# CCTV Visual Flame Detector

# Technical Manual

| RELEASE NOTES | | | | | |
|---|---|---|---|---|---|
| Rev. | Date | Revision History | ECN | Prepared | Approved |
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|---|---|---|
| R.Johnson | S.Duncan | 12/12/2000 |

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Micropack (Engineering) Ltd would greatly appreciate being informed of any errors or omissions that may be found in our documents. To this end we include a form, given in Appendix 10.3, for you to photocopy, complete and return to us so that we take the appropriate action. Thank you.

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# 1 Safety Instructions

For the correct and effective use of this equipment, to maintain safety and avoid hazards it is essential that you read and understand these instructions and act accordingly **BEFORE** installing, operating or maintaining the equipment.

**Pay particular attention to all Safety Warnings, Cautions and Important Notices.**

## 1.1 Warnings

- This equipment is certified for, and intended for, use in potentially hazardous areas. Install and use the equipment in accordance with the latest regulations.
- For UK installations BS/EN60079-14 *'Electrical Installations in Hazardous Areas'* and BS/EN60079-17 *'Inspection and Maintenance in Hazardous Areas'* should be strictly observed.
- For installations in North America the National Electrical Code (NEC) should be strictly observed
- Elsewhere the appropriate local or national regulation should be used.
- The equipment must be properly earthed to protect against electrical shock and minimise electrical interference.
- Do not drill holes in any housing or enclosure as this will invalidate the explosion protection.
- Ensure that the enclosure lid is fully tightened and locked into position before energising the equipment.
- Do not open the enclosure in the presence of an explosive atmosphere.
- All permits and proper site procedure and practises must be followed and the equipment must be isolated from the power supply before opening the enclosure in the field.
- Operators must be properly trained and aware of what actions to take in the event of a fire being detected.
- Repair of equipment should only be performed in a safe area and by trained personnel.

## 1.2 Cautions

- Use only approved parts and accessories with this equipment.
- To maintain safety standards, commissioning and regular maintenance should be performed by qualified personnel.

## 1.3 Important Notices

- Pay attention to the guidelines given throughout this document.
- If in any doubt ask your local sales representative or contact Micropack (Engineering) Ltd.
- Micropack (Engineering) Ltd take no responsibility for installation and/or use of its equipment if this is not in accordance with the appropriate issue and/or amendment of the manual.
- Micropack (Engineering) Ltd reserve the right to change or revise the information contain herein without notice and without obligation to notify any person or organisation of such action.
- Only those parameters and configurations highlighted with the FM triangle ( ) have been tested and approved by Factory Mutual.

# 2 Introduction

The **Micropack CCTV Visual Flame Detector** is a combined flame detection and surveillance system. The detectors are based on a unique video imaging based flame detection technology developed by Micropack. The software algorithms are capable of discriminating between genuine fire conditions and other radiant sources that may cause unwanted alarms.

## 2.1 FEATURES

**Immunity/ Discrimination**

The detector is immune to common sources of unwanted alarms such as hot work (e.g. grinding and welding), Hot $CO_2$ emmissions (such as turbine exhausts) and Flare Reflections.

**Live Video**

A live video image is available from each detector, this allows information about the protected area to be displayed on a monitor in the control room. This provides the operator with a visual image of the event reducing reaction time.

**Robust and Reliable**

The detector has been designed for the extreme environmental conditions experienced offshore.

**Detection Coverage**

The detector is sensitive to fires of 10kW radiant heat output (RHO), or greater, and up-to 20m within a 90° field of view.

**Selectivity**

The detector sensitivity can be configured to a precise fire size between 10kW and 50kW RHO.

## 2.2 Visual Flame Detection

The detector can operate 'stand alone' or can be integrated with other control systems. The detectors are located in fixed locations throughout the installation to achieve the specific detection coverage and ensure the site performance requirements are always met. Each detector provides live video images and fire alarm/fault signalling to the control equipment. Each detector operates independently, incorporating within a single unit an imaging camera, Digital Signal Processing and Software Algorithms to process the live video image and interpret flame characteristics.

## 2.3 Surveillance System

Live video images are available from each detector allowing a remote operator to interrogate the system and, during an alarm situation, see the hazard develop. The detectors can be individually configured to operate as a combined CCTV and Flame detection system or as a CCTV surveillance system only (with the flame detection capability disabled).

## 2.4 Detection Coverage

The CCTV system can detect fires of 10kW Radiant Heat Output (RHO), or greater, at 20m within a 90° field of view. The detectors will only respond to visible flames within their field of view. In this way the CCTV system provides a high level of discrimination from unwanted sources of false alarm. The detectors also reduce the likelihood of cross-propagation of alarms caused by fires or products of fires burning outside its field of view.

## 2.5 Detector Overview

The detector is a single standalone unit and comprises of two primary components, the detector enclosure, and the camera detector assembly. The camera assembly consists of three electronic printed circuit board (pcb) assemblies, these are: the termination board, the sensor board, and the processor board. The camera detector assembly is pre-assembled into the enclosure and comes complete with all parts required for installation (excluding the client mounting support, glands and cabling). Each detector contains the following parts:

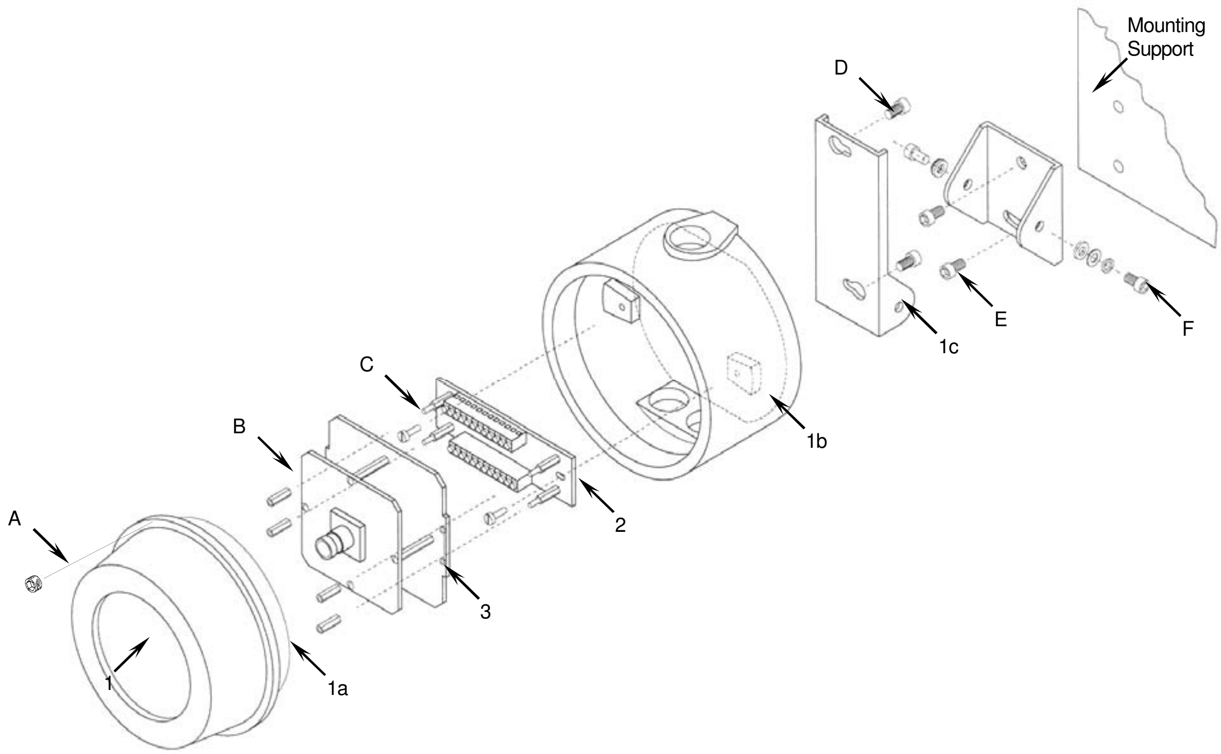



*Figure 1 Exploded view of all detector components*

*Table 1Detector Assembly Parts List*

| | | | | |
|---|---|---|---|---|
| 1 | Detector (Faceplate) | A | Enclosure lid locking screw | 1 off M4 set screw |
| 1a | Enclosure Cover | B | Detector sensor board retaining pillars | 4 off M3 x 16 hex pillar |
| 1b | Enclosure Body | C | Detector baseboard retaining screws | 2 off M4 x 8 pozi-drive screw |
| 1c | Mounting Bracket | D | Enclosure bracket fixing screws | 2 off M6 x 8 hex socket screw |
| 2 | Detector Baseboard | E | Mounting support fixing bolts | 2 off M6 x 8 hex socket screw |
| 3 | Detector Sensor Board | F | Mounting bracket assembly screws | 2 off M6 x 8 hex socket screw<br>2 off M6 spring washers<br>2 off M6 plain washers |
| **Detector Assembly Drawing Key** | | | | |

## 2.6 Detector Enclosure

The detector electronics are housed in an enclosure certified for use in zone 1 hazardous areas. The enclosure comprises of the enclosure cover (and faceplate window), the enclosure body (and certification label) and the mounting bracket.

The mounting bracket allows the detector's orientation to be adjusted vertically from 0 to 45°, and allows an axial rotation of +/-10° (to adjust the horizon). Horizontal adjustment is to be provided by the client-supplied detector mounting support.

The detector enclosure carries the certification label and serial number as shown below:

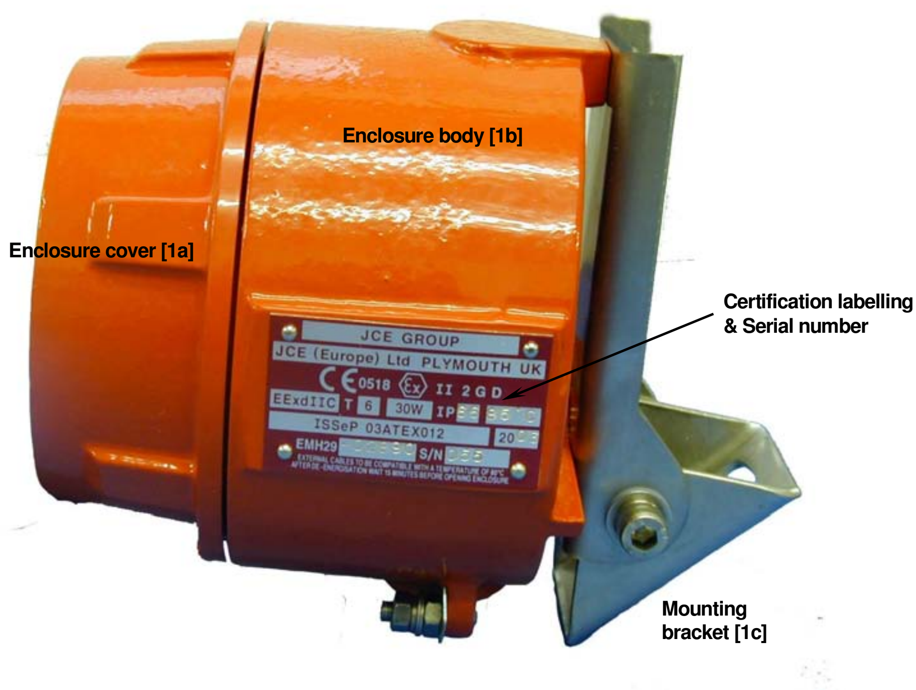



*Figure 2 Detector Enclsoure and Bracket*

## 2.7 Detector Sensor Board

The detector sensor and processor boards [3] contains the imaging sensor, signal processing and communications hardware. The sensor/processor board assembly plugs into the baseboard on four alignment pillars. All four fixing pillars [B] must be fitted and fully tightened. When removed from the enclosure the sensor board should be protected from mechanical and electrostatic damage. The key elements of the sensor board are shown below:

