



Ultima[®] OPIR-5

Infrared Open Path Detector for
Hydrocarbon Gas Applications



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Instruction Manual

06-14

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Part No.
Revision


MANOPIR5
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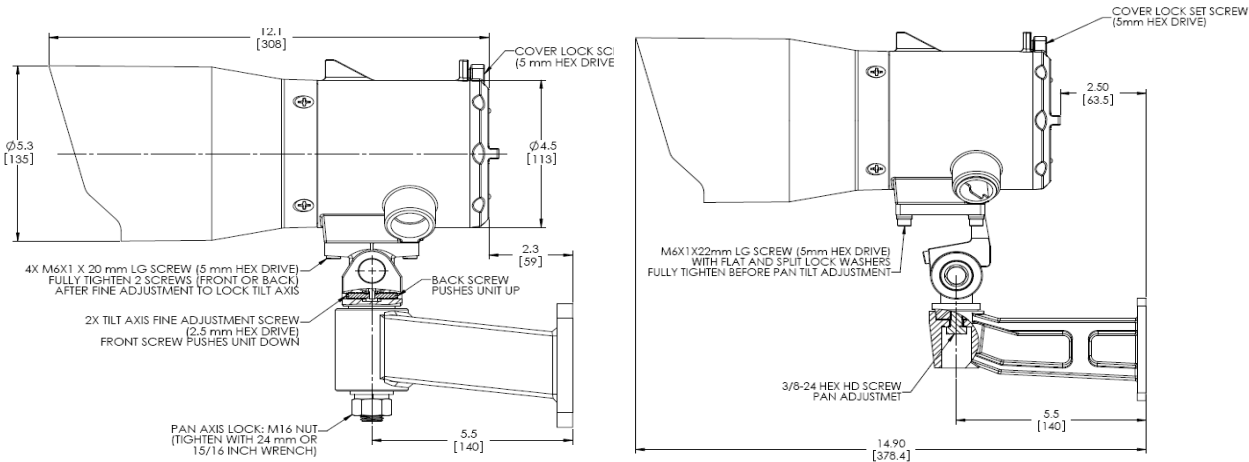
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Quick Start Guide

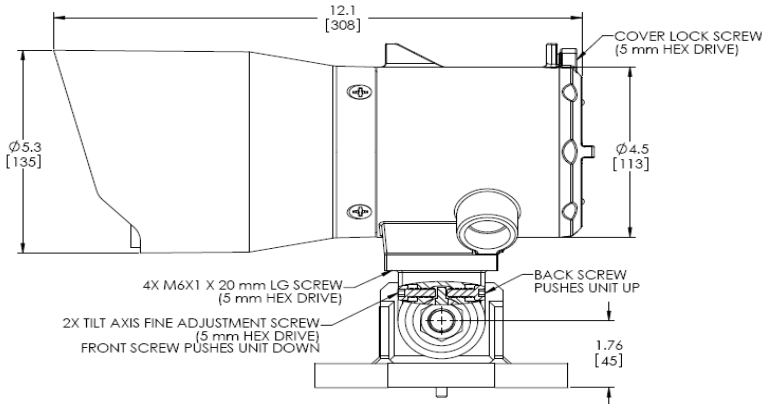
System Mounting

The Ultima OPIR-5 Detectors are shipped with either mounting assembly shown below. After the mounting location has been established, mount the support arm/base. Attach a pan-tilt assembly to each unit. Apply lithium grease on each taper joint before attaching a unit to a support arm/base. Add the supplied bolt and washers; do not tighten until unit is fully adjusted. If the bolt has been tightened and further adjustment is necessary, loosen the bolt two turns and use a screwdriver between the pan-tilt assembly and arm to release the taper.



Pan Tilt Arm Assembly with Fine Adjustments

Support Arm Assembly



Pan Tilt Base Assembly with Fine Adjustments

Conduit Sealing

Each conduit run from a hazardous to a non-hazardous location should be sealed so that gas or flames cannot pass from one electrical installation to another through the conduit system. A conduit seal must also be installed within 18 inches of the Source and Receiver enclosure if installed in a Division 1 location. A conduit seal may not be required if installed in a Division 2 location.

MSA requires the use of a drain loop or conduit seal in the conduit to prevent moisture from entering the unit housing. For installation in a Division 2 location using Division 2 wiring methods, a drain loop or conduit seal may not be required. Consult Article 501 of the NEC for details.



WARNING: The conduit entries should be sealed per the NEC 501.15 or Canadian Electrical Code Handbook (Part 1, Section 18-154) for Division 1 installations.

WARNING: Unused cable entry holes must be sealed with an approved explosion-proof stopping plug.



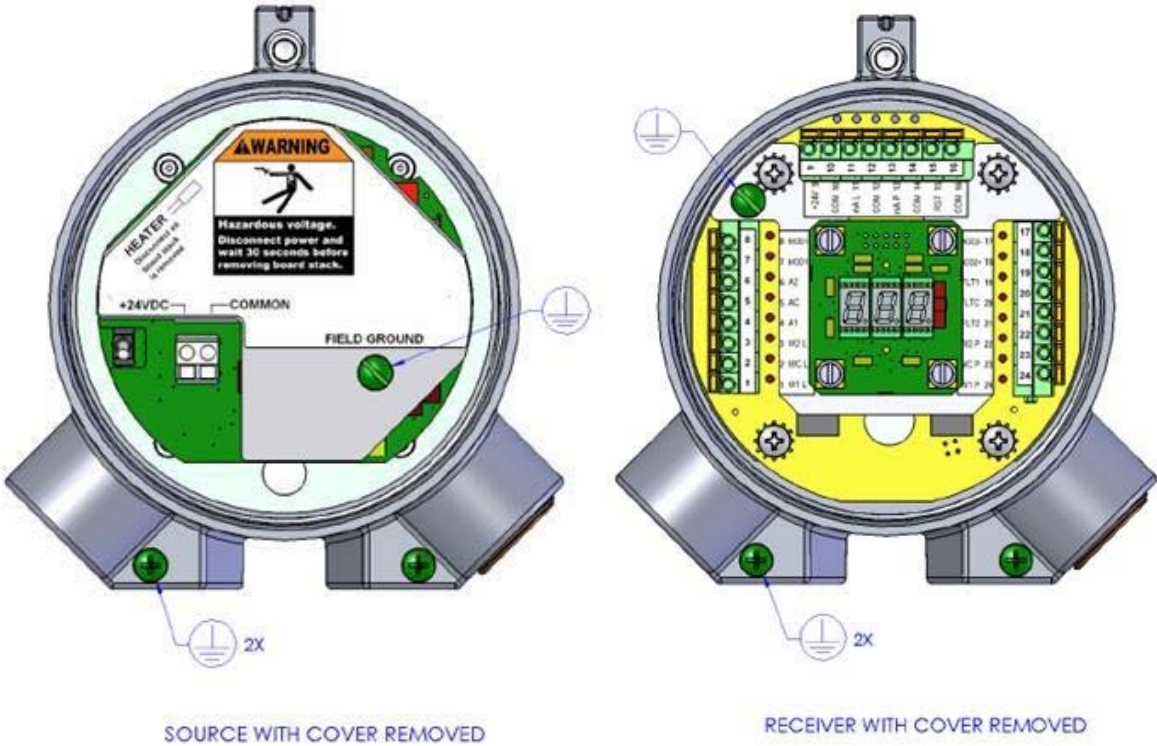
CAUTION: Acetic acid will damage metal components, hardware, and other components. If damage results from the use of a sealant that outgases acetic acid such as a room temperature vulcanizing sealant (RTV), the two-year warranty will be void.

CAUTION: Consult the manufacturer for dimensional information on the flameproof joints for repair.

Terminal Connections

To make the wiring connections to the Ultima OPIR-5 Detector, loosen the retaining screw on the cover of each unit using the supplied hex wrench and unscrew the rear cover. All output connections are made inside the housing (see figures on following page for terminal block locations). Recommended stripping length is 4/10" (10 mm) for push terminals, 1/2" (11 mm) for screw terminals.

NOTE: Contact with printed circuit board (PCB) components should be avoided to prevent damage by static electricity.



Ultima OPIR-5 Detector

9	10	11	12	13	14	15	16
+24V	COM	0-20mA L	COM	0-20mA P	COM	RST	COM

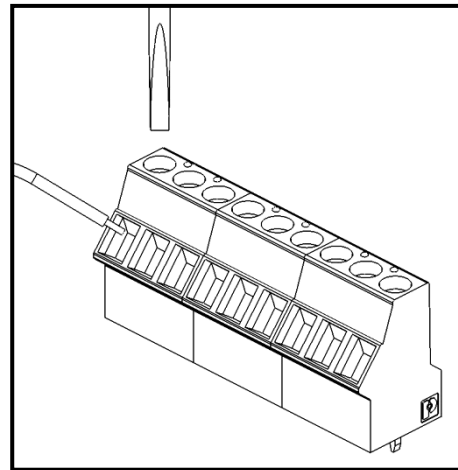
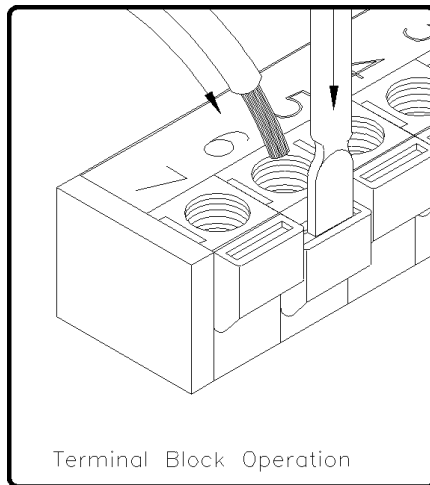
8	MOD1-	Modbus1-	
7	MOD1+	Modbus1+	
		Normally De-energized	Normally Energized
6	A2	Alarm NO	Alarm NC
5	AC	Alarm C	Alarm C
4	A1	Alarm NC	Alarm NO
3	W2 L	Warn LEL•m NO	Warn LEL•m NC
2	WC L	Warn LEL•m C	Warn LEL•m C
1	W1 L	Warn LEL•m NC	Warn LEL•m NO

	Modbus2-	MOD2-	17
	Modbus2+	MOD2+	18
	Normally Energized	Normally De-energized	
	Fault NO	Fault NO	FLT1 19
	Fault C	Fault C	FLTC 20
	Fault NC	Fault NC	FLT2 21
	Warn ppm•m NC	Warn ppm•m NO	W2 P 22
	Warn ppm•m C	Warn ppm•m C	WC P 23
	Warn ppm•m NO	Warn ppm•m NC	W1 P 24

Receiver Wiring Terminal Locations

Terminal Block Operation

To connect wiring to the terminal block, insert a screwdriver into the orange tab and press down, opening the terminal (see figure below). Insert the wire into the terminal and release the orange tab, clamping the wire in the terminal. Check the clamp by GENTLY tugging the wire to ensure it is locked in. Make sure that the terminal clamps on to the wire, not the insulation.



