IPES-IR4000 Flame Detector
Operating Manual

820-0011

ESP SAFETY INC

Technology of the Future...Protection for today

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Operating Manual
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ESP Safety, Inc.
555 North First Street
San Jose, CA 95112
408-886-9746

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It is important that this entire manual be thoroughly read and understood prior to installing or operating the IPES-IR4000. Any deviation from the recommendations in this manual may impair system performance and compromise safety.

1.0 Introduction

Introduction

The IPES-IR4000 flame detector's advanced microprocessor-based technology ensures rapid flame recognition and alarm signaling. In addition, the IPES-IR4000's selective, multiple spectrum technology virtually eliminates false alarms from a variety of sources including:

- Direct or indirect sunlight
- Arc welder flash, resistive heaters
- Fluorescent, halogen
- Incandescent light
- Nuclear radiation

The IPES-IR4000 is a multi-channel infrared flame detector, the most resilient to false alarms out of the IPES flame detector lineup. The IPES-IR4000 consists of an explosion-proof casing with sensors to detect infrared radiation from flames at multiple points within a spectral window of 4.0 to 5.0µm. Detection is performed using Infrared Sensors that capture heat and radiating gas signatures emitted by fire. Significantly, the IPES-IR4000 can detect fires fueled by hydrocarbon-based liquids and gases that may not be visible to the human eye. These IR inputs are digitally processed in order to analyze the environment for flame sources. An alarm signal is generated only when input from all 4 optical sensors positively correlate to the presence of a flame. Upon confirmation of flame or fire, the IPES-IR4000 triggers alarm relays and provides alarm signals via RS-485, Modbus, and industry standard +4 to 20mA current loop to the users' receiving devices and alarm systems.

The basic technology is well tested and used for many devices designed for human interaction. These include night vision equipment, FLIR navigation assist, and spectral telescopes used in astronomy.

For ease of operation status and alarm condition the IPES-IR4000 provides an easily visible high illumination Tri State LED that follows an Industry Standard protocol:

- *Green for normal operation*
- *Yellow for fault conditions*
- *Red for alarm conditions*

The IPES-IR4000 provides superior false alarm processing making it the detector of choice. Alarms occur instantly after our proprietary False-Positive Algorithm determines possible alarm states. This makes IPES-IR4000 the industry standard for several industrial applications.

Our Mission

ESP Safety, Inc.'s mission is to provide complete turn-key protection solutions beginning with the design stage, through system installation and commissioning, and on-going field service in hazardous environments. Our line of industry-leading products, services, and systems benefits society, saves lives, and preserves capital resources.

ESP Safety, Inc. Contact Information

Telephone: 408-886-9746
website: www.espsafetyinc.com
Address: 555 North First Street, San Jose, CA 95112

2.0 Description

Application

The IPES-IR4000 design and explosion-proof ratings make it an excellent choice for indoor and outdoor applications, including:

- Drilling and production
- Automated and manned ocean based platforms.
- Fuel loading and transfer facilities
- Refineries
- Bulk terminals
- Tank farms and storage facilities
- LNG/LPG processing and storage
- Compressor stations
- Pipelines and pump stations
- Petrochemical processing facilities
- Fertilizer production
- Paint production
- Power Plants- Nuclear, Coal, Oil, Natural Gas, Solar Process, MHD
- Shipping Tankers, Freighters. Virtually any vessels that may have a potential fire hazard.
- Laboratory and Plasma Study/Process
- Transportation facilities, Airports, Subways, Aircraft hangers
- Oil and Gas Boilers
- Stage and entertainment special effects

Specifications

The IPES-IR4000 meets industry certifications and requirements for Hazardous Locations.

Detection Type: Optical

Detection Method: Multiple Spectrum Infrared Radiation Source

Spectral Range: Four points in a range of 4.0 to 5.0 μm

Detection Process Time: 4.5 to 7 Seconds

Detection Distance: Minimum 41ft (12.5m) to 345ft (105m) depending on detected fuel. Refer to Section 4.0

Detection Cone of Vision: Up to 120° (60° Left/Right of center)

Sensitivity: Selectable settings for NEAR/FAR and FAST/SLOW. Factory default configuration is FAR and SLOW

Power requirements: 24VDC nominal (18-32VDC range)

Power Consumption: 6 VA (3 Watt) Max

Outputs:

- Industry Standard +4 to 20mA
- 1 Alarm Relays (SPDT/Form-C latching)
- 1 Fault condition Relay (NO/Form-A)

*All Relays Contact Rating 1 Amp@125VAC/30VDC

- Digital RS-485 Modbus

Cable Distance: 6200ft (1900m) 18 AWG

Ingress Protection: IP66

Vibration: Meets FM 3260

Impact Resistance: 1.9 Joules

Test Method: IPES Test Lamp (PN: 120-0007)

RFI- Resistant to interference by EMI and RFI; EMC Directive compliant with CE mark. Not susceptible to keying 5 watt walkie-talkie at distances greater than 1 foot.

Optical Integrity: IPES-IR4000 performs an automatic calibrated performance test once per minute to verify complete detector operation capabilities.

Operating Temperature (T4): -40°F to +194°F (-40°C to 90°C)

Operating Temperature (T5): -40°F to +185°F (-40°C to 84°C)

Storage Temperature: -76°F to +185°F (-60°C to 85°C)

Humidity Range: 0 to 95% relative humidity
(can withstand 100% condensing humidity for short periods of time)

Conduit Entry: Two (2) M20 X 1.5 entries located on Back Cover

Enclosure Material: Stainless Steel Grade 316
Aluminum 6061 with red powder coat finish.

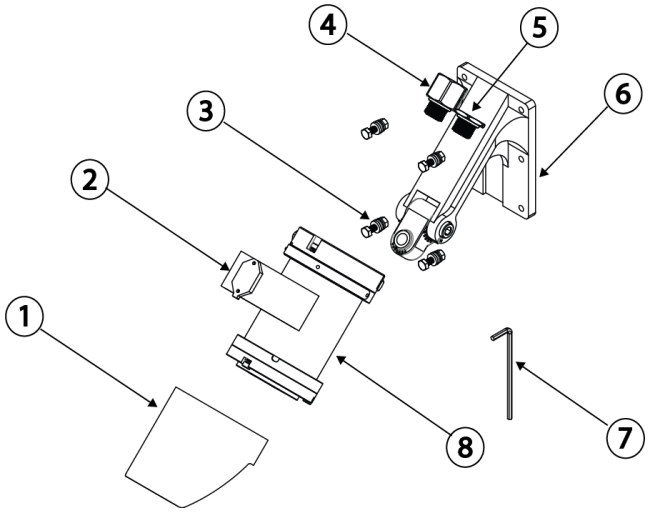
Weight: Stainless Steel 11lbs (5.0kg)
Aluminum 5.5lbs (2.5kg)

Included Equipment:
IPES-IR4000 Fire Detector
Adjustable Mounting Bracket
Magnetic Test Collar
Sun Shade Hood

Optional Equipment

- *IPES-IR4000 Configuration and Monitoring Software*

Delivery Set



The typical IPES delivery set consists of the following components

1. Visor / Sun Shade(Qty 1), P/N 125-0005

2. Magnetic Collar (Qty 1) *one provided per 1-10 IPES, P/N 120-0006

3. Mounting Bolts (Qty 4), P/N 125-0001

4. M20 to 3/4” NPT Adapter (Qty 1), P/N 420-0208

5. M20 Threaded Plug (Qty 1), P/N 420-0209

6. Mounting Bracket (Qty 1), P/N 125-0003

7. 4mm Hex Wrench (Qty 1) *one provided per 1-10 IPES, P/N 120-0077

8. IPES-IR4000 Flame Detector (Qty 1), P/N 100-0017-01

Response Time

The sensitivity and response time can be varied in order to reduce unwanted "noise" when the IPES-IR4000 identifies a fire, or the distance to the probable place of fire is short ("near/far" and "slow/fast" modes).

