyroPen can be LOCKED into the ON position if continuous measurements are required. The last measured value can also be held for those situations where it is not easy to see the display whilst measuring.

ST640 Series

Low Cost Handheld Infrared Thermometer



- Wide temperature range
- Built-in laser pointer to improve aim
- Narrow field of view
- Input for type K thermocouple (ST642)
- Adjustable emissivity (ST642)
- Adjustable high and low alarms, audible and visual
- Backlit display with Data Hold
- °C/°F switchable
- Fast sampling time
- Auto-hold and power off
- High quality construction

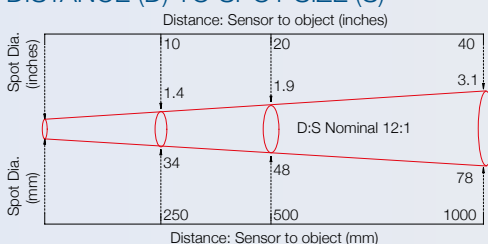
GENERAL SPECIFICATIONS

Field-of-view	12:1
Temperature Range	-32°C to 535°C (-25°F to 999°F)
Accuracy*	±3°C (±5°F) from -32°C to -20°C (-25°F to -4°F) ±2°C (±3°F) from -20°C to 100°C (-4°F to 212°F) ±2% above 100°C (212°F)
Spectral Range	5 to 14µm
Repeatability	±1°C (±2°F)
Resolution	0.1°C (0.1°F)
Response Time	500ms
Ambient Range	0°C to 50°C (32°F to 122°F), 10% to 90%RH
Power OFF	Automatic after approx. 7s
Display	LCD with backlighting
Battery Type	9V, PP3
Dimensions	180mm x 130mm x 40mm
Weight	195g

*Accuracy is given at ambient temperature of 25°C (77°F)

	ST640	ST642
Emissivity	Fixed at 0.95	Adjustable 0.1 to 1.0
Type K Thermocouple Input	NO	YES
eSmart Emissivity Correction	NO	YES
Audible Alarm	YES	YES
CIS Visual Alarm	YES	YES
°C/°F Switchable	YES	YES
Backlight	YES	YES
Laser Sight Switchable	YES	YES
Max/Min/Avg/ΔT	YES	YES
Carrying case	YES	YES

DISTANCE (D) TO SPOT SIZE (S)



The ST640 Series is a range of low cost, handheld infrared thermometers with laser sighting and large backlit LCD displays.

Each unit measures from -32°C to 535°C with 0.1°C resolution. They also offer a superior 12:1 field of view, which helps to minimise errors by producing a small diameter measurement area.

The emissivity setting on the ST640 is fixed at 0.95, making it ideal for most organic materials and non-shiny (painted, corroded or anodised) metals. The emissivity setting on the ST642 is adjustable from 0.1 to 1.0 and can be set automatically by using the thermocouple input and eSmart feature.

Both models provide adjustable audible and visual alarms in which the colour of the display changes when the target temperature exceeds the alarm set point.

Readings can be taken in °C or °F, and when the trigger is released the last measurement is held for approximately 7 seconds before the unit automatically turns off.

ST640 series thermometers will operate in ambient temperatures from 0°C to 50°C and are powered by a standard PP3, 9V battery.

Each unit is supplied complete with a soft carrying case.

ST680 Series

Handheld Infrared Thermometer



- Wide temperature range, -50°C to 1000°C
- Narrow 50:1 field of view
- USB Data Output (ST689)
- Input for type K thermocouple (ST689)
- Built-in laser pointer to improve aim
- Adjustable emissivity
- Adjustable high and low alarms
- Backlit LCD display
- °C/°F switchable
- Fast sampling time
- Auto-hold and power off
- High quality construction

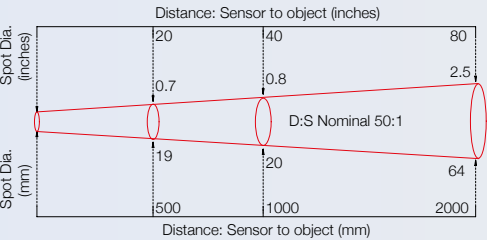
GENERAL SPECIFICATIONS

Field-of-view	50:1
Temperature Range	-50°C to 1000°C (-58°F to 1832°F)
Accuracy*	±3°C (±5°F) from -50°C to -20°C (-58°F to -4°F) ±2°C (±3°F) from -20°C to 100°C (-4°F to 212°F) ±2% above 100°C (212°F)
Spectral Range	8 to 14µm
Repeatability	±1°C (±2°F)
Resolution	0.1°C (0.1°F)
Response Time	500ms
Ambient Range	0°C to 50°C (32°F to 122°F), 10% to 90%RH
Power OFF	Automatic after approx. 6s
Display	4-digit LCD with backlighting
Battery Type	9V, PP3
Dimensions	200mm x 127mm x 47mm
Weight	330g

*Accuracy is given at ambient temperature of 25°C (77°F)

	ST688	ST689
Emissivity	Adjustable 0.1 to 1.0	Adjustable 0.1 to 1.0
Type K Thermocouple Input	NO	YES
USB Data Output	NO	YES
10 point memory	YES	YES
Audible Alarm	YES	YES
°C/°F Switchable	YES	YES
Backlight	YES	YES
Laser Sight Switchable	YES	YES
Max/Min/Avg/ΔT	YES	YES
Carrying case	YES	YES

DISTANCE (D) TO SPOT SIZE (S)



The ST680 Series is a range of high quality, handheld infrared thermometers with laser sighting and large backlit LCD displays.

Each unit measures from -50°C to 1000°C with 0.1°C resolution. They also offer a superior 50:1 field of view, which helps to minimise errors by producing a small diameter measurement area.

Model ST689 has a USB data output. The emissivity setting is adjustable from 0.1 to 1.0 and both models provide adjustable audible alarms.

Readings can be taken in °C or °F, and when the trigger is released the last measurement is held for approximately 6 seconds before the unit automatically turns off.

ST680 series thermometers will operate in ambient temperatures from 0°C to 50°C and are powered by a standard PP3, 9V battery.

Each unit is supplied complete with a soft carrying case.

Thermocouples and RTDs

- Temperature probes manufactured to your requirements
- All thermocouple types including Type J, K, N, R, S, T and B
- Platinum resistance thermometers including Pt100 and Pt1000
- PTC and NTC thermistors
- Probe materials such as stainless steel, ceramic, Inconel and titanium
- Probes available with hardwired cable, or fitted with a sealed connection head
- Optional temperature transmitter and extension cable
- Curved or straight probes, diameters from 1 mm to 30 mm
- Choice of process connections
- Let us know your requirements and we will help you find a suitable probe



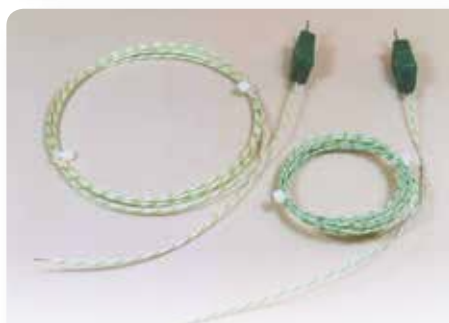
Ceramic probes



Curved probes



DIN connection head and threaded mounting



Exposed-junction wire thermocouples



Hardwired cables



Low-cost sealed connection boxes



Probes fitted with M12 connectors



Probes with flange mount



Screw clamp process connection

PPT245

DIN-Rail Mounted Multifunction Indicator/Controller



- Metalworking furnaces
- Heating element control
- Footwear machinery
- Plastic extrusion
- Injection moulding
- Motorised valve control
- Woodworking machinery
- Pharmaceutical industry
- Current control
- Remote control via RS485
- Signal converter

GENERAL SPECIFICATIONS

Housing	DIN 43880 for mounting on type EN 50022 rail or on a flat surface
Supply Voltage	24 to 230VAC/DC +/- 15% 50/60Hz
Power Consumption	3W
Display	4-digit dual LED, 8 red status LEDs
Operating Conditions	0-45°C, 35-95%RH
Inputs	1 configurable for J, K, R or S thermocouples; Pt100; Ni100; Pt1000; Pt500; PTC1k; NTC10k; 0 to 10V; 0/4 to 20mA; 0 to 40mV; potentiometer 6k Ω / 150k Ω ; TA 50mA.
Outputs	2 relays 5A resistive + 1 logic SSR 12V-30mA / 4 to 20mA / 0 to 10V for control or retransmission, galvanically isolated from input and power supply RS485 Modbus RTU (57600 baud max) Input TA 50mA for Loop Break Alarm
Digital Input	Tuning start, Setpoint change, Man/Auto selection, Hold function, Start/Stop preprogrammed cycle
Control Modes	ON/OFF, P, PI, PID, Autotuning
Accuracy	0.5% \pm 1digit for TC/RTD; 0.2% \pm 1digit for V/mA
Sampling Time	Selectable (15ms max)
Sealing	IP20
Configuration	Parameters protected by password; optional memory card with battery for repeat configurations; LabSoftView software for configuration via a PC
Optional Enclosure	Polycarbonate with transparent lid, IP65, 160H x 90W x 90D mm

The PPT245 DIN-rail mounted controller provides a highly versatile alternative to panel-mounted instruments. It has one analogue input which is configurable for up to 18 different sensors/signals, two relay outputs, and a third output which can be configured either as a SSR logic signal or a 4 to 20mA / 0 to 10V analogue signal for control or re-scalable retransmission of the process variable or setpoint.