Terminal Block Operation Diagram

The push terminal block is designed to accept 24 AWG to 16 AWG (0.2 mm² to 1.5 mm²) stranded or solid-wire. The optional screw terminal block accepts 26 AWG to 14 AWG (0.14 mm² to 2.5 mm²) wire.

Primary DC voltage power must be provided by the customer. Since the Ultima OPIR-5 Detector is designed to continuously monitor for leaks of combustible gas, a power switch is not included to prevent accidental system shutdown. Power must remain disconnected until all other wiring connections are made.

Startup

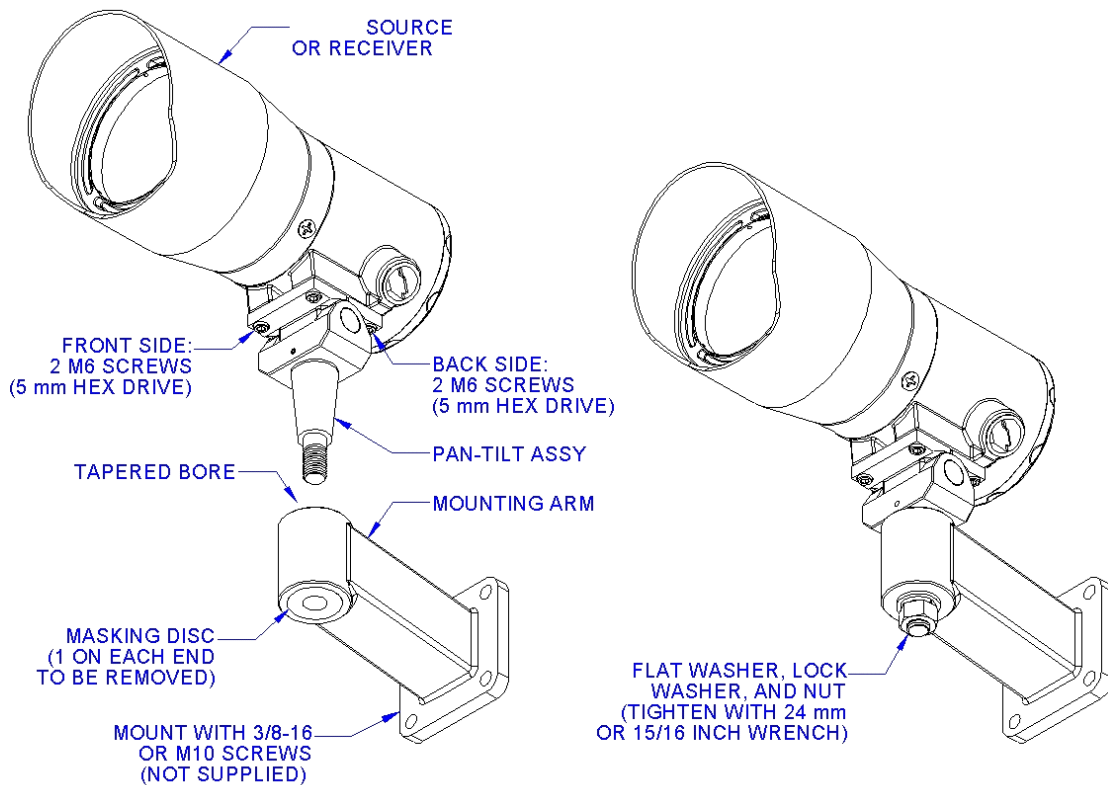
Before applying power to the system for the first time, all wiring connections should be checked and the housing cover securely fastened.

Display Sequence on Power Up

Display	Duration (s)
0 0 0	1
8.8.8. (Test all segments)	2
blank	3
Software revision letter	2
SU (Start Up)	120
0 (Gas Concentration)	Continuous

The Ultima OPIR-5 Detector contains a heater circuit to remove condensation from the windows. The unit should be allowed to stabilize for approximately two hours before continuing with the setup mode.

The resolution of the display is the either 0.1 LEL•m or 100 ppm•m. Since HART, Modbus, and 4-20 mA outputs have more resolution, the least significant digit of the displayed value might not agree with that of other outputs due to rounding error.



Alignment/Adjustment

Ensure that there is no significant amount of background gas when the unit is setting the zero value, as this will alter the Ultima OPIR-5 Detector performance. If there is gas present, try setting-up the Ultima OPIR-5 Detector on a breezy day, as this dissipates the gas.

1. It is recommended that two people are involved in aligning the Extended Range Unit. One person should be at the Source and one person should be at the Receiver. An alignment scope is helpful but not necessary. Otherwise follow the general Alignment and Adjustment instructions.
2. At the Source, check the four screws that hold the unit to the pan-tilt assembly. Verify that the back two screws have been tightened but that the front two have not. On the pan-tilt assembly, verify that the front and back fine adjust screws are flush with the assembly surface, to allow full movement of tilt. If necessary, use a 2.5 mm hex wrench to adjust the screws. Use the housing sights to aim the unit at the center of the Receiver. Align the notch and pin of the sights with the Receiver center.
3. At the Receiver, check the four screws that hold the unit to the pan-tilt assembly. Verify that the back two screws have been tightened but that the front two have not. On the pan-tilt assembly, verify that the front and back fine adjust screws are flush with the assembly surface. Use the housing sights to aim the unit at the center of the Source. Verify that the Receiver display is 0. Put the magnet on the upper right edge of the display. The display will change from 0 to rst, ---, SE, and AJ (Adjustment). Remove the magnet when AJ appears. The Receiver will display "A" with an AJ value from 0 to 99 or "]-[" if no Source signal is detected. Note that in 60 minutes, the alignment mode will time

Ultima OPIR-5 Detector

out and return to run mode. If this occurs, reapply the magnet and return to alignment mode.

4. At the Receiver, lightly tighten the front fine adjust screw until it bottoms out against the internal tilt lever. Slowly make a small turn to tighten the screw and lower the front of the Receiver. Wait a few seconds for the AJ number to settle. Continue making small turns, waiting after each turn for the AJ number to settle. Once the AJ number begins to decline, back out the front fine adjust screw until it is flush with the assembly surface. Lightly tighten the back fine adjust screw until it bottoms out, and then slowly make a small turn to further tighten it. Wait a few seconds for the AJ number to settle. Continue until the AJ reaches its maximum and begins to decline. Back out the back fine adjust screw.
5. Secure the two front mounting screws. Verify that AJ is reduced by 2 or less (increase of any amount is acceptable).
6. Adjust the Receiver pan for maximum AJ. Slowly tighten the nut at the bottom of the pan-tilt assembly while holding the left side of the Receiver. Verify that the AJ is reduced by 2 or less (increase of any amount is acceptable).
7. With the Receiver secure, verify that the AJ is comparable to typical values listed below.
8. At the Source, repeat steps 3 through 6 to adjust its position, while checking the AJ number at the Receiver.
9. With the Source secure, verify that the AJ is comparable to typical values listed below.

Range	20 m	30 m	40 m	50 m	60 m	70 m	80 m	90 m	100 m
AJ value	72 to 67	65 to 60	59 to 54	53 to 48	49 to 43	45 to 38	43 to 35	39 to 32	35 to 30

Typical AJ Values

10. At the Receiver, put the magnet on the upper right edge of the display to exit alignment mode. The unit will display a flashing AC and begin zeroing the gas reading. Once zeroing is complete, the unit will display gas concentration. System alignment is complete.

NOTE: The basic mounting arm offered by MSA to wall mount the system follows similar alignment instructions, with the difference being the lack of a fine adjust.

Response Test

After initial alignment, a test of the Ultima OPIR-5 Detector should be carried out using the test gas films for methane or propane (part numbers 329083-1 or 329084-1, respectively). Follow the instructions listed on the films.

1.0 Introduction

1.1 Protection for Life

MSA's mission is to benefit society by providing solutions through industry leading safety products, services, and systems that save lives and protect capital resources from the dangers of hazardous flames, gases, and vapors.

This manual provides instruction for installing and operating MSA's Ultima OPIR-5 Detector for combustible gas detection. It should be read in full and the information contained herein understood before attempting to place the system in service.

The safety products you have purchased should be handled carefully and installed, calibrated, and maintained in accordance with the respective product instruction manual. Remember these products are for your safety.

Special Warnings

The Ultima OPIR-5 Detector contains components which can be damaged by static electricity. Special care must be taken when wiring the system to ensure that only the connection points are touched.



WARNING: Toxic, combustible, and flammable gases and vapors are dangerous. Extreme caution should be used when these hazards are present.

Do not open when an explosive atmosphere is present.

Potential electrostatic charging hazard. Use only a damp cloth for cleaning.



CAUTION: Read and understand this instruction manual before operating or servicing the equipment.

Seal all conduits within 18 inches of enclosure.

Use wire suitable for 16°C above ambient for the Receiver and 32°C above ambient for the Source.



Figure 1: Ultima OPIR-5 Detector

1.2 Features and Benefits

The advantageous features and benefits of the Ultima OPIR-5 Detector include:

- **Performance certified:** only open path detector to meet multiple agency performance requirements on both the LEL•meter and ppm•meter scales.
- **Single detection beam:** eliminates drift and false alarms.
- **Dual detection ranges (ppm•meter & LEL•meter):** sensitive to low-level leaks.
- **Unitized design - digital readout, 4 relays and two 4 to 20 mA outputs:** wide variety of outputs.
- **Type 4X, IP66/IP67 weatherproof rating:** highly durable unit.
- **Fail-to-safe operation:** alerts user to fault in operation.
- **Automatic gain control:** compensates for dirty optics, rain, and fog.
- **Power supply input reversal protection:** protection against miswiring damage.
- **Dirty Window delay and Beam Block delay:** reduces maintenance and false alarms.

1.3 Applications

This is a partial list of applications suitable for the Ultima OPIR-5 Detector:

- **Compressor stations**
- **Drilling and production platforms**
- **Fence line monitoring**
- **Fuel loading facilities**
- **Gas turbines**
- **LNG/LPG processing and storage facilities**
- **Petrochemical plants**
- **Tank farms**
- **Wastewater treatment**

1.4 System Integrity Verification

Commissioning Safety Systems

Before power up, verify wiring, terminal connections and stability of mounting for all integral safety equipment including, but not limited to:

- **Power supplies**
- **Control modules**
- **Field detection devices**
- **Signaling or output devices**
- **Accessories connected to field and signaling devices**

After the initial application of power and any factory specified warm-up period to the safety system, verify that all signal outputs to and from devices and modules, are within the manufacturers' specifications. Initial alignment, alignment checking, and testing should be performed according to the manufacturers' recommendations and instructions.

Proper system operation should be verified by performing a full, functional test of all component devices of the safety system, ensuring that the proper levels of alarming occur. Fault detection should be verified.

