Model 5710/5710SS High Temperature Transit Flame Sensor

MANUAL

INSTALLATION - COMMISSIONING

OPERATION - MAINTENANCE

DOCUMENT REF. D1259

Issue	Change	Date	Remarks
1	Original	13/05/2014	Approved KM
2	Contact details	27/11/2014	
3	DCN067	06/09/2018	Approved SW
4	DCN107	30/09/22	Approved MD

Contact Details:
Patol Limited
Archway House
Bath Road
Padworth, Reading,
Berkshire
RG7 5HR
Tel: +44 (0)1189 701 701
Fax: +44 (0)1189 701 700
Email: info@patol.co.uk
Web: www.Patol.co.uk

INDEX

1. INTRODUCTION

1.1 General

The Patol 5000 Series of equipment is specifically designed for the protection of establishments and systems where a movement of materials with a potential fire hazard is a routine occurrence.

The 5710 Sensor employs enhanced Infra-red monitoring technology that enables the detection of fire initiating materials, whilst they are being transported, at the ember and flame condition. The unit has ATEX rating IECEx **Ex d 11C T5 Gb Ex tb 111C T95°C Db** and thus may be installed in hazardous areas. The system has many applications within industries such as Power Generation, Coal Mining, Process Plant and Road / Rail Terminals and has been specifically designed to both meet the rigors of these environments and to provide the reliability required. The equipment monitors for fire and fire potential of materials in transit. The system can detect anomalies where combustion has not yet been reached, but where there is sufficient energy for a fire initiation upon destination arrival.

A typical example is in the coal feed systems on power stations where coal on the 'out field stack', may very well smoulder with little adverse effect for long periods of time. However, if imported to the power station it may have devastating effects on conveyor systems, holding hoppers, blending plants etc.

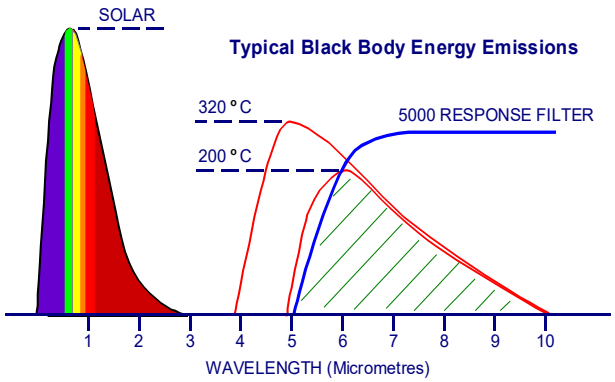
- Detection of hazards at temperatures greater than 220°C including both embers and buried hot spots.
- Air purged system for *Dusty* environments.
- Two wire operation - Powered by direct connection to standard fire trigger circuits or addressable loop interfaces, signalling mode user configurable to simulate smoke & heat detector protocols.
- Volt free relay contact output operation selectable as standard.
- Twin high integrity detection circuit channels for maximum reliability.
- Unique reflective cone lensing system provides wide uniform coverage.
- Coincidence - *Double Knock* - option for unit detector channels as standard.
- Timed auto reset / coincidence analyser circuit.
- Tuned response - solar blind.
- High degree of ingress protection - IP66.
- ATEX / IECEx approved.
- Specifically designed for high EMC compliance.

1.2 Principles

The principle of operation is that temperature dependant emissions occur for all materials. These emissions range through the infra red spectrum to visible light. Both the wavelength and level of peak energy emission are related to temperature.

The 5710 Sensors are designed to detect the changes in these emissions that occur when a hot body enters the field of view of the detector

By the use of both optical filtering and electronic analysis of the various parameters the system is blind to visible light from the sun or local luminaires, whilst being able to detect over temperature material moving through the field of view.



2. EQUIPMENT DETAIL

2.1 General Description

The 5000 Series system described here comprises two primary elements:-

- Sensor unit - Type 5710/ 5710SS
- Compressed Air Supply

The Sensor is located above the materials transit path (e.g. conveyor) by means of the adjustable mounting bracket and aligned such that the monitored hazard passes through the unit's field of view. The height and angle of the sensor determine the width of the monitored path.

The 5710 Sensor case is equipped with a 10mm hose fitting for connection of a compressed air supply. This is required such that a positive air pressure is maintained around the unit's sensor "windows".

There is a continuous air flow from the optical path visor which stops dust settling on the sensor 'glazed' optical aperture.

The air purging is essential in dusty environments such as coal conveyors, and is recommended in even relatively clean applications.