The analogue output can also be used to adjust the emissivity setting on a PyroEpsilon non-contact temperature sensor – the value is adjusted between 0.2 and 1.0 using the lower (red) LED display and associated push buttons.

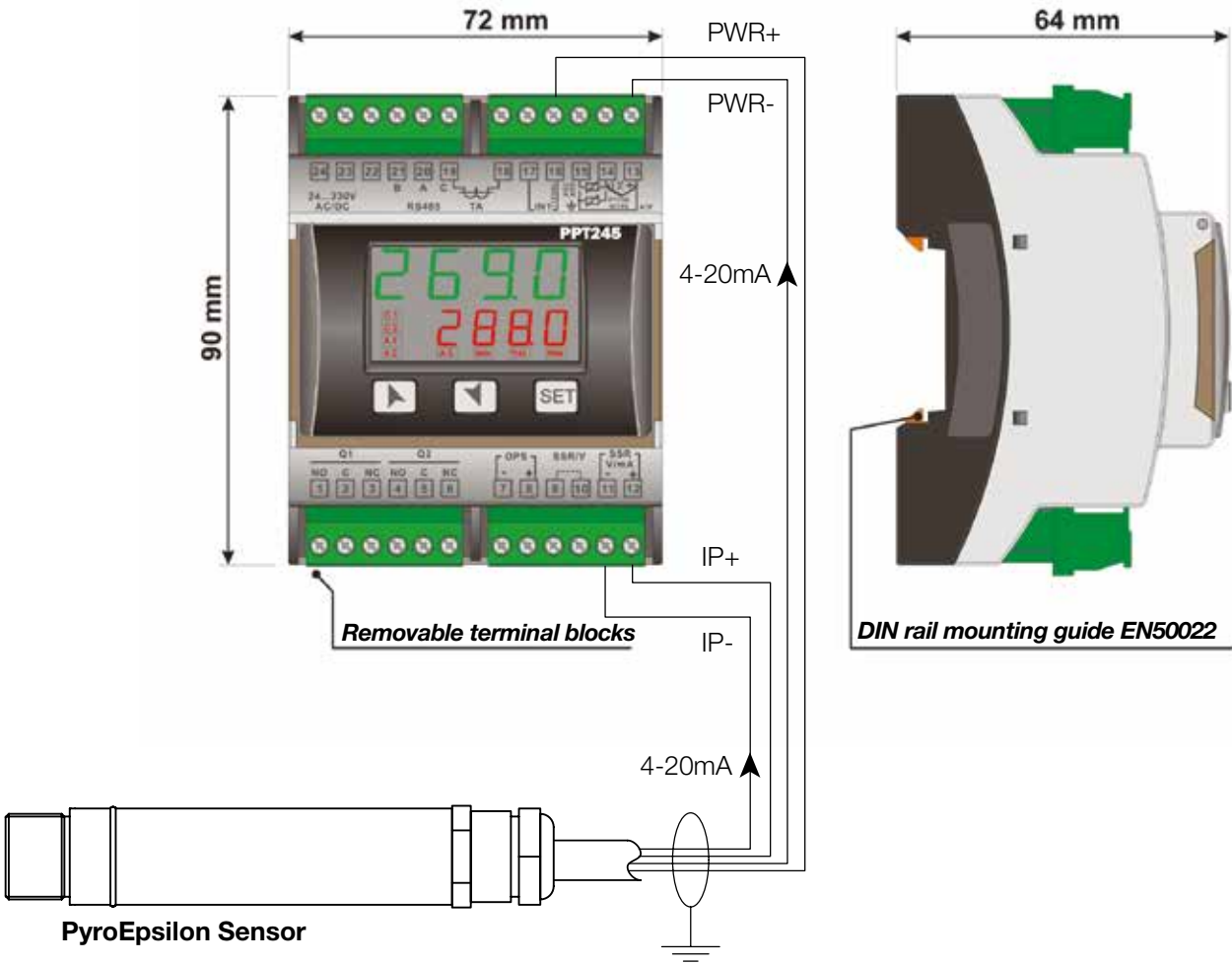
The built-in switching power supply has an extended range of 24 to 230VAC/DC and does not require any jumper setting. The control modes are ON/OFF, PID + Autotuning and Heating/Cooling PID with a neutral zone.

Software features include launch tuning, setpoint selection via digital input, optional manual reset of the output via the front keypad, latch-on function for sensor calibration (including load cells) and a programmable cycle of 3 steps. RS485 serial communication (Modbus RTU) and load monitoring function (Loop Break Alarm) with current transformer TA are also provided.

There is an optional Memory Card to copy all of the configuration parameters from one controller to another without powering them up, whilst LabSoftView for Windows enables setting and monitoring of parameters on a PC.

The PPT245 is also available mounted in an IP65 enclosure with clear lid, which is ideal for mounting on a machine or close to the process where the operator can see the display.

If the PPT245 is ordered with a PyroEpsilon sensor, it is supplied pre-configured to display the 4 to 20mA signal from the sensor over the appropriate temperature range. It is also pre-configured to allow the emissivity setting on the sensor to be adjusted over the range 0.2 to 1.0. Since the PyroEpsilon derives its power from the PPT245 no other power source is required. The PPT245 can be supplied from a 24V to 230V source (+/-15%), AC or DC.



MODEL	INPUTS	OUTPUTS	POWER SUPPLY
PPT245-21ABC-T	Selectable	2Relays + SSR / 4..20mA / 0..10V + RS485	24...230V AC/DC +/- 15% 50/60Hz

ATR121

Controller with Dual Setpoint



- Food industry
- Ovens/furnaces
- Refrigeration
- Sterilizers
- Environmental chambers
- Safety units
- Injection moulding
- Driers

GENERAL SPECIFICATIONS

Dimensions	32H x 74W x 58D mm
Supply Voltage	230VAC
Power consumption	2W
Display	3-digit red LED plus decimal point; green status LEDs
Operating Ambient	0-40°C, 35-95%RH
Inputs	1 configurable for J, K, R or S thermocouples; Pt100; Ni100; Pt500; Pt1000; PTC; NTC; 0/4 to 20mA; 0 to 10VDC; potentiometers $\leq 6k\Omega$ or $\leq 150k\Omega$
Outputs	Control relay 8A; Alarm relay 5A; SSR Control/Alarm; Open/Close logic (time-proportioned)
Control Action	ON/OFF; PID Autotuning; Heating/Cooling PID
Accuracy	0.5%±1digit for TC/RTD; 0.2%±1digit for mA/V
Sampling Time	66ms (selectable software filter on input and display)
Sealing	IP54 front panel (IP65 with gasket), IP30 housing, IP20 terminal blocks
Configuration	Parameters protected by password

The ATR121 is a dual-setpoint controller with a 3-digit red LED display. The input is configurable for thermocouples type J, K, S & R; Pt100; PTC1000; Ni100; NTC10k (typically used in the refrigeration industry); Pt500/Pt1000 (widely used in air-conditioning); 0 to 1V; 0 to 10V; 0 to 20mA and 4 to 20mA. Potentiometers with a full scale value of $6k\Omega$ or $150k\Omega$ may also be used and there is a "latch on" function for quick calibration and setting of minimum, maximum and zero via the front keys.

Two set-points are available, one for control and one for the alarm function. They can be configured to activate two relay outputs or an SSR output. The main relay for the control output is rated at 8A. The alarm relay is rated at 5A (alarm modes: threshold, band, deviation). Open/Close logic for motorised valves is also available.

Software features include ON/OFF control, PID + Autotuning and Heating-Cooling PID with a neutral zone. A single output (1 relay + SSR) version is also available.

Front of panel sealing to IP65 can be achieved using a gasket (optional). There is also an optional Memory Card to copy all of the configuration parameters from one controller to another without powering them up.