Periodic Testing of Field Devices

Periodic testing or alignment should be performed per the manufacturers' recommendations and instructions. Testing and alignment procedures should include, but not be limited to:

- **Verify zero reading**
- **Verify gas reading by applying a Test Gas Film**
- **Verify integrity of all optical surfaces and devices**

When testing produces results outside of the manufacturers' specifications, repair, or replacement of the suspect device(s) should be performed as necessary. Test intervals should be independently established through a documented procedure, including a verification log maintained by plant personnel or third party testing services.

Periodic System Verification

The following system verifications should be performed at least annually:

- **Wiring, terminal connections and stability of mounting**
- **Proper system operation verified by performing a full, functional test of all component devices of the safety system, ensuring that the proper levels of alarming occur**
- **Fault circuit operation**

2.0 Product Description

2.1 General Description

The Ultima OPIR-5 Detector is a hydrocarbon gas detector (Figure 1). The system consists of a Source and a Receiver. Both units are calibrated at the factory and need no further alignment. The operation of the Ultima OPIR-5 Detector can be checked by placing a Test Gas Film in front of the Receiver. The system requires only a periodic cleaning of the windows to assure dependable performance, and is recommended prior to zero check, test gas, and optical integrity testing. The Ultima OPIR-5 Detector continuously monitors hydrocarbon gases. The gas detection range of a Receiver calibrated for methane is 0 to 5,000 ppm•meter and 0 to 5 LEL•meter while that for propane it is 0 to 2,000 ppm•meter and 0 to 1 LEL•meter. The Receiver provides two 4 to 20 mA analog signals, one proportional to ppm•meter and the other to LEL•meter. Alarm and Fault relays, split range (A/O-ppm), Modbus, and HART outputs are optional.

The Ultima OPIR-5 Detector is easily aligned using the digital display and adjustable mounting arms, therefore does not require any bulky setup equipment such as digital volt meters and handheld alignment aids. For setups that require the distance from the Source to the Receiver to be greater than 100 meters, MSA offers an optical alignment scope that makes the initial alignment easier.

2.1.1 Infrared Detection Principles

Most gases absorb infrared radiation. Hydrocarbon gases absorb infrared radiation at specific wavelengths but with different degrees of absorption. Absorption of the radiation follows the Beer-Lambert Law, which states that the transmittance (T) of radiation through an absorbing medium decreases exponentially by the product of the absorption coefficient (A), the concentration (C), and the path length (L):

$$T = \exp(-ACL)$$

Here T_0 is the transmittance of light containing no absorbing medium.

2.1.2 Ultima OPIR-5 Detection Method

The Ultima OPIR-5 Detector uses a single beam, dual wavelength method of infrared absorption detection. The gas absorbs one wavelength but not the other, which is the reference wavelength. By comparing the signals from these two wavelengths, the detector measures gas concentration. The reference wavelength is chosen to compensate for interferences that can otherwise occur from atmospheric variation, such as humidity, rain, dust, snow, fog, steam, and temperature. This method of detection comes under what is commonly known as the non-dispersive infrared (NDIR) absorption principle.

NOTE: Extremely dense fog, steam or interruption of the beam by an object or person may cause a system fault

2.1.3 Measurement Scale

With the Ultima OPIR-5 Detector, as there is no fixed path length, the reading is reported in concentration meter. The Ultima OPIR-5 Detector reports

concentrations in the ppm•meter range (highly sensitive to low levels of hydrocarbons) and the LEL•meter range (large hazardous levels of hydrocarbons). The Ultima OPIR-5 Detector display is auto-ranging. In general, an open path monitor can give similar responses to large, low concentration gas clouds and small, high concentration gas clouds as shown below. The Alarm setpoint should be equal to or less than the reading for a gas concentration of 60% LEL at the target gas cloud length.

Typical gas cloud configuration:

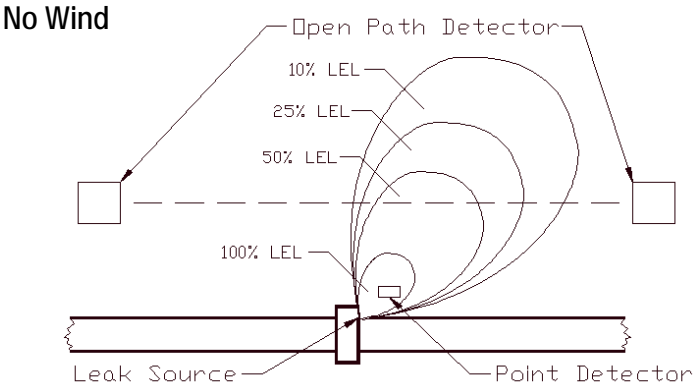


Figure 2: Indoor Gas Cloud

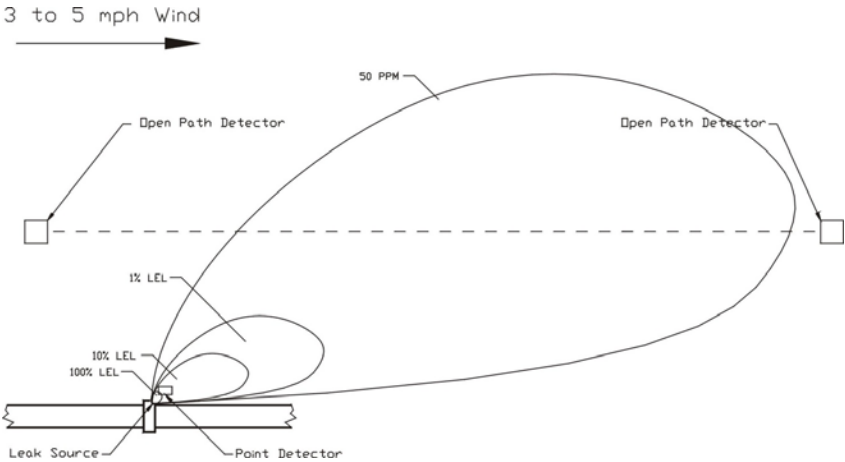


Figure 3: Outdoor Gas Cloud

2.1.4 Typical System Gas Cloud Measurements

Example readings of methane gas clouds by the standard Ultima OPIR-5 Detector are:

Size of gas cloud	Ultima OPIR-5 Display
50 ppm x 2 meters	100 ppm•meter
25 ppm x 4 meters	100 ppm•meter
10 ppm x 10 meters	100 ppm•meter
100 ppm x 5 meters	500 ppm•meter
50 ppm x 10 meters	500 ppm•meter
500 ppm x 5 meters	2500 ppm•meter
100 ppm x 25 meters	2500 ppm•meter
5% LEL x 1 meter	2500 ppm•meter
1% LEL x 5 meters	2500 ppm•meter
.5% LEL x 10 meters	2500 ppm•meter

Table 1: Readings of Methane Gas Clouds 0-5000 ppm•meter Range

Size of Gas Clouds	Ultima OPIR-5 Display
20% LEL x 1 meter	0.2 LEL•meter
10% LEL x 2 meters	0.2 LEL•meter
100% LEL x 2½ meters	2.5 LEL•meter
50% LEL x 5 meters	2.5 LEL•meter
100% LEL x 1 meter	1.0 LEL•meter
50% LEL x 2 meters	1.0 LEL•meter
25% LEL x 4 meters	1.0 LEL•meter
10% LEL x 10 meters	1.0 LEL•meter

Table 2: Readings of Methane Gas Clouds 0-5 LEL•meter Range

2.1.5 Control Electronics

Both the Ultima OPIR-5 Detector Source and Receiver units operate from a 24 VDC input. This unregulated 24 VDC is fed to on-board power supplies that produce all necessary voltages for the Ultima OPIR-5 Detector Source and Receiver.

In normal operation, the microprocessor program constantly monitors the two infrared wavelengths and performs mathematical operations on this information in conjunction with values obtained during the factory calibration process.

The microprocessor derives output information and feeds it to the digital to analog converter to produce two 4 to 20 milliampere (mA) signals that are proportional to the 0 to 5,000 ppm•meter and 0 to 5 LEL•meter for the methane sensing unit and 0 to 2,000 ppm•meter and 0 to 1 LEL•meter for the propane unit. The 4-20 mA signal is converted to gas concentration in % of full scale using the formula $[(\text{Analog Output} - 4)/16] * (100\% \text{ full scale})$, where Analog Output is the 4-20 mA signal.

The microprocessor program also monitors aspects of system operation such as supply voltage and optical path integrity.

3.0 Installation

3.1 Receipt of Equipment

Original shipping containers should be kept for future shipping or storage needs.

Shipping container contents should be carefully removed and checked against the packing list. If any damage has occurred or there is any discrepancy in the order, please notify MSA as soon as possible. All correspondence with MSA must specify the equipment part number and the serial number.

Each unit is tested by the factory; however, a complete system checkout is suggested upon initial installation to ensure system integrity.

3.2 Location Considerations

There are no standard rules for placement, since the optimum location varies with each application.

Some factors to consider when selecting locations are as follows:

- The system should be accessible for occasional response checks.
- The Receiver should be mounted so that the display is visible to aid in alignment.
- Do not mount near strong magnetic fields as degradation of performance may result.
- The line of sight between the Source and Receiver should be free from obstructions such as:
 - a parked truck or moveable machinery
 - frequent human or animal crossings
- Although the Source and Receiver are designed to resist radio frequency interferences, they should not be mounted close to radio sources or similar equipment.
- Mount the Receiver unit so that direct sunlight does not enter the front window.
- Locate the units away from concentrated sources of heat.
- Mount away from sources of excessive vibration and away from high voltage/high current power lines.
- If the path length is less than 20 meters (65 feet), a Source with an attenuation plate is required.

3.3 System Mounting

The Ultima OPIR-5 Detectors are shipped with either mounting assembly shown in Figure 4. After the mounting location has been established, mount the support arm/base. Attach a pan-tilt assembly to each unit. Apply lithium grease on each taper joint before attaching a unit to a support arm/base. Add the supplied bolt and washers; do not tighten until unit is fully adjusted. If the bolt has been tightened and further adjustment is necessary, loosen the bolt two turns and use a screwdriver between the pan-tilt assembly and arm to release the taper.