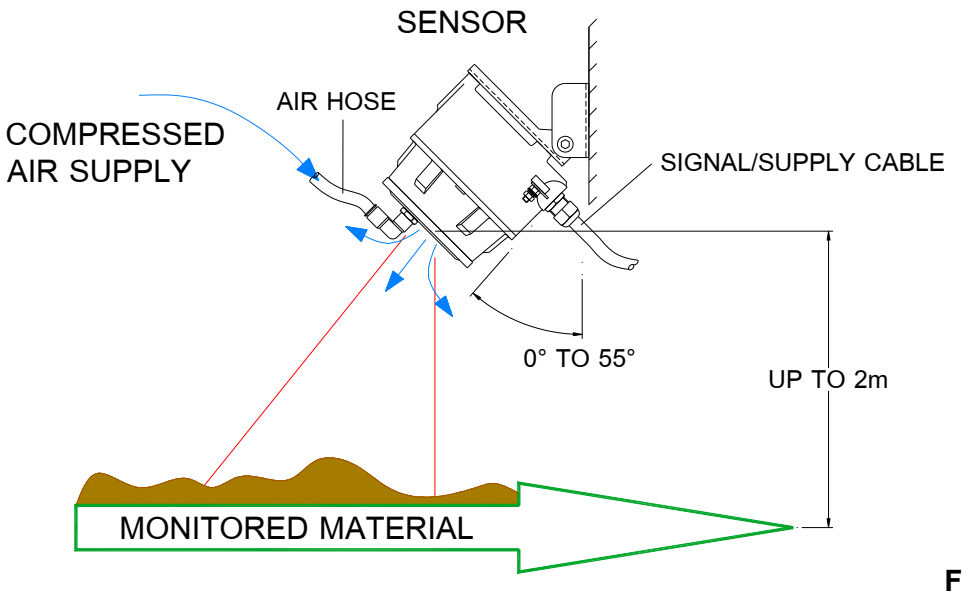


Fig. 2

The unit may be user selected to either of two principal operating settings which are referenced as :-

- "Relay Mode" - Operation from a 20 to 30 Vdc supply.
- "Low Power Mode" - Operation from a fire alarm trigger circuit / addressable loop.

A description of these arrangements is provided in sections 2.2 and 2.3 following.

2.2 Relay Mode

The unit is equipped with relays which are enabled in this mode.

A 24Vdc (nom) supply is required to operate the unit (max current 24mA).

The unit's Volt free relay contacts are used for signalling of Fire and Fault conditions.

The Fire relay is normally de-energised and energises on an Infra-red detection Alarm.

The Fault relay is normally energised and de-energises on power supply removal or module regulation failure. Fault relay signalling can also be arranged for loss of air supply if a pressure switch is employed.

Refer to Figure 3.

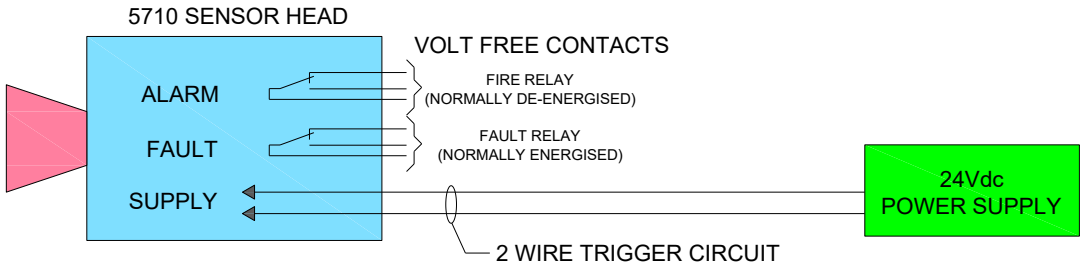


FIG.3

2.3 Low Power Mode

In this mode the relays are disabled and the unit's quiescent supply current is very low and of a similar level to conventional Smoke and Heat detectors.

By the connection of appropriate resistor values to the sensor's "solid state" outputs the unit will signal Normal, Fire & Fault conditions by line current levels, in a manner that permits the unit to be connected directly to fire control panels via alarm trigger circuits, or to the monitored inputs of Addressable Loop Interface Modules.

The unit can also be employed with the two wire connection to a remote Patol Signal Relay Module.

Refer to Figures 4 & 5.

