INFRA-RED FLAME DETECTION

S200+ SERIES TRIPLE IR FLAME DETECTORS

USER MANUAL

S200+ USER MANUAL INDEX

SECTION A - INTRODUCTION

1. INTRODUCTION

The S200+ range of triple IR flame detectors comprises five flame detector variants. The detectors share the same flame detection circuitry, optics and main mechanical housing. Each variant is available as an Intrinsically Safe (i) or Flameproof (f) version except the S261+ which is available only in the Flameproof version. The five variants are:

VARIANT	INTRINSICALLY SAFE	FLAMEPROOF
Conventional 2-Wire Interface	S231i+	S231f+
4-20mA Current Loop Interface	S241i+	S241f+
Analogue Addressable Loop Interface	S251i+	S251f+
Relay Interface	-	S261f+
MX Digital Interface	S271i+	S271f+

The S200+ Advanced Flame Detector offers a major improvement in both flame detection capability and immunity to blackbody radiation. The S200+ is available in intrinsically safe and flameproof models except for the S261f+ which is available only as a flameproof version. In particular, the range incorporates models for conventional detection circuits (S231i+, S231f+), models for connection to 4-20 mA current loop (S241i+, S241f+), models for connection to Thorn Security Minerva analogue addressable systems (S251i+, S251f+), a flameproof model with relay outputs (S261f+) and models for connection to Minerva MX Digital systems (S271i+, S271f+). The output of the S241+ provides a truly analogue current output and the S251+ and S271+ provide an additional level of signalling to indicate a pre-alarm condition.

The detectors have been tested by LPCB to EN 54 : Part 10 and have been classified as Class 1 flame detectors on the 50m and 25m range settings and as Class 3 on the 12m range setting. For marine applications, the detectors have been tested to Lloyd's Register Test Specification Number 1 (2002). Environmental Category ENV1, 2, 3 and 5 and to DNV Certification Notes No.2.4 (April 2001).

2. FLAME DETECTION OPERATION

The S200+ detectors analyse radiant energy at three different wavelengths and as such offer the full benefits of the triple IR flame detector. The detector uses a well proven, flame detection technique. This is based on monitoring for modulated infra-red radiation in the 4.3µm waveband corresponding to CO_2 emission. It incorporates Thorn Security patented techniques for improved rejection of solar energy by using a combination of two 4.3µm filters for Gaussian noise rejection by averaging the output signal of two separate sensor elements.

Three different alarm delays of 3s, 6s and 12s are provided in all versions of the S200+.

2.1 BLACKBODY REJECTION

The S200+ implements a new concept for eliminating nuisance alarms from modulated blackbody sources. The new design incorporates a novel optical filter[(1)] which enables a single electronic infra-red sensor to measure the radiated energy present in two separate wavebands placed on either side of the flame detection waveband, at 3.8µm and 4.8µm respectively (see Fig A-1). The signal obtained from this 'guard' channel is cross-correlated with the signal from the flame detection channel to provide an accurate prediction of the non-flame energy present in the flame detection waveband. This prediction is independent of the temperature of the radiation source, allowing the S200+ to provide blackbody rejection over a wide range of source temperatures.

(1) Patented (see Section C, 8.4).

Fig. A-1 shows the amount of energy given by a 'hot' object (blackbody) as viewed in the electromagnetic spectrum. This curve has a peak which moves further to the left with higher temperature objects. The amount of energy seen between 3.8μm and 4.8μm can be approximated to a linear function. Thus, a measurement of the energy at these two wavelengths provides information to calculate with sufficient accuracy the level of blackbody radiation at the intermediate flame detection wavelength of 4.3μm. The energy due to the emission from hot carbon dioxide given by a flame is superimposed on that from any blackbody in the detector field of view without adding any significant emissions at 3.8μm or 4.8μm, thus enabling proper segregation between non-flame signals and flame signals. Because a large fire will possibly produce a large amount of black smoke which will behave like a blackbody and may weaken the carbon dioxide peak, signals greater than a pre-determined upper limit will be classed as a fire.

The use of an optical processing technique, as opposed to the use of two separate electronic sensors for the guard channel, improves the overall reliability of the detector by reducing the number of components and eliminating the need for complex calibration procedures during manufacture.

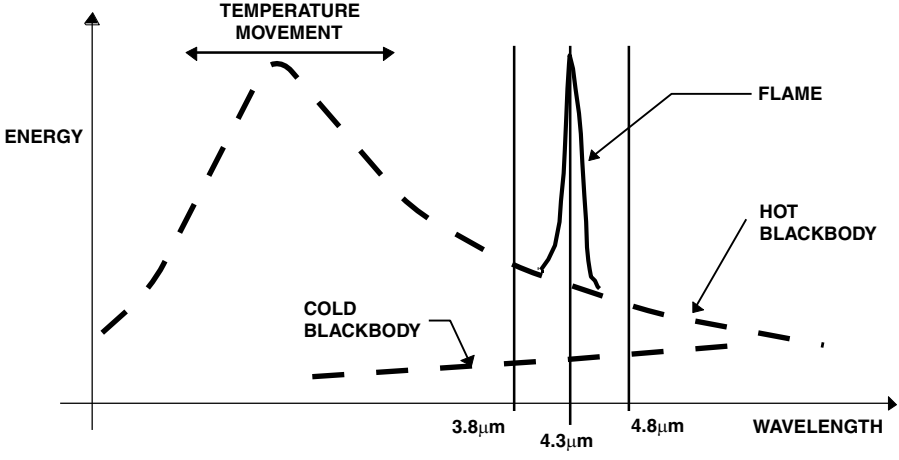


Fig. A-1 Radiation from Objects

2.2 DETECTION RANGE

The S200+ range can detect on axis a fully developed $0.1m^2$ n-heptane or petrol pan fire at up to 50m and the same fire up to 25m on the 25m setting. A 12m setting is also available.

2.3 DETECTION OF FLAME IN THE PRESENCE OF BLACKBODY RADIATION

The ability of the detector to determine accurately the amount of non-flame radiation received at any one time by the flame detection channel allows a variable alarm threshold to be determined (see Fig. A-2). This threshold is positioned so as to minimise the possibility of a false alarm due to the presence of modulated blackbody sources of different temperature and intensity.

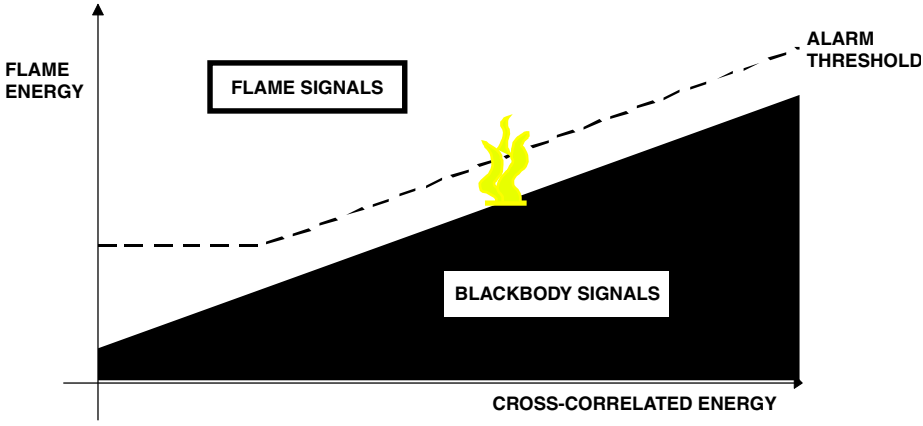


Fig. A-2 Signal Processing

2.4 DETECTOR CONDITION SIGNALLING

The S200+ incorporates two different colour light emitting diodes, red for Alarm and yellow for Fault. By using different flashing rates for the yellow (Fault) LED, separate indication of detector (electronic) fault and 'dirty' window (optical integrity monitoring) is provided. The yellow LED is not fitted to the S251+ and S271+ detectors.

The S241+ provides an analogue output current, in the range 4-20mA, proportional to the flame detection signal. The S251+ provides two pre-set current values to signal alarm and pre-alarm conditions. Pre-set currents, in the range 0-4mA, are used to separately signal detector (electronic) fault and 'dirty' window for both detector types.

The S271+ shows the same signalling conditions as the S251+ but instead of the units being in mA, they are signalled digitally using the MX protocol.

3. GENERAL CONSTRUCTION

Fig. A-3 shows a general view of a complete detector.

Fig. A-3 S200+ Detector - General View

The detector is of robust construction to allow its use in harsh environments.

The detector comprises a two-part stainless steel enclosure. The front section of the enclosure contains the encapsulated electro-optical assembly which is connected to the terminal board on the rear section by a small cableform. A sapphire window is fitted in the front of the housing. The window allows infra-red radiation to fall on the sensors, the LED alarm and fault indicators are visible through the window.

The front section of the enclosure is attached to the rear section by four captive screws. A seal provided between the front and rear sections ensures protection to IP66 and IP67.

Two 20mm cable entries are provided at the bottom. All electrical connections are made to three 4-way terminal blocks (four 4-way terminal blocks for the S261f+).

The detector may be fitted directly to a suitable surface or an optional adjustable mounting bracket may be used.

A stainless steel guard is fitted to the ‘flameproof’ versions to protect the integrity of the window (shown in Fig. A-3).

Until the end of 2004, the detectors had two cable entries at the bottom and one at the top. The detector design has been changed to remove the top cable entry due to problems with water ingress where the top cable entry has not been sealed properly during installation.

SECTION B - PRODUCT APPLICATION

1. APPLICATION

1.1 GENERAL

The detectors are intended for the protection of high-risk areas in which accidental fires are likely to result in flaming combustion with the production of carbon dioxide. Typical materials in this type of risk are:

a) Flammable liquids, including petroleum products, alcohol, and glycol etc.

b) Flammable gases including methane.

c) Paper, wood and packing materials.

d) Coal.

e) Plastics.

These substances ignite readily and burn rapidly, producing flame, often accompanied by large volumes of dark smoke.

Note: The detectors are not designed to respond to flames emanating from fuels which do not contain carbon eg, hydrogen, ammonia, metals, and should not be used for such risks without satisfactory fire testing.

The S200**+** series, by virtue of their construction and rejection of spurious radiation, are suitable for use both indoors or outdoors in a wide range of applications.

Note: The detectors must be mounted to a rigid support which will not move in windy conditions. This is to avoid false alarms due to detector movement modulating radiation from hot bodies at the edge of the field of view.
Avoid mounting detectors where they are subject to high levels of vibration.

1.2 USE IN HAZARDOUS ATMOSPHERES

The S200i+ series detectors are ATEX/IECEx certified intrinsically safe, and are classified E Ex/ Ex ia IIC T5 or T4 (-40°C ≤ Ta ≤ +80°C). In an intrinsically safe system the detectors are suitable for use in hazardous zones 0, 1 and 2 where group IIC gases and vapours are present in explosive concentrations. See Section 8.1 for full details.

The S200f+ series detectors are ATEX certified 'flameproof'. They are classified E Ex d IIC T6 or T5 (-20°C ≤ Ta ≤ +80°C) and are suitable for use in hazardous areas zones 1 and 2.

The S200f+ detectors are also IECEx certified flameproof. They are classified Ex d IIC T6 or T5 (-20ºC ≤ Ta ≤ +60ºC) and are certified for use in hazardous areas zone 1 and zone 2. See Section 8.2.

1.3 USE IN NON-HAZARDOUS AREAS

In non hazardous ares it is recommended the following detectors are fitted:

S231i+, S241i+ and S251i+ without a barrier. These detectors are electrically the same as the f+ versions. They are less expensive and have a wider field of view as they do not require the window guard.

S261f+ (has no intrinsically safe version available).

S271f+ Do not fit the S271i+ as for this detector the MX communications is optimised for use with an IS barrier. Its performance without a barrier is not characterised.

Note: The S271i+ will not communicate without the EXI800 and barrier fitted.

1.4 FEATURES

- A self-test facility is incorporated to test a number of characteristics, including the cleanliness of the window. The self-test may be initiated remotely.
- Switch selectable range settings.
- Switch selectable time to alarm settings.
- Operational range up to 50m, fuel dependent.
- Remote control of range.
- S271+ has fast detection using MX interrupt facility.
- Remote control of delay, range and remote test on S271+.
- Completely solar blind.
- Very low quiescent power consumption.
- High sensitivity to hydrocarbon fire in oily environments.
- Rugged stainless steel 316 housing and mounting bracket.
- Flexible mounting and angular adjustment.
- Ease of installation.
- Connection for remote LED.
- Selectable latching/non-latching alarm output (not S251+/S271+).
- Selectable latching/non-latching fault output (not S251+/S271+).

2. BENEFITS OF THE S200+ SERIES

Infra-red flame detectors offer certain benefits over detectors working in the visible or ultra-violet regions of the spectrum. For example they are:

- Highly sensitive to flame thus increasing probability of early detection of hydrocarbon fires.
- Not greatly affected by window contamination by dirt and oil deposits thus decreasing maintenance frequency leading to operating cost reduction.

- Able to see flames through smoke, and able to see flames through high densities of solvent vapours thus increasing the probability of early detection of hydrocarbon fires over other (ultra-violet) detectors in the same conditions.
- Several detectors on a single 2-wire conventional or analog addressable circuit.

The S200+ series have all the above benefits and additionally are:

- Completely "solar-blind" in normal conditions, thus, eliminating false alarms due to direct or indirect sunlight.
- Insensitive to electric arcs thus eliminating false alarms from welding operations.
- Insensitive to artificial light sources. See Section C (6.4) for more details on false alarm performance.
- Sealed to IP66 and IP67 (when suitable cable glands and sealant are used) ensuring long term reliability in harsh environments.

SECTION C - SYSTEM DESIGN INFORMATION

1. INTRODUCTION

The electrical, mechanical, environmental characteristics and the performance of the S200+ series flame detectors, must be taken into account when designing a system which uses these detectors. This information is given below, together with guidance on detector siting.

2. ELECTRICAL CHARACTERISTICS

2.1 S231i+/S231f+

The S231i+/231f+ detectors are two-wire devices, designed to operate on any typical conventional fire detection control equipment providing a regulated 20V dc current monitoring loop, including controllers manufactured by Thorn Security. Compatibility should be assessed using the technical data below and it is recommended that evaluation tests are carried out prior to siting and installation. The quiescent current drain is very small and the alarm condition is signalled by a large increase in current demand. Resetting is achieved by removing the supply voltage for a period greater than 0.5 seconds.

2.1.1 COMPATIBILITY WITH OTHER THORN SECURITY CONVENTIONAL DETECTORS

The connection of Thorn Security's plug-in conventional detectors, ie M300 and M600 ranges, in the same circuit as S231+ flame detectors is not generally recommended.

S231+ flame detectors may be connected in the same circuit as S131/S161 type detectors.
The number of S231+ detectors per zone should be assessed taking account of good engineering principles, controller characteristics and cable parameters. As a guide, most controllers will permit 4 S231+ units per zone. We do no recommend exceeding 6 x s231+ units per zone.

Note:

1) *S161 flame detectors may be connected in flameproof circuits and can, therefore, be connected with S231f+ flame detectors.*
2) *If detectors are mixed, then an S231+ detector must be the last detector on the zone or a fault condition on an S231+ detector will not be signalled to the controller.*

2.1.2 TECHNICAL DATA

Supply Voltage:	15V to 28V. (Voltage at the detector when not in alarm).
Quiescent Current:	350μA (typical).
Alarm Current:	33mA (typical) at 24V source, supplied via 330 ohms. 38mA (typical) with remote LED fitted. 18mA (typical) with MTL 5061 barrier fitted.
Alarm Output Mode:	See Fig. C-1. Operation must be restricted to the safe area shown by use of external resistance if necessary.
Reset Time/Voltage:	Supply must be reduced to less than 2V for greater than 0.5 seconds.

Stabilisation time after reset/ power up:	60 seconds (typical) to 90 seconds (maximum).
Equivalent Inductance:	0mH.
Equivalent Capacitance:	1.5nF.

Note:

1) *The maximum number of detectors that may be connected to a zone circuit is 6 (see 2.1.1).*
2) *The alarm currents shown above include current through a 4k7 end-of-line resistor.*
3) *In general, it is not possible to use a remote indicator on detectors which are supplied via a shunt barrier safety diode or galvanic isolator.*
4) *Where a remote LED is used, a 33 ohm resistor should be fitted in series with it to limit the current through the LED to approximately 30mA.*

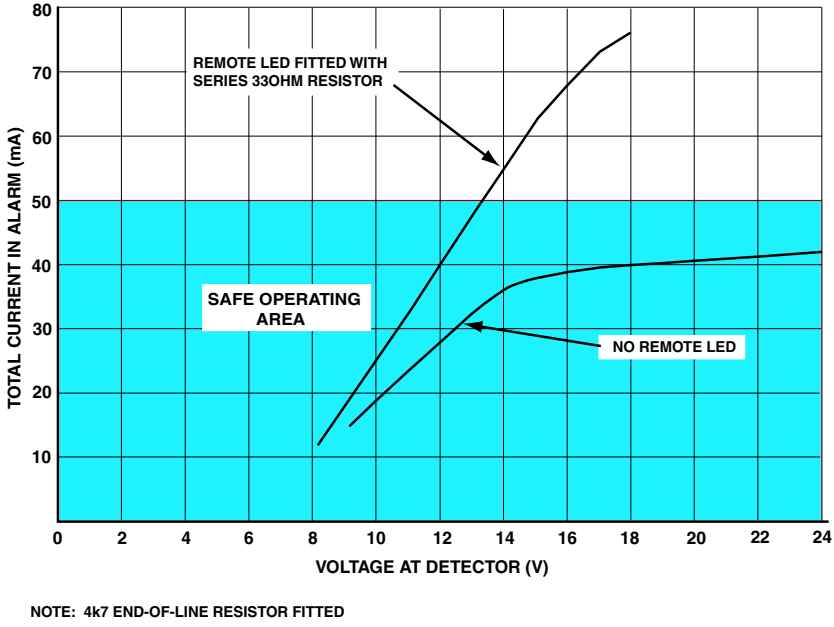


Fig. C-1 Load

2.2 S241i+/S241f+

The S241i+/S241f+ detectors provide a 4-20mA current sink output, suitable for standard programmable logic controllers.