When an IPES-IR4000 detector is exposed to a series of test fires along the center line of the sensor as described in the table below, the alarm response of the IPES-IR4000 is below the 30-second response time required under FM Standard 3260.

Table 2-1: Test Fire and Response Time

Fuel	Distance	Fire Size	Average Time
n-Heptane + toluene	213 ft. (65 m)	1 ft. x 1 ft. (32.5 sq cm) pan	22 sec.
Ethanol	82 ft. (25 m)	1 ft. x 1 ft. (32.5 sq cm) pan	7 sec
n-Heptane + toluene	82 ft. (25 m)	1 ft. x 1 ft. (32.5 sq cm) pan	7 sec.
Methane	82 ft. (25 m)	19.7 in (50 cm) flame ht (torch)	22 sec.

Generation of Alarm Signals

The IPES-IR4000 takes the following parameters into consideration when generating an alarm signal:

- Magnitude of signals from different optical channels
- Ratios between the signal amplitudes of different channels
- Signal modulation frequency
- Phase relationships among the channels

Elimination of False Alarms

False alarms from detectors used for industrial applications can cost productivity in down time. This is especially noted for automated systems and processes.

Conversely, failure to generate an alarm can have catastrophic results.

The combination of microprocessor, algorithms, multiple sensors and wavelength range settings makes the IPES-IR4000 an excellent choice for elimination of false positive indicators caused by non-flame sources of radiation such as artificial lighting, direct and indirect sunlight, lightning, electrical arcs, radiation (nuclear), arc welding and metal grinding.

An alarm condition will normally override a Fault condition unless a loss of operating power impairs the detector's ability to generate or maintain an alarm. The IPES-IR4000 reports both Fault and Alarm conditions exclusive of each other. This means both a Fire and Fault can be reported at the same time if they occur simultaneously.

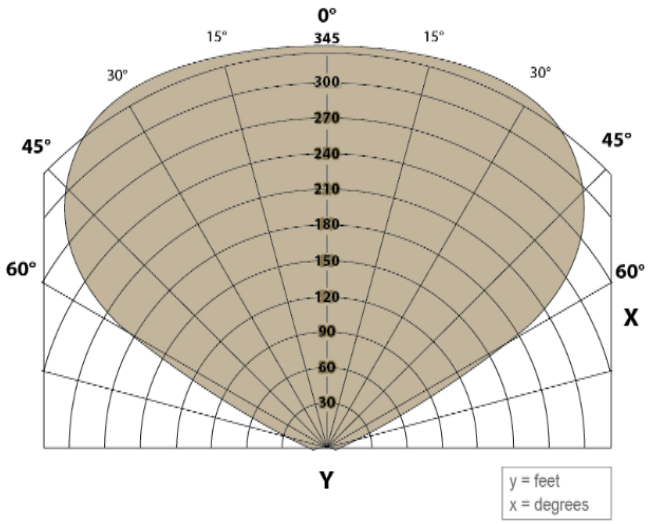
When the IPES-IR4000 is exposed to a false stimuli source, no false alarm activation or instability will occur at the minimum distances listed below:

Table 2-2: Fault Alarm Test

Source	Distance
1.5 kW Heater	36 inches (0.9 m)
Arc welder, 200A, 3/16" – 7018 electrode	9.0 feet (3.7 m)
Fluorescent, (2) 20W (6000 Lux)	0 inches (0 m)
Halogen, 500W	36 inches (0.9 m)
Incandescent, 100W (2000 Lux)	12 inches (0.3 m)
Direct sunlight	Detectors not affected by frequency range of visible light
Indirect sunlight	Detectors not affected by frequency range of visible light

Field of View

The IPES-IR4000 has a 120° cone of vision (horizontal) with the highest sensitivity lying along the central axis.



X= Angle of Vision Y= Distance in Ft

Optical Integrity

To maintain reliability of the IPES-IR4000, the optical devices are automatically self-tested for radiation transmission every 25 to 45 minutes. This routine test does not require the use of a test lamp. This test determines whether any dust or other contamination has formed on the detecting windows which would scatter the infrared radiation.

LED

Normal, Fire and Fault conditions are indicated by status LEDs located on the cover. After completing all installation steps, refer to the illustration and LED indicator table below to determine LED conditions.

Table 2-3: Determining LED Conditions

State	IPES-IR4000 status	Fire Relay State	Fault Relay Status	Output signal, mA	LED Status Condition
		Normally open when energized	Normally closed when energized		
1	No power supply voltage	Open	Open	0mA	Off
2	After switching on during 40 sec.	Open	Open	2mA	Flashing yellow LED for 40 seconds.
3	Fault or optical interference (dust)	Open	Open	2mA	Alternate flashing yellow and green LED lights.
4	Normal (no faults or fires during operation)	Open	Closed	4mA	Continuous green LED light.
5	Fire	Closed	Closed	18mA	Alternate flashing red/green during potential fire detection, then continuous red LED.
6	Fire & Fault	Closed	Open	18mA	Alternate flashing red/green during potential fire detection, then continuous red LED.
7	Test mode (magnetic collar is on)	Open	Open	2mA	Magnetic collar is on. Fire relay is blocked Continuous yellow LED light.
8	Built-in Test (BIT)	Open	Closed	4.1mA	Two white self-test lights will flash

Analog Signal

Analog signal (4-20 mA)	
Signal level	**Detector State**
(0 ± 0.1) mA	Circuit opening
(2 ± 0.1) mA	Fault
(4 ± 0.1) mA	Normal
(18 ± 0.1) mA	Fire
(4.1 ± 0.1) mA	Test (Built-in Test)

(Detail wiring instruction in Appendix B.)

Digital Signal

Informational digital signals are standard RS-485 communication with Modbus:

- Hardware self-test Fault
- Optical interference Fault
- Fire detected

(The digital channel protocol Modbus RTU is described in Appendix B.)

Relay Dry Contact Signal

Relay dry contact signal:

- Operation of the normally open Fire relay dry contacts *
  - FIRE relay – two-directional single-pole contact, which allows the state to be changed at the output to normally closed or normally open. The contact relay is rated for currents ranging from 10 mA to 5 A at DC voltage of 30 V.

    The output signal "Fire" can be cleared after eliminating the source of the alarm signal.

    * A normally closed condition of the Fire relay contacts does not comply with the requirements of NFPA 72 or ULC/ORD – C386 and is not approved by FM approvals.
- Operation of the normally open Fault relay dry contacts
  - FAULT relay – single-direction pole contact which is normally open. The relay is designed to handle currents of 10 mA to 5 A at DC voltage of 30 V.

Refer to **Table 2-3: Determining LED Conditions** above.

Configuration Settings

The IPES–IR4000 has the following detector configuration settings:

- "Near/far" and "slow/fast" modes – To provide maximum sensitivity.
- "Latching/non-latching mode"– To select either latching or non-latching functionality of the fire relay, which provides latching alarm state for the fire-alarm relay in compliance with NFPA 72 and ULC/ORD – C386.

The manufacturer's default settings correspond to **far, slow and non-latching**. To change the manufacturer's settings connect the flame detector to the computer and use the ESP Commander program.

