SharpEye™

Hydrogen Flame Detector

Model 20/20SH

User and Maintenance Manual

TM 784600, Rev. A, May 2005

Factory Mutual (Pending)
Class I Div. 1 Groups B, C, D
Class II Div. 1 Groups E, F, G

ATEX (Pending)
Ex II 2G
EExd IIB + H_2 T5
EExde IIB + H_2 T5

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GASTECH AUSTRALIA

Warning:

This manual should be carefully read by all individuals who have or will have responsibility for using, maintaining or servicing the product.

The Detector is not field-repairable due to the meticulous alignment and calibration of the sensors and the respective circuits. Do not attempt to modify or repair the internal circuits or change their settings, as this will impair the system's performance and void the Spectrex, Inc. Product warranty.

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1. Scope

1.1 Product Overview

The Spectrex Model 20/20SH is a special version of the Hydrogen Flame Detector that is manufactured in S.M.T. Technology. The detector is designed to provide maximum fire protection in areas where hydrogen fires are likely to occur.

This detector includes sensors with special filters with spectral bands typical to hydrogen flame emission's main combustion product - water vapor (H_2O) - in the 1-4 microns band and reference filters to discriminate background radiation. The microprocessor design allows for unique field programmability, making the 20/20SH highly immune to false alarms.

The front section of the 20/20SH is sealed to keep the electronic and sensor chamber dry for longer life. The programmable functions are available through a RS-485 port used with a standard PC or by hand held computer and software supplied by Spectrex.

Refer to Manual TM 784050 for instructions to use the HOST software and to change the required Functions.

1.2 Document Overview

This manual describes the detector and its features and provides instructions on the installation, operation and maintenance.

This manual is divided into separate chapters as follows:

Chapter 1.	**Scope** - a general introduction and overview of the product and the Manual, with a brief description of its content.
Chapter 2.	**Technical Description** - the detector's theory of operation.
Chapter 3.	**Performance -** the detector features and capabilities.
Chapter 4.	**Operation** - the detector's operation modes, user interface and indications.
Chapter 5.	**Technical Specifications** - the Detector's electrical, mechanical and environmental specifications.
Chapter 6.	**Installation Instructions**, including wiring and mode setting.
Chapter 7.	**Operating Instructions** and power-up procedures.
Chapter 8.	**Maintenance Instructions** and support procedures.
Appendix A.	**Wiring Selection Tables** for electrical wire selection according to installation configuration.
Appendix B.	**Typical Wiring Configurations** - wiring diagrams for installation.
Appendix C.	**RS-485 Communication Network**
Appendix D.	**Mounting the "EExde" version**

2. Technical Description

- **Detection Range**: up to 100 ft (30 m) for an Hydrogen plume fire with 20" (0.5m) height and 8" (0.2m) width.
- **Ultra High Immunity to False Alarms** (see section. 3.3).
- **Advanced Digital Processing of the Dynamic Characteristics of Fire**: Flickering, Threshold correlation and Ratio.
- **Three Separate IR Channels**: Between 1-4 microns.
- **Field Programmable Sensitivity**: four ranges.
- **Two Response Levels**: Warning & Detection.
- **Solar Blind**
- **Microprocessor Based**: Digital signal processing.
- **Built In Test**: Manual and Automatic (see section. 4.2.2).
- **Electrical Interface**:
    - Dry contact RELAYS.
    - Communication network RS-485.
    - 4-20mA output.
- **Certification**: Pending by F.M and ATEX.

2.1 Principles Of Operation

2.1.1 Hydrogen fire detection

This Fire Detector detects the invisible Hydrogen flames by spectral analysis of the infrared energy emitted by the fire. Special sensors and filters have been selected to identify the hydrogen's main combustion product – water vapor.

2.1.2 Identifying the H_2O peak

The hydrogen fire is characterized by a typical radiation emission. The H_2O peak emits intense radiation at several peaks in the spectral band between 1-4 µ and weaker radiation intensity outside these spectral bands. Special sensors and filters have been selected to analyze this radiation pattern. The result is a unique flame detector, which does not produce false alarms and, at the same time, provides detection over greatly increased distances compared to previous methods.

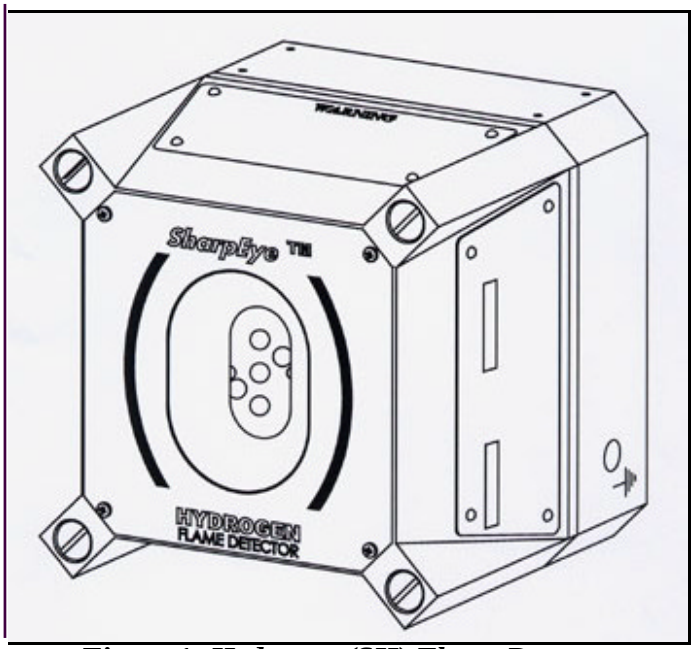


Figure 1: Hydrogen (SH) Flame Detector

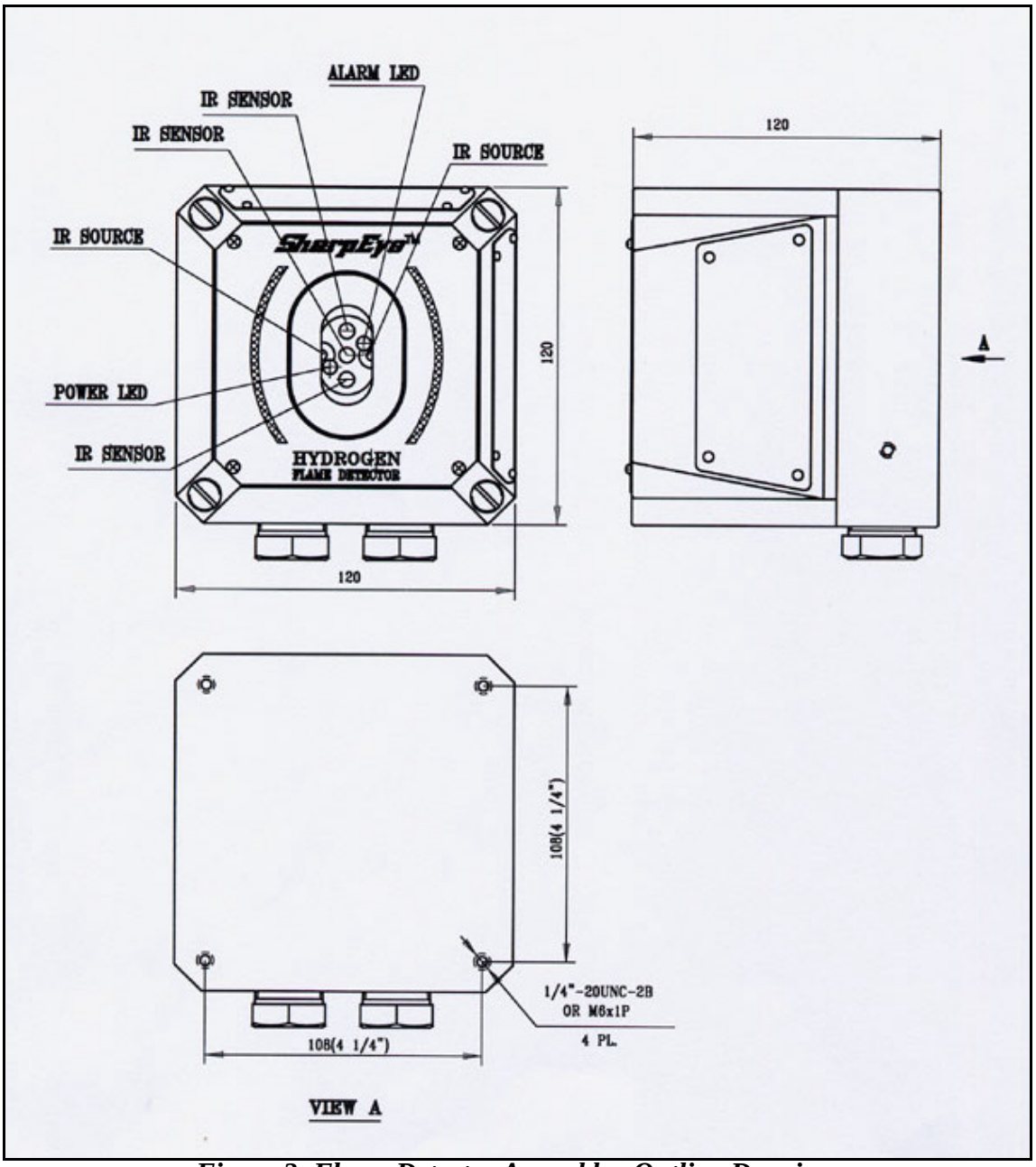


Figure 2: Flame Detector Assembly - Outline Drawing

3. Performance

3.1 Detection Sensitivity

Detection sensitivity is the maximum distance at which the detector will reliably detect a specific size of fire & typical type of fuel (standard fire).

Standard Fire:

Gases – define by a plume fire with 20" (0.5m) height and 8" (0.2m) width
or
Liquid - 1ft^2 (0.1m^2) pan fire

Wind speed of 6.5 ft/sec (2 m/sec).

Sensitivity Ranges:

The detector has four user selectable sensitivity ranges. For each range there are two response levels.

1. WARNING (Pre-alarm)
2. ALARM

The detection distance, for the WARNING level, is approximately 10% higher than the ALARM distance.

Alarm response times for a "standard fire" at a specified range are shown hereunder.

Table 1: Alarm Response Time Versus Range

Sensitivity	**1**	**2**	**3**	**4**
Range – ft (m)	16 (5)	33 (10)	66 (20)	100 (30)
Response Time (sec)	3	5	8	10

** These results refers to Hydrogen*

For some typical ambient conditions the Zeta parameter as defined in NFPA 72 for the detector is 0.005 (1/meter).

Note:
Zeta parameters may vary significantly with changes in temp, air pressure, humidity, visibility conditions, etc.

Other fuels
The detector will react to other types of fires as follows:
Fire Size: Methanol and ethanol - 1ft^2 (0.1m^2) pan fire

Maximum Wind Speed: 6.5 ft/sec (2 m/sec)
Maximum Response Time: 10 sec

Table 2: Response Sensitivity for other Fuels

Type Of Fuel	% of Max. Distance
Hydrogen	100%
Ethanol	62%
Methanol	26%

3.2 Cone Of Vision

Horizontal: 90°
Vertical: 90°

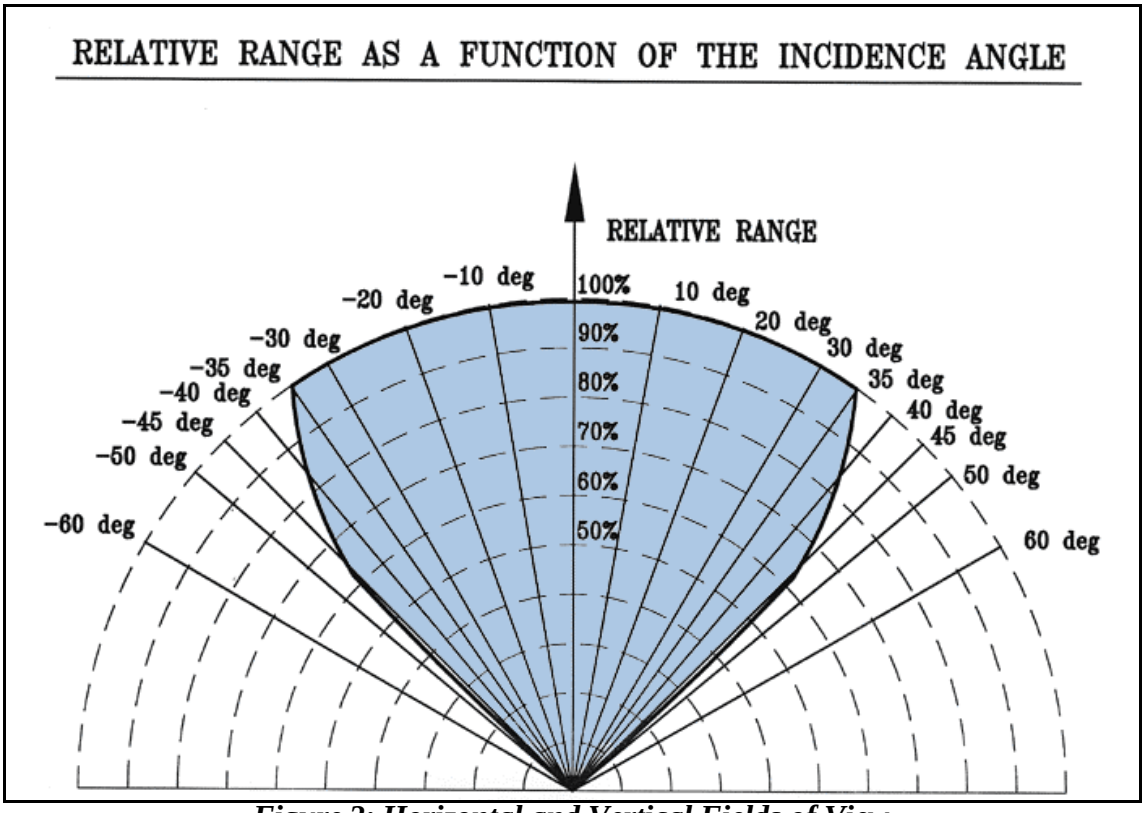


Figure 3: Horizontal and Vertical Fields of View

3.3 False Alarms Prevention

The detector will not provide an alarm or a warning signal as a reaction to the radiation sources specified below.