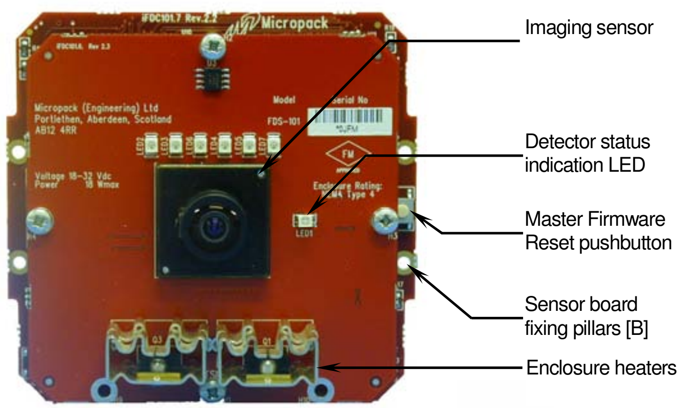



*Figure 3 Detector Sensor Board*

## 2.8 Detector Baseboard

The detector baseboard [2] comprises of the field interface hardware, screw terminals and hardware configuration links [J1 to J4]. The baseboard mounts into the enclosure body on two fixing screws [C]. Both screws must be fitted and fully tightened. When removed from the enclosure the baseboard should be protected from mechanical and electrostatic damage. The key elements of the baseboard are shown below:

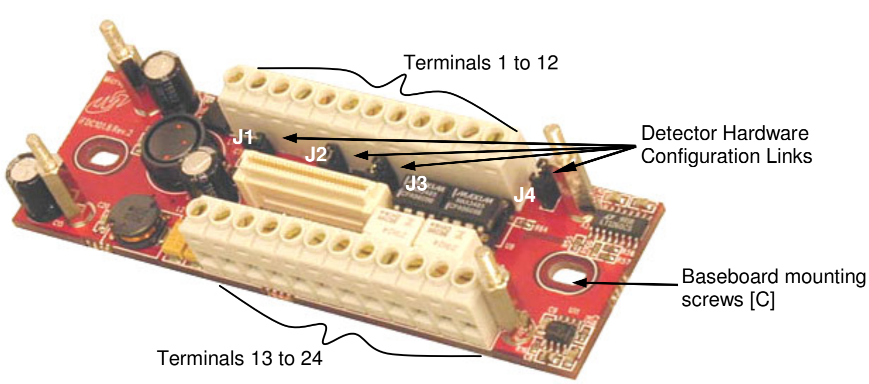



*Figure 4 Detector Baseboard*

# 3 Application Guidelines

In considering the application of the detector it is important to know of any conditions that may prevent the detector from responding. The detector provides reliable response to visible flames and insensitivity to common false alarm sources. The detector provides protection within its field of view. Solid obstructions or a direct view of intense light sources may result in partial reduction in the coverage and/or a reduction in the detector sensitivity. The construction of scaffolding or tarpaulins in the detector's field of view will reduce the coverage. Contamination of the detector window will result in a partial reduction in sensitivity.

The detector provides a CCTV video image for surveillance of the protected area. As with conventional CCTV cameras the detector should not face directly towards the sun or a brightly lit scene. In such conditions the detectors automatic exposure control will darken the image to prevent overexposure. The resultant picture may be too dark for surveillance purposes. To obtain the best possible picture the detector should be facing away from the sun. In the case of an FPSO, where the vessel is moving, the detectors should face inwards with minimal view of the horizon.

With the standard lens the detector has a horizontal field of view of 90° and a vertical field of view of 65°. The location and orientation of the detector in relation to the protected area determine the actual footprint. Achieving the desired coverage depends on the congestion within the protected space, the location of the detector(s) and the distance of the detector from the hazard. It may be necessary to install more than one detector within an area to achieve adequate coverage.

For special applications it is possible to change the detector's coverage by selecting a suitable wide or narrow angle lens (i.e. changing the field of view and depth of field / range). A narrow angle lens (9°) offers 10x magnification increased range of operation to over 100m (up-to 200m).

The detector sensitivity, expressed as fire Radiant Heat Output (RHO) at a distance, is determined visually by the apparent size of the fire. This is a function of the fuel source, how it is released and distance from the detector faceplate to the fire. The detector response time is relatively independent of fuel type and/or distance.

In common with other forms of flame detection the detector's sensitivity is reduced and potentially blinded by dense airborne obscurants such as smoke, fog and other airborne particulate. The detector is insensitive to arc welding, however it should not be conducted within 3m of the detector.

### 3.1 Siting requirements

The following guideline have been based on operational feedback, reflecting commonly experienced problems, which can be traced to a failure to observe the following:

- Ensure the mounting position is free from vibration or movement
- Prevent accidental knocking or forcing out of alignment
- Where snow or ice build up is likely the heater should be enabled
- To ensure the best possible video image the detector should be facing away from the sun
- Isolate as far as possible from local electrical interference sources
- Sufficient detection to ensure adequate coverage for all likely hazards
- Minimise exposure to contamination of the detector face plate
- Ensure ease of maintenance access to detector (i.e. direct, ladder or scaffold access)

All these issues are of *crucial* importance to a successful installation and they should be afforded great attention during the detailed design, construction and commissioning phases of the work.

### 3.2 Detection Coverage

Detection can be located from computer models or from site surveys. The detectors should be aligned to view the intended hazard taking into account any obstruction and congestion

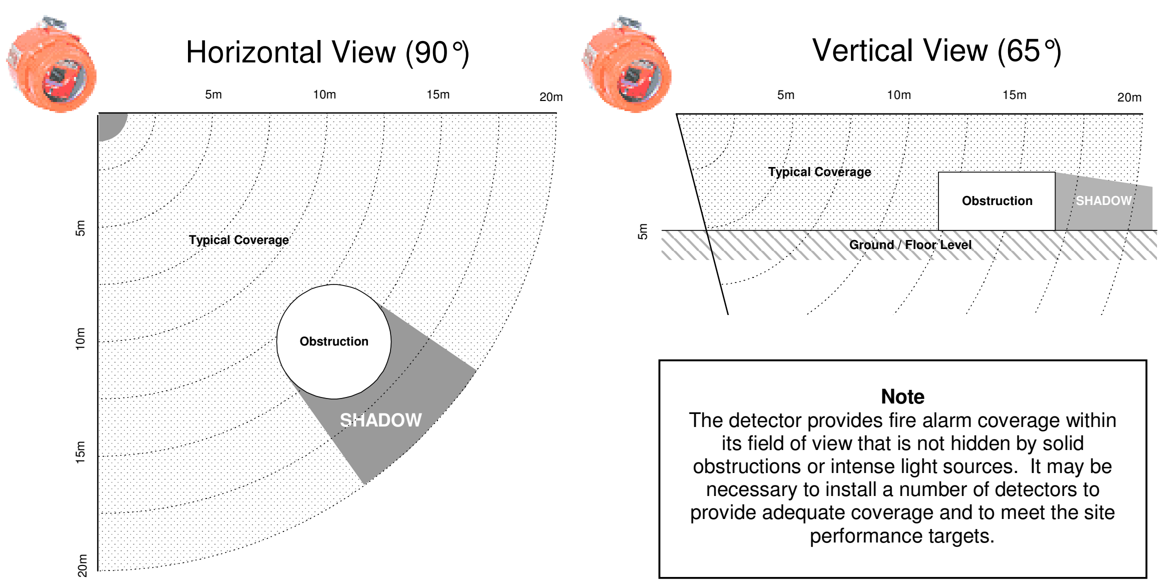



*Figure 5 Example Detector Coverage and Field of View*

Software analysis of the actual detector coverage may be required to assure adequate coverage of the hazards. This analysis can also be used to optimise the number of detectors and the loop configuration.

### 3.3 Exposure to Flare Radiation

Flame detectors are frequently used where hydrocarbon fire hazards are expected, typically process plant and engine room hazards. The detector should not have a direct view the flame, if this cannot be avoided they should be masked out to prevent an alarm being detected using the built-in alarm masking facility.

### 3.4 Flexibility of mounting location

The detector requires a clear unobstructed view of the local hazard. In order to avoid local obstructions, such as pipe-work and cable trays, a 2m helix should be provided in the detector cable to allow local repositioning of the detector.

### 3.5 Mounting Arrangements

Firm, vibration free mountings are essential for trouble free operation of optical systems and the detector should, wherever possible, be fixed to comparably rigid mountings.

### 3.6 Thermal Disruption

Thermal convection plumes and exhaust gas plumes generally exhibit a visual 'mirage' effect. In most cases this does not affect detector operation or sensitivity. The detector does not respond to black body radiation near the exhaust.

### 3.7 Optical Contamination

There are many sources of contamination such as oil, water (deluge water, rain and sea-spray), snow and ice and internal misting. The design of the detector incorporates an internal heater and hydrophobic-coated glass (inner and outer surfaces) to assist in maintaining the optical surfaces. Excessive contamination of the detector faceplate will result in an increased maintenance requirement and potentially reduce the detector's sensitivity. Where detectors are mounted at low level, care should be taken to avoid contamination (such as water and oil) from equipment above the detector. Care should be taken in siting the detector to minimise the likelihood of such contamination.

### 3.8 Enclosed Areas

In enclosed areas, if dense smoke is expected to accumulate at the onset of the fire, the detectors should be mounted 1 to 2m below the ceiling level.

## 3.9 Fog (and other airborne obscurants)

Fog, smoke and potentially other similar airborne contaminants affect the detector's sensitivity by reducing the detector's range. In general the detector's range is limited to the Meteorological Optical Range or M.O.R. The M.O.R. represents the range of human visibility as defined by the MET office and is expressed as 'meters of visibility', i.e. the attenuation of light over a given distance.

$$Visibility[MOR] = -L \times \left( \frac{\log_e 20}{\log_e \tau} \right)$$

$$\tau = transmissivity = 1 - \left( Opacity[\%] \div 100 \right)$$

*L* = *measurement path length*
$\tau$ = *transmissivity (optical attenuation)*

Opacity is the measurement of optical attenuation expressed as a percentage between 0% and 100%

*Equation 1 Meteorological Optical Range (M.O.R.) Calculation*

For example, this means an M.O.R. distance of 20 meters results in the detector having a maximum range of 20 meters.

## 3.10 Detector Sensitivity

The detector's response to a fire is a function of the fuel source and how it's released, fire size and distance, orientation to the detector, local ambient conditions and the detector threshold settings. The following typical figures are based on in-house tests. As with all tests the results must be interpreted according to the individual application taking into account all possible variables.

The detector sensitivity to different fuel sources is dependent on the apparent size of the flame, the detectors typical response is shown below.

*Table 2 Typical Detector Response Characteristics*

| **Fuel** | **Fire Size** | **Fire RHO** | **Distance** |
|---|---|---|---|
| Methane or Methane intense source | 48L/min | 10kW | 10m (33 feet) |
| Ethane | 28L/min | 10kW | 10m (33 feet) |
| Propane | 20L/min | 10kW | 10m (33 feet) |
| Butane | 15L/min | 10kW | 10m (33 feet) |
| Diesel | 0.3m x 0.3m pan | 10kW | 10m (33 feet) |
| Crude Oil (heavy fuel oil) | 0.5m x 0.5m pan | 10kW | 10m (33 feet) |
| Wax Inhibitor (Clear 10) | 0.3m x 0.3m pan | 10kW | 10m (33 feet) |
| Anti Foam (Surflo AF-300) | 0.3m x 0.3m pan | 10kW | 10m (33 feet) |
| Wood Stack | 0.3m x 0.3m crib | 10kW | 10m (33 feet) |
| nHeptane | 0.3m x 0.3m pan | 5kW | 10m (33 feet) |
| Gasoline | 0.3m x 0.3m pan | 5kW | 17m (56 feet) |

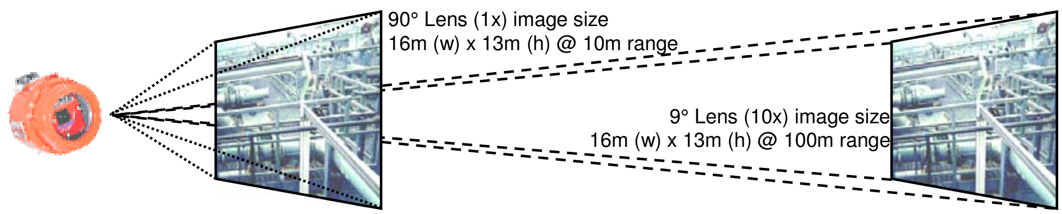
The detector sensitivity is inversely proportional to distance, approximately equivalent to a square-law. For example with the detector sensitivity set to 10kW @ 10m the detector would equally respond to a 2.5KW fire at 5m or a 22.5kW fire at 15m.

### 3.11 Detector Field of View

The CCTV detector does not have a traditional cone of vision like a conventional IR flame detector. The detector's field of view is a rectangular pyramidal shape and represents a radial projection of the detector rectangular sensing element. Refer to attached drawing 2200.6001 for the actual field of view footprints.