2.2.1 TECHNICAL DATA

Supply Voltage:	15V to 28V (Voltage at the detector).
Quiescent Current:	350μA (typical), excluding signalling current.

Supply Current in Alarm:	12mA (typical), at 24V supply.
	20mA (typical), with remote LED fitted.
	10mA (typical), with 600 ohm barrier.
	12mA (typical), with 600 ohm barrier + remote LED.
Alarm Output Mode:	4-20mA CURRENT SINK. (See Appendix 1 for S241+ wired as a current source output).
Signalling Currents:	

DISCRETE SIGNALLING (OLD SYSTEM)	
CONDITION	**AFD CURRENT TYP. (mA)**
Fault	1.5
Normal	4.5
Alarm	17.0

Table 1: S241+ Discrete Signalling (Old System)

CONTINUOUSLY VARIABLE SIGNALLING (NEW SYSTEM)	
CONDITION	**AFD CURRENT TYP. (mA)**
Non Window Fault	0.0
Window Fault	2.0
Normal	4.0
Flame Sensing	5.7 to 17.0*

Table 2: S241+ Continuously Variable Signalling (New System)
*** See Para 5.5 for Sensitivity (Range) Selection**

Note: The signalling mode is selected by means of a DIL switch, see section E 2.1. In both discrete and continuously variable signalling the alarm LED will come on when a 4-20mA output exceeds 17.0mA.

Reset Time/Voltage:	Supply must be reduced to less than 2V for greater than 0.5 seconds.
Stabilisation Time after reset /power up:	60 seconds (typical) to 90 seconds (maximum).
Equivalent Inductance:	0mH.
Equivalent Capacitance:	1.5nF.

Note: An external 33 ohm resistor should be fitted in series with a remote LED.

S241+ is designed with a 4-20mA current sink output. However, it can be wired as a current source device with limitations. See Appendix 1 for details.

2.3 S251i+/S251f+

The S251i+/251f+ detectors are analogue addressable devices which are designed to operate with the Minerva range of analogue addressable fire control equipment currently manufactured by Thorn Security Limited.

2.3.1 TECHNICAL DATA

The maximum number of detectors that may be connected to a Minerva system loop is 50.

The maximum number of detectors that may be connected to each barrier in a Hazardous Area circuit is 10.

Average current consumption: 350μA

Stabilisation Time after reset /power up: 60 seconds (typical) to 90 seconds (maximum).

S251+ analogue addressable signalling currents:

DISCRETE SIGNALLING (OLD SYSTEM)			
CONDITION	**AFD CURRENT TYP. (mA)**	**MINERVA MEASUREMENT (mA)**	**MINERVA LIMITS (mA)**
Fault	0.75	1.5	0 to 3.0
Normal	2.25	4.5	3.0 to 10.4
Alarm	9.0	18.0	16.2 minimum

Table 3: S251+ Discrete Signalling (Old System)

ENHANCED SIGNALLING MODE			
CONDITION	**AFD CURRENT TYP. (mA)**	**MINERVA MEASUREMENT (mA)**	**MINERVA LIMITS (mA)**
Non Window Fault	0	0	0 to 2.0
Window Fault	1.5	3.0	2.0 to 4.0
Normal	3.0	6.0	4.0 to 12.0
Pre-Alarm	7.0	14.0	12.0 to 16.0
Alarm	9.0	18.0	16.0 minimum

Table 4: S251+ Enhanced Signalling (New System)

Note:

1) *The signalling mode is selected by means of a DIL switch, see Section E 2.1, Table 3.*
2) *'Remote Range' and 'Self Test' selection is not available for the S251i+ when used with a shunt diode safety barrier.*

CAUTION:
IF USING AN S251+ WORKING IN THE ENHANCED SIGNALLING MODE TO REPLACE AN S251, THE S251+ MUST BE CONFIGURED IN 'CONSYS' VERSION 12.0 OR LATER.

2.4 S261f+

The S261+ is only provided in a 'flameproof' version. The S261f+ provides a relay interface for alarm and fault conditions.

2.4.1 TECHNICAL DATA

Supply Voltage:	15V to 28V. (Voltage at the detector).
Fault relay:	Normally closed, opens under fault conditions.
Alarm relay:	Normally open, closes under alarm conditions.
Quiescent Current:	11mA. (typical) at 28V supply.
Alarm Current:	30mA. (typical) at 28V supply.
	37mA. (typical) at 28V supply with remote LED fitted.
Fault Current:	350μA. (typical).
Reset Time/Voltage:	Supply must be reduced to less than 2V for greater than 0.5 seconds.
Stabilisation Time after reset /power up:	60 seconds (typical) to 90 seconds (maximum).

Note:

1) *The relay contacts are rated 2A at 28V dc.*
2) *An external 33 ohm resistor should be fitted in series with the remote LED.*

2.5 S271i+/S271f+

The S271+ is designed to operate with the Minerva MX range of digital addressable fire control equipment currently manufactured by Thorn Security Limited.

2.5.1 TECHNICAL DATA

For the Maximum number of S271i+ detectors and maximum cable length connected to the MX Intrinsically Safe loop, refer to document 17A-02-ISLOOP MX Intrinsically Safe System - Loop Loading Calculation.

Stabilisation Time after reset /power up:	60 seconds (typical) to 90 seconds (maximum).

The average current consumption is 500μA.

The S271+ digital signalling:

CONDITION	DELTA OUTPUT (Bits)
Non-Window Fault	≤10
Window Fault	≤51 and ≥11
Pre-Alarm	≥153
Alarm	≥190
Normal	≅68

Table 5:

3. MECHANICAL CHARACTERISTICS

3.1 TECHNICAL DATA

Dimensions (see Fig. C-2)

Height:	167mm
Width:	167mm
Depth:	89.5mm max (maximum depth with flameproof guard fitted 94mm)
Weight:	3.8kg
Mounting Bracket Weight:	1.1kg

Materials

Enclosure:	Stainless steel 316L, ANC4BFCLC to BS3146 Part 2
Window:	Sapphire
Mounting Bracket:	Stainless steel to BS1449 Part 2 316 S16
Screws etc. exposed to the elements:	Bright stainless steel 316

Electronic Module: Encapsulated.

Electrical Access: Standard M20 gland holes (two)

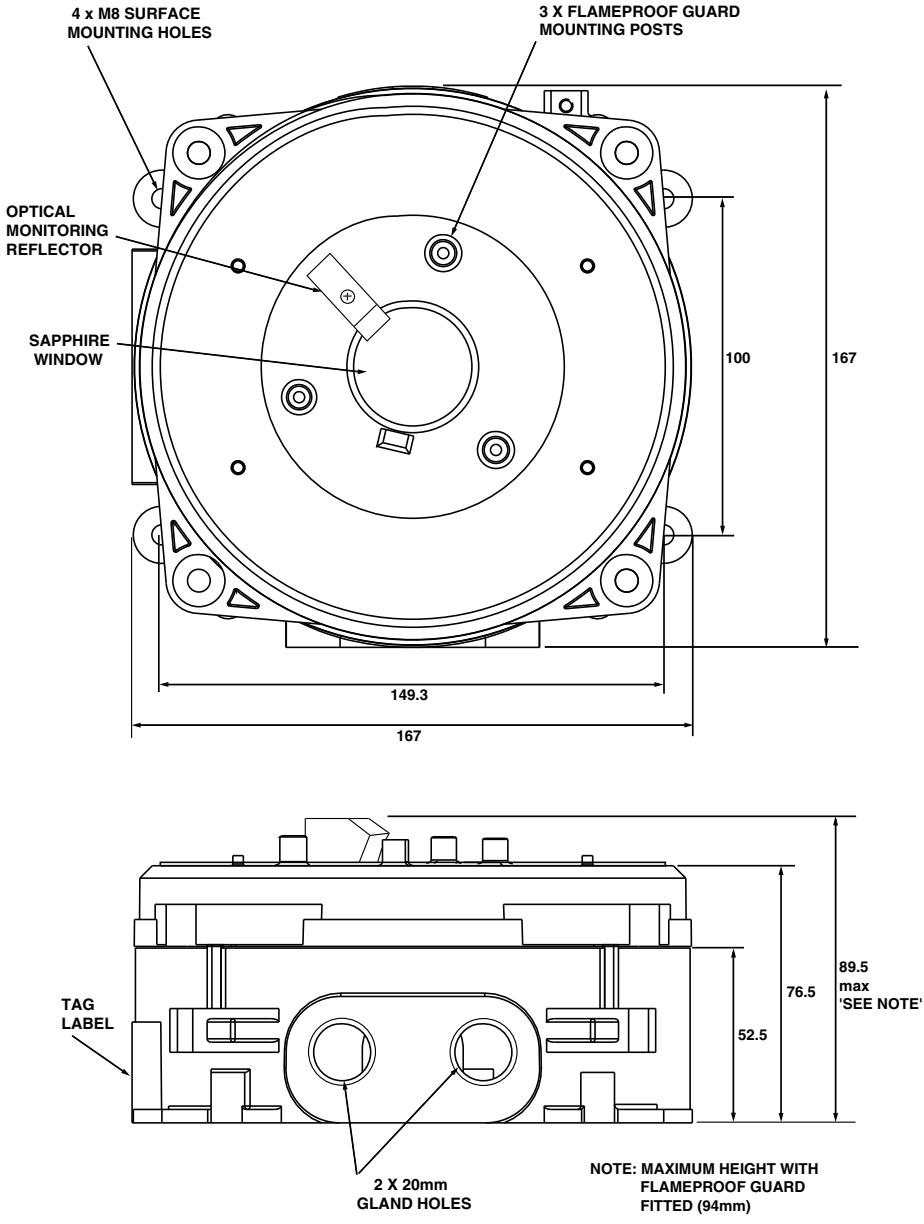


Fig. C-2 S200+ Series - Overall Dimensions

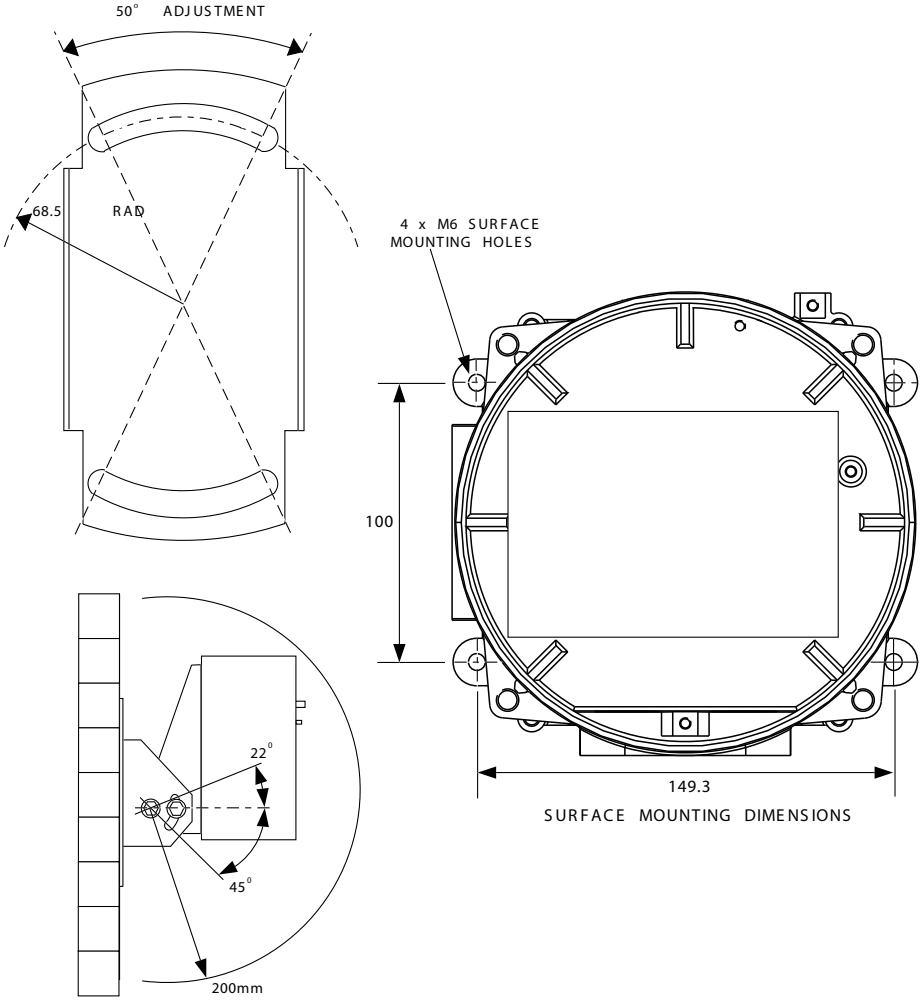


Fig. C-3 Adjustable Mounting Bracket and Surface Mounting Dimensions

4. ENVIRONMENTAL
4.1 GENERAL

The design and construction of the S200+ series detectors are such that they may be used over a wide range of environmental conditions. Relevant limits are given in Para 4.2.

4.2 TECHNICAL DATA

4.2.1 TEMPERATURE, HUMIDITY, PROTECTION AND PRESSURE

Operating temperature range	
For non hazardous installations:	-40°C to +80°C (110°C for short durations)
For hazardous installations using flameproof S200f+ detectors in ATEX certified applications:	-20°C to 80°C
For hazardous installations using flameproof S200f+ detectors in IECEx applications:	-20°C to 60°C
For hazardous installations using intrinsically safe S200i+ detectors in ATEX or IECEx applications:	-40°C to 80°C
Storage temperature range:	-40°C to +80°C
Relative humidity:	Up to 95% RH (non-condensing)
Enclosure protection:	Tested to IP66 and IP67*
Normal operating atmospheric pressure:	910mbar to 1055mbar
Heat radiation from sun:	0 to 1000Wm^2 typical

* Cable gland entries must be suitably sealed to achieve the required IP rating (see 3.4 Section D).

4.2.2 VIBRATION AND SHOCK

The S200+ series detectors are designed and tested for vibration and shock to EN54-10 (the Standard for flame detection components of automatic fire detection systems). For marine applications, the detectors have been tested to Lloyd's Register Test Specification Number 1 (1996) Vibration Test 1 and to DNV Certification Notes No2.4 (May 1995) Class A.

4.2.3 ELECTROMAGNETIC INTERFERENCE

The detector is insensitive to radio frequency interference. It has been designed and tested to the requirements of EN54-10 (the Standard for flame detection components of automatic fire detection systems) and BS EN 61000-6-3 Generic Emissions Residential Commercial and Light Industry and EN 50130-4, the generic standard for electromagnetic immunity within the European Union. The detectors have been tested to the product family standard for fire alarm systems, EN50130-4. Tests have proved the operation in field strengths of 10V/m at frequencies from 150kHz to 2000MHz with amplitude and pulse modulation, when installed in accordance with this manual. For Marine applications the detectors, have been tested to Lloyd's Register Test Specification Number 1 (1996) E.M.I. Immunity for Electronic products and to DNV Certification Notes No.2.4 (May 1995) Electromagnetic Compatibility Tests. To comply with the above standards, ferrite tubes must be fitted to the detector base as shown in Fig. D3, Page 40.

4.2.4 IONISING RADIATION

The S200+ series, like other infra-red detectors, is insensitive to X-rays and gamma radiation as used in non-destructive testing.

The detector will operate normally and will not false alarm when exposed to this type of radiation although long term exposure to high radiation levels may lead to permanent damage.

4.2.5 CORROSION

The detector is able to withstand the effects of corrosion conditioning with sulphur dioxide (SO2) concentration as specified in EN54-10. For Marine applications the detectors have been tested to Lloyd's Register Test Specification Number 1 (1996) Salt Mist test and to DNV Certification Notes No.2.4 (May 1995) Salt Mist Test.

5. OPERATION

5.1 ALARM INDICATION

A red LED is visible through the front window which gives the same indication for the S231+, S241+ and S261+ variants. Illumination indicates an alarm.

The S251+ (analogue addressable variant) and the S271+ (digital addressable variant) indicate in the same manner as the other variants, but the LED is driven by the controller. In normal conditions the LED is pulsed at two second intervals for the S251+ and 5 seconds for the S271+. Continuous illumination indicates an alarm under control of the Minerva controller.

5.2 ALARM SIGNALLING

The detectors signal an alarm condition as follows:

- S231+ - Increase in current drawn from supply, see Fig.C-1.
- S241+ - Current drawn on the loop will be between 5.7-17.0mA.
  (A single value between 16.0-19.0mA is drawn for the S241 compatible mode).
- S251+ - Returned current will be between 8.3 and 9.7mA. A pre-alarm function is also available which returns a current value between 6.5 and 7.5mA. The latter is not available for the S251 compatible mode.
- S261+ - Alarm relay will close.
- S271+ - Returned values will be ≥190 bits. A Pre-alarm function is also available which returns values of ≥153 bits.

The S231+, S241+ and S261+ may be set as alarm latching or non-latching. When the S241+ is operated in the Continuously Variable Signalling mode, the alarm latching function is inoperative. The S251+/S271+ have only the non-latching mode. In the non-latching mode, if the alarm source is removed for greater than 5 seconds, then the detector will stop indicating an alarm. In the latching mode the controller must be reset to remove the alarm condition.

Note: The use of an S231i+ in a non-latching mode is generally possible when the detector is connected after a shunt diode safety barrier but evaluation tests are recommended.

5.3 FAULT INDICATION

For the S231+, S241+ and S261+ variants the yellow LED will flash indicating a fault. Different flashing rates are used to indicate different faults, as follows:

- Window obscuration: 0.5Hz
- Detector fault: 2.0Hz

The S251+/S271+ will not provide a local indication for a fault, instead the fault indication will be displayed on the controller.