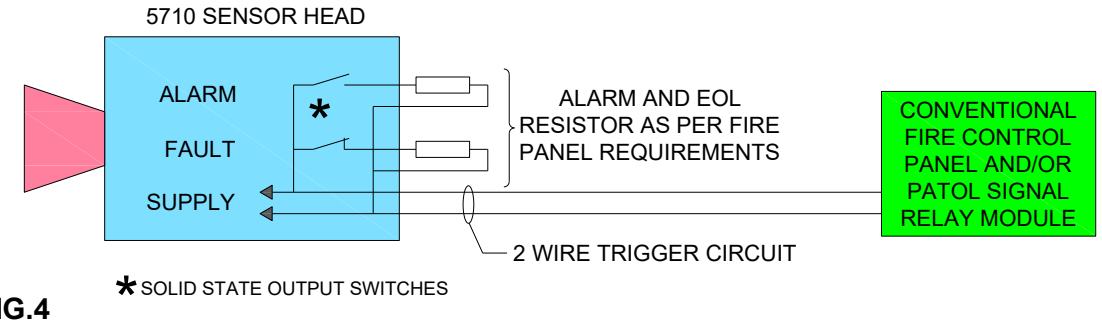


FIG.4

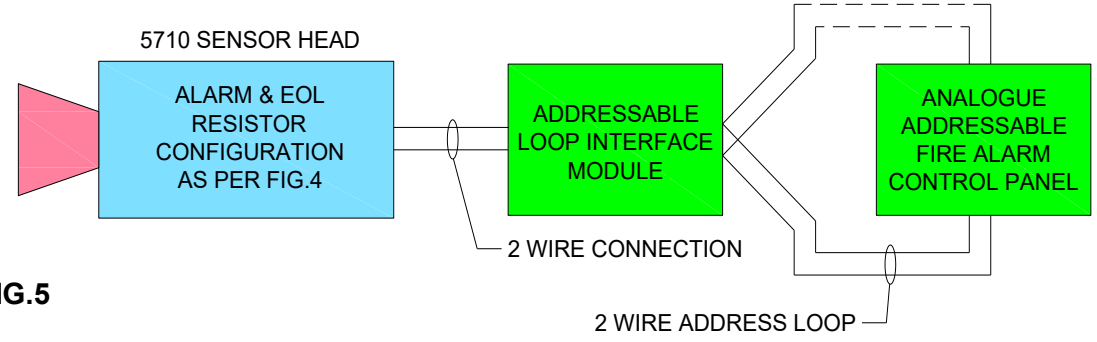
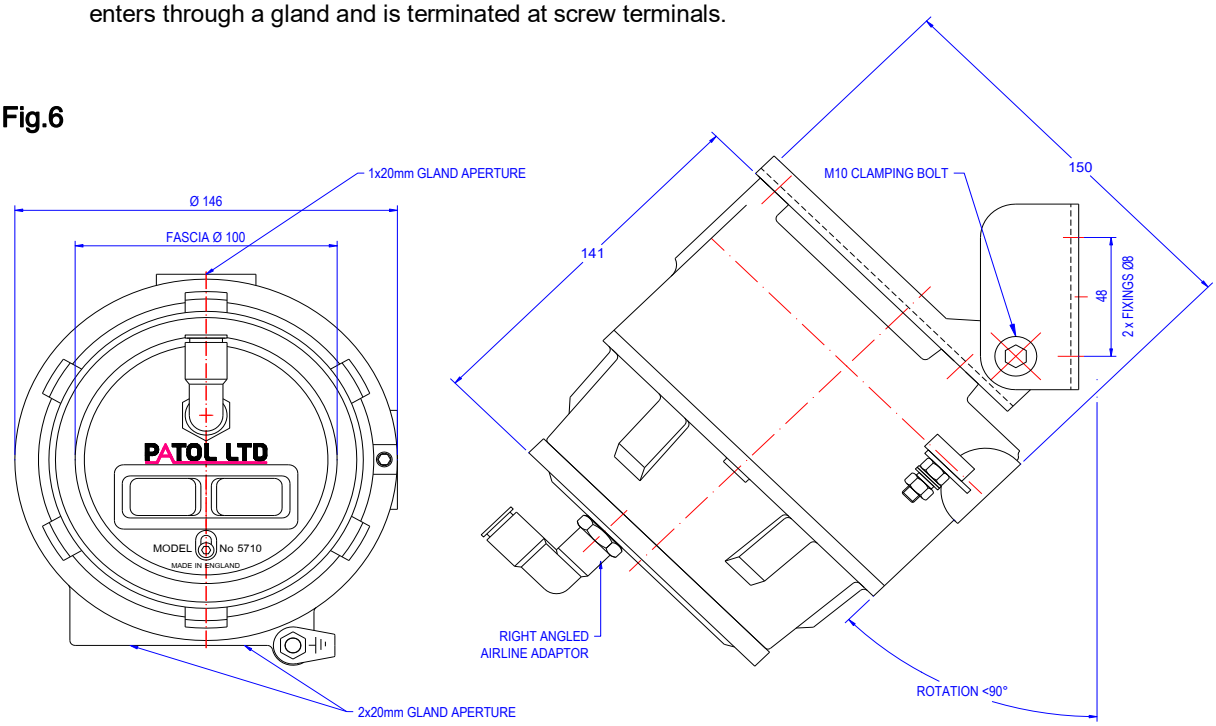


FIG.5

2.4 Sensor Arrangement

A dual detector channel sensing circuitry is located within an aluminium alloy enclosure (5710) or Stainless Steel (5710SS) which is mounted by means of an adjustable bracket permitting alignment in both vertical and horizontal planes. The housing is equipped with a 10mm compressed air hose adaptor. The signal cable enters through a gland and is terminated at screw terminals.

Fig.6



2.5 Specification

2.5.1 General

a)	5710 Outer Case:-	Material:	Aluminium Alloy
		Finish:	Red - RAL 3020
	5710SS Outer Case:-	Material:	Stainless Steel 316
		Finish:	Natural Finish
b)	Termination:-	Rising clamp terminals	
		Cable Core Size: 1.5mm²-16AWG	
c)	Temperature:-	-20°C to +60°C	
d)	Weight:-	3kg	
e)	Purge Air Supply:-	Pressure: 175 to 700 mBar (2.5 psi to 10 psi)	
		Minimum Delivery:	30 litres / min
		Input Fitting:	10mm Compressed Air Hose Adaptor

2.5.2 Internal / Maintenance Features - Accessed on removal of lid / fascia.

a)	Indications:-	2 off Red LEDs - One per sensor channel	
b)	Controls:-	Test Push-button	
		Reset Push-button	
c)	Program Switch:-	Sensitivity:	4 Levels
	(SIL 8 Way)	Alarm Operation:	'OR' / 'AND' - Latching / Auto-Reset
		Auto Reset Timer:	4 Settings

Specification - continued

2.5.3 Relay Mode - Direct Supply - Relays Enabled

a)	Supply Voltage:-	20 to 30 Vdc
b)	Supply Current:-	Standby - 9 mA
		Fire (Alarm) - 24 mA (max)
c)	Alarm Output:-	Fire Relay Contact - 1 pole change over - 30 Vdc 500 mA
		Normally De-energised
d)	Monitor Output:-	Fault Relay Contact - 1 pole change over - 30 Vdc 500 mA
		Energised Normal - De-energises on supply / air failure
		NOTE:- Air failure signalled if pressure switch employed