### 3.12 Alternative Lenses

In special applications requiring long-range operation or a specific field of view it is possible to change the detector's coverage by selecting a suitable wide or narrow angle lens. The alarm mask facility can then be used to precisely define the detection coverage.




The standard detector has a 90° wide-angle lens (1x) while a 9° narrow-angle lens (10x) offers the longest range (i.e. highest magnification) currently available.

# 4 System Design Guidelines

The following guidelines are intended to assist with the electrical design and engineering of systems for use with the visual flame detector.

## 4.1 Electrical Connections

The electrical connections and detector configuration links are located on the detector baseboard, as shown below:

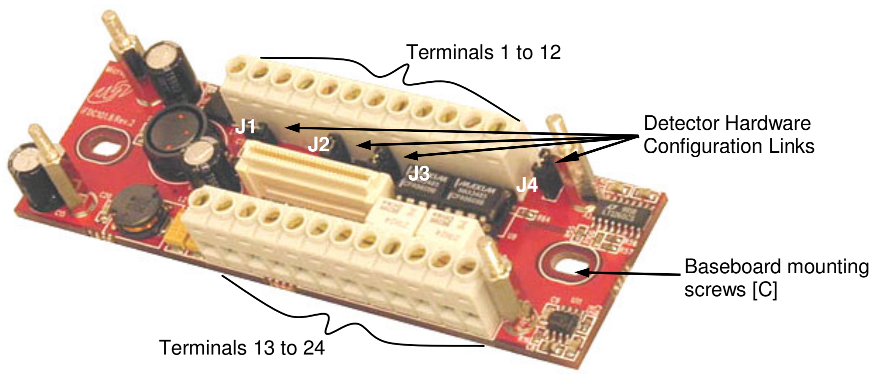



*Figure 6 Detector Terminations & Hardware Links*

### 4.1.1 Hardware links

The detector baseboard has 4 user configurable links.

*Table 3 Baseboard Configuration Links*

| Link | Signal | Link Function / Description | State if Link Not Fitted | State if Link Fitted |
|---|---|---|---|---|
| **J1** | +24V | +24Vdc Supply A & B Shorting Link | **Default State** | A & B Shorted |
| **J2** | RS485.A | RS485 Channel A Line Termination Link | Not Terminated | **120R Terminated** |
| **J3** | RS485.B | RS485 Channel B Line Termination Link | Not Terminated | **120R Terminated** |
| **J4** | Video | Video Balanced Line Termination Link | Not Terminated | **150R Terminated** |

The links should be set appropriately for the detector cabling topology, as described in the following sections.

### 4.1.2 Field Terminations

There are 24 field terminals available, these have the following function:

*Table 4 Detector Baseboard Terminal Descriptions*

| Terminal | Signal | Terminal Function / Description | Notes / Comment |
|---|---|---|---|
| 1 | +24V | +24Vdc Supply A Input | |
| 2 | 0V | 0V Supply Common | |
| 3 | +24V | +24Vdc Supply B Input | |
| 4 | 0V | 0V Supply Common | |
| 5 | A (+) | RS485.A Channel A | |
| 6 | B (-) | RS485.B Channel A | |
| 7 | A (+) | RS485.A Channel B | ***Factory Use Only*** |
| 8 | B (-) | RS485.B Channel B | ***Factory Use Only*** |
| 9 | +Y | +Video Signal Output (Coax or Balanced Line) | |
| 10 | -Y | -Video Signal Output (Balanced Line Only) | |
| 11 | 0V | Video GND (Coax screen) | ***Connected to 0V Supply Common*** |
| 12 | X | Screen Terminal (electrically isolated terminal) | |
| 13 | +24V | 24Vdc Pulse supply For Automatic Camera Bright Video | ***Pulse for 5 Seconds*** |
| 14 | 0V | 0Vdc Pulse supply For Automatic Camera Bright Video | |
| 15 | +24V | 24Vdc Supply For Automatic Video Overlays | ***Pulse for 5 Seconds*** |
| 16 | 0V | 0Vdc Supply For Automatic Video Overlays | |
| 17 | NO | Detector Fire Alarm Relay (0) - Normally Open | |
| 18 | NC | Detector Fire Alarm Relay (0) - Normally Closed | |
| 19 | C | Detector Fire Alarm Relay (0) - Common | ***Contacts shown quiescent (i.e. de-energised)*** |
| 20 | NC | Detector Healthy Relay (1) - Normally Closed | |
| 21 | NO | Detector Healthy Relay (1) - Normally Open | |
| 22 | C | Detector Healthy Relay (1) - Common | ***Contacts shown quiescent (i.e. energised)*** |
| 23 | A | 4 – 20mA output | |
| 24 | X | **DO NOT USE** | |

### 4.1.3 Electrical Connection Symbol

For convenience the following electrical schematic block diagram is used to represent the detector:

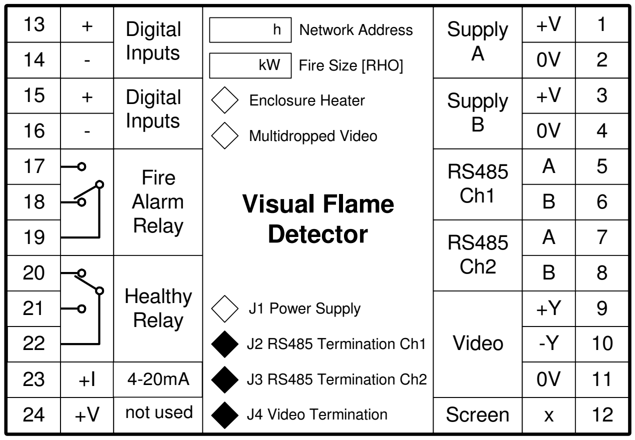
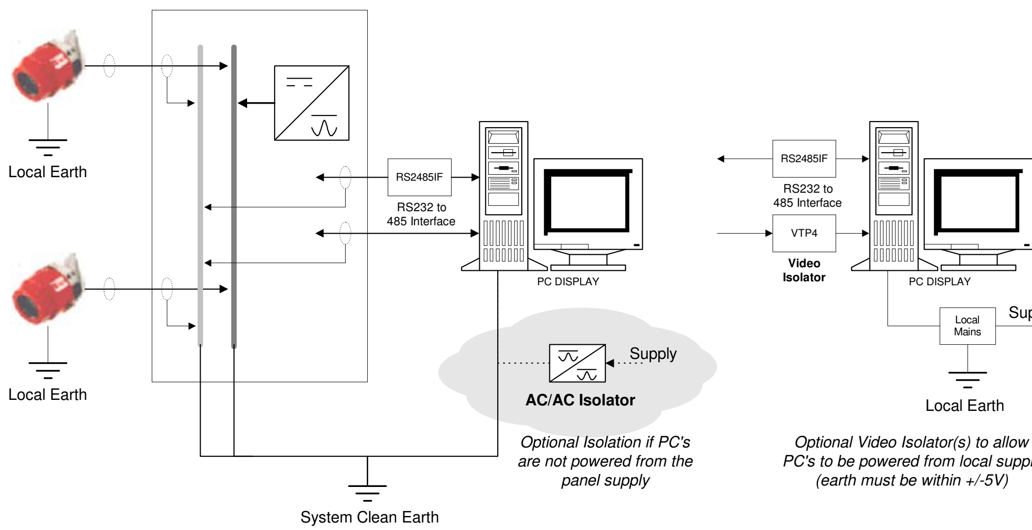



*Figure 7 Electrical Schematic Block Diagram*

### 4.1.4 Earthing & Screening Requirements

It is important to ensure that the system is correctly connected to earth. Incorrect or poor earthing can adversely affect system operation and may result in intermittent RS485 communications and video image corruption.

The system 0V should be connected to a clean earth at only one point, generally this should be at the panel power supply (or 0V bus bar). Where PC equipment is connected to the RS485 and Video signals, care should be taken to ensure that the PC's and Panel's power supply are at the **same** ground potential**.** Even small differences in earth potentials can cause an earth fault current to flow resulting in video corruption. Where this is not possible either the PC's local supply should be isolated and the PC's connected to the system clean earth, or alternatively, the Video and RS485 signals should be isolated. The Micropack twisted pair to BNC video converter (*VTP4)* and RS232 to RS485 converter (*RS2485IF)* can be used so long as the maximum potential difference between each earth does not exceed +/-6V, as shown below:




In distributed systems with multiple DC-DC power supply units all 0V supplies must be connected together to a common clean earth. Where this is not possible each system can either be connected to a local clean earth so long as the maximum potential difference between each earth does not exceed +4 to -1Vdc, alternatively the Video and RS485 signals can be galvanically isolated from the central system. Where earth fault monitoring is used care should be taken to ensure that the system 0V to earth potential is not exceeded.

The detector enclosure is to be connected to a local earth and the detector cable screens (shields) should be cut back to the crotch and not terminated within the detector. If the detector enclosure cannot be connected to a local earth then care should be taken to ensure the cable armour braid provides a suitable earth or that the enclosure earth stud (external) is separately connected to a suitable earth point using a single core 4mm$^2$ earth cable.

All detector cable screens should be connected to the local clean earth at the control panel. The screens (and twisted pairs) should be maintained to within 1" (25.4mm) of the terminations at the detector, within all junction boxes and at the control panel. Where unscreened cables are used for panel wiring, then all cables must be suitably twisted into pairs and video cables should be segregated from other signal sources.

### 4.1.5 Power Supply

The detector has two supply connections, supply A & B, the +24V supplies are diode 'OR' together and the 0V are common. Either or both can be connected to the detector. The detector power supply connects to terminal 1 (or 3) for +24Vdc and terminal 2 (or 4) for 0V. The power supply loop through link **J1**, located on the detector baseboard, is normally not fitted. Fitting link **J1** connects the two +24V supplies together.

The detector requires an absolute minimum supply voltage of 18V, measured at the detector terminals. The system power supply voltage and power distribution should be arranged such that on the longest cable run the detector(s) has a supply voltage of **greater** than 18V. All detectors must share a common 0V supply. In distributed systems with multiple DC-DC power supply units all 0V supplies must be connected together. Where this is not possible the RS485 and Video signals may need to be galvanically isolated, such as with a fibre optic transceiver.

To prevent RS485 communications or video corruption the maximum volt drop on the 0V return must not exceed +4V or -1V, refer to figure below. Voltages greater than these will exceed the common mode input range of the RS485 and Video drivers. Power supply cable selection is described in the Power Supply section 4.1.4.

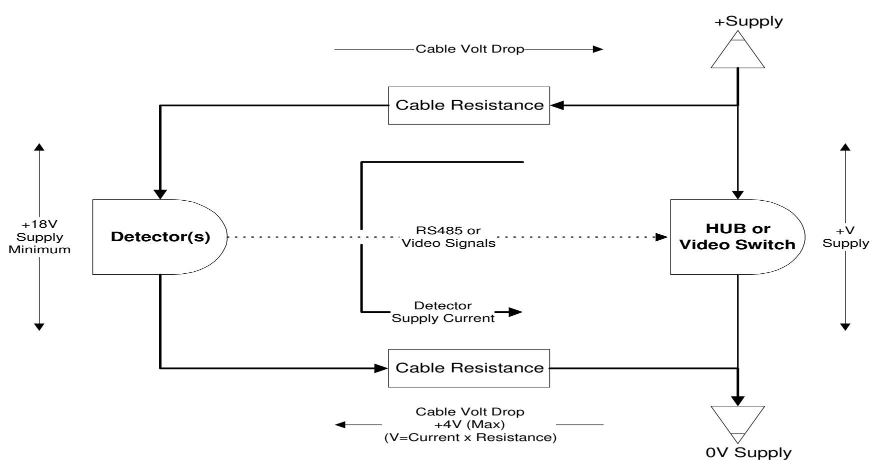



*Figure 8 Detector Power Supply Cabling*

### 4.1.6 RS485 Communications

The RS485 twisted pair cable is connected to the detector RS485-A signal on terminal 5 and the RS485-B signal on terminal 6. It is possible to multi-drop more than one detector using twisted pair cabling, refer to the following sections. The RS485 line termination link **J2** an **J3** for channels **A** & **B** respectively, located on the detector baseboard, should be fitted if the detector is either the last detector of a multi-drop loop or where only one detector is fitted. Each detector represents one RS485 unit load. A maximum of 32 devices, either detectors or other RS485 compatible equipment, can be connected to a single transmission line.