5.4 FAULT SIGNALLING

The detectors signal a fault condition as follows:

S231+ - Open circuit fault band ie, the EOL resistor is made open circuit. The faulty detector puts 4 pulses of total width 45ms and level 55mA on the line which is detected by the S231+ connected at the end of the zone. This detector open circuits the EOL resistor.

Note: The end detector in the zone must be an S231+ with the EOL fitted as it is this device which will signal a fault, the faulty detector will indicate with a flashing yellow LED.

- S241+ - Current drawn on the loop will be as follows:
  - 0.0 to 0.5mA for a detector fault
  - 1.8 to 2.2mA for a window fault
  - 1.3 to 1.7mA for any fault in the S241 compatible mode

- S251+ - Analogue returned current will be as follows:
  - 0.0 to 0.5mA for a detector fault
  - 1.3 to 1.7mA for a window fault
  - 0.65 to 0.85mA for any fault in the S251 compatible mode

- S261+ - Fault relay will open

- S271+ - Digital returned values will be as follows:
  - between ≤51 and ≥11 bits for a window fault
  - ≤10 for a non-window fault

The S231+/S241+/S261+ detectors may be selected as fault latching or non-latching. In the non-latching mode, the fault condition will be cancelled up to 80 seconds after the fault has been removed. The S251+/S271+ have only the non-latching mode.

5.5 SENSITIVITY (RANGE) SELECTION

The range is switch selectable on a 6-way DIL (4-way S271+) switch (S1, Fig. C-4) on the backbox terminal PCB. The following nominal ranges are available:

- Extended range. (50 metres)
- Normal range. (25 metres)
- Reduced range (12.5 metres)
- 6m (S251f+ and S271f+ only)

These ranges are for an n-heptane fire in a $0.1m^2$ pan located on the main axis of the detector field of view.

With the S241+ set to Continuously Variable Signalling mode (see Section E 2.1), the nominal ranges above correspond to an alarm threshold set to 17mA. Laboratory tests indicate that setting the alarm thresholds at 9 and 15mA (as opposed to 17mA) will increase the range a fire is detected at by approximately 20 and 10% respectively.

For the S251+/S271+, the detection distance for the PRE-ALARM function is approximately 18% higher than the ALARM distance.

Range can also be selected in MX CONSYS and will take effect if all switches are in the OFF position from the controller for the S271+.

There is provision for halving the range value selected by the switches. If the terminal connector 'Range' is connected to 0V then the detection range is reduced to half that of the switch setting. This may be done by taking cables to a remote contact the other side of which is connected to the same 0V as the reference for 'Line In' supply.

5.6 DELAY TO ALARM

The minimum delay to alarm is 3 seconds from a fire being present in the field of view that is large enough to be detected. This delay is also switch selectable using 6-way (4-way S271+) DIL switch (S1, Fig. C-4), the following additional values are available:

- 6 seconds.
- 12 seconds.

Note: The minimum delay to alarm is 3 seconds. However, with this setting, the detector requires that the alarm threshold level has been exceeded throughout for a minimum of 3 seconds in any given 5 second window. Therefore, for fires where the intensity varies, the time to alarm may be longer.
Similarly, for the 6 second setting, the alarm threshold level must be maintained for a minimum of 6 seconds in any 8 second window and for the 12 second setting, the alarm threshold level must be maintained for a minimum of 12 seconds in any 14 second window.

When the S241+ is operated in Continuously Variable Signalling mode, the delay to alarm switches on S1 are inoperative. This means that in windy conditions where the fire signal varies over time, the detection range will be reduced on the longer time to alarm settings. The signal is smoothed to reduce jitter and this results in a settling time of between 3s and 5s. Further delay could be added by the controller if required.

In the case of the S251+, there is additional delay to alarm introduced by the confirmation procedure of the Minerva control panel. This extra delay is between 4 and 6 seconds. For the S251+/S271f+ PRE-ALARM function, the delay to alarm settings on switch S1 are inoperative, the only delay is that introduced by the Minerva/MX panel.

For the S271+, the delay may be set from MX CONSYS via the controller if all the switches are in the OFF position.

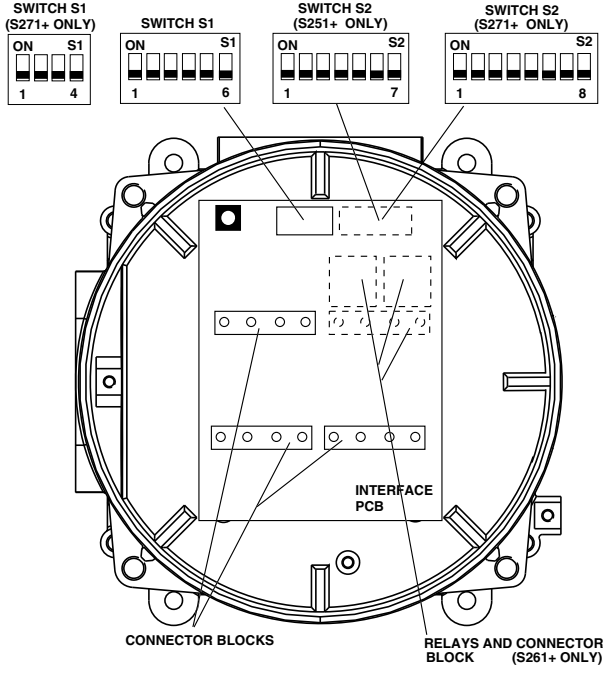


Fig. C-4 Switch Location

5.7 SELF-TEST

The detector normally carries out a complete self-test every 20 minutes. The self-test exercises the pyro-electric sensors, electronics and monitors the window for cleanliness. If the window cleanliness test fails on 20 successive occasions (6 hours 40 minutes), a fault condition is generated and the fault LED, where fitted, flashes at the rate of 0.5Hz. In this condition, the window self-test only is automatically repeated every minute until the window clears and window self-test passes. If the window test continuously fails then the complete self-test will still be repeated every 20 minutes. Other self-test failures will be indicated on the first test after they have occurred.

For the complete 'self-tests' to be run automatically, the 'self-test' connection on the terminal board must be left open circuit when the unit is powered up. In this mode, additional self-tests may be initiated remotely by connecting 0V to the 'self-test' terminal, refer to the wiring diagrams in Section D.

The detector may be powered up in such a condition that the window 'self-test' can only be initiated remotely on demand (the automatic window 'self-test' is disabled). In order for this to be achieved the detector must be powered up with the 'self-test' terminal connected to 0V (terminals 3 or 5). To initiate the test for the first time after power up, the connection to the 'self-test' terminal must be opened for at least 5 seconds and then closed again. This 'self-test' function (which takes 10 seconds) will commence within 2 seconds of the closing and the result of the test indicated for as long as the connection remains closed.

If the test passes, an alarm condition will be indicated and if it fails a fault condition will be indicated. To remove the test indication, the connection to the 'self-test' terminal must be opened. A self-test fail indication due to a window fault will remain until a window 'self-test' is successful and will then unlatch after a 1 minute delay. The 'self-test' should not be repeated more frequently than every 20 seconds (to allow the 'self-test' circuitry to recharge) as erroneous results may occur.

Note: that if a unit is poorly sited such that sunlight can reach the window test detector element, the receive amplifier may saturate. In this event, that particular test is aborted and if this situation persists for 6 hours 40 minutes, the unit will register a fault condition.

CAUTION:

A REMOTELY INITIATED TEST WILL PRODUCE AN ALARM SIGNAL FROM THE DETECTOR IF THE TEST SHOWS THAT THE WINDOW IS CLEAN.

TAKE THE NECESSARY STEPS TO INHIBIT A FULL ALARM CONDITION AT THE CONTROL PANEL BEFORE PROCEEDING.

IF THE SELF-TEST CONNECTION IS NOT OPENED AFTER A SELF-TEST THE DETECTOR WILL REMAIN DISABLED.

The window 'self-test' may be disabled by permanently connecting the 'self-test' terminal to 0V (pins 3 or 5) before power up. This may be desirable in those conditions in which contaminants may make the window appear dirty but which may not affect the ability of the detector to otherwise function normally.

The detector may be reset by reducing the voltage to less than 2 volts for greater than 0.5 seconds.

A remote LED may be used with the detector except for the S251i+ and S271i+ when the detector is used through a shunt diode safety barrier or galvanic isolator.

A 'self-test' may be initiated remotely from the controller for the S271+ (dependant on MX firmware version).

6. PERFORMANCE CHARACTERISTICS

6.1 GENERAL

A large number of fire tests have been carried during the development phase of the S200+ Series detectors to determine their response limits. The results of these tests are summarised below. In order to appreciate their significance, an understanding of the mode of the operation of the detector is necessary, and a brief explanation follows:

6.2 MODE OF OPERATION - BEHAVIOUR IN FIRE TESTS

Flaming fires involving carbonaceous materials produce large quantities of carbon dioxide. This part of the combustion process gives rise to a very high level of infra-red radiation in a narrow wavelength region centred upon 4.3µm.

The radiation from a fire flickers in a characteristic way and the detector uses this flicker signal in conjunction with the black body rejection technique described in Section A to discriminate between flame and non-flame signals.

The level of the signal depends upon the size of the flame and its distance from the detector. For liquid fuels the signal level increases as the surface area of the burning liquid increases. For any type of fire the signal level generally varies inversely with the square of the distance.

For convenience, fire tests are normally carried out using liquid fuels burning in pans of known area in still air.

Note: The results of fire tests can be significantly affected by weather conditions prevailing at the time, eg, - wind.

The sensitivity of a detector can then be conveniently expressed as the distance at which a particular fire size can be detected. While the S200+ will reject modulated signals from blackbody sources, the presence of such sources of high intensity may affect the sensitivity of the detectors.

It is important to think in terms of distance rather than time because of the different burning characteristics of different fuels. Fig. C-5 shows the response to two different fuels which ultimately produce the same signal level.

The signal level given by n-heptane quickly reaches its maximum and produces an alarm within about six seconds of ignition. Diesel, on the other hand, being less volatile, takes about a minute to reach equilibrium and an alarm is given in about 60 seconds from ignition.

Note: If a fire test is carried out using non-miscible fuels then it is strongly recommended that water be placed in the bottom of the pan to keep it cool and prevent it deforming. A sufficient amount of fuel must be placed in the pan to ensure combustion occurs over all of its area throughout the intended duration of the test.

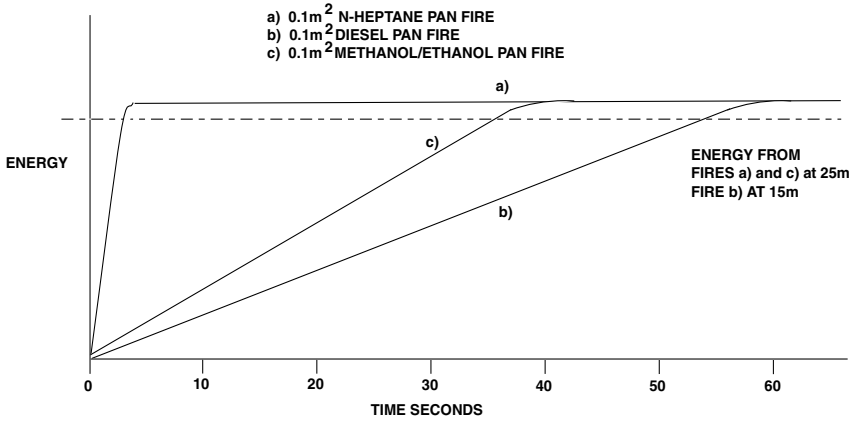


Fig. C-5 Burn Characteristics of Pan Fires

The time taken by the fire to reach equilibrium depends on the initial temperature of the fuel. If diesel were to be pre-heated to a temperature above its flash point then its behaviour would be more like that of n-heptane at 25^{o}C.

The test data presented below refers to fires which have reached their equilibrium condition.

6.3 FIRE TEST DATA

The S200+ range has been tested by LPCB to BS EN 54 Part 10 : 2002 and classified as a Class 1 flame detector on the 50m and 25m range settings. The S200+ is certified as Class 3 on the 12m range setting.

6.3.1 N-HEPTANE

The most convenient fuel for fire tests is n-heptane since it is readily available and quickly reaches its equilibrium burning rate. The range figures specified in Para 5.5 relate to a n-heptane fire in a 0.1m^2 pan on the main axis of the detector field of view.

6.3.2 OTHER LIQUID HYDROCARBONS

Typical ranges achieved with other fuels burning on 0.1m^2 pans, relative to that for n-heptane, are as follows:

Alcohol (Ethanol, Meths)	100%*
Petrol	95%
Paraffin, Kerosene, JP4	70%**
Diesel fuel	52%

* Test performed using meths in a 0.25m^2 pan.

** Test performed using paraffin.

The detection range is also a function of pan area. Field trials using n-Heptane fires indicate that the detection range increases by approximately 20% when the pan area is doubled.

Note: When testing at the limits of the detectors range, the delay in response will vary due to the ambient conditions and may be significantly longer than the minimum response times, as described in 5.6.

6.3.3 GAS FLAMES

The S200+ will not detect a hydrogen fire as it does not contain carbon. The S200+ will detect gas fires from inflammable gases containing carbon and hydrogen providing its flame produces flame modulation in the 1 to 15Hz range. Fires burning a premixed air/gas mixture may be difficult to detect as they may produce little modulation.

Tests show that an S200+ detector set to the 50m range will typically detect a 0.8m high and 0.2 sqm area methane/natural gas flame (venting from an 8mm diameter gas vent at 0.5Bar (7.5lbs/sq in) as below:

Range	30m	40m	50m
Time to Respond	3 seconds	6 seconds	15 seconds

6.3.4 DIRECTIONAL SENSITIVITY

WARNING:
WHEN MOUNTING THE FLAMEPROOF VERSIONS OF THE S200+ DETECTORS, ENSURE THAT THE PARTS OF THE FLAMEPROOF GUARD INDICATED IN FIG. C-6 ARE NOT DIRECTED AT THE RISK AREA BEING PROTECTED, AS THE FIELD OF VIEW IS RESTRICTED.

Fig. C-6

The sensitivity of the S200+ is at a maximum on the detector axis. The variation of range with angle of incidence is shown in (Polar Diagrams) Figs. C-7 and C-8 for open air tests using 0.1m^2 pan fires with the detector operating at normal range.

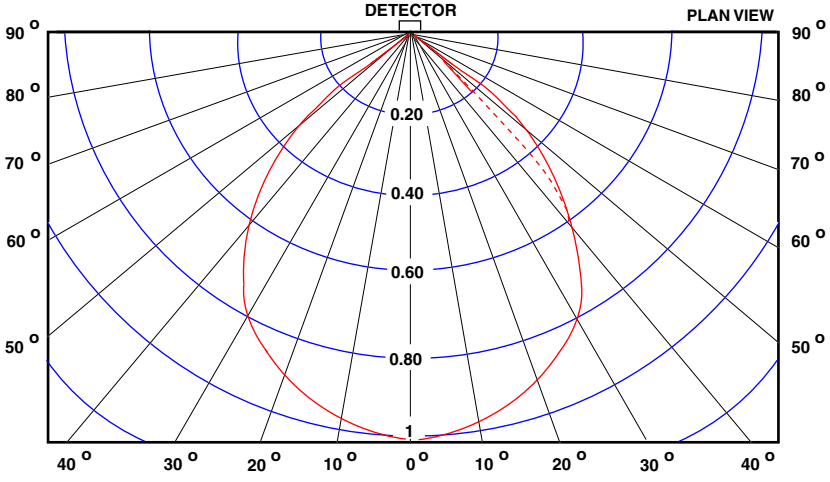


Fig. C-7 Pan Fires - Relative Range vs Angle of Incidence. - Horizontal Plane Dotted Line Shows Flameproof Version with Steel Guard Fitted

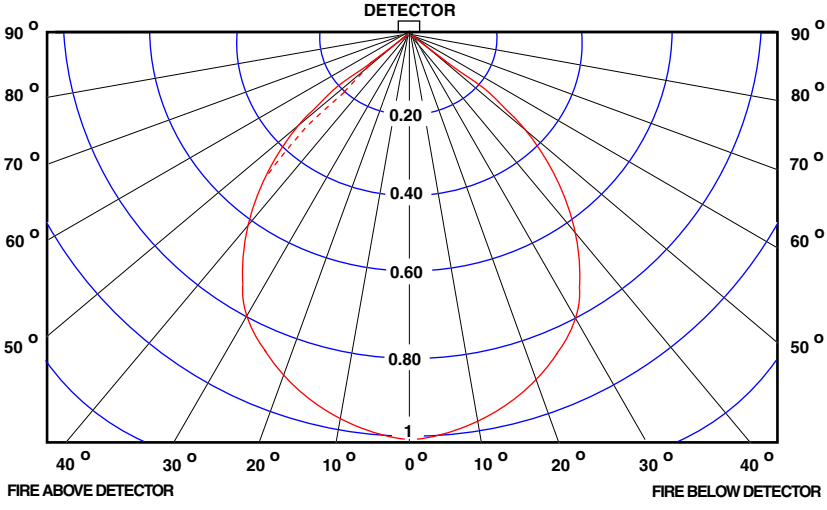


Fig. C-8 Pan Fires - Relative Range vs Angle of Incidence. - Vertical Dotted Line Shows Flameproof Version with Steel Guard Fitted Solid Line Shows IS Version

6.4 RESTRICTION OF FIELD OF VIEW DUE TO WINDOW GUARD

The following measurements were made by LPC on an optical bench to determine the detector's directional dependence as required in pr EN54 : Part 10.

The results given below are for the IS version of the detector and measured on an optical bench viewing a gas flame 35 degrees off axis. The detector is then rotated anticlockwise about its optical axis in steps of 45 degrees.

The detection ranges have been normalised against the detection range for viewing the test flame on axis (ie, 0 degree).

