INFRA-RED FLAME DETECTION

FlameVision

FV300 SERIES IR ARRAY FLAME DETECTORS

USER MANUAL

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1. INTRODUCTION

The FV300 *FlameVision* range is a new family of advanced, high technology infra-red array flame detectors with reliable wide area flame detection and excellent false alarm immunity. The FV300 *FlameVision* detectors offer a major improvement in both flame detection capability and immunity to false alarm sources over triple IR detectors. The detector can be supplied with an optional built-in colour video camera for connection to CCTV systems to display the field of view with an overlay showing alarm location and status information. All FV300 models provide fire and fault relays, 4-20mA output and a field network interface as standard for connecting to external equipment.

The FV300 *FlameVision* detectors use an array of 256 sensitive infra-red sensors to view the protected area. The IR array is combined with 2 other optical sensors to provide 3 highly sensitive optical channels. Powerful algorithms running on a Digital Signal Processor (DSP) are tuned to the characteristics of a fire and analyse the signals from these 3 channels to reliably identify fires. The FV300 offers sensitive flame detection over a long range with a wide and consistent field of view. It also has excellent immunity to false alarms.

One of the key advantages of using an array is that the detector can identify the location of the flame within the field of view. The location information is used to overlay a marker on the live camera image to highlight the fire. The user can quickly see the location of the fire and decide on the appropriate action. The location information is also available on the field network interface.

The FV300 *FlameVision* range is highly configurable to provide flexible detectors for all applications. The most common options are set using DIP switches with more advanced options set using a PC tool. The detectors also include features designed to reduce maintenance, including remote configuration, internal diagnostic logs and built-in alarm and window cleanliness tests. A portable test tool, suitable for use in hazardous areas is available to operate the alarm and window test facilities remotely.

The FV300 *FlameVison* detectors are housed in a rugged stainless steel enclosure suitable for harsh environments. All detectors share the same detection circuitry, optics and mechanics and the choice of two back box variants gives two basic flameproof (explosion proof) flame detector models. The FV311S series features cable gland entries and integral cable termination facility. The FV312S series features a sealed back box with cable for connection of field wiring via an EExe junction box.

Each model is available in three variants depending whether the detector is fitted with an internal CCTV camera and which type of camera is fitted. The range of variants includes:

FV311S	Cable entries	No CCTV camera
FV311SC	Cable entries	PAL CCTV camera
FV311SC-N	Cable entries	NTSC CCTV camera
FV312S	Sealed back box	No CCTV camera
FV312SC	Sealed back box	PAL CCTV camera
FV312SC-N	Sealed back box	NTSC CCTV camera

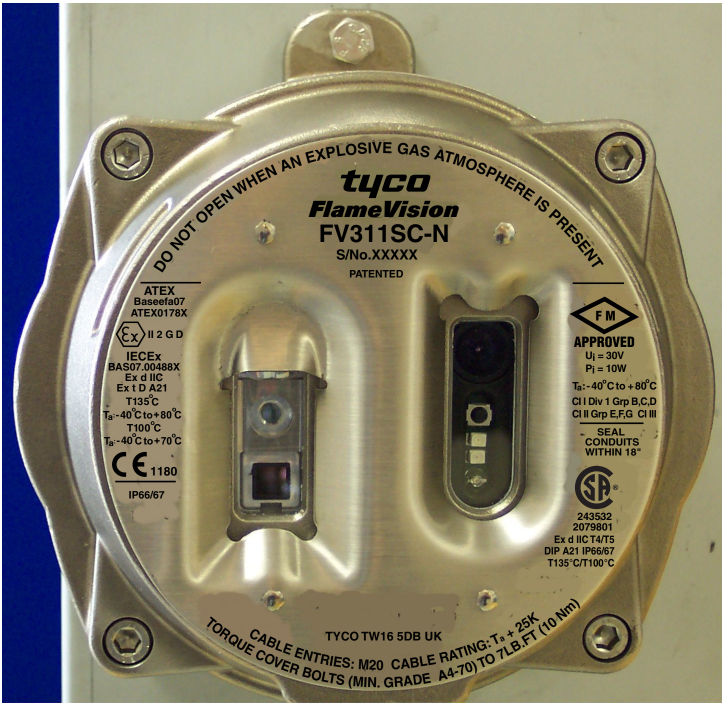


Fig. 1 FV300 Series Detector - General View

Summary of features:

- Advanced array based detector
- Powerful signal processing on DSP with algorithms to give reliable flame detection
- Detection range: Over 50m for 0.1m^2 n-heptane pan fire
- Field of view: 90° horizontal, 80° vertical with full range maintained
- High immunity to false alarms
- Solar blind
- Built-in video camera (option): View protected area with alarm location and status overlay
- Masking of areas in field of view
- Self-test: Automatic Self-test of detector features
  : Window test (automatic/manual/remote operation)
  : Alarm test (automatic/manual/remote operation)

Electrical Interfaces (Standard on all models):

- Fire and Fault relays (NO or NC contacts)
- 4 - 20 mA (Source or Sink)
- Video twisted pair balanced line (NSTC/PAL)
- Modbus (RS485) interface
- Configuration port (RS485)

2. PRINCIPLES OF OPERATION

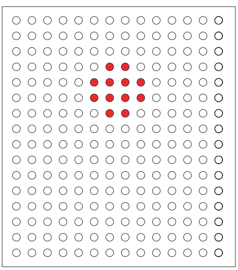
2.1 GENERAL

In order to optimise the detection of flames from hydrocarbon, the FV300 detectors analyse radiant infrared energy at the peak carbon dioxide emission wavelength around 4.5µm. In a separate guard channel, the detectors also sense additional wavelengths between 4.8 and 5.8µm to determine whether the spectral content received possesses the signature of a real flame. The signal received is further analysed to determine whether its modulation frequency has the irregular and quasi-random characteristic of a flame within a pre-determined frequency band. A powerful Digital Signal Processor (DSP) is continuously analysing the radiation signals to detect a fire.

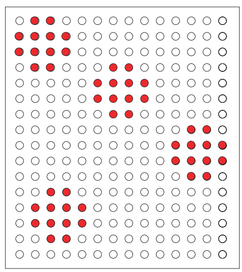
2.2 ARRAY-BASED FLAME DETECTION

The field of view of the detector is scanned by a 16 by 16 array of highly sensitive pyroelectric sensors. A sapphire convergent lens collimates the infrared energy onto the surface of the array. A precise narrow band interference filter centred at 4.5µm then eliminates unwanted wavelengths.

If the signal received is of sufficient intensity to form a detectable image on several elements on the array, called a cluster, the DSP analyses their frequency characteristic as well as their correlation and spectral ratio with the signal present on the guard channel. A value representing the instant probability that a real fire is present, results from this calculation. This probability value is then analysed over a period of time to confirm whether a flame has been detected.



SINGLE ACTIVE ARRAY CLUSTER



MULTIPLE ACTIVE ARRAY CLUSTERS

Fig. 2 Array Cluster

By using an array as the sensing component, the FV300 detectors are able to locate the angular position of the fire within the field of view. The detectors use this information to provide superimposed location information on a composite video output from an internal CCTV camera and to signal the coordinates of this location on its field bus data output. The array, together with its optical components and software intelligent interpolation gives the detector an angular resolution of better than 0.5 degrees.

Array-based detection also enables the FV300 detectors to identify several separate radiation sources within its field of view. For practical purposes, the number of separate detectable sources that are reported has been limited to the four strongest, with information on these available on both video and field bus outputs.

Fig. 3

Another advantage of array-based detection is that non-flame interferences, eg, black body or light sources, can be uniquely identified to within an area of the field of view. This ability to separately analyse signals from flame and non-flame sources enables array based flame detectors to not be desensitised in the presence of non-flame interferences, unless such sources are physically coincidental. It also enables a known but unwanted source of radiation that is likely to be present in the field of view of the detectors, to be ignored by applying of a ‘software’ mask to the signal processing but still detect fires in the rest of the area.

2.3 REJECTION OF NON-FLAME SOURCES

2.3.1 GENERAL

In a new concept for eliminating nuisance alarms from modulated blackbody and other unwanted non-flame radiation sources, the FV300 employs a combination of multiple spectral analysis and time domain analysis techniques.

2.3.2 BLACKBODY REJECTION

A measure of the radiated energy in the CO_2 emission waveband, between 4.4µm and 4.7µm, and in a higher waveband, between 5µm and 5.7µm, provides a means to discriminate real flames from blackbodies. Unfortunately, most fuels do not have a clean burn and, except for a distinctive peak at the carbon dioxide emission wavelength, possess a characteristic more akin to that of a blackbody, exhibiting the distinctive CO_2 atmospheric emission band as well as a significant emission beyond 4.7µm.

To ensure that flames from all potential fuels are detected whilst minimising the risk of nuisance alarms, an optimum spectral signature of a flame, defined by its ratio at the two measuring wavebands (A/B in Fig. 4) has been established experimentally by lighting characteristic fuels at different distances. This was compared with a similarly obtained blackbody ratio (C/D in Fig. 5), enabling an optimum flame decision threshold to be defined.

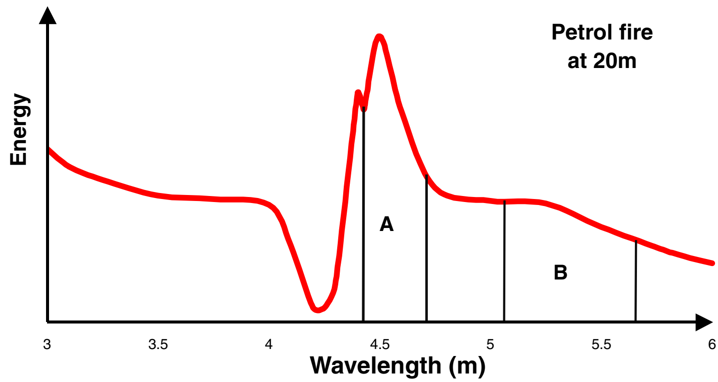


Fig. 4 Measured Flame Spectral Characteristics

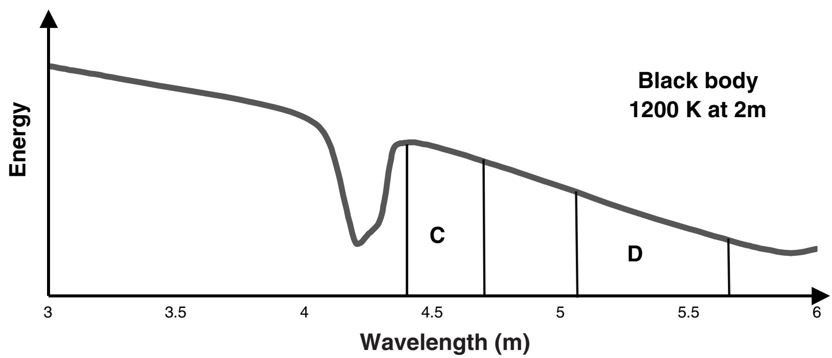


Fig. 5 Measured Blackbody Spectral Characteristics

In addition to the above spectral analysis, the modulated infrared energy seen by each activated cluster of the array is further analysed for frequency irregularities over a period of time that would be typical of that of a flame, but not a blackbody source. With this sophisticated level of signal processing, the FV300 *FlameVision* range of detectors offers a high degree of immunity to all blackbody sources likely to be present in the application.

2.3.3 IMMUNITY TO SOLAR RADIATION

Modulated radiation from direct or reflected sunlight as well as modulated radiation from strong sources of artificial lighting can produce an unwanted response from infrared flame detectors. To counter this possibility, the FV300 detector looks for the flame in a very narrow waveband where most of the sun radiation is absorbed by CO_2 gases in the atmosphere. Secondary re-radiation effects from sun heated optical components is minimised by an additional long wave IR filter on the guard channel and a special sun-block coating on the array lens.

To further eliminate the risk of unwanted alarms from modulated sun radiation or radiation from sources of artificial lighting, the FV300 incorporates a third sensor looking specifically for radiation in the visible and short wave infrared band. The output signal from this sensor is mixed with that of the long wavelength infrared filter to operate as a spectral guard for modulated sunlight or any other strong artificial lights.

2.4 DETECTION RANGE

The FV300 *FlameVision* detectors can detect a fully developed 0.1 m^2 n-heptane or petrol (gasoline) fire at 50m. The collimating optics and the ability of the detector to separately process signals from individual sensing elements of the array enables the detector to correct signal losses due to off-axis incident angles. This results in a 'flatter' response throughout the detector field of view. Performance details are given in the System Design Information section.

2.5 MULTIPLE FIRES DETECTION

The FV300 sensor array, together with its associated digital signal processing, can identify more than one fire event occurring at the same time within the detector field of view. At any one time, up to four alarms from the strongest flames can be reported and signalled. Fires that are sufficiently close or in the same line of sight will generate merged activity clusters on the sensor array and can only be identified as a single fire event.

2.6 DETECTION OF FLAME IN THE PRESENCE OF BLACKBODY

The ability of the detector to identify and process multiple activity clusters within its field of view allows radiation signals from fire sources and blackbody sources to be analysed separately for both their spectral and time domain signature. Thus, in the presence of modulated blackbody sources, the detector will not generally be desensitised when responding to a fire event. In some applications, large blackbody sources may overshadow areas of the field of view where detection is required. In these cases, care should be taken in the number and positioning of detectors that are needed for achieving the degree of protection required.

3. APPLICATION

3.1 GENERAL

The FV300 *FlameVision* 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 or metals, and should not be used for such risks without satisfactory testing.

The FV300 detectors, by virtue of their construction and rejection of spurious radiation, are suitable for use indoors and outdoors in a wide range of applications. The System Design Information section gives system design recommendations and the Installation section, installation recommendations.

3.2 USE IN HAZARDOUS ATMOSPHERES

The FV300 FlameVision detectors are certified 'Flameproof' to the ATEX directive and IECEx by Baseefa. They are classified as suitable for zone 1 and 2 areas over an ambient temperature range -40°C to +80°C for temperature class T135°C (T4) gasses and dust, or -40°C to +70°C for temperature classification T100°C (T5) gasses and dust. See System Design - Section 4.9 for certification and marking details.

The FV311 detectors are also certified ‘Explosionproof’ by Factory Mutual (FM) approvals. The FV311 detectors meet the requirements of FM 3600 and FM 3615 and are suitable for hazardous locations Class 1 Division1 Groups B, C and D, Class 2 Groups E, F and G and Class 3.

3.3 FEATURES AND BENEFITS OF THE FV300 *FlameVision* DETECTORS

The FV300 Flamevision detectors are a family of advanced, high technology array based infra-red flame detectors. They have been designed to give reliable wide area flame detection with excellent false alarm immunity. The FV300 detectors also have a wide range of features to provide a flexible detector that can operate in all environments and can be connected to many different types of system.

Summary of FV300 FlameVision features and benefits:

Detection:

- The FV300 provides high sensitivity flame detection with high false alarm immunity, undiminished throughout a wide field of view.
- An infra-red array combined with 2 other optical sensors provides 3 sensitive optical channels. Signals are analysed by powerful algorithms running on a DSP to give reliable flame detection. The algorithms have been extensively proven with real fires.
- Operational range 50m (0.1m^2 heptane pan fire) with no reduction in range across the 90° horizontal and 80° vertical field of view.
- Consistent detection of different sizes of flames from a wide range of hydrocarbon fuels from alcohol to aviation fuel (JP4 and JP5).
- Excellent false alarm immunity. Proven to be immune to common radiation sources (continuous or modulated) such as halogen lamps, welding, heaters, etc.
- Solar blind.
- By using an array, the FV300 can locate the flame within the field of view and displays the information on the video overlay to pinpoint the location of the fire enabling more effective counter measures to be taken. The location information is also available on the network interface for use in external systems.
- Software Field of View Masking: The array can locate and track active known permanent sources, such as a flare stack, within the field of view. The detector can be configured to ignore such sources, including flames, in a certain area of the field of view. External, physical blinkers and shutters are not required.