2.5.4 Low Power Mode - Line current signalling via Fire Alarm Trigger Circuit

a)	Supply Voltage:-	13 to 30 Vdc
b)	Supply Current:-	Normal / Standby - 350µA (plus EOL *resistor current)
		Fire (Alarm) - 5 mA (plus Alarm Load** resistor current)
		Fault - <350 µA
c)	Alarm Output:-	Solid state switch - Fit with Alarm Load** resistor
		Normally Off - Alarm Load switched across supply on fire
d)	Monitor Output:-	Solid state switch - Fit with EOL *resistor
		Normally On - EOL open on supply / air failure
		NOTE: - Air failure signalled if pressure switch employed

2.5.5 Detectors

a)	Configuration:-	2 off - Employing reflective cone optical focusing system	
		Coincident fields of view arranged as separate channels	
a)	Field Of View:-	+5°/-15°(along transit axis path) +/-38°(across transit path	
b)	Characteristic	Spectral Filter:	4.2 - 4.7 µm
		Sensitivity:	10 - 40 µW
		Transit speed:	0.5 to 6 m/sec 6.5 to 10 m/sec
		Response:	220 - 1000 ºC (399 - 1800 ºF)
		NOTE:- For conveyor speeds greater than 6m/sec the properties of the monitored material needs to be considered	

Exact response is dependant on the emissivity factor of the monitored material, sensor orientation and target speed. Above Response temperatures are nominal.

2.6 Operational Programmability - SIL Switch

An eight pole SIL switch is located within the unit which programs the unit's operation. Most of the various option features are for special applications, factory test, commissioning or maintenance purpose.

A summary of the switch functions is as follows:-

2.6.1 LED Operation - Pole 1

Normally the internal LEDs will only illuminate on 'Alarm' signalling. In the case of coincidence (double knock) operation the LEDs only illuminate when both channels have triggered. This is to avoid momentary increases in line current for single channel operations. For factory test and maintenance purpose Pole 1 of the switch allows the LEDs to individually illuminate irrespective of operating mode. Refer to Table 1.

2.6.2 Channel AND / OR selection. - Pole 2

The unit can operate such that detection by either sensor channel results on an alarm output (single knock / OR operation). Alternatively the unit may be set to an alarm output only occurs on detection by both sensor channels (double knock / coincidence / AND operation). Refer to Table 1 & 2.7.6.

2.6.3 Non-latching option. - Pole 3

The sensor channels normally latch on detection. A non-latching setting is available for maintenance, factory test and special application analysis. Refer to Table 1.

2.6.4 Auto Reset operation. - Pole 4

When in double knock mode an auto reset is applied after a preset delay.

This only occurs if only a single channel has operated within the delay time. If both channels have operated then the auto reset is prevented. The delay time is in effect the scan period for coincidence. An option to Auto Reset 'AND Alarms' is provided for maintenance test purpose. Refer to table 1, 2.6.5 & 2.7.6.

2.6.5 Auto Reset Delay (Scan Period) - Poles 5 & 6

The duration is set by these switch poles. Refer to Table 2.

2.6.6 Sensitivity. - Poles 7 & 8

The unit detection level sensitivity is set by these switch poles. The range approximates to 10 - 40 µW. Refer to Table 3.

Table 1.

Pole		FUNCTION
1	OFF	Channel LED's only illuminate on alarm
	ON	Channel LED's illuminate before Double Knock alarm
2	OFF	Double Knock - Coincident Output
	ON	Single Operation - OR - Output
3	OFF	Latching Operation
	ON	Non-latching Operation
4	OFF	Only single detections auto-reset after scan period
	ON	All detections auto-reset after scan period

Table 2.

Pole	AUTO RESET DELAY - SCAN PERIOD							
5	OFF	2.6 s	OFF	1.3 s	ON	0.9 s	ON	0.6 s
6	OFF		ON		OFF		ON	

Table 3.

Pole	SENSITIVITY (A=Most : D=Least)							
7	OFF	A	OFF	B	ON	C	ON	D
8	OFF		ON		OFF		ON	