IS Version
35 degree off axis

Rotated Angle	Normalised Range	
0	0.80	
45	0.84	Mirror towards flame source
90	0.85	Top of detector towards flame source
135	0.82	
180	0.81	
225	0.79	
270	0.80	Bottom of detector towards flame source
315	0.80	

The measurements were then repeated for the flameproof version with the guard fitted. The detector was measured using the gas flame 25 degrees off axis.

Flameproof Version
(Guard Fitted)
25 degree off axis

Rotated Angle	Normalised Range		
0	0.94		
45	0.95		
90	0.96	Maximum range	
135	0.95		
180	0.96		
225	0.89	Minimum range	Window protector restricting field of view
270	0.95		
315	0.93		

The EN54 : Part 10 requirement is that the ratio of maximum range to minimum range be less than 1.41. The ratio for the IS version is 0.85/0.79=1.08 and for the flameproof version is 0.96/0.89=1.08, for off axis angles of 35 and 25 degrees respectively the detector meets the requirement of EN54 : Part 10.

The measured acceptance angle as defined in EN 54 : Part 10 as measured by LPC was 25° for the S200f+ and 35° for the S200i+ detectors.

The above data is for approvals purpose. The following data is included to show the polar response of the detector to real fires.

For the flameproof version, the field of view in some orientations is restricted by parts of the window guard projecting into the field of view. (These projections are required to protect the window as defined in the standards relating the flameproof enclosures.) The polar diagram (Fig. C-9) gives the detection range to pan fires for cone angles of 50, 60, 70, 80 and 90 degrees. The plots are obtained by combining pan fire and optical bench measurements. In the area where the field of view is restricted by the window protector, extra measurements have been made to define the extent of the obstruction.

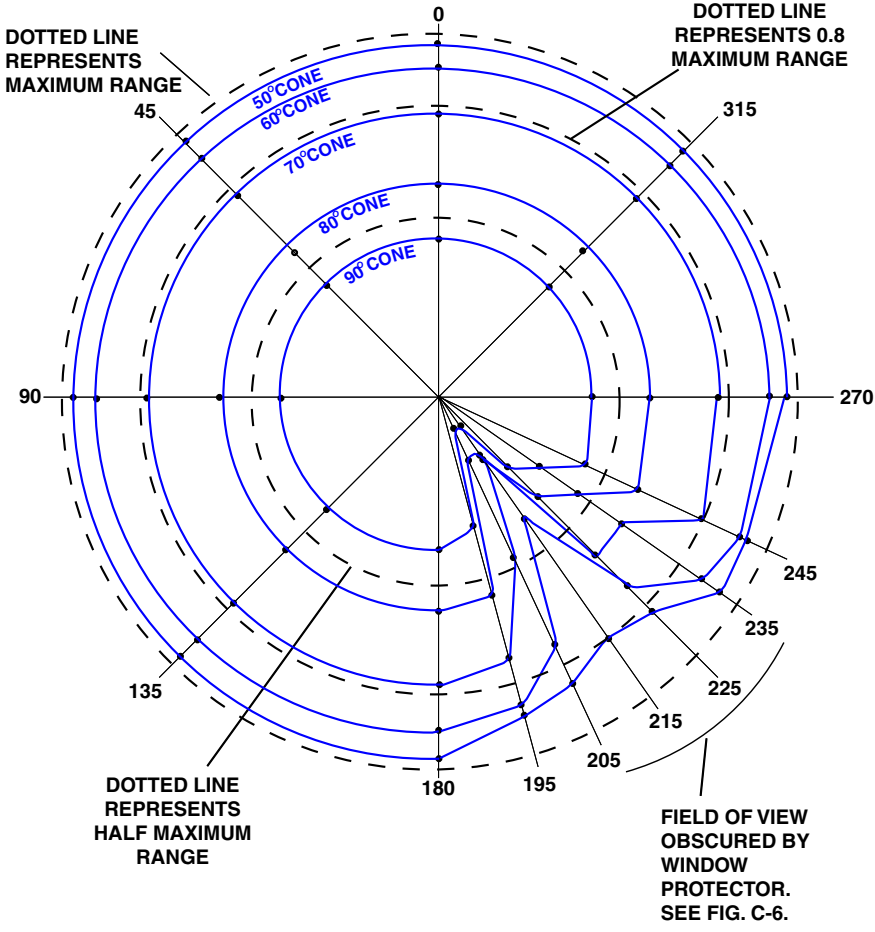


Fig. C-9 S200f+ Detection Range for Viewing cones of 50°, 60°, 70°, 80° and 90°.

6.5 HOT BODY DISCRIMINATION - FIELD OF VIEW

The S200+ flame detectors discriminate against false alarms from hot radiating objects in the field of view of the detector. This is done firstly by looking for modulation in the flame flicker frequency band (1 to 15Hz) and secondly by comparing the signal in the guard channel. For the S200+ detectors there are two areas in the field of view where the guard channel is partly obscured. In these areas the discrimination against modulated black bodies is compromised and a modulated black body could possibly produce an alarm.

The areas where this may happen are shown shaded in the field of view diagram in Fig. C-10 and Fig. C-11. Detectors should be mounted so that potential hot bodies are not located in the shaded areas. This can normally be achieved by rotating the detector.

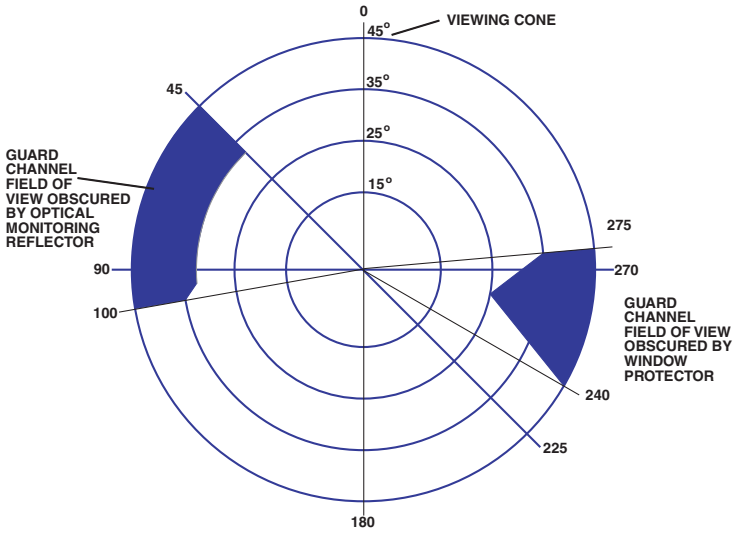


Fig. C-10 Areas Where S200f+ May Not Discriminate Between Fire and a Modulated Hot Body

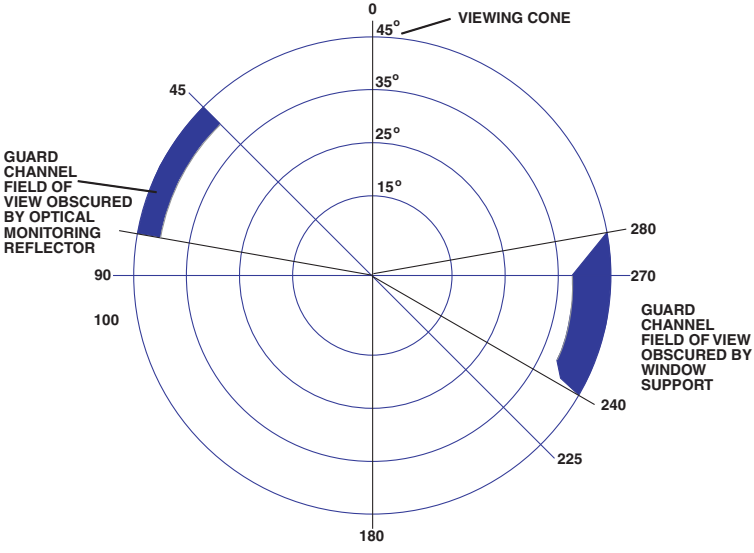


Fig. C-11 Areas Where S200i+ May Not Discriminate Between Fire and a Modulated Hot Body

6.6 FALSE ALARM DATA

The S200+ has been subjected to the following stimuli which might be considered potential sources of false alarms. Unless otherwise specified, tests were performed at a minimum distance between source and detector of 0.3m. Detectors were set to maximum sensitivity (50m range). Steady state sources were chopped at frequencies in the range 0 - 10Hz.

	RADIATION SOURCE	IMMUNITY DISTANCE (m)
1	Sunlight	No response
2	Sunlight with rain	No response
3	100W tungsten filament lamp	No response
4	Fluorescent lamp (bank of 4 x 32 W circular lamps)	No response
5	125W mercury vapour lamp	No response
6	1 kW radiant electric fire element	> 0.5
7	2 kW fan heater	No response
8	Halogen torch	No response
9	Car headlights (60W halogen)	No response
10	Lighted cigarette	No response
11	Grinding metal	No response
12	Electric arc welding (2.5mm rod)	>5
13	Photographic quartz lamp (1000W)	> 0.3
14	Photographic electronic flash unit*	No response

*Minolta Maxim/ Program Flash 5400HS - operated in both single and multi-flash modes.

A sun shade is available for use in tropical climates where intense sunlight may occur (see Fig. C-12), it also provides protection from rain falling on the window.

Fig. C-12 Weather/Sun Shield

7. DESIGN OF SYSTEM

7.1 GENERAL

Using the information given in Sections 5 and 6, it is possible to design a flame detection system having a predictable performance. Guidelines on the application of the above data and on siting of detectors is given in the following paragraphs.

CAUTION:

THE GUIDELINES GIVEN CANNOT CATER FOR ALL EVENTUALLITIES THAT MAY BE ENCOUNTERED ON A SITE.

7.2 USE OF FIRE TEST DATA

It has been explained in Section 6 that the sensitivity of the detector is most easily specified in terms of its response to well-defined test fires. Tests are conveniently carried out using a $0.1m^2$ pan. Sensitivity to other pan areas is estimated from field trial results.

7.3 DETERMINING NUMBER OF DETECTORS

It will be clear that the number of detectors required for a particular risk will depend on the area involved and the fire size at which detection is required. Large areas or small fires require large numbers of detectors.

There are as yet no agreed “rules” for the application of flame detectors and the overall system sensitivity must, therefore, be agreed between the installer and the end user. Once this agreement has been reached the system designer can determine the area covered by each detector using a scaled plot based on Figs. C-7, C-8, C-9, C-10, C-11 and the fire test data. This plot is best drawn to the same scale as the site plan so that direct superposition can be used to determine detector coverage.

In carrying out the design, certain factors should be kept in mind:

a) For area rather than spot protection, the best coverage will normally be obtained by mounting the detectors on the perimeter of the area and pointing into the area.

b) As the S200+ series are line of sight detectors any object within the detector’s field of view will cause a “shadow” in the protected area. Even small objects close to the detector can cause large shadows.

c) The detector should not be mounted in such a position that water will collect on the window.

d) The detectors are passive devices and will not react with one another. They may therefore be positioned with their fields of view overlapping.

8. APPROVALS, COMPLIANCE WITH STANDARDS AND PATENTS

8.1 INTRINSIC SAFETY S200i+ RANGE

The S231i+, S241i+, S251i+ and S271i+ are designed to comply with EN 50014/BS EN 60079-0: 2004 and EN 50020 for intrinsically safe apparatus. They are certified

ATEX code: ⟨εx⟩ II 1 G

Cenelec code: EEx ia IIC T5 or T4 (-40°C ≤Ta ≤+80°C)

Under ATEX certificate number Baseefa02ATEX0257.

This certification shows the S200i+ detectors are certified intrinsically safe, meeting the requirements of EN 50020. They are classified as suitable for zone 0, 1 and 2 areas over an ambient temperature of -40°C to +80°C for temperature class T4 gasses and -20°C to +40°C for temperature class T5 gasses.

The detectors must be used in conjunction with an ATEX certified barrier/isolator. See Section D para 3.3.

The S231i+, S241i+ and S271i+ are also IECEx certified:

IECEx BAS05.0051

Ex ia IIC T5 or T4 (-40°C ≤Ta ≤+80°C)

This certification shows the S200i+ detectors are certified intrinsically safe, meeting the requirements of BS EN 60079-0 and EN 50020. They are classified as suitable for zone 0, 1 and 2 areas over an ambient temperature of -40°C to +80°C for temperature class T4 gasses and -20°C to +40°C for temperature class T5 gasses.

The detectors must be used with an IECEx certified barrier/isolator. Refer to Section D Para 3.3.

8.2 FLAMEPROOF CERTIFICATION

The S231f+, S241f+, S251f+, S261f+ and S271f+ are designed to comply with EN 60079-0 : 2006 and EN 60079-1 : 2004 for flameproof enclosure**s.** They are certified

ATEX code: Ⓔx II 2 G

Cenelec code: Ex d IIC T6 or T5 (-20°C ≤Ta ≤+80°C)

Under ATEX certificate number Baseefa02ATEX0185.

This certification shows the S200f+ detectors are certified 'flameproof', meeting the requirements of EN 60079-1 : 2004. They are classified as suitable for zones 1 and 2 areas over an ambient temperature range -20°C to +80°C for temperature class T5 gasses and for temperature class T6 gasses.

The certified labels for the S241f+ and S261f+ are shown in Fig. C-15 and C-16. The labels for the S231f+, S251f+ and S271f+ are not shown as apart from the model number they are identical to the S241f+.

The S231f+, S241f+, 261f+ and S271f+ are also IECEx certified:

IECEx BAS 05.0056

Ex d IIC T6 or T5 (-20°C ≤Ta ≤+60°C)

This certificate shows the S200f+ detectors are certified, meeting the requirements of EN 60079-0. They are certified as suitable for Zones 1 and 2 over temperature range -20°C to +60°C for temperature class T5 gasses and -20°C to +40°C for temperature class T6 gasses.

8.3 CONSTRUCTION PRODUCTS REGULATION

The S200+ range of flame detectors comply with and are manufactured to the requirements of the Construction Products Regulation – see "CPR INFORMATION" on page 34. The detectors carry the CE mark.

8.4 OTHER APPROVALS

The S200+ detectors also have the following approvals:

LPCB	Loss Prevention Certification Board
DNV	Det Norske Veritas (Norway)
LRS	Lloyds Register of Shipping
NF	CNMIS France (S261f+ and S271f+)

Note:

1) *The S200+ detectors are LPCB approved to EN54 : Part 10, but not when used with the 'Remote LED', 'REMOTE RANGE' and/or 'REMOTE SELF TEST' functions connected.*
2) *S261f+ is LPCB approved with monitoring arrangement within the detector as shown in Fig. D-13 and fed via a 2-core cable.*

8.5 PATENTS

The S200+ design and manufacture is covered by the following patents:

UK patents	GB 2 281 615, GB 2 335 489 and GB 2 286 735 (S251+ only)
European patent	0 064 811
US patent	US 6,255,651

8.6 CPR INFORMATION

CE

0832

Thorn Security Limited

Dunhams Lane

Letchworth Garden City
Hertfordshire SG6 1BE
United Kingdom
14

0832-CPR-F0219/F0220/F0221/F0222/F0223/F0224/F0225/
F0226/F0227

S231i+, S231f+, S241i+, S241f+, S251i+, S251f+, S261f+,
S271f+, S271i+

EN54-10

Flame detectors - Point detectors

List of essential characteristics:

Nominal activation conditions / Sensitivity, Response delay (response time) and performance under fire conditions: Pass

Operational reliability: Pass

Tolerance supply voltage: Pass

Durability of operational reliability and response delay; temperature resistance: Pass

Durability of operational reliability, Vibration resistance: Pass

Durability of operational reliability, Humidity resistance: Pass

Durability of operational reliability, corrosion resistance: Pass

Durability of operational reliability, Electrical stability: Pass

8.7 LABELLING

All the labelling required by the various approval bodies is on the front label with the exception of the NF mark and Year of Manufacure/Construction which is stated on a label. Both are affixed to the potting assembly. These are only visible when the front case assembly is unbolted from the base assembly.

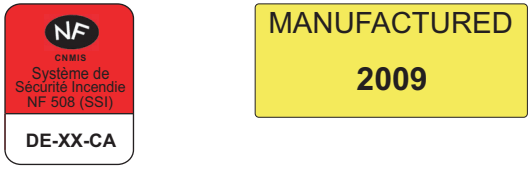


Fig. C-13 NF Mark and Year of Manufacture Labels

8.8 ATEX AND IECEx REQUIREMENTS

These detectors are designed and manufactured to protect against other hazards as defined in paragraph1.2.7 of Annex I1 of the ATEX directive 94/9/EC.

The detector cannot be repaired and must be replaced by an equivalent detector.

When the detector is installed as described in Section D, the detector will not be subject to mechanical stresses.

The detector should not be installed where they may be subject to mechanical or thermal stresses or where they may be attacked by existing or foreseeable aggressive substances.

The detector must not be exposed to dusty conditions.

The electronic assemblies of the detector contains encapsulated electronic assemblies so that all critical components and conductors are given protection against corrosion and mechanical shock.

Fault indications are described in Section 5.3.

IECEx installations require that:

Cable entry holes are provided as specified on the certified drawings for the accommodation of flameproof cable entry devices, with or without the interposition of a flameproof thread adapter. Unused entries are to be fitted with suitable certified stopping plugs.

The cable entry devices, thread adapters and stopping plugs shall be suitable for the equipment, the cable and the conditions of use and shall be certified as Equipment (not a Component).

8.9 THORN SECURITY CERTIFIED SYSTEMS FOR HAZARDOUS AREAS

The S200i+ Series detectors are certified by a Notified Body for the ATEX Directive 9/94/EC [Baseefa (2001) Ltd] as intrinsically safe apparatus and, as such, may be used as part of a certified intrinsically safe system. The system must incorporate specified barriers and there will also be restrictions on cable types and lengths. The detailed parameters will depend on the type of barrier used.