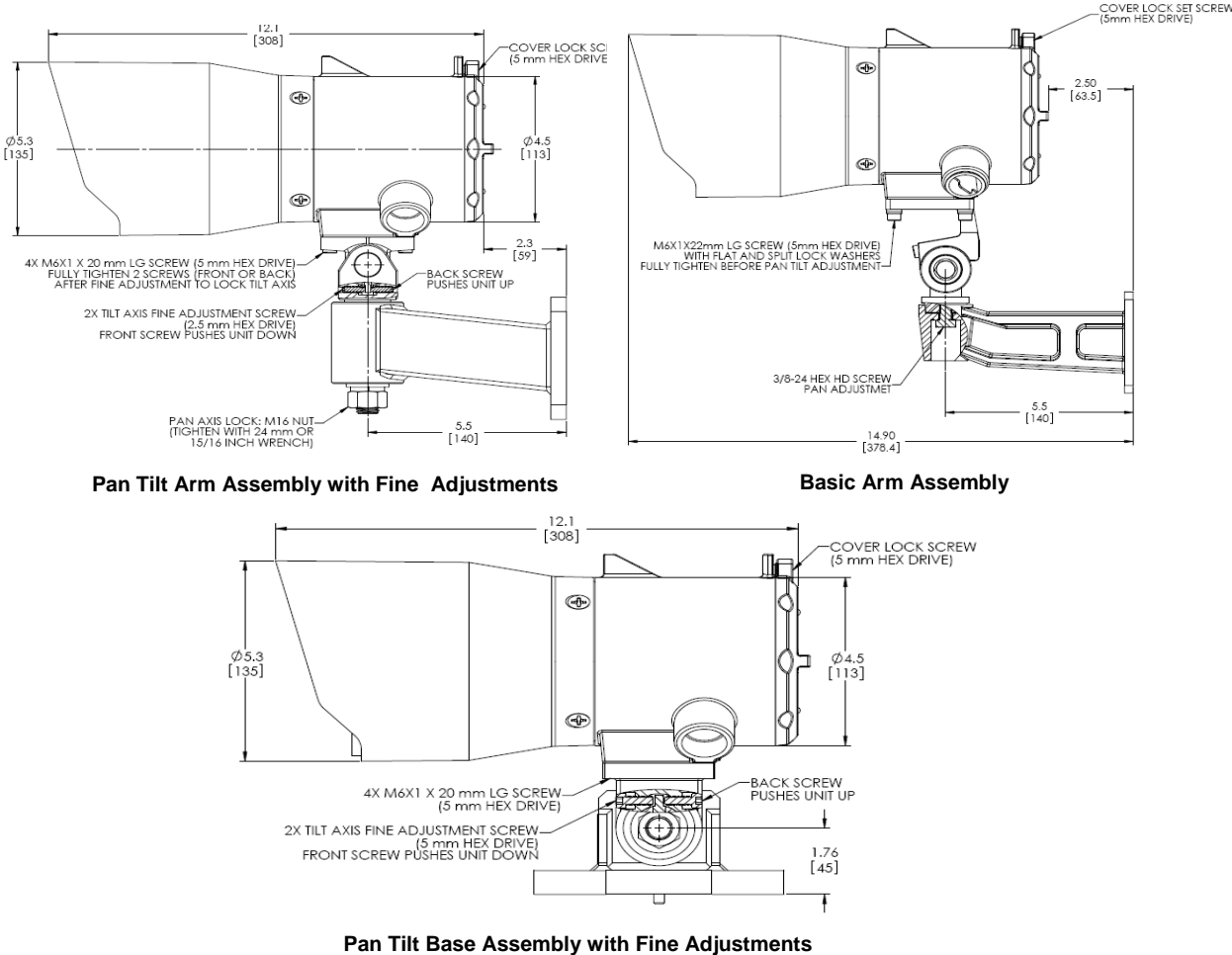


Figure 4: Outline and Dimensional Drawing

3.4 Installation

1. If necessary, remove the pan-tilt assembly from the arm. To do so, unscrew the 24 mm nut from the bottom of the pan-tilt. Remove the lock washer and flat washer. Put the washers and the nut in a secure place.
2. Put the source or the receiver unit on a work surface with the 4 mounting holes facing up. Align the 4 mounting holes of the pan-tilt assembly with those on the unit. Verify that the gap in the mounting surface of the pan-tilt assembly is across the unit rather than from front to back. Install the 4 screws without tightening the front two. Tighten the back two screws.
3. Mount the unit and pan-tilt assembly on the arm. Install the washer, the lock washer, and the 24mm nut to the bottom of the pan-tilt assembly, without tightening the nut.
4. Verify that the front and back fine adjust screws for tilt are flush with the assembly surface, to allow full movement of tilt. If necessary, use a 2.5 mm hex wrench to adjust the screws.

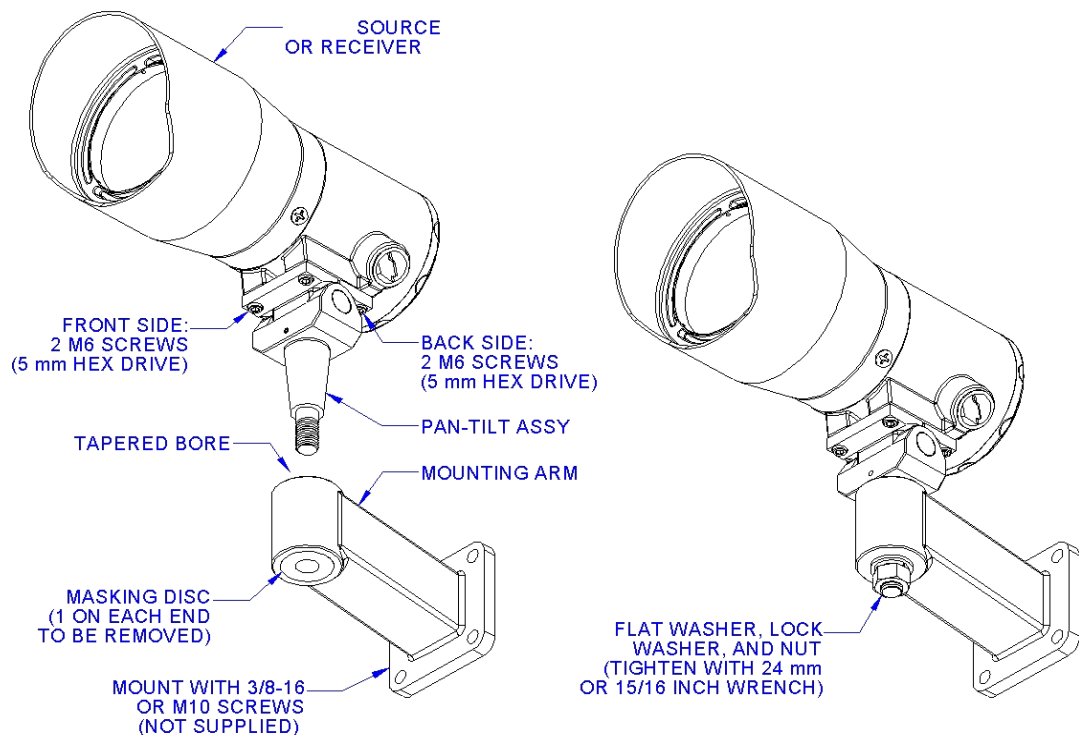


Figure 5: Installing onto the Mounting Arm

NOTE: The basic mounting arm offered by MSA to wall mount the system follows similar alignment instructions, with the difference being the lack of a fine adjust.

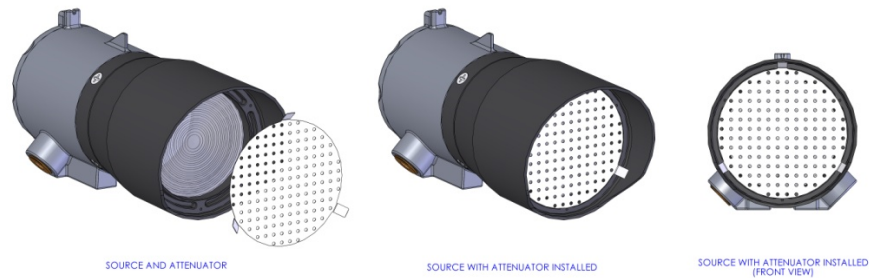


Figure 6: Ultima OPIR-5 Source with Attenuator (P/N 329113-1)

Attenuator P/N 329113-1 must be installed on the Source when the path length is 5 to 30 meters. Bend the three tabs on the Attenuator if necessary so that they firmly engage the inside diameter of the Source Nosecone. The Attenuator should be seated flush against the Lens Assembly inside the Nosecone.

3.5 Conduit Sealing

Each conduit run from a hazardous to a non-hazardous location should be sealed so that gas or flames cannot pass from one electrical installation to another through the conduit system. A conduit seal must also be installed within 18 inches of the Source and Receiver enclosure if installed in a Division 1 location. A conduit seal may not be required if installed in a Division 2 location.

MSA requires the use of a drain loop or conduit seal in the conduit to prevent moisture from entering the unit housing. For installation in a Division 2 location using Division 2 wiring methods, a drain loop or conduit seal may not be required. Consult Article 501 of the NEC for details.



WARNING: The conduit entries should be sealed per the NEC 501.15 or Canadian Electrical Code Handbook (Part 1, Section 18-154) for Division 1 installations.

WARNING: Unused cable entry holes must be sealed with an approved explosion-proof stopping plug.



CAUTION: Acetic acid will damage metal components, hardware, and other components. If damage results from the use of a sealant that outgases acetic acid such as a room temperature vulcanizing sealant (RTV), the two-year warranty will be void.

CAUTION: Consult the manufacturer for dimensional information on the flameproof joints for repair.

3.6 Terminal Connections

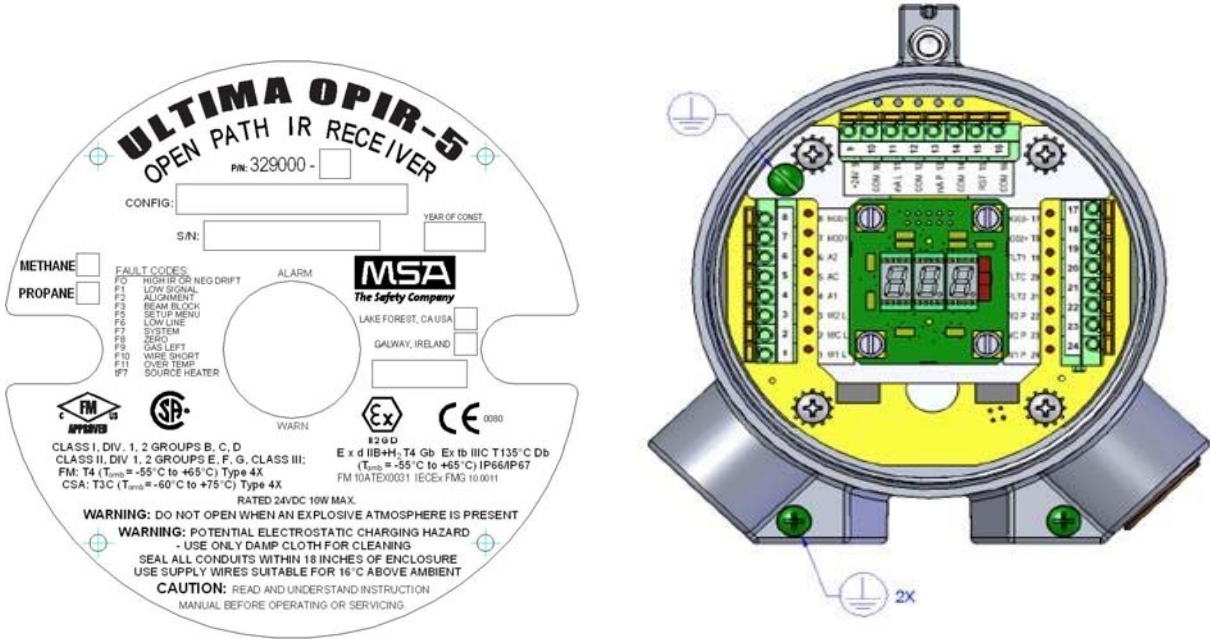
To make the wiring connections to the Ultima OPIR-5 Detector, loosen the retaining screw on the cover of each unit using the supplied hex wrench and unscrew the rear cover. All output connections are made inside the housing (see figures on following page for terminal block locations). Stripping length is 4/10" (10 mm) for push terminals, 1/2" (11 mm) for screw terminals.