Interfaces:

- Fire and fault relays, 4-20mA output and a field network (RS485) interface are standard on all models to connect to monitoring equipment.
- Modbus protocol is supported on the field network interface to connect to PLCs.
- Internal wide angle CCTV camera (optional) covering detection field of view. With a video output (balanced line) to connect to on-site video monitoring (CCTV) system. Detector overlays identification information on the video image to show alarm location and details.

Functions:

- Window heater standard on all models to reduce misting.
- Flexible configuration: Primary options on DIP switches such as alarm delay timings, fire/fault latching, etc. Advanced options set using PC configuration tool such as mask area, network parameters etc.
- Regular self-testing of critical electronic circuits and regular monitoring of the detector window cleanliness and optical path monitoring (OPM) which reduces the frequency of regular maintenance visits.
- Integral flame simulation for verification of detection path enabling either easy walk-testing of the installation or testing by remote control to ensure continued reliability of the detector operation.
- Diagnostic logs: The detector keeps a log of all events, alarms etc. This information can be read remotely using the configuration tool for maintenance purposes.
- Hand-held walk test tool available to initiate alarm and window tests and reset detector on demand. Tool can activate detectors from up to 6m away so can be used without poles or other access methods. Walk-test tool is ATEX approved by Baseefa and can be used in hazardous areas.

Mechanical:

- Rugged two part stainless steel 316L housing sealed to IP66/IP67 for use in harsh environments.
- Choice of gland entry back box with terminal blocks for direct field wire termination or sealed entry back box fitted with a flying lead to connect to an external EExe junction box.
- Optional mounting bracket in 316L stainless steel allows 90° adjustment in both horizontal and vertical plane and includes angular markings.
- Detector ATEX and IECEx certified (‘Flameproof’) by Baseefa.

The FV300 FlameVision series are infrared flame detectors giving the FV300 major benefits over detectors working in the visible or ultra-violet regions of the spectrum, such as UV detectors or video flame detectors. These include:

- Highly sensitive to flame, thus increasing probability of early detection of hydrocarbon fires over a longer range.
- Much less affected by window contamination from dirt and oil deposit, thus decreasing maintenance requirements leading to operating cost reduction.
- Able to see flames through smoke and through high densities of solvent vapours thus increasing the probability of early detection of hydrocarbon fires, particularly from heavy black smoke generating fuels.

3.4 POINTS TO NOTE WHEN USING FV300 *FlameVision* DETECTORS OR S200 FLAME DETECTORS

The FV300 *FlameVision* series are a whole new range of flame detectors developed from the knowledge and experience built up from previous detectors such as the S100 and S200 series. However, the FV300 series is not a complete replacement for the existing detectors and the following should be considered:

- The FV300 will only be available in Flameproof versions. An IS version will not be available due to the power consumed, especially by the camera. The S200 range should continue to be used in these applications.
- The FV300 consumes more power than the S200 and needs an external PSU.
- The FV300 is smaller than the S200 and does not fit the S100/200 bracket. To replace an S200 with an FV300 the FV300 bracket will have to be fitted.
- FV300 has a discrete 4-20mA level for pre-alarm. It is not variable like the S200.
- The FV300 has a consistent range over the field of view and automatically adjusts to the distance and size of a fire. It does not need adjustable sensitivity as used on the S200.
- The FV300 has a clear field of view, there are no blind spots.
- The FV300 provides all electrical interfaces (relays, 4-20mA, etc.) on ALL models.

4. SYSTEM DESIGN INFORMATION

The electrical, mechanical, environmental characteristics and the performance of the FV300 *FlameVision* series detectors must be taken into account when designing a system which uses these detectors. This information is given in this section, together with guidance on detector siting. Fig. 6 shows the interfaces available on the detectors.

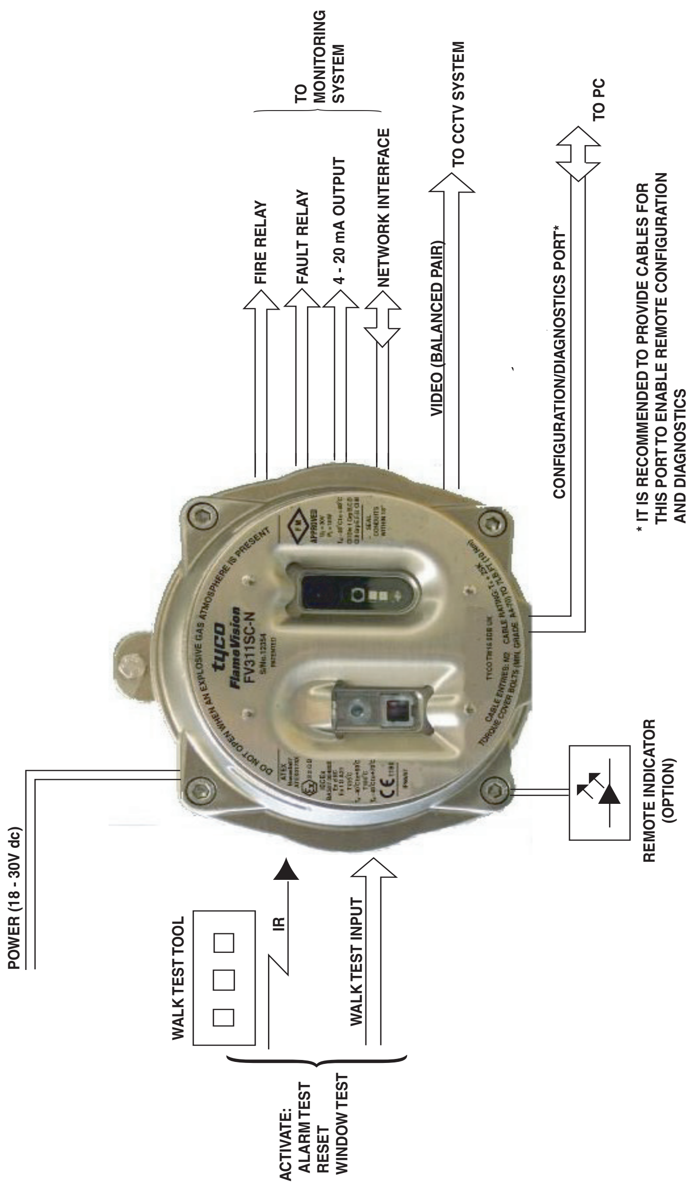


Fig. 6 FV300 Interfaces

4.1 ELECTRICAL CHARACTERISTICS

4.1.1 GENERAL

Supply voltage:	20V to 30V dc
Power:	up to 10W (depending on model)
Quiescent current:	
- no camera fitted:	158mA at 24V
- with camera:	196mA at 24V
Alarm current:	
- no camera fitted:	166mA at 24V
- with camera:	205mA at 24V
Additional current when using 4 to 20 mA output in source mode	
- Quiescent:	4.0mA at 24V
- Alarm:	11.5mA at 24V
Window heater additional current:	$V_{Supply} \div 270\Omega$ (90mA at 24V)
Stabilisation time after power up:	5 - 20 minutes

Note: For CSA compliance the detectors must be powered from a class 2 certified PSU.

4.1.2 RELAY CONTACT OUTPUTS

Fault relay:	Selectable normally closed or open contact.
Alarm relay:	Selectable normally closed or open contact.
Alarm relay coil monitoring:	Supplied as standard.
Contact rating:	2A at 30V dc

4.1.3 4 to 20 mA OUTPUT

Signalling currents:	Nominal	Range
General fault:	0mA	(0.0 to 0.7mA)
Window dirty:	2mA	(1 to 3mA)
Normal:	4.5mA	(3.5 to 5.5mA)
Pre-alarm:	11.5mA	(10 to 13mA)
Alarm:	17mA	(15 to 19mA)
Maximum current monitor resistance in source mode:	130Ω	

Output mode: Selectable current sink or current source output (SW2).

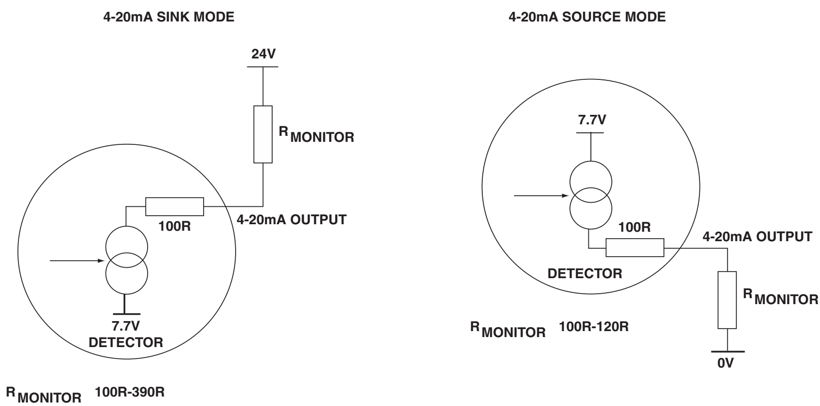


Fig. 7 4-20mA Current Sink/Source Wiring Diagrams

4.1.4 MODBUS NETWORK INTERFACE

The FV300 can be a slave RTU device on a MODBUS network using a standard RS485 electrical interface.

4.1.4.1 MODBUS COMMUNICATIONS PARAMETERS

Baud rate:	9,600 or 19,200 selectable.
Maximum number of units:	32
Protocol:	To MODBUS Application Protocol Specification V1.1 - See 'Annex A for register definitions
Mode:	RTU

4.1.4.2 MODBUS LINE TERMINATION

The MODBUS network should have 390Ω bias resistors, to give defined voltage levels on the line, and a 220Ω matching resistor fitted near to the controller, as shown below. In addition, a 220Ω termination should be fitted at the end of the pair cable to give reliable operation, especially with long cable runs.

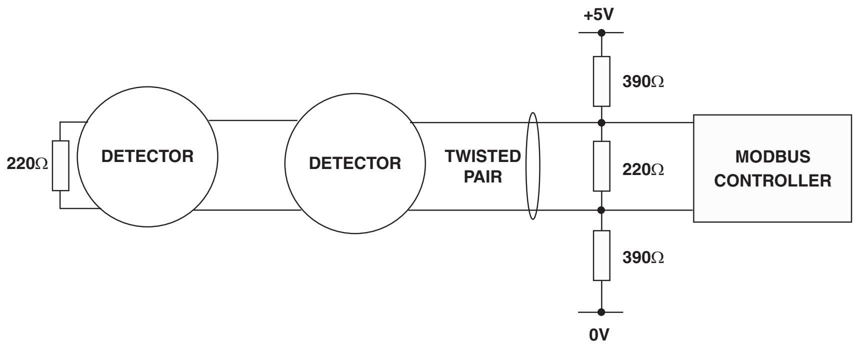


Fig. 8 Line Termination

4.1.5 VIDEO OUTPUT

The FV300 provides a video output from the optional internal camera for connection to CCTV systems. It is available in either PAL or NTSC format (option). The detector superimposes an overlay with status information on top of the picture to notify alarms, including location, and faults.

The video output can be used on units without a camera to display the status information overlay on a CCTV system. The status information is displayed on a coloured background. The output is enabled by configuration.

The video output is a balanced signal suitable to drive twisted pair cable. The cable should be terminated in a balun to provide the connection to the video system.

The video output operates over a reduced temperature range from -40 to +70°C. The detector controls the video output to prevent damage if the temperature goes outside the range. See Table 1.

Output impedance:	100Ω into 100Ω twisted pair.
Receiving end:	Active balun NV - 652W (603.015.027).

A 24V supply is required - it must be isolated from detector supply if the RS485 interface option is used. Leave the balun ground connection O/C.

From (° C)	To(° C)	Text overlay	Video camera	Video output
+70	+80	Off	Off	No video signal
+50	+70	On	Off	Overlay with blue background
-10	+50	On	On	Camera or blue background with overlay
-30	-10	On	Off	Overlay with blue background
-40	-30	Off	Off	No video signal

Table. 1 Video Output

Note: The detector monitors the internal temperature to decide when to switch the video output mode. The temperatures in Table 1 are external temperatures and vary depending on the environmental conditions and if the window heater is enabled.

4.1.6 WINDOW HEATER

The FV300 has a heater to warm the sensing window and prevent misting. The heater is enabled on the DIP switches. When enabled, the heater will turn off when the detector temperature rises above +40º C.

4.1.7 WALK TEST INPUT

The walk test input provides a means to connect remote switches to the FV300 detector to activate the alarm test and window test (OPM) functions or to reset the detector. The required operation is selected by connecting the appropriate resistor value, see Fig 9, between the walk test input and 0V using a momentary switch. The switch should be opened once the function has been activated. See Figs. 24, 25 and 26.

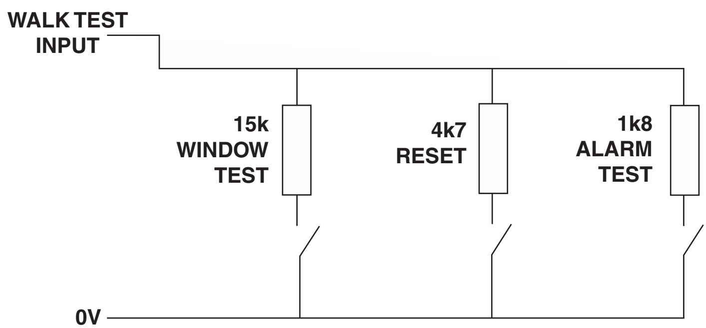


Fig. 9 Walk Test Input

Note: The FV300 detectors are approved for use in both gas and dust atmospheres but the WT300 Test tool is only approved for gas atmospheres. Where FV300 detectors are installed in dust risk environments the walk-test wired input should be used.

4.1.8 REMOTE LED

An external LED indicator can be connected to the detector. The output follows the indications of the alarm LED. The connection is as follows:

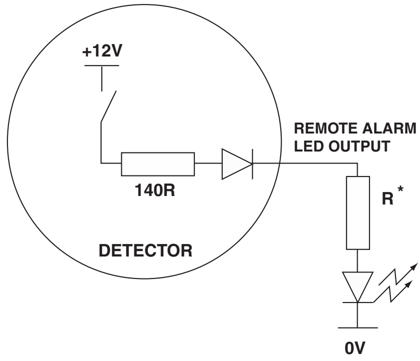


Fig. 10 Remote LED Wiring Diagram

Note: The external LED output should be used for visual indication only. It should not be used for signalling alarms to other equipment

4.2 MECHANICAL CHARACTERISTICS

4.2.1 DIMENSIONS (SEE FIGURES 11 AND 12)

Height:	138.8 mm
Width:	152.8 mm
Depth:	91.7 mm
Weight:	3.96 kg
Mounting bracket weight:	1.54 kg

4.2.2 MATERIALS

Enclosure:	Stainless steel 316L, ANC4BFCLC to BS 3146: Part 2
Detection window:	Sapphire
Camera window:	Toughened glass
Guard/label plate:	Stainless steel 316S16 to BS 1449: Part 2
Mounting bracket:	Stainless steel 316S16 to BS 1449: Part 2
Screws etc. Exposed to the elements:	Stainless steel 316 A4
Electronic modules:	Fibreglass substrate

4.2.3 ELECTRICAL ACCESS

FV311 series detectors: Standard M20 gland holes (two)
FV312 series detectors: Multi twisted pair screened cable

4.2.4 IP RATING:

Enclosure protection: Tested to IP66 and IP67*

* Cable gland entries must be suitably sealed to achieve the required IP rating (see Section 6.3.3).