System 800 MX Digital Addressable circuits (cat.(ia)) is a certified circuit incorporating the

S271i+ detector. Details of these systems are contained in Publication 17A-13-D2. Loop loading calculations for the S271i+ are contained in Publication 17A-02-ISLOOP

Comprehensive design documentation covering System 800 is available from Thorn Security/Tyco web sites (secure part).

System 800 does not at this time cover IECEx certified systems.

For IECEx certified systems, the barriers used must be IECEx certified.

Wiring from the hazardous area to the safe area passes through the shunt diode safety barrier and/or galvanic isolator as shown in Figs D-6, D-8, D-9, D-11 and D-15.

1. GENERAL

The S200+ Series detectors may be surface mounted, or may use the S100/200 adjustable mounting bracket for fixing to a convenient rigid surface. All electrical connections are made via terminal blocks inside the detector rear housing. Three 20mm cable entries are provided. Guidance on mounting and wiring the detectors is given below.

2. MOUNTING A DETECTOR

The location of each detector should have been determined at the system design stage according to the principles detailed in Section B and marked on the site plan.

The actual mounting position must, however, be decided during installation and in choosing the position, the following principles together with the original system requirements should be followed.

2.1 CHOICE OF MOUNTING POSITION

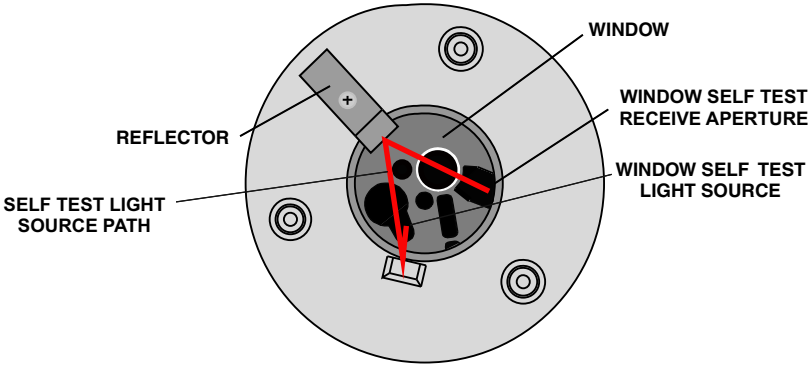
The following points must be observed when choosing the mounting position.

a) The detector must be positioned such that a clear line of sight is provided to all parts of the risk area. Roof trusses, pipework, supporting columns etc. in front of the detector can cause significant shadowing and should be avoided.

b) If supervision of an area immediately below the detector is required, it is essential that the angle between the detector and the horizontal is not less than 50^{o}.

c) The detector should not be sited in a position where it will be continuously subjected to water drenching.

d) In outdoor installations in areas of high solar radiation, some form of sunshade is recommended to prevent excess heating of the detector.



e) Precautions should also be taken to ensure the angle of incidence of sunlight, either direct or reflected, is not such that it can penetrate the receiving aperture of the window test optical path.

f) The detector should not be sited in a position in which it will be subject to severe icing.

g) The detector must be mounted on a stable structure which is readily and safely accessible for maintenance staff.

h) Wherever possible, the detector should be mounted such that the face is tilted downwards at a small angle to prevent water collection and lessen the settlement of particle deposits on the window.

The detector mounting bracket is to be secured with two M8 bolts, studs or screws at the fixing centres shown in Fig. D-1. A drilling template is provided to allow optimum selection of the fixing centres and the 2.5mm diameter, 3mm deep pivot hole. The detector is to be secured to the bracket using the four M6 screws supplied with the detector.

Alternatively, the detector may be secured directly to the fixing surface with four M6 bolts, studs or screws at the fixing centres shown in Fig. D-1. The surface chosen for the mounting should be flat over the area of the bracket to ensure a stable fixing.

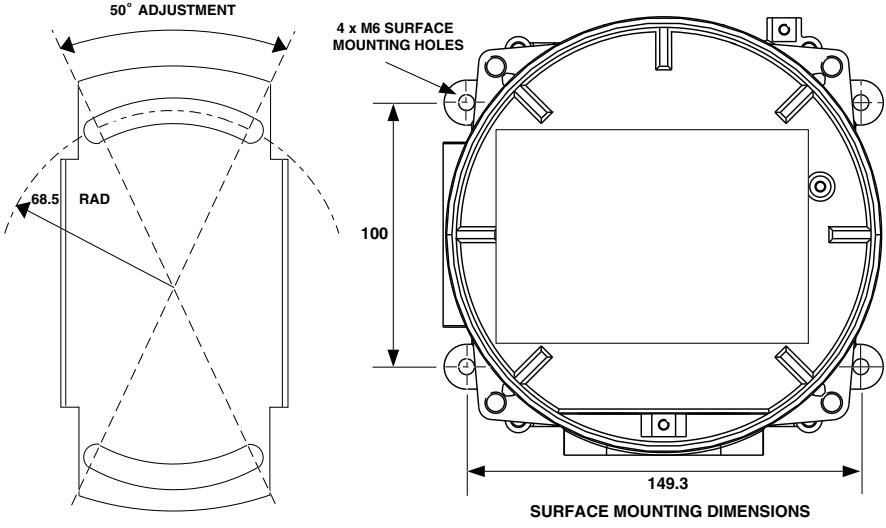


Fig. D-1 Adjustable Mounting Bracket and Surface Mounting Dimensions

The S200+ Series may be operated in any position but the mounting point must obviously be chosen to allow sufficient clearance for adjustment of the angle and must also allow space for the cable assembly. A clearance of 200mm, in all directions, from the fixing point will normally be sufficient to allow the full range of adjustment. (Fig. D-2 refers).

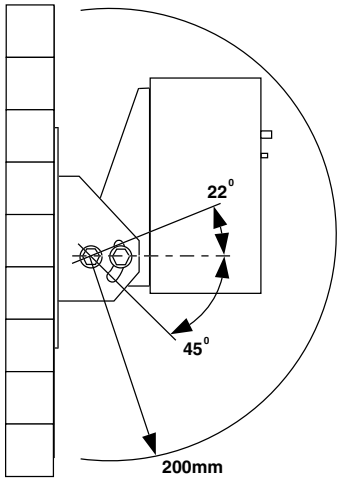


Fig. D-2 Clearance Required at Full Adjustment

3. DETECTOR WIRING

3.1 GENERAL

The wiring between the detectors and control equipment/zener safety barriers must provide the required degree of mechanical protection but allow the detector alignment to be adjusted to suit the area to be protected.

To meet the mandatory EMC requirements of BS EN 61000-6-1, it is necessary to stipulate a particular cable arrangement. The important criteria is to terminate the armouring / screening of the cable through 360^0 at the detector housing gland and ensure that the detector is solidly bonded to a good local earth. In addition, to meet the requirement of BS EN 61000-6-2 : 1999 and BS EN 50130-4 : 1996 and to comply with the Approval rules of LPCB, LRS and DNV, it is necessary to pass the conductors through the ferrite tube (supplied). See Section 3.6 and Fig. D-3.

For earthing arrangements of Armouring and Screening see Figs. D-4 and D-5.

Figs. D-6, D-8, D-9, D-11 and D-15 show wiring diagrams for intrinsically safe circuits in hazardous areas. Figs. D-7, D-10, D-12, D-13 and D-14 show wiring diagrams for non-hazardous areas.

3.2 RECOMMENDED CABLE TYPES

3.2.1 CONVENTIONAL CIRCUITS

The cable selected for interconnection to the control equipment should meet the requirements of any national codes (eg, BS5839) or relevant approval bodies. Cables should not normally have a cross sectional area of less than $1mm^2$ for solid conductors or $0.5mm^2$ for stranded conductors.

The following cables are generally recommended for use:

a) Shipwiring Cable to BS6883.

b) PVC insulated cable to BS6004, run in screwed steel conduit to BS4568 Part 1.

c) 16/0.2mm twin or multi-core cable to DEF Standard 61-12 (Part 5), run in screwed steel conduit to BS4568 Part 1.

d) PVC insulated cable to BS6231, Type BK, run in screwed steel conduit to BS4568 Part 1, or plastic conduit to BS4607, or trunking. (Conductors having a cross-section of less than $1mm^2$ should not be drawn into conduit but can be run in trunking).

e) Mineral insulated cable, twin or multi-core, to BS EN 60702-1:2002, with all cable terminations and fittings supplied by the manufacturer of the cable.

f) PVC insulated, PVC inner sheathed, steel wire armoured and PVC oversheathed cable to BS6346.

g) Cabling and conduit for flameproof circuits must comply with BS EN 60079-14:1997.

The cable used for LPCB approval was Shipwiring Cable to BS6883.

3.2.2 CABLE ROUTING

All interconnecting cables should be run in conduit or trunking which is reserved exclusively for fire alarm circuits. Where such separation is not possible MICC cable should be used.

Particular care must be taken to ensure that detector wiring is not run close to ac power circuits.

3.3 CABLE ENTRY SEALING

CAUTION:
CABLE GLANDS AND STOPPING PLUGS MUST BE SUITABLY SEALED TO PREVENT THE INGRESS OF MOISTURE.

Only cable glands incorporating an inner cable seal should be used. In exposed outdoor areas, it is recommended that a shroud be fitted over the cable glands. Cable glands should also be sealed to the detector housing by fitting a nylon washer between their flange and the housing.

In applications where the ambient temperature is expected to be 40^oC or higher, cable glands with a silicon inner seal must be used and, when fitted, the shroud must be made of CR rubber.

The use of stopping plugs with a mushroom head and integral 'O' ring is recommended.

The glands/stopping plugs should be hand-tightened with the addition of, at least, a further $^1/_4$ turn applied by spanner or other suitable tool.

Where it is not practicable to use a nylon gland washer or where an anti-seizing union is required, the following alternative methods may be used:

a) For Safe Area or Intrinsically Safe applications, the thread of cable glands/ stopping plugs may be sealed using PTFE tape or other jointing putty or mastic.

b) For Flameproof applications the threads of the flameproof glands/stopping plugs may be sealed using any non-setting grease as described in BS EN 60079-14 : 1997.
PBC BA 200 loaded mineral oil based grease is a suitable compound and is available in 100g tubes (Stock Code No. 517.001.250).

3.4 FLAMEPROOF WIRING

Cabling and conduit systems must comply with BS EN 60079-14 : 1997.

3.5 FITTING FERRITE TUBES

Fit the ferrite tubes to conductors as shown in Fig. D-3. For optimum RF suppression, each pair of cables must be looped once around the ferrite tube.

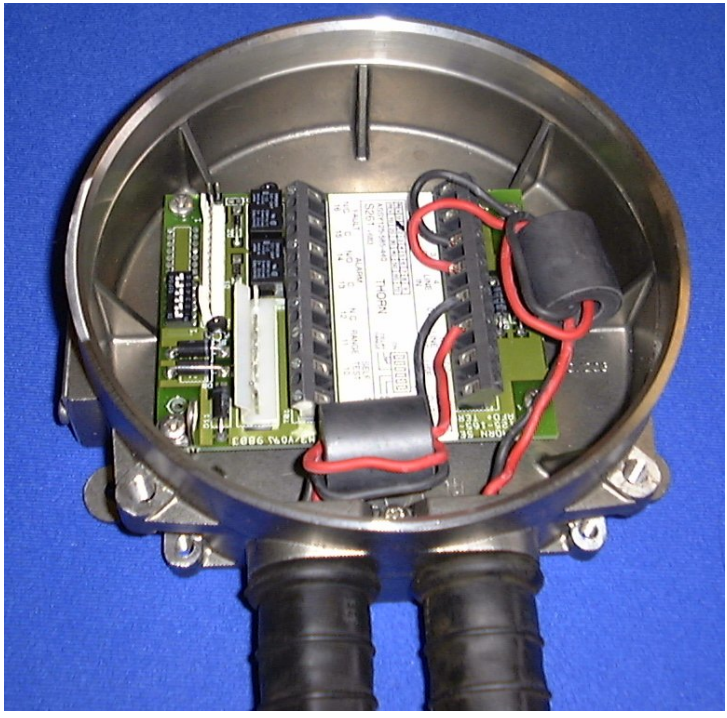


Fig. D-3 Fitting of Ferrite Tubes

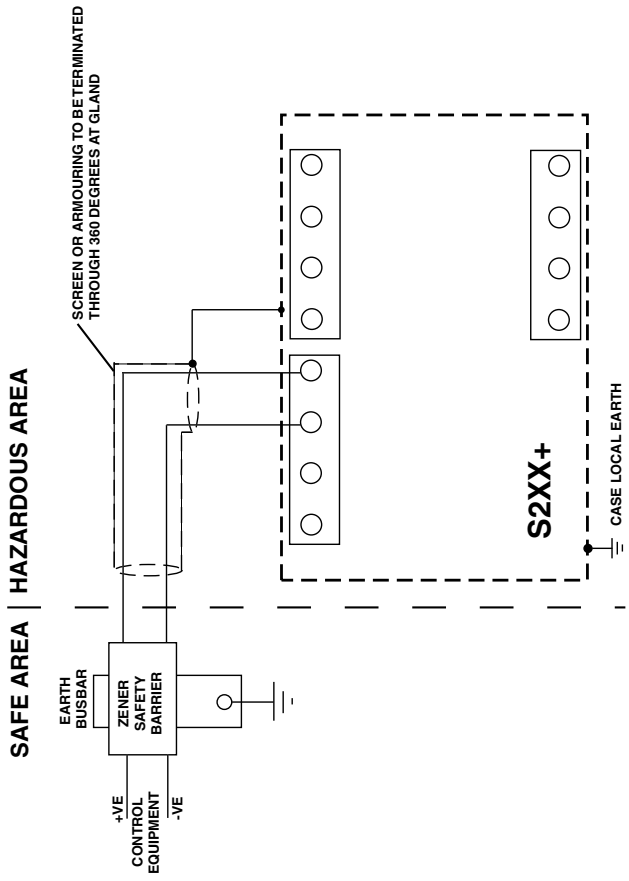


Fig. D-4 EMC Directive - Earthing Arrangements for Screened Cable or Armoured Cable