Notes:

IAD = Immune at Any Distance.

All sources are chopped from 0 to 20Hz.

Table 3: Immunity To False Alarm Sources

Radiation Source	Immunity Distance ft(m
Sunlight	IAD
Indirect or reflected sunlight	IAD
Vehicle headlights (low beam) conforming to MS53023-1	IAD
Vehicle IR lights (low beam) conforming to MS53024-1	IAD
Incandescent frosted glass light, 100 W	IAD
Incandescent clear glass light, rough service, 100 W	IAD
Fluorescent light with white enamel reflector, standard office or shop, 40 W (or two 20 W)	IAD
Electric arc [12mm (15/32 in) gap at 4000 V alternating current, 60 Hz]	IAD
Arc welding [4 mm (5/32 in) rod; 240 A]	See Table 4
Ambient light extremes (darkness to bright light with snow, water, rain, desert glare and fog)	IAD
Bright colored clothing, including red and safety orange.	IAD
Electronic flash (180 watt-seconds minimum output)	IAD
Movie light, 625 W quartz DWY lamp (Sylvania S.G.-55 or equivalent)	6.5 (2)
Red dome light conforming to MS51073-1	IAD
Blue-green dome light conforming to M251073-1	IAD
Flashlight (MX 991/U)	IAD
Radiation heater, 1500 W	IAD
Radiation heater, 1000 W with fan	IAD
Quartz lamp (1000 W)	10 (3)
Mercury vapor lamp	IAD
Grinding metal	IAD
Lit cigar	1 (0.3)
Lit cigarette	1 (0.3)
Match, wood, stick including flare up	10 (3)

Table 4: Welding Immunity Distance

SW setting	Detection Range	Immunity Distance
1	16 ft (5m)	>13 ft (4m)
2	33 ft (10m)	>20 ft (6m)
3	66 ft (20m)	>30 ft (9m)
4	100 ft (30m)	>40 ft (12m)

4. Operation

4.1 Visual Indications

Two LED-indications are located in the detector front window:

i. Power L ED (Yellow)
   Normal - LED ON
   BIT failure - LED flashes (4 Hz)
ii. Alarm LED (Red)
   Normal - LED OFF
   Warning - LED flashes (2 Hz)
   ALARM - LED ON

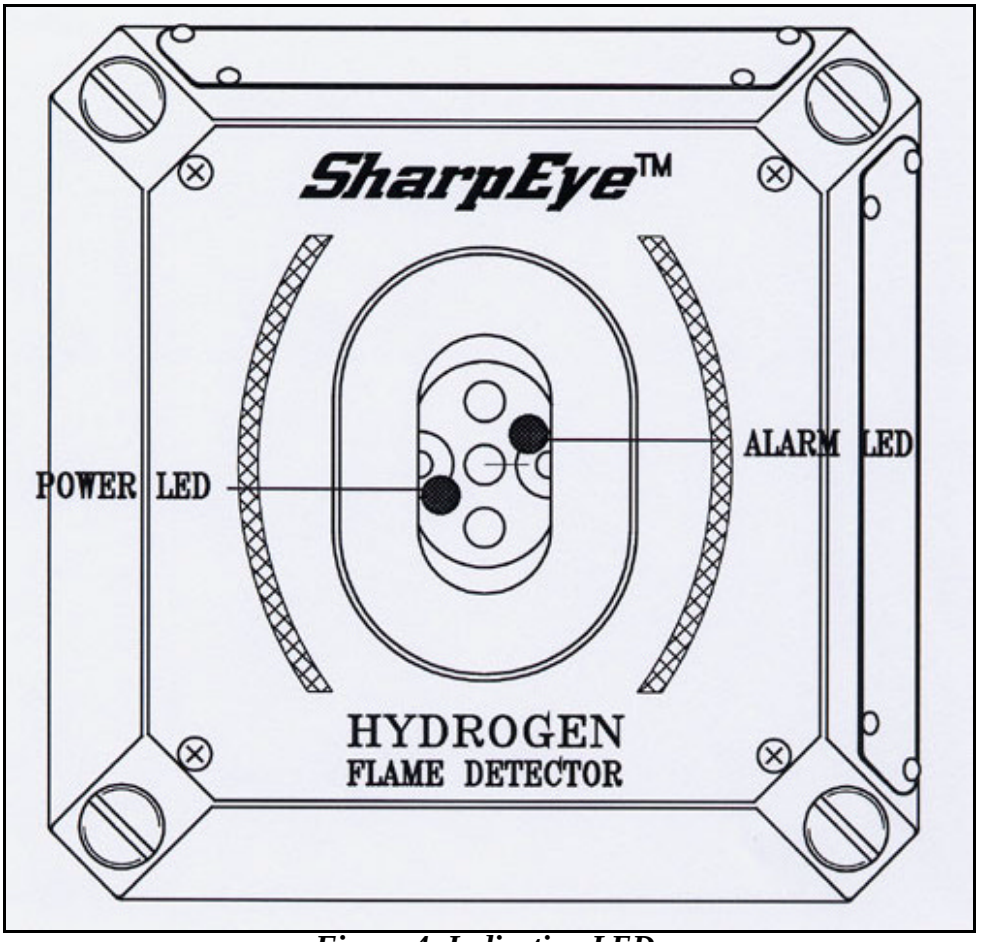


Figure 4: Indication LEDs

4.2 Output Signals

The detector controls the following outputs:

- Alarm relay
- Accessory relay
- Fault relay
- 4-20mA current output
- RS-485 communication

The detector can be in one of the following states.

Normal:	The detector is functioning normally.
BIT:	The detector performs a Built-In-Test.
Warning:	Fire detected - changed to warning – pre-alarm state.
Alarm:	Fire detected - changed to fire alarm state.
Latched Alarm (Optional)	The alarm outputs are latched due to the detection of a fire that has already been extinguished.
BIT Fault:	A fault is detected during BIT sequence. The detector will continue to detect fire if the alarm conditions occur.
Fault:	A fault is detected when the power supply is too low or during a software fault.

In each state the detector will activate different outputs as specified in table 5.

Table 5: Output Signals Versus Detector State

Detector State	Power Led	Alarm Led	Alarm Relay	Accessory Relay	Fault Relay	4-20mA Output
Normal	On	Off	Off	Off	On	5mA
Warning	On	Flash 2Hz	Off	On(1)	On	10mA
Alarm (4)	On	On	On	On	On	15mA
Latch(2)	On On	On On	On On	Off On(1)	On On	15mA 15mA
BIT Fault(3)	Flash	Off	Off	Off	Off	2mA
Warning at BIT Fault	Flash 4Hz	Flash 4Hz	Off	On(1)	Off	10mA
Alarm at BIT Fault	Flash 4Hz	On	On	On	Off	15mA
Fault	Flash 4Hz	Off	Off	Off	Off	0mA

Note:

1 Accessory relay can be activated at warning level or alarm level depending on programmable function

2 The Alarm state can be latched according to programmable function

3 The detector will be in its BIT FAULT state until it has passed a successful BIT.

4 The alarm outputs will be activated as long as the alarm conditions are present and will stop approximately 5 seconds after the fire is no longer detected.

4.2.1 Optional latching

The detector includes a latched alarm output capability, which operates according to the programmable function. Upon the detection of a fire, the detection signal is latched until manually reset (disconnecting the power supply or performing a manual BIT). Latching affects the *Alarm Relay*, 4-20mA output, the *Alarm LED* (the *Accessory Relay* will be latched only when the function "Alarm Latch" at YES (see table 6)).

4.2.2 Built-In-Test (BIT)

Successful **Manual BIT** will activate the following outputs according to programmable function (see table 6).

Alarm BIT at Yes	• The *Alarm Relay* will be activated for 3 sec. • The 4-20mA output will provide 15mA for 3 sec.
Alarm BIT and Accessory BIT at Yes	• The *Accessory & Alarm Relays* will be activated for 3 sec. • The 4-20mA output will provide 15mA for 3 sec.
Accessory BIT at Yes	• The *Accessory Relay* will be activated for 3 sec.
Alarm BIT at No	• The 4-20mA output will provide 10mA for 3 sec.

4.2.3 Accessory Relay as EOL

The accessory relay is used as End of Line relay. In this case, the accessory relay is active as long as the detector is not in its FAULT state.

4.3 Detector Mode Setup

The setup screen allows seeing and programming the detector function to determine different functions of the detector. Refer to Manual TM784050.

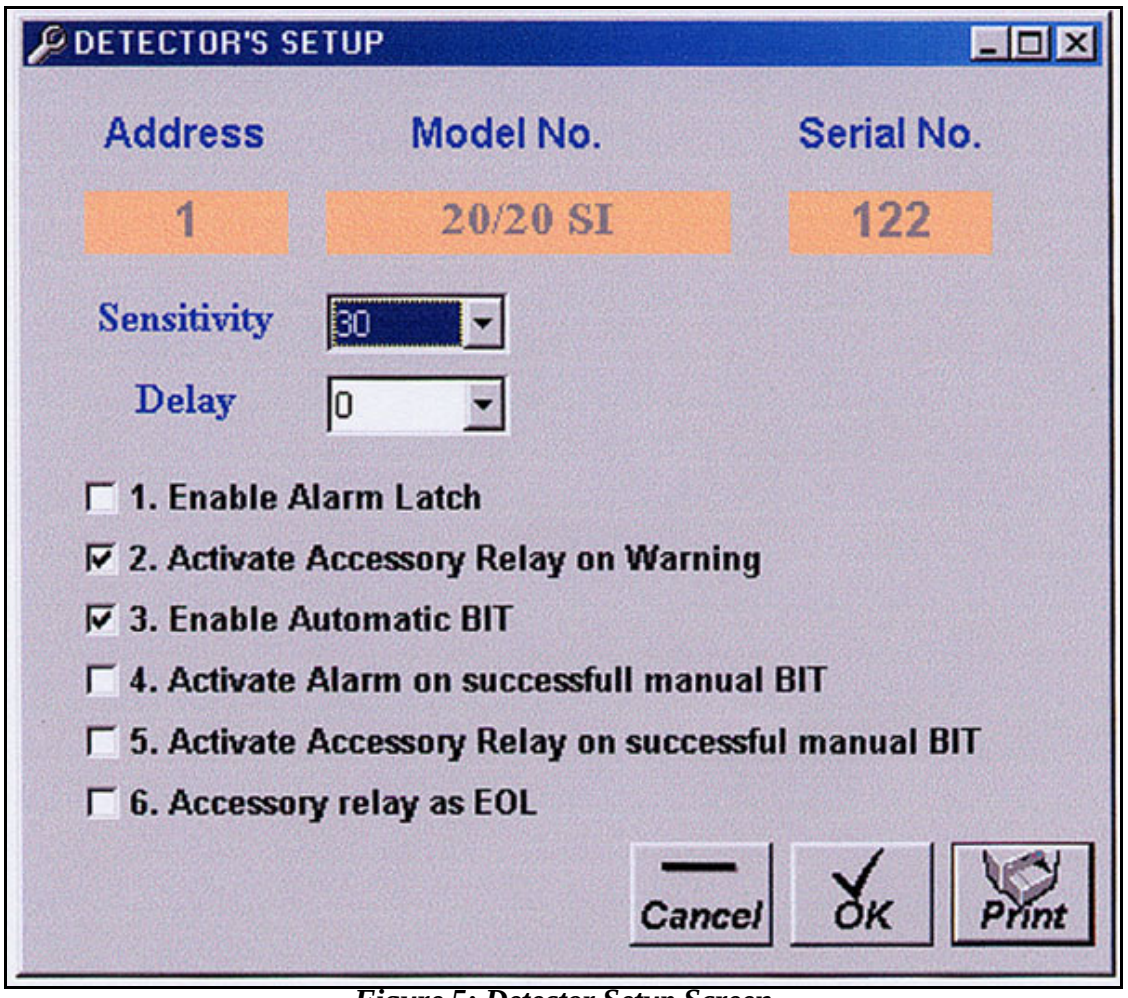


Figure 5: Detector Setup Screen

4.3.1 Function Setup

The user can select the desired mode of operation by means of host.