2.7 Connections

2.7.1 Relay Mode - Direct Supply - Relays Enabled

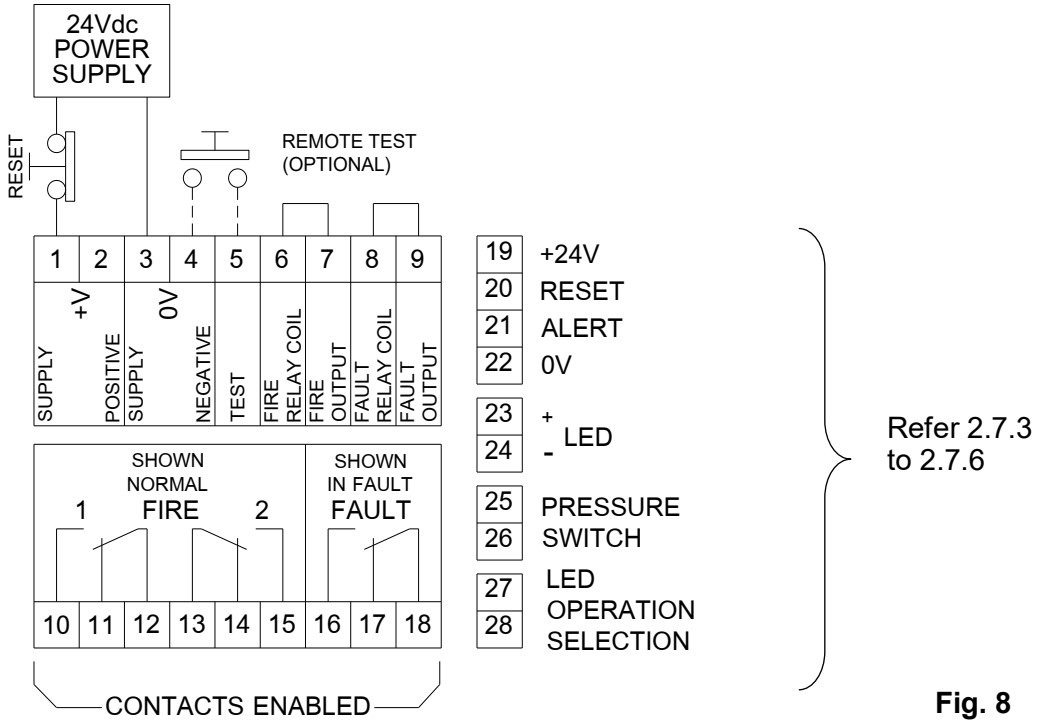


Fig. 8

2.7.2 Low Power Mode - Relays Disabled

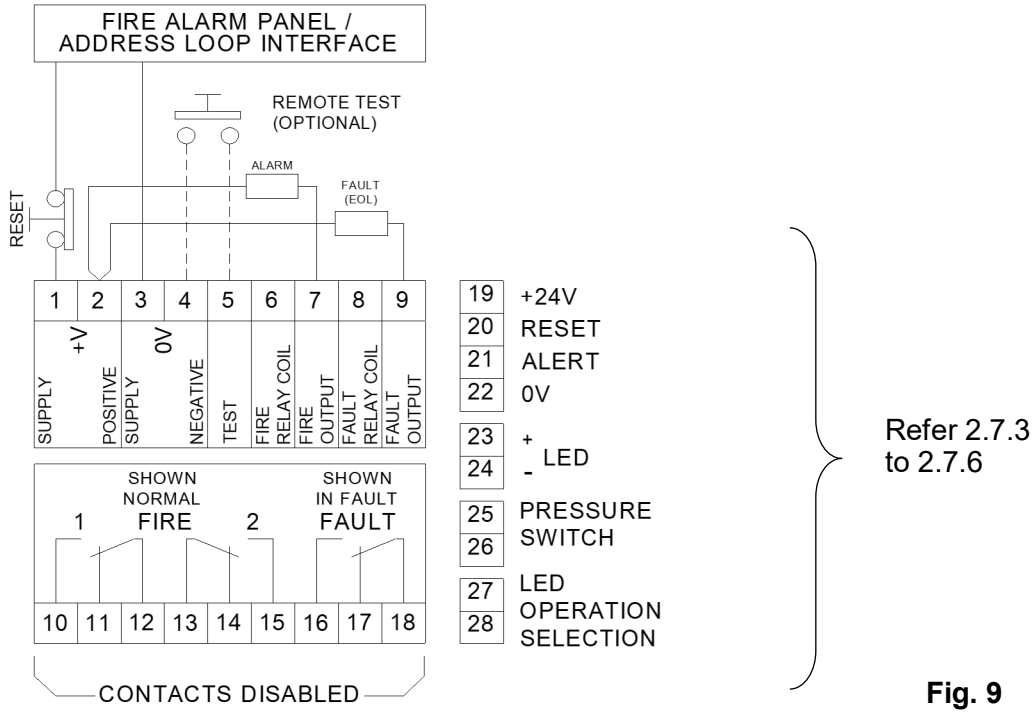


Fig. 9

2.7.3 Normal LED

An LED indicating normal operation may be connected at terminals 23/24.

The LED is illuminated under normal conditions. When terminals 27/28 are open the LED extinguishing on either electrical supply Fault or air pressure failure. When terminals 27/28 are linked the LED extinguishes on electrical supply Fault only.

The output is constant current regulated at 1.5mA. A low current LED may be connected in both relay and low power modes. In the latter case the 1.5mA LED current should be taken into account when determining the value of the EOL resistor appropriate to any control panel monitoring circuit employed.

2.7.4 Pressure Switch

The compressed air supply may be monitored by connection of a pressure switch at terminals 25/26. The switch must be normally closed - opening on air supply failure.

If no switch is employed terminals 25/26 should be linked.

2.7.5 Auxiliary / Local Reset Push-button

A normally open Reset Push-button may be connected at terminals 20/22. (The signal at terminal 22 is switch low / 0V)

2.7.6 Alert Output

A signal at terminal 21 is in effect an open collector switch low (0V) on either channel detection. This output occurs even if the unit is set for coincidence Alarm operation and may be considered as an Alert which will operate for the duration of the scan period, with Auto-Reset if coincidence condition does not occur. Also refer to 2.6.2 & 2.6.4.

In Relay Mode the output may be used for example for connection of a 24V indicator between terminals 19/21.

In Low Power Mode it is likely that the maximum permissible non-alarm current parameter of the control equipment monitoring (trigger) circuit will preclude the use of this output.

2.7.7 Local Alarm Indicator

When in Relay Mode one of the sets of alarm contacts may be employed to switch a local Alarm LED or Lamp.