### 4.1.7 Video (twisted pair)

The video twisted pair cable is connected to the detector +Video signal on terminal 9 and the -Video signal on terminal 10. It is possible to multi-drop more than one detector using twisted pair video cabling for details refer to the following sections. The video line termination link **J4**, located on the detector baseboard, should be fitted if the detector is either the last detector of a multi-drop loop or where only one detector is fitted. A maximum of 6 detectors can be connected in a multi-drop loop.

### 4.1.8 Video (Coaxial)

The video coaxial cable is connected to the detector +Video signal on terminal 9 (coax conductor) and the Video ground on terminal 11 (coax screen). Care should be taken when connecting to commercial video equipment as the Video ground is often connected to the equipment 0V or earth. This can result in the detector supply current returning through the coaxial cable screen, which may affect the video quality. In such cases the detector supply cables should be increased in size to reduce cable volt drop to a minimum. The video line termination link **J4** should not be fitted. It is not possible to multi-drop more than one detector using coaxial video cabling.

## 4.2 Connection Topologies

### 4.2.1 Point to Point Connection

In a point to point connection a single detector is connected to the power, RS485 and Video cables. This arrangement has the best reliability and availability since any single failure in the field equipment or cabling affects only the one detector. All line termination links for the RS485 and Video signals must be fitted at the detector. The example shown below is for twisted pair video.

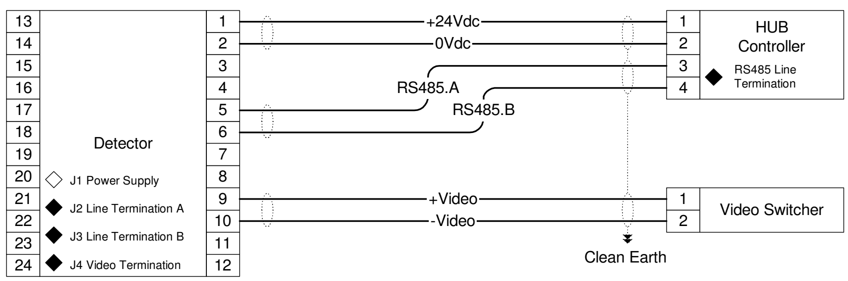



*Figure 9 Detector Point to Point Cable Connection*

### 4.2.2 Stand Alone Detector – With Short Circuit Monitoring

In a stand-alone configuration, the detector alarm and fault relays can be connected to a 3rd party Fire Alarm Panel. The configuration shown below shows a series device connected to the alarm relay, and an end of line device connected to the fault relay – this will enable short-circuit monitoring. The Hub controller and Video Switcher outputs are optional, and must be connected via twisted screen cables if required.

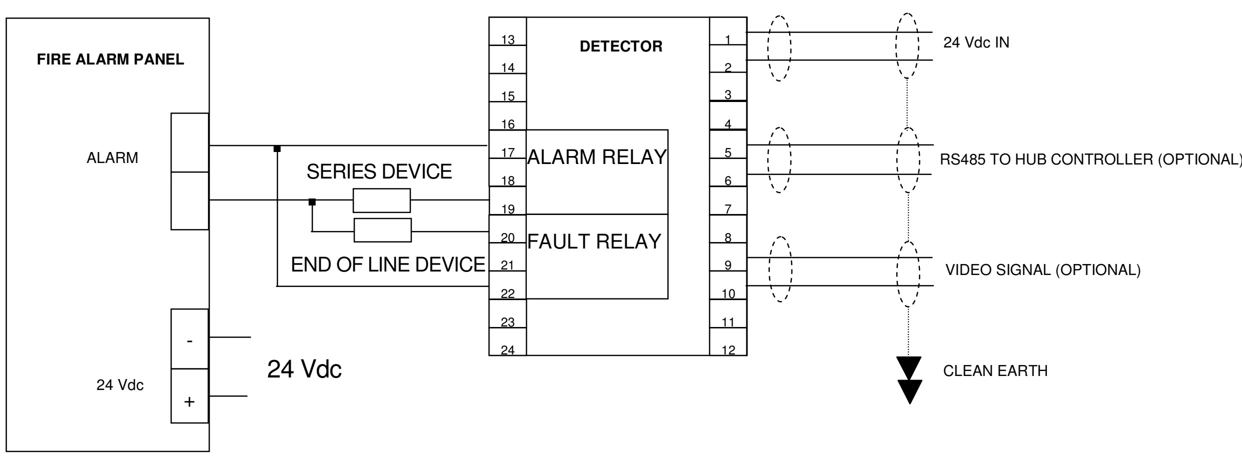



*Figure 10 Stand-alone Detector – With Short Circuit Monitoring*

### 4.2.3 Stand Alone Detector – Without Short Circuit Monitoring

In a stand-alone configuration, the detector alarm and fault relays can be connected to a 3rd party Fire Alarm Panel. The configuration shown below shows no series device connected to the alarm relay – this will **not** enable short-circuit monitoring. The Hub controller and Video Switcher outputs are optional, and must be connected via twisted screen cables if required.

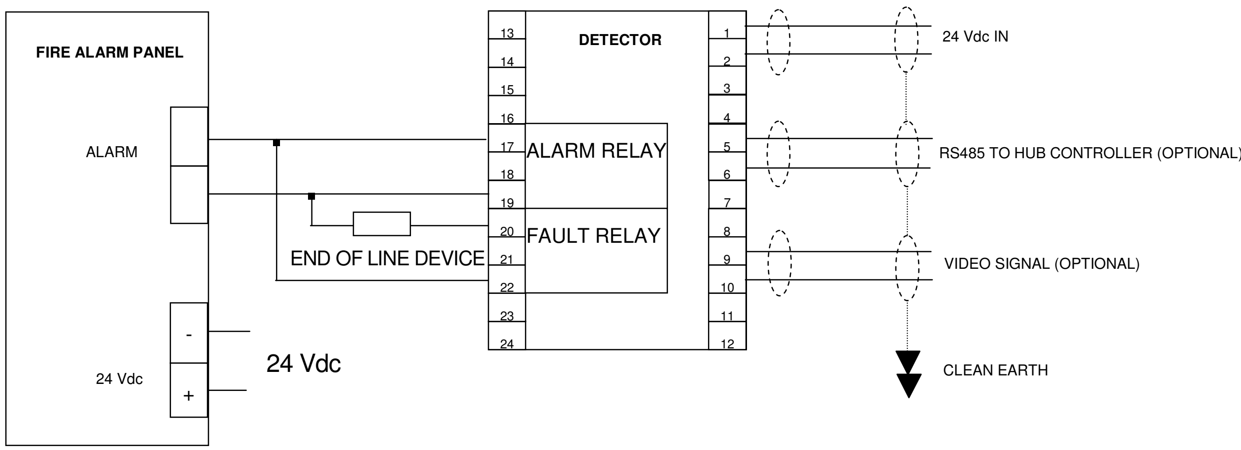



*Figure 11 Stand-alone Detector – Without Short Circuit Monitoring*

### 4.2.4 4-20mA Output Connection

The camera can be configured to provide a 4-20mA output option. If pins 22 and 23 are linked, then current output from pin 20, when connected to zero volts may be monitored. The current ranges for this output may be configured within the *thresholds* option for the flame detector to be found within the display Software.

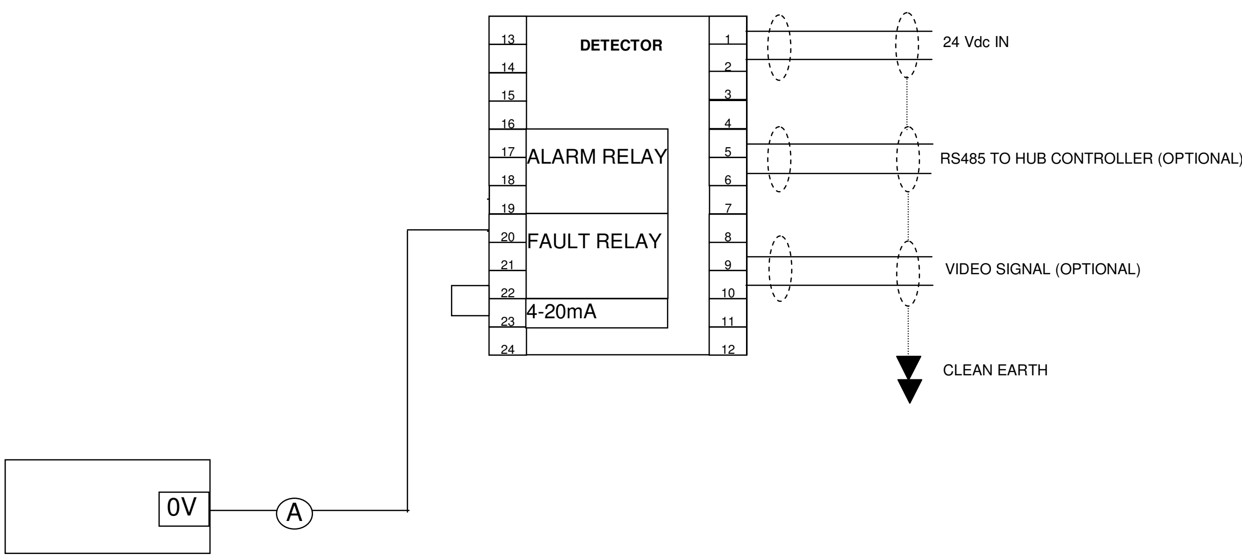



*Figure 12 4-20mA Output*

### 4.2.5 Stand Alone Detector (digital inputs)

In a stand-alone configuration, the detector can be automatically taken out of dark video by pulsing 24V dc to terminals 13 and 14 for approximately 5 seconds. The camera overlay features can be switched on by pulsing terminals 15 and 16 for approximately 5 seconds. Both these options will stay on for the default time of the dark video configuration.

### 4.2.6 Multi-drop Looping

In a multi-drop loop connection multiple detectors are connected to the power, RS485 and Video cables. All line termination links for the RS485 and Video signals must be fitted at the detector at the end of the loop (Detector A in the example below), all other detectors have their links removed (Detector B, etc). The example shown below is for twisted pair video. Coaxial video is not possible with this arrangement.

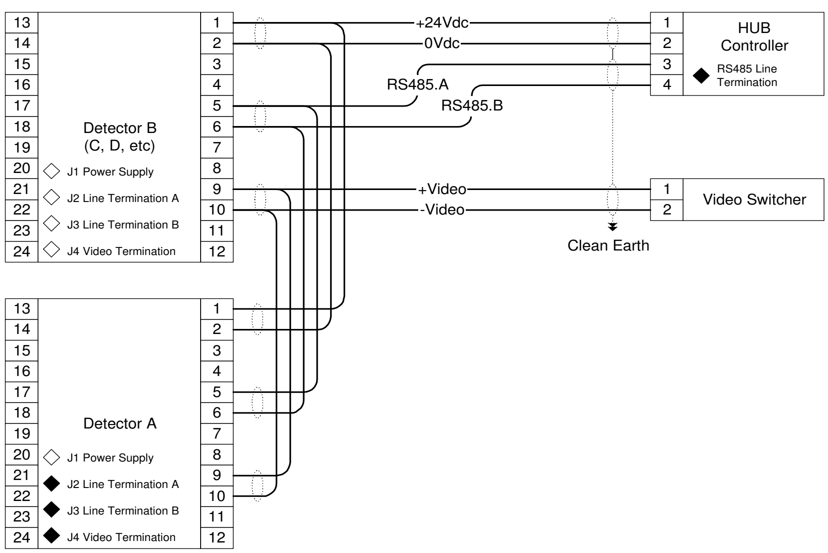



*Figure 13 Detector Mulit-drop Loop Cable Connection*

### 4.2.7 Coaxial Video Connection

This arrangement is similar to the twisted pair example except coaxial cabling is used for the video signal. All line termination links for the RS485 and Video signals must be fitted at the detector.