Certifications and Compliance

Certifications and Compliance

USA and CA:	FM20US0015X Explosion proof for Class 1, Div.1, Group B, C, D indoors and outdoors (IP66) Hazardous (classified) locations Flameproof for Class 1, Zone 1, AEx/Ex db IIC Gb indoors and outdoors (IP66) Hazardous (classified) locations Tamb = -40°C to 84°C for T5 Tamb = -40°C to 90°C for T4 For both Stainless Steel and Aluminum Enclosure
	FM20CA0055X Explosion proof for Class 1, Div.1, Group B, C, D indoors and outdoors (IP66) Hazardous (classified) locations Flameproof for Class 1, Zone 1, AEx/Ex db IIC Gb indoors and outdoors (IP66) Hazardous (classified) locations Tamb = -40°C to 84°C for T5 Tamb = -40°C to 90°C for T4 For both Stainless Steel and Aluminum Enclosure
ATEX: 2014/34/EU	FM20ATEX0027X CE 2809 II 2 G Ex db IIC Gb IP66 Tamb = -40°C to 84°C for T5 Tamb = -40°C to 90°C for T4
IECEx	IECEx FMG 20.0031X Ex db IIC Gb IP66 Tamb = -40°C to 84°C for T5 Tamb = -40°C to 90°C for T4
EN Standards	EN 60529: 1991+A2: 2013 EN 60079-1:2014 EN IEC 60079-0:2018 EN 54-10:2002

Specific Conditions of Use:

1. The flamepath joints of the equipment are not intended to be repaired. Consult the manufacturer if repair of the flamepath joints is necessary.

2. Consult the manufacturer for genuine replacement fasteners. M5 x 0.8 mm, class 6g, 16 mm in length, hexagon socket cap screws, grade 18-8 stainless steel or better are acceptable alternatives.

3.0 Safety Considerations

Guidelines

For maximum safety:

- Only persons who have thoroughly read and understood this manual, are trained in safety techniques, and have electric-safety certificates are permitted to install and operate the IPES-IR4000.
- Never operate the IPES-IR4000 if the casing is damaged.
- Do not open, separate or disassemble the IPES-IR4000 when energized.
- Refer to the Appendices and diagrams in this manual to ensure that the wiring is in compliance with local ordinances and the NEC.
- Perform regular testing and maintenance as outlined in the Maintenance section.
- Ensure that fire-alarm and fire-extinguishing systems and controls are switched off before any testing or maintenance to avoid unwanted operation of alarms and fire-extinguishing equipment.
- It is the responsibility of the installer to take proper precautions during installation to protect the electrical connections and components from moisture.
- All cable/conduit entries must be sealed with an appropriate and certified sealing plug and cable gland. The use of industrial grade, armored field cable is recommended.
- If installing connection cables in an explosion proof conduit, do not use the same conduit to carry wiring for any other purpose or equipment.
- The IPES-IR4000 detector must receive a nominal voltage of 24 VDC (+/-8VDC) to operate properly.
  Note: Appendix A provides information on effect of wire size on maximum length
- System ground must be provided at the point of origination for 24VDC. Failure to do this may result in loss of range and/or signal integrity.
- Avoid low frequency, high voltage, and non-signaling conductors to prevent potential EMI problems.

Also see the individual sections in this manual for relevant specific safety guidelines.

Explosion Protection Means

Feature	Protection Means
Enclosure of Current Carrying Parts	The casing includes spigot joints with controlled gaps to meet explosion-proof requirements for installation in Class I, Division I, Group B, C and D, and T4 & T5 locations.
Case Mechanical Strength	The high mechanical strength of the case is able to withstand high explosive pressures without rupture or failures of mechanical parts. The case design is in accordance with FM 3600 and FM 3615.
Manufacturing Control Of Casing	Important parameters include: • Maximum width and minimum length of spigot joints • Surface roughness of the joined parts • The number of complete intact threads at the conduit entry point
Ignition Temperature	The ignition temperature of the surrounding environment is limited by the outside surface temperature of the housing, which does not exceed 275°F (135°C).
Securing of Bolts, Joints and Grounding	Spring washers, lock washers, and lock nuts maintain the integrity of the bolted connections by preventing loosening of the bolts.
Joined Parts Protection	Anti-seize lubricant is applied on the critical joints.
Casing Ingress Protection	The design of the casing is protection class IP 66 in accordance with IEC 60529-004.
Sealing Cables at Conduit Entry	Use approved hazardous location sealed conduit fittings. For outdoor installations, ensure sealing meets IP66 requirements.

The table above describes design features that protect the IPES-IR4000 against explosions

4.0 Installation

Before Installation

- Make sure all removable parts are joined to the casing as tightly as possible.
- Make sure the nameplates and warning labels are in place.
- Make sure the external surfaces of the elements and joined surfaces of the casing are free of dents or damage.
- Make sure the tamper-proof screw is intact on the front cover.
- Anti-seize lubricant is provided for easy assembly and corrosion protection of the joints between the enclosure/cover and enclosure/base. After disassembly, wipe these surfaces clean with a soft cotton or wool cloth and then re-apply a thin layer of lubricant prior to assembly.
- Minimum 22 AWG (0.326mm^2) shielded cable conductors are required, with 14 AWG (2.08 mm^2) recommended for optimal performance. The gauge of the wire used determines the maximum distance between the 24VDC power sources. Wire rated 110°C or higher is required for installation.
- When using Modbus, power and signal must be separate shielded twisted pair conductors
- The IPES-IR4000 detector has a maximum power draw of 6VA/Watt in an active alarm state with all relays and optics heater active. (Fault, Alarm1) Select a power supply with adequate capability for the calculated load. Ensure that the 24VDC (+/-8VDC) power positive and common connections are from the same source

Detector Placement Consideration

1. Position the detector to provide an unobstructed view of the area to be protected. The detector's 120° viewing angle is most sensitive along the central axis; therefore, position the central axis so that it has the best unobstructed view of the place of probable fire. Use line of sight or laser level for more precise targeting.
2. Identify all high risk fire sources, to determine the number of detectors needed for adequate coverage.
3. Locate the detector(s) for ease of cleaning and servicing. Ensure that probable fire sources are within the detector(s) field of view and detection range.
4. When installing multiple detectors in the same area, be aware of overlapping fields of view and detector hierarchy. Overlapping fields of view can be used to provide additional protection against false positives or false negatives, depending on the control system logic connected to the detectors.

   Note: To mitigate false positives, position the detector so that its field of view does not cover any areas outside the area of interest.
5. Mount the detector on a rigid surface which minimizes vibrations using the mounting hardware provided. It is recommended to use rubber bushings to further isolate the detector from vibrations.

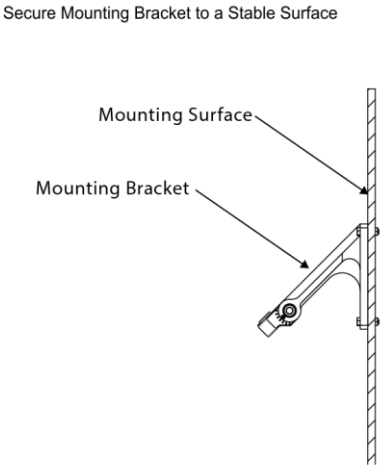
   Note: ESP Safety Inc. recommends bolting the mounting base plate to the mounting surface. If bolting is not possible, the mounting plate can be welded to the mounting surface if it is a similar metal (either 316 Stainless Steel or 6061 aluminum). Before welding, be sure to remove the detector from the base plate before attempting any weld operation.
6. Care should be taken to not install the detector where heavy condensate, rain, or fog can cover the lens and reduce the sensitivity of the detector.