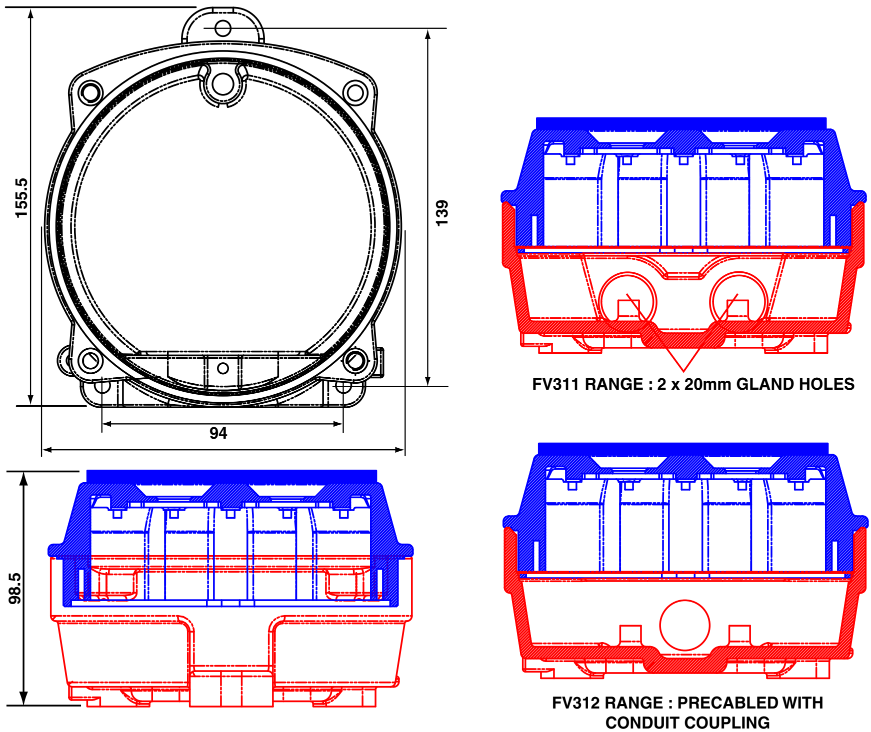


Fig. 11 FV300 Series - Overall Dimensions

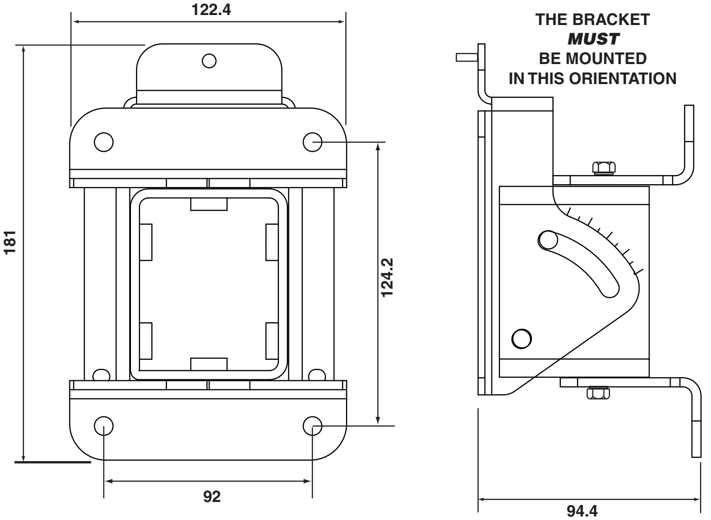


Fig. 12 Adjustable Mounting Bracket and Surface Mounting Dimensions

4.3 GENERAL CONSTRUCTION

Fig. 13 shows a general view of a complete detector with its mounting bracket.

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

The detector comprises a two-part stainless steel ‘spigot-type’ enclosure. Both halves of the enclosure are guided into the correct position by an alignment pin. The front section of the enclosure contains the detector optical and electronic sub-assemblies. Mating connectors at the rear of the front section and on the terminal board mounted in the rear section of the enclosure provide a means of electrical connection to the installation cables.

The rear enclosure of the FV311 series of detectors is provided with two M20 gland entry holes at the bottom of the detector. Two 10-way terminal block arrangements are provided for termination of installation cables.

The rear enclosure of the FV312 series of detectors is provided with a permanently attached cable sealed in the enclosure. With these detectors, termination of installation cables is made in an external EExe junction box.

Both types of rear enclosure have a dedicated earthing point on the side of the casting (Fig. 14) to connect an earth bonding wire from the nearest safety earthing point to the enclosure. Also, a tagging loop is provided on the side of the rear enclosure to attach a suitable label to identify the detector on site.

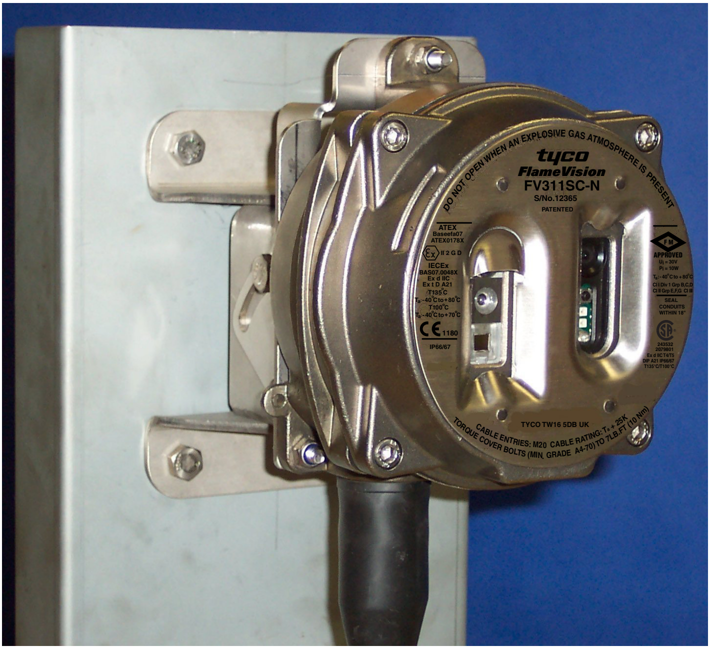
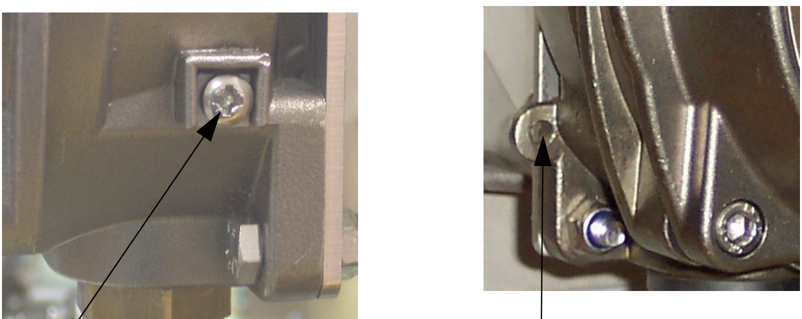


Fig. 13 FV300 Detector - General View



EARTH BONDING CONNECTION

TAGGING LOOP CONNECTION POINT

Fig. 14 Earthing and Label Fixing Points

A hanging cord enables the two halves of the enclosure to remain attached when opening the detector during maintenance work.

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.

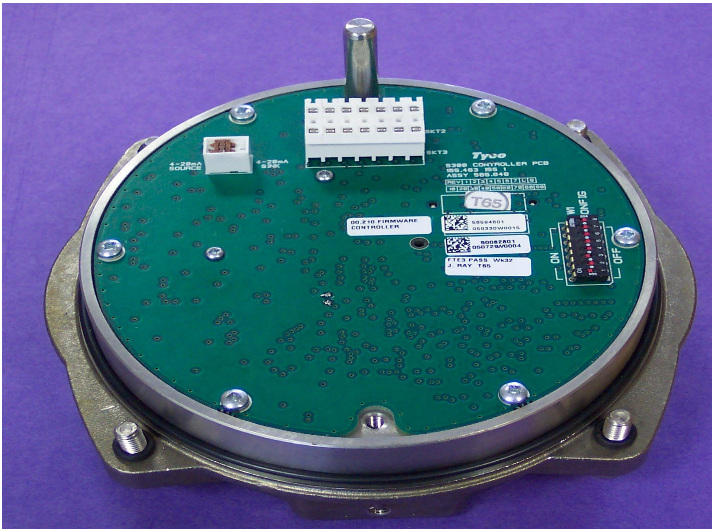


Fig. 15   FV311/FV312 Top Section

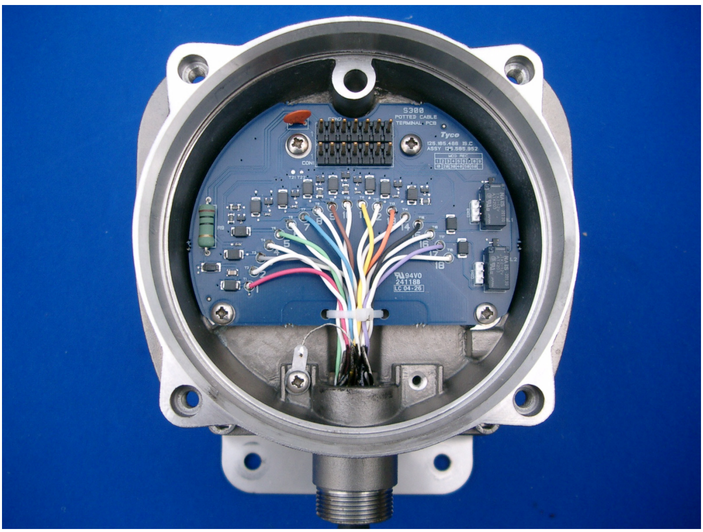


Fig. 16   FV312 Bottom Section

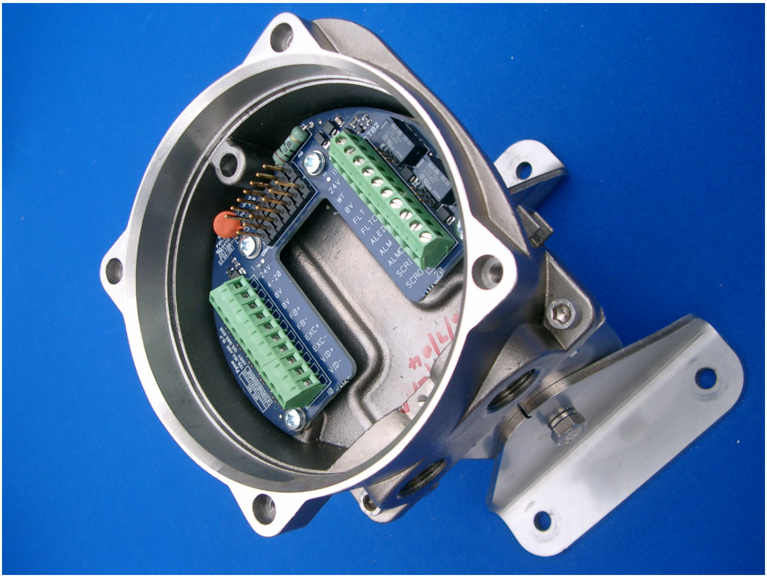


Fig. 17   FV311 Bottom Section

The front section of the enclosure is fitted with a window guard plate to protect the two detector viewing windows. A locally formed section of this plate acts as a mirror for the Optical Path Monitoring test. This plate also contains the mandatory markings required by the Flameproof and Explosion Proof Regulatory standards (ATEX, IECEx and FM).

The detector may be fitted directly to a suitable surface or an optional adjustable mounting bracket may be used. An optional weather hood is available for use where protection against extreme environmental conditions such as hot sun or downpour is needed.

A weather hood is available for use in tropical climates where intense sunlight may occur (Fig. 18). It also provides protection from rain falling on the window.

Fig. 18 FV300 Detector With Weather Hood Fitted

4.4 ENVIRONMENTAL CHARACTERISTICS

4.4.1 GENERAL

The design and construction of the FV300 series detectors are such that they may be used over a wide range of environmental conditions. Relevant limits are given in Para 4.2.

4.4.2 TEMPERATURE AND HUMIDITY

FV311S/FV312S - models without camera	
Operating temperature range:	-40°C to +80°C
Storage temperature range:	-40°C to +80°C
FV311SC(-N)/FV312SC(-N) - models with camera	
Operating temperature range:	-10°C to +50°C*
Storage temperature range:	-20°C to +70°C
All models	
Relative humidity:	Up to 99% (non-condensing)

*Note: * The detector will turn the camera off if the temperature goes outside this range but fire detection capability is still present when the video is switched off.*

4.4.3 VIBRATION AND SHOCK

The FV300 detectors have been designed and tested for vibration and shock and comply with the requirements of:

EN 54-10, European standard for point flame detectors,
Lloyd's Register of Shipping (LRS) Test Specification Number 1 (2002),
Det Norske Veritas (DNV) Certification Notes No 2.4 (April 2001) Class A,
Germanischer Lloyd (GL) Rules for Classification and Construction, Test Requirements for Electrical, Electronic Equipment, Computers and Peripherals (April 2001),
Factory Mutual FMRA 3260, Approval Standard for Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signalling.

The following maximum levels are applicable:

Operational vibration:	1.24 mm displacement (from 5 Hz to 14.2 Hz) 1.0 g (from 14.2 Hz to 150 Hz)
Operational shock/impact:	20.0ms^2

4.4.4 ELECTROMAGNETIC COMPATIBILITY

The FV300 detector is insensitive to normal levels of radio frequency interference. It has been designed and tested, and complies with the following requirements:

EN 50130-4, the European product family standard for components of fire and security systems,
VdS 2504 1996-12 (01),
LRS Test Specification Number 1 (2002),
DNV Certification Notes No 2.4 (April 2001), Class A,
GL Rules for Classification and Construction, Test Requirements for Electrical, Electronic Equipment, Computers and Peripherals (April 2001),
Factory Mutual FMRA 3260, Approval Standard for Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signalling.

The following maximum levels of interference are applicable:

Radiated radio frequency:	10V/m (from 80MHz to 2GHz) 30V/m (from 415MHz to 466MHz) 30V/m (from 890MHz to 960MHz)
Conducted radio frequency*:	10V/m (from 150kHz to 100MHz)
Fast electrical transient burst:	± 2kV (applied for 5 minutes)
Slow high-energy surge:	± 2.4kV
Electrostatic discharge:	± 8kV (air discharge) ± 6 kV (contact discharge)

*Radio frequency coupled into signalling, d.c. power supply and screen/earthing wires.

The FV300 detector has also been tested for compliance with the radio frequency emission requirements of EN 61000-6-3 and, hence, meets the European Union EMC Directive 89/336/EEC. It also complies with the radio frequency emissions requirements of LRS, DNV and GL Maritime Societies.

4.4.5 IONISATION RADIATION

The FV300 detector, like other infrared 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. However, long-term exposure to high radiation levels may lead to permanent damage.