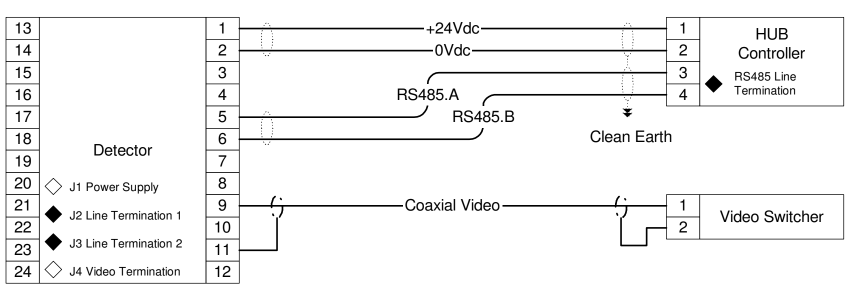



*Figure 14 Detector Coaxial Cable Connection*

### 4.3 Detector Threshold Configuration

The detector has two types of user configuration, the hardware links on the baseboard described previously and the detector threshold setting. The detector configuration should be recorded in the project design at a suitable location to ensure that repairs or replacements are correctly configured.

The detector baseboard contains a non-volatile memory, this is used to store all detector thresholds for the specific detector location (other than the detector alarm mask which is stored on the detector sensor board). Should the detector sensor board be replaced the replacement will automatically read the memory and configure itself accordingly. In the event the baseboard needs to be replaced the replacement will need to be manually reconfigured with the correct configuration. However since the detector sensor board stores the alarm mask data, should the sensor board be replaced its replacement will need to be manually reconfigured.

The detector threshold allows the detector operation to be configured for the specific location.

*Table 5 Default Detector Threshold Settings*

| Function/Description | Default | Comment |
|---|---|---|
| Detector Baseboard Address | 1200h | Set to address (201h to FFFh) |
| Fire Size | 10kW (RHO) | Set to performance target |
| Detector Enclosure Heater Enable | Disabled | Enable for ambient <10°C |
| Multi-dropped Video | Disabled | Enable for muli-drop loop |

The detector thresholds should be set appropriately for the installation, refer to *get thresholds* for details of detector thresholds.

### 4.4 Cable Selection

The installation and local regulations and standards determine the overall cable specification. This section specifies suitable cable characteristics to ensure correct operation of the flame detector. There are many different cabling methods available, each has advantages and disadvantages, and these are:

1. Video coaxial cable plus combined twisted pairs for DC power and RS485 signals
2. Three twisted pair cable, one each for DC power, RS485 and video signals
3. Four twisted pair cable, two for DC power and one each for RS485 and video signals
4. Two twisted pair cable for DC power and RS485 and separate video coaxial cable

Option three allows smaller conductors to be used for RS485 and Video signals with double the cross sectional area available for the DC power cables.

*Table 6 Typical cable lengths (24V Supply)*

| Installation based on 24V nominal supply | Number of Flame Detectors | Maximum Power (W) | Maximum Cable Length (m) with 1.5mm$^2$ Conductors (12 ohms/Km) | Maximum Cable Length (m) with 2.5mm$^2$ Conductors (7.6 ohms/Km) |
|---|---|---|---|---|
| Detector and Heater | 1 | 18 | 333 | 506 |
| Detector (no Heater) | 1 | 6 | 1,000 | 1,578 |
| Detector and Heater | 4 | 72 | 83 | 131 |
| Detector (no Heater) | 4 | 24 | 250 | 395 |

Note increasing the supply voltage to 26V would increase the maximum cable lengths by +40%.

*Table 7 AWG Conversion Table*

| Cross Sectional Area (mm$^2$) | American Wire Gauge (AWG) | Typical Conductor Resistance per Km (3280*ft*) DC Ohms/Km @ 20°C (approximate) |
|---|---|---|
| 0.5 | 22 | 36 |
| 1 | 18 | 19 |
| 1.5 | 16 | 12 |
| 2.5 | 14 | 7.6 |

### 4.4.1 General Guidance

The overall performance and the transmission distance depend on the selected twisted pair cable. Individually screened twisted pairs offer better electrical immunity. When individually screened twisted pairs are used the transmission distances are considerably reduced due to the higher capacitance introduced by the screen. The choice between screened and unscreened pairs is a compromise between transmission distance and immunity towards noise and crosstalk. When multiple detector signals are carried on a single cable the pairs must be individually screened to prevent interference. Avoid locating unscreened twisted pair cable parallel to cables carrying high-speed data or high energy and/or high frequency signals.

### 4.4.2 DC Power

It is not necessary for the DC power cable to be a twisted pair or individually screened, a 2-core stranded cable with an overall screen is sufficient. The minimum conductor size is determined by the cable length, the number of Flame Detectors on each loop and the maximum allowed voltage drop at the last detector. To prevent RS485 and Video common mode problems this is limited to a maximum of four volts (4V) on the negative supply (0V).

$$V_{pd}(\leq 4V) = \frac{Vs_{min} - Vd_{min}}{2}$$

$$R_{Km} = \left( \frac{V_{pd} \div \left( \frac{Pd \times N}{Vs_{min}} \right)}{L_{Km}} \right)$$

| | |
|---|---|
| $V_{pd}$ | = Potential across each conductor (limited to ≤4V) |
| $Vs_{min}$ | = Minimum Supply Voltage |
| $Vd_{min}$ | = Minimum Detector Voltage (18V) |
| $Pd$ | = 18 watts per Flame Detector (inc. Heater) or 6 watts excluding Heater |
| $N$ | = Number of Detector |
| $L_{Km}$ | = Cable Length In Kilometres |
| $R_{Km}$ | = Maximum Conductor Resistance per Kilometres |

*Equation 2 DC Supply Conductor Resistance Calculation*

Use the value of $R_{km}$ calculated above to select a suitable gauge of conductor, alternatively, to calculate the maximum cable length from a known conductor resistance swap $R_{km}$ and $L_{km}$ in the above equation. The supply voltage and cable cross-sectional area (which equates to its resistance) limits the maximum cable length, increasing the supply voltage (up-to a maximum of 32V) can dramatically increase cable length.

Prudence dictates that a cable is selected with a lower resistance than calculated above, with sufficient allowance for the effects of crimps, terminals and ageing which can increase overall resistance. Where a single cable cross sectional area cannot be found to satisfy both the needs of the power and signal conductors consideration should be given to using multiple paralleled conductors of a smaller cross section for the power.

### 4.4.3 Video (Coaxial)

The video cable should be low loss (attenuation) 75R coaxial cable with a stranded conductor to facilitate crimping, such as equivalent to RG59 or RG11, with the following characteristics:

*Table 8 Video (Coaxial) Cable Characteristics*

| Cable Characteristic | Characteristic Impedence | Capacitance | Conductor Resistance | Attenuation @ 1MHz | Inductance |
|---|---|---|---|---|---|
| **Nominal** | **75R** | 62pf/m | - - | - - | - - |
| **Absolute Limit** | - - | 75pf/m | <150R | **6db** | - - |

The maximum cable length is determined by the cable manufacturer's attenuation specification, typically 300m, as shown in the calculation below. Coaxial video cabling generally produces the highest video quality and allows the use of commercial CCTV video switching equipment.

$$L_{km} = A_{db} \div A_{km}$$

| | |
|---|---|
| $A_{db}$ | = Attenuation Limit (db) |
| $A_{m}$ | = Cable Attenuation per Kilometre (db/km) |
| $L_{km}$ | = Cable length in Kilometres |

*Equation 3 Video (Coaxial) Cable Length Calculation*

#### 4.4.4 Video (Twisted Pair)

The video cabling should be a twisted pair stranded cable with an overall screen. Where multi-core cables are used then individual screened twisted pairs are recommended. The cable should have the following characteristics:

*Table 9 Video (Twisted Pair) Cable Characteristics*

| Cable Characteristic | Characteristic Impedence | Capacitance | Conductor Resistance | Attenuation @ 1MHz | Inductance |
|---|---|---|---|---|---|
| **Nominal** | **150R** | 50nf/Km | - - | - - | - - |
| **Absolute Limit** | 90R to 150R | 100nf/Km | 150R | **6db** | 0.7mH/Km |

The maximum cable length is dependent on the cable manufacturers attenuation specification, which is approximately proportional to conductor size. The characteristic impedance of a transmission line is a function of the physical dimensions of the conductor and the permittivity of the dielectric (the insulation), at high frequencies this is approximately equivalent to:

$$Zo(\Omega) = \sqrt{L \div C}$$

*L = Cable Inductance (mH)*
*C = Cable Capacitance (uF)*
*Zo = Characteristic Impedence (Ohms)*

*Equation 4 Characteristic Impedence Calculation*

#### 4.4.5 RS485 Communication

The RS485 communications cabling should be a twisted pair stranded cable with an overall screen. Where multi-core cables are used then individual screened twisted pairs are recommended. The cable should have the following characteristics:

*Table 10 RS485 Communications Cable Characteristics*

| Cable Characteristic | Characteristic Impedence | Capacitance | Conductor Resistance | Attenuation @ 1MHz | Inductance |
|---|---|---|---|---|---|
| **Nominal** | **120R** | 50nf/Km | - - | - - | - - |
| **Absolute Limit** | 90R to 150R | 100nf/Km | 150R | **12db** | 0.7mH/Km |

The maximum cable length is dependent on the cable manufacturers attenuation specification, which is approximately proportional to conductor size. The characteristic impedance of a transmission line is the same as for the video above.

## 4.5 Fibre Optic Cabling

Fibre Optic transmission equipment is available from third party companies. Their products are available 'commercially off the shelf' (COTS) and are intended for use in CCTV and security applications. Typically the equipment provides simultaneous transmission of up-to four 75 Ohm PAL Video signals and one channel of bi-directional RS485 communications along a single multi-mode fibre (62.5/125um).

When selecting suitable equipment care should be taken in selecting the fibre type (single or multi-mode) and in calculating the optical budget. The optical budget should consider the actual make-up of the fibre path including:

- fibre attenuation per Km (at the transmission wavelengths)
- all splices and connectors
- rotary couplings/slip rings
- the total path length
- an allowance for the long term affects of ageing, etc

An example worse case optical budget is shown below:

| Fibre Optic Losses | 780nm | Comment | 1300nm | Comment |
|---|---|---|---|---|
| Rotary Coupling Insertion Losses[1] | 5.5dB | | 5.5dB | |
| Rotary Coupling Spectral Variation[2] | -- | | 1.5dB | |
| Splice / Connector Losses[3] | 4dB | 8 @ 0.5dB | 4dB | 8 @ 0.5dB |
| Fibre Optic Cable Losses[4] | 3dB | 1km @ 3dB/km | 1dB | 1km @ 1dB/km |
| **Total Losses** | **12.5dB** | | **12dB** | |
| Transmission Equipment Available Budget[5] | 14dB | | 14dB | |
| **Available Budget** | **1.5dB** | | **2dB** | |

The available optical budget, after losses, is better than 1.5dB. This is sufficient to allow for the effects of installation variations and ageing.

[1] Taken from Focal Inc "fibre optic swivel specification" February 8, 1998

[2] Taken from discussion with Focal Inc. engineering staff November, 1998

[3] Based on maintaining high quality (cut and polished) spliced connections (typically <0.25db)

[4] Taken from Anixter Canada quotation 09522 and technical attachments for a typical multi-mode fibre

[5] Taken from Coe Ltd S-400 technical data sheets (later revised from 12db to 14db)

# 5 Installation

Experience has shown that poor installation and commissioning practice may result in an unreliable fire detection system that is prone to malfunction and unwanted alarms, and at the same time fails to meet the site performance targets. Before installing the detector it is important to take into account where it is to be located and how it is to be mounted.