ATR142

Controller/Indicator with Triple Setpoint



- Dairy industry
- Refrigeration
- Sterilizers
- Environmental chambers
- Footwear machinery
- Cereal driers
- Metalworking
- Heating element control
- Indicator for inverters
- Building Automation
- Galvanizing
- Chillers

GENERAL SPECIFICATIONS

Dimensions	32H x 74W x 58D mm
Supply Voltage	24 to 230VAC/DC
Power Consumption	2W
Display	4-digit green + 4-digit red LED; 6 status LEDs
Operating Conditions	0-40°C, 35-95%RH
Inputs	1 configurable for J, K, R or S thermocouples; Pt100; Ni100; Pt500; Pt1000; PTC; NTC; 0/4 to 20mA; 0 to 10VDC; potentiometers $\leq 6k\Omega$ or $\leq 150k\Omega$
Outputs	Control relay 8A; Alarm relay 5A; SSR Control/Alarm; Open/Close logic (time-proportioned); RS485 serial communication, MODBUS-RTU/Slave (version -T)
Control	ON/OFF; PID Autotuning; Heating/Cooling PID
Accuracy	0.5% \pm 1digit for TC/RTD; 0.2% \pm 1digit for mA/V
Sampling Time	15ms (selectable software filter on input and display)
Sealing	IP54 front panel (IP65 with gasket), IP30 housing, IP20 terminal blocks
Configuration	Parameters protected by password
Optional Functions	Timer ON/OFF; Pause/Continue Timer (assigned to alarm relay)

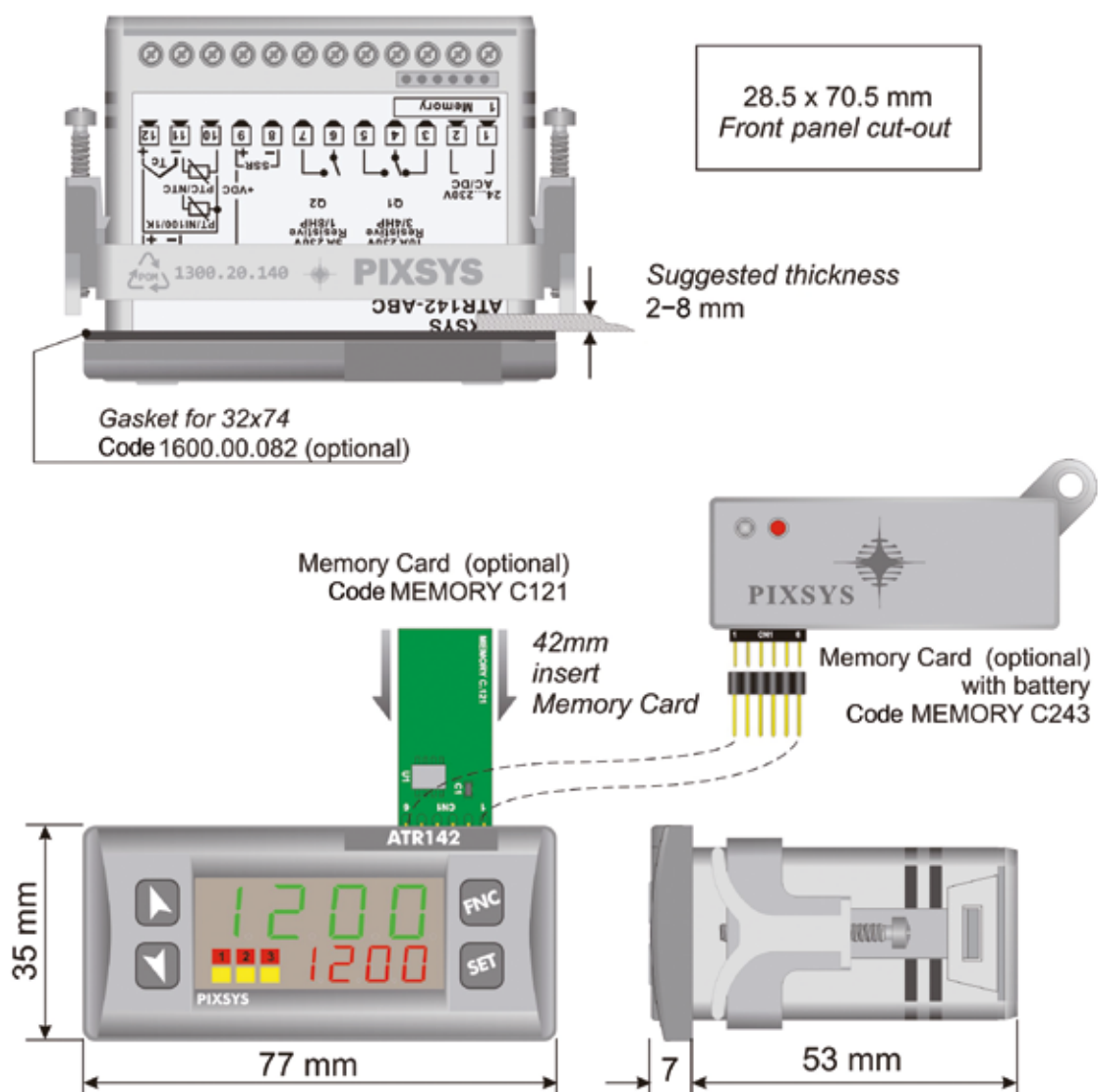
This triple-setpoint controller has a dual red/green LED display which shows the process variable and setpoint value at the same time. The built-in switching power supply has an extended range of 24 to 230VAC/DC and does not require any jumper setting. The analogue input is selectable for thermocouples J, K, R & S; Pt100; PTC1000; Ni100; NTC10k (refrigeration industry); Pt500/Pt1000 (widely used in air-conditioning); 0 to 10V; 0 to 20mA and 4 to 20mA. Potentiometers with full scale up to $6k\Omega$ and $150k\Omega$ may also be used and there is a "latch on" function for quick calibration and setting of minimum, maximum and zero via the front keys.

Three setpoints are provided for control and/or alarm functions. They can be assigned to two relay outputs or an SSR output. The main control relay is rated at 8A. The alarm relay is rated at 5A (alarm modes: threshold, band, deviation). Open/Close logic for motorised valves is also available.

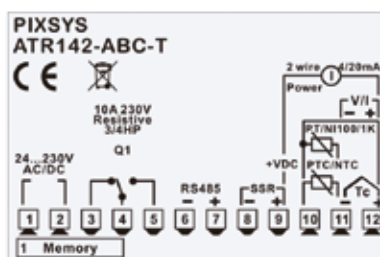
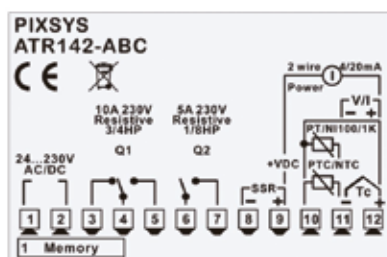
Software features include ON/OFF control, PID + Autotuning and Heating-Cooling PID with a neutral zone. A single output (1 relay + SSR) version is available with RS485 serial communication and Modbus-RTU/Slave protocol for supervisory systems.

Front of panel sealing to IP65 can be achieved using a gasket (optional). There is also an optional Memory Card to copy all of the configuration parameters from one controller to another without powering them up.

Software application LabSoftView for Windows enables setting and monitoring of parameters on a PC. A special software release which integrates both the basic control loop and the timer function is available upon request.



Model :



MODEL	INPUTS	OUTPUTS	POWER SUPPLY
ATR142-ABC	Selectable	2 Relays + SSR	24...230V AC/DC +/- 15% 50/60Hz
ATR142-ABC-T		1 Relay + SSR + RS485	

ATR243

Multifunction Controller



- Metalworking furnaces
- Heating element control
- Refrigeration
- Footwear machinery
- Plastics extrusion
- Injection moulding
- Dryers
- Load cell control
- Motorised valve control
- Woodworking machinery
- Pharmaceutical industry
- Cold stores
- Current control
- Remote control via RS485
- Signal converter

GENERAL SPECIFICATIONS

Dimensions	48H x 48W x 122.5D mm
Supply Voltage	24 to 230VAC/DC +/- 15% 50/60Hz
Power Consumption	3W
Display	4-digit dual LED, 8 red status LEDs
Operating Conditions	0-45°C, 35-95%RH
Inputs	1 configurable for J, K, R or S thermocouples; Pt100; Ni100; Pt1000; Pt500; PTC1k; NTC10k; 0 to 10V; 0/4 to 20mA; 0 to 40mV; potentiometer 6k Ω /150k Ω ; TA 50mA.
Outputs	ATR243-20ABC: 2 relays 5A resistive OR 1 relay + 1 logic SSR 12V-30mA /4 to 20mA / 0 to 10V for control or retransmission ATR243-21ABC-T: 2 relays 5A resistive + 1 logic SSR 12V-30mA /4 to 20mA / 0 to 10V for control or retransmission + RS485 Modbus RTU (57600 baud max) + Input TA 50mA for Loop Break Alarm ATR243-31ABC: 3 relays 5A resistive + 1 logic SSR 12V-30mA / 4 to 20mA / 0 to 10V for control or retransmission + Input TA 50mA for Loop Break Alarm.
Digital Input	Tuning start, Setpoint change, Man/Auto selection, Hold function, Start/Stop preprogrammed cycle
Control Modes	ON/OFF, P, PI, PID, Autotuning
Accuracy	0.5% \pm 1digit for TC/RTD; 0.2% \pm 1digit for V/mA
Sampling Time	Selectable (15ms max)
Sealing	IP54 front panel (IP65 with gasket), IP30 housing, IP20 terminal blocks
Configuration	Parameters protected by password; optional memory card with battery for repeat configurations; software for configuration via a PC.