4.4.6 CORROSION

The use of a sealed stainless steel 316L enclosure allows the FV300 detector to withstand the effects of most corrosive substances and gas. In particular, it meets the requirements for sulphur dioxide (SO_2) conditioning in EN 54-10 and exposure to salt mist concentration as specified in LRS, DNV and GL test specifications for approval of equipment for marine use.

Note: Over time, the outer surfaces of the detector may discolour and give an appearance of being 'rusty'. This discolouration is caused by the oxidation of contaminants collected on the surface of the enclosure, especially areas with a textured finish. It only affects the surface of the material and does not reduce the thickness or affect the mechanical properties of the enclosure in any way.

4.5 FIRE DETECTION CHARACTERISTICS

4.5.1 GENERAL

A large number of fire tests have been carried during the development phase of the FV300 *FlameVision* detector to determine the response limits. The results of these tests are summarised below.

4.5.2 FIRE DETECTION RANGE AND RESPONSE TIME

The following table shows the detection range and field of view for the FV300 detectors for a selection of typical fuels. The FV300 dynamically adjusts to the fire size and does not need selectable sensitivity levels. These performance figures have been tested and confirmed by FM Approvals apart from the figure marked †.

Fuel	Size m^2 (ft x ft)	Field of View H: Horizontal V: Vertical	Distance m (ft)
N-Heptane	0.1 (1 x 1)	H: ±45° V: ±40°	50 (165)
Petrol	0.1 (1 x 1)	H: ±45° V: ±35°	50 (165)
Aviation fuel (JP5)	0.4 (2 x 2)	H: ±45° V: ±40°	50 (165)
Alcohol (Methylated spirits)	0.1 (1 x 1)	H: ±45° V: ±40°	35 (115)
Diesel	0.1 (1 x 1)	H: ±45° V: ±30°	25 (82) †
Diesel	0.1 (1 x 1)	H: ±45°	24 (80)
Diesel	0.1 (1 x 1)	V: ±30°	15 (50)
Methane plume	30 inches	H: ±45° V: ±40°	20 (64)

The detector range is unaffected by the presence of hot objects (black bodies) within the field of view.

The typical response time for the detector is less than 12 seconds. The following table shows the response time for a selection of fuels measured on axis for fully developed fires. These performance figures have been tested and confirmed by FM Approvals.

Fuel	Size m^2 (ft x ft)	Distance m (ft)	Response Time Seconds
N-Heptane	0.1 (1 x 1)	50 (165)	9
N-Heptane	0.1 (1 x 1)	61 (200)	11
N-Heptane	0.2 (1.5 x 1.5)	61 (200)	7
Petrol	0.1 (1 x 1)	55 (180)	9
Aviation fuel (JP5)	0.4 (2 x 2)	61 (200)	9
Alcohol (Methylated spirits)	0.1 (1 x 1)	35 (115)	11
Diesel	0.1 (1 x 1)	30 (100)	11
Diesel	0.4 (2 x 2)	50 (165)	7
Methane plume	30 inches	24 (80)	18

4.6 DIRECTIONAL SENSITIVITY

The FV300 *FlameVision* detector has been designed to achieve constant sensitivity across the field of view. The relative variation of range with angle of incidence (polar diagrams) is shown in Figs. 19 and 20 for open-air tests using $0.1m^2$ pan petrol fires.

The continuous line indicates response of the detector within 30 seconds (as required by both FMRC 3260 and EN 54-10), with the detector at the minimum alarm delay. The dotted line indicates response of the detector within 12 seconds, for the minimum alarm delay.

Note: When test fires are carried out outdoors, the response of the detector can be significantly affected by wind as the flame may be blown horizontally outside its field of view, at least during part of the test. In effect, the detector is seeing only a portion of the total radiant energy from the fire during a given period. This effect is accentuated, as the fire gets closer to the 45° position.

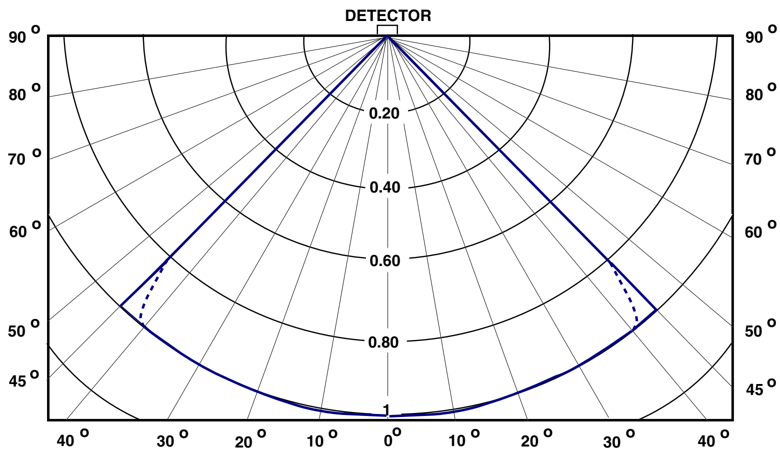


Fig. 19 Relative Range vs Angle of Incidence - Horizontal Plane

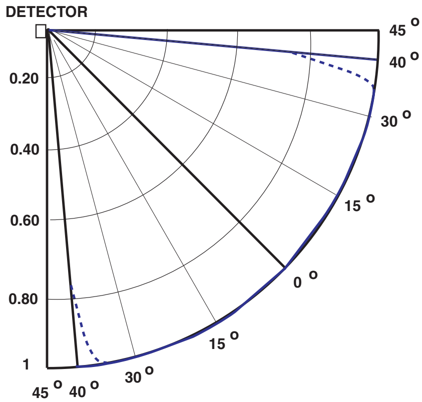


Fig. 20 Relative Range vs Angle of Incidence - Vertical Plane

4.7 FALSE ALARM IMMUNITY

The FV300 has been subjected to the following stimuli that might be considered potential sources of false alarms. Unless otherwise specified, tests were performed at a minimum distance between source and detector. Steady state sources were chopped at both regular and random frequencies in the range 0 - 10Hz.

	FALSE ALARM SOURCE	IMMUNITY DISTANCE RESPONSE (m)
1	Sunlight	No response
2	Sunlight with rain	No response
3	150W tungsten filament lamp	1m
4	Fluorescent lamp (bank of 4 x 32 W circular lamps)	1m
5	70W sodium lamp	1m
6	125W mercury vapour lamp	1m
7	4.8kW IR radiant heater	1m
8	2 x 500W quartz halogen lamps (unshielded)	2m
9	2 kW fan heater	1m
10	Car headlights (60W halogen)	No response
11	Car headlights (60W xenon)	4m
12	Lighted cigarette	No response
13	Grinding of ducting metal (angle grinder)	No response
14	Electric arc welding (2.5mm rod)	4m
15	MIG welding	1m
16	Vibration	N/A

4.8 DESIGN OF SYSTEM

4.8.1 GENERAL

Using the information given in Sections 4.5 and 4.6, 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, are given in the following paragraphs.

CAUTION:

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

4.8.2 USE OF FIRE TEST DATA

It has been explained in Sections 4.5 and 4.6 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.

4.8.3 DETERMINING THE 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. 20 and 21 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) Mounting the detectors on the perimeter of the area and pointing into the area will give the best coverage for area rather than spot protection.

b) As the FV300 detectors 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.

4.9 APPROVALS, COMPLIANCE WITH STANDARDS AND PATENTS

4.9.1 FLAMEPROOF CERTIFICATION

All models of the FV300 *FlameVision* detectors are flameproof and are certified to the ATEX directive and IECEx by Baseefa.

The detectors are designed to comply with EN60079-0: 2006, EN60079-1: 2004, EN60079-7:2006, IEC61241-0: 2006 and IEC61241-1: 2004.

They are certified:

ATEX code:	**Ex II 2 G D**
Certificate:	**Baseefa07ATEX0178X**
IECEx/Cenelec code:	**Ex d IIC T4 ExtD A21 IP66/67 T135°C (-40°C ≤ Ta ≤+80°C) or** **Ex d IIC T5 ExtD A21 IP66/67 T100°C (-40°C ≤ Ta ≤+70°C)**
Certificate:	**BAS07.0048X**

These detectors are designed and manufactured to protect against other hazards as defined in paragraph 1.2.7 of Annex I1 of the ATEX directive 94/9/EC.

The one special condition of the certification is that, when using the fitted cable from the FV312 series detectors, this cable must be suitably terminated and protected from impact. See the installation section for installation recommendations.

4.9.2 FM APPROVALS

The detectors are also designed to comply with the requirements of Factory Mutual FMRC 3600 and FMRC 3615 for use in hazardous area locations Class I, Div 1, Group B, C, D and Class II Group E, F G and Class III.

The FV300 *FlameVision detectors* have been designed to and comply with requirements of Factory Mutual FMRC 3260, the approval standard for Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signalling.

4.9.3 CSA APPROVALS

The FV311S, FV311SC and FV311SC-N are approved by CSA for use in Canada in both gas and dust environments. They are certified:

Ex d IIC T4 DIP A21 IP66/67 T135°C; -40°C ≤ Ta ≤ 80°C
Ex d IIC T5 DIP A21 IP66/67 T100°C; -40°C ≤ Ta ≤ 70°C

Certificate: **2079801**

Note: For CSA compliance the detectors must be powered from a class 2 certified PSU.

4.9.4 CONSTRUCTION PRODUCTS DIRECTIVE

The FV300 range of flame detectors comply with and are manufactured to the requirements of the Construction Products Directive. The detectors carry the CE and CPD marks.

CE

0786

Tyco Safety Products
Dunhams Lane
Letchworth SG6 1BE
UK

10

0786-CPD-20929

EN 54-10: 2002 + A1: 2005

FV311S
Class 1 IR point flame detector for use in fire detection and alarm systems

FV311SC-N
Class 1 IR point flame detector for use in fire detection and alarm systems

FV311SC
Class 1 IR point flame detector for use in fire detection and alarm systems

FV312S
Class 1 IR point flame detector for use in fire detection and alarm systems

FV312SC-N
Class 1 IR point flame detector for use in fire detection and alarm systems

FV312SC
Class 1 IR point flame detector for use in fire detection and alarm systems

Installation/Service Instructions: 120.415.886

Fig. 21

4.9.5 MARKING

All the markings required by the various approval bodies are on the front plate (see Fig. 22) with the exception of:

a) The Year of Manufacture/Construction which is stated on a label affixed to the rear of the front case assembly. This is only visible when the front case assembly is unbolted from the base assembly.

b) The ‘WEE’ mark, VdS EN54-10 approval and CPD approval which are on a label affixed to the backbox. This is only visible when the front case assembly is unbolted from the base assembly.

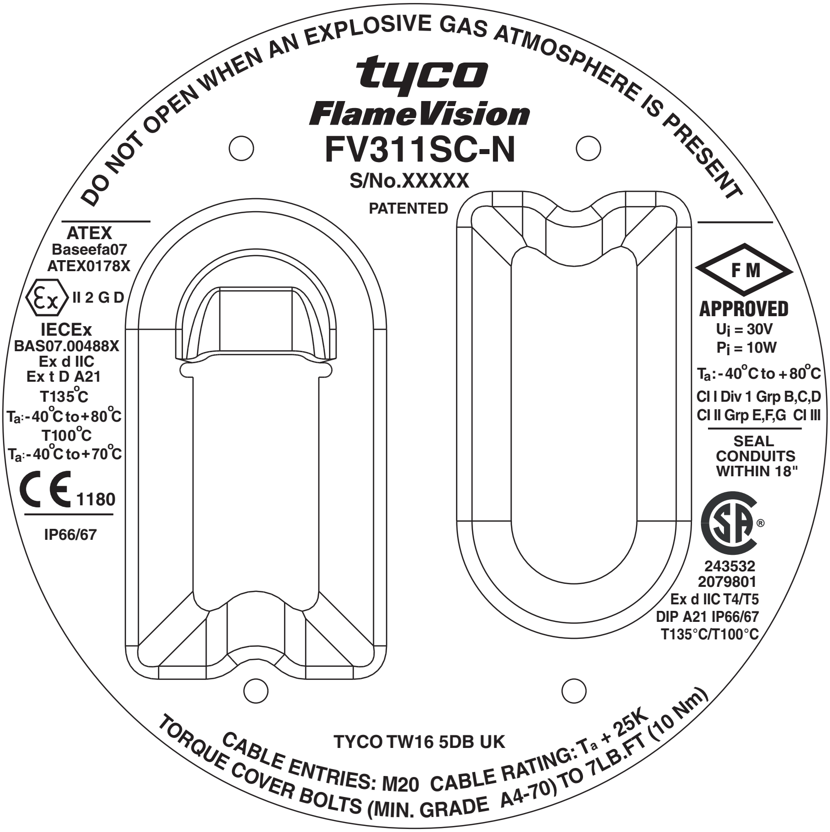


Fig. 22 View of Detector Label with Regulatory Markings

4.9.6 PATENTS

The FV300 design and manufacture is covered by the following patents licensed from InfraRed Integrated Systems Limited:

UK patents:	GB 2 353 856, GB 2 353 424 and GB 2 372 317
European patents:	EU 1 079 349 and EP 1 233 386
US patents:	US 6 528 788, US 6 476 859 and US 6 818 893
Hong Kong patent:	HK 1 050 951

5. OPERATION

5.1 INDICATORS

The FV300 *FlameVision* detector has a red LED for reporting alarms and a yellow LED for reporting faults. Both LEDs are located in the camera window, see Fig. 23. The alarm LED turns on to report an alarm. The fault LED turns on to report hardware faults or is flashed to show an OPM 'dirty window' fault.

The red LED will turn on briefly when an alarm test is performed.

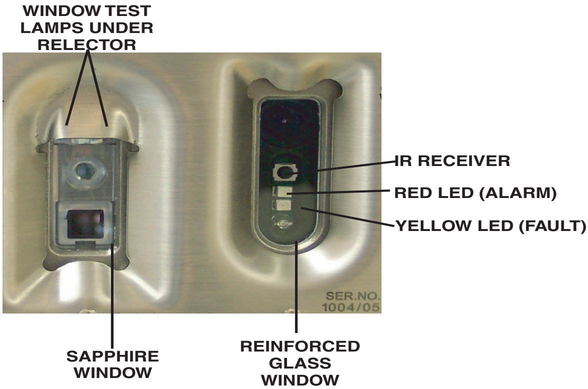


Fig. 23 LED Location

5.2 POWER UP AND INITIALISATION

On power up, the detector performs a complete self-test to check all functions. The alarm (red) and fault (yellow) LEDs flash briefly as power is applied. The alarm LED then turns off and the fault LED remains on for the duration of the self-tests. If a fault is detected the LED remains on and the fault signalled as below.

With the self-tests complete, the array is now allowed to warm-up and settle. During this time the fault LED will flash rapidly (about 3 times per second). When the array is ready, the fault LED will turn off. This will take about 5-20 minutes. If the array does not settle within 30 minutes then a fault will be indicated and signalled.

Note: The detector cannot detect alarms, do OPM tests or alarm tests whilst the array is settling.

5.3 ALARM AND PRE-ALARM INDICATION

The alarm (red) LED will illuminate when the detector is in alarm. It will remain illuminated until the reason for the alarm has cleared (non-latching mode) when it will turn off. In latching mode the detector will also need to be reset, see below.

The alarm (red) LED remains off when the detector enters the pre-alarm state.
The alarm LED is located in the camera window, see Fig. 23.
The remote LED output will be activated when the alarm LED is on to give an external alarm indication.