## 5.1 Mechanical Installation

| | |
|---|---|
| **Notes** | **When locating the detector consideration should be given to maintenance access to the detector**<br>**The detector mounting should be secure and vibration free**<br>**It is advisable to check the detection locations, prior to fabrication of the mounting supports, as changes are frequently made during construction at site which can affect detector coverage**<br>**The installation should allow subsequent detector removal, for maintenance or repair, to be easily achieved** |
| 1 | The detector should be fixed to a stable supporting structure using the mounting bracket provided. The supporting structure must allow for horizontal adjustment of the detector orientation. The support structure should be in place prior to detector installation. Examples of typical mounting supports are shown below. |
| 2 | The threaded flame path of the enclosure cover and body must be protected from damage during installation. Any such damage can destroy the validity of the enclosure |
| 3 | The detector sensor board and baseboard electronics should be removed from the enclosure prior to installation. The detector electronics shall be protected form mechanical damage and external sources of EMI such as X-rays, RFI and electrostatic discharge |
| 4 | Fit the mounting bracket to the support structure using the bolts provided. The detector (bracket) should be oriented to provide the desired coverage |
| 5 | The hex head bolts should be fitted to the enclosure body prior to mounting to the bracket. The detector enclosure body should then be fitted to the mounting bracket. The bolts locate into key slots in the bracket. Twist the enclosure to locate the bolts, these are then tightened using a 6mm Allen key. |

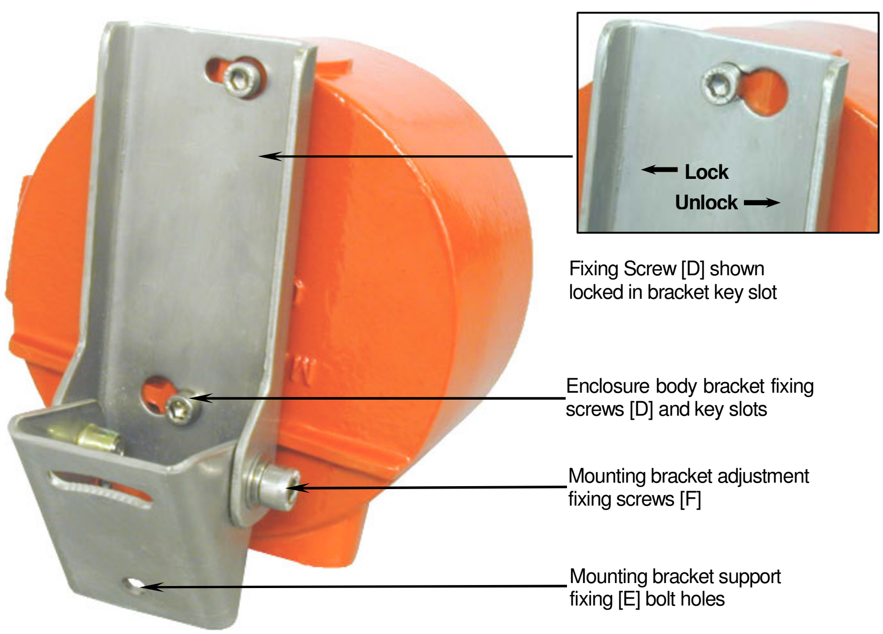


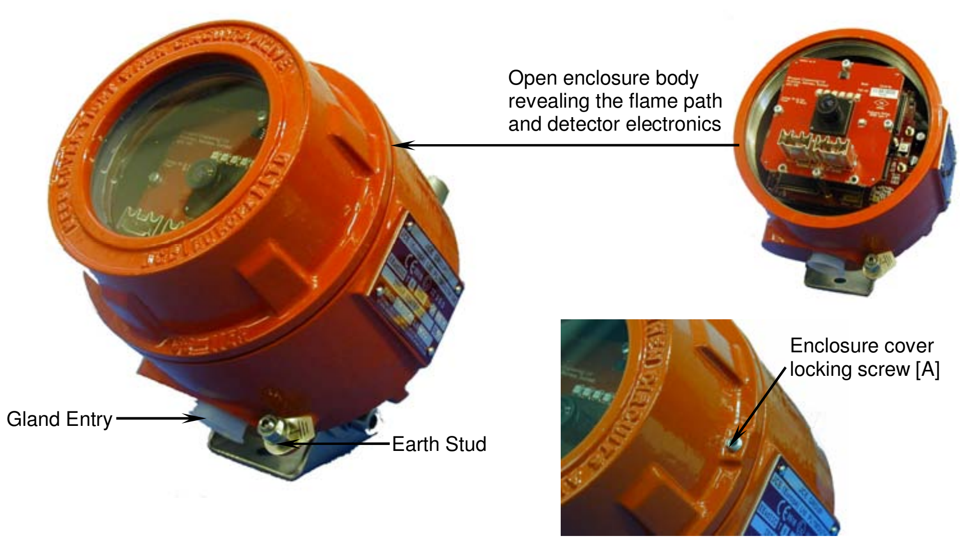

*Figure 15 Enclosure Mechanical Installation*

## 5.2 Electrical Installation

In order to maintain compliance with the EMC regulations it is essential the electrical installation be engineered correctly.

| **Notes** | **It is advisable to check the detection locations, prior to fabrication of the mounting supports, as changes are frequently made during construction at site**<br><br>**Detector cabling must be segregated from cables carrying high-speed data or high energy and/or high frequency signals and other forms electrical interference**<br><br>**The detector requires a clear unobstructed view of the local hazard. In order to avoid local obstructions, such as pipe-work and cable trays, a 2m helix should be allowed in the detector cabling**<br><br>**The detector baseboard should only be fitted just prior to commissioning the detector. Experience shows that the detector can be damaged due to cable testing operations (Insulation Tests, etc)** |
|---|---|
| 1 | Isolate all associated power supplies. Ensure that they remain OFF until required for commissioning |
| 2 | The threaded flame path of the enclosure cover and body must be protected from damage during installation. Any such damage can destroy the validity of the enclosure |
| 3 | The detector sensor board and baseboard electronics should be removed from the enclosure prior to installation. The detector electronics shall be protected form mechanical damage and external sources of EMI such as X-rays, RFI and electrostatic discharge |
| 4 | The detector external earth stud should be connected to a local earth point |
| 5 | Remove the blanking plug(s) from the enclosure body gland entries |
| 6 | Fit approved cable glands using sealing washers to maintain ingress protection |
| 7 | Prepare the cable tails. The cable screens should be cut back to the crotch at the detector and insulated from contact with the enclosure or any other local earth. The twisted pairs should be maintained to within 1" (25mm) of the termination. Cable tails should be 8" (200mm) long |
| 8 | Where plastic junction boxes are used the cable screens (shield) should be maintained to within 1" (25mm) of the termination and fully insulated |
| 9 | Where unscreened cables are used for panel wiring, then all cables must be suitably twisted into pairs and video cables should be segregated from other signal sources |
| 10 | All cable screens (shield) should be connected to the local clean earth at the control panel. The screens and twisted pairs should be maintained to within 1" (25.4mm) of the terminations |
| 11 | Following installation completion, the cabling shall undergo full earthing and insulation tests (with baseboard removed) |

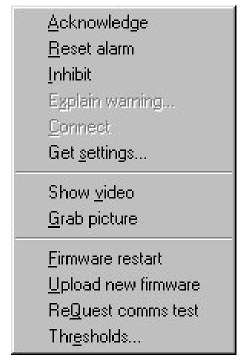
*Figure 16 Detector Electrical Installation*



# 6 Operating Instructions

Many of the detector features are only available via the RS485 communications. Throughout this section these features are described with reference to the CCTV Display and Alarm Handling system. Refer to the CCTV Display and Alarm Handling System technical manual for a detailed description of operation. In general this section will only describe the features available at the detector and not how these are accessed and represented at the PC display.

The following features are available by selecting the detectors local menu, this gives access to the following detector features:




## 6.1 Acknowledge (Alarms)

Acknowledge alarm is a display only function and does not affect the detectors operation. To acknowledge an alarm condition select the detectors acknowledge option.

## 6.2 Reset Alarms

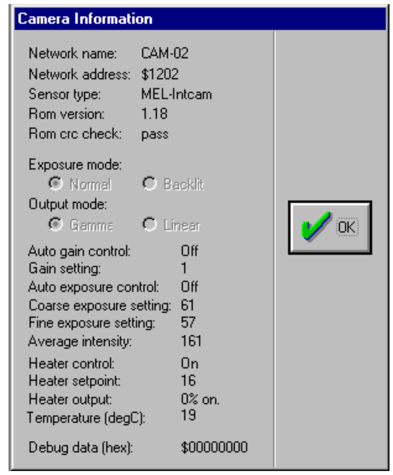
The detector latches into the fire alarm condition until the operator resets the alarm(s), the alarms must be acknowledged before the reset is selected. To individually reset detectors select the reset alarm option. If the fire condition is no longer present the alarm condition will clear.

## 6.3 Inhibit Alarms

The inhibited condition determines how the display and control system respond to the detector alarm condition and does not affect the detectors operation. To inhibit any control actions being taken when the detector is in a fire alarm condition select the detector inhibit option.

## 6.4 Get Settings

Get setting is intended for diagnostic purposes. This function allows the detectors current operating parameters to be viewed. Get settings is commonly used to verify the detectors current firmware revision as well as to review real-time data such as the current enclosure temperature and current exposure settings.




*Note :*

*The contents in this graphic are illustrative only, and are dependant of project specification and ongoing development. Refer to individual installation for actual name, address and rom version details.*

## 6.5 Show Video

To display live video images from the detector select the *show video* option. Where two or more detectors are connected on a multi-drop loop all the detectors should be configured to have multidropped video configured. When instructed, by the HUB, to *show video* only the requested detector turns ON its video output. If there is only one detector on the loop the video output should be set to enable on power-on, i.e. permanently ON.

## 6.6 Firmware Restart

Selecting the firmware restart option will restart the detector electronics and firmware, this is equivalent to a power-on cycle. The restart will take up-to 8 seconds to complete during which time the RS485 communications and live video image will be lost and any acknowledged alarm condition will be reset. Following a power-on or firmware reset there is a delay of up-to 10 seconds before the detector resumes operation.

## 6.7 Grab Picture

It is possible to grab three image formats from the detector, these are used for diagnostics and record keeping. The desired image type is selected in the display preferences and the image can be viewed by selecting the detector '*grab picture'* option. The grab picture feature is also used for the detectors alarm map and alarm masking facilities, described in the following sections:

- **Raw greyscale format**
  (highest fidelity, slow to transfer)
- **JPEG compressed greyscale format**
  (much faster transfer, slight loss of fidelity)
- **Live Thresholded image**
  (used for diagnostics)

### 6.7.1 Raw Image & JPEG Images

These image formats are intended for use with the alarm masking and alarm map features. When the grab picture is requested the detector takes a single still frame from the live video signal and sends this via the RS485 communications for display on the PC system. Generally the grabbed picture will appear in a window as shown, the example given is a fire test at the Micropack test ground.

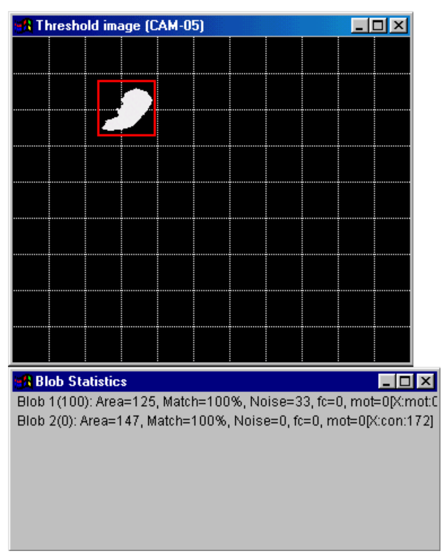
A raw image offers the highest quality image at the expense of download time. The JPEG image offers quick download time at the expense of some image quality.


### 6.7.2 Threshold Image

The threshold display is intended for used by Micropack trained technicians. The threshold image provides diagnostic information over the RS485 communication network. When the threshold image has been selected an updating image is displayed at the operator console, in the upper window. This image comprises a series of white objects (or candidates) representing the signal being processed by the detector. The lower window gives the current statistics for the candidate(s). The current status of the detection algorithm is reflected in the colour of the rectangle bounding the candidate(s). The example given is the same fire test as shown above.

The colours are defined in the table below:

| Colour | Meaning |
|---|---|
| **None** | Not a candidate - i.e. ignored |
| **Green** | Candidate being processed - i.e. candidate may or may not be a fire |
| **Red** | Fire Detected |
| **Blue** | Discounted - i.e. blob is not a fire |



### 6.7.3 Alarm Mask Feature

The alarm mask facility is intended for used by Micropack trained technicians. The alarm mask allows the detector's field of view to be truncated by defining specific regions where fire detection is excluded on a two-dimensional (2D) mask. In this way un-graded or adjacent fire areas within the detectors field of view can be excluded from fire detection. The alarm mask is created on the PC Display and Alarm Handling system. Example shows the Micropack test facility vessels being masked.

The current alarm mask setting can be displayed and edited in the following manner:

- Set the display preferences for a JPEG picture
- Select the detector and grab bitmap
- To clear the current mask select and delete all masks from the JPEG image and select send to detector from the display menu (this sends a blank mask to the detector)
- On the display request the current alarm mask (the mask will be overlaid onto the JPEG picture)
- To edit the masks on the display select the edit tool. New masks are drawn as polygons over the JPEG image. To update the detectors mask select send mask to detector from the display menu


### 6.7.4 Alarm Map Feature

The alarm map facility is intended for used by Micropack trained technicians. The detector maintains a visual 2D map of each fire alarm to assist in post event analysis. The map is a single two-dimensional image of all the fire alarms since the last firmware restart. To clear the alarm map it is necessary to restart the detector firmware. The example shows the alarm map for the fire test shown previously.