Mounting and Wiring the IPES-4000

Tools Required

 Open End Wrench or Socket	 Hex Wrench	 Screwdriver	 Wire Stripper
32.5mm 17mm 10mm	8mm 4mm (Provided)	2.5 mm (flat) 1.5mm (Phillips)	

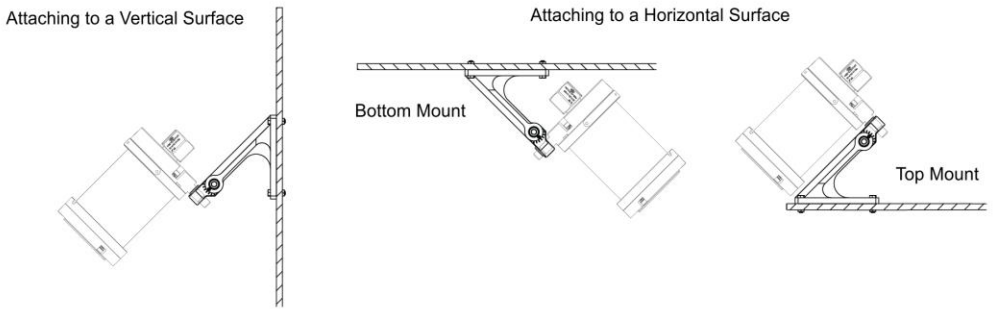
Mounting Instructions:



1. Secure mounting bracket to a stable surface using the ESP supplied hardware or user-furnished hardware. The bolt holes on the mounting bracket are sized for M6 bolts.

* The mounting bracket can be attached to a vertical or horizontal surface. Refer to Figure 4-1 below for mounting options

Figure 4-1: Mounting Options



Wiring:

Figure 4-2: IR-4000 Terminals

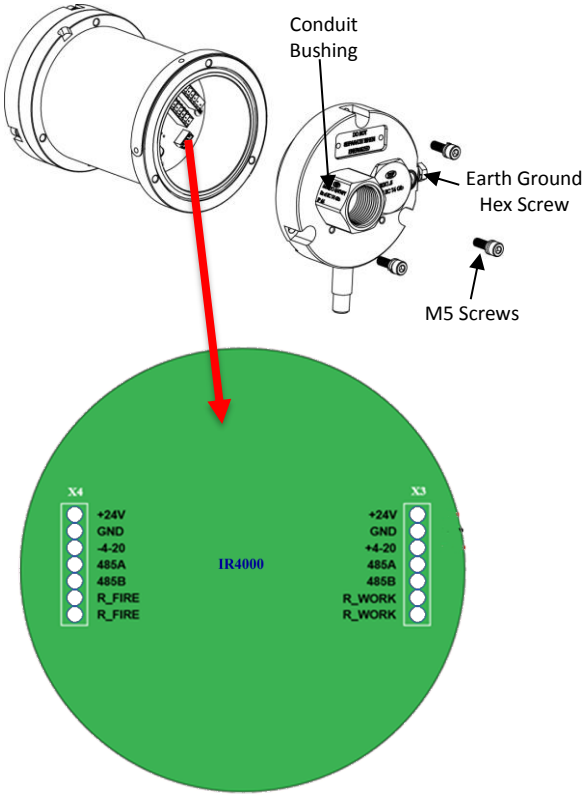


Table 4-1: Terminal Block Assignments

TB	Pin	Function
X3	+24V	24VDC from system power source (External User Provided)
	GND	System Ground from system power source (External User Provided)
	+4/20	Industry standard +4-20mA current loop output
	RS485A	RS-485 MODBUS
	RS485B	RS-485 MODBUS
	R_WORK R_WORK	Fault/Obstruction Relay Normally Closed (NC Type B) When Energized
X4	+24V	24VDC from system power source (External User Provided)
	GND (0V)	System Ground from system power source (External User Provided)
	+4/20	Industry standard +4-20mA current loop output
	RS485A	RS-485 MODBUS
	RS485B	RS-485 MODBUS
	R_FIRE R_FIRE	Alarm Relay Normally Open (NO Type A) When Energized

W1. Unscrew the M5 Socket Head Cap screws from the base. Separate the detector from the base.

W2. Run the power, control, and ground wires from the conduit into the conduit bushing and connect to the wiring terminals on the detector terminal board. Refer to Table 4-1 for terminal assignments.

W3. Note: There are different communication options. Appendix B provides detailed wiring diagrams on 4-20 mA Current Loop and HART interface. Appendix C provides detailed wiring diagrams on Digital RS-485 Circuit.Loosen the hex screw sufficiently to enable wrapping of the wire or wire terminated with a crimped lug around the thread in a “U” shape. Raise the flat and lock washers and position the wire between the 2 flat washers and ground base.

W4. Connect the earth ground wire {14 AWG copper (Stranded, or Solid) wire} to the external ground stud on the base. Tighten the hex screw.

*Note: Earth and System Grounds are separated to prevent ground loop potential plus maintain signal and current output integrity

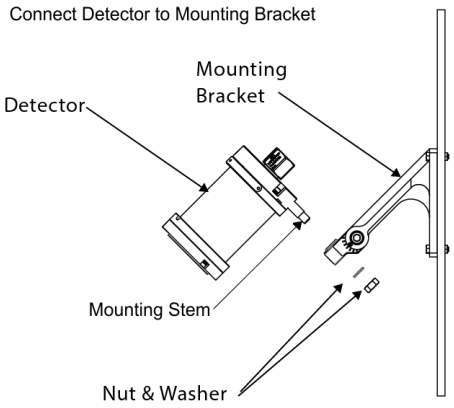
W5. Inspect the mating surfaces of the base and detector as well as the o-ring seal, ensuring that they are clean and free of debris. Reattach the detector to the base and evenly tighten the M5 screws to 40 in-lbs.

W6. Upon completing the installation, check the resistance of the earth ground lug to ground which should not exceed 1 ohm.

W7. Arrange the power-supply system so that the power-supply voltage across the device terminals ranges from 18 to 32 V (taking into account the IPES-IR4000 consumption).

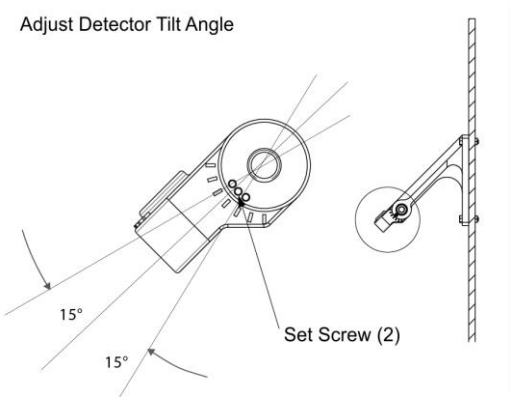
**External ground connection is optional for US and Canada Zones installations.*

**Note: Conduit bushing is not included in the evaluation of the detector with certification body.*



2. Connect the flame detector to the mounting bracket by inserting the mounting stem into the bracket receiver hole.

3. Secure the detector with the supplied flat washer and hex nut.



4. Adjust the detector tilt angle by first removing the set screws from the adjustment arm. There are two (2) set screws (one on each side)

5. Select one of the three pre-drilled angles. Once selected, re-insert and tighten the set screws.

Note:*The mounting bracket swivel bolts shall be tightened to at least 22 ft-lbs. (265 in-lbs.)

5.0 Startup and Operation

Installation Review Prior to Startup

Before applying power to the system for the first time, review the steps below:

- Verify that the IPES IR4000 has been properly mounted.
- Verify that all conduit / cable gland entries have been tightened and sealed if necessary.
- Verify that all sensor wiring has been installed correctly.
- Verify that the enclosure has been connected to an earth/ground.
- Verify that the IPES IR4000 cover is securely installed
- Disconnect or power down all output devices and alarms to prevent false actuation.