Table 6: Function Setup

	Name	Yes	No
1	Alarm Latch	Alarm latching enable	Alarm latching disable **(default)**
2	Accessory Relay	Accessory Relay activate at warning level	Accessory Relay activate at Alarm level **(default)**
3	Automatic BIT	Automatic & manual bit **(default)**	Manual bit only
4	Alarm BIT	Successful manual bit activates the Alarm Relay for approximately 3 seconds **(default)**	Successful manual bit does not activate the Alarm Relay
5	Accessory BIT	Successful manual bit activates the Accessory Relay for approximately 3 seconds **(default)**	Successful manual bit does not activates the Accessory Relay
6	EOL	Accessory Relay is used as End of Line	Accessory Relay operates in accordance with Function 2 and 5 **(default)**

4.3.2 Sensitivity Ranges

The detector offers four (4) sensitivity settings. The settings refer to the Hydrogen plume fire with 20" (0.5m) height and 8" (0.2m) width, from low sensitivity of 16 ft. (5m) to 100 ft. (30m). For other types of fuel sensitivity, refer to table 2.

Table 7: Sensitivity range

##	Sensitivity
1	16 ft. (5m)
2	33 ft. (10m)
3	66 ft. (20m)
4*	100 ft. (30m)

** Default*

4.3.3 Alarm Delay

The detector is equipped with an Alarm Delay option, which provides programmable time delays of 0 to 30 sec. with eight (8) fixed settings at: 0, anti-flare, 3, 5, 10, 15, 20, and 30 sec. When an Alarm (Detection) level condition is encountered, the detector delays the execution of the Alarm output's relay by the specified period of time. The detector will then evaluate the condition for 3 sec. If the Alarm level is still present, the Alarm outputs will be activated. If this condition no longer exists, the detector will return to its standby state. The Alarm delay option will affect the output relay and the 4-20mA. The LEDS will indicate warning level during the delay time only if the fire condition exists.

ANTI FLARE

Anti Flare mode is selected to prevent false alarm in locations where fast flares may be present. The Time delay for fire alarm in this mode is from 2.5 to 15 sec. (mostly less than 10 sec.).

Table 8: Time delay

Delay (sec.)
0
A* -- anti-flare
3
5
10
15
20
30

** Default*

Note: The new FM approval from January 2003 does not allow using 20 and 30 second delay.

4.3.4 Addresses Setup

Refer to TM784050 for instructions for defining the addresses of the detectors. The detector provides up to 247 addresses that can be used with RS-485 communication link.

4.4 Built In Test

A. General

The detectors' Built In Test (BIT) checks the following:

- Electronics circuitry
- Sensors
- Window cleanliness

The detector can be set to perform the BIT automatically and manually or manually only.

B. Principles

If the result of a BIT is the same as the current status of the detector (NORMAL or BIT FAULT), the detector's status is unchanged. If the result of a BIT differs from the current status of the detector, the detectors' status is changed (From NORMAL to BIT FAULT or from BIT FAULT to NORMAL).

Note: In BIT FAULT status the detector can continue to detect a fire.

C. Manual BIT only

The BIT is initiated manually by momentarily connecting Terminal No. 3 with Terminal No. 2. A successful manual BIT activates the following:

- FAULT relay is closed.
- ALARM relay is activated for 3 sec. (only when Function Alarm BIT at YES)
- ACCESSORY relay is activated for 3 sec. (only when Function Accessory BIT at YES)
- 4-20mA OUTPUT current will be 15mA only when Function Alarm BIT at YES or 10mA when Function Accessory BIT at YES and Function Alarm BIT at NO.

Unsuccessful BIT activates the following:

- FAULT relay is released.
- 4-20mA output indicates BIT FAULT condition (2mA).
- POWER LED (yellow) flashes (4 Hz).

Note

During a *Manual BIT*, if Function Alarm BIT or Function Accessory BIT are in YES position, the *Alarm*, *Accessory Relays and 4-20mA* will be activated. Therefore, automatic extinguishing systems or any external devices that should not be activated during BIT should be disconnected.

D. Automatic & Manual BIT

Manual Bit
Functions as described in Paragraph 4.4.C. In the case of an unsuccessful BIT all outputs will function as described in Paragraph. 4.4.C, but the BIT will be automatically executed every 1-minute. This mode of operation will continue until successful Bit has been encountered. As a result, the detector will resume its normal operation.

Automatic BIT
The detector automatically performs a BIT every 60 minutes.

A successful BIT sequence does not activate any indication:

The FAULT relay	is CLOSED (NORMAL).
The POWER LED	is ON (NORMAL).
The 4-20mA Output	Indicate NORMAL (5mA).

An unsuccessful BIT sequence activates the following:

The FAULT relay	is opened.
4-20mA output	indicate BIT FAULT (2mA).
The POWER LED (yellow)	flashes (4 Hz).
BIT procedure	will be performed every 1 minute.

5.Technical Specifications

5.1 Electrical Specifications

A. **Operating Voltage**: 18-32 VDC

B. **Power Consumption**:
Max. 100mA in Stand-by
Max. 150mA in Alarm

C. **Electric input protection**: The input circuit is protected against voltage-reversed polarity, voltage transients, surges and spikes according to MIL-STD-1275A.

D. **Electrical Interface**:

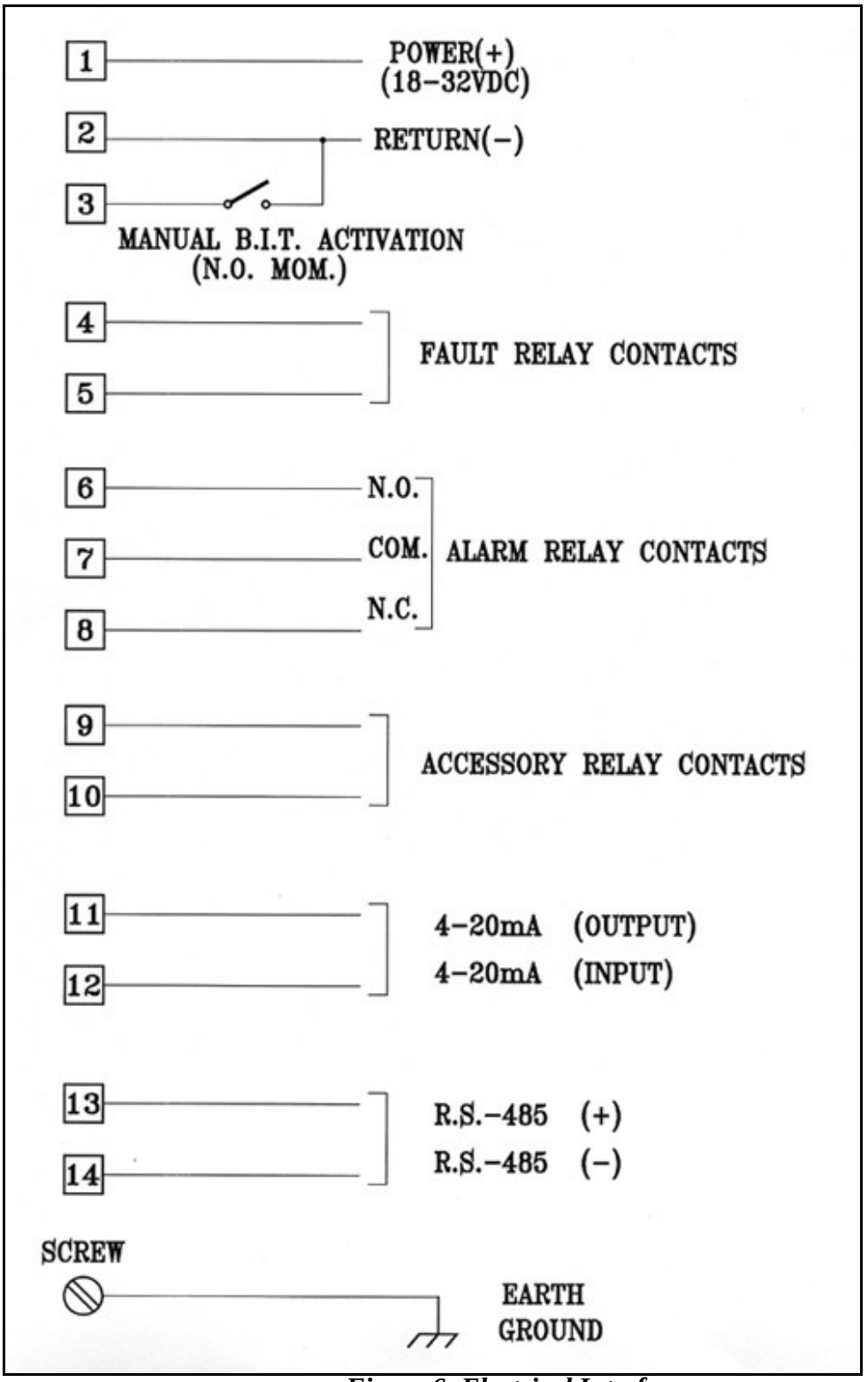


Figure 6: Electrical Interface

E. Electrical outputs

- ***Dry Contact Relays***:

Table 9: Contact Ratings

Relay Name	Type	Normal position	Maximum Ratings
Alarm	SPDT	N.O. N.C.	2A at 30VDC or 0.5A at 250 VAC
Accessory	SPST	N.O.	5A at 30VDC or 250 VAC
Fault	SPST	N.C.	5A at 30VDC or 250 VAC

- ***4-20mA Current Output***:

Terminals 11 and 12:

STATE	Output
FAULT	0 + 0.5mA
BIT FAULT	2mA±10%
NORMAL	5mA±10%
WARNING	10mA±5%
ALARM	15mA±5%

- ***Communication Network***:

The detector is equipped with an RS-485 communication link that can be used in installations with computerized controllers.

The communicator protocol is compatible with the Modbus communicator protocol.

- This protocol is a standard and widely used.
- It enables continuous communication between a single standard Modbus controller (Master device) and a serial Network of up to 247 detectors.
- It enables connection between different types of Spectrex detectors or other
- Modbus devices to the same Network.

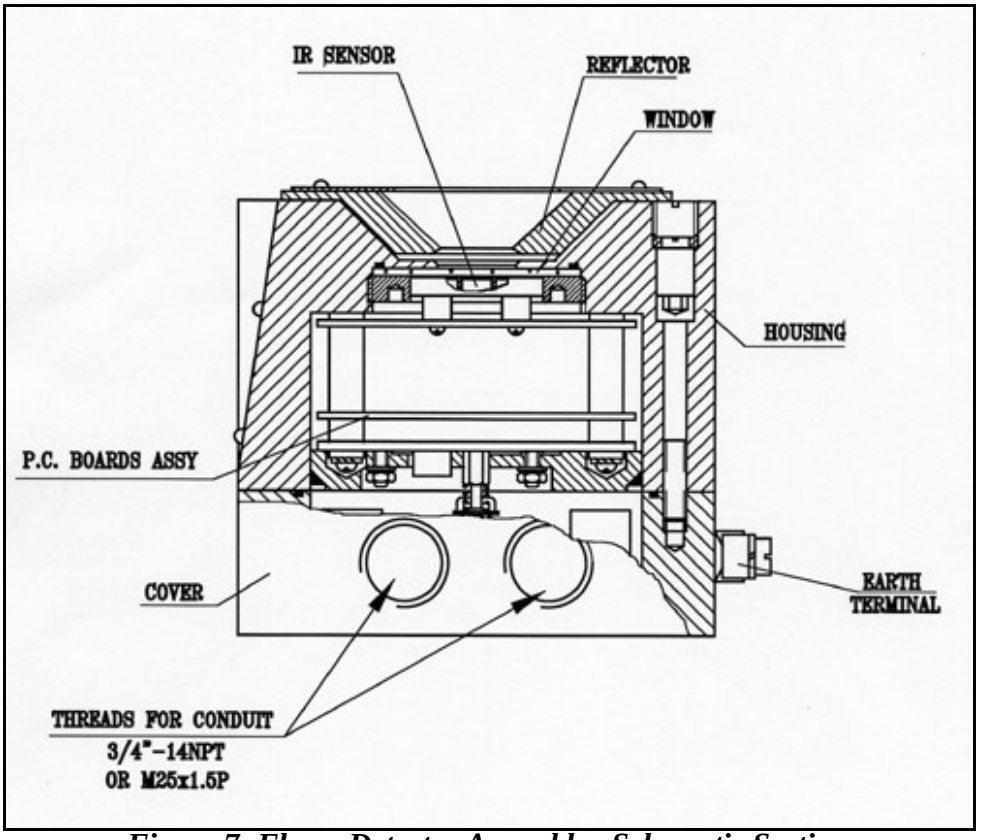


Figure 7: Flame Detector Assembly - Schematic Section

5.2 Mechanical Specifications

A. Enclosure

Aluminum: Chromate coating and Epoxy enamel finish
or
Stainless Steel 316: Electrochemical passivation coating

B. Explosion proof

FM (pending)	Class I Div. 1 Groups B, C and D; Class II Div. 1 Groups E, F and G.	
ATEX (pending)	Ex II 2G SIRA 00ATEX 1163, 1164	
	EExd IIB + H_2	Temp. -40°F (-40 °C) to 160°F (70 °C)
	T5	Option: -40°F (-40 °C) to 185°F (85 °C)
		Per EN 50014 & EN 50018
	EExde IIB + H_2	Temp. -40°F (-40 °C) to 160°F (70 °C)
	T5	Per EN 50014, 50018 & 50019
		(see Appendix D)

C. Water and dust tight

NEMA 250 type 6p.
IP 66 and IP 67 per EN 60529

D. Electronic Modules

Conformable coating.