In Low Power Mode the indicator should be integrated with the alarm resistor connection at terminals 2/7. The voltage and current of the device must be appropriate to the alarm current parameter and load characteristic of the control equipment monitoring (trigger) circuit.

3. INSTALLATION

3.1 Detection Coverage

The angle and height of mounting determine the monitored width.

Fig. 10

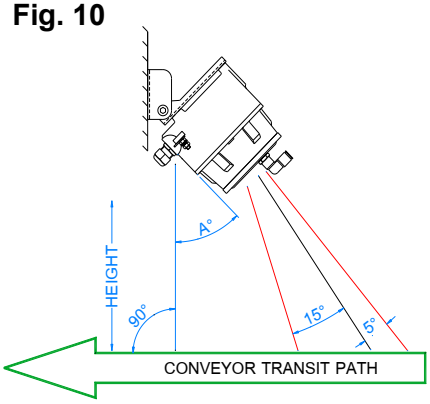


Fig. 11

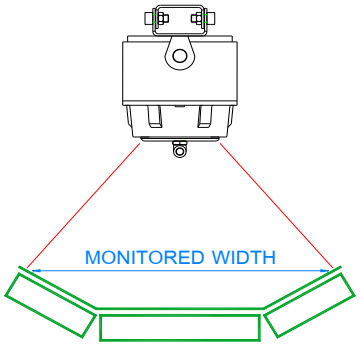
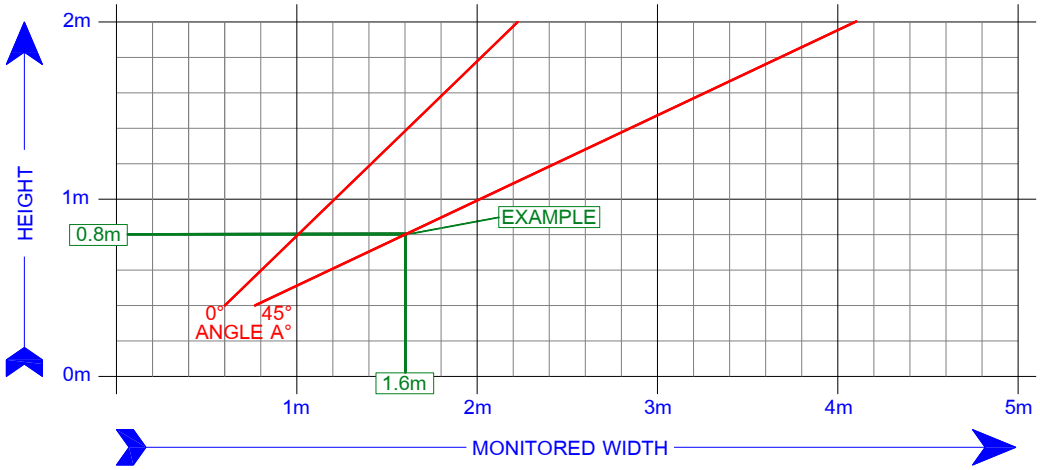


Fig. 12

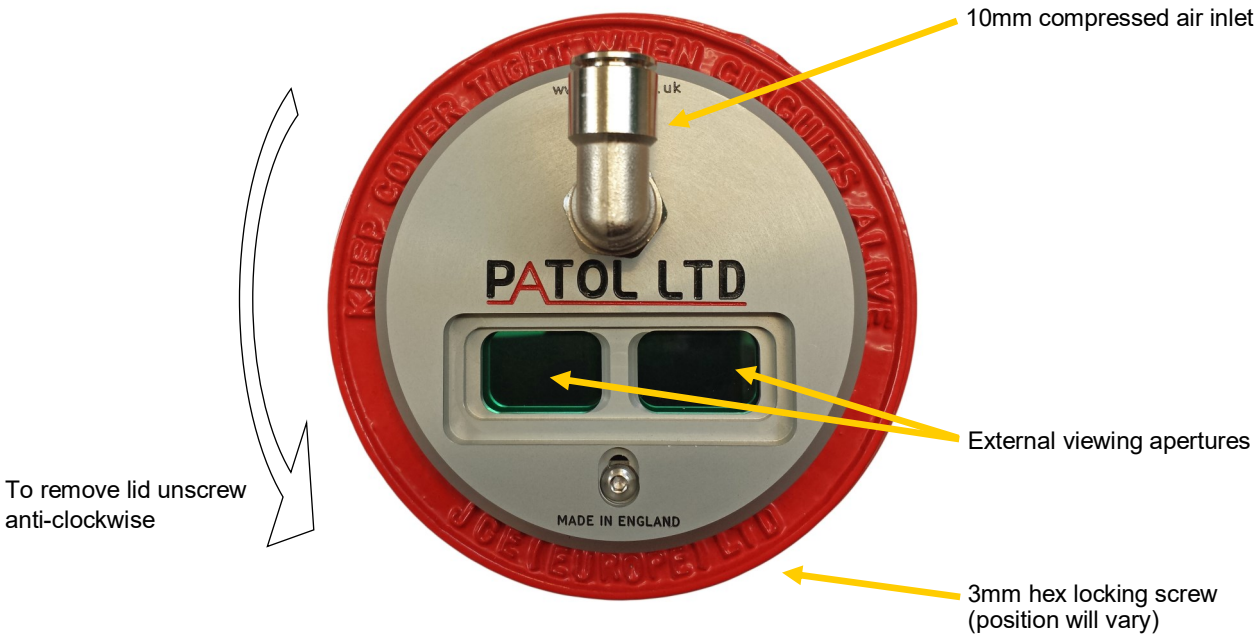


The example shown on the chart is for a sensor mounted 0.8m above the transit path at an angle 'A' of 45°. This provides a maximum monitored width of 1.6m which would be suitable for most conveyors. Should the most practical mounting height (e.g. 1m) produce a wider view field than the conveyor this is perfectly acceptable, so long as the "overlap" on each side is not so large that external hot targets, such as vehicles on an adjacent roadway, are within the units view.