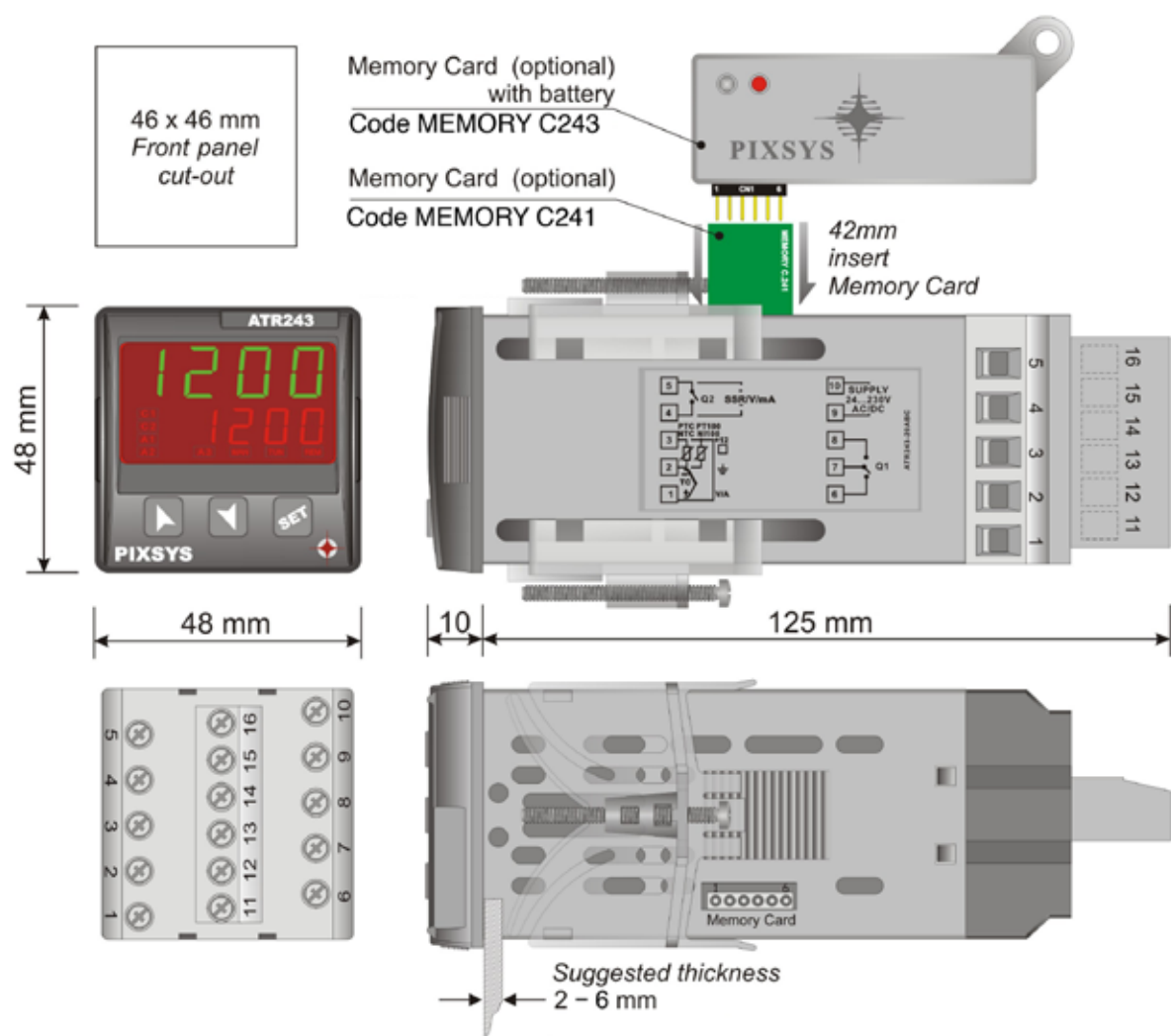
This multifunction controller offers 2 to 4 setpoints. It has one analogue input which is configurable for up to 18 different sensors/signals. The 2 to 4 outputs are configurable as relays (including Open/Close logic for motorised valve control), SSR, 4 to 20mA and 0 to 10V (either for control or re-scalable retransmission of the process variable/setpoint).

The built-in switching power supply has an extended range of 24 to 230VAC/DC and does not require any jumper setting. The control modes are ON/OFF, PID + Autotuning and Heating/Cooling PID with a neutral zone.

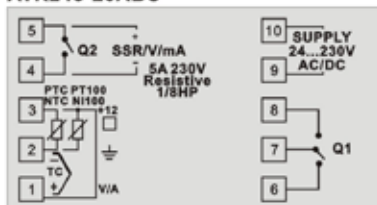
Software features include launch tuning, setpoint selection via digital input, optional manual reset of the output via the front keypad, latch-on function for sensor calibration (including load cells) and a programmable cycle of 3 steps. Optional features include RS485 serial communication (Modbus RTU) and load monitoring function (Loop Break Alarm) with current transformer TA.

Front of panel sealing to IP65 can be achieved using a gasket (optional). There is also an optional Memory Card to copy all of the configuration parameters from one controller to another without powering them up.

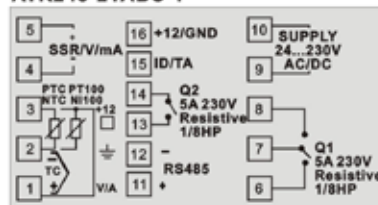
Software application LabSoftView for Windows enables setting and monitoring of parameters on a PC.



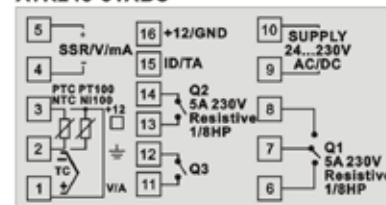
ATR243-20ABC



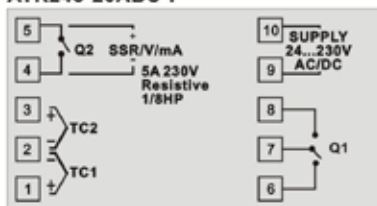
ATR243-21ABC-T



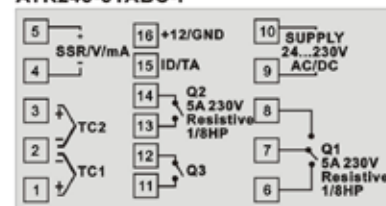
ATR243-31ABC



ATR243-20ABC-I



ATR243-31ABC-I



MODEL	INPUTS	OUTPUTS	POWER SUPPLY
ATR243-20ABC	Selectable	2 Relays + SSR / 4..20mA / 0..10V	24...230V AC/DC +/- 15% 50/60Hz
ATR243-20ABC-I		2 Relays + SSR / 4..20mA / 0..10V + RS485	
ATR243-21ABC-T		3 Relays + SSR / 4..20mA / 0..10V	
ATR243-31ABC-I			

Fixed Mount Infrared Temperature Calibration Checker



The FTK provides a quick and accurate way to check the calibration of infrared temperature sensors.

This rugged and portable unit is designed to provide fast calibration checks anywhere they are needed, from the factory to the workshop or laboratory.

Eighteen models are available; offering target temperatures from 35°C or 150°C, all providing outstanding stability with less than ±0.2°C deviation.

The FTK takes between 5 and 15 minutes to heat and stabilise at the desired temperature (depending on the model), and uses a clear LED to show when it has reached that temperature: green when the FTK is warming up, orange when the FTK is ready for operation and red when the FTK is above the calibration temperature.

The FTK can be used with any infrared temperature sensor that is able to measure between 35°C and 150°C and can focus on a target area less than Ø 50.8 mm.

SPECIFICATIONS

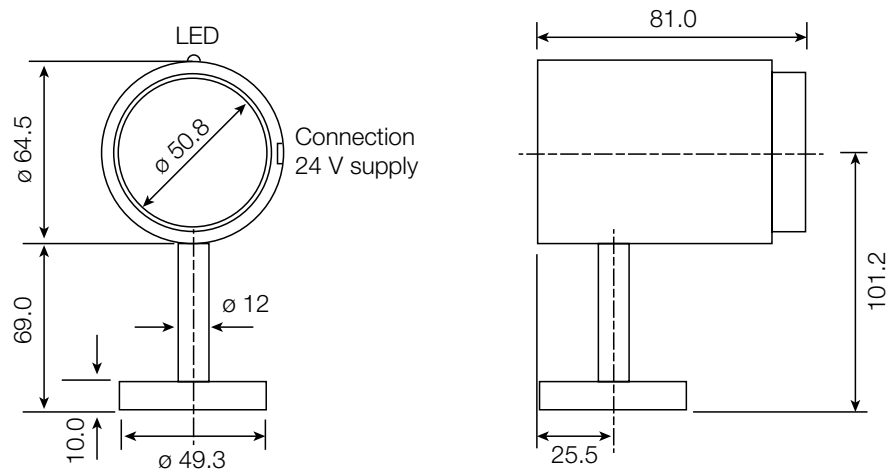
CALIBRATION SOURCE

Target Temperature:	from 35 °C to 150 °C depending on model (see table overleaf)
Emissivity (ε):	0.98 ± 0.004 (for wavelength of 2 to 5.4 µm and 8 to 14 µm)
Aperture diameter:	50.8 mm
Warm-up time:	max. 5 minutes (FTK 35) to 15 minutes (FTK 150)
Temperature uncertainty:	0.4 °C for T _{amb} = 10 to 30 °C (FTK 35 - 120) 0.6 °C for T _{amb} = 0 to 10 °C (FTK 35 - 120) 0.5 °C for T _{amb} = 10 to 40 °C (FTK 130 - 150) 0.7 °C for T _{amb} = 0 to 10 °C (FTK 130 - 150)
Repeatability:	0.2 °C
Stability:	0.1 °C
Temperature uniformity:	0.2 °C (central area ø 45 mm)
Operating temperature: T _{amb} :	0 to 30 °C, temporary (2 minutes) up to 70 °C
Storage temperature:	0 to 70 °C
Relative humidity:	10 to 85 %, non condensing
Status LED:	green: warm-up orange: ready for operation red: above calibration temperature
Power supply:	24 V DC, max. 1 A
Protection class:	IP50 (EN 60529)
Weight:	0.9 kg
Dimensions [mm]:	64.5 x 81.0 x 133.5 (ø x D x H)
CE marking:	according to EU regulations