E. Electrical connection (two positions)

3/4"-14NPT conduit or M25 x 1.5(ISO).

F. Dimensions

Base: 5.2 x 5.2 in (132 cm x 132 cm)
Height: 4.7 in (120 cm)

G. Weight

8.1 lbs. (3.7 Kg) – Aluminum Alloy
14.3 lbs. (6.5 Kg) – ST.ST 316

5.3 Environmental Specifications

A. High Temperature

Design to meet MIL-STD-810C, method 501.1 procedure II

Operating temperature:	+160 °F (+70 °C)
Optional operating temperature:	+185 °F (+85 °C)
Storage temperature:	+185 °F (+85 °C)

B. Low Temperature

Design to meet MIL-STD-810C, method 502.1, procedure I

Operating temperature:	-40 °F (-40 °C)
Storage temperature:	-65 °F (-55 °C)

C. Humidity

Design to meet MIL-STD-810C, method 507.1, procedure IV
Relative humidity of up to 95% for the operational temperature range.

D. Salt Fog

Design to meet MIL-STD-810C, method 509.1, procedure I
Exposure to a 5% Salt Solution Fog for 48 hours.

E. Dust

Design to meet MIL-STD-810C, method 510.1, procedure I
Exposure to a dust concentration of 0.3 frames/cubic ft. at a velocity of 1750 fpm, for 12 hours.

F. Vibration

Design to meet MIL-STD-810C, method 514.2, procedure VIII
Vibration at an acceleration of 1.1g within the frequency range of 5-30 Hz, and an acceleration of 3g within the frequency range of 30-500 Hz.

G. Mechanical Shock

Design to meet MIL-STD-810C, method 516.2, procedure I
Mechanical Shock of 30g half-sin wave, for 11 msec.

6. Installation Instructions

6.1 Scope

The "Spectrex" Model 20/20SH is a self-contained Optical Flame Detector, designed to operate as a stand-alone unit directly connected to alarm systems or automatic fire extinguishing systems. The detector can be a part of a more complex system where many detectors and other devices are integrated through a common control unit. This chapter does not attempt to cover all of the standard practices and codes of installation. Rather, it emphasizes specific points of consideration and provides some general rules for qualified personnel. Wherever applicable, special safety precautions are stressed.

6.2 General Considerations

Very Important

The detector should be aimed toward the center of the detection zone and have a completely unobstructed view of the protected area. Whenever possible, the detector face should be tilted down at a slight angle to prevent the accumulation of dust and dirt. Do not start an installation unless all conceivable considerations regarding detector location have been taken into account.

To ensure optimal performance and an efficient installation, the following guidelines should be considered:

A. **Sensitivity**
To determine the level of sensitivity, the following issues should be considered:
- Size of fire at determined distance to be detected.
- Type of flammable materials.

B. Spacing and Location
The number of detectors and their locations in the protected area are affected by:
- Size of the protected area
- Sensitivity of the detectors
- Obstructed lines of sight
- Cone of view of the detectors

C. Environment
- Dust, snow or rain can reduce the detectors sensitivity and require more maintenance activities.
- The presence of high intensity flickering of IR sources may affect sensitivity.

6.3 Preparations for Installation

Installation should comply with NFPA 72E or other local codes, as applicable to flame detectors. The detectors can be installed with the use of general-purpose common tools and equipment.

1 Verify the appropriate Purchase Order. Record the Part No. and the Serial No. of the detectors and the installation date in the appropriate Log-book.

2 Open the container package prior to detector installation and visually inspect the detector.

3 Verify that all components required for the detector installation are readily available before commencing the installation. In case that the installation is not completed in a single session, secure and seal detectors and conduits.

4 For wiring, use color-coded conductors or suitable wire markings or labels. 12 to 20 AWG wires may be used for site wiring. The selection of wire gauge should be based on the number of detectors used on the same line and the distance from the control unit, in compliance with specifications (See Appendix A).

6.4 Conduit Installation

1 To avoid water condensation water in the detector, it should be installed with the conduits /cable entries facing downwards, and should include drain holes.

2 When using the optional swivel mount, use flexible conduits / cables for the last portion connecting to the detector.

3 For installations in atmospheres as defined in group B of the NFPA 72E, conduits inlets should be sealed.

4 When pulling the cables through the conduits, ensure that they are not tangled or stressed. Extend the cables about 30 cm. (12 in.) beyond the detector location to accommodate wiring after installation.

5 After the conductor cables have been pulled through the conduits, perform a continuity test.

6.5 Detector Mounting

The detector may be mounted on a simple fabricated bracket, or preferably the optional Swivel Mount, Model 20/20-003. The Swivel Mount enables the detector to be rotated up to 40 degrees in all directions.

6.5.1 Swivel Mount Kit:

Table 10: Mounting according to US Version

Item	Qty.	Type/Model	Location
Swivel Mount	1	20/20-003	
1/4"-20UNC Screw	4	1/4" –20UNC	Detector - Holding plate
1/4" Spring Washer	4	1/4"	Detector - Holding plate

Table 11: Mounting according to EU Version

Item	Qty.	Type/Model	Location
Swivel Mount	1	20/20-003-1	
Screw	4	M6 X 1P	Detector - Holding plate
Spring Washer	4	M6	Detector - Holding plate

6.5.2 Swivel installation (Figs. No. 8 and 9):

1 Place the swivel mount (item 6) in its designated location and secure it with four (4) M6 or 1/4" screws (item 11) (recommended), placed 76.2 mm. (3.0 in.) apart on the swivel mount plate (item 10).

Note: Skip this step if the Swivel Mount is already installed. Also detector removal for maintenance purpose does not require Swivel Mount removal.

2 Unpack the detector.

3 Place the detector, with its conduit inlets pointing down, on the holding plate of the swivel mount (item 7). Secure the detector by four (4) 1/4"-20UNC (or M6) screws with 1/4" (or M6) spring washers from the Swivel Mount Kit (using the holes (item 5)). Use 3/16 Hex Key for 1/4" screws and No. 5 for M6 screws.

4 Tighten the three locking 3/8"-24UNF screws (item 8) of the swivel mount ring until the friction in the ball joint holds the detector in its position, maintaining the ability to be moved by hand-applied force (Use 3/16" HEX KEY).

5 Point the detector towards the protected area and make certain that the view of the area. Secure the detector in that position by tightening the locking screws (item 8) of the swivel mount ring.

The detector is now correctly located and aligned and ready for connecting to the system.

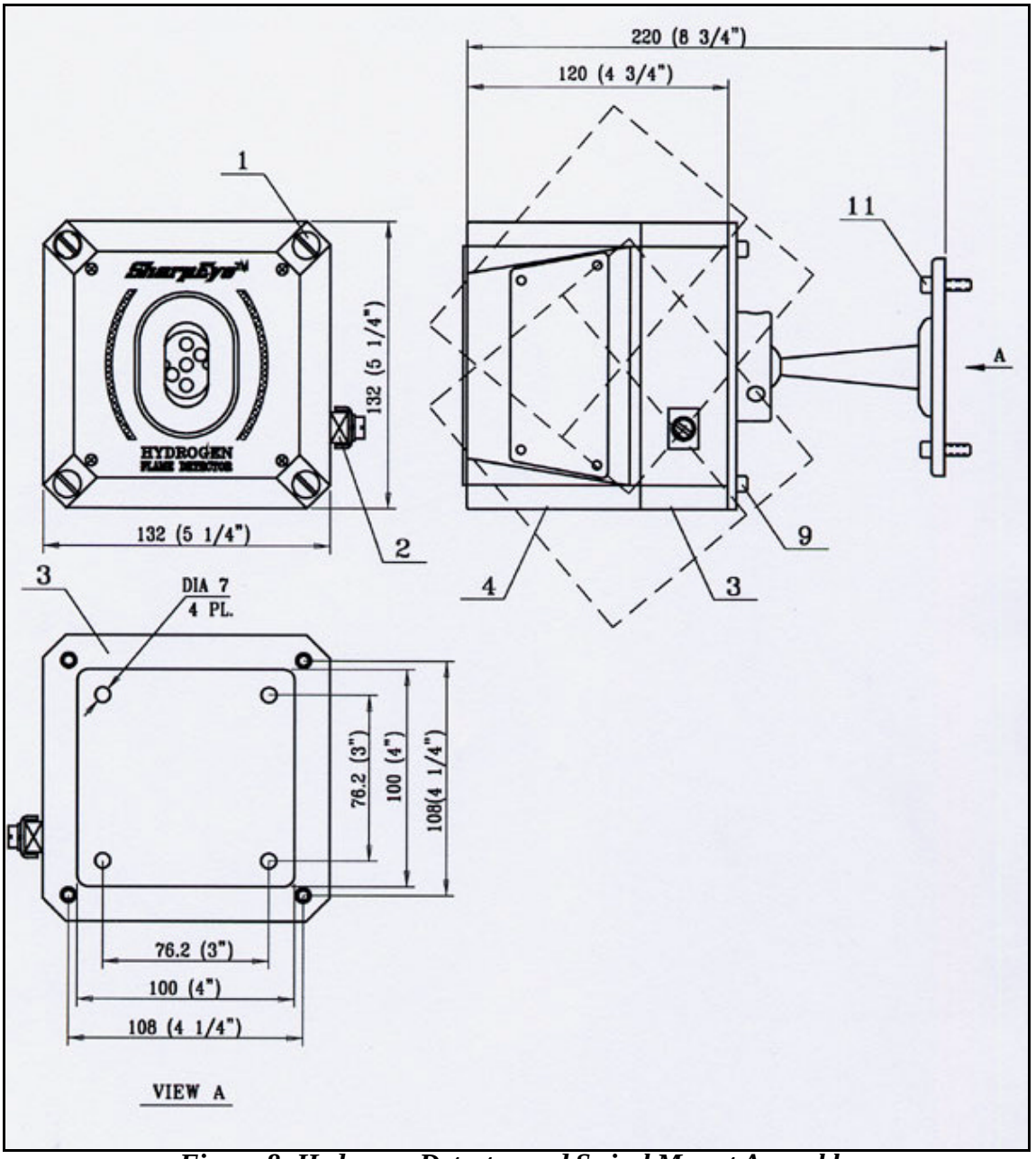
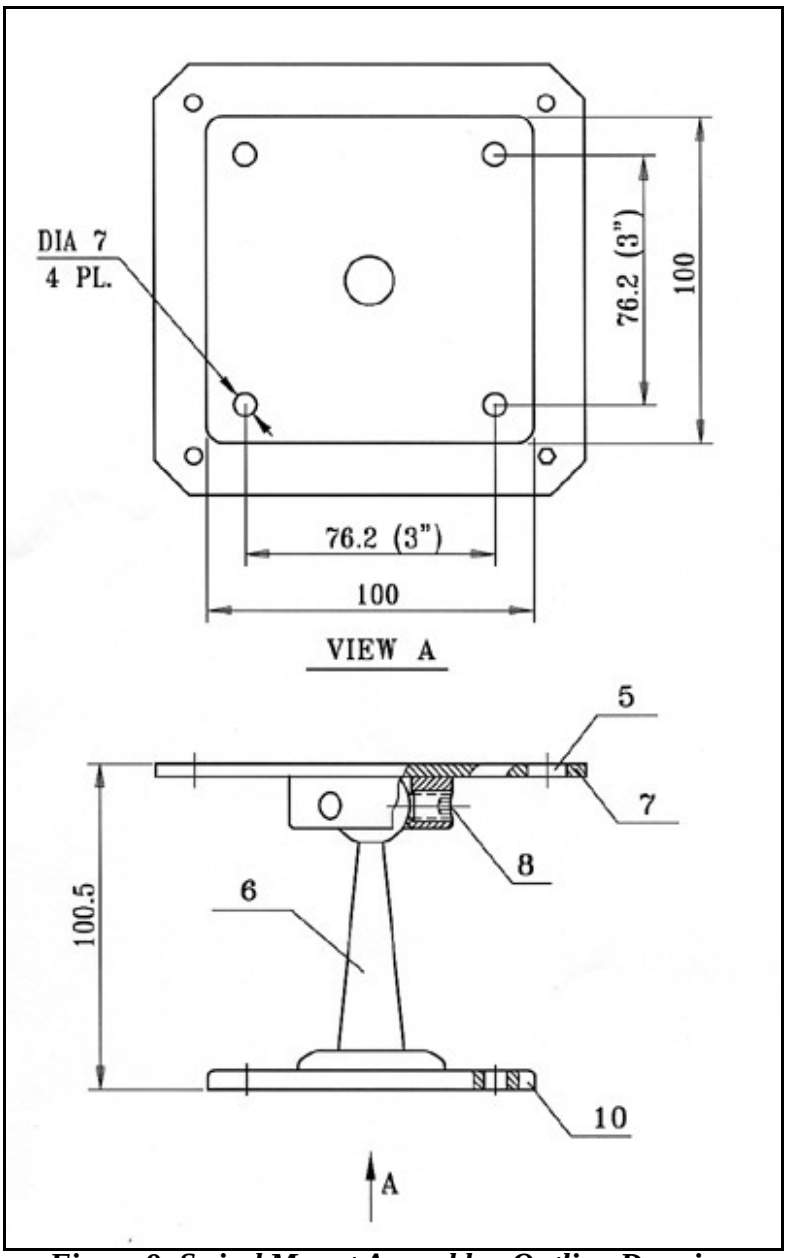