3.2 Supply / Signal Cable

The 5710 Sensor outer case has 3 x 20mm cable entries as standard, Cable terminations are made at rising clamp screw terminal connectors located within the inner module. The terminals accept wires of up to 1.5mm² (16AWG). Refer to section 2.7 for connections.

To access the terminals it is necessary to remove the lid / fascia and the internal detector assembly. This is achieved by releasing the outer locking 3mm hexagonal grub screw, then unscrewing the lid. To remove the internal detector assembly, unscrew the two fixings labeled A & B (see Fig. 13). The detector assembly is connected to the termination board via a ribbon cable and plug / socket.



When refitting the inner sensor assembly ensure the external viewing apertures are positioned above in line with the detection sensors.

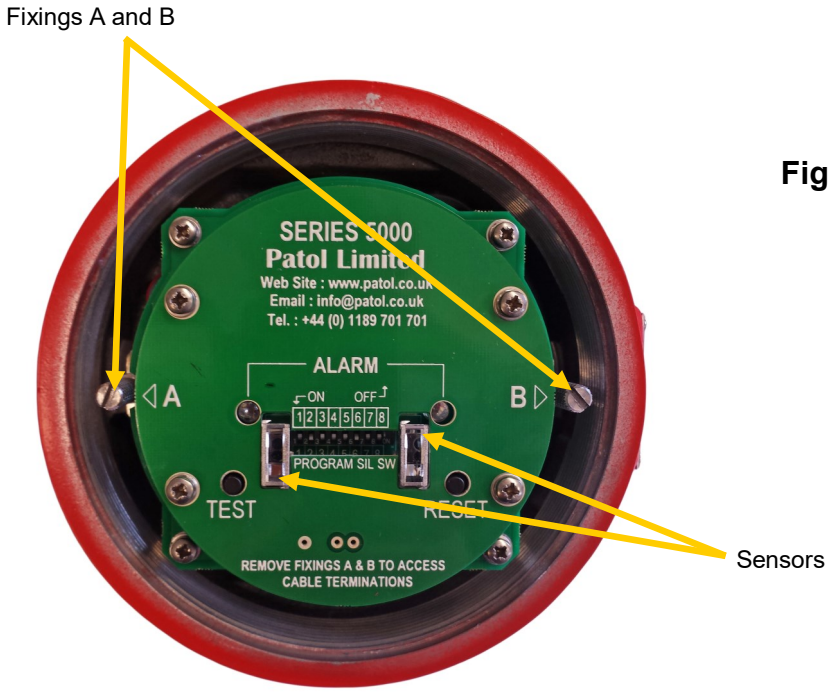


Fig. 13

3.3 Purge Air Supply

The unit is equipped with a fitting for connection to a 10mm compressed air flexible hose.

The air supply must be capable of delivering at least 30 ltrs / min at this connection and have a pressure of 175 to 700 mBar (2.5 to 10 PSI)

4. COMMISSIONING

4.1 Cable Checks

The installation wiring should be checked for correct connection, continuity and insulation.

For relay mode implementation the relay coil link connections at terminals 6/7 & 8/9 should be checked. Refer to Figure 8 section 2.7.1.

For Line Powered (trigger circuit) Mode the Alarm resistor at terminals 2/7, and EOL (end of line) resistor at terminals 2/9 should be checked for both correct value and fitment. Refer to Figure 9 section 2.7.2.

Terminals 25/26 should be linked if appropriate.

4.2 Unit Set Up

The program SIL switch must be set for the required operation.

The setting below is for double channel coincidence detection with a 1.3s scan. The unit latches on coincidence Alarm until manually reset.

The detection sensitivity is set to level B.

POLE 1	POLE 2	POLE 3	POLE 4	POLE 5	POLE 6	POLE 7	POLE 8
OFF	OFF	OFF	OFF	OFF	ON	OFF	ON

4.3 Power Up Procedure

Note 1: The unit has three signaled / output states which are monitored by remote equipment. These are referenced as Normal - Fire - Fault in the following.

For Relay Mode:	Normal =	Fire relay de-energized & Fault relay energized
For Low Power Mode:	Normal =	EOL resistor connected across trigger circuit.
	Fault =	EOL resistor disconnected from trigger circuit.
	Fire =	Alarm resistor connected across trigger circuit.

Note 2: The tests of 4.3.2 & 4.3.3 can only be conducted with the enclosure lid / fascia open. This may not be permissible in hazardous areas in which case go straight to 4.3.4.

4.3.1 Apply power to the Sensor. (Connect supply or trigger circuit)

Check supply = 20 to 30 Vdc for Relay Mode or 13 to 30 Vdc for low power mode.

4.3.2 Operate Sensor Test PB - Check: Sensor Alarm LEDs A & B illuminate.

Operate Sensor Reset PB - Check: Sensor Alarm LEDs A & B extinguish.