NOTE: Contact with printed circuit board (PCB) components should be avoided to prevent damage by static electricity.



SOURCE WITH COVER REMOVED

Figure 7: Source Wiring



RECEIVER WITH COVER REMOVED

Figure 8: Receiver Wiring

9	10	11	12	13	14	15	16
+24V	COM	0-20mA L	COM	0-20mA P	COM	RST	COM

8	MOD1-	Modbus1-	
7	MOD1+	Modbus1+	
		Normally De-energized	Normally Energized
6	A2	Alarm NO	Alarm NC
5	AC	Alarm C	Alarm C
4	A1	Alarm NC	Alarm NO
3	W2 L	Warn LEL•m NO	Warn LEL•m NC
2	WC L	Warn LEL•m C	Warn LEL•m C
1	W1 L	Warn LEL•m NC	Warn LEL•m NO

	Modbus2-	MOD2-	17
	Modbus2+	MOD2+	18
	Normally Energized	Normally De-energized	
	Fault NO	Fault NO	19
	Fault C	Fault C	20
	Fault NC	Fault NC	21
	Warn ppm•m NC	Warn ppm•m NO	22
	Warn ppm•m C	Warn ppm•m C	23
	Warn ppm•m NO	Warn ppm•m NC	24

Table 3: Receiver Wiring Terminal Locations

3.6.1 Terminal Block Operation

To connect wiring to the terminal block, insert a screwdriver into the orange tab and press down, opening the terminal (see Figure 9 7). Insert the wire into the terminal and release the orange tab, clamping the wire in the terminal. Check the clamp by GENTLY tugging the wire to ensure it is locked in. Make sure that the terminal clamps on to the wire, not the insulation.

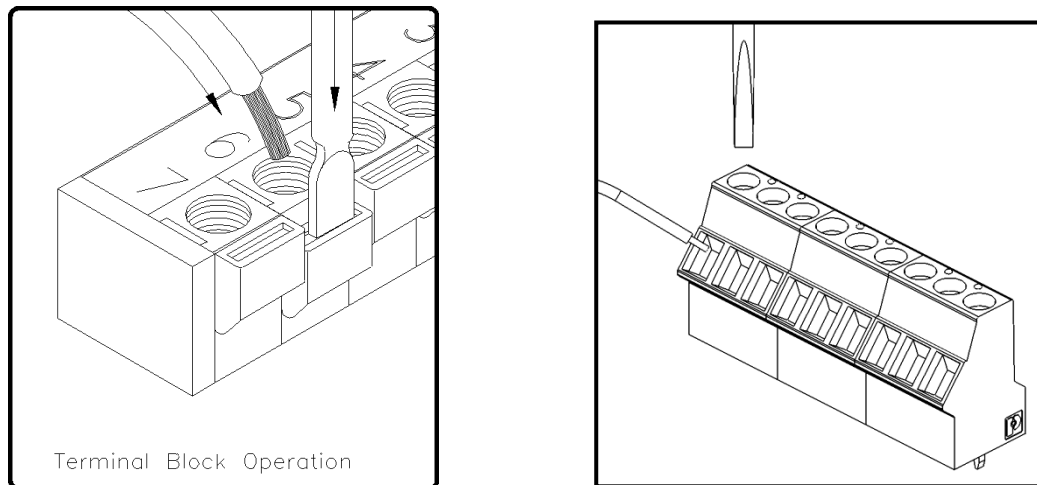


Figure 9: Terminal Block Operation Diagram

The push terminal block is designed to accept 24 AWG to 16 AWG (0.2 mm² to 1.5 mm²) stranded or solid-wire. The optional screw terminal block accepts 26 AWG to 14 AWG (0.14 mm² to 2.5 mm²) wire.

Primary DC voltage power must be provided by the customer. Since the Ultima OPIR-5 Detector is designed to continuously monitor for leaks of combustible gas, a power switch is not included to prevent accidental system shutdown. Power must remain disconnected until all other wiring connections are made.

3.6.2 Terminal Functions

Reset

The Ultima OPIR-5 Detector provides external Reset Switch terminations to allow remote resetting of the alarms. Connect each end of a normally open SPST momentary switch to RST and COM (refer to Table 3). To reset a latched relay, simply press and release the switch.

Relays

Inductive loads (bells, buzzers, and relays) on dry relay contacts must be clamped as shown in Figure 10 8. Unclamped inductive loads can generate voltage spikes in excess of 1,000 volts. Spikes of this magnitude may cause false alarms and contact damage.

NOTE: All relay states shown with power applied.

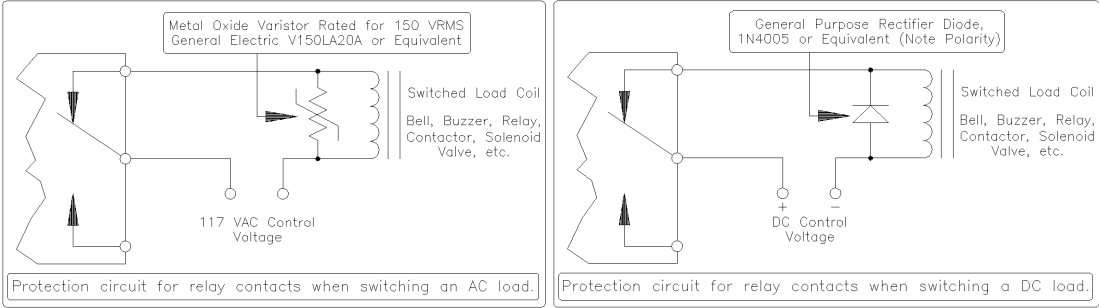


Figure 10: Relay Contact Protection for AC/DC Loads

3.7 Applying Power and Alignment

3.7.1 Start-Up Checklist

Prior to starting the system, perform the following steps:

- Inhibit any external devices, such as a trip amplifier, a PLC, or a DCS system.
- Verify that optional settings are correct.
- Verify that the unit is properly mounted. Ensure the conduit/cable gland entries are pointed downward.
- Verify that the signal wiring is correct.
- Verify that the power supply is connected properly. The Ultima OPIR-5 Detector is powered by +24 VDC.
- Make sure the cover is securely installed or the area has been declassified.

3.7.2 Startup

Before applying power to the system for the first time, all wiring connections should be checked and the housing cover securely fastened.

Display Sequence on Power Up

Display	Duration
0 0 0	1 second
8.8.8. (Test all segments)	2 seconds

blank	3 seconds
Software revision letter	2 seconds
SU (Start Up)	2 minutes
0 (Gas Concentration)	Ongoing

The Ultima OPIR-5 Detector contains a heater circuit to remove condensation from the windows. The unit should be allowed to stabilize for approximately two hours before continuing with the setup mode.

The resolution of the display is the either 0.1 LEL•m or 100 ppm•m. Since HART, Modbus, and 4-20 mA outputs have more resolution, the least significant digit of the displayed value might not agree with that of other outputs.

3.7.3 Alignment and Adjustment

Ensure that there is no significant amount of background gas when the unit is setting the zero value, as this will alter the Ultima OPIR-5 Detector's performance. If there is gas present, try setting-up the Ultima OPIR-5 Detector on a breezy day, as this dissipates the gas.

1. It is recommended that two people are involved in aligning the Extended Range Unit. One person should be at the Source and one person should be at the Receiver. An alignment scope is helpful but not necessary. Otherwise follow the general Alignment and Adjustment instructions.
2. At the Source, check the four screws that hold the unit to the pan-tilt assembly. Verify that the back two screws have been tightened but that the front two have not. On the pan-tilt assembly, verify that the front and back fine adjust screws are flush with the assembly surface, to allow full movement of tilt. If necessary, use a 2.5 mm hex wrench to adjust the screws. Use the housing sights to aim the unit at the center of the Receiver. Align the notch and pin of the sights with the Receiver center.
3. At the Receiver, check the four screws that hold the unit to the pan-tilt assembly. Verify that the back two screws have been tightened but that the front two have not. On the pan-tilt assembly, verify that the front and back fine adjust screws are flush with the assembly surface. Use the housing sights to aim the unit at the center of the Source. Verify that the Receiver display is 0. Put the magnet on the upper right edge of the display. The display will change from 0 to rst, ---, SE, and AJ (Adjustment). Remove the magnet when AJ appears. The Receiver will display "A" with an AJ value from 0 to 99 or "]-[" if no Source signal is detected. Note that in 60 minutes, the alignment mode will time out and return to run mode. If this occurs, reapply the magnet and return to alignment mode.
4. At the Receiver, lightly tighten the front fine adjust screw until it bottoms out against the internal tilt lever. Slowly make a small turn to tighten the screw and lower the front of the Receiver. Wait a few seconds for the AJ number to settle. Continue making small turns, waiting after each turn for the AJ number to settle. Once the AJ number begins to decline, back out the front fine adjust screw until it is flush with the assembly surface. Lightly tighten the back fine adjust screw until it bottoms out, and then slowly make a small turn to further tighten it. Wait a few seconds for the AJ number to settle. Continue until the AJ reaches its maximum and begins to decline. Back out the back fine adjust screw.

5. Secure the two front mounting screws. Verify that AJ is reduced by 2 or less (increase of any amount is acceptable).
6. Adjust the Receiver pan for maximum AJ. Slowly tighten the nut at the bottom of the pan-tilt assembly while holding the left side of the Receiver. Verify that the AJ is reduced by 2 or less (increase of any amount is acceptable).
7. With the Receiver secure, verify that the AJ is comparable to typical values listed below.
8. At the Source, repeat steps 3 through 6 to adjust its position, while checking the AJ number at the Receiver.
9. With the Source secure, verify that the AJ is comparable to typical values listed below.