Figure 8: Hydrogen Detector and Swivel Mount Assembly



Description	
1	Protective Set Screws
2	Ground Terminal (for ATEX) or Ground Thread (for FM)
3	Back Cover
4	Housing
5	Swivel Mount Screw Hole
6	Swivel Mount
7	Holding Plate
8	Locking Screws
9	Detector Mounting Screws
10	Swivel Mount Plate
11	Swivel mounting screws

Figure 9: Swivel Mount Assembly - Outline Drawing

6.6 Wiring (Refer to Fig. 12)

1 Disconnect power.

2 Remove the four (4) protective set-screws from detector front. (Fig. 8 Item 1)

3 Release the four (4) socket-head screws that secure the detector housing (Item 1) to its back cover (Item 4) Using HEX KEY No. 5. Hold the housing (Item 1) during the removal of the screws. With the screws removed, pull the detector housing (Item 1) from its cover (Item 4). The cover remains attached to the detector mount. The Terminal Board inside the detector cover is now revealed.

4 Remove the protective plug mounted on the detector conduit inlet, pull the wires through the detector cover (Item 4) and secure them firmly to the cover using the cable-clamp (Item 2) attached to it. Use a 3/4"-14NPT or M25x1.5 explosion-proof conduit connection to assemble the conduit to the detector.

5 Connect the wires to the required terminals (Item 3) according to the wiring diagram. See paragraph 6.7 and figures no. 10 and no. 11.

6 Connect the grounding wire to the ground screw outside the detector cover (Item 6).

The detector must be well grounded to *Earth Ground* for proper operation.

7 Verify the wiring. Improper wiring may damage the detector.

8 Check the wires for secure mechanical connection and press them neatly against the terminal board to prevent them from interfering while closing the detectors' housing.

6.7 Terminal wiring (See Fig. No.10 and No.11.)

The detector contains a Terminal Board consisting of two (2) terminal blocks. The left terminal block is labeled 1 to 7, the right terminal block is labeled 8 to 14.

The following describes the function of each electrical terminal of the detector:

- ***Power Supply*** (Terminal Numbers 1, 2):
  Input power -Terminal No. 1.
  RETURN - Terminal No. 2.

- ***Manual Bit Activation*** (Terminal No. 3):
  Terminal No. 3 is used for the Manual BIT activation. The manual BIT is initiated by a momenta ry connection of Terminal No. 3 to the power supply Return line.

  Fault Relay (Terminal Numbers 4, 5):
  The Fault output is N.O. SPST relay at Terminals No. 4 and 5. The contacts are normally energized closed when the detector is in its normal operational condition.

- ***Alarm Relay*** (Terminal Numbers 6, 7, 8):
  The Alarm output is a change over contact relay (SPDT).
  Terminal No. 6 is the N.O. relay contact.
  Terminal No. 7 is the COMMON relay contact.
  Terminal No. 8 is the N.C. relay contact.

- ***Accessory Relay*** (Terminal Numbers 9, 10):
  The Accessory output is N.O. SPST relay at Terminals No. 9 and 10.
  The Accessory relay may act in parallel with the ALARM relay to activate another external device or it may provide a warning signal, depending on the Function setup 4.3.1

Note
To protect the dry contacts from voltage surges when connected to reactive loads (electric motors, sirens, etc.), connect an appropriate varistor over these contacts.

- ***4-20mA Output*** (Terminal Numbers 11, 12):
  Terminal Numbers 11 and 12 are used for analog, 4-20mA current output as specified in paragraph 4.e
  Terminal No. 11 - output Terminal.
  Terminal No. 12 - input Terminal (see appendix B for more details)

- ***RS-485*** (Terminal Numbers 13, 14):
  Terminal Numbers 13 and 14 are used for communication network as specified in appendix C.
  Terminal No. 13 - positive (+) lead.
  Terminal No. 14 - negative (-) lead.

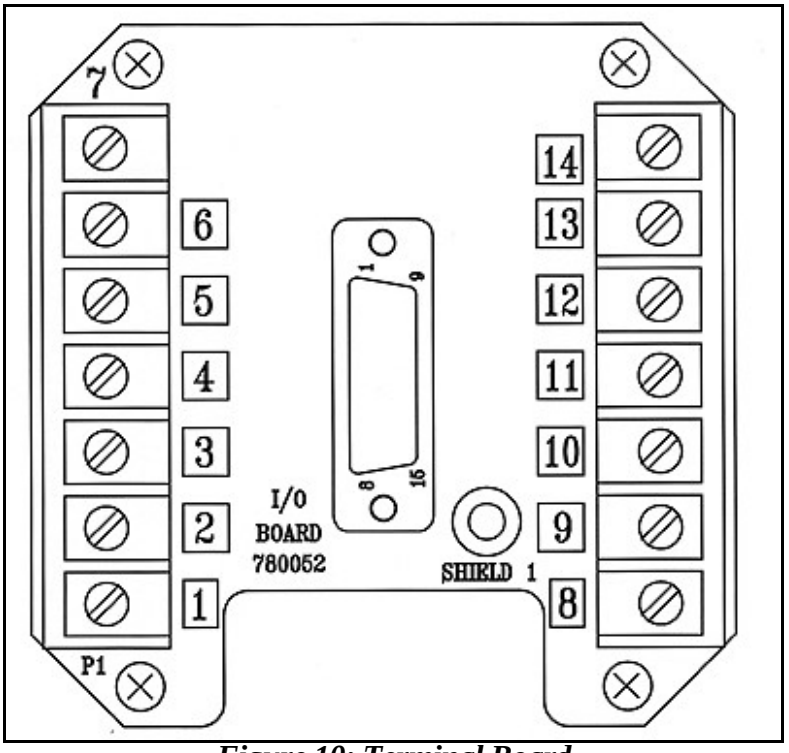


Figure 10: Terminal Board

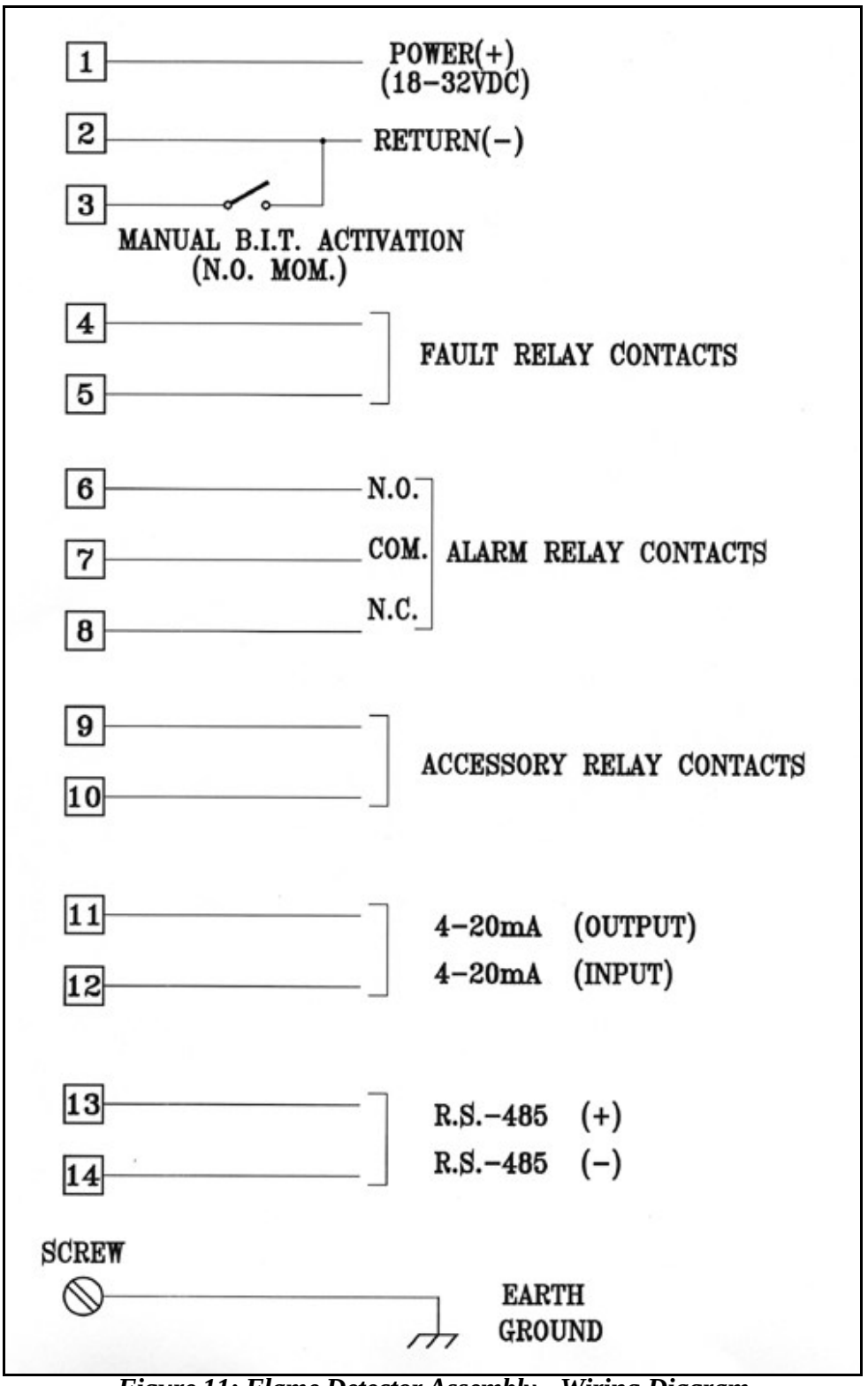
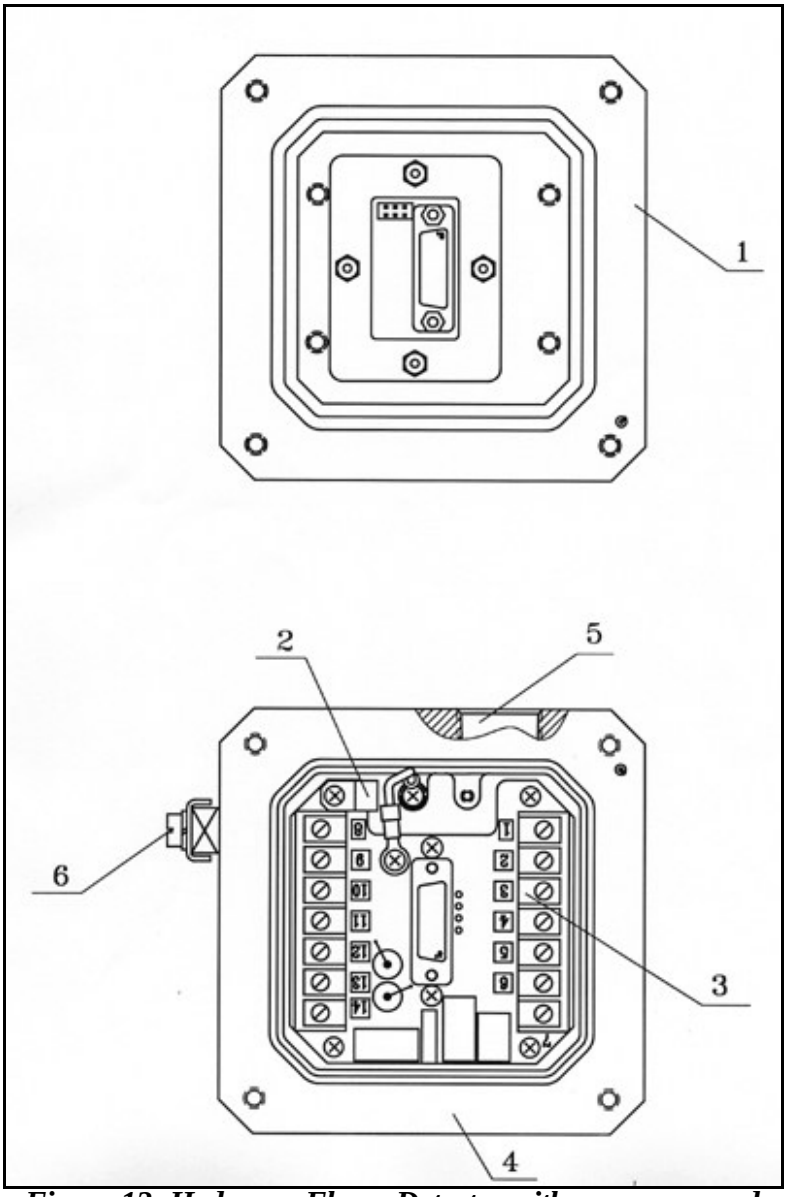


Figure 11: Flame Detector Assembly - Wiring Diagram



Description	
1	Housing
2	Cable Clamp
3	Terminal Board
4	Back Cover
5	Inlet Conduit
6	Earth Terminal

Figure 12: Hydrogen Flame Detector with cover removed

6.8 Operation Mode

When wiring is completed the operational mode can be selected.