Once you are ready to begin startup, verify that the power supply is connected properly and verify the power supply voltage with the IPES IR4000 is disconnected at the source. The IPES IR4000 is powered by 24 VDC (18 to 32 VDC voltage range).

After completing the above, the IPES IR4000 is ready to be powered on.

Power-On Self-Test

After supplying power to the detector (24VDC +/-8VDC) the unit will perform a self-test procedure

1. When power is applied, the status indicator led lights up for 3 seconds in a solid yellow color. In three seconds, the status led will blink yellow for 7-8 seconds, after this, the self-testing of the device starts (three self-test lamps beneath the cantilevers of the optics window will flash three times).

    a. The ‘Working order' relay (R_WORK on the IPES-IR4000 X3 receptacle) will be open (Fault Indication) during portions of the initial self-test cycle.
    b. The analog +4 to 20mA output will be at 2.0mA indicating the IR4000 is in the power on mode

2. After the self-test, the LED will glow with a solid color depending on the test results: yellow-test failed, green-the device is operable

IPES-IR4000 in Self-Test Mode

After a successful test, the output signals of the IPES-IR4000 will be in the following states:

- Actuation (closure of contacts) of 'Fault relay, indicating a 'Working order' /operational condition.
- Indicator led has a solid green light, which corresponds to the 'Normal work'/operational mode of the detector as detailed in the above image.
- The +4-20mA analog output will be at (4±0,1) am (Operational Status)

Fire Detection Test

After installation is complete, conduct a fire detection test to ensure that the detector properly detects a fire condition.

An Test Lamp in conjunction with a magnetic Test collar are used to perform the test on the IPES-IR4000.

Fig 5-1: Placement of Magnetic Collar and Testing with Test Lamp

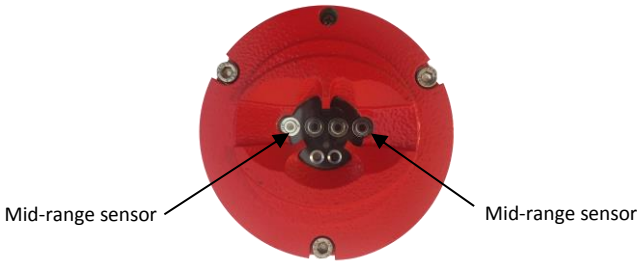
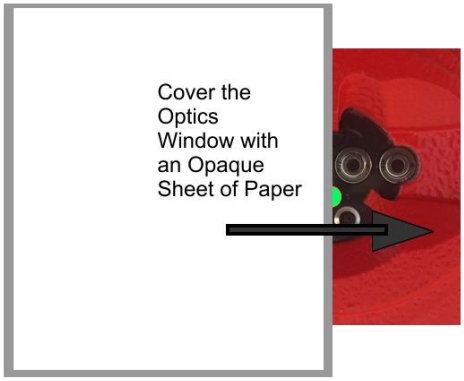


Fig 5-2: Target IR Sensor Locations

- Attach the Magnetic Collar with the Magnet placed into the slot on the enclosure. This will put the IPES-IR4000 into Fault Mode. The status LED will remain Green during this Test function.
- Point the laser beam at one of the two mid-range sensor 4.45 uM IR detector, the farthest left and right sensors. This will set the IPES-IR4000 into fire indication mode. The status indicator will now blink yellow-red indicating *both Fault and Fire conditions.*
- To prevent a false alarm during this test, the Fault relay will be actuated (In an open state) and the Fire relay will remain in a not active state (Open)
- The Analog +4 to 20mA will indicate 2mA for Test Mode
- Once testing is successfully completed, remove magnetic collar to return the IPES-IR4000 into operation.

Dust/ Obstruction Fault Test

Simulation of dust or obstruction on optical window of the IPES-IR4000 is done by placing a non-transparent material with good reflective properties (white sheet of paper) in front of the optical window of IR channel for 15-20 sec.



If the Dust/obstruction detection function is working properly, the FAULT Relay will activate (Open) and the status LED will alternate YELLOW-GREEN to indicate the fault.

When the obstruction is removed, the status indicator will return to the GREEN-Operational State and the Fault Relay will return to the normal closed state.

6.0 Troubleshooting

The sensor module ("front" half of the detector) contains no user-serviceable components and should never be opened. The terminal compartment is the only part of the enclosure that should be opened by the user in the field.

Troubleshooting Table

If testing reveals a Fault condition or failure to detect a flame, follow the troubleshooting procedures in the table below. The table describes a variety of possible failures and corrective actions.

If the troubleshooting procedures do not correct the problem, contact ESP Safety Inc.

Failure Symptoms	Possible Cause	Corrective Procedure
Red LEDs do not glow.	No power supply.	Detach the base with the cable entry from the IPES-IR4000 enclosure and make sure that the terminals are supplied with a voltage of 24±8 VDC.
Fault relay contacts are open; signaling LEDs blink frequently.*	Optical interference (dust)	Clean the IPES-IR4000 window with: • *Commercially available optical lens cleaning pads* • *Optical Lens Cleaning Solution and optical grade suede chamois* • *Flushing the surface with Isopropyl Alcohol* A clean soft cloth or cotton swab dampened with Isopropyl Alcohol. After wiping the

		surface with alcohol, wipe it again with a dry cloth in order to remove residual film.
IPES does not react to the test flame.	Optical interference (dust, or contaminated with substances) preventing passage of radiation to the detector.	Wipe the protection windows with a soft cloth wetted with denatured isopropyl alcohol (IPA) and then wipe with a clean dry cloth to remove any residue of dirt.

7.0 Maintenance

Disconnect or power down all output devices and alarms to prevent false actuation.

Maintenance Activities

IPES-IR4000 maintenance includes the following activities:

- Visual examination
- Cleaning
- Checking the grounding and explosion-protection systems
- Performance test

This section describes maintenance activities to be performed once a day or every six months. Automatic testing is also discussed.

Daily Maintenance

Visual Examination

Perform a daily examination of the IPES-IR4000, checking for any visible mechanical damage such as dents to the enclosure or a cracked lens. If any damage is noted, immediately pull the detector from service and replace with a new detector.

Every Six Months

Every six months, or as required, perform the following:

Cleaning

Clean the IPES-IR4000 every six months (if there is no visible severe contamination) or as required if the signal "Fault" arises; also clean the surface of the detector if it is covered with dust. To clean the detector:

- **Enclosure** - Remove dust from the enclosure with a brush or a soft cloth slightly wetted with denatured isopropyl alcohol (IPA). After wiping the surface with alcohol, wipe again with a clean dry cloth to remove any residual dirt.
- **Protection windows** – Clean with a soft cloth wetted with denatured isopropyl alcohol (IPA). After wiping the surface with alcohol, wipe again with a clean dry cloth to remove any residual dirt.

Grounding and Explosion-Protection Systems

Check to be sure that the joints are sufficiently tight. Thoroughly clean the external grounding wire and apply anti-seize lubricant (supplied by the manufacturer) on the critical joints

Perform this test on all detectors in the system.

1. Apply power to the detector. After 1 to 5 seconds, the output current will increase to 4 mA, and the indicating LEDs will start blinking.
2. If it is necessary to isolate the detector fire relay from the alarm system, apply the magnetic collar over the enclosure as shown in Figure 5-1. Placing the collar over the enclosure as shown allows the fire relay contacts to remain in the non-alarm state during testing.
3. Perform the test with the ITES Test Lamp per Section 5.0, Fire Detection Test

   If any detector fails this test, refer to Section 6.0, Troubleshooting.
4. Once testing is complete, remove the magnetic collar before reconnecting the detector to the fire-alarm or burglar-fire alarm system.