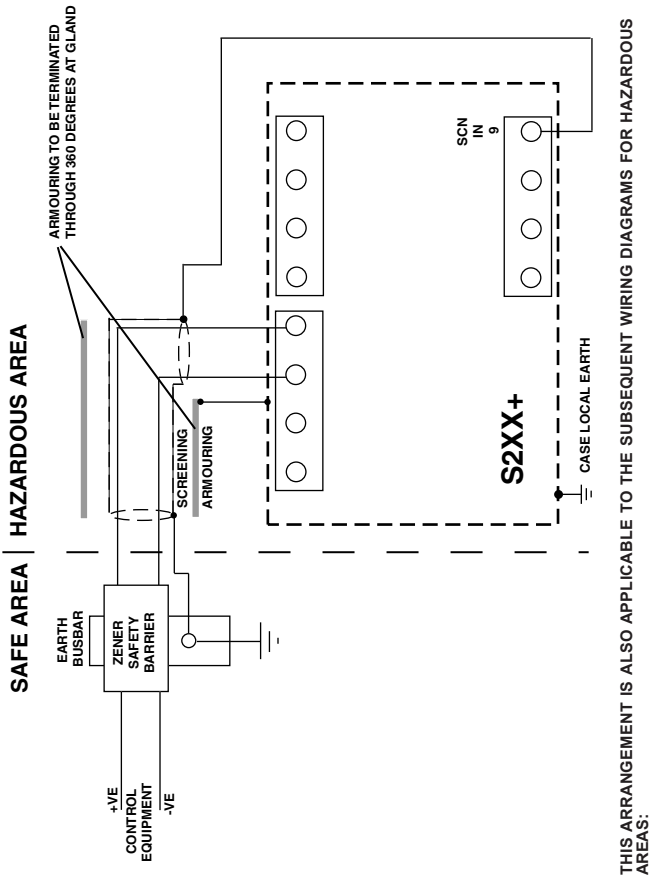


Fig. D-5 EMC Directive - Earthing Arrangements for an Armoured Screened Cable

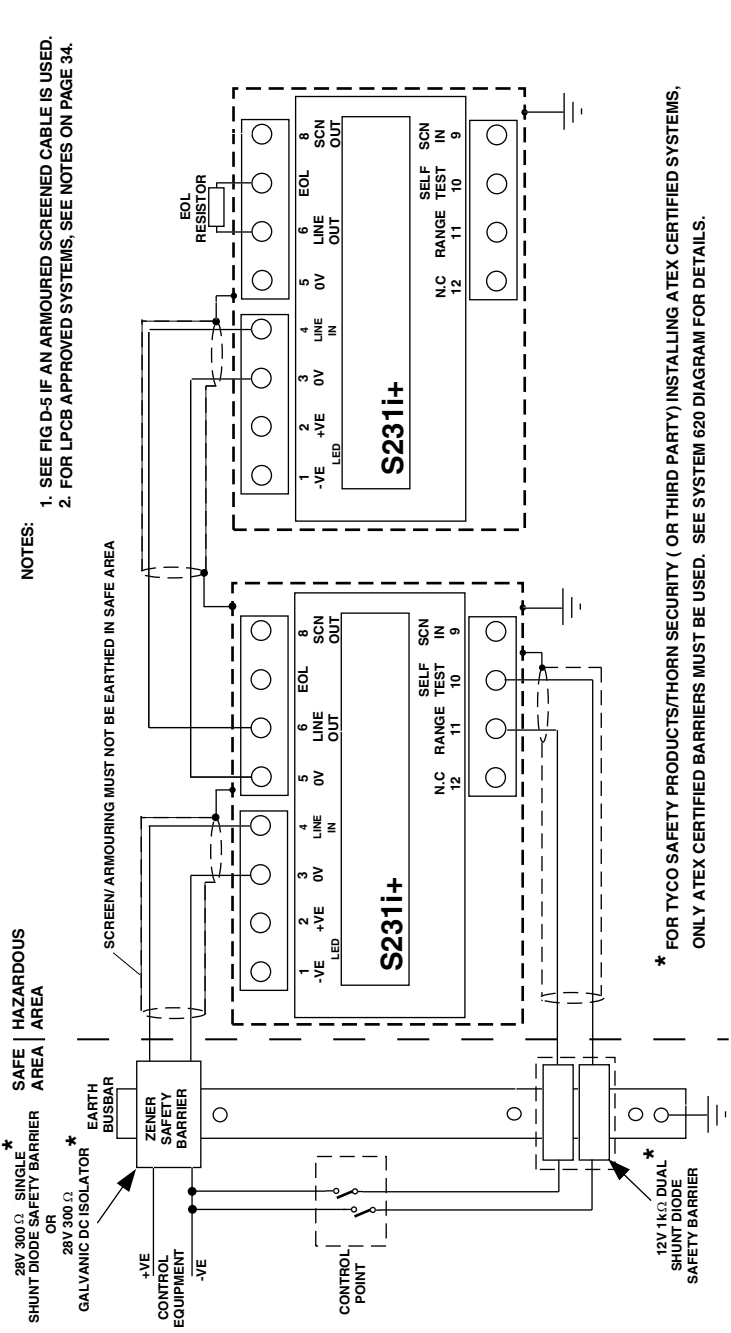


Fig. D-6 S231i+ Wiring Diagram for Hazardous Areas

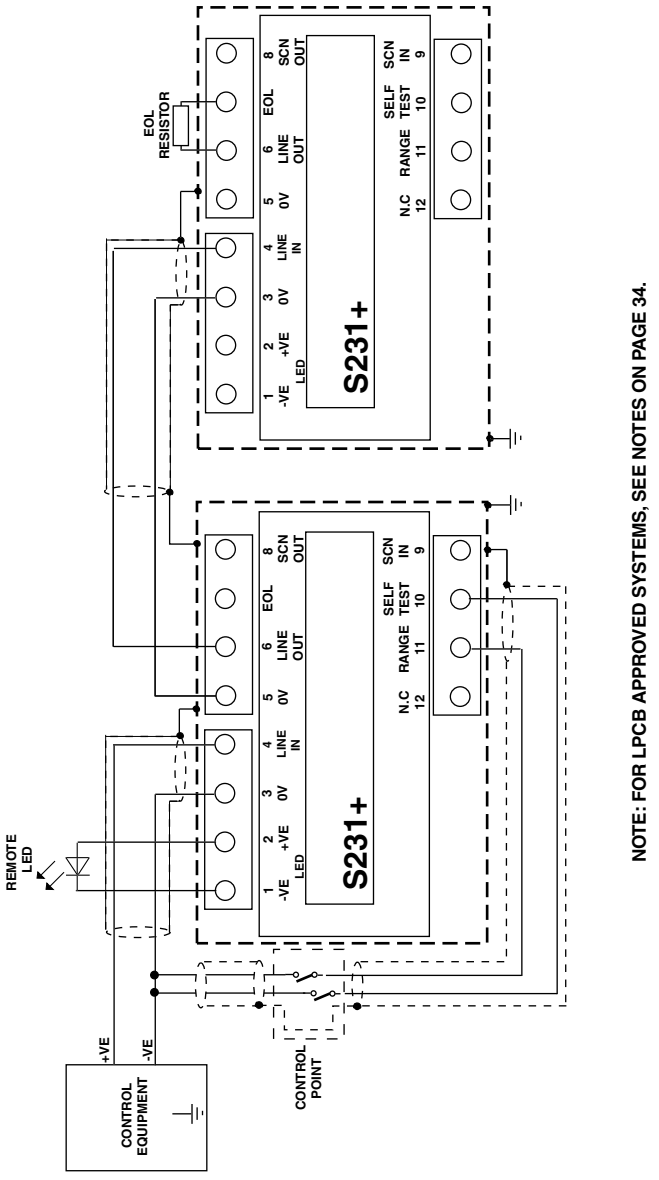


Fig. D-7 S231f+ Wiring Diagram for Non-Hazardous Areas or Flameproof Areas
S231i+ Wiring Diagram for Non-Hazardous Areas

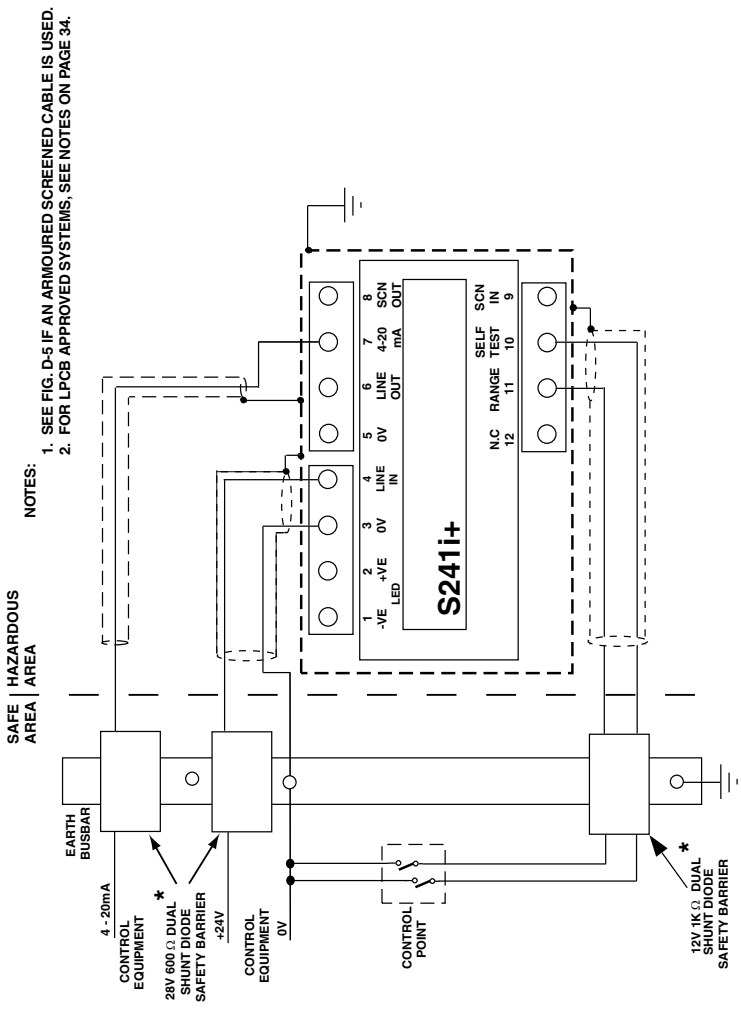


Fig. D-8 S241i+ Wiring Diagram for Hazardous Areas Using Shunt Diode Barriers

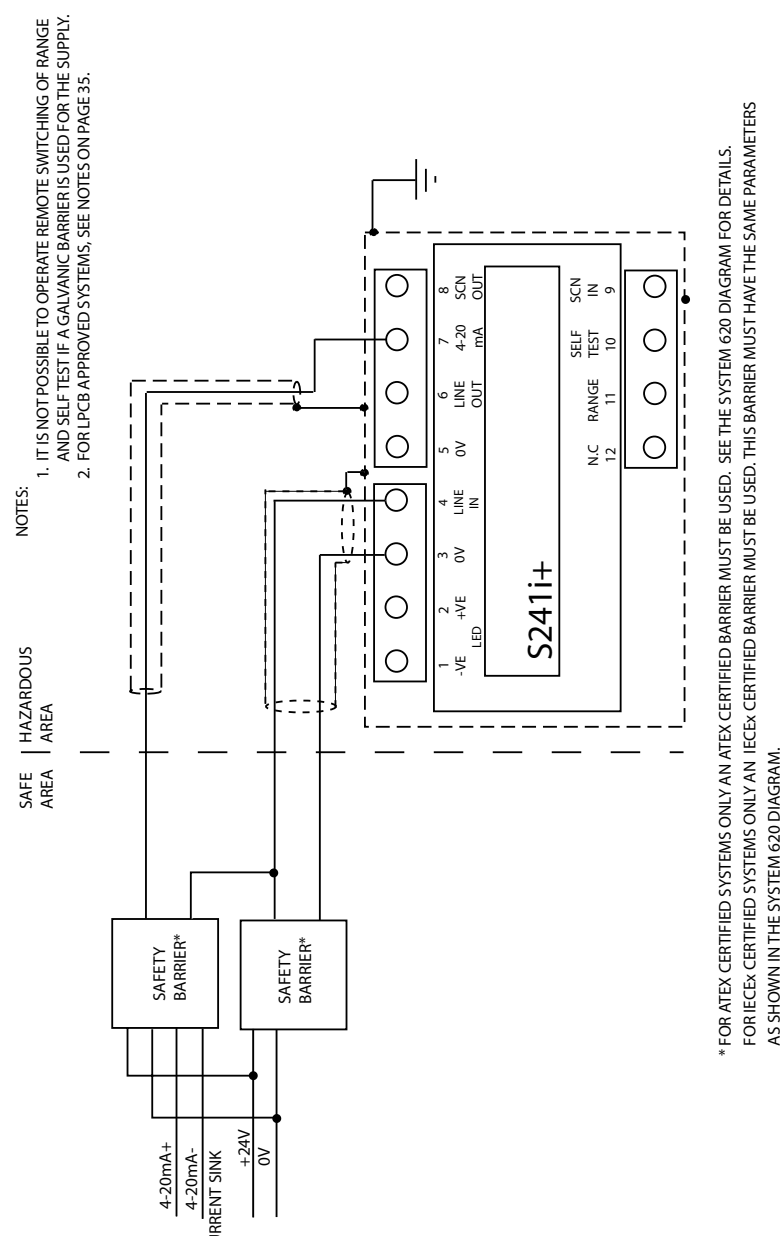


Fig. D-9 S241i+ Wiring Diagram for Hazardous Using Galvanic Isolators

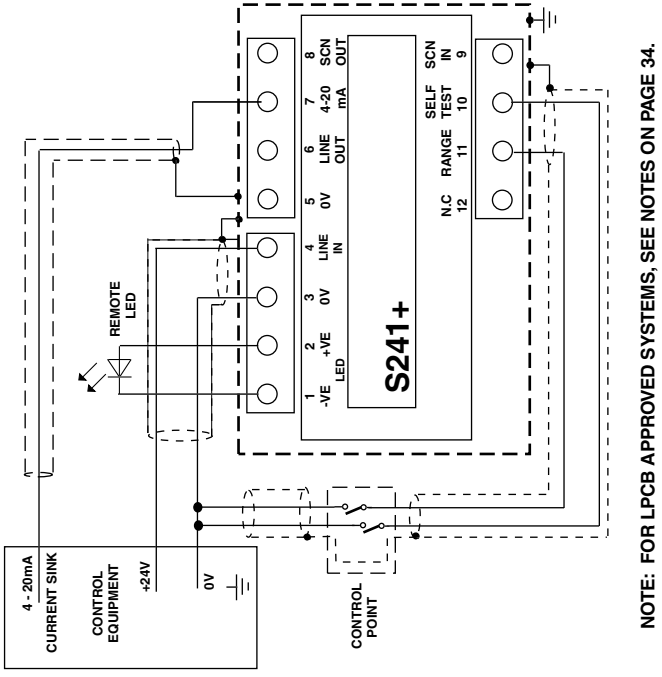


Fig. D-10 S241f+ Wiring Diagram Non-Hazardous or Flameproof Installations
S241i+Wiring Diagram Non-Hazardous Installations

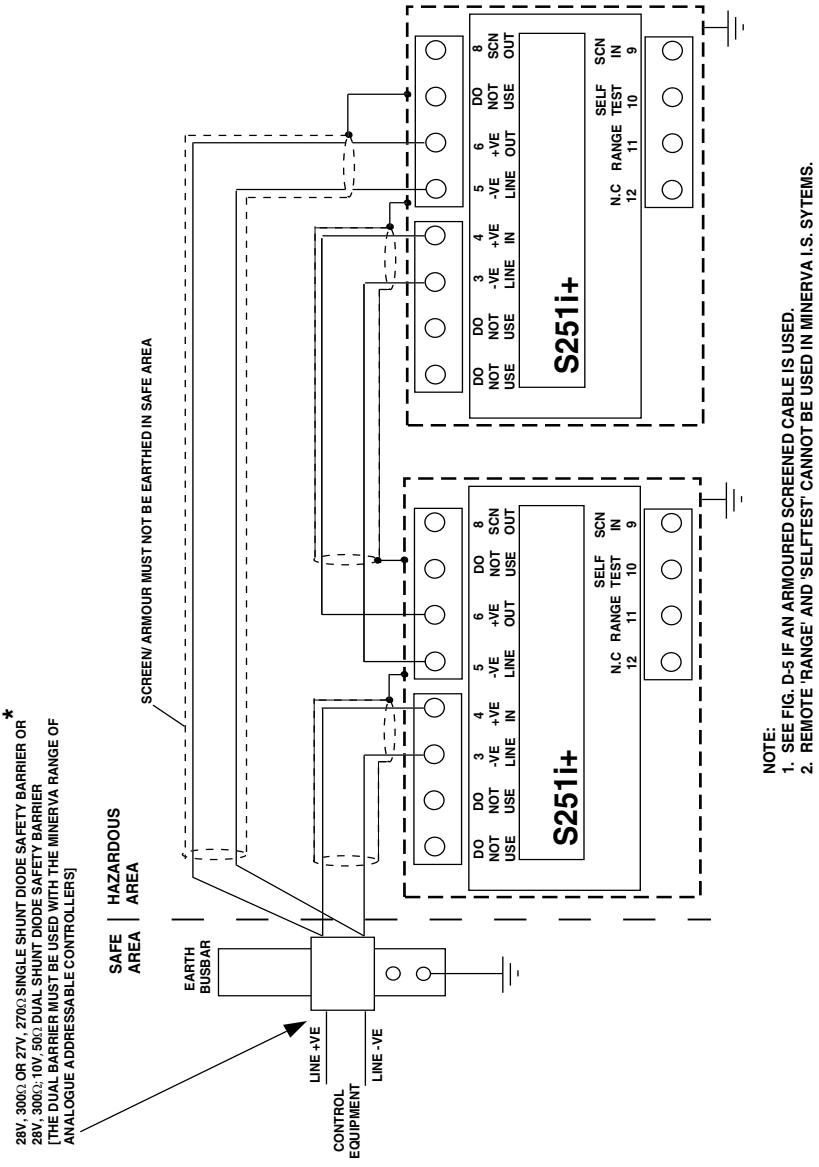


Fig. D-11 S251i+ Wiring Diagram for Hazardous Areas

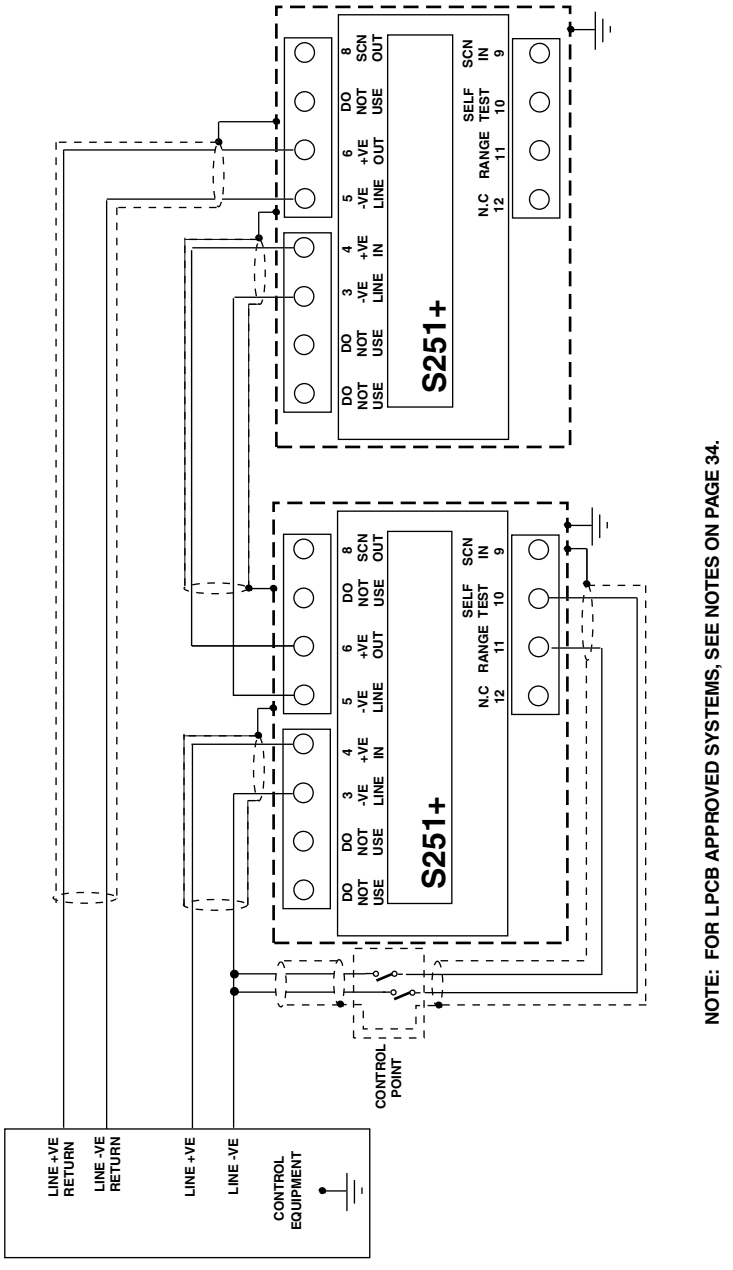


Fig. D-12 S251f+ Wiring Diagram for Non-Hazardous or Flameproof Installation
S251i+ Wiring Diagram for Non-Hazardous