Mode selection is achieved through RS-485 using a PC with a Spectrex Host. Refer to TM784050.

Programmable Function:

Modes of operation are programmable with a PC or Handheld unit according to the selection table in Paragraph 4.3.1 and Refer to TM 784050.

Address:

The detector has the capability of acting as an addressable device.
The detector provides 247 addresses, which can be used by the RS-485 communications link as described in paragraph 4.3.4 and Refer to TM 784050.

Alarm Delay:

An Alarm Delay may be required for certain applications. The detector has an Alarm Delay that permits time delays from 0, anti-flare, 3, 5, 10, 15, 20 and 30 seconds respectively. The delay can be defined by the RS-485. See paragraph 4.3.3 and refer to TM 784050.

7. Operating Instructions

7.1 Scope

The following instructions are designed to obtain optimal performance from the detector over its life cycle.

7.2 Power-Up

1 Apply power and wait approximately 60 seconds for the automatic self-test of the detector.

Note: Applying power initiates the following sequence:

- POWER LED flashes
- BIT is executed, if successful then
- POWER LED turns ON continuously
- FAULT relay contacts close

2 Wiring Inspection: If a short-circuit or line discontinuity exists, indications will appear on the control unit display panel. Review your wiring.

3 The detector goes into its FAULT state when supply voltage drops under 16.5V. The detector status goes back to NORMAL, when the supply voltage is above 17.5V.

4 Detector Inspection: Visually inspects the viewing window of the detector. It should be clean and clear. The POWER LED should be ON and the ALARM LED should be OFF. The ALARM and ACCESSORY relays should be OFF and the FAULT relay should be ON. The 4-20mA Output should be 5mA.

5 If any of the outputs or indications are different from the description in step 4, see paragraph 8.6.1 for troubleshooting.

The Flame Detector is now ready for Functional Testing.

7.3 Reset (if optional latching operation selected)

To RESET a detector when in its ALARM state, disconnect power (terminal No. 1 or terminal No. 2), or initiate a manual BIT.

7.4 Functional testing

Following is a testing procedure for proper functioning of the detector. The detector can be tested using the Manual Built-in-Test.

7.4.1 Manual BIT Test

Important Note!
If the function setup "Alarm BIT" and/or "Accessory BIT" are in YES, then the Alarm, Accessory Relay and 4-20mA Output will be activated during a manual BIT, therefore, automatic extinguishing systems or any external devices that may be activated during BIT must be disconnected.

1 Verify that the detector is operated properly.

2 Initiate manual BIT. After a few seconds the following occurs:
- Alarm Relay will be activated and the 4-20mA output turns to 15mA for 3 seconds (only if SW1-4 is ON).
- Accessory Relay will be activated and the 4-20mA output turns to 10mA for 3 seconds (only if SW1-5 is ON).
- The 2 LEDs should be ON.
- Fault Relay will stay active during the test.

7.5 Safety Precautions

After Powering-up, the detector requires hardly any attention in order to function properly, but the following should be noted:

1 Follow the instructions in the manual and refer to the drawings and specifications issued by the manufacturer.

2 Do not expose the detector to radiation of any kind unless required for testing purposes.

3 Do not open the detector housing while power is supplied.

4 Do not touch internal parts. Interference with internal circuits may impair detector performance and will invalidate manufacturer's Warranty.

5 Disconnect external devices, such as automatic extinguishing systems before carrying out any maintenance.

8. Maintenance Instructions

8.1 Scope

This chapter deals with preventive maintenance, describes possible faults in detector operation and indicates corrective measures. Ignoring these instructions may cause problems with the detector and may invalidate the warranty. Whenever a unit requires service, please contact the manufacturer or its authorized distributor for assistance.

8.2 Maintenance Instrumentation and Personnel

The detectors' maintenance requires ordinary tools and qualified personnel, who should be familiar with local codes and practices.

8.3 Preventive Maintenance Procedures

The detector must be kept as clean as possible. The viewing window and the reflector of the Model 20/20SH Flame Detector must be cleaned on a periodic basis. The frequency of cleaning operations depends upon the environmental conditions and specific applications. The fire detection system designer will give his recommendations.

Use of the optional AIR SHIELD Model 20/20-920 is highly recommended and will help to keep the window clean and prevent dirt from accumulating on the window.

1 Disconnect power to the detector before proceeding with any maintenance including lens cleaning.

2 To clean the detector viewing window and reflector use water and detergent, rinse with clean water.

3 Where dust, dirt or moisture accumulates on the window, first clean with a soft optical cloth and detergent, then rinse with clean water.

8.4 Periodic Maintenance Procedures

In addition to preventive cleaning and maintenance, the detector should be functionally tested every six months. This test should also be carried out if, for any reason, the detector has been opened.

8.4.1 Power-Up Procedure

Perform Power-Up procedure every time power is restored to the system. Follow the instructions in paragraph 7.2.

8.4.2 Functional Test Procedure

Perform a functional test of the detector as described in paragraph 7.4.

8.5 Maintenance Records

It is recommended to record maintenance operations performed on a detector in a system log-book. The record should include information, which identifies the unit, the installation date, contractor, and entries for every maintenance operation performed including the description of the operation, date and personnel ID. If a unit is sent to the manufacturer or distributor for service, a copy of the Maintenance records should accompany it.

8.6 Troubleshooting

8.6.1 Fault Indication

1 Check power supply for correct voltage, p olarity and wiring.

2 Check detector window and reflector for cleanliness. If necessary clean the window as indicated in paragraph 8.3 and repeat the test.

3 Disconnect the power supply to the system and check the detector's internal wiring.

4 Reconnect power supply and wait approximately 60 seconds. Repeat the test. If the indication LED is still blinking, the unit requires service.

8.6.2 False Alarm or Warning Indication

1 Disconnect the power supply from the system and check internal wiring.

2 Reconnect power supply and wait approximately 60 seconds. If indication remains, the unit requires service.

Appendix A - Wire Selection Tables

General Instructions For Electrical Wiring

1. Refer to Table 12 to determine the required wire gauge for general wiring, such as relay wiring. Calculate the permitted voltage fall with respect to loads current, wire gauge and length of wires.
2. Refer to Table 13 to select wire gauge for power supply wires. DO NOT connect any circuit or load to detectors' supply inputs.

Table 12: Maximum DC resistance at 68 F for copper wire

AWG #	mm^2	Ohm per 100 ft.	Ohm/100 meter
26	0.12 - 0.15	4.32	14.15
24	0.16 - 0.24	3.42	11.22
22	0.30 - 0.38	1.71	5.60
20	0.51 - 0.61	1.07	3.50
18	0.81 - 0.96	0.67	2.20
16	1.22 - 1.43	0.43	1.40
14	1.94 - 2.28	0.27	0.88
12	3.09 - 3.40	0.17	0.55
10	4.56 - 6.64	0.11	0.35

A. Select "Number of detectors" connected in one circuit.
B. Select "wiring length" per your installation requirements.
C. Refer to "power supply range" for voltage extreme applied.

Table 13. Wiring length in feet (meter)

No. of Detectors	**Recommended Wire Diameter**					**Power Supply Range (VDC)**
24	18	16	14	-	-	22-32
20	18	16	14	-	-	22-32
16	20	18	16	14	-	22-32
12	20	18	16	14	-	20-32
8	20	18	16	14	-	20-32
4 and less	20	18	16	16	14	20-32
Feet (meters)	164 (50)	328 (100)	492 (150)	656 (200)	820 (250)	
	Max. Length from Power Supply to Last Detector					