The current alarm map can be displayed in the following manner:

- Set the display preferences for a JPEG picture
- Select the detector and grab bitmap
- Request the current alarm map (the map will be overlaid onto the JPEG)
- The alarm map can be edited as described in the alarm mask section
- If required the alarm mask can be requested, the alarm mask data is then merged with the alarm map image
- If required the alarm map can be sent to the detector as a new alarm mask

### 6.8 Upload Firmware

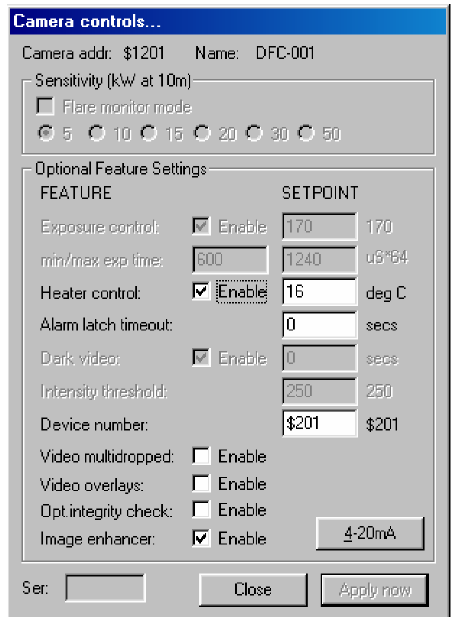
The upload firmware is intended for used by Micropack trained technicians. The detector firmware (its software programme) can be updated by selecting the upload firmware option. The dialogue box allows detectors to be programmed individually or all together. It is recommended that the detectors be programmed individually, and that a successful upload is confirmed by manually checking the firmware revision in *get settings*. Always ensure the latest firmware version has been installed onto the display PC since this is used to both programme the detector and to verify the detector's firmware is at the correct revision. Uploading firmware can take several seconds during which time the operator should not begin a second upload or grab picture. When the upload is completed the detector will automatically initiate a firmware restart.

### 6.9 Request Comms Test

This is a feature of the Hub Controller and allows the RS485 communication link between the detector and the Hub to be tested.

## 6.10 Get Thresholds (Detector Controls)

This function allows the detectors current threshold setting (configuration) to be viewed and changed. Note that these thresholds significantly affect the detectors operation, detection performance may be compromised as a result of unauthorised changes. The following thresholds are available for **trained personnel** only:




- Intensity threshold *[Factory set = 250]*
- Sensitivity (Fire, 10 RHO @ 10m)
- **Exposure Control**
    - Exposure Control Enable *[Factory set = ]*
    - Max Exposure Time *[Factory set]*
    - Target Intensity *[Factory set]*
    - Dark Video Enable *[Factory set]*
    - **Heater Control**
    - Heater Control Enable
    - Heater Set Point *[Factory set]*
- Device Number (Network Address)
- Multidropped Video Enable
- Overlays Enable

**Note: 'Factory set' options are only to be changed by Micropack personnel. The settings shown in the above graphic have been tested and approved by Factory Mutual.**
**The FM Approval is void if these settings are adjusted.**

### 6.10.1 Heater Control and Set-Point

The detector heater can be **enabled** by setting the heater control option to ON, the default setting has the detector heater set to **disabled**. The heater temperature set-point can be set to the desired temperature, the default setting is **16°C**. The heater is intended to prevent ice and condensation forming on the detector optics, it is recommended that the set-point is only changed after consultation with Micropack (Engineering) Ltd. The heater increases the detectors power consumption (by up-to 14W per detector), ensure that the power supply, power distribution and cabling are rated sufficiently before enabling the heater.

### 6.10.2 Device Number

All devices on the RS485 network must have a unique network address in the range of 001h to 1FFh and 201h to FFFh (hex). The detector defaults to the reserved address 200h (hex), this address is used by the system for a new or unconfigured detector and must not be used as an address for any other detector. **Note: To prevent address conflicts, since all new detectors have the same address, only one new or unconfigured detector can be added to the system at a time.**

### 6.10.3 Video Multi-dropped

The video multi-dropped option is **disabled** as default, the detector's live video output is thereby set to be ON. Where a number of detectors share a common video cable, such as a multi-drop loop of two or more detectors, all the detectors on that loop should have multi-dropped video **Enabled**, i.e. its video output OFF. Each detector will only activate their video output on demand for display at the operator console.

### 6.10.4 Video Overlays

The detector threshold overlay is set to clear as default, the overlay can be enabled by setting the detector overlay option to on. When enabled threshold data in the form of greyscale rectangles overlaying the live video images. The rectangles represent a signal being processed by the detector. The current status of the detection algorithm is reflected in the colour of the rectangle.

| Colour | Meaning |
|---|---|
| **MID GREY** | Candidate being processed - i.e. signal may or may not be a fire |
| **WHITE** | Fire Detected |
| **BLACK** | Discounted - i.e. signal is not a fire |

### 6.10.5 Image Enhancer

The image Enhancer when selected will enhance the video picture brightness.

### 6.10.6 Milliamp Otuput

When the milliamp output is selected the Fault, Healthy and alarm thresholds can be configured as per system design.

#### 6.10.7 Factory Only Thresholds

The following threshold options are pre-set at the factory and must only be changed by Micropack authorised engineers.

- Fire sensitivity
- Intensity Threshold Level (default 250)
- Exposure Control Enable (default ON)
- Max. Exposure Time [Auto Exposure Stop] (default 600 or 1240 )
- Target Intensity Level (170)
- Dark Video (default ON)

### 6.11 Function Testing

The detector should be function tested using the Visual Flame Detector Test Torch, which has been specifically design to provide a convenient means of field testing the flame detector. Refer to the test torch user manual for instructions on its use.

# 7 Maintenance and Testing

The maintenance schedule is intended for guidance only. The actual level of maintenance required is dependant on the detectors operating environment and the likelihood of damage or the rate of contamination from oil or sea spray/deluge. Where there is no operating history it is advisable to regularly review the maintenance reports and adapt the maintenance period to the operating environment. For function testing refer to the test torch user manual for instructions on its use.

| Step | Periodic Inspection and Maintenance | Suggested Interval |
|---|---|---|
| 1-6 | General Inspection and maintenance of the detector and faceplate | **6 monthly** |
| 6-14 | Specific inspection and maintenance of the detector enclosure | **12 monthly** |
| 16 | Detector function testing | **6 monthly** |
| **Step** | **Activity** | **Key Points** |
| 1 | Detectors that require maintenance should be taken off line and inhibited. Detectors which require to be opened up will need to be isolated electrically | Ensure that panel wiring and terminations associated with all units under test are in good order |
| 2 | Ensure that detector mounting arrangements are secure and undamaged | |
| 3 | Ensure that the detector enclosure is intact and undamaged | |
| 4 | Ensure that all associated cables and glands are correctly made up, secure and undamaged | |
| 5 | Clean the enclosure faceplate (outside) with a mild detergent solution and a soft cloth until the window is clear of all contamination. Wash the window thoroughly with clean water and dry with a clean lint free cloth or tissue | Assess requirement for opening the enclosure, for maintenance or cleaning, follow steps 6 to 14 |
| 6 | Open up the detector enclosure if required, by removing the enclosure cover. This exposes the enclosure flame path and detector electronics | Avoid damage to the flame path and faceplate |
| 7 | Clean the enclosure cover and body flame paths with a dry clean cloth to remove any contamination. If the flame path or threads are badly pitted the component should be replaced | |
| 8 | Check the 'O' ring seal on the enclosure cover is not damaged or perished, replace as required. Note the ingress protection is compromised if the seal is not correct | |
| 9 | Clean the enclosure faceplate (inside) with a mild detergent solution and a soft cloth until the window is clear of all contamination. Wash the window thoroughly with clean water and dry with a clean lint free cloth or tissue | |
| 10 | No-setting waterproof grease should be evenly applied to the flame path on both the enclosure cover and body | |
| 11 | Clean the detector lens. This should be done with a soft, dry and clean cloth | Avoid touching the electronics |
| 12 | Clean the detector enclosure faceplate. Use a degreasing agent on the outside in order to remove deposits | |
| 13 | Visually inspect detector electronics and inside the enclosure body for any sign of damage or moisture, replace or rectify as required | |
| 14 | The enclosure cover must be screwed on to a minimum of 5 full turns or until fully tight and secured using the locking screw provided | |
| 15 | Reinstate the detector back into service. | |
| 16 | Ensure that inhibits are applied, then, using the flame test torch, function test the detector. Note the detector LED indicator, within the detector housing, changes colour to RED | Check the complete display system for correct function and indication. |

# 8 Fault Finding

## 8.1 Diagnostics

It is impossible to provide fault diagnostics for every possible detector fault. The following flowcharts represent the most likely faults. In all cases it is advised that the following best practise is followed:

- Only make one change at a time (changing more than one thing makes diagnosis very difficult)
- Check the most obvious possible causes first
- Work systematically through the problem
- Keep good notes on the original problem, each step taken and the results observed

### 8.1.1 Led Indication (Detector Status)

The detector LED indicator is used to reveal the detectors current state, as shown below:

| LED Colour | Status |
|---|---|
| Green | Healthy |
| Steady OFF | No Power |
| Yellow | Fault |
| Red | Alarm |

*Figure 17 LED Status Diagnostic Chart*

Refer to the following sections on diagnosing Power Supply, RS485 communications and Video faults.

### 8.1.2 Power Supply

If the detector LED indicator is OFF then there may be a power supply fault, as shown below:

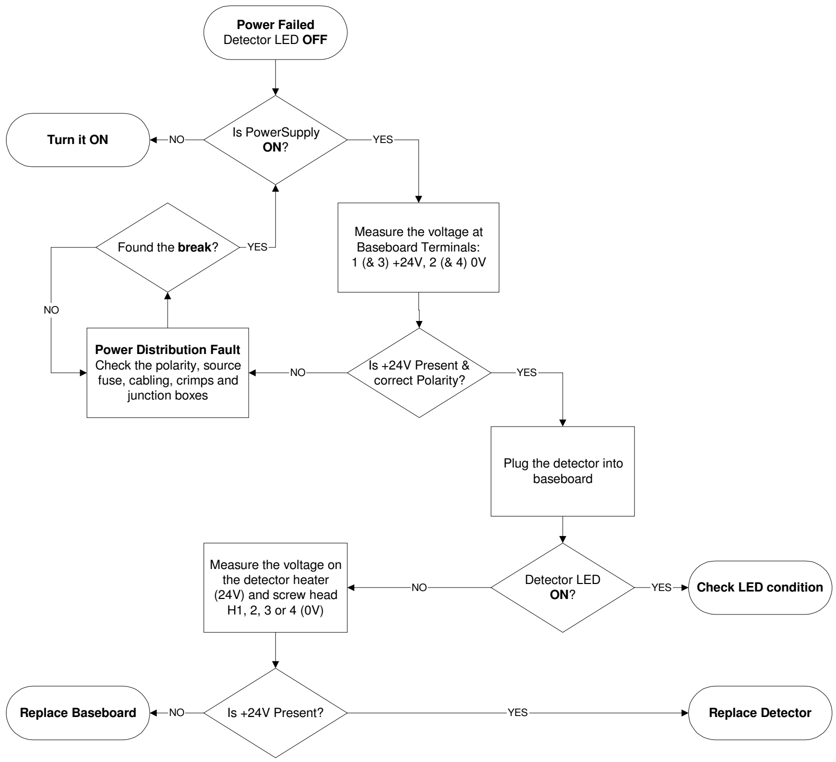



*Figure 18 Power Supply Diagnostic Chart*

When investigating power supply faults it is important to check that all voltages are within the detectors operating range (18V to 32V) under full load conditions as the voltages measured under no load conditions can be misleading.

### 8.1.3 RS485 Communications

If the RS485 communications are poor or completely failed the problem could be due to a great number of possible causes. If the communications to the detector were formerly OK this simplifies the number of possible causes to those shown below. Familiarity with this chart will also help diagnose communications faults during commissioning.