Range	20 m	30 m	40 m	50 m	60 m	70 m	80 m	90 m	100 m
AJ value	72 to 67	65 to 60	59 to 54	53 to 48	49 to 43	45 to 38	43 to 35	39 to 32	35 to 30

Typical AJ Values

10. At the Receiver, put the magnet on the upper right edge of the display to exit alignment mode. The unit will display a flashing AC and begin zeroing the gas reading. Once zeroing is complete, the unit will display 0C, followed by the gas concentration. System alignment is complete.

NOTE: The basic arm assembly offered by MSA to wall mount the system follows similar alignment instructions, with the difference being the lack of a fine adjust.

3.7.4 Response Test

After initial alignment, a test of the Ultima OPIR-5 Detector should be carried out using the Test Gas Films for methane or propane (part numbers 329083-1 or 329084-1, respectively). Follow the instructions on the films.

3.7.5 Visible Light Filter

One of the OPIR-5 Detector's configurations is equipped with a visible light filter (Figure 11).

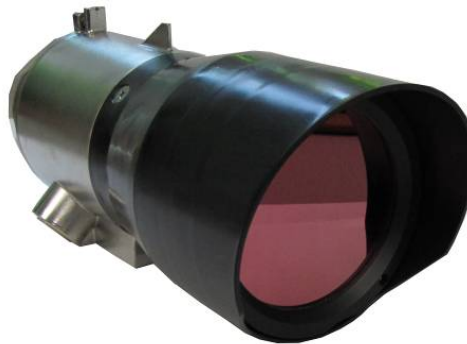


Figure 11: Ultima OPIR-5 Source with Visible Light Filter

Such configuration can prove useful in installations where an intermittent light beam is considered disruptive to surrounding operations. A visible light filter blocks light in the visible portion of the electromagnetic spectrum, allowing the instrument to detect and measure hydrocarbon gas concentrations without the attendant effects of flashing light.

OPIR-5 Detectors with a visible light filter should be installed as described in the installation section. The AJ numbers range advised in Section 3.7.3 (9) apply. Without the flashing light as a guide for alignment, users may need to use the Long Range Alignment Kit (P/N 329082-1) to establish orientation and positioning of the receiver and source. The kit is recommended for separations of 50 meters or more.

Visible light filters should not be removed from the OPIR-5 Detector. The filters are attached at the factory with a protective seal that prevents ingress of water or dust into the Source. If removed by accident, the Source should be returned to the factory for repair.

3.8 Operational Cautions



WARNING: During operation, the line of sight between the Source and the Receiver should be free from blockage caused by frequent human or animal crossings. The Ultima OPIR-5 Detector **will not** respond to gas leaks upon complete IR beam blockage. **Interruptions of the IR beam will delay the response time of this unit, and thus lead to a potentially unsafe situation.**

The Heavy Hydrocarbon version of the Ultima OPIR-5 Detector performs accurately and reliably for propane gas detection applications in extreme industrial environments. However, under certain conditions, the Heavy Hydrocarbon Ultima OPIR-5 Detector could give a beam block indication rather than a gas reading or alarm.

3.8.1 Rapid and Massive Liquid Propane Releases

A sudden release of a large amount of liquid propane can form very cold gas clouds due to cooling resulting from gas expansion and liquid propane evaporation. This is an intrinsic problem for all open path optical detection technologies. Installing the Ultima OPIR-5 at a distance of at least 10 meters from potential liquid propane leakage will reduce this problem.

3.8.2 Solutions to Guard against These Situations

- Use complementary point detectors at potential sources of leaks of high concentration liquid propane
- Use the beam block signal as an alarm. To reduce the number of false alarms due to an actual physical beam block, there are user selectable time delays. A signal will then be given if a beam block exceeds the specified time delay.

The ppm•m range of the Ultima OPIR-5 Detector should be used as a warning that there is a gas leak. This may allow action to take place before a leak reaches a hazardous level, while the LEL•m range should be used for a gas leak alarm.

NOTE: The Ultima OPIR-5 Detector will detect hydrocarbons other than methane and propane. Consult the manufacturer for details regarding sensitivity to these other hydrocarbons.

4.0 Operation

The Ultima OPIR-5 Detector front panel includes an LED digital display, Alarm and Warning LEDs, and displays a set of menu options that provide the user with the most flexible detector system possible. In addition to the Ultima OPIR-5 Detector menu options for operations and configuration tasks, there is an extensive set of Modbus and HART commands for the same tasks that can be sent from remote Modbus and HART devices in control room areas.

- The Ultima OPIR-5 Detector menu options are described in detail in this section.
- Modbus commands are described in a separate Modbus programming manual available for download from the MSA website.
- HART commands are described in the HART Field Device Specification available for download from the MSA website.

4.1 Using the Ultima OPIR-5 Detector Menus

The Ultima OPIR-5 Detector menus allow the user to complete many operational tasks.

- Start the alignment of the Source and Receiver or initiate a gas check via Test Gas Mode.
- Configure the % LEL required to generate a Warning or Alarm, as well as the warning and alarm relay settings for Energized/De-energized and Latching/Non-Latching,
- Configure Modbus or HART communication settings.
- Select mirror image option for display (FLP)
- Select delays for beam block fault

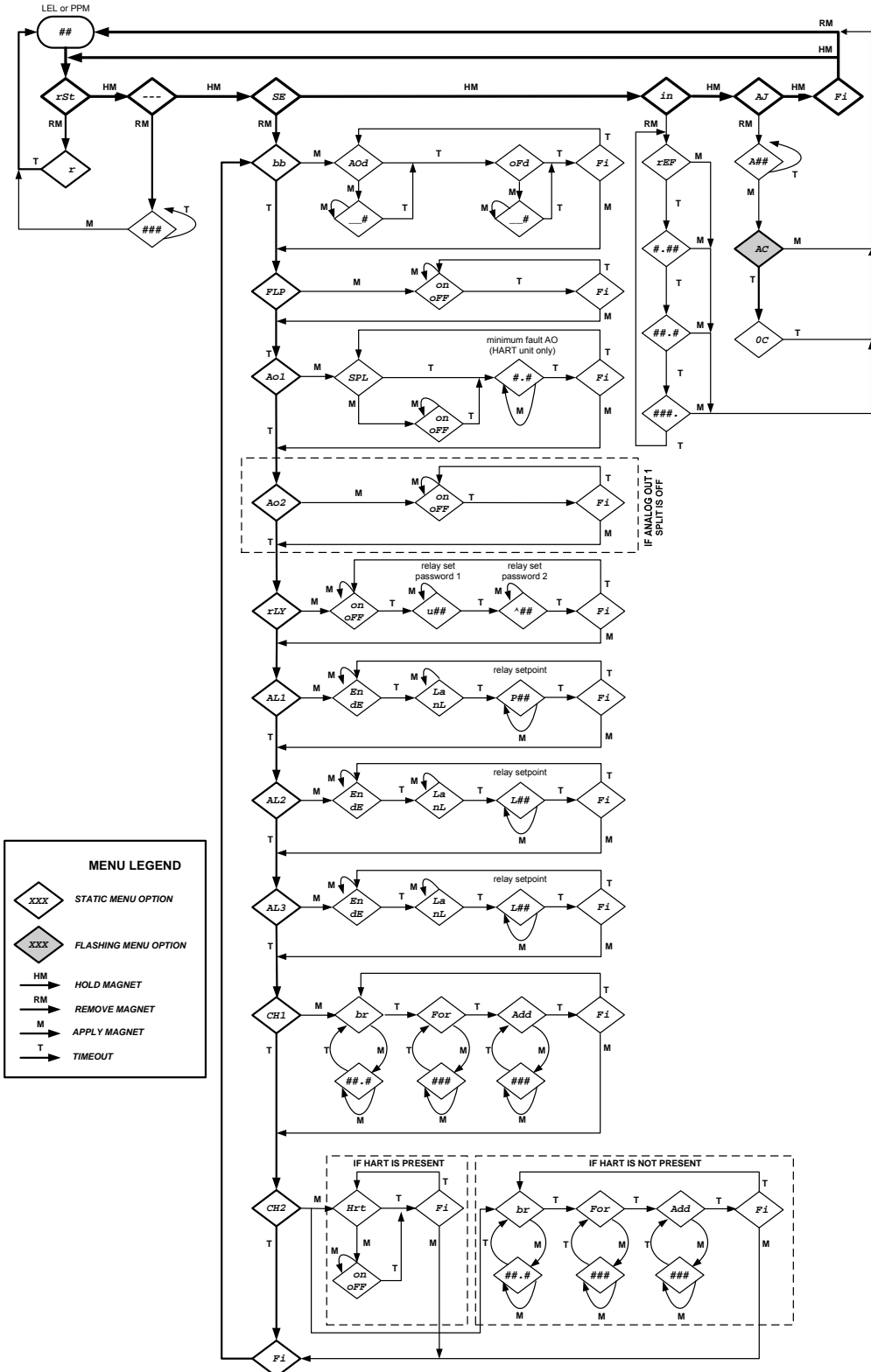


Figure 12: Ultima OPIR-5 Detector Menu Tree

4.2 Menu Options

The Ultima OPIR-5 Detector allows the user to reset, test, and align the system as well as configure Receiver outputs. To access the menu, place the magnet supplied with the Ultima OPIR-5 Detector over the MSA logo on the label of the Receiver for approximately five seconds. The display will cycle between the options. Remove the magnet to select an option. These options are:

“**rSt**” – Reset – Resets relays

“**---**” - Test

“**SE**” - Setup

“**AJ**” - Alignment/Adjustment

“**Fi**” - Finish, return to normal operation

4.3 Test “---”

Apply the magnet when the flashing bars are showing and the unit enters Test Mode. While the unit is in this mode the optical faults and relays will be inhibited, the analog output will drop from 4 mA to 1.5 mA and the display will flash.

This mode allows the user to check the Ultima OPIR-5 Detector response to a Test Gas Film without activating the relays and analog outputs. After verifying the response, remove the Test Gas Film. The unit will return to normal operation. If the Test Gas Film is not removed after 5 minutes, the unit will revert to a fault condition. If left in this mode for 5 minutes without a Test Gas Film, the unit will return to normal operation automatically.

To abort Test Mode before the gas has been applied, reapply the magnet and the unit will return to normal operation.

4.4 Setup “SE”

Apply the magnet when “**SE**” is showing and the unit enters Setup.

This mode allows the user to change various unit attributes. Following is the order in which the options are displayed (to change, apply magnet when the desired option is showing):

Fi - Exits the current option and goes on to next.

bb - Beam Block and High IR settings

- **AOd – 0, 1, 2...10, 15, 20, 25... 60** - Seconds before analog output changes to Beam Block level.
- **oFd – 0, 1, 2...10, 15, 20, 25...60** - Minutes before optical fault F3 appears and analog output changes to Fault level.