Appendix B – Typical Wiring Configurations

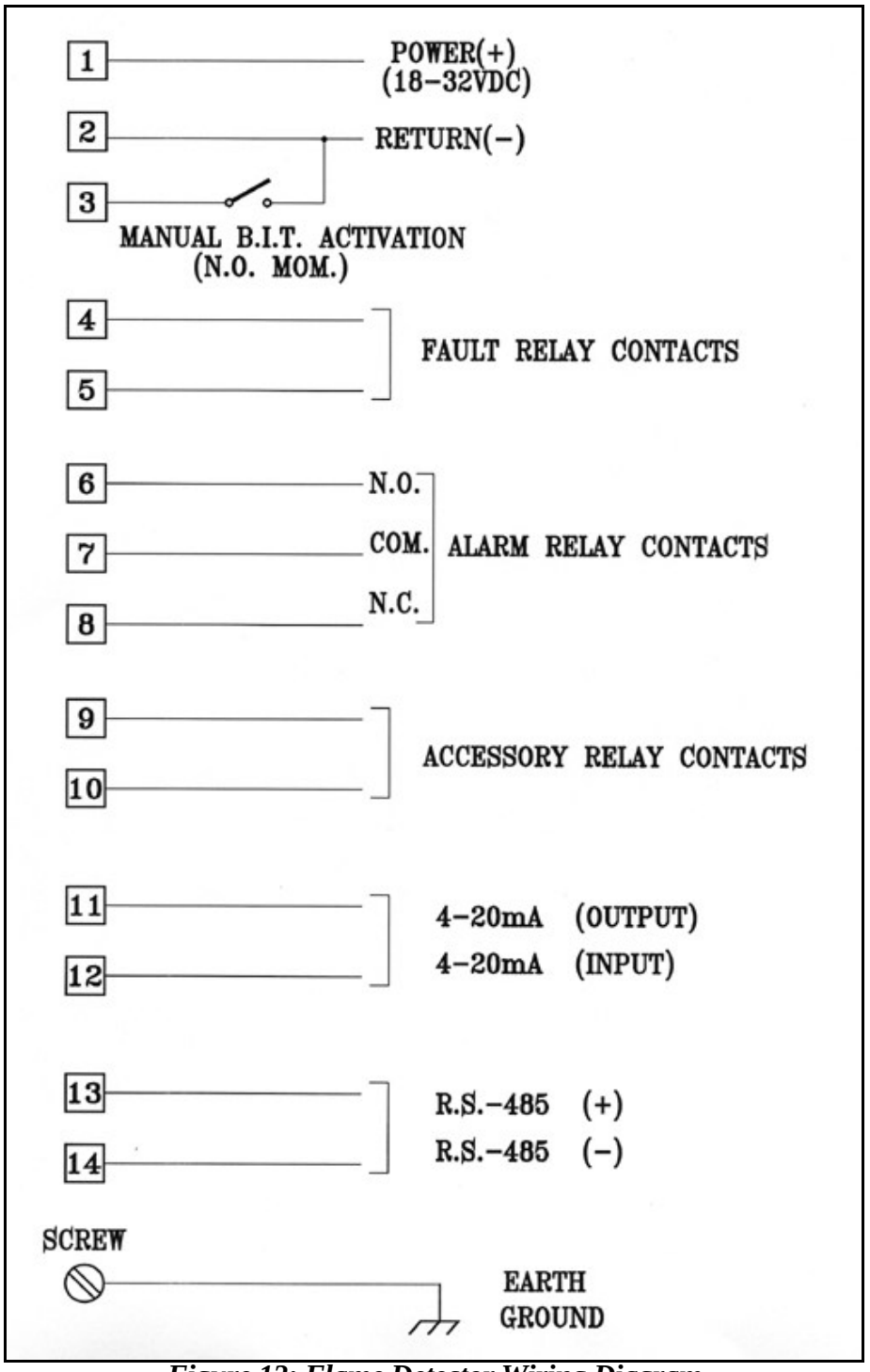


Figure 13: Flame Detector Wiring Diagram

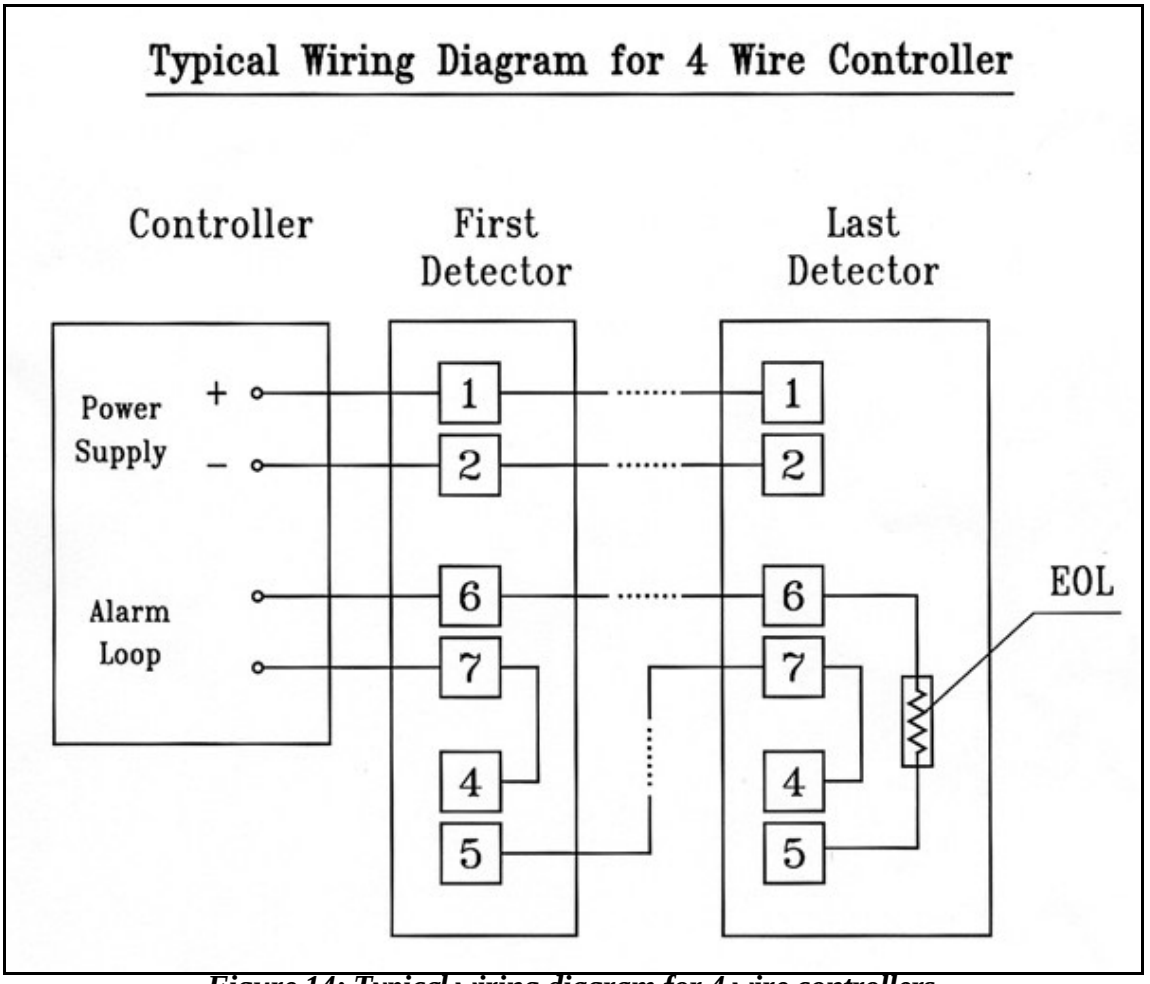


Figure 14: Typical wiring diagram for 4 wire controllers

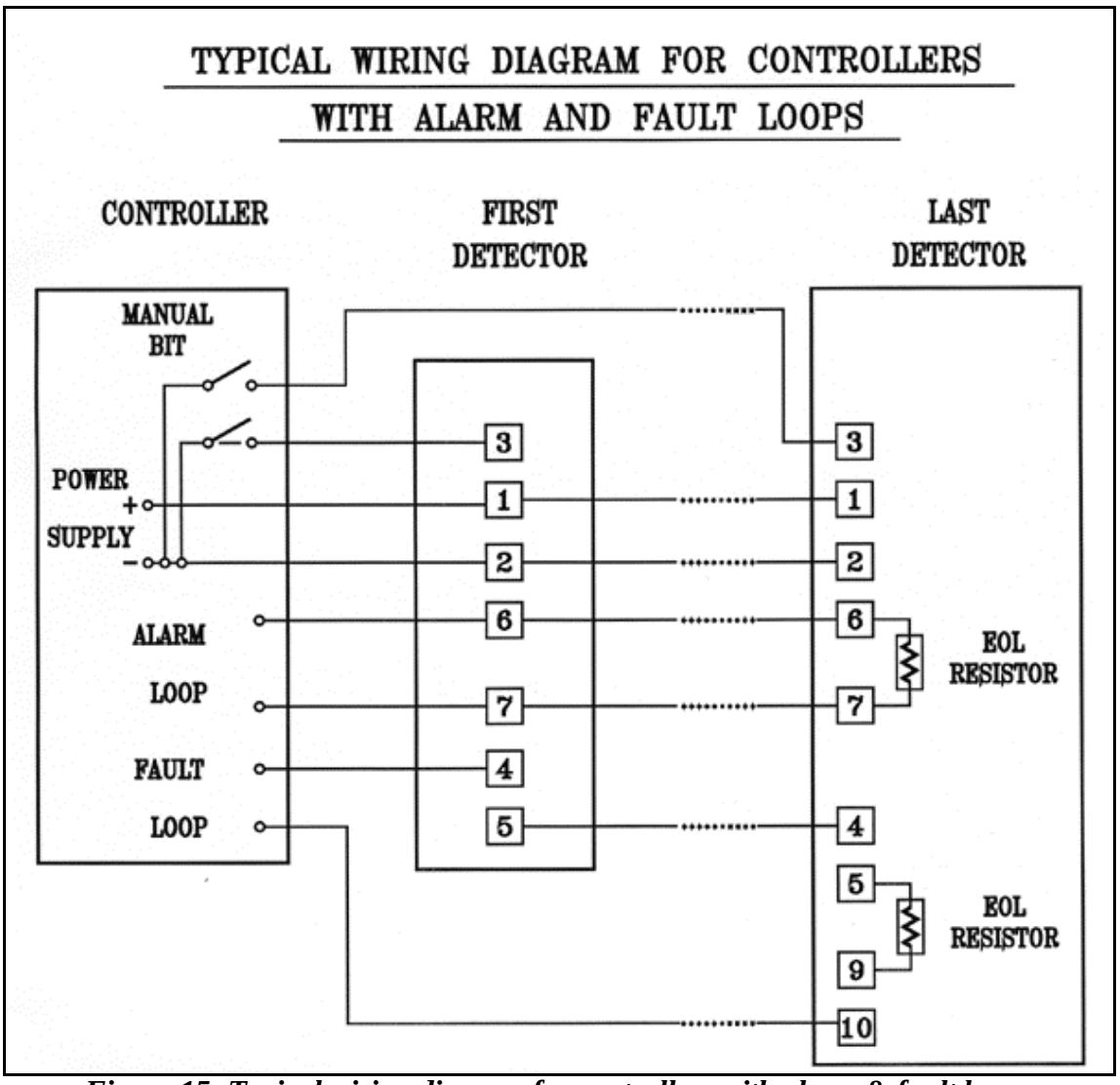


Figure 15: Typical wiring diagram for controllers with alarm & fault loops

Notes:

1. For EOL Resistors Values See Controller Manual
2. The Accessory Relay in The Last Detector Should be Configured as an EOL (Function "EOL" at YES)

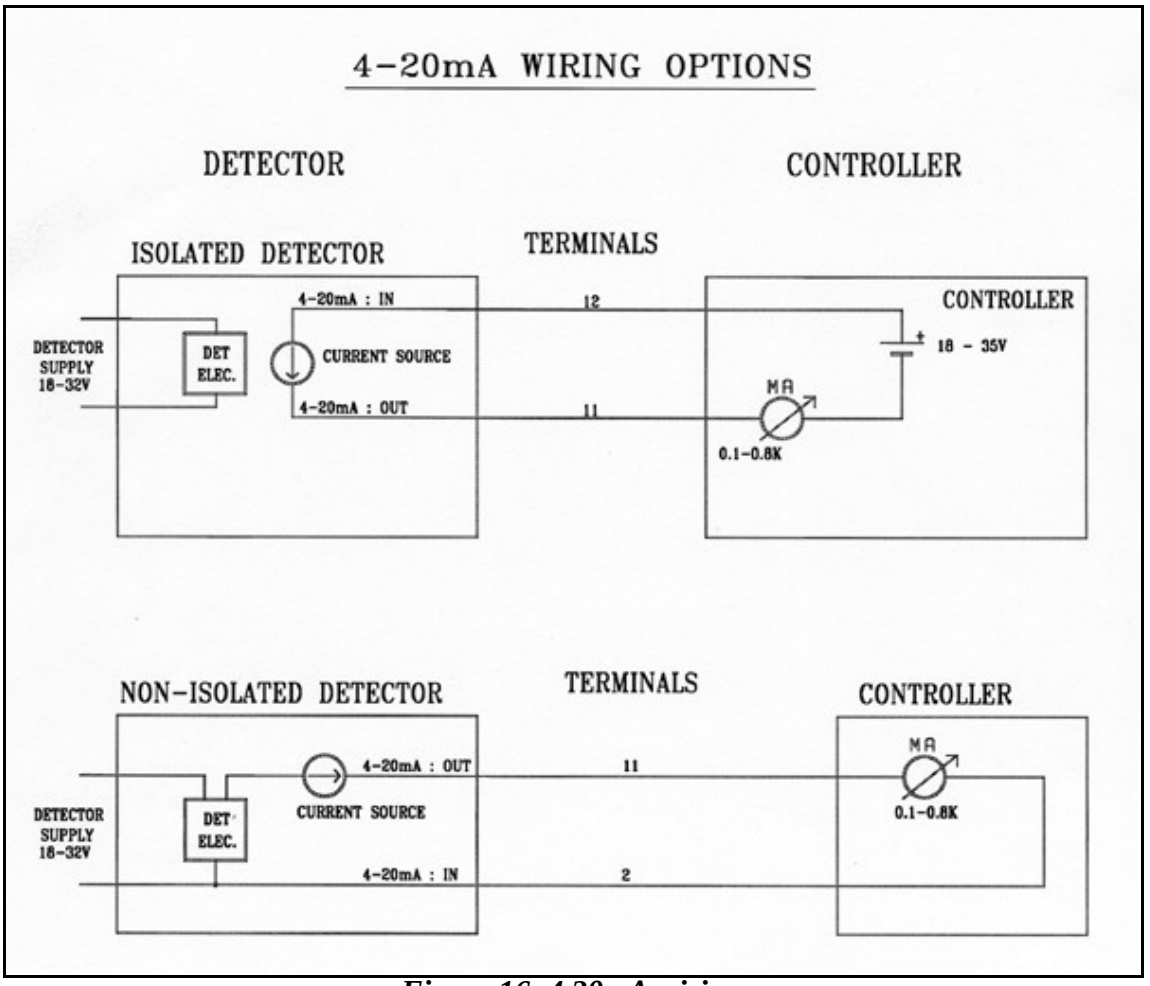


Figure 16: 4-20mA wiring

Notes:
The detectors are factory set to isolated 4-20mA 'sink' version.

To work at non-isolated 4-20mA 'source' version, connect Terminal 12 to Terminal 1. The 4-20mA meter is connected between Terminal 11 and Terminal 2.

Appendix C – RS-485 Communication Network

Using the RS-485 network capability of the Hydrogen detector and additional software, it is possible to connect up to 32 detectors in an addressable system with 4 wires only (2 for power & 2 for communication). Using repeaters, the number of detectors can be much larger (32 detectors for each repeater) up to 247 on the same 4 wires. When using the RS-485 network it is possible to read each detector status (FAULT, WARNING, ALARM) and to initiate a BIT to each detector individually.

Fore more details, consult the factory.