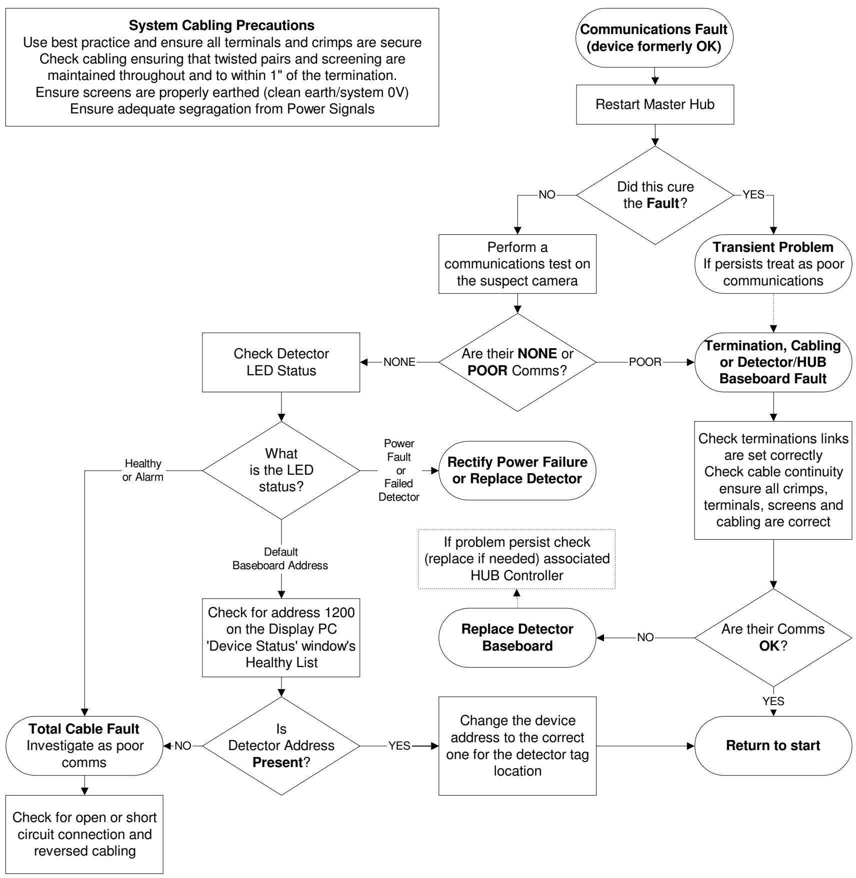



*Figure 19 RS485 Communications Diagnostic Chart*

8.1.4 Live Video Images

The live video signal suffers more potential problems than for RS485 communications because the signal is an analogue transmission and available for operator scrutiny. The cabling is critical to video image quality. Due to the nature of the video signal video corruption will appear differently on each detector/installation. The following chart is intended as a guideline for diagnosis of video problems.

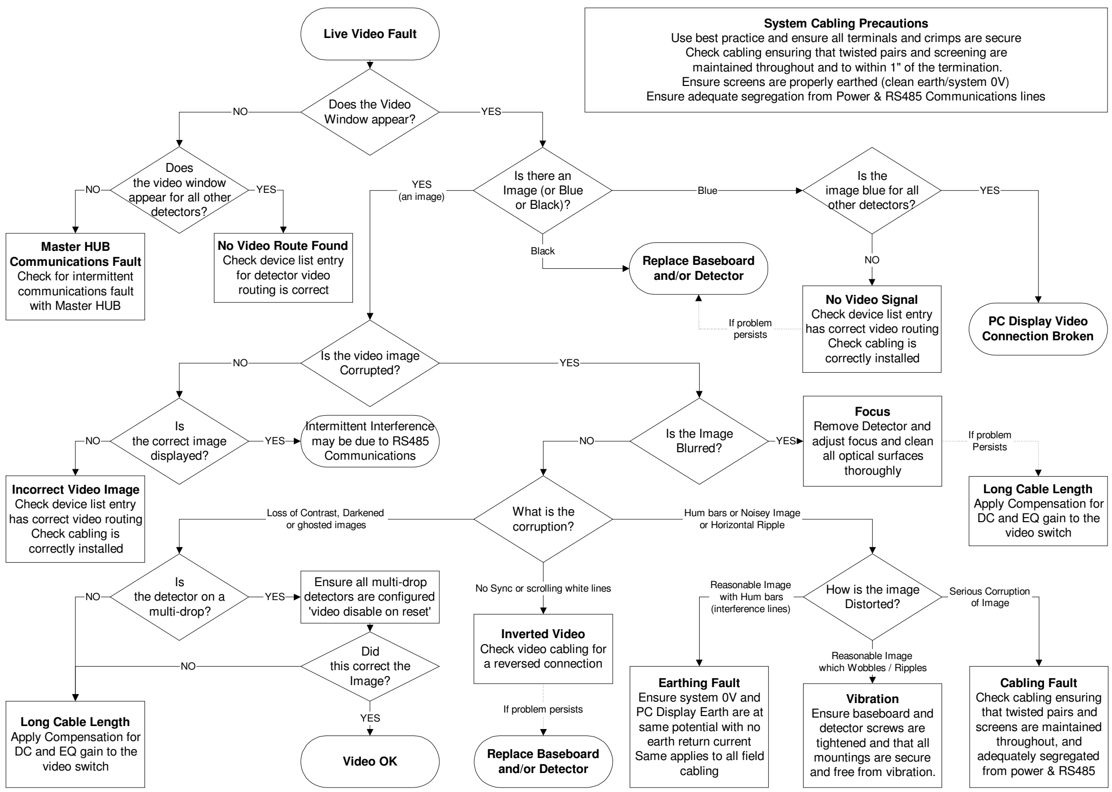



*Figure 20 Video Signal Diagnostic Chart*

## 8.2 Replacement and Repair

The detector contains no user serviceable parts.

If the detector baseboard is replaced its replacement must be reconfigured with the correct threshold settings and jumper link settings, as described in *'get thresholds'* in section 6.10.

If the detector sensor board is replaced its replacement may need to be reconfigured with the correct alarm mask image, as described in *'Alarm mask feature'* in section 6.7.3.

# 9 Technical Specification

## 9.1 Engineering Specification

## 9.2 Electrical Specification

| Parameter | Units | Min | Max | Comment |
|---|---|---|---|---|
| **Power Supply** | | | | |
| Supply Voltage | V | 18 | 32 | Inc. ripple |
| Supply Ripple | V | - - | 1V pk-pk | |
| Detector Power Consumption (no heater) | W | - - | 6 | |
| Detector Power Consumption (inc. heater) | W | 6 | 18 | |
| Heater Power Consumption | W | 0 | 14 | |
| Detector shutdown voltage (low supply) | V | | <17 | |
| **RS485 Transceiver** | *Meets EIA-485 Specification* | | | |
| Line Termination Resistor | R | - - | 120 | |
| Driver Differential Output Voltage | V | 1.5 | - - | |
| Driver Fan Out | Unit loads | 0 | 31 | |
| Receiver Common Mode Input Range | V | -7 | +12 | |
| Receiver Input threshold | V | -0.2 (Lo) | +0.2 (Hi) | |
| Receiver Input Resistance | R | >12K | - - | |
| Receiver Unit Load | | - - | 1 | |
| **Video Driver (Twisted Pair)** | | | | |
| Line Termination Resistor | R | - - | 150 | |
| Driver Output Resistance | R | - - | 150 | |
| Driver Differential Output Voltage | V | - - | 4 | Into no load |
| Driver Differential Output Voltage (loaded) | V | - - | 2 | Into 75R |
| Driver Shutdown Resistance (tri-state) | R | 4.8K | - - | |
| Driver Fan Out | Unit loads | 0 | 5 | |
| **Video Driver (Coaxial)** | | | | |
| Line Termination Resistor | R | - - | 75 | |
| Driver Output Resistance | R | - - | 75 | |
| Driver Output Voltage | V | - - | 2 | Into no load |
| Driver Output Voltage (loaded) | V | - - | 1 | Into 75R |
| Driver Fan Out | Unit loads | 0 | 1 | |

## 9.3 Mechanical Specification

| Parameter | Units | Value | Comment |
|---|---|---|---|
| **Enclosure** | | | |
| Overall Dimensions | mm | 150H x 150W x 150L | |
| Shipping Weight | Kg | 2.5 | |
| Material | | LM25 Alloy | |
| Coating | Colour | Red Epoxy Coated Finish | |
| Cable Entries | mm | 1 x M25, 2 x M20 (or equivalent) | 2 x M25<br>with top entry |
| Terminal Wire Size | $mm^2$ | 2.5 | |
| Ingress Protection | IP | 66 | |
| **Mounting Bracket** | | | |
| Support Fixings | mm | 2 x M6 | |
| Vertical Adjustment | Degrees | 0 to 45 degrees | |
| Horizontal Adjustment | Degrees | 0 degrees | Provided by support |
| Axial (horizontal) Rotation | Degrees | +/-10 degrees | |

## 9.4 Environmental Specification

| Parameter | Units | Min | Max | Comment |
|---|---|---|---|---|
| Operating Ambient Temperature | °C | -20 | +70 | |
| Storage Ambient Temperature | °C | -20 | +80 | |
| Relative Humidity | % RH | 5 | 95 | Non Condensing |

## 9.5 Certification and Approvals

| Parameter | Authority/Standard | Approval | Certificate |
|---|---|---|---|
| Hazardous Area Certification | ATEX: EN50.014 & 018 | Eex-d, IIC T6 | ISSEPO3ATEX012X |
| | CSA: C22.2 | | SA 1500-74324-1 |
| CE Certification | GEC: EN55022 & 082 | | |
| Millennium | - - | - - | Y2K Compliant |

## 9.6 Operating Specification

| Parameter | Units | Min | Max | Comment |
|---|---|---|---|---|
| Detector Sensitivity | kW @ 10m | 50 | 5 | |
| Detector Range (depth of field) | m | 2 | 20 | Standard Lens (1x) |
| Horizontal Field of View | Degrees | - - | 90 | |
| Vertical Field of View | Degrees | - - | 65 | |
| Detector Response Time | Seconds | 10 | - - | |
| Power on reset delay | Seconds | - - | 10 | |

# 10 Appendices

## 10.1 Acronyms, Terms and Abbreviations

| Term | Description |
|---|---|
| AC | Alternating Current |
| AWG | American Wire Gauge |
| BS | British Standard |
| CCTV | Closed Circuit Tele-Vision |
| CE | European Commission (approval) |
| $CO^2$ | Carbon Dioxide |
| CSA | Canadian Standards Association |
| dB | Decibel |
| DC | Direct Current |
| EN | European National (standard) |
| FOV | Field of View |
| FPSO | Floating Production Storage Operation |
| h | Hexadecimal |
| I or A | Electrical Current or Ampere (Ampage) |
| JB | Junction Box |
| Km | Kilometre |
| kW | Kilo Watt |
| LED | Light Emitting Diode |
| MEL | Micropack (Engineering) Ltd |
| mH | Milli Henry - Inductance |
| MOR | Meteorological Optical Range |
| NEC | National Electrical Codes |
| nF, pF | Nano Farad, Pico Farad - Capacitance |
| PC | Personal Computer (IBM PC Compatible) |
| R or Ω | Ohms (electrical resistance) |
| RHO | Radiant Heat Output |
| V | Voltage |
| Vs | Versus |
| W | Watts (Wattage) |
| Y2K | Year 2000.AD |

## 10.2 Drawings and Illustrations

| Drawing Number | Description |
|---|---|
| 2200.6001 | CCTV FLAME DETECTOR FIELD OF VIEW GRAPHS |
| 2200.6002 | CCTV FLAME DETECTOR MOUNTING SUPPORT ARRANGEMENTS |
| 2200.6003 | CCTV FLAME DETECTOR CABLING ARRANGEMENTS |

## 10.3 HELP US TO HELP YOU

| **TO:** | **From:** |
|---|---|
| **QA Department**<br>**Micropack (Engineering) Limited**<br>**Fire Training Centre**<br>**Schoolhill, Portlethen**<br>**AB12 4RR** | |
| **Tel : +44 (0) 1224 784055**<br>**Fax : +44 (0) 1224 784056**<br>**Email : info@micropack.co.uk** | **Tel :**<br>**Fax :**<br>**Email :** |

**I suggest the following corrections/changes be made to Section ……………**

| | |
|---|---|
| Marked up copies attached (as appropriate): | Yes/No |
| Please inform me of the outcome of this change: | Yes/No |

For Micropack (Engineering) Limited :

Actioned By: ______________________________________________________ Date: ___________

Response: ________________________________________________________ Date: ___________