FLP – Flip display – on or off (To read display with a mirror)

Ao1 - Analog #1 (0-5,000 / 0-2,000 ppm•meter)

- **SPL – Split-Range - on or off**
- **(HART Only) 1.2 or 3.5 - mA signal fault level**

Ao2 - Analog #2 (0-5 / 0-1 LEL•meter) (Not available if Split-Range is on)

rLy – Relay

- **Password required to turn relays off: u19, ^61**

AL1 - Alarm Relay #1 (0-5,000 / 0-2,000 ppm•meter)

- **En** or **dE** - Energized or De-energized.
- **LA** or **nL** - Latching or Non-Latching.
- **2000** to **4500** - Alarm level, increments by 500 or
- **800** to **1800** - Alarm level, increments by 200.
(Value increments each time magnet is applied)

AL2 - Warn Relay #2 (0-5 / 0-1 LEL•meter)

- **En** or **dE** - Energized or De-energized.
- **LA** or **nL** - Latching or Non-Latching.
- **0.5 (0.1)** to **AL3** - Alarm level, increments by 0.5 (0.1).
(Value increments each time magnet is applied)

AL3 - Alarm Relay #3 (0-5 / 0-1 LEL•meter)

- **En** or **dE** - Energized or De-energized.
- **LA** or **nL** - Latching or Non-Latching. If this relay is set to “nL” (non-Latching), the Ultima OPIR-5 Detector must be connected to an auxiliary system which is able to provide the same function as a latching relay i.e. the alarm can only be reset manually.
- **AL2** to **4.5 (1.8)** - Alarm level, increments by 0.5 (0.1).
(Value increments each time magnet is applied)

CH1 – Channel 1 (Modbus)

- **br** – baud rate – **2.4, 4.8, 9.6, 19.2, or 38.4 kbps**
- **For** – Format – **8n1, 8E1, 8o1, or 8n2** – bits, parity (none, Even, odd), stop bits
- **Add** – Address

CH2 – Channel 2 HART or Modbus, depending on product configuration)

HART

- **on** or **off**

Modbus

- **br** – baud rate – **2.4, 4.8, 9.6, 19.2, or 38.4 kbps**
- **For** – Format – **8n1, 8E1, 8o1, or 8n2** – bits, parity (none, Even, odd), stop bits
- **Add** – Address

4.4.1 Setup Options Sheet

- SE** - Apply Magnet when this code is showing to enter Setup.
- bb** - Apply magnet when this code is showing to alter the options for Beam Block
- 5 to 60** - Select how many seconds before sending beam block fault _____
- 0 to 60** - Select minutes of beam block before sending optical fault _____

- 01** - Apply magnet when this code is showing to alter the options for Analog Output #1
- SPL (Split Range) on or oFf** - Select whether Split Range is on or off _____

- 02** - Apply magnet when this code is showing to alter the options for Analog Output #2
- on or oFf** – Select whether 0-5000 (0-2000) ppm•m range is available

- AL1** - Apply magnet when this code is showing to alter the options for Alarm Relay #1
- En or dE** - Select whether relay is Energized or De-energized _____
- LA or nL** - Select whether relay is Latching or Non-latching _____
- 2000 to 4500 (800 to 1800)** - Select where relay alarm level is set _____
(in ppm•m)

- AL2** - Apply magnet when this code is showing to alter the options for Warn Relay #2
- En or dE** - Select whether relay is Energized or De-energized _____
- LA or nL** - Select whether relay is Latching or Non-latching _____
- 0.5 (0.1) to A3 level** - Select where relay alarm level is set (in LEL•m) _____

- AL3** - Apply magnet when this code is showing to alter the options for Alarm Relay #3
- En or dE** - Select whether relay is Energized or De-energized _____
- LA or nL** - Select whether relay is Latching or Non-latching _____
- AL2 level to 4.5 (0.8)** - Select where relay alarm level is set (in LEL•m) _____

- Fi** - Saves changes and exits Setup.
- Fi** - Apply magnet when this code is showing to save changes and exit Setup.

NOTE: Values in parentheses are for the Heavy Hydrocarbon (Propane) unit.

4.5 Flash Input “in”

Apply the magnet when “in” is showing, and the unit will enter the Flash Input diagnostics mode. This mode allows the user to measure input flash variation for F12 troubleshooting, where “X.XX” is flash noise, “XX.X” is flash variance, and “XXX.” is the F12 fault threshold. When the variance repeatedly exceeds the threshold, the fault comes on. When the signal variance is below the threshold for a minimum duration, the fault turns off. The measurements indicate the stability of the flash and how close the variance is to the fault threshold.

4.6 Alignment/Adjustment “AJ”

Apply the magnet when “AJ” is showing and the unit will enter the Alignment/Adjustment Mode.

This mode allows the user to re-align the Model Ultima OPIR-5 and set a new “zero” value. This mode is covered in Section 3.6.

4.7 Finish “Fi”

Apply the magnet when “Fi” is showing and the unit will exit the Options Mode, save any changes that were made, and return to normal operation. This is the only way changes made in Setup Mode are saved.

4.8 Maintenance

After the Ultima OPIR-5 Detector has been initially aligned, the unit requires little maintenance. Although calibration is not required, response should be tested from time to time using the Test Gas Films designed for the Ultima OPIR-5 Detector.

If the Model Ultima OPIR-5 Detector is operated under dusty or dirty conditions, the windows should be cleaned periodically. This is accomplished by gently wiping them with a soft, clean cloth, which has had a commercial window cleaning solution applied. Water and ethanol are suitable solvents. The cleaning should be done in Test Gas Mode to prevent false alarms.

The estimated mean time between failures (MTBF) for the Source lamp is 4 years. Should the Source lamp need replacement, use the Lamp Replacement Kit listed in the Spare Parts section.

The Ultima OPIR-5 Detector should be stored in a clean, dry area, and within the temperature and humidity ranges noted for environmental specifications in Section 8.2. Insert the red dust caps into any vacant cable entry holes while the unit is stored.

NOTE: The Ultima OPIR-5 Detector will detect vapors from alcohol and other cleaning solvents.

4.9 Display and Fault Codes

The display codes during normal operation are:

- SU** Start-Up - This is displayed immediately after power is applied and lasts for approximately two minutes.
- SF** Re-Start from an optical Fault - This is displayed when an optical Fault condition has been corrected.
- 0-50** Steady Numeric Indications - This is displayed when a concentration of gas is detected in the operational mode.

0-50 Flashing Numeric Indications - This is displayed when a concentration of test gas is at the detector in the test gas mode.

Other codes that can appear on the display are Fault codes, which are listed in the following section.

4.10 LEL and ppm Negative Drift Faults

The ppm negative drift fault occurs when the Ultima OPIR-5 Detector is zeroed with a small background gas and strong air currents dissipate the remaining gas. Under such circumstances, the ppm range current may decrease to 0 mA, prompting the detector to produce a fault.

It is unsafe to use the Ultima OPIR-5 Detector when there is negative drift in the LEL range. A LEL negative drift causes both currents to go to zero and the fault relay to de-energize. The LEL negative drift may occur when the system is first installed and not yet aligned.

Negative drift on the ppm range is not a dangerous condition as with a LEL negative drift. The ppm negative drift does not put the Ultima OPIR-5 Detector into a total fault. Nonetheless, it returns the ppm current to zero.

5.0 Troubleshooting

If equipment or qualified personnel required to troubleshoot are not available, it is recommended that the defective unit be returned to MSA for repair.



CAUTION: MSA's warranty will be voided if damage results from repair attempts other than routine replacement of recommended spare parts. Repairs performed by persons other than MSA's authorized personnel may void the warranty. Please read the warranty statement carefully. A defective Ultima OPIR-5 Detector Infrared Open Path System should be returned to the factory for repair even if the warranty has expired. A complete written description of the problem should be included with all returned equipment.

CAUTION: Component level repair must be undertaken either by MSA personnel, or by competent authorized service engineers. SMT PCB repair shall only be performed at an MSA facility. Failure to comply with this requirement will invalidate the warranty.

Be sure to inhibit or disconnect the external alarm wiring before making any check, which might send the unit into alarm.

5.1 Fault Codes

The Ultima OPIR-5 Detector will indicate a fault code number on the three-digit display as an aid to troubleshooting. The following list identifies the fault codes, gives a description of the fault, and indicates the corrective action that should be taken.

Multiple faults will result in alternating fault codes being displayed. All faults have a 10-second delay before activating, unless otherwise noted. There are twelve fault conditions monitored by the microprocessor:

5.1.1 F0 Excessive Negative Drift or High IR

This fault indicates either excessive LEL-m negative drift or excess IR received.

ACTION – Verify that the distance between the Source and Receiver is greater than the range minimum. Align the system. Protect the Receiver from stray IR sources.

5.1.2 F1 Partial Beam Block or Dirty Lens

This fault indicates the Receiver is seeing less than optimum infrared from the Source.

ACTION – Unit windows should be cleaned and the optical path checked for blockage. If the window is clean and the path is clear, realigning the Source and Receiver when no background gas is present should correct this fault.

5.1.3 F2 Alignment

This fault indicates that the alignment of the Ultima OPIR-5 Detector is outside of the manufacturers limits.

ACTION – Realign the unit until the **AJ** value is close to the typical values listed in Section 3.7 Applying Power & Alignment Mode.

5.1.4 F3 Beam Block

This fault indicates that the infrared source from the Source is too dim. It activates its relay after the user defined beam block timeout period is exceeded.

ACTION – The system optical path should be checked for blockage or windows cleaned. If this continues, the unit should be returned for repair.

5.1.5 F4 Flash Erratic

Flashes from the Source are erratic.

ACTION – Verify that the voltage input to the Source is adequate.

5.1.6 F5 Setup Menu

This fault indicates that the user has not exited the setup menu within 6 minutes of inactivity.

ACTION – Apply the magnet to exit the setup menu. See page 19.

5.1.7 F6 Low Supply Voltage

This fault indicates the unit is receiving a low line supply voltage. It is displayed if the Receiver or the Source is supplied with less than 18.5 VDC.

ACTION – Ensure the supply voltage at each unit is above 18.5 VDC.

5.1.8 F7 Code Checksum

This fault indicates a fault in device program memory.

For rev A firmware, F7 also indicates a fault for the Receiver heater, non-volatile memory or AO circuit.

ACTION – The unit must be returned for repair.

5.1.9 F8 Failed Zeroing

This fault indicates the unit failed to acquire a zero during Alignment/Adjustment Mode or is responding to a loss of background gas.

ACTION – Attempt to re-zero by re-entering Alignment/Adjustment Mode with no background gas present.

5.1.10 F9 Gas Left

This fault indicates the unit timed out while in Gas Check Mode (Section 4.2)

ACTION – Remove the Test Gas Film and apply the magnet to clear the fault.

5.1.11 F10 Reset Short

This fault indicates that the reset external connection is shorted to ground for more than 30 seconds.

ACTION – Remove the reset short wire from ground.

5.1.12 F11 Unit Overheating

This fault indicates the Source and/or Receiver unit is over temperature. The Ultima OPIR-5 Detector continues to detect gas but its accuracy is degraded and the long term reliability is compromised.