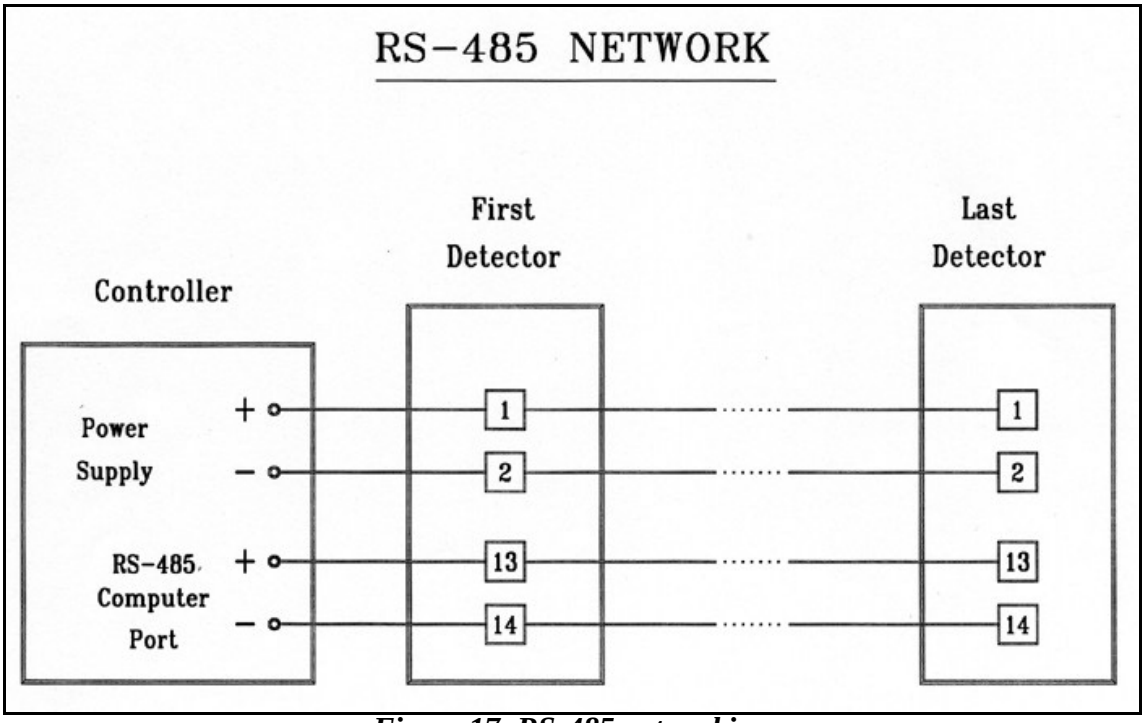


Figure 17: RS-485 networking

Appendix D - Mounting the "EExde approved" version

The EExde approved version provides an additional EExe terminal box attached below the EExd detector and therefore allows easier access in hazardous areas (see fig. 18). The detector is prewired to the terminals in the additional EExe terminal section ready for field wiring connections
Due to restricted number of terminals, there are two options for this pre-wiring (paragraph 2.1)

- RS-485 & 4-20mA
- Alarm & Fault Relays

1. Detector Mounting

The detector may be mounted on a simple fabricated bracket, or preferably the optional Swivel Mount, Model 20/20-003. The Swivel Mount enables the detector to be rotated up to 40 degrees in all directions.

1.1 Swivel Mount Kit - Use the kit from the paragraph 6.5.1

1.2 Swivel installation

1 **Refer to Fig.8 and Fig 9**. Place the swivel mount (item 6) in its designated location and secure it with four (4) M6 or 1/4" screws (item 11) (recommended), placed 76.2 mm. (3.0 in.) apart on the swivel mount plate (item 10).
Note: Skip this step if the Swivel Mount is already installed. Also detector removal for maintenance purpose does not require Swivel Mount removal.

2 Unpack the detector.

3 Place the detector, with its conduit inlets pointing downwards, on the holding plate of the swivel mount (Fig. 9 item 7). Secure the detector by four (4) M6 screws with M6 spring washers from the Swivel Mount Kit using the holes (Fig. 9 item 5). You can use the thread on the modified cover (Fig. 18 item 1) marked either triangle symbol or square symbol. Use No. 5 Hex Key for M6 screws.

4 Tighten the three locking 3/8"-24UNF screws (Fig. 9 item 8) of the swivel mount ring until the friction in the ball joint holds the detector in its position. Yet, still permits it to be moved by hand-applied force (Use 3/16" HEX KEY).

5 Point the detector towards the protected area and make certain that the view of the area. Secure the detector in that position by tightening the locking screws (Fig.9 item 8) of the swivel mount ring.

The detector is now correctly located and aligned and ready for connecting to the system.

2. WIRING (REFER TO FIG. 18.)

1 Disconnect power.

2 Release the four (4) slotted-head screws (item 3) that secure the terminal box cover (Item 2). The terminal box is now revealed.

3 Remove the protective plug mounted on the detector conduit inlet, pull the wires through the terminal box (Item 7). Use M25x1.5 EExe cable glands to assemble the cable to the detector/terminal box.

4 Connect the wires to the required terminals (Item 4) according to the wiring diagram. See paragraph 2.1 and figures no. 19 and no. 20.

5 Connect the grounding wire to the ground screw outside the detector cover (Item 5).

The detector must be well grounded to *Earth Ground* for proper operation.

6 Verify the wiring. Improper wiring may damage the detector.

7 Check the wires for secure mechanical connection and press them neatly against the terminal to prevent them from interfering while closing the cover (Item 2).

8 Place and secure the terminal box cover(Item 2) using four (4) slotted-head screws (Item 3).

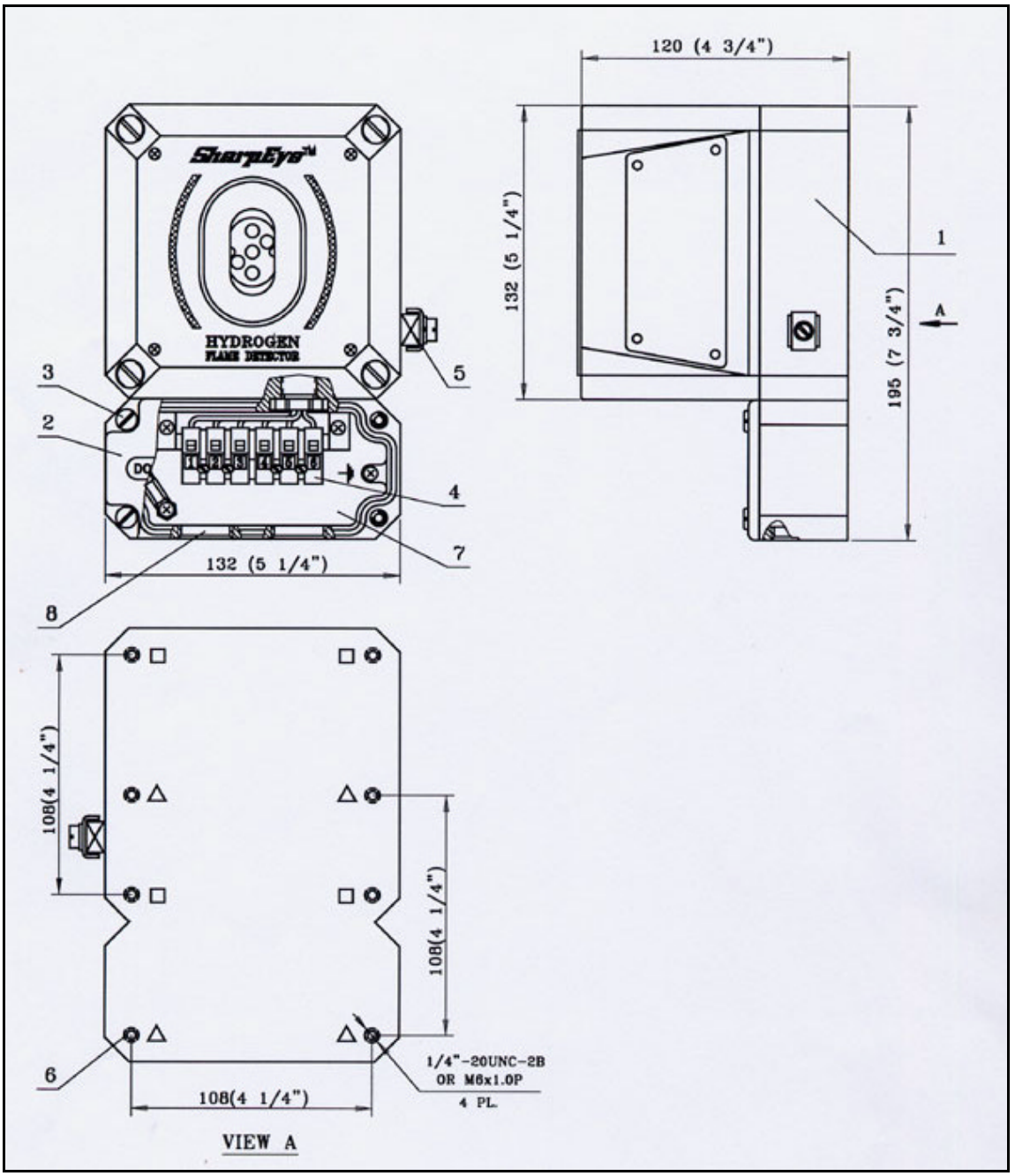


Figure 18: Flame Detector Assembly - Wiring Diagram

Description	
1. Modified Back Cover	5. Ground Terminal
2. EExe terminal box Cover	6. Mounting Thread
3. Slotted Screw	7. EExe terminal box
4. Terminal Block	8. Cable Inlets

2.1 Terminal Wiring

The detector contains an EExe chamber consisting of a terminal block (Item 4). The terminal block is labeled 1 to 6. **(See Fig. No.18)**
The following describes the function of each electrical terminal of the detector:
There are two options:

RS-485 & 4-20mA Version Option A (See Fig. No. 19)	**Alarm & Fault Relays Version Option B (See Fig. No. 20)**
Power Supply (Terminal Numbers 1, 2): Input power is supplied to Terminal No. 1. RETURN is connected to Terminal No. 2.	**Power Supply** (Terminal Numbers 1, 2): Input power is supplied to Terminal No. 1. RETURN is connected to Terminal No. 2.
RS-485 (Terminal Numbers 3, 4): Terminal Numbers 3 and 4 are used for communication network as specified in appendix C. Terminal No. 3 is the positive (+) lead. Terminal No. 4 is the negative (-) lead.	**Alarm Relay** (Terminal Numbers 3, 4): The Alarm output is a NO. SPST contact at Terminal Numbers 3 and 4. The contacts are closed at Alarm Mode.
4-20mA Output (Terminal Numbers 5, 6): Terminal Numbers 5 and 6 are used for analog, 4-20mA current output as specified in paragraph 5.e Terminal No. 5 is used as output Terminal. Terminal No. 6 is used as input Terminal. (see appendix B for more details)	**Fault Relay** (Terminal Numbers 5, 6): The Fault output is N.C. SPST contact at Terminal Numbers 5 and 6. The contacts are open at Fault condition.

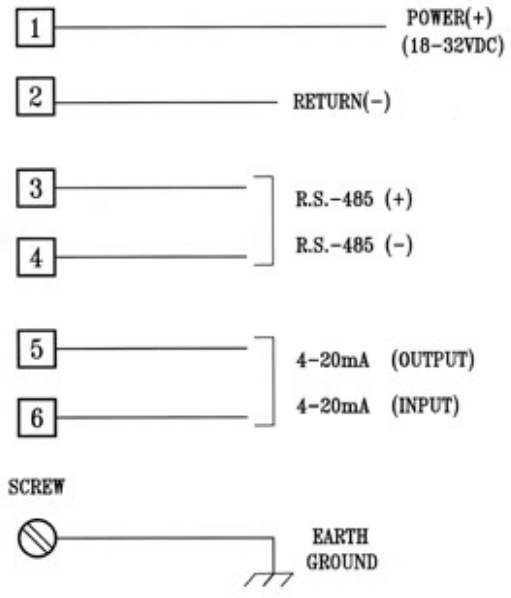
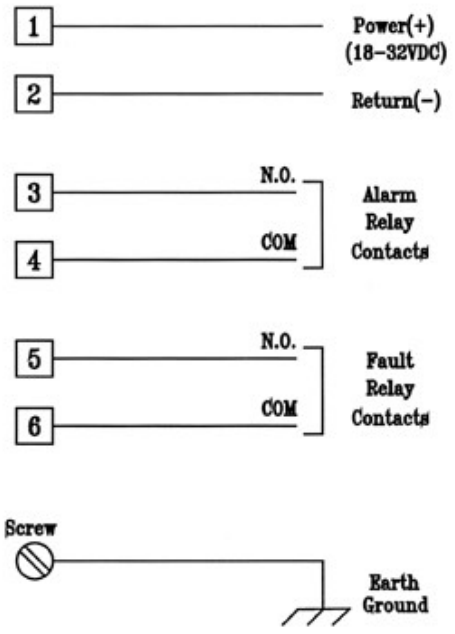

	

Figure 19: OPTION A Flame Detector Assembly - Wiring Diagram ("de version")	***Figure 20: OPTION B Flame Detector Assembly - Wiring Diagram ("de version")***

For additional details or assistance, please contact

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