5.4 ALARM SIGNALLING

The FV300 detector has a number of external interfaces. An alarm condition is signalled on all of these interfaces as follows:

Alarm relay:	The alarm relay will close.
4-20mA:	The current (source or sink) becomes 17mA
Modbus:	The alarm bit is set in the status register and is available at the next read of the unit.
Video:	An alarm banner will be superimposed on the CCTV image along with a target showing the location of the alarm.

Each interface will remain activated until the reason for the alarm has cleared (non-latching mode) when it will turn off. In latching mode the detector will also need to be reset, see below.

5.5 PRE-ALARM SIGNALLING

The detector enters a pre-alarm state when it detects a source within the field of view that has not yet reached the alarm threshold. The source may be worthy of investigation.

The FV300 detector has a number of external interfaces. A pre-alarm condition is signalled on some of these interfaces as follows:

Alarm relay:	No change, the alarm relay will remain open.
4-20mA:	The current (source or sink) becomes 11.5mA
Modbus:	The pre-alarm bit is set in the status register and is available at the next read of the unit.
Video:	No change.

The pre-alarm condition will escalate into a full alarm if the source is determined to be a fire. Or it will clear if the source is removed.

5.6 FAULT AND OPM INDICATION

The fault (yellow) LED will illuminate when the detector has detected a hardware fault. It will remain illuminated until the reason for the fault has cleared (non-latching mode) when it will turn off. In latching mode the detector will also need to be reset, see 5.9.

If the regular OPM test determines that the window is dirty then the fault (yellow) LED will flash approx.(1 second, 1 second off). If the window is found to be completely obscured it is treated as a hardware fault and the fault LED is illuminated.

The fault LED is located in the camera window, see Fig. 23.

5.7 SERVICE MODE INDICATION

The detector is put into the Service Mode when it is connected to a PC for configuration or diagnostics. When in this mode, the fault (yellow) LED wil flash slowly (2 seconds on, 2 seconds off).

Note: In Service Mode the detector is disabled and will not detect a fire.

5.8 FAULT AND OPM SIGNALLING

The FV300 detector has a number of external interfaces. A fault condition is signalled on these interfaces as follows:

Fault relay:	The fault relay will open. (Hardware, window and OPM faults)
4-20mA:	The current (source or sink) become 0mA for hardware and window faults or 2mA for OPM faults.
Modbus:	The appropriate fault bit will be set in the status register and is available at the next read of the unit. Hardware faults, window obscured and window dirty are separately identified.
Video:	A fault banner will be superimposed on the CCTV image with an information field to specify the fault type.

Each output will remain activated until the reason for the fault has cleared (non-latching mode) when it will return to normal status. In latching mode the detector will also need to be reset, see section 5.9.

5.9 DELAY TO ALARM

The FV300 processes the array and sensor signals to identify a potential alarm event twice a second. The detector takes 9 cycles, 4.5 seconds, to confirm that there is an event to report. The detector considers each report and will indicate and signal an alarm if several alarm event reports are produced within a time window. The number of reports to consider is selectable and defines the response time. The detector response time consists of the initial 4.5 seconds followed by the selectable delay.

The FV300 detector provides 4 selectable alarm response times. These are set on the DIP switches, see Section 7.2.2.

SW 1-2	SW 1-3	Delay Description	Alarm / Prealarm ON condition	Alarm / Prealarm OFF condition
0	1	SHORT	1.5 seconds over threshold in any 4 second period	10 seconds under threshold
0	0	MEDIUM (Default)	4.5 seconds over threshold in any 8 second period	10 seconds under threshold
1	0	LONG	9 seconds over threshold in any 12 second period	12 seconds under threshold
1	1	EXTRA LONG	12 seconds over threshold in any 15 second period	15 seconds under threshold

The default setting requires that in an 8 second window the event should be reported for at least 4.5 seconds to put the detector into alarm. This gives an overall response time of 9 seconds. The minimum time from the presentation of a detectable fire to activation of the outputs is 6 seconds (short delay). The alarm delay response times are also used for the pre-alarm response.

The selected response time also defines the alarm clearing time in non-latching mode. An alarm is cleared when a number of reports of no alarm are produced. The default setting requires that 20 reports (10 seconds) are detected. Thus a detector will remain in alarm for at least 10 seconds.

5.10 RESETTING ALARM AND FAULT CONDITIONS

In latching mode, alarms and faults will continue to be indicated and signalled, even if the original cause has been removed. The detector needs to be reset to clear the condition. The detector can be reset by activating the wired input or remotely using the walk-test trigger tool. During the reset the indicators and outputs will be turned off but if the alarm or fault is still present the condition will be re-established. The detector will perform re-tests if necessary, such as an OPM test, to determine if faults have cleared.

5.11 SELF-TEST

The FV300 detector performs a regular self-test of the electronics and monitors the interfaces in the detector. This occurs automatically at pre-set timed intervals and does not disturb the normal operation of the detector. If a fault is detected it will be indicated and signalled as described in section 5.7.

5.12 OPTICAL PATH MONITORING (OPM) TEST

The FV300 detector can check the cleanliness of the window used by the array and other optical sensors. The detector flashes a lamp that radiates IR at the same wavelength used for fire detection for about 5 seconds. The lamp shines onto a mirror that reflects the energy back through the window onto a specific section of the array. The detector analyses the reflected signal to assess if the window is dirty.

The OPM test can be initiated manually, on demand, using the walk-test trigger tool, the walk-test wired input or from the field bus interface. When the OPM test is activated manually, a single test is performed and the result reported on the indicators and outputs. If the window is considered to be dirty or obscured then an OPM fault is reported. The fault will be cleared when the window is cleaned and the test re-run to give a clean result. Requests for a manual OPM test will be ignored if the detector is in alarm, pre-alarm or performing an alarm test.

Alternatively, the detector can be configured to perform the OPM test automatically at regular intervals by setting a DIP switch (OPM Man/Auto). The default is automatic OPM testing. The time interval can be adjusted using the PC configuration tool. The default OPM test interval is every 20 minutes. The first OPM test will be made 20 minutes (or the configured time) after power-up. The regular OPM test will be delayed if the detector is in alarm, pre-alarm or performing an alarm test. A manual OPM test can be initiated at any time when the detector is in automatic OPM mode and will produce an immediate test result reported on the indicators and outputs as described above.

If the automatic OPM test detects the dirty condition (5-50%) for 20 successive tests then an OPM fault is reported. If the window is considered to be obscured (<5%) then the OPM test interval reduces to 5 minutes and if the window remains obscured for 5 further tests then an OPM fault is reported. The obscured condition is thus detected and reported much faster. Either fault will be cleared when the window is cleaned and the test re-run to give a clean result. The test can be activated manually after cleaning rather than waiting for the next timed automatic test.

The detector is fitted with 2 lamps. These are used alternately to maximise their lifetime. If a lamp should fail then the detector can continue using the one lamp without reporting a fault. The failure of both lamps will be reported as a hardware fault.

5.13 WALK-TEST (ALARM TEST)

WARNING:

THE DETECTOR OUTPUTS WILL BE ACTIVATED DURING A WALK-TEST. DISCONNECT ALL EXTINGUISHING SYSTEMS OR EXTERNAL DEVICES THAT SHOULD NOT BE ACTIVATED DURING A TEST.

The FV300 detector has a built in alarm test facility. The lamps used for the OPM test are flashed in a pattern to simulate a flame. The IR output from the lamps reflects off the mirror and onto the array. The lamp signal is then processed using the same algorithms as used for external sources to produce an alarm which is then indicated on the LED and signalled on all external interfaces. This is a true test of the ability of the detector to detect a fire.

The alarm test can be triggered from the wired walk-test input or remotely using the walk-test trigger tool.

When the test is started, a lamp will flash until an alarm is detected, typically after 10 seconds. The lamp will then turn off. The detector will indicate the alarm on the LED and activate all outputs as described above. The outputs will remain active for the duration of the alarm hold time set on the DIP switches (10-15 seconds).

If the flashing lamps do not trigger an alarm then a hardware fault is reported and the lamps are turned off.

Note: The alarm test cannot be performed whilst the array is settling or whilst the detector is in alarm, pre-alarm or performing an OPM test.

The alarm test may not generate an alarm if a strong black body source is in the field of view or modulated sunlight falls onto the detector.

5.14 VIDEO DISPLAY

The FV300 can overlay alarm and fault information on top of the camera picture (CCTV output). The overlay is normally enabled but can be disabled by configuration. If no camera is fitted then the overlay can be viewed on a plain colour background. This is enabled by configuration.

If an alarm is detected, the overlay will flash an alarm message and display a box drawn around the alarm source to show the location within the field of view.

Faults are individually identified on the display as shown in Annex B.

6. INSTALLATION

6.1 GENERAL

The FV300 Series detectors may be surface mounted or may use the FV300 adjustable mounting bracket.

On the FV311 series, all electrical connections are made via terminal blocks inside the detector rear housing. Two 20mm cable entries are provided. On the FV312 series, electrical connections are made through the FlameVision Exe junction box, selecting the appropriate circuits required.

Guidance on mounting and wiring the detectors is given below.

6.2 MOUNTING A DETECTOR

6.2.1 GENERAL

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

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

6.2.2 CHOICE OF MOUNTING POSITION

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

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

b) 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.

c) 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°.

d) The detector should not be sited in a position where it will be continuously subject to water drenching. The FlameVision Weather hood should be use to protect the detector from heavy downpours that may be frequent in certain climates.

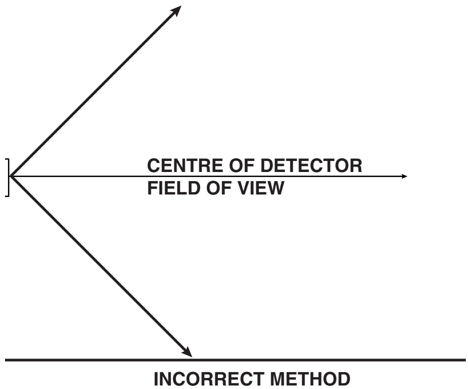
e) In outdoor installations, in areas of high solar radiation, some form of sunshade is recommended to prevent excess heating of the detector. The FlameVision Weather hood can provide protection against direct sun.

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

g) Where a certain amount of icing or water condensation can occur, it is recommended that the window de-mister be selected. See the System Deign Information section for additional power requirement.

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

i) Preferably, the detector should be mounted such that the face is tilted downwards to prevent water collection and lessen the settlement of particle deposits on the window.



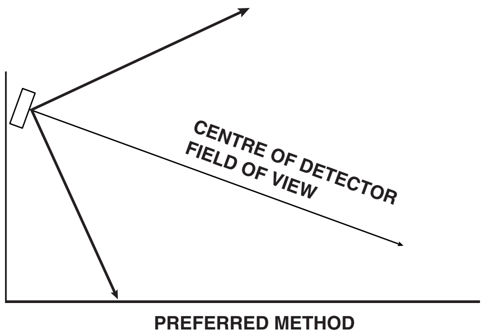


Fig. 24 Detector Orientation Relative to Horizon

The detector mounting bracket must be secured to the mounting surface with four M8 Bolts, studs or screws at the fixing centres shown in the orientation shown in Fig. 12. A drilling template is provided to allow optimum selection of the fixing centres. The detector is to be secured to the bracket using the three M6 studs with nuts and locking washers provided.

The FV300 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. 24 refers).

Alternatively, the detector may be secured directly to the fixing surface with three M6 bolts, studs or screws at the fixing centres shown in Fig. 11. The surface chosen for the mounting should be flat over the area of the bracket to ensure a stable fixing.

6.2.3 MOUNTING THE FV312 SERIES DETECTOR WIRING

In addition to the installation recommendations given in 6.2, the following applies when installing FV312 series detector:

a) The detector in-built cable should interface with the field cable via an EExe junction box with EExe cable entry glands suitable for the size of cable used. The FlameVision EExe has been designed to provide a ready-made solution to interfacing with any of the inputs/outputs of the FV300 detector.

b) It is a requirement of the ATEX/IECEx approval that the cable between the detector and the EExe junction is protected against mechanical damage. For this purpose the FV312 has been designed to mate with a flexible metal conduit. It is recommended that the Kopex Liquid Tight LT-H 316 stainless steel 20mm conduit system is used (Kopex FSH04). This conduit uses a Type H flame retardant covering to give a high resistance to oils and chemicals. A connector kit (Kopex KSO/1005) is available to terminate the conduit and couple directly onto the FV312 enclosure.

c) The selected mounting position for the detector must take into account the siting of the EExe junction box. The detector is supplied with a maximum of 1m cable and allows sufficient slack in the flexible conduit for adjusting the orientation of the detector when using the adjustable mounting bracket.

6.3 DETECTOR WIRING

6.3.1 GENERAL

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

To meet the mandatory EMC requirements of EN 61000-6-3 for emissions and EN 50130-4 for susceptibility, it is necessary to terminate the armouring / screening of the cable through 360° at the detector cable gland and ensure that the detector is solidly bonded to a good local earth.

Fig. 25 through to Fig. 27 show wiring diagrams for the FV311 series of detectors. The FV312 series detectors are wired in the same way. The cores are listed in Table 5.

Notes:

1) *If FV300 detectors are installed in dust risk environments then the walk-test wired input should be used. The WT300 is not approved for dust risk environments.*
2) *It is recommended that the RS485 Configuration port from the FV300 is wired back to a central point to support remote configuration and diagnostics. The configuration port can be wired as a bus connecting up to 16 detectors. An RS485 to PC interface (RS232 or USB) is required that can communicate at up to 38,400 baud with direction controlled by the RTS line.*

6.3.2 RECOMMENDED CABLE TYPE

6.3.2.1 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.

Cable temperature rating must allow for an increase in the enclosure temperature of 25° above ambient.

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 1mm2 should not be drawn into conduit but can be run in trunking).

e) Mineral insulated cable, twin or multi-core, to BS6207 Part 1, 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 EN60079-14:2003.

h) For the FV312 series, the EExe junction box must be mounted within 0.6m of the detector.

6.3.2.2 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 a.c. power circuits.

6.3.3 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^{o}C 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) 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 or putty 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).