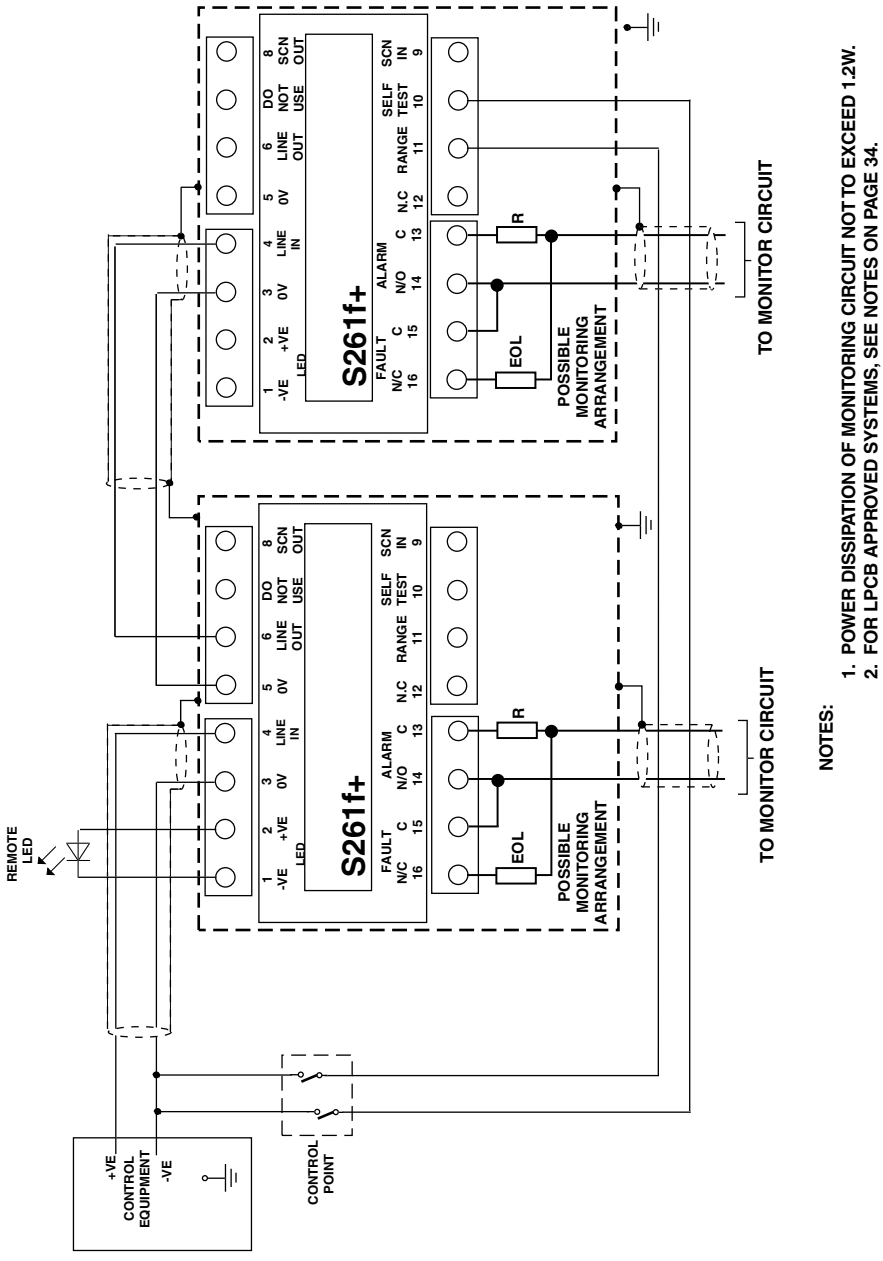


Fig. D-13 S261f+ Wiring Diagram for Non-Hazardous Areas or Flameproof

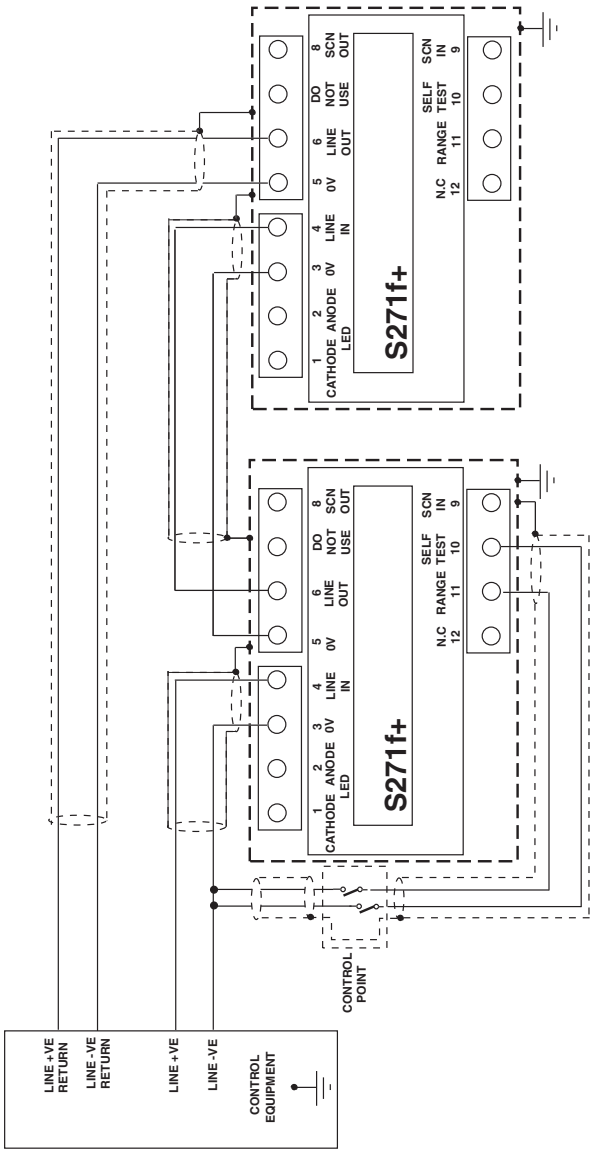


Fig. D-14 S271f+ Wiring Diagram for Non-Hazardous Areas or Flameproof

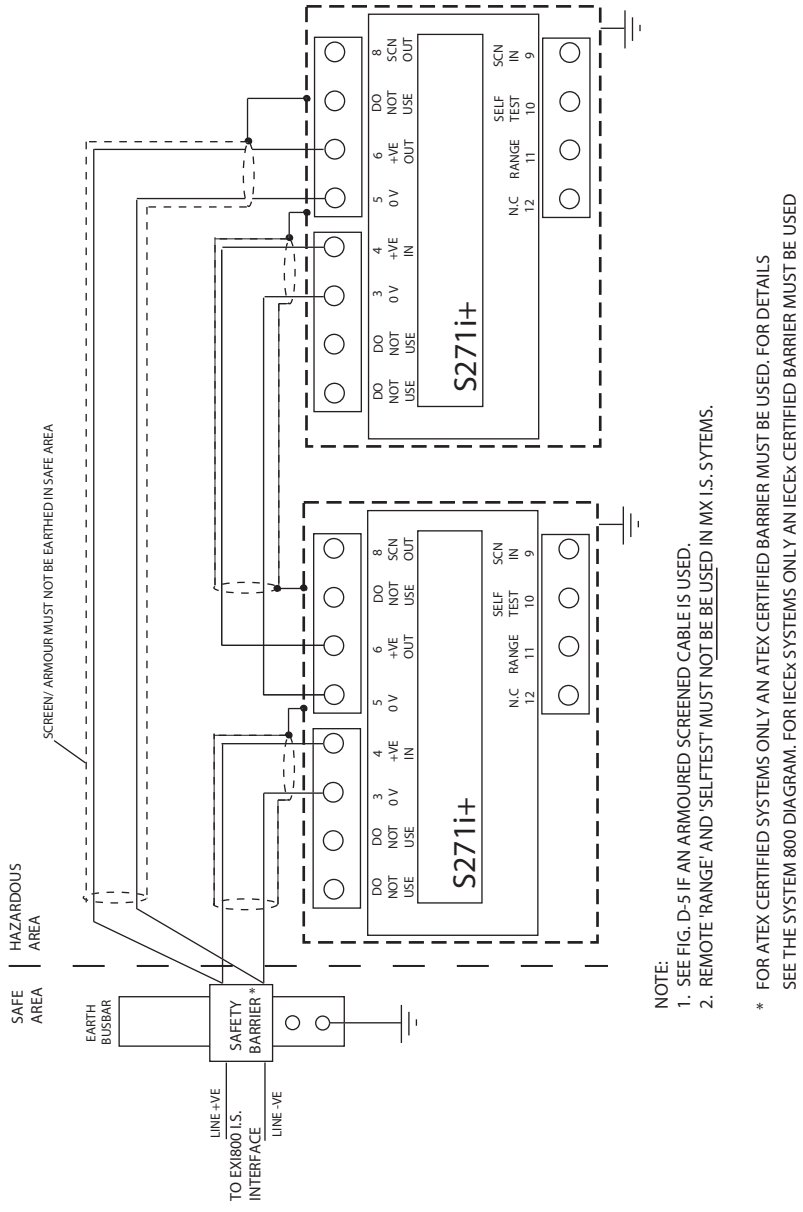


Fig. D-15 S271i+ Wiring Diagram for Hazardous Areas

4. INITIAL WIRING CHECK

After installing the wiring as detailed above and before connecting any detectors or end-of-line devices, the following tests should be carried out.

4.1 CONTINUITY TESTS

To check continuity proceed as follows:

a) Short-circuit + to + and - to - at each detector terminal block.

b) Short-circuit the pair at the end furthest from the control equipment.

c) Using an ohmmeter set to its lowest range, check the loop resistance at the control equipment end.

d) If the reading obtained is less than 50 ohms record the reading obtained and proceed to Para 4.2.

e) If the reading obtained is greater than 50 ohms locate and rectify continuity faults by quartering the system.

4.2 INSULATION TESTS

To check the insulation proceed as follows:

a) Using an ohmmeter set to its highest range, check the resistance between the circuit and earth.

b) If the reading obtained is greater than 1 megohm record the reading and proceed to c), otherwise locate and rectify the earth fault.

c) Remove the short-circuit at the end furthest from the control equipment.

d) Measure the resistance between the zone conductors.

e) If the reading obtained is greater than 1 megohm record the reading, otherwise locate and rectify the insulation fault.

On completion of all tests to ensure no moisture ingress to the detector during the time between Installation and Commissioning, fit the weatherproof cover Fig. D-14. Ensure that the 'O' ring supplied is fitted to the cover. Securely tighten the four M8 x 40mm socket cap cover retaining screws.

4.3 TESTS ON INTRINSICALLY SAFE SYSTEMS

When carrying out tests on wiring of intrinsically safe systems, it is essential that an INTRINSICALLY SAFE INSULATION TESTER AND A SAFETY OHMMETER are used, unless the area can be shown to be completely free of flammable gases. Further guidance on testing such systems can be found in BS EN 60079 Part 14.

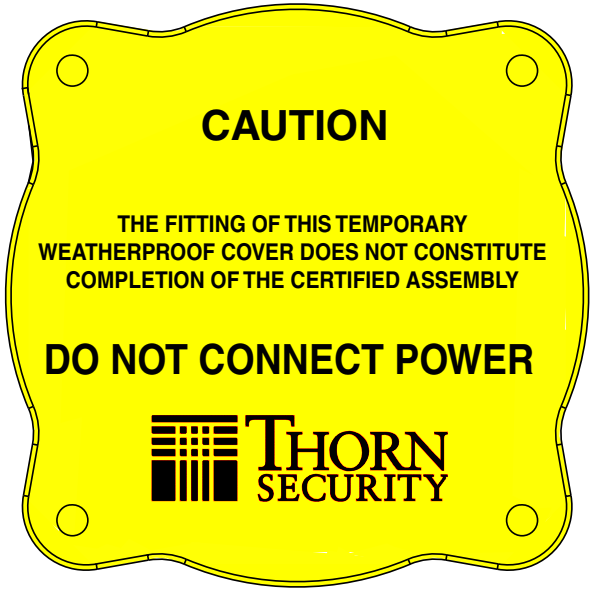


Fig. D-16 Protective Cover

SECTION E - COMMISSIONING

1. SYSTEM CHECKS

Before connecting the zone wiring to the control equipment, safety barriers or to the detectors, a general inspection of the system should be carried out. In particular, the positions of the detectors should be checked to ensure that the requirements given in the System Design and Installation sections are met.

If the detectors are installed as part of a certified intrinsically safe system, then particular attention should be paid to any special conditions required by the system certification.

2. CONNECTING AND COMMISSIONING THE DETECTORS

When the system wiring has been successfully tested and the control equipment commissioned, the detector electronic assemblies may be fitted. Set the Range (Tables 1 and 4) Delay, (Table 2) Latching, (Table 4) and Signalling Mode, (Tables 3 and 4) switches as required. Also, set the point address switch for the S251+ (Table 5) and the S271+ (Table 6). Record the switch settings for future checking during service and maintenance inspections. The Window self-test may be disabled by linking the self-test terminal to 0V before applying power to the unit (ie terminal 10 linked to either terminals 3 or 5). Self-test (S251i+ and S271i+ excluded) may be demanded by taking the input high (disconnected) and then low again. Automatic operation will not restart unless the self-test input is disconnected before power-up.

CAUTION:
DO NOT MOVE THE ALARM OR FAULT LATCHING SWITCHES
AFTER THE DETECTOR HAS BEEN POWERED UP.

2.1 SWITCH SETTINGS

Tables 1 to 6 give the switch settings for switches S1 and S2, see Fig. E-1 for switch locations.

SW1-1	SW1-2	RANGE
OFF	OFF	EXTENDED RANGE (50m)*
ON	ON	EXTENDED RANGE (50m)*
OFF	ON	NORMAL RANGE (25m)*
ON	OFF	REDUCED RANGE (12.5m)*

Table 1: Range Setting: S251+ and S271+**

* The Range Settings are halved if the Range Terminal (No 11) is connected to 0 volts.

** The Range and Delay settings for the S271+ may be set from the controller via MX CONSYS (the Range/Delay switches must be in the OFF position for this option to take effect), dependant on MX Firmware version.

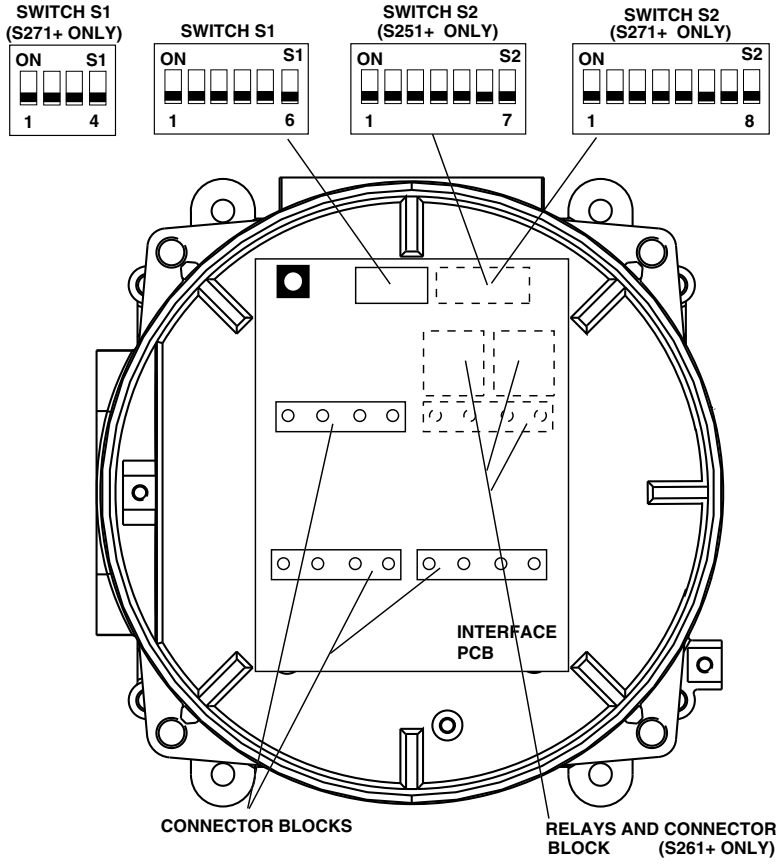


Fig. E-1 Switch Location

SW1-3	SW1-4	DELAY TO ALARM FUNCTION
OFF	OFF	3 POSITIVE SAMPLES FROM 5
ON	ON	3 POSITIVE SAMPLES FROM 5
OFF	ON	6 POSITIVE SAMPLES FROM 8
ON	OFF	12 POSITIVE SAMPLES FROM 14

Table 2: Delay Settings (All Types - one sample per second)

The delay may set remotely for the S271f+

SW1-5	NO ACTION	
SW1-6	OFF	S251 COMPATIBLE MODE
	ON	ENHANCED SIGNALLING MODE

Table 3: Switch SW1-5 and SW1-6 Settings S251+

SW1-1	OFF	EXTENDED RANGE (50m)*
	ON	NORMAL RANGE (25m)*
SW1-2#	OFF	FAULT UNLATCHING
	ON	FAULT LATCHING
SW1-5# ‡	OFF	ALARM LATCHING
	ON	ALARM UNLATCHING
SW1-6 ‡ S241+ only	OFF	DISCRETE SIGNALLING CURRENTS (S241 compatible mode)
	ON	VARIABLE SIGNALLING CURRENT
SW1-6	NO ACTION FOR S231+ AND S261+	

Table 4: Range and Latching Settings S231+, S241+ and S261+

* The Range Settings are halved if the Range Terminal (No 11) is connected to 0 volts.

If switches SW1-2 and SW1-5 are changed from OFF to ON whilst the unit is powered, the change will not be effective until the unit is powered down and re-started.