4.3.3 A general check of Sensor field of view may be conducted at this stage whilst the module LEDs, Reset PB and SIL switch is still accessible. Refer to section 4.4.

For “Single Knock” mode Pole 3 may be set ON for non-latching alarms.

For “Double Knock” mode Pole 4 may be set ON for auto-reset.

The SIL switch must be returned to the setting of 4.2 before proceeding to 4.3.4.

4.3.4 Fit Sensor lid and connect compressed air hose.

4.3.5 Check at the Sensor that purge air is blowing from the optical aperture.

4.3.6 Momentarily remove the electrical supply and check that the unit signals Fault for the duration of the supply interruption.

4.3.7 If an air pressure switch is employed, momentarily interrupt the air supply and check that the unit signals Fault.

4.4 Hot Body Simulation Tests

A heat simulation test should be conducted.

The test is conducted by moving a “hot” (IR emitting) target into the view field of the Sensor Head and observing / checking the consequential Alarm operation.

It is preferable that the “test target” is of sufficient size and temperature that the simulation can be conducted at the plane of the monitored path (conveyor) such that the view field of the Sensor can be validated. However, a smaller and cooler “test target” may be employed so as to at least confirm basic operation of the sensor. It will be necessary with a “target” of this nature to introduce it to the view field nearer to the Senor than the “monitored plane”.

When the 5710 Sensor is connected to a Fire Panel via a conventional trigger circuit or Addressable Loop Detector Interface, latched 5710 detections are normalized by Alarm Reset operation at the Fire Panel. Similarly, when in Relay Mode, reset is conducted by momentary supply interruption by an external push-button or other means.

Field of view test confirmation (which requires a number of Alarm triggers) may more easily be conducted when the unit’s covers are removed and the internal LEDs, Reset PB and program SIL switch are still accessible. Refer to section 4.3.2.

If the location of the Sensor is classified as a “Hazardous Area” it will be necessary to make special arrangements for this testing as the electrical / hot nature of the test simulation may breach normal site regulations. It may even be that the test is precluded.

Refer to section 6.3 for information on “test targets”.

5 OPERATION

5.1 Normal

- Relay Mode:- Fault relay energized. Fire relay de-energized.
- LP Mode:- End of Line resistor connected across trigger circuit.

5.2 Alarm Condition

An Alarm condition will occur on abnormal Infra-red detection by the Sensor Head.

Normally this status will Latch On, however in special configurations the condition can be set to momentary operation - Auto Resetting after a selected delay.

During the ALARM:-

- Either or both internal red LED indicators illuminated.
- Relay Mode:- Fire relay energized.
- LP Mode:- Alarm resistor switched across trigger circuit.

5.3 Reset

Latched Alarm conditions may be normalized by:-

- Momentary interruption of the supply - less than 7V.

  When directly connected to a Fire Panel via a trigger circuit or Addressable Loop Interface this condition will occur on Fire Panel reset operation.

  A local or remote normally closed push-button may also be implemented.
- Operation of the internal Reset push-button.

5.4 Fault Warning

- Relay Mode:- Fault relay de-energized
- LP Mode:- End of line resistor disconnected from trigger circuit.

A Fault warning may occur for any of the following:-

- Low / failed supply.

  Supply less than 20V in Relay Mode.

  Supply less than 13V in LP Mode.

(Note:- An Alarm will remain latched below the Fault threshold so long as the Reset Voltage is not reached.)

- Unit internal power regulation circuit Fault.

The output will automatically normalize on rectification of the Fault.

5.5 Test

Operation of the sensor's internal Test push-button simulates an Alarm as per 5.2.

A remote test push-button has identical result if implemented.

6. MAINTENANCE

6.1 General

It is recommended that a System Log Book / File is raised at the Commissioning Stage and that the system configuration and initial settings recorded. These should include:-

- Operation configuration and Sensitivity - SIL switch set-up.
- Supply Voltage.

Subsequently all system events should be recorded in the log.

These should include all maintenance activity, changes to settings, Fault warnings and Alarm occurrences. (including cause and actions taken)

An operational regime should be developed that includes both frequent inspection of the Sensor for undue accumulation of dust, and to confirm air (blower) operation. The regime may encompass use of the Test facility to check basic operation.

In addition, the system should be subjected to a '**periodic service'** as defined in the following.

6.2 Fault Monitoring Functions

A test should be conducted to confirm the correct operation of the Fault monitoring circuits:-

Supply Failure - Check as per 4.3.6

6.3 Infra-red Detection

A Heat Simulation Test should be conducted by moving a "hot" (IR emitting) target into the view field of the Sensor and checking the consequential Alarm operation.

It is preferable that the "test target" is of sufficient size and temperature to enable simulation at the plane of the monitored path (conveyor) in order to validate the view field of the Sensor. Smaller and / or cooler "test targets" may be used closer to the Sensor so as to at least confirm basic operation of the Sensor.

Fig.7 in Section 2.5 indicates the relationship between the surface area and temperature required for triggering at the various trip settings.

In hazardous areas it may be necessary to make special arrangements for this testing as the electrical / hot nature of the test simulation may breach normal site regulations. It may even be that the test is precluded.

Potential "test targets" are:-

Type 5503 Infra-red Radiator - Test and Commissioning Platen - Patol product.

Type 5502 Infra-red Radiator - Test and Commissioning Wand - Patol product.

Note : Infra-red LED Torches are <u>NOT</u> suitable for testing 5000 Series equipment.