6.3.4 FLAMEPROOF WIRING

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

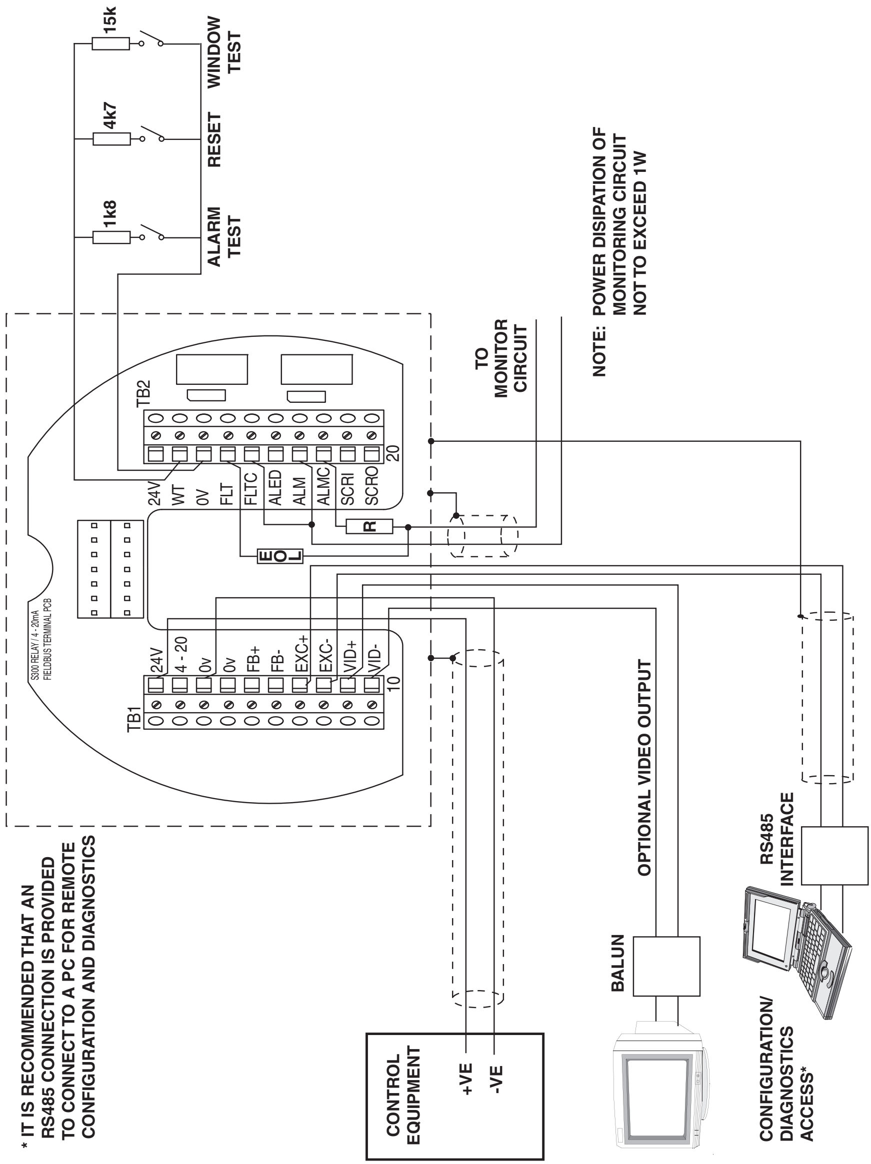


Fig. 25 Relay Wiring Diagram

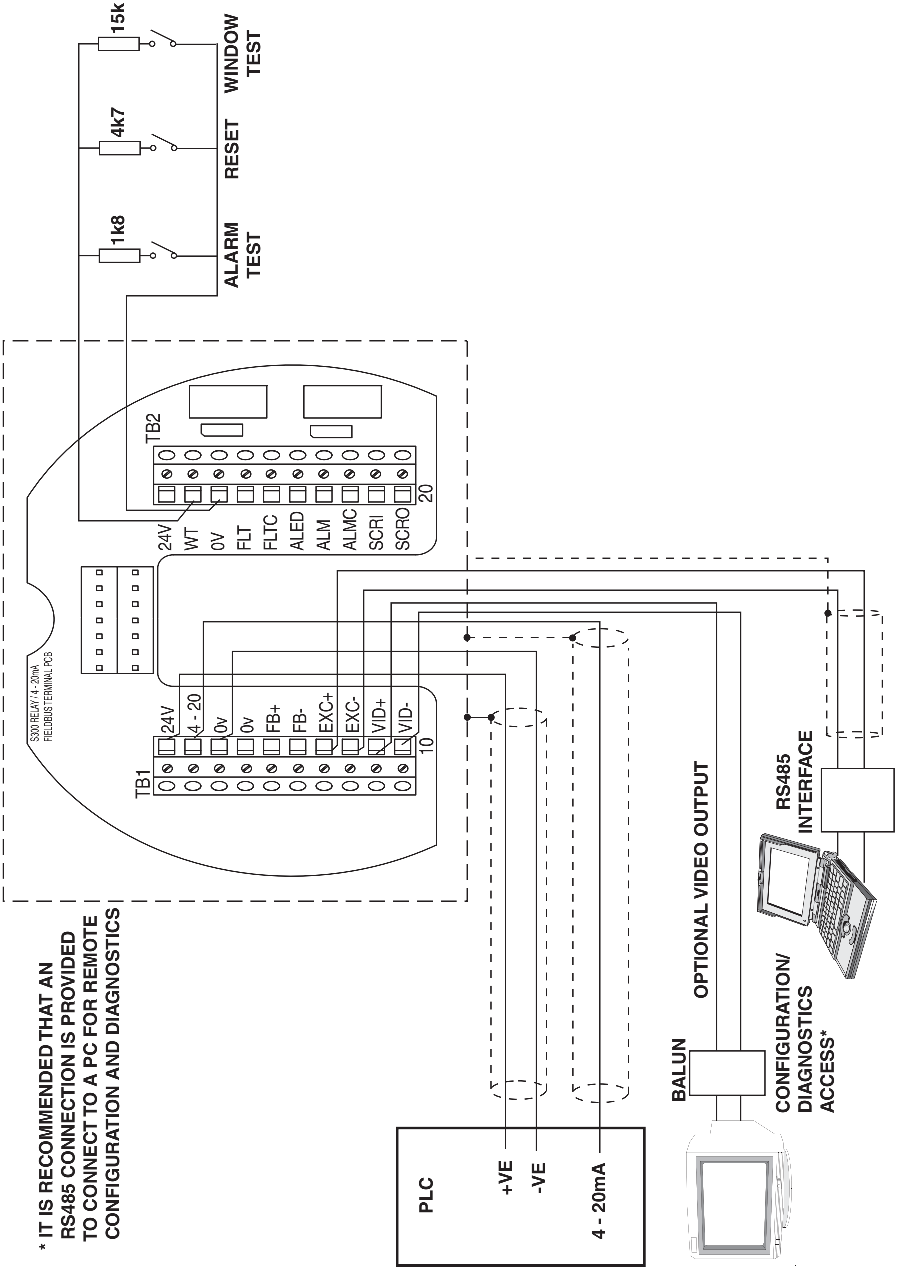


Fig. 26 4-20mA Output Wiring Diagram

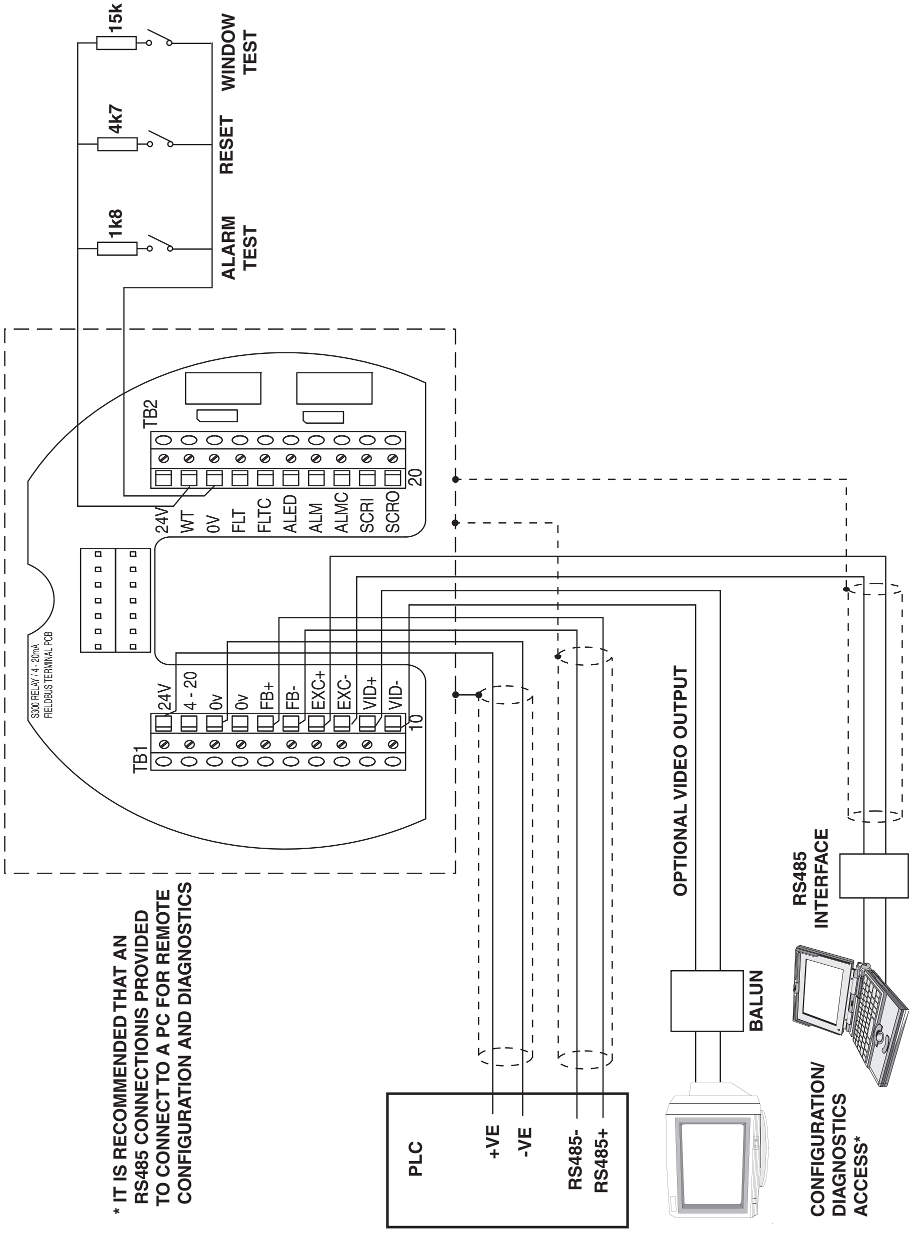


Fig. 27 Field Network Wiring Diagram

6.4 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.

6.4.1 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 6.4.2.

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

6.4.2 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. 28. Ensure that the ‘O’ ring supplied is fitted to the cover. Securely tighten the four M6 x 20mm hex head screws to retain the cover.

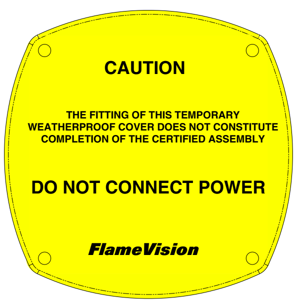


Fig. 28 Temporary Cover

7. COMMISSIONING

7.1 SYSTEM CHECKS

Before connecting the zone wiring to the control equipment 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.

When the system wiring has been successfully tested and the control equipment commissioned, the detector electronic assemblies may be fitted. Set the Remote Configuration (Table 3), Delay Options (Table 4), Alarm Latching (Table 5), Fault Latching (Table 6) and OPM Inhibit (Table 7). The selectins should be recorded in Annex C for future checking during service and maintenance operations.

7.2 SWITCH AND HEADER SETTINGS

The FV300 FlameVision detectors are very flexible and can be configured for a wide range of applications. For ease of installation the most common, primary, options are available on DIP switches located on the back of the detector. Advanced options, such as masking, and entering location information for the video display are set using the PC configuration tool.

7.2.1 SWITCH LOCATION

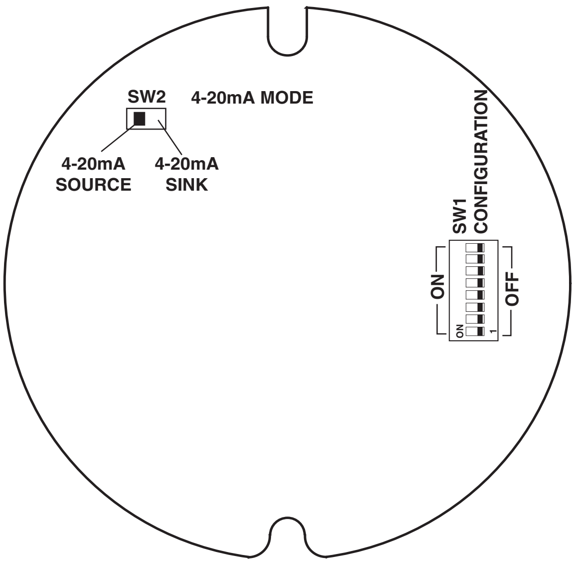


Fig. 29 Switch Location

7.2.2 CONFIGURATION DIP SWITCHES (SW1)

The primary configuration options can be set on DIP switches located on the back of the detector, see Fig. 29. The switch settings are described in Table 2. The default, supplied, setting is all switches off.

Switch	Function	Action	
		Off (Default)	On
1-1	Remote Configuration(*)	Ignore DIP switch settings (Use programmed settings)	Use DIP switch settings
1-2	Alarm Delay	Refer to Table 3 Delay Options	
1-3			
1-4	Reserved	Set in Off position	
1-5	Alarm Latching	Latching	Non-Latching
1-6	Fault Latching	Non-Latching	Latching
1-7	Window Heater	Off	On
1-8	OPM Man/Auto	Automatic	Manual

Table. 2 Configuration DIP Switches

Notes:

1) *(*) When switch 1-1 is turned off (default) then DIP switches 2 to 8 are ignored and all detector settings must be made using the PC configuration tool. If switch 1-1 is on, then the primary options are set by the DIP switches and can be supplemented by advanced options set using the PC configuration tool.*
2) *For detectors with V1.001 software, when the DIP switches are active the action of switch 5, Alarm Latching, is inverted (Off = Alarm Latching Disabled, On = Alarm latching enabled).*
3) *The detector is supplied with the default configuration shown in Table 2.*

SW 1-2	SW 1-3	Delay Description	Alarm / Prealarm ON condition	Alarm / Prealarm OFF condition
Off	On	SHORT	1.5 seconds over threshold in any 4 second period	10 seconds under threshold
Off	Off	MEDIUM (Default)	4.5 seconds over threshold in any 8 second period	10 seconds under threshold
On	Off	LONG	9 seconds over threshold in any 12 second period	12 seconds under threshold
On	On	EXTRA LONG	12 seconds over threshold in any 15 second period	15 seconds under threshold

Table. 3 Delay Options

7.2.3 4-20mA MODE SWITCH (SW2)

The 4-20mA output can operate in either a source or sink mode. This is selected on switch SW2, see Fig. 29.

7.2.4 RELAY CONTACT HEADER SETTINGS

The fire and fault relays can be used as either normally closed or normally open contacts. The contacts are selected by fitting links to CON3 and CON4 on the terminal board, see Fig. 30. The links must be fitted for the output to operate.

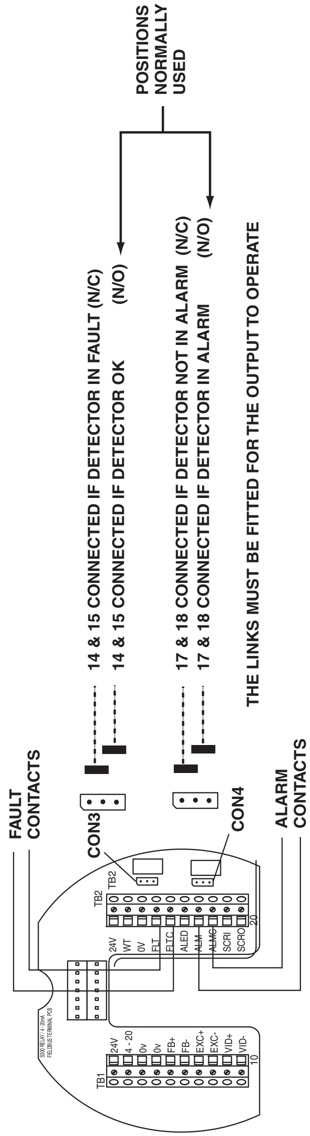


Fig. 30 Header Settings on Terminal Board

7.2.5 ADVANCED CONFIGURATION OPTIONS

The advanced configuration options are set using the PC configuration tool which connects to the detector using an RS485 link via an interface unit. The following options can be set using the tool:

- Primary options: Options available on DIP switches can alternatively be set by configuration tool (need to set a DIP switch to select this option).
- OPM timing: Set time interval for regular OPM test.
- Video output mode: Select what information is overlaid on camera image
- Video information: Enter and edit detector location and identity information that can be overlaid on camera image
- Select logging options: Select which events and information are logged by the detector
- Field network parameters: Enter and edit network settings such as baud rate, addresses, etc.
- Alarm Mask: Define masked area in field of view and masking options

The configuration tool can also be used to view internal parameters and for diagnostics by extracting and processing log data stored in the detector. Further details on the settings and how to use the tool for diagnostics are covered in the PC300 help file.