‡ In the Variable Signalling Current mode (SW1-6 ON), the alarm output will always be UNLATCHING, ie, the setting of SW1-5 has no effect. In this mode, the final alarm decision and latching should be made at the controller, eg, PLC.

x=ON o=OFF

SWITCHES 1, 2, 3, 4	5, 6, 7							
	ooo	xoo	oxo	xxo	oox	xox	oxx	xxx
oooo		16	32	48	64	80	96	112
xooo	1	17	33	49	65	81	97	113
oxoo	2	18	34	50	66	82	98	114
xxoo	3	19	35	51	67	83	99	115
ooxo	4	20	36	52	68	84	100	116
xoxo	5	21	37	53	69	85	101	117
oxxo	6	22	38	54	70	86	102	118
xxxo	7	23	39	55	71	87	103	119
ooox	8	24	40	56	72	88	104	120
xoox	9	25	41	57	73	89	105	121
oxox	10	26	42	58	74	90	106	122
xxox	11	27	43	59	75	91	107	123
ooxx	12	28	44	60	76	92	108	124
xoxx	13	29	45	61	77	93	109	125
oxxx	14	30	46	62	78	94	110	126
xxxx	15	31	47	63	79	95	111	

Table 5: SW2 Address Switch Settings for S251+ only
Note: Address '0' and '127' are reserved.

SWITCHES 1, 2, 3, 4	SWITCHES 5, 6, 7, 8															
	0000	X000	0X00	XX00	00X0	X0X0	0XX0	XXX0	000X	X00X	0X0X	XX0X	00XX	X0XX	0XXX	XXXX
0000		16	32	48	64	80	96	112	128	144	160	176	192	208	224	
X000	1	17	33	49	65	81	97		129	145	161		193			
0X00	2	18	34	50	66	82	98		130	146	162		194			
XX00	3	19	35		67				131							
00X0	4	20	36	52	68	84	100		132	148	164		196			
X0X0	5	21	37		69				133							
0XX0	6	22	38		70				134							
XXX0	7															
000X	8	24	40	56	72	88	104		136	152	168		200			
X00X	9	25	41		73				137							
0X0X	10	26	42		74				138							
XX0X	11															
00XX	12	28	44		76				140							
X0XX	13															
0XXX	14															
XXXX																

Table 6: SW2 Address Switch Settings for S271i+ only (92 Addresses with Switch 3 ON)
Note: Address '0' and '251 to 255' are reserved (the address cannot be set or changed from the control panel).

2.2 ASSEMBLING THE UNIT

Connect the hanging cord (as a precaution) to the top and bottom assemblies as shown in Fig. E-2 (page 58). Connect the two preformed cables from the top assembly to the bottom assembly (with the cables running to the centre of the detector). Fit the front assembly to the rear assembly. Care should be taken to ensure that the internal wiring is not trapped between the terminal blocks and the front assembly.

It should be noted that a rubber seal is provided between the front and rear sections of the housing and this seal must be clean and dry before assembly. It is also important to ensure that no moisture is trapped inside the housing. Using a torque wrench, tighten the four socket cap retaining bolts with a maximum force of 10 Nm.

At this stage, the angle of the detector should be adjusted to view the required area and the fixing nuts and bolts finally tightened. The cable from the circuit to the detector should then be routed, using cable ties or clips as necessary, to minimise the risk of physical damage.

2.3 DETECTOR TESTING - SAFE AREAS

Functional testing of detectors mounted in safe areas is most easily carried out using a small flame such as a match or cigarette lighter. The flickering radiation from such a flame should produce an alarm at a distance of 1 metre within 5 seconds (Dependent on the range and delay selected). The red LED indicator in the detector should then light and the appropriate alarm response should be obtained at the control equipment.

In order to demonstrate the correct coverage of the system, it is desirable to perform full-scale fire tests. These tests should use liquid fires as described in System Design Information Section B.

2.4 DETECTOR TESTING - HAZARDOUS AREAS

For testing detectors in hazardous areas an appropriate test torch certified for use in hazardous areas must be used, such as the Thorn Security T210+ Test Torch. The same product is also suitable for use in safe areas.

A self-test of the detector electronics and window monitoring may be carried out from the MX controller (S271+ only) during Walk Test.

The S200+ remote self-test cannot be used by the S251i+ of S271i+ detectors.

2.5 ACCESSORIES

WEATHER/SUN SHIELD: A Stainless steel sun shield is available to reduce the heating effect of the sun in tropical conditions, where the detector has to be mounted in direct equatorial sun. The shield also provides protection from rain falling on the window. The sun shield fits round the bracket and is bolted on to the rear of the detector.

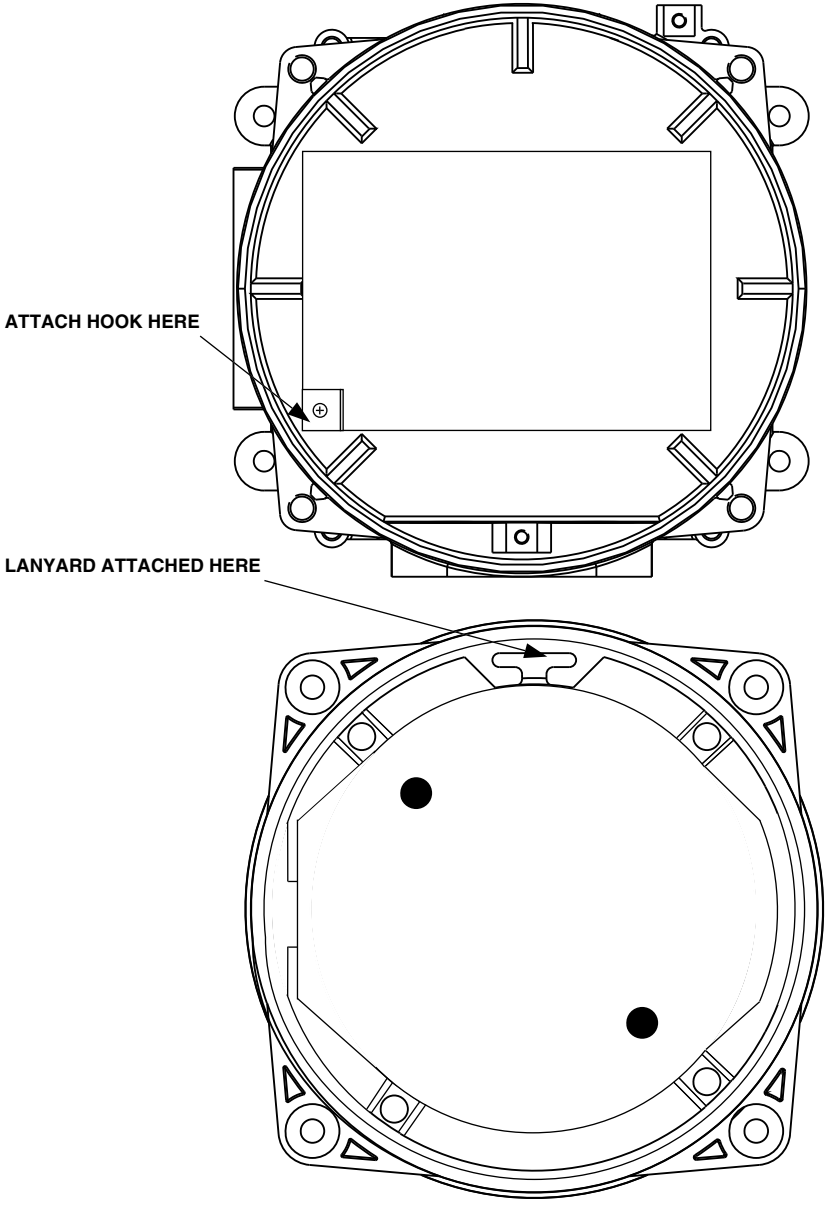


Fig. E-2 Hanging Cord Connection

SECTION F - MAINTENANCE

1. GENERAL

The S200+ series detectors contain encapsulated electronic assemblies. There are no replaceable or adjustable components within the housing, which should not be opened once installed and commissioned.

Routine maintenance is, therefore, limited to cleaning and testing the detectors.

1.1 ROUTINE INSPECTION

At regular intervals of not more than 3 months, detectors should be visually inspected to confirm that no physical damage has occurred and that the alignment of the detectors has not been disturbed. The detector windows should be checked to confirm that they are not blocked and that no physical obstructions have been placed between the detector and the protected area. Check that switch settings are correct.

In addition, at intervals of not more than 1 year, each detector should be checked for correct operation. Any excessive deposits of dirt, oil etc. should be removed from the detector housing as described in 1.2.

Note: The inspection frequency specified above should be considered as a minimum requirement to be applied in the average environment. The inspection frequency should be increased for dirtier environments or those which present a higher risk of physical damage.

For flameproof detectors, the following periodic checks should be made:

a) The dimensions of gaps at flameproof joints should be checked to see that they do not exceed the maximum figure specified in BS229, BS4683 : Part 2 or BS5501 : Part 5.

b) Spigot joints should be separated and the faces examined for possible defects resulting from corrosion, erosion or other causes.

c) Check that all stopping plugs and bolts are in position and tight.

d) No attempt should be made to replace or repair windows except by complete assembly replacement.

1.2 DETECTOR CLEANING

The S200+ series detectors are relatively tolerant of accumulations of dirt on the sensor window or optical monitoring reflector (see Fig. F-1). However, thick deposits of dirt and oil will cause a loss of sensitivity and a subsequent fault indication.

It is recommended that detectors be cleaned using water or a detergent solution. A stiff bristle (not wire) brush may be used to remove heavy deposits. Particular attention should be paid to the reflector and sapphire window (Fig. F-1). The detectors must not be cleaned without first removing power or isolating the detector.

Note: Do not remove the Optical Monitoring Reflector to clean the detector.

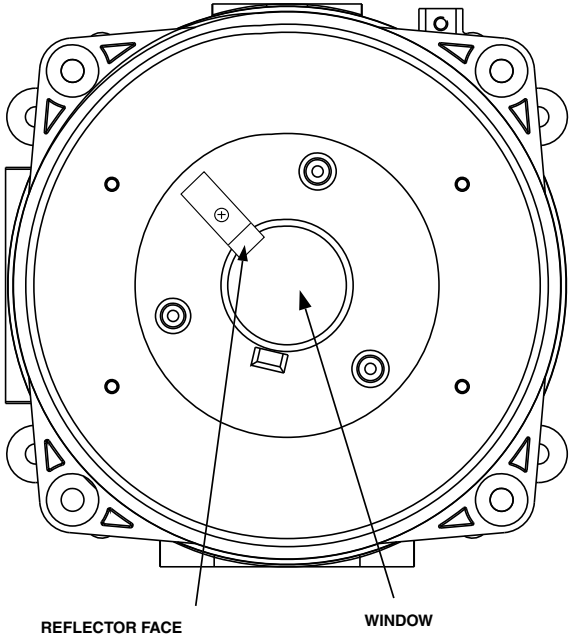


Fig. F-1 Reflector and Window

1.3 FAULT FINDING

If a fault is indicated at the controller, it may be due to a number of self-test outputs, the most common fault would be obscuration of the window.

If the remote self-test is connected, put the controller into the walk test mode, by switching the self test input to 0V. If an alarm is indicated then the window is clean and the front-end circuitry is operating correctly.

Reset the controller and wait two minutes. If no fault is indicated then it is likely that the fault was due to a software watchdog timeout which might be caused in rare circumstances by very excessive electrical interference.

If the detector fails the remote test or no remote test can be performed, clean the window and the reflector as specified, reset the controller. If the detector still shows a fault after a $7^1/_2$ hour period, replace the detector.

It should be remembered that unless the processor has malfunctioned, the detector will still be capable of detecting a fire at higher levels or with greater susceptibility to false alarms unless the window is totally obscured by something other than gradual contamination.

A faulty detector will be indicated by a flashing built-in yellow LED. For the S251**+**/S271**+**, the panel will indicate the fault.

SECTION G - ORDERING INFORMATION

Description	Stock Code Number
S231i+ Conventional Triple IR Flame Detector:	516.037.004
S231f+ Conventional Triple IR Flame Detector:	516.037.003
S241i+ 4-20mA Current Triple IR Flame Detector:	516.038.004
S241f+ 4-20mA Triple IR Flame Detector:	516.038.003
S251i+ Analogue Addressable Triple IR Flame Detector:	516.039.004
S251f+ Analogue Addressable Triple IR Flame Detector:	516.039.003
S261f+ Relay O/P Triple IR Flame Detector:	516.040.002
S271f+ MX Digital Addressable Triple IR Flame Detector:	516.041.003
S271i+ MX Digital Addressable Triple IR Flame Detector:	516.041.004
S100/S200 Mounting Bracket:	517.001.184
T210+ infra-red test source:	592.001.016
Adaptor S200 series:	592.001.014
Nicad battery and charger:	592.001.010
Solo 100 telescopic extension pole set:	517.001.230
Solo 101 extension pole:	517.001.226
Solo 704 adaptor tube B:	517.001.224
Solo 610 Carryall bag:	517.001.264
Weather/Sun Shield:	517.001.263
S200+ Spares Kit and Sealant:	517.001.266

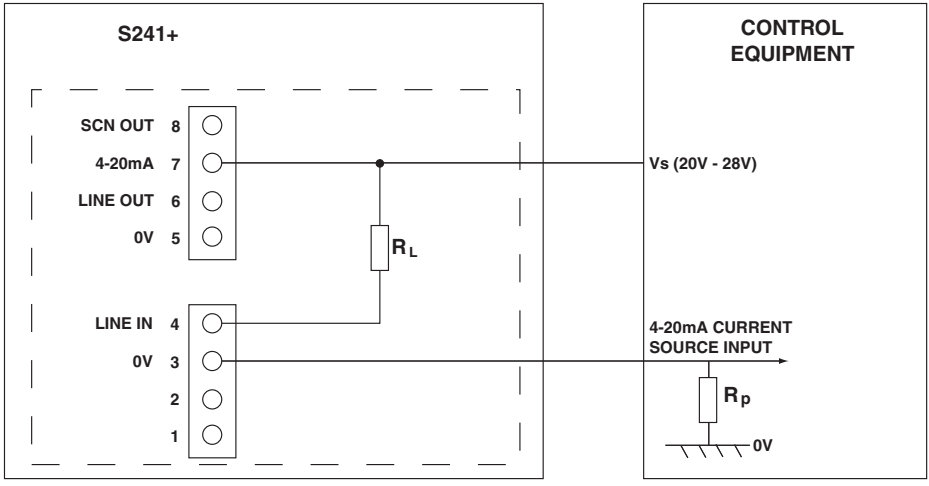
Le manuel en français est disponible sur le site Internet de Tyco Safety Products:

tycoemea.com

APPENDIX 1

1. TWO-WIRE CONFIGURATION FOR CONNECTING S241+ AS A CURRENT SOURCE DEVICE

Below is an alternative method of connecting the S241+ where the customer needs to connect the S241+ into a current source monitoring circuit. (It is an adaption with limitations, see below). It is recommended the S241+ is used wherever possible in a 4-20 mA current sink configuration. The following may be used for S241f+, or S241i+ in safe areas where no I.S. barriers are in circuit.



Signalling Currents:

DISCRETE SIGNALLING	
CONDITION	**CURRENT THROUGH Rp (TYPICAL)**
Fault	1.9mA (+0.7mA, 300ms wide pulse every 2 seconds)
Normal	4.9mA
Alarm	17.4mA + alarm LED current, see page 12

Table 7:

CONTINUOUSLY VARIABLE SIGNALLING	
CONDITION	**CURRENT THROUGH Rp (TYPICAL)**
Non-window fault	0.8mA (+0.7mA, current spike every 500ms)
Window Fault	2.4mA (+0.7mA, current spike every 2 seconds)
Normal	4.4mA
Flame Sensing	6.1 to 17.4mA + alarm LED current above 17.4mA, see page 12

Table 8:

APPENDIX 1

Notes:

1) *Because the signalling current is returned on the 0 volt line, it is important that this line is kept isolated from earth potential.*

2) *The two-wire configuration cannot be used in an Intrinsically Safe circuit through Zener Safety Shunt Barrier/Galvanic Isolator.*

When the S241+ alarm indicator (red) is activated, the current flowing in Rp will rise to approximately 28mA at 28V supply, due to the detector alarm LED current. The controller used must be capable of accepting this current overload.

Resistor RL connected between the 4-20mA and LINE IN terminals limit the alarm current. The optimum value of RL will depend upon the supply voltage and the panel 4-20mA input impedance Rp.

A value for RL suggested is 1k ohm (1W) for values of Rp of 10 to 250ohms. Maximum alarm current measured at Rp are 21 to 28mA (This is 17mA from 4-20mA current source and 4-11mA current taken by detector alarm LED. The approximate formula for calculating the total alarm current is:

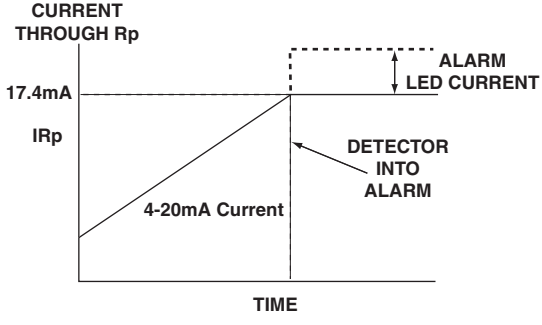
$$17.4\text{mA} + \left(\frac{Vs - 5}{R_L + R_P + 1.32} \right) \text{mA} \quad [R_L, R_P \text{ in kohms}]$$

The above assumes no remote LED connected. For Rp >250ohms (400ohms max.) Vs should be 22V (min.) to provide extra voltage to latch detector in alarm.

For Rp = 25ohms, *RL* may be increased to reduce the 4-20mA current in alarm. Measured values of IRp are shown below:

RL	IRp (Vs = 20V)	IRp (Vs = 22V)	IRp (Vs = 24V)
1k	23.6mA	24.5mA	25.3mA
2k2	21.4mA	22.2mA	22.7mA
3k3	20.2mA*	20.7mA*	21.1mA*

* Detector does not latch



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