NOTES:

- Always make sure that the ITES Test Lamp has fresh batteries.
- Keep the Test Lamp lens free from dust, dirt, and moisture. If necessary, clean the lens with a soft wool or cotton cloth.

Automatic Testing

If the lens becomes dirty or coated, a change in radiation transmissibility could reduce the detector's sensitivity. To safeguard against this, the IPES-IR4000 continuously tests the lens for optical clarity and sends a Fault alarm when the radiation transmissibility reaches a critical threshold.

In addition, the sensors are routinely tested every 25 to 45 minutes by use of internal test lamps. If the IPES-IR4000 does not pass the self-test, a Fault alarm is sent. This routine test does not require the use of an external ITES Test Lamp.

8.0 Transportation and Storage

Transportation

When shipped in the factory-supplied carton, the model IPES-IR4000 can be shipped via any method of transportation from the manufacturer's site to any destination regardless of distance.

Storage

Until use, store the detector in the manufacturer's original carton. The storage facility should be free of dust, acid and alkaline vapors, corrosive gases and other harmful substances.

9.0 Warranties

ESP Safety, Inc. (“ESP”) warrants the IPES-IR4000 Flame Detector to be free from defects in material and workmanship under normal use and service for a period of five (5) years, beginning on the date of shipment to the buyer. This warranty extends only to the sale of new and unused products to the original buyer. ESP’s warranty obligation is limited, at ESP’s option, to refund of the purchase price, repair, or replacement of a defective product or a component thereof, to the extent that the product is properly returned to ESP within the warranty period.

This warranty does not include:

a) fuses, disposable batteries or the routine replacement of parts due to the normal wear and tear of the product arising from use;
b) any product or component which in ESP’s opinion, has been misused, altered, abused, tampered with, improperly maintained or used, neglected or otherwise damaged by accident or abnormal conditions of operation, handling or use, or to have deteriorated due to aging of any component made of rubber or any other elastomer; or
c) any damage or defect attributable to repair of the product by any person other than an authorized dealer, or the installation of unapproved parts on the product.

The obligations set forth in this warranty are conditional on:

a) proper storage, installation, calibration, use, maintenance and compliance with the product manual instructions and any other applicable recommendations of ESP;
b) the buyer promptly notifying ESP of any defect and, if required, promptly making the product available for correction. No goods shall be returned to ESP until receipt by buyer of shipping instructions from ESP. A return authorization number must be obtained from ESP prior to shipment; and
c) all warranty returns being shipped directly to ESP Safety, Inc.;
d) the right of ESP to require that the buyer provide proof of purchase such as the original invoice, bill of sale or packing slip to establish that the product is within the warranty period.

THE BUYER AGREES THAT THIS WARRANTY IS THE BUYER’S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ESP SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES. ESP WILL NOT BE LIABLE FOR LOSS OR DAMAGE OF ANY KIND CONNECTED TO THE USE OF ITS PRODUCTS OR FAILURE OF ITS PRODUCTS TO FUNCTION OR OPERATE PROPERLY. IN NO EVENT SHALL ESP’S LIABILITY HEREUNDER EXCEED THE PURCHASE PRICE ACTUALLY PAID BY THE BUYER FOR THE PRODUCT.

To the extent any provision of this warranty is held invalid or unenforceable by a court of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

10.0 Repair and Return

Field Repair

The IPES-IR4000 detector is not intended to be repaired in the field. If a problem should develop, refer to Section 8.0 Troubleshooting of this manual. If it is determined that the problem is caused by a manufacturing defect, please return the device to the factory for repair or replacement.

Return Material Authorization (RMA) Number

Contact ESP Safety Inc. at +1-408-886-9746 to obtain a Return Material Authorization (RMA) number. Please provide the following information during your call:

-Your Company Name
-Product Type
-Serial Number
-Date of Shipment
-Brief explanation of malfunction

Pack the unit properly to ensure that no shipping damage occurs and ship to:

ESP Safety, Inc.
555 North First Street
San Jose, CA 95112 USA

Write the RMA number on the front of the shipping carton

ESP Safety, Inc. recommends that an inventory of spare detectors be kept on hand to enable rapid field replacement and minimize downtime.

11.0 Parts Ordering Information

The following items for the IPES-IR4000 may be ordered:

1. Visor / Sun Shade, P/N 125-0005
2. Magnetic Collar, P/N 120-0006
3. Mounting Bolts (kit), P/N 125-0001
4. M20 to 3/4" NPT Adapter, P/N 420-0208
5. M20 Threaded Plug, P/N 420-0209
6. Mounting Bracket, P/N 125-0003
7. 4mm Hex Wrench, P/N 120-0077
8. IPES-IR4000 Flame Detector, P/N 100-0017-01

Please note that shipping charges will be added to your order.

Appendix A: Effect of Wire Size on Maximum Length

Power Cable Conductor Size

Wire size requirements are dependent upon power supply voltage and wire length. It is recommended that a single run of wire does not exceed 40 ohms of resistance from end to end; please see Table A-1 for maximum lengths of wire depending on gauge.

There are several possible methods to electrically connect an IPES-IR4000 that are determined by each user's application.

These can run from a single IPES-IR4000 running on 24VDC that is operating as an isolated device and is connected directly to a warning system of alarms and/or lights, or alternatively, to a network of devices that are connected in series that can provide any mix of RS-485 Modbus, +4 to 20 mA, and relays to separate devices.

Wire Gauge	Resistance per 1000 feet (Ω)	Resistance per 1000 meters (Ω)	Max Feet	Max Meters
22 AWG (0.326mm2)	16.1	52.7	2,450	750
20 AWG (0.518mm2)	10.2	33.2	3,950	1,200
18 AWG (0.823mm2)	6.4	20.9	6,250	1,900
16 AWG (1.31mm2)	4.0	13.2	10,000	3,050
14 AWG (2.08mm2)	2.5	8.28	15800	4820

Table A-1: Effect of wire size on maximum length

Appendix B: Wiring Diagram (+4-20mA)

+4 to 20 mA Current Loop

When using the current loop method of connection, the circuit is a point-to-point connection between a single IPES-IR4000 and a threshold detection device. In most cases the threshold device will provide the 24VDC power and will operate in a closed loop.

Refer to Table 2-4 Corresponding 4-20mA signal to Detector State for interpretation of 4-20 mA indications.

If 24VDC is from a common source, use of a connection bus-block is recommended to provide connect/disconnect capability without disruption to any other devices using the same power source.

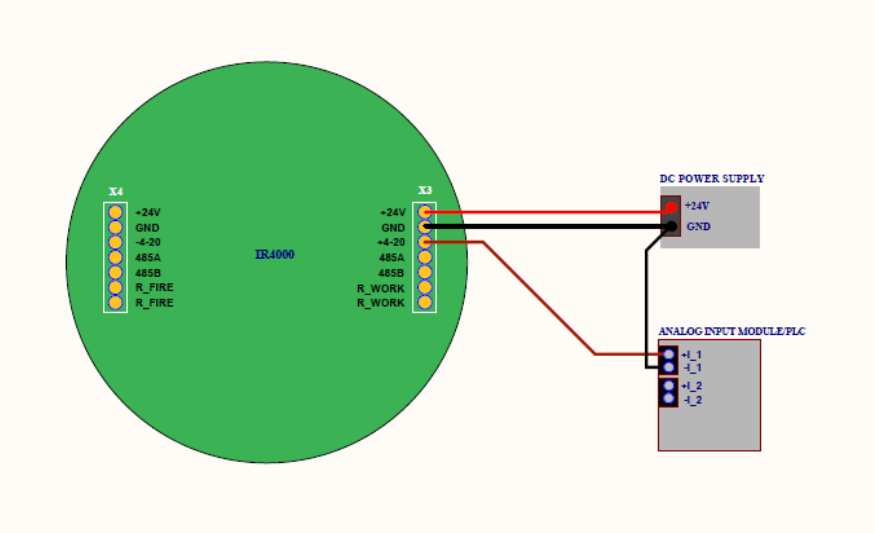


Figure B-1: IPES-IR4000 4-20mA to Analog Module/PLC (3-wire)