7.3 TERMINAL BOARD CONNECTIONS

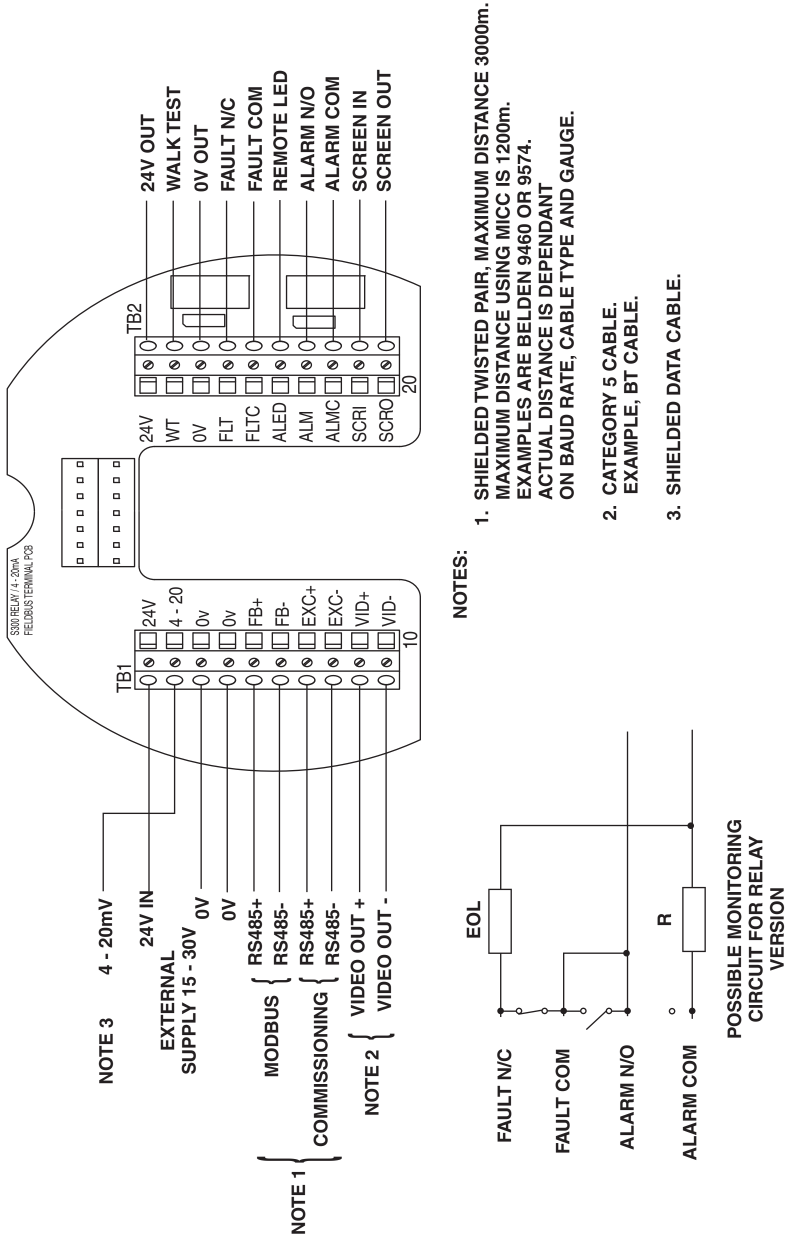


Fig. 31 Simplified Wiring Diagram

7.4 SEALED BACKBOX FLYING LEAD CONNECTIONS

Wire Identification		
Pair	**Colour**	**Signal**
1	Red	+24V
	White	0V
2	Grey	Walk Test Input
	White	0V
3	Green	Remote Alarm LED
	White	0V
4	Blue	Configuration RS485+
	White	Configuration RS485-
5	Brown	Camera Video Out+
	White	Camera Video Out-
6	Yellow	Field Network RS485+
	White	Field Network RS485-
7	Orange	4 - 20mA Source/Sink
	White	0V
8	Black	Fault Contact
	White	Fault Contact Common
9	Violet	Alarm Contact
	White	Alarm Contact Common
Drain		Chassis

Table. 4 Sealed Backbox Flying Lead Connections

7.5 CONNECTING AND COMMISSIONING THE DETECTOR

7.5.1 ASSEMBLING THE UNIT

Remove the temporary cover from the back box. Check that the wiring is correct and that all the pins on CON1 and CON2 on the terminal PCB in the base of the back box are straight. If the relay outputs are being used, check that links have been fitted to CON3 and CON4 to select the contacts (see Fig. 30).

Check that the rubber seal is fitted snugly around the body of the top case assembly. Ensure that the seal is clean and dry and before assembly. This seal is essential to provide a weather tight seal for the enclosure. Check that four bolts are fitted to the top case retained with O-rings and that the lanyard is firmly attached.

Bring top case up to the back-box and connect the safety chain (as a precaution) from the top assembly to the bottom assembly as shown in Fig. 32.

Hold the top case in two hands, one on each side, and then hold the unit over the back-box. Introduce alignment pin into barrel at top of back-box and slide top case into back box. Care should be taken to ensure that the internal wiring is not trapped between the terminal blocks and the front assembly. It is also important to ensure that no moisture is trapped inside the housing.

Push top case firmly into back box until it is fully in. The air inside the unit needs to escape and it may be necessary to push the top case down in several stages to allow the air to escape. Screw up the four socket cap retaining bolts until hand tight using an allen key. Then tighten with a torque wrench set to a maximum force of 7lb.ft (10 Nm).

Adjust the angle of the detector for the required field of view and then tighten the fixing nuts and bolts. Then complete the routing of the cable to the detector using cable ties or clips as necessary.

Fig. 32 Safety Chain Connection

The safety chain secures the top case to the bracket. The end with the ‘L’ shaped link, is screwed to the underside of the top case, see figure 32 above. The washers must be fitted between the screw head and the chain when fitting this link. The other end should be fixed to one of the bolts at the bottom of the bracket. The screw link must be securely closed when the detector is being fitted or removed. Otherwise if the detector is dropped the safety chain may not stop the top case falling.

7.5.2 POWER UP

Apply power to the detector. The alarm (RED) and fault (yellow) LED should both come on briefly. The alarm LED will turn off and the fault light will remain on for a few seconds whilst the detector performs internal self-tests. The fault LED will then change to flashing whilst the sensors are settling. The alarm and fault signalling outputs will now report the normal state. If a fault is detected, then the LED remains on (not flashing) and a fault will be signalled on all of the outputs.

The fault LED will continue flashing until the array and other sensors have settled. The detector will take between 5 and 10 minutes to settle; depending on the temperature of the detector. When the sensors have settled then the fault LED will turn off and the detector is now ready for functional tests. If the detector fails to settle then a fault will be indicated, the fault LED will turn on and a fault will be signalled on all the outputs.

7.5.3 INITIAL FUNCTIONAL TESTS

When the detector has settled, the built-in window and alarm tests can be used to check the detector.

Initiate a window test using the walk-test input or walk-test tool and confirm a fault is not reported. This shows that the window is clean. It is recommended that the window is then blocked and the window test repeated to generate a deliberate window fault. This will confirm that a fault condition can be reported to the monitoring system. The fault can then be cleared by unblocking the window and then repeating the window test or resetting the unit.

Then initiate an alarm test and confirm the detector reports an alarm on the LED and signalling outputs and then clears. The detector is now ready for operation.

7.5.4 FIRE TESTING

When the detector has settled and the initial functional tests are completed, the FV300 FlameVision is ready for operation as a fire detector. If required, further functional tests can be performed to confirm the field of view of the unit or just to confirm it can see fires within the planned field of view.

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 10 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 fuel pan fires as described in System Design Information section.

8. MAINTENANCE

8.1 GENERAL

The FV300 series detectors contain 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.

8.1.1 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 8.1.2.

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 BS EN 50018 : 2000.

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.

8.1.2 DETECTOR CLEANING

The FV300 series detectors are relatively tolerant of accumulations of dirt on the sensor window or optical monitoring reflector (see Fig. 23). 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. 23). The detectors must not be cleaned without first removing power or isolating the detector.

8.1.3 FAULT FINDING

If the detector reports a fault, then the indicators along with the 4-20mA, video or network interfaces can be used to diagnose the cause. Refer to Section 5 'Operation' for more details and Appendix B for information on video overlay messages.

The most likely fault is a dirty or obscured window. To clear the fault, clean the window and manually activate the window test using the walk-test input or the walk-test tool. When the window test has finished the fault should be cleared.

All other faults cannot be rectified on site and the detector needs to be replaced.

8.1.4 WALK TEST AND WINDOW TEST (OPM)

The FV300 FlameVision detectors have a built in alarm and window test facility. By flashing lamps built into the detector that radiate IR, a simulated flame signal can be produced. This signal is reflected back onto the array using an external mirror. The detector responds to the lamps and will go into alarm. This is used as an alarm test to check the operation of the detector. It can be used in any environment.

The same lamps are used to check the cleanliness of the window to monitor the optical path. In this case the lamps are flashed in a regular pattern and the reflected signal level analysed by the array to measure the cleanliness of the window. The window test can either operate automatically at a regular timed interval (default 20 minutes) or can be activated at any time manually.

The alarm and window (OPM) test can be activated by using the walk-test tool, see below, the walk-test input or by network command.

8.1.5 WT300 WALK TEST TOOL

The WT300 walk-test tool is a portable, hand-held tool that can be used in hazardous areas to activate the alarm test, window test and reset the FV300 FlameVision detectors. It uses IR signals to communicate with the detector to activate commands and has a range of 6m. This means the walk-test tool can activate tests on the FV300 from the ground without needing poles or other means to reach the detector. The WT300 is battery powered using AA cells.

9. ORDERING INFORMATION

FV311S:	516.300.006
FV311SC-N:	516.300.007
FV311SC:	516.300.008
FV312S:	516.300.055
FV312SC-N:	516.300.056
FV312SC:	516.300.057
FlameVision MB300 Mounting Bracket:	517.300.001
FlameVision WH300 Weather Hood:	517.300.002
FlameVision JB300 Exe Junction Box:	517.300.005
FlameVision MK300 Field Spares Kit:	517.300.006
*FlameVision*WT300 Walk Test Controller:	517.300.021
FlameVision CTI300 Off-line Configuration Tool Kit:	517.300.022
NV – 652W Active video balun:	603.015.027
ADAM4520 RS485/RS422 to RS232 Converter:	557.180.151

A 1. INTRODUCTION

The FV300 can connect to a MODBUS network as a slave device conforming to V1.1 protocol specification. The detector provides a bank of 16 bit registers to provide comprehensive information on the status of the detector.

A status register is available so that a MODBUS controller can request the alarm and fault status from the detector. Full location information is available for an alarm. The detector also supports commands to perform OPM and alarm tests, reset latched alarms and faults and to control masking.

A 1.1 REFERENCES

MODBUS Application Protocol Specification V1.1, available from www.modbus.org

MODBUS over serial line specification and implementation guide V1.0, available from www.modbus.org

A 1.2 ELECTRICAL INTERFACE

The FV300 MODBUS interface operates on a 2-Wire serial bus in accordance with EIA/TIA-485 standard.

Note: The Modbus serial bus must be fitted with a set of termination resistors at one point only. See section 4.1.4.2 on page 12 of manual for details. When installing on an existing bus check that the correct resistors have been fitted.

A 1.3 FV300 MODBUS SERIAL LINE PARAMETERS

The FV300 meets the Basic Implementation Class for a Slave device. These options are summarised in Table. 5.

	Basic	Default Value	FV300 Configurations
Node Addressing	Configurable Address from 1 to 247		1 to 247
Register Address Offset			0 to 0xFFFF
Broadcast	Accept broadcast, (target address 0)		Yes (non configurable)
Baud Rate	9600 (19200 recommended)	19200	19200, 9600
Parity	EVEN	EVEN	EVEN, ODD, NONE
Mode	RTU	RTU	RTU only
Electrical Interface	RS-485 2W-cabling	RS-485 2W-cabling	
Connector Type	Screw Terminal		

Table. 5

The Modbus parameters are configured on the Network tab of the PC300 configuration tool.

Note: *When Modbus is enabled or disabled or if the network parameters are changed then the detector needs to be powered down and up or restarted from the configuration tool to activate the new settings.*

A1.4 SUPPORTED MODBUS FUNCTION CODES

The FV300 supports the following MODBUS Function Codes:

Code	Function
03	Read Holding Registers
04	Read Input Registers
06	Write Single Register
16	Write Multiple Registers

A1.4.1 FV300 REGISTERS

The FV300 has one block of 16 bit registers used for MODBUS access organised as follows:

Offset	Register	Data		Read/Write (R/W)
00	Commands	See 1.4.2		R/W
01	Reserved			
02	Reserved			
03	Reserved			
04	Reserved			
05	Reserved			
06	Reserved			
07	Reserved			
08	Overall Status	See 1.4.3		R
09	4-20mA level	4-20mA level x 1000 e.g. Alarm=17mA,Value=17000		R
10	1st Cluster state	0	CS	R
11	1st Cluster centre	X (0-255)	Y (0-255)	R
12	1st Cluster size	SX (0-255)	SY (0-255)	R
13	2nd Cluster state	0	CS	R
14	2nd Cluster centre	X (0-255)	Y (0-255)	R
15	2nd Cluster size	SX (0-255)	SY (0-255)	R
16	3rd Cluster state	0	CS	R
17	3rd Cluster centre	X (0-255)	Y (0-255)	R
18	3rd Cluster size	SX (0-255)	SY (0-255)	R
19	4th Cluster state	0	CS	R
20	4th Cluster centre	X (0-255)	Y (0-255)	R
21	4th Cluster size	SX (0-255)	SY (0-255)	R

Table. 6

The cluster state (CS) reports the current status as follows:

0 - Inactive
1 - Active
3 - Pre-alarm
5 - Alarm

The field of view is considered to be a 256 x 256 square space with the origin in the top right hand corner as you look out from the detector. The position of the centre of the alarm is reported by X,Y coordinate values. The site of the alarm SX,SY is reported using the same coordinates to define a box around the outside of the detected signal.

The base address for the register block is set in the PC configuration tool. The default is 00.

A1.4.2 THE FV300 COMMAND REGISTER

The command register allows the PLC to activate functions within the detector.

MSB												LSB
Command Request Bit												Command Code

Command Codes

1 = Initiate alarm test
2 = Initiate manual OPM test
3 = Reset latched alarm or faults
4 = Mask OFF
5 = Mask ON (inside mask area)
6 = Mask ON (outside mask area)

Note: Mask ON / OFF setting is maintained following a power cycle. The mask area is defined using the PC configuration tool

A1.4.3 THE FV300 OVERALL STATUS REGISTER

The status register is a collection of flags that report the current state of the detector.