POWER SUPPLY

Model	Description
Power supply:	100 to 240 V AC, 50 Hz
Output:	24 V DC, 1.3 A
Protection class:	EN 60950
Weight:	approx. 0.3 kg
CE marking:	according to EU directives regarding electromagnetic immunity

DIMENSIONS



All dimensions in mm

MODELS

Model	Description	Target Temperature
FTK 35	Calibration source FTK 35	35 °C
FTK 45	Calibration source FTK 45	45 °C
FTK 50	Calibration source FTK 50	50 °C
FTK 55	Calibration source FTK 55	55 °C
FTK 60	Calibration source FTK 60	60 °C
FTK 65	Calibration source FTK 65	65 °C
FTK 70	Calibration source FTK 70	70 °C
FTK 75	Calibration source FTK 75	75 °C
FTK 80	Calibration source FTK 80	80 °C
FTK 85	Calibration source FTK 85	85 °C
FTK 90	Calibration source FTK 90	90 °C
FTK 95	Calibration source FTK 95	95 °C
FTK 100	Calibration source FTK 100	100 °C
FTK 110	Calibration source FTK 110	110 °C
FTK 120	Calibration source FTK 120	120 °C
FTK 130	Calibration source FTK 130	130 °C
FTK 140	Calibration source FTK 140	140 °C
FTK 150	Calibration source FTK 150	150 °C

ACCESSORIES

Model	Description
FTKPSU	Power supply 100 to 240 V AC or 24 V DC
FTKPLUG-EU	Power plug EU
FTKPLUG-USA	Power plug US
FTKPLUG-UK	Power plug UK
FTKPLUG-AUS	Power plug AUS
FTKMOUNT	Adjustable ball and socket mounting block

BB976

Blackbody Source



- 30°C to 550°C
- Emissivity > 0.995
- 65 mm Diameter Cavity

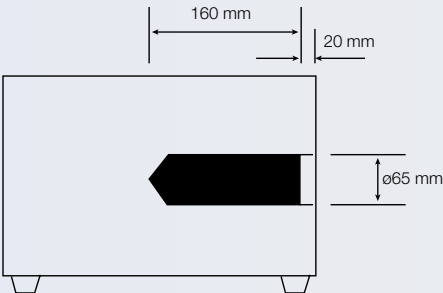
GENERAL SPECIFICATIONS

Temperature Range	30°C to 550°C
Emissivity	Greater than 0.995
Stability	±0.1°C
Display Resolution	0.01°C to 99.99; 0.1°C from 100 to 550
Heating Time	45 minutes
Aperture Diameter	65 mm
Cavity Depth	160 mm
PC Interface	Included
Power	1000 W typical
Voltage	100-130 or 208-240 V AC, 50/60 Hz
Dimensions	H 310 mm, W 265 mm, D 200 mm
Weight	10 kg

OPTIONS

Gallium Hockey Puck Cell	431-03-00
Indium Hockey Puck Cell	976-05-00A
Tin Hockey Puck Cell	976-05-00B
Zinc Hockey Puck Cell	976-05-00C
Orifice Plates 10, 20, 30, 40 50 mm (Restricts Cavity Aperture)	976-01-05
Carrying Case	931-22-64

BB976



The BB976 Portable Blackbody Calibration Source allows for calibration of non-contact infrared thermometers over the temperature range 30°C to 550°C.

It is suitable for use as a primary radiation source for infrared thermometers.

Laboratory performance and low uncertainty calibrations are ensured by the combination of high emissivity and excellent temperature uniformity.

The digital temperature controller allows the block temperature to be set to any value from 30°C to 550°C.

Traceability of the radiance temperature is established by a separate, built-in temperature indicator and included platinum resistance thermometer.

A three point traceable calibration certificate is included. UKAS calibration of the resistance thermometer is available, as is radiometric calibration.

Uniformity of the block is ensured by using distributed heating technology.

For the smallest of uncertainties the BB976 may be used with ITS-90 Fixed Point Cells, Gallium 29.7646°C, Indium 156.5985°C, Tin 231.928°C and Zinc 419.527°C. The cells are provided with a certificate of metal purity.

BB982

Blackbody Source



- -10°C to 80°C
- Emissivity > 0.995
- 50 mm Diameter Cavity

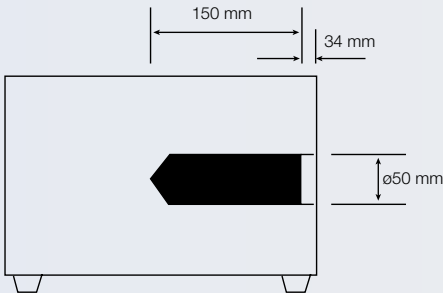
GENERAL SPECIFICATIONS

Temperature Range	-10°C to 80°C
Emissivity	Greater than 0.995
Stability	±0.1°C
Display Resolution	0.01°C
Heating Time	45 minutes to 80°C
Cooling Time	45 minutes to -10°C
Aperture Diameter	50 mm
Cavity Depth	150 mm
PC Interface	Included
Power	200 W typical
Voltage	100-130 or 208-240 V AC
Dimensions	H 310 mm, W 265 mm, D 200 mm
Weight	10 kg

OPTIONS

Orifice Plates 10, 20, 30, 40 50 mm (Restricts Cavity Aperture)	812-01-06
Carrying Case	931-22-64

BB982



The BB982 Portable Blackbody Calibration Source allows for calibration of non-contact infrared thermometers over the temperature range -10°C to 80°C.

It is suitable for use as a primary radiation source for infrared thermometers from sub zero to 80°C.

Laboratory performance and low uncertainty calibrations are ensured by the combination of high emissivity and excellent temperature uniformity.

The digital temperature controller allows the block temperature to be set to any value from -10°C to 80°C.

Traceability of the radiance temperature is established by a separate, built-in temperature indicator and included platinum resistance thermometer.

A three point traceable calibration certificate is included. UKAS calibration of the resistance thermometer is available, as is radiometric calibration.

Uniformity of the block is ensured by distributed thermoelectric heat pumps with the benefit of solid state vibration-free cooling.

32000 Series

Open Frame AC/DC Regulated Linear Power Supplies



GENERAL SPECIFICATIONS

A.C. Input

D.C. Output

Line Regulation

Load Regulation

Output Ripple

Transient Response

Short Circuit and

Overload Protection

Overvoltage Protection

Remote Sensing

Stability

Temperature Rating

100/120/220/240 V AC +10%, -12%, 47 to 60 Hz
See Voltage/Current Rating Chart. Adjustment range
 $\pm 5\%$ minimum.

$\pm 0.05\%$ for a 10% line change.

$\pm 0.05\%$ for a 50% load change.

2 V to 15 V units: 5.0 mV PK-PK maximum

20 V to 28 V units: 0.02% PK-PK maximum

50 μ s for a 50% load change

Automatic current limit/foldback

Built-in on all 5 V outputs. Set at 6.2 V ± 0.4 V

Other models use optional overvoltage protection.

See Option 3 overleaf

Provided on most models, open sense load
protection built in.

$\pm 0.3\%$ for 24 hour period after 1 hour warm-up

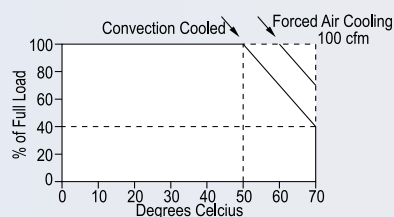
Standard Range: 0°C to +50°C full-rated,

derated linearly to 40% at 70°C

Extended Range: -40°C to +50°C full-rated,

derated linearly to 40% at 70°C

TEMPERATURE DERATING CURVE



Temperature Coefficient

Efficiency (typical)

Isolation

$\pm 0.03\%/^{\circ}\text{C}$ maximum

5V unit: 45%; 12 V and 15 V units: 55%; 24 V units: 60%

Input to ground: 3750 V AC min.

Input to output(s): 3750 V AC min.

Output to ground: 500 V AC min.

Leakage current (live to ground): 5 μ A max.

Yes

RoHS Compliant

These high quality linear regulated power supplies provide outstanding value and are designed for ease of application and long trouble-free life. They will accommodate AC inputs from 100 V to 240 V and provide a wide range of DC outputs with very low ripple.

All 32000 series power supplies are built around industry-standard case sizes to simplify installation and a 3.75 kV isolation safety transformer. For additional safety the transformer primary is protected from thermal overloads by a thermal fuse. This fuse will blow if a transformer temperature of 130°C is exceeded. Every unit incorporates a safety earth tag.

All models are fitted with automatic foldback current limiting. An overvoltage protection (OVP) circuit protects sensitive loads against excessive voltage such as in TTL logic. OVP is a standard feature of all 5 V output units and an option on all other units.