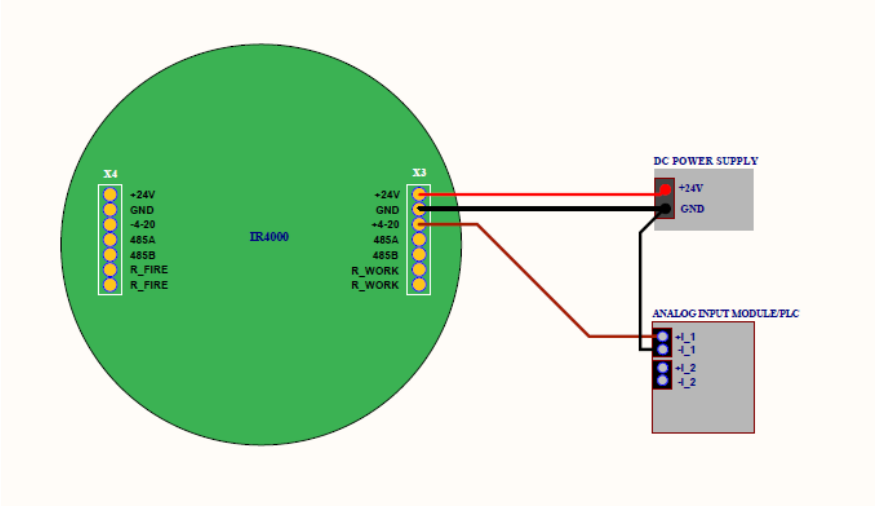


Figure B-2: IPES-IR4000 4-20mA to Analog Module/PLC (4-wire)

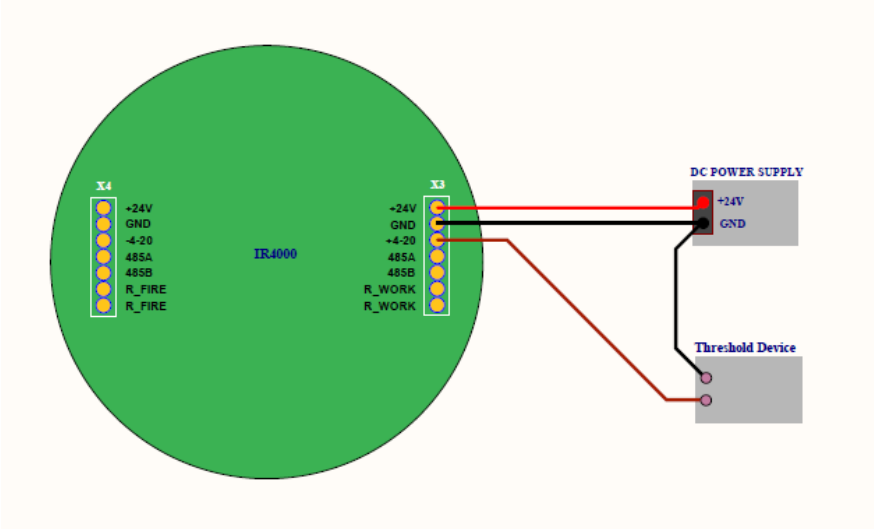


Figure B-3: IPES-IR4000 4-20mA to Threshold Device

IPES-IR4000 HART Interface

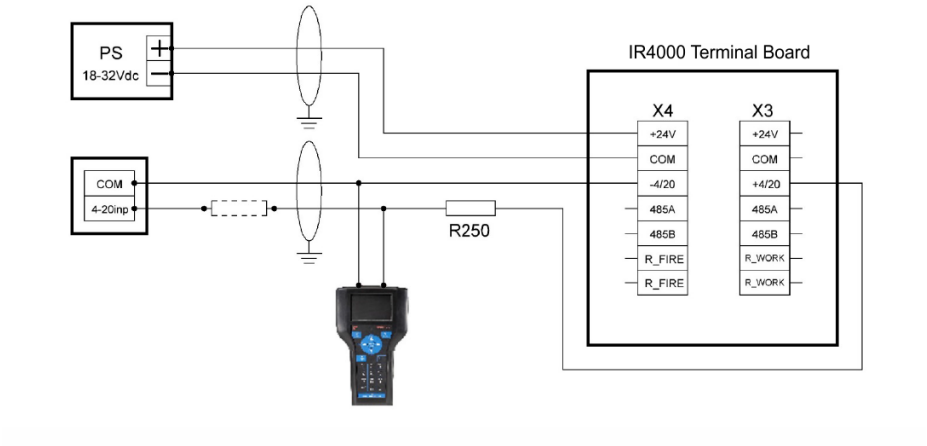


Figure B-4: IPES-IR4000 HART Interface w 4-20mA Current Loop

Appendix C: Wiring Diagram (RS-485)

Digital RS-485 Circuit

Setting the Modbus Address and Baud Rate

To ensure proper communications, a unique address must be assigned to each device, as duplicate addresses are not automatically detected. Modules with duplicate addresses will report with the same address, confusing latest updates. Record all addresses and device types after completing the installation.

When using an RS-485 bus connection, it is advisable to connect the IPES-IR4000 to the bus via the terminal box. To connect the detector to the terminal box, use a cable not longer than 1.64 feet (0.5 m). The cable characteristics should meet the requirement of the cable entries mounted on the IPES-IR4000 casing and those of the terminal box.

RS-485 connections should be used with a twisted pair of wire to prevent communication reflections

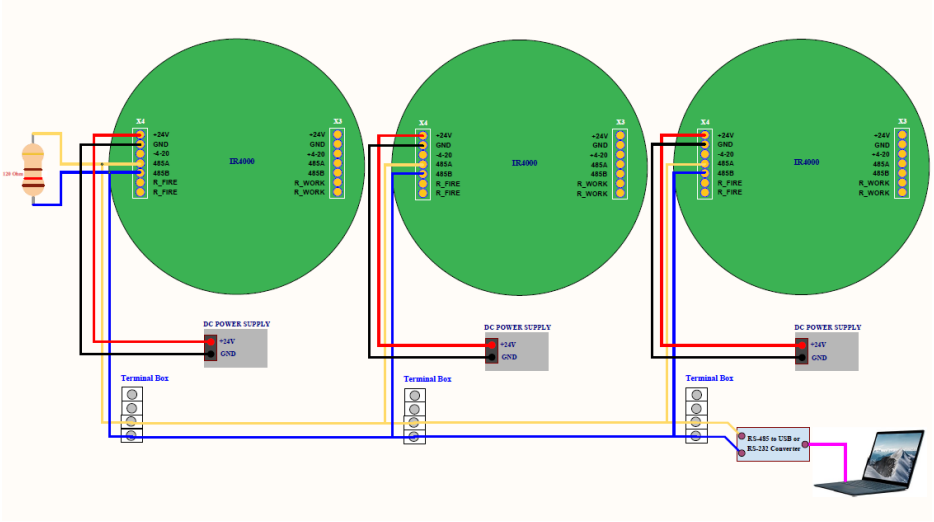


Figure C-1: IPES-IR4000 Connection to Digital RS-485 Circuit (Parallel Chain)