MSB															LSB
Reserved	Reserved	Alarm	Pre-Alarm	Reserved	Hardware Fault	Window Obscured	Window Dirty	Reserved	Reserved	Alarm Test Active	OPM Test Active	Mask Enabled	Reserved	Command Done	Watchdog Heartbeat

The Watchdog Heartbeat toggles from 0 to 1 or from 1 to 0 every 16 seconds.

A 1.5 Command Transfer from PLC to FV300

1) The PLC will examine the Command Done bit in the FV300 overall status register and wait until it is cleared by the FV300.
2) The PLC will set the Command Code in the Command Register.
3) The PLC will set the Command Request bit in the Command Register.
4) The FV300 will detect the change in Command Request bit and will action the command code.
5) When completed, the FV300 sets the Command Done in the Overall Status register.
6) The PLC will detect that the Command Done bit has been set showing that the command has been completed.
7) The PLC will clear the Command Request bit in the Command Register.
8) The FV300 detects the change in Command Request bit and clears the Command Done bit.

B 1. VIDEO TEXT OVERLAY DETAILS

The FV300 FlameVision detectors can be supplied with a built in colour video camera which looks out over the same field of view as seen by the IR array and other flame sensors. The camera provides a balanced output video signal on twisted pair connections suitable to feed into a CCTV system. (An active balun may be required to connect to some systems.)

The detector superimposes a text overlay (12 lines of 24 characters) onto the live video output to provide identity and status information. The content of the overlay changes depending on the state of the detector and is described below.

Detectors without cameras can be configured to show identity and status information on the video output. In this mode the text overlay is displayed on a plain blue background. The content and layout of the overlay is the same with or without the camera.

The following describes the overlay configured in standard mode. The fields are shown enclosed in ‘< >’.

Identity and Location Information:

Each detector can be configured with a user defined text string up to 24 characters long. This is normally used to identify the detector and its location. This information is programmed using the PC configuration tool. The identity and location will be displayed on the overlay if an event occurs but can be permanently shown if required.

In addition to the upper (ABC…) and lower (abc…) case alphabet and numbers (0123…), the following characters may be used in the identity and location string:

! ” # % & ’ ( ) * + , - . / : ; < = > ? [ ] _ | ~ and {will be display as ((with } as))

Characters that cannot be displayed on the overlay will be shown as a “?”.

B 1.1 QUIESCENT STATE

In quiescent, normal, operation, the text overlay displays basic identity, location and status information. The default layout of the overlay is shown below.

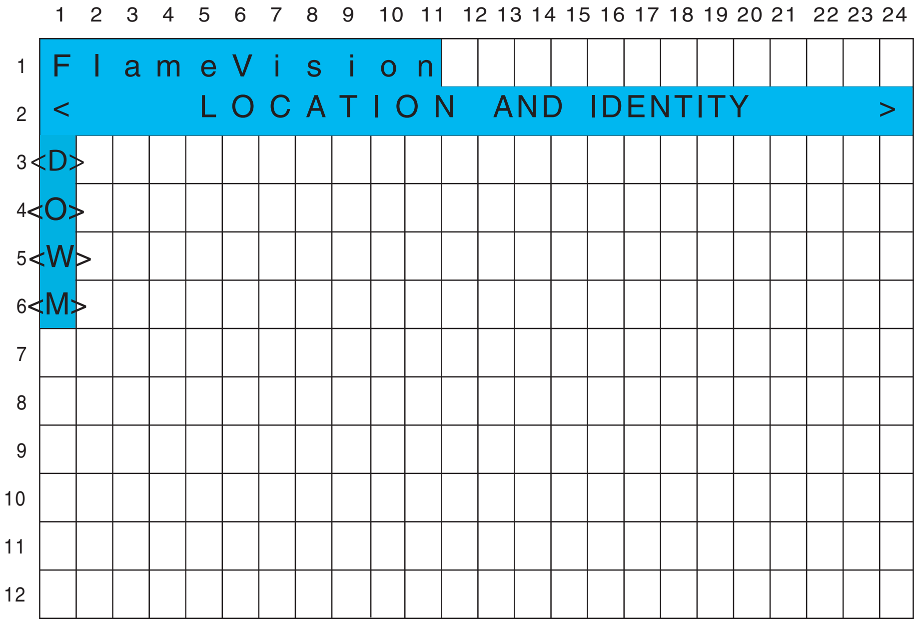


Fig. B-1 Quiescent State Overlay

Fig. B-1 shows the positions of data fields on the quiescent state text overlay.

The top of the overlay gives the basic identity and location information, with option flags down the left hand edge. The displayed fields can be turned on/off in the PC configuration tool.

Overlay Field	Description
'FlameVision'	Name of detector range, permanently displayed.
LOCATION AND IDENTITY	A user defined location and identity message up to 24 characters. Set by the configuration tool.

The top left hand corner of the overlay gives status information about configurable options and the delay settings as follows:

Overlay Field	Description
D	This field shows the selected alarm delay setting: S – Short delay M – Medium delay (default) L – Long delay X – Extra long delay
O	Shows the mode of the OPM test: <D> for manual (on Demand) or <A> for automatic. (Timed)
W	Shows the window heater status: <-> window heater disabled, <W> window heater enabled
M	Shows the alarm mask status: <->mask is disabled, <M> mask is enabled.

B 1.2 ALARM STATE

If the detector enters the alarm state then the overlay will change to report the event and highlight the location of the fire within the field of view. The alarm will be identified by a box shown on the overlay which encloses the fire with "ALARM" flashing at the top. The box will adjust in size according to the size of the fire. The log counter will be displayed to show where the event is recorded in the detectors internal log.

Fig. B-2 Alarm State Overlay

Fig. B-2 Shows the alarm location box and information fields on the text overlay.

The identity fields are now displayed next to the box on the text overlay. If the location and identity field is empty then, the serial number will be displayed instead. These fields will move according to the size and position of the alarm box so that the information can be seen on the overlay. Their position will depend on where the alarm is within the field of view and how big it is. The fields showing the status of options are not displayed.

B 1.3 OPM AND ALARM TEST INFORMATION

The OPM test and alarm test (AT) have their own sections of the text overlay to report status. The OPMMODE (<O>) field shows the current OPM operating mode, automatic or manual.

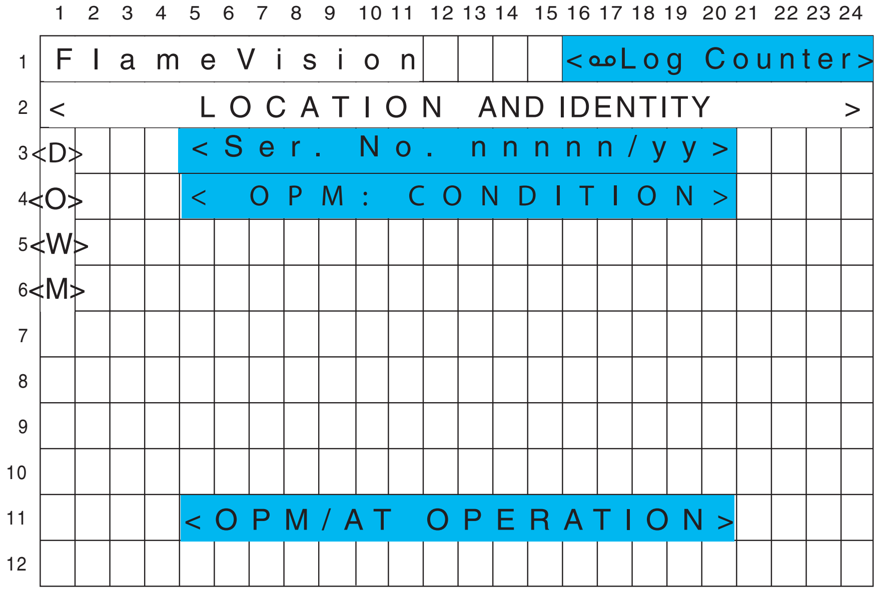


Fig. B-3 OPM/AT Operation Overlay

Fig. B-3 Shows the position of OPM/AT information fields on the text overlay.

The top of the text overlay gives the basic identity and location information which are displayed as described for the quiescent state above. The log counter will be displayed when an event occurs to show where it is held it is recorded in the internal log.

The OPM/AT operation field displays alternating messages to show progress and how the test was initiated. This field can also give a prompt when a regular alarm test is due; this is triggered by a timer set by configuration. The following messages are displayed:

OPM/AT Message	Description
"MANUAL OPM TEST" / "IN PROGRESS"	An OPM test is in progress; initiated manually using the walk-test tool, wired input or network.
"AUTO OPM TEST" / "IN PROGRESS"	An OPM test is in progress; initiated automatically at the configured regular time interval.
"ALARM TEST" / "IN PROGRESS"	An alarm test is in progress; initiated manually using the walk-test tool, wired input or network.
WALK TEST DUE	A reminder that the regular alarm test should be performed. This is a configurable option.

If the OPM test determines that the window is clean then the overlay returns to the quiescent condition.

However, if the OPMtest fails then the Serial Number and a message describing the problem are displayed on two lines of the overlay.

The OPM condition field reports the result of the test whether initiated manually or automatically. This is in addition to the fault being indicated on the fault LED and signalled on the outputs as described in Section 5.

OPM Condition Messages	Description and How to fix it
DIRTY	The sensing window is dirty and must be cleaned soon.
BLOCKED	The sensing window is completely blocked and must be cleaned immediately.
LAMP FAULT	Both lamps have failed and the detector cannot perform an OPM test.

B 1.4 HARDWARE FAULT STATE

If a hardware fault is found in the detector then it will be reported by a message displayed in the middle section of the text overlay. This is in addition to the fault being indicated on the fault LED and signalled on the outputs as described in Section 5.6 and 5.7.

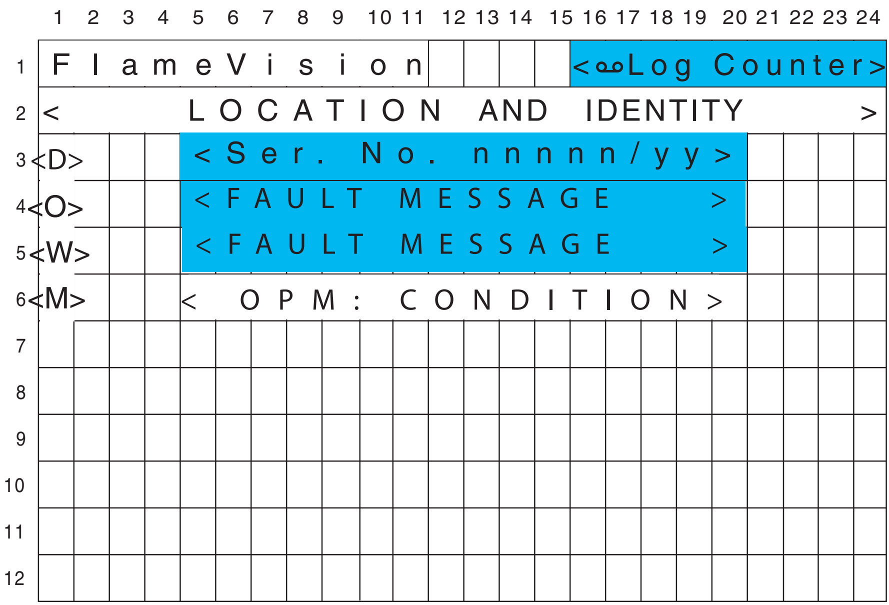


Fig. B-4 Hardware Fault Overlay

Fig. B-4 shows the position of data fields on the hardware fault text overlay.

The top of the fault state overlay gives the basic identity and location information which are displayed as described for the quiescent state. The log counter will be displayed when an event occurs to show where it is recorded in the internal log.

The next line displays the device serial number. This is the serial number as etched on the front plate of the detector and is entered during manufacture, it cannot be changed. This is followed by one or two lines describing the fault.

Fault Message	Description and How to fix it
Wiring fault	A fault has been detected on the circuit from the detector. Check wiring.
Detector fault	The detector has an internal fault. Record the model and serial number and contact your supplier.

If the detector also has an OPM condition or fault to report then this will move to the line below the hardware fault.

B 1.5 OTHER MESSAGES

There are a few messages that can appear towards the bottom of the quiescent mode text overlay to report other states of the detector.

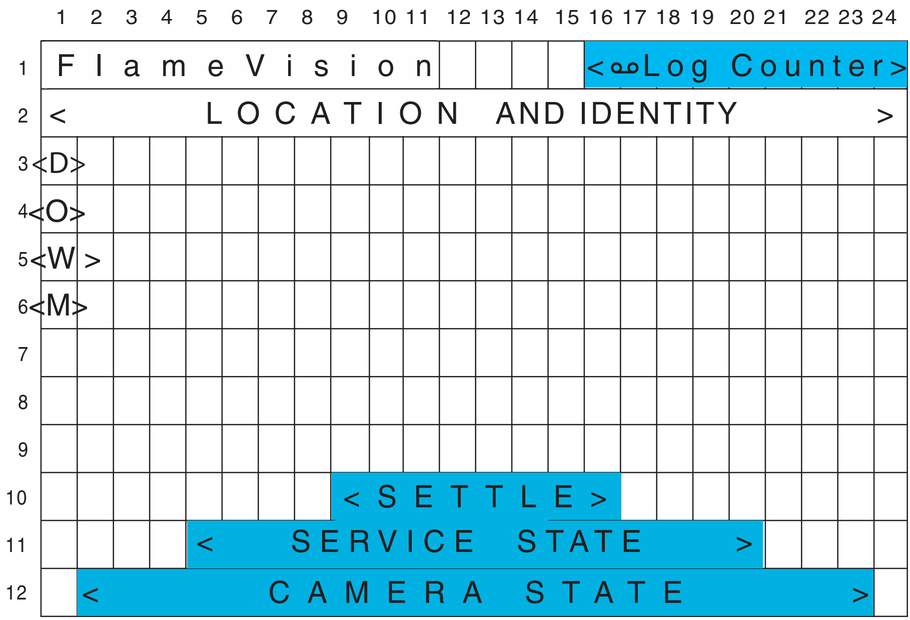


Fig. B-5 Other Detector States Overlay

Fig. B-5 shows the position of other message fields on the text overlay.

The log counter will be displayed when an event occurs to show where it is recorded in the internal log.

Message Field	Description
SETTLE	“SETTLE” is displayed in this field whilst the detector is settling after power up. Once the detector has settled this field will be blank.
SERVICE STATE	“OUT OF SERVICE” is displayed in this field when the detector is in service mode for configuration or diagnostics. In normal operation this field is blank.
CAMERA STATE	The following messages will be displayed on a blue background as the camera signal is not available: CAMERA LOST - The camera signal has been lost. CAMERA OFF: TOO HOT - The camera temperature is too hot and it has been turned off. CAMERA OFF: TOO COLD - The camera temperature is too cold and it has been turned off.

tyco
FlameVision

Detector Serial No.: ....

Detector Location: ....
....

Dip Switch Settings (see Tables 2 and 3 Page 44):

Switch	Function	Configured
1-1	Remote Configuration*	
1-2	Alarm Delay	
1-3		
1-4	Reserved	Set in Off position
1-5	Alarm Latching	
1-6	Fault Latching	
1-7	Window Heater	
1-8	OPM Man/Auto	

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