The remote sensing feature, included in almost all 32000 series power supplies, may be used to compensate the voltage drop across the load lines. All dual-output power supplies feature a unique anti-latch circuit to minimise common mode latch up.

SINGLE OUTPUT MODELS

Model	Output Voltage Volts	Output Current Amps	Case
32005AR	5	3.0	A
32005BR	5	6.0	B
32005CR	5	9.0	C
32005DR	5	12.0	D
32012AR	12 to 15	1.7	A
32012BR	12 to 15	3.4	B
32012CR	12 to 15	5.1	C
32012DR	12 to 15	6.8	D
32012ER	12 to 15	10.2	E
32024AR	24 to 28	1.2	A
32024BR	24 to 28	2.4	B
32024CR	24 to 28	3.6	C
32024DR	24 to 28	4.8	D
32024ER	24 to 28	7.2	E
32024ER/10	24 to 28	10.0	E
32048AR*	48	0.5	A
32150AR	120 to 200	0.150**	A

* No remote sensing

** Output current from 180 to 200V falls linearly from 150mA to 125mA

OVP SELECTION CHART

	Case	OVP Model Required
Single Output	A/B/C/D	32901AR
	E	32901BR
Dual Output	AA/BB/CC	32901AR, protects both outputs
	E	32901BR, protects both outputs
Triple Output	AA/AAA/D	32901AR, protects dual outputs
	BBB/131	OVP built-in on 5 V outputs

DUAL OUTPUT MODELS

Model	Output 1		Output 2		Case
	Voltage Volts	Current Amps	Voltage Volt	Current Amps	
32212AR	12 to 15	1.0	-12 to -15	1.0	AA
32212BR	12 to 15	1.7	-12 to -15	1.7	BB
32212CR	12 to 15	3.4	-12 to -15	3.4	CC

TRIPLE OUTPUT MODELS

Model	Output 1		Output 2		Output 3		Case
	Voltage Volts	Current Amps	Voltage Volts	Current Amps	Voltage Volts	Current Amps	
32305AR	5*	2.0	9 to 15*	0.4	-9 to -15*	0.4	AA
32305BR	5	3.0	12 to 15	1.0	-12 to -15	1.0	AAA
32305DR	5	6.0	12 to 15	1.7	-12 to -15	1.7	BBB
32305ER	5	8.0	12 to 15	1.7	-12 to -15	1.7	BBB
32305FR	5	12.0	12 to 15	1.7	-12 to -15	1.7	DBB

OPTIONS

1 Tropicalisation – suffix code 'T'

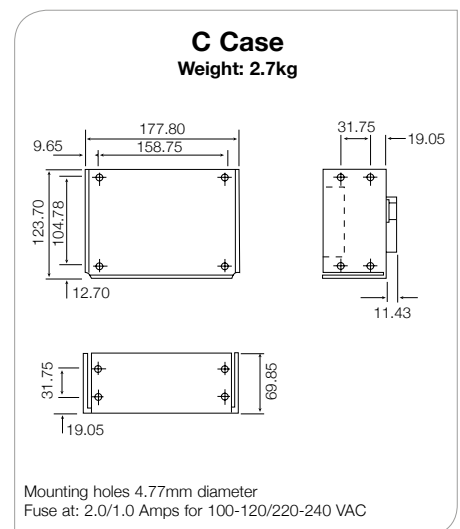
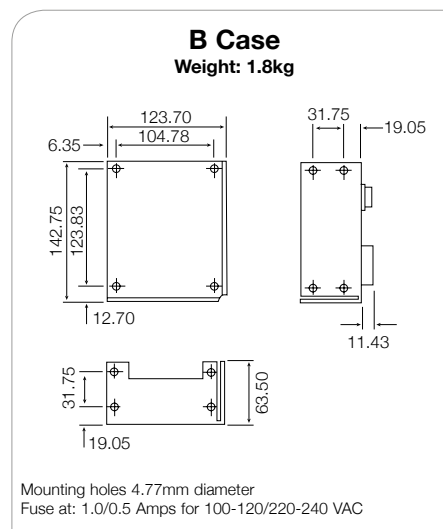
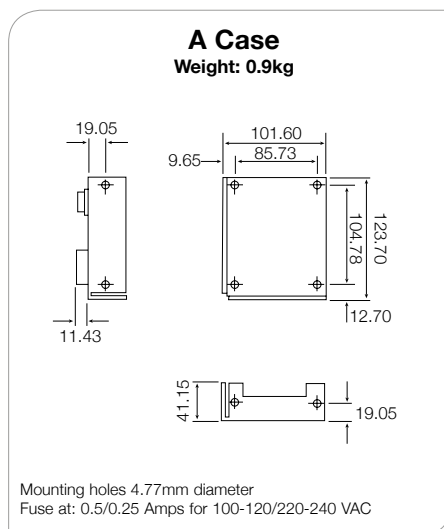
2 Low temperature operation -40°C to +50°C – suffix code 'LT'

3 Overvoltage Protection Modules – These optional Overvoltage Protection Modules are available for use with any power supply NOT supplied with built-in OVP. Each is adjustable from 6.4V to 34V and should be used when maximum load protection is of prime

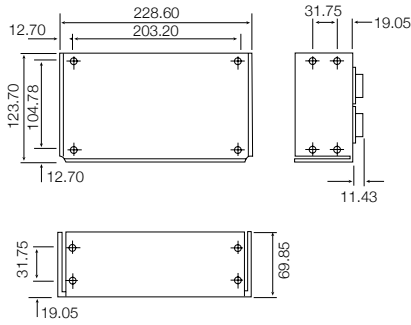
importance. Response time is 1 ms. Mounting holes are provided on the chassis for these modules, which mount within the specified outline dimensions of each power supply.

32000 SERIES - GENERAL DIMENSIONS

All dimensions are in mm

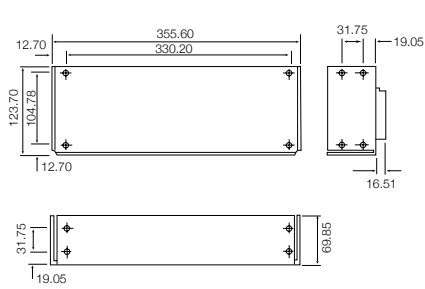


D Case Weight: 3.4kg



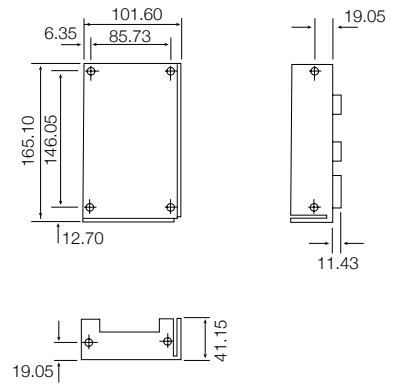
Mounting holes 4.77mm diameter
Fuse at: 2.0/1.0 Amps for 100-120/220-240 VAC

E Case Weight: 4.5kg



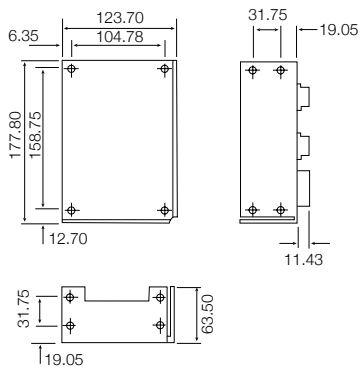
Mounting holes 4.77mm diameter
Fuse at: 3.0/1.5 Amps for 100-120/220-240 VAC

AA Case Weight: 0.9kg



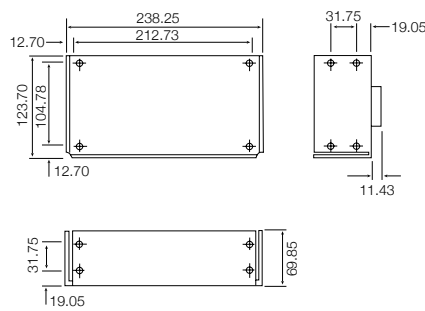
Mounting holes 4.77mm diameter
Fuse at: 0.5/0.25 Amps for 100-120/220-240 VAC

BB Case Weight: 1.8kg



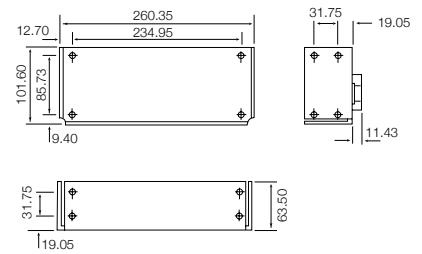
Mounting holes 4.77mm diameter
Fuse at: 2.0/1.0 Amps for 100-120/220-240 VAC

CC Case Weight: 3.2kg



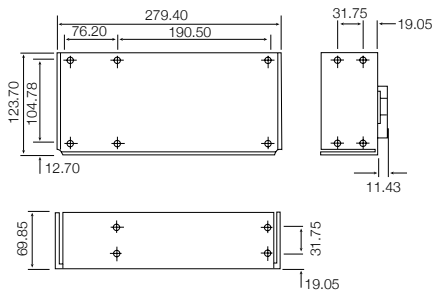
Mounting holes 4.77mm diameter
Fuse at: 2.0/1.0 Amps for 100-120/220-240 VAC