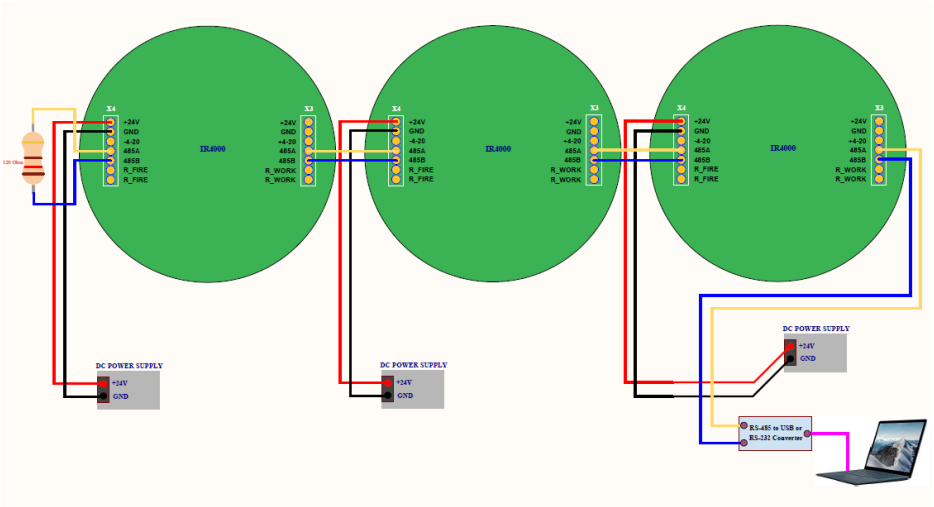


Figure C-2: IPES-IR4000 Connection to Digital RS-485 Circuit (Daisy Chain)

Appendix D: Modbus Protocol

IPES Commands

In addition to supporting analog signals (current loop and relays), IPES-IR4000 flame detectors are also capable of digital communications with remote consoles. IPES-IR4000 detectors use a standard RS-485 interface with a Modbus RTU protocol layer defining the transactions between the IPES-IR4000 and the console. Refer to the document "MODBUS APPLICATION PROTOCOL SPECIFICATION v1.1b" available online at www.modbus.org for complete details of the Modbus protocol.

Setting Address/ Baud Rate Command

The factory default Modbus address for the IPES-IR4000 is 247. The factory default baud rate for each detector is 9600.

The following 8-byte Modbus command must be sent to the IPES-IR4000 in order for the Modbus address and baud rate to be changed:

Set address/baud rate command	
Byte	Description
0	Current Modbus address (247 if IPES-IR4000 set to factory default)
1	6 (Modbus function code for writing to the device)
2	0
3	0
4	New Modbus address (must be in the range 1 to 247)
5	New baud rate (must be one of the following values): 1 – 1200 baud 2 – 2400 baud 4 – 4800 baud 8 – 9600 baud 16 – 19200 baud
6	Low byte of 16-bit CRC
7	High byte of 16-bit CRC

The Modbus address and baud rate are stored in non-volatile memory with a write endurance of 10000 erase-write cycles. Repeated transmission of the set address/baud rate command to the IPES-IR4000 detector can potentially degrade the memory beyond its ability to retain the data being written to it. The address and baud rate should be changed only when necessary to connect the IPES-IR4000 detector to a remote console.

The IPES-IR4000 will respond to the host by transmitting an identical packet to the host at the original baud that was used to receive the command. After the response has been transmitted, the IPES-IR4000 will change its Modbus address and baud rate to the ones specified in the command. At that point, the remote console must change its baud rate in order to communicate further with the detector. The new Modbus address and baud rate are stored in non-volatile memory and these parameters will be retained through power cycles.

Poll Status Command

The following 8-byte Modbus command may be sent in order to poll the status of the IPES-IR4000:

8-byte Modbus command	
Byte	Description
0	Current Modbus address (247 if IPES-IR4000 set to factory default.
1	4 (Modbus function code for reading from the device)
2	0
3	1
4	0
5	1
6	Low byte of 16-bit CRC
7	High byte of 16-bit CRC

The IPES-IR4000 responds with a 7-byte packet with the following format:

7 byte Poll Status Command	
Byte	Description
0	Current Modbus address
1	4 (Modbus function code for reading from the device)
2	2
3	Status: Bit 0: 1 = fast detection, 0 = slow detection Bit 1: 1 = high sensitivity, 0 = medium sensitivity Bit 2: 1 = latching on, 0 = latching off Bit 3: 1 = fire relay enable, 0 = fire relay disable Bit 4: 1 = fault relay enable, 0 = fault relay disable Bit 5: 1 = heater enable, 0 = heater disable Bit 6: 1 = very high sensitivity enable, 0 = very high sensitivity disable Bit7: not used
4	Detector status Bit 0: 1 = fire detected, 0 = no fire detected Bit 1: 1 = hardware fault, 0 = no hardware fault Bit 2: 1 = dust fault, 0 = no dust fault Bits 3-7: not used.
5	Low byte of 16-bit CRC
6	High byte of 16-bit CRC

Sending any commands other than the ones specified is not permitted.

Appendix E: Dimensional Drawing

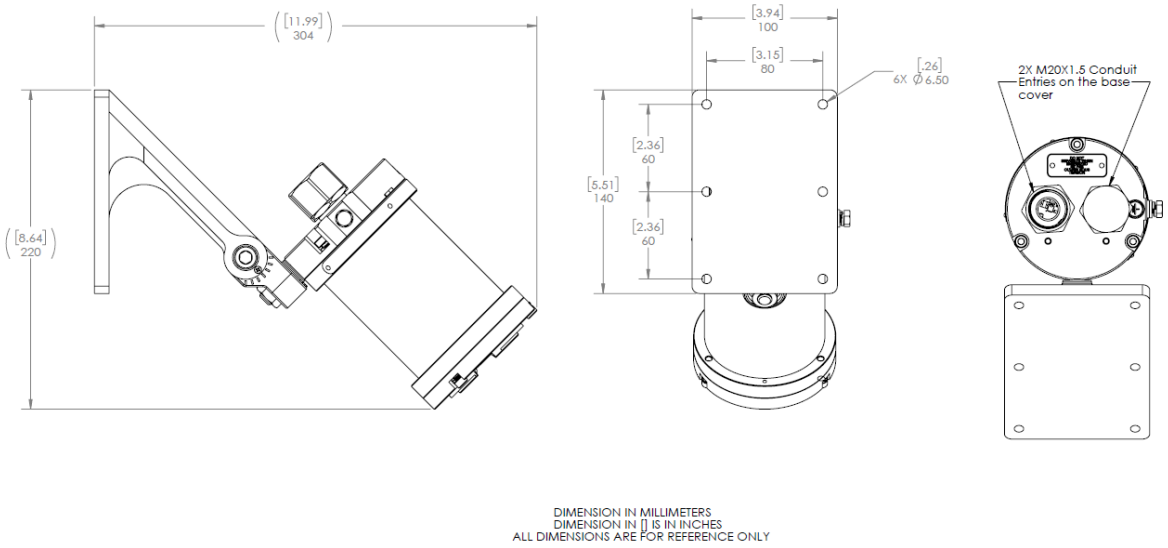


Figure E-1: IPES-IR4000 Connection Overall Dimension

Appendix F: IR4000 Name Label

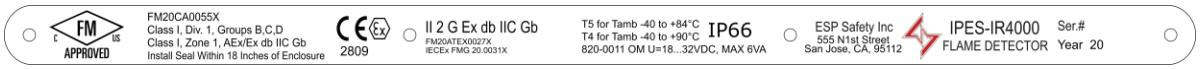


Figure F-1: IPES-IR4000 Name Label