AAA Case Weight: 2.3kg



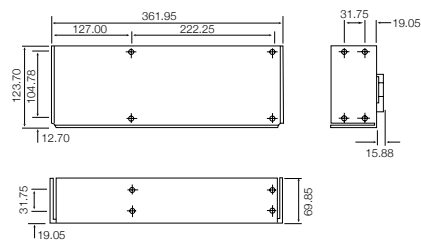
Mounting holes 4.77mm diameter
Fuse at: 1.0/0.5 Amps for 100-120/220-240 VAC

BBB Case Weight: 3.6kg



Mounting holes 4.77mm diameter
Fuse at: 2.0/1.0 Amps for 100-120/220-240 VAC

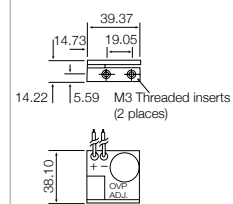
DBB Case Weight: 5.0kg



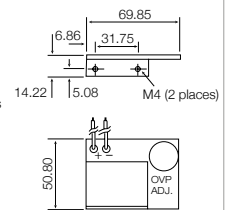
Mounting holes 4.77mm diameter
Fuse at: 3.0/1.5 Amps for 100-120/220-240 VAC

Overvoltage Protection Modules

OVP-12 32901A



OVP-24 32901B



41000 Series

DIN Rail Mounting Power Supplies for Instrumentation Applications



GENERAL SPECIFICATIONS

Input	115 V AC or 230 V AC (±10%) link selectable
DC Output	See model chart
Ripple & Noise	less than 5 mV rms.
Output Voltage Tolerance	±0.5% max.
Load Regulation	±0.2% for 50% load change
Line Regulation	±0.05% for 10% line change
Isolation: Input to output	3750 V AC min.
Temperature Rating	Standard Range: 0°C to +50°C full-rated, derated linearly to 40% at 70°C
Environmental Rating	IP20
Case Size	(l x w x h) 119.2 x 45 x 73.2 mm.
Case Material	Polycarbonate (self extinguishing to UL 94V-0)
Weight	0.37 kg 41245: 0.53 kg

Model	Output Voltage Volts	Output Current mA
41052	5	200
41055	5	500
41121	12	100
41122	12	200
41124	12	400
41151	15	100
41153	15	300
41241	24	100
41242	24	200
41245	24	500

The 41000 Series range of power supplies are designed for quick and trouble-free installation onto 35mm profile DIN rails. With outputs ranging from 5V to 24V and maximum current capabilities from 100mA to 500mA, these units are ideal for most instrumentation and control systems.

Every model in the range is provided with output current foldback limiting and is fully short-circuit protected. Great attention has been taken to usability and safety. The double insulated housing protects users without the need for earthing. A green “supply on” LED is provided to clearly indicate the presence of power, and link selection allows the use of 110 or 230V supplies without derating.

42000B Series

DIN Rail Mounting Linear Power Supplies



GENERAL SPECIFICATIONS

Input	115/230 V AC 50/60 Hz
DC Output	See model chart
Ripple & Noise	5 mV PK-PK max.
Output Voltage Tolerance	±0.5% max.
Load Regulation	±0.05% for 50% load change
Line Regulation	±0.05% for 10% line change
Isolation: Input to output	3750 V AC min.
Temperature Rating	Standard Range: 0°C to +40°C full-rated, derated linearly to 40% at 70°C
Case Size	(l x w x h) 162 x 105 x 98 mm
Case Material	Steel housing with aluminium base
Weight	2.49 kg

Model	Output Voltage Volts	Output Current Amps
42024B/3	24	3
42024B	24	4

The 42000 Series DIN rail mounting power supplies are supplied ready for connection. The unit has only to be snapped on to the 35mm profile rail (DIN 46277-3) and connected to the clearly marked terminal screws. A status LED indicates power is on.

For increased power two or more units may be connected in parallel. The output of these units is fully protected against short circuits and overload

52000 Series

Chassis Mounting AC/DC Single/Dual Output Linear Power Supplies



GENERAL SPECIFICATIONS

AC Input	216 to 264 V AC, 47 to 60 Hz
Temperature Rating	0 to +50°C (fixed-voltage units) -25 to +50°C (adjustable-voltage units)
Overall Dimensions	(l x w x h) 160 x 100 x 57 mm

SINGLE FIXED OUTPUT REGULATED MODELS

Model *	Output Voltage Volts	Output Current Amps	Line Regulation mV	Load Regulation mV	Output Ripple mV
52012	12	1.0	120	120	30
52024	24	0.5	500	500	30
52048	48	0.25	500	500	30

SINGLE ADJUSTABLE OUTPUT REGULATED MODELS

Model *	Output Voltage Volts	Output Current Amps	Line Regulation mV	Load Regulation mV	Output Ripple mV
52008A	4 to 12	1.0	120	30	6
52015A	10 to 20	0.5	20	30	10
52024A	18 to 30	0.25	25	30	15

DUAL ADJUSTABLE OUTPUT REGULATED MODEL

Model *	Output Voltage Volts	Output Current Amps	Line Regulation mV	Load Regulation mV	Output Ripple mV
52212A	± 10 to 15	0.5	10	20	5

* For RoHS compliant version, add suffix 'R' to model number

These high quality linear regulated power supplies provide outstanding value and are designed for ease of application and long trouble free life.

Different models are available with fixed or adjustable outputs. There is also a model with adjustable dual outputs.

The 52000 Series uses rugged screw terminal blocks for input and output connections. Those models with adjustable outputs can be set via an easily accessible potentiometer.

The metal case used on all models provides screening, and threaded inserts allow these supplies to be mounted on the insulated base or on the side.

Adjustable output models are short circuit protected. Fixed voltage models can have their outputs short circuited for a maximum of three minutes.

Emissivity

What it is and why it matters

What is emissivity?

All surfaces emit infrared radiation. The amount of energy they emit depends on their temperature and emissivity.

To accurately measure the temperature of a surface, the infrared sensor needs to know how much of the energy it is “seeing” has been emitted from the surface as a result of the object’s temperature, and not reflected from the surface, or transmitted through it.

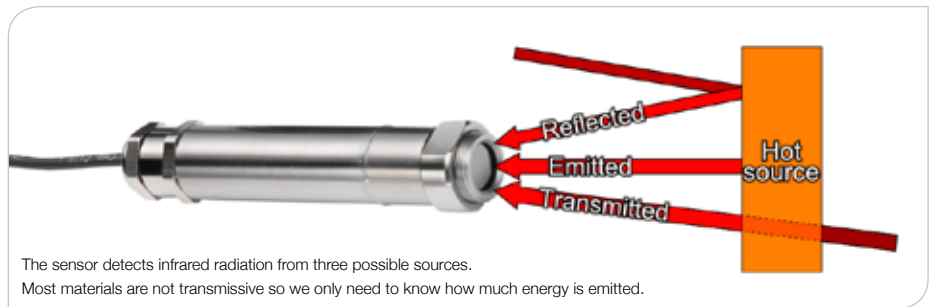
The emissivity of a surface is a measure of how effectively a surface emits infrared radiation.

The sensor’s emissivity setting should be set to match the emissivity of the target surface for maximum accuracy.

Transmissive materials

Most materials do not transmit any infrared radiation, so we can assume all the energy the sensor detects has been either emitted or reflected.

Transmissive materials are a special case. See below for more information.



How to adjust the emissivity setting

The emissivity setting can be adjusted in a different way for each type of sensor:

PyroMini and FibreMini

Via the touch screen, Modbus, or two rotary switches in the electronics module, depending on the model.

PyroEpsilon

Via the 4-20 mA input.

PyroUSB and PyroMiniUSB

Via USB using the included cable and software.

PyroBus and PyroMiniBus

Via the Modbus Master.

ExTemp

Via the optional USB adapter and software.

PyroPen L & U

Via push-buttons on the unit.

PyroCouple

The emissivity setting is fixed at 0.95 and cannot be adjusted.

PyroNFC

Via NFC using the smartphone app

High emissivity materials

e.g. painted or very dirty surfaces, food, rubber, thick plastics, paper, glue, asphalt

A surface with a high emissivity is easy to measure with a low-cost, general-purpose sensor. In this case, reflections are minimal.

Note: The colour of a surface does not usually affect the emissivity much.



Up to 1000°C: Low-cost 8 to 14 μm sensors such as the PyroCouple and PyroMini give good results.

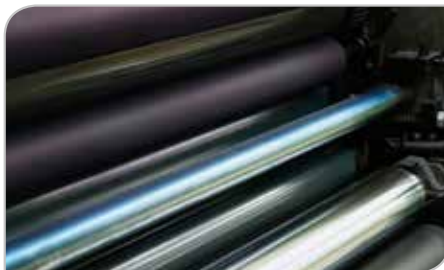
It is also possible to use a 2.2 μm sensor such as the PyroUSB 2.2 above 45°C.

Low emissivity materials

e.g. clean, bare, reflective metal surfaces including iron and steel

Reflective surfaces have a low emissivity and are more difficult to measure accurately.

If the emissivity is known, it is possible to achieve a good reading from a bare metal surface using a short-wavelength sensor.



If it is possible to paint the surface, you can use a low-cost 8 to 14 μm sensor such as the PyroCouple, PyroNFC or PyroMini.

Otherwise, try a short-wavelength sensor such as the PyroUSB 2.2 or PyroMini 2.2.

Some metals, most commonly aluminium and copper, are very difficult to measure. Contact Calex for advice.

Transmissive materials

e.g. thin film plastics, silicon

A small number of materials, such as thin film plastics and silicon, transmit most wavelengths of infrared energy. If the plastic film is thinner than about 1-2 mm, general-purpose IR sensors could “see” through it.



Transmissive materials are difficult to measure. A specialised sensor may be required to achieve a good reading.

Contact Calex for advice.

For more advice on emissivity, including how to measure the emissivity of a surface, see the Guide to Infrared Thermometry on our website, or contact us for help and guidance about a specific application.

Emissivity Table

To ensure an accurate temperature measurement, the emissivity setting of the sensor must match the emissivity of the target surface. Emissivity can depend on temperature, material and surface finish. The values in this emissivity table should be used as a guide and a starting point only, and you may find that further emissivity adjustment is required. If accuracy is critical, we recommend reading the guide “Understanding and Using the Infrared Thermometer”. Contact us to obtain a copy.

FERROUS AND NON FERROUS METALS

Material	Temp (°C)	Temp (°F)	ε-Emissivity
Alloys			
20-Ni, 24-CR, 55-FE, Oxidized	200	392	0.90
20-Ni, 24-CR, 55-FE, Oxidized	500	932	0.97
60-Ni, 12-CR, 28-FE, Oxidized	270	518	0.89
60-Ni, 12-CR, 28-FE, Oxidized	560	1040	0.82
80-Ni, 20-CR, Oxidized	100	212	0.87
80-Ni, 20-CR, Oxidized	600	1112	0.87
80-Ni, 20-CR, Oxidized	1300	2372	0.89
Haynes Alloy C, Oxidized	316-1093	600-2000	.90-.96
Haynes Alloy 25, Oxidized	316-1093	600-2000	.86-.89
Haynes Alloy X, Oxidized	316-1093	600-2000	.85-.88
Inconel Sheet	538	1000	0.28
Inconel Sheet	649	1200	0.42
Inconel Sheet	760	1400	0.58
Inconel X, Polished	24	75	0.19
Inconel B, Polished	24	75	0.21
Iron			
Oxidized	100	212	0.74
Oxidized	499	930	0.84
Oxidized	1199	2190	0.89
Unoxidized	100	212	0.05
Red Rust	25	77	0.70
Rusted	25	77	0.65
Liquid	1516-1771	2760-3220	.42-.45
Cast Iron			
Oxidized	199	390	0.64
Oxidized	599	1110	0.78
Unoxidized	100	212	0.21
Strong Oxidation	40	104	0.95
Strong Oxidation	250	482	0.95
Liquid	1535	2795	0.29
Wrought Iron			
Dull	25	77	0.94
Dull	349	660	0.94
Smooth	38	100	0.35
Polished	38	100	0.28
Lead			
Polished	38-260	100-500	.06-.08
Rough	38	100	0.43
Oxidized	38	100	0.43
Oxidized at 593°C	38	100	0.63
Gray Oxidized	38	100	0.28

Material	Temp (°C)	Temp (°F)	ε-Emissivity
Steel			
Cold Rolled	93	200	.75-.85
Ground Sheet	938-1099	1720-2010	.55-.61
Polished Sheet	38	100	0.07
Polished Sheet	260	500	0.10
Polished Sheet	538	1000	0.14
Mild Steel, Polished	24	75	0.10
Mild Steel, Polished Smooth	24	75	0.12
Mild Steel, Liquid	1599-1799	2910-3270	0.28
Steel, Unoxidized	100	212	0.08
Steel Oxidized	25	77	0.80
Steel Alloys			
Type 301, Polished	24	75	0.27
Type 301, Polished	232	450	0.57
Type 301, Polished	949	1740	0.55
Type 303, Oxidized	316-1093	600-2000	.74-.87
Type 310, Rolled	816-1149	1500-2100	.56-.81
Type 316, Polished	24	75	0.28
Type 316, Polished	232	450	0.57
Type 316, Polished	949	1740	0.66
Type 321	93-427	200-800	.27-.32
Type 321 Polished	149-816	300-1500	.18-.49
Type 321 w/BK Oxide	93-427	200-800	.66-.76
Type 347, Oxidized	316-1093	600-2000	.87-.91
Type 350	93-427	200-800	.18-.27
Type 446, Polished	149-816	300-1500	.15-.37
Type 17-7PH	93-316	200-600	.44-.51
Type 17-7PH Polished	149-816	300-1500	.09-.16
Type C1020, Oxidised	316-1093	600-2000	.87-.91
Type PH-15-7 MO	149-649	300-1200	.07-.19
Titanium			
Alloy C110M, Polished	149-649	300-1200	.08-.19
Alloy C110M, Oxidised at 538°	93-427	200-800	.51-.61
Alloy T1-95A Oxidised at 538°	93-427	200-800	.35-.48
Anodized onto SS	93-316	200-600	.96-.82

OTHER MATERIALS

Adobe	20	68	0.90
Asphalt, pavement	38	100	0.93
Asphalt, tar paper	20	68	0.93
Basalt	20	68	0.72

Material	Temp (°C)	Temp (°F)	ε-Emissivity
Brick			
Red, rough	21	70	0.93
Gault Cream	1371-2760	2500-5000	.26-.30
Fire Clay	1371	2500	0.75
Light Buff	538	1000	0.80
Lime Clay	1371	2500	0.43
Fire Brick	1000	1832	.75-.80
Magnesite, Refractory	1000	1832	0.38
Gray Brick	1100	2012	0.75
Silica, Glazed	1093	2000	0.88
Silica, Unglazed	1093	2000	0.80
Sandlime	1371-2760	2500-5000	.59-.63
Carbon			
Lampblack	25	77	0.95
Unoxidized	25	77	0.81
Unoxidized	100	212	0.81
Unoxidized	500	932	0.79
Candle Soot	121	250	0.95
Filament	260	500	0.95
Graphitized	100	212	0.76
Graphitized	300	572	0.75
Graphitized	500	932	0.71
Carborundum	1010	1850	0.92
Ceramic			
Alumina on Inconel	427-1093	800-2000	.69-.45
Earthenware, Glazed	21	70	0.90
Earthenware, Matte	21	70	0.93
Greens No. 5210-2C	93-399	200-750	.89-.82
Coating No. C20A	93-399	200-750	.73-.87
Porcelain	22	72	0.92
White Aluminium Oxide	93	200	0.90
Zirconia on Inconel	427-1093	800-2000	.62-.45
Clay			
Clay Fired	70	158	0.91
Clay Tiles, Red	1371-2760	2500-5000	.40-.51
Concrete			
Rough	0-1093	32-2000	0.94
Tiles, Brown	1371-2760	2500-5000	.87-.83
Tiles Black	1371-2760	2500-5000	.94-.91
Cotton Cloth	20	68	0.77
Glass			
Convex D	100	212	0.80
Convex D	316	600	0.80
Convex D	500	932	0.76
Nonex	100	212	0.82
Nonex	316	600	0.82
Nonex	500	932	0.78
Smooth	0-93	32-200	.92-.94
Gypsum	20	68	.80-.90
Ice, Smooth			
Ice Smooth	0	32	0.97
Ice Rough	0	32	0.96
Lacquer			
Black	93	200	0.96
White	93	200	0.95

Material	Temp (°C)	Temp (°F)	ε-Emissivity
Lime Mortar	38-260	100-500	.90-.92
Limestone	38	100	0.95
Marble, White			
Marble, Smooth, White	38	100	0.56
Marble, Polished Gray	38	100	0.75
Paints			
Blue, Cu ₂ O ₃	24	75	0.94
Black, CuO	24	75	0.96
Green, Cu ₂ O ₃	24	75	0.92
Red, Fe ₂ O ₃	24	75	0.91
White Al ₂ O ₃	24	75	0.94
White Y ₂ O ₃	24	75	0.90
White ZnO	24	75	0.95
White MgCO ₃	24	75	0.91
White, ZrO ₂	24	75	0.95
White ThO ₂	24	75	0.90
White MgO ₂	4	75	0.91
White PbCO ₃	24	75	0.93
Yellow, PbO	24	75	0.90
Yellow PbCrO ₄	24	75	0.93
Paints, Oil			
All colours	93	200	.92-.96
Quartz, Rough, Fused			
Glass, 1.96 mm	282	540	0.90
Glass, 1.96 mm	838	1540	0.41
Glass, 6.88 mm	282	540	0.93
Glass, 6.88 mm	838	1540	0.47
Opaque	299	570	0.92
Opaque	838	1540	0.68
Red Lead	100	212	0.93
Rubber, Hard	23	74	0.94
Sand			
Sandstone	38	100	0.67
Sandstone Red	38	100	.60-.83
Sawdust	20	68	0.95
Silicon Carbide	149-649	300-1200	.83-.96
Silk Cloth	20	68	0.78
Soil			
Surface	38	100	0.95
Soot			
Acetylene	24	75	0.97
Camphor	24	75	0.94
Candle	121	250	0.95
Coal	20	68	0.95
Stonework	38	100	0.93
Water	38	100	0.97
Waterglass	20	68	0.96
Wood	Low	Low	0.95



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