ACTION – Ensure that the ambient temperature for each unit is within specification.

5.1.13 F12 Optical Signal Variation

This fault indicates that the flashing signal to the Receiver is unstable.

F12 is most often caused by inadequate alignment. Other causes are partial obscuration, interference from another Source, low supply voltage to the Source, and mounting movement or vibration.

ACTIONS

- Re-align Source and Receiver for maximum AJ.
- Remove partial obstructions or move the system so that the beam path is clear.
- Clean optics.
- Prevent flash input from another Source by either swapping Source and Receiver or changing system orientation.
- Verify that the Source voltage supply exceeds minimum requirements.
- Ensure that mounting for the Source and Receiver is stable.

5.1.14 F13 Non-Volatile Memory

This fault indicates a fault in device data memory.

ACTION – The unit must be returned for repair.

5.1.15 F14 AO Circuit

This fault indicates that the Analog Output circuit has malfunctioned.

ACTION – The unit must be returned for repair.

5.1.16 F15 Receiver Heater

This fault indicates that the heater in the Receiver has malfunctioned.

ACTION – The unit must be returned for repair.

5.1.17 tF7 Source Heater

This fault indicates that the heater in the Source has malfunctioned.

ACTION – The unit must be returned for repair.

NOTE: During the **F1, F5, F6, F10, F11, F15, tF7**, and **F0** for negative drift faults, the unit will attempt to output an alarm if gas is present.

5.2 Other Troubleshooting Tips

5.2.1 Source does not flash

- Verify the Source is fitted with a visible light filter. A Source with a visible light filter does not display a flashing light.
- Verify that the wiring is correct and that there are no stray wire strands that could create an intermittent short.
- Verify that the voltage at the Source wiring terminal is stable and meets minimum requirements.
- If all above conditions are met and the Source does not flash, replace the lamp. Detailed instructions are in the lamp replacement kit listed in the Spare Parts section.

5.2.2 Receiver does not display startup sequence when power is applied

- Verify that the power supply is on and that it is set to 24 volts ± 1 V.
- Verify that the wiring is correct.
- Use a voltmeter to check the voltage at the wiring terminal, or remove the unit and check it using a different supply.

5.2.3 Receiver displays]-[during alignment

- Verify that the Source is aimed at the Receiver and that the Receiver is aimed at the source.
- Verify that the beam path from the Source to the Receiver is free of obstruction.
- On the Receiver and on the Source, with power removed from the Source, verify that the window on each unit is clean and that an attenuation plate is not in place.

5.2.4 Receiver displays F1 or F3 after alignment

- Verify that the Source is aimed at the Receiver and that the Receiver is aimed at the source.
- Verify that the beam path from the Source to the Receiver is free of obstruction.
- On the Receiver and on the Source, with power removed from the Source, verify that the window on each unit is clean and that an attenuation plate is not in place.

5.2.5 Receiver does not respond to the magnet

- Try a slightly different location for the magnet.

5.2.6 Receiver AJ number went to 0 with no “A” on the display

- Apply the magnet to resume alignment (The alignment mode times out after 30 minutes).
- Stack a second magnet onto the first.

5.2.7 Receiver displays information other than described

- Refer to the Ultima OPIR-5 Detector Receiver User Menu to apply the magnet and resume alignment

5.2.8 Source or Receiver will not move

- Verify that fine adjust screw tops are flush with the assembly surface.
- Verify that the two front mounting screws have not been tightened down.
- Verify that the nut at the bottom of the pan-tilt assembly has not been tightened down.
- Insert a large screw driver or rod between the bottom of the unit and the mounting assembly. Press on it to loosen the mounting.

6.0 Customer Support

Address	Phone/Email
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UNITED STATES

Mine Safety Appliances Co.
26776 Simpatica Circle
Lake Forest, CA 92630

Toll Free: 1-800-MSA-INST
Email: customer.service@MSAsafety.com

Table 4: MSA Location

7.0 Appendix

7.1 Warranty

MSA warrants the Ultima OPIR-5 Detector to be free from defects in workmanship or material under normal use and service within two years from the date of shipment.

MSA will repair or replace without charge any such equipment found to be defective during the warranty period. Full determination of the nature of, and responsibility for, defective or damaged equipment will be made by MSA personnel.

Defective or damaged equipment must be shipped to the MSA plant or representative from which the original shipment was made. In all cases, this warranty is limited to the cost of the equipment supplied by MSA. The customer will assume all liability for the misuse of this equipment by its employees, or other personnel.

All warranties are contingent upon proper use in the application for which the product was intended and do not cover products which have been modified or repaired without MSA approval or which have been subjected to neglect, accident, improper installation or application, or on which the original identification marks have been removed or altered.

Except for the express warranty stated above, MSA disclaims all warranties with regard to the products sold, including all implied warranties of merchantability and fitness, and the express warranties stated herein are in lieu of all obligations or liabilities on the part of MSA for damages including, but not limited to, consequential damages arising out of, or in connection with, the performance of the product.

7.2 Specifications

7.2.1 System Specifications

Sensor Type:	Infrared
Gas Detected:	Methane or Propane
Dual Measuring Range:	<u>Methane Light Hydrocarbon Unit:</u> 0 to 5,000 ppm•m and 0 to 5 LEL•m <u>Propane Heavy Hydrocarbon Unit:</u> 0 to 2,000 ppm•m and 0 to 1 LEL•m
Response Time:	$T_{90} \leq 3$ seconds
Accuracy:	$\leq \pm 5\%$ of full scale concentration at 25°C
Repeatability:	$\leq \pm 5\%$
Linearity:	$\leq \pm 5\%$ of full scale for each scale Or $\pm 10\%$ of applied gas concentration, whichever is greater
Drift:	Short term: $\leq \pm 5\%$ of the measuring range or $\leq \pm 10\%$ of the measured value, whichever is greater. Long term: $\leq \pm 10\%$ of the measuring range or $\leq \pm 20\%$ of the measured value, whichever is greater
Hazardous Locations Classification:	<u>CSA/FM:</u> Class I, Division 1, 2 Groups B, C, D; Class II, Division 1, 2 Groups E,F,G; Class III T4 (Tamb=-55°C to +65°C) for FM T3C (Tamb=-60°C to +75°C) for CSA <u>ATEX/IECEX:</u> II 2 G D, Ex d IIB+H ₂ T4 Gb, Ex tb IIIC T135C Db, IP66/67 (Tamb=-55°C to +65°C) IEC 60079-29-4 FM11ATEX0013X, IECEX FMG 11.0006X
Path Lengths	5-30 m*, 20-100 m, 50-150 m *5 m achieved with attenuation plate
Modes:	Set-up, test mode, alignment
Misalignment:	Meet all performance specifications with at least $\pm 0.5^\circ$ of misalignment
Solar Blind:	Complies with FM 6325 performance requirements
Fog Immunity:	FM 6325 performance requirement: at least 90% blockage with $\leq \pm 10\%$ mid-scale gas accuracy
Hazardous Location and Electrical Safety Temperature Range:	-60°C to +75°C
Certified Performance Temperature Range:	-55°C to +65°C
Warranty:	Two years

7.2.2 Electrical Specification

Input Voltage: 20 to 36 VDC, 24 VDC nominal
Input Current: Source: 0.64 A maximum at 20 VDC input voltage
Receiver: 0.50 A maximum at 20 VDC input voltage; less 0.04 A with relays disabled
Supply Power: Source: Rated 12 watts maximum at 24 VDC input
Receiver: Rated 10 watts maximum at 24 VDC input
Start-up Time: 2 minutes
Warm-up Time 2 hours minimum
Relay Ratings: 8 A @ 250 VAC, 8 A @ 30 VDC resistive max.
Relay Quantity: 4 internal; Fault, Alarm, ppm-m Warn, LEL-m Warn
Relay Contact Type: Single Pole Change Over (SPDT)
Analog Signal: 0 to 22 mA (700 ohms max. load)

Function	HART Not Installed	HART Low Range	HART High Range
Fault	0 mA	1.25 mA	3.5 mA
Test Gas	1.5 mA	1.5 mA	3.5 mA
Setup mode	1.5 mA	1.5 mA	3.5 mA
Beam Block	2.0 mA	2.0 mA	3.5 mA
Startup	0 mA	1.25 mA	3.5 mA
Zero reading	4.04 mA	4.04 mA	4.04 mA
0-5 LEL·m	4-20 mA	4-20 mA	4-20 mA
Split Range	4-12 mA for 0-5000 ppm·m (methane) or 0-2000 ppm·m (propane) 12-20 mA for 0-5 LEL·m (methane) or 0-1 LEL·m (propane)	4-12 mA for 0-5000 ppm·m (methane) or 0-2000 ppm·m (propane) 12-20 mA for 0-5 LEL·m (methane) or 0-1 LEL·m (propane)	4-12 mA for 0-5000 ppm·m (methane) or 0-2000 ppm·m (propane) 12-20 mA for 0-5 LEL·m (methane) or 0-1 LEL·m (propane)
Over-range	21.7 mA	21.7 mA	21.7 mA

RS-485 Output: Modbus RTU with Block and Single Data transfer modes
Baud Rate: 2400, 4800, 9600, 19200, or 38400 BPS
HART (Optional): Fully HART Compliant. User selectable between HART and Modbus.
HART current source Rx = 120 kilo ohms Cx = 8 nF.
RFI/EMI Protection: EN 61000-6-4, EN 50270

7.2.3 Mechanical Specification

Length: 12.4 inches (315 mm)
Diameter: 4.5 inches (113 mm) for SS enclosure
5.3 inches (135 mm) for Nosecone
Weight: Source: 12.20 lb (5.53 kg)
Receiver: 12.34 lb (5.60 kg)
Pan-Tilt Arm Assembly 329073-1: 7.62 lb (3.46 kg)
Material: 316 stainless steel for electronics enclosure

7.2.4 Environmental Specification

Operating Range:	-55°C to +65°C @ 10% to 95% RH non-condensing, 86-108 kPa non-compensated
Storage Range:	-65°C to +75°C @ 10% to 95% RH non-condensing, 86-108 kPa non-compensated
Enclosure Protection Rating:	Type 4X, IP66/67

7.2.5 Approvals

Meets the performance requirements of FM 6325, EN 60079-29-4 and IEC 60079-29-4, CSA, FM, ATEX, IECEx, INMETRO approved; HART Registered; IEC 61508 approved to SIL 3, 2 or 1.

CSA & FM Approval:

Explosion-proof for Class I, Division 1, Groups B, C, and D, Dust-ignition proof for Class II/III, Division 1 Groups E, F and G, Non-Incendive for Class I/II/III, Division 2, Groups B, C, D, E, F, G.

ATEX & IECEx Approval:

Flameproof 'd' with Equipment Protection Level 'Gb' for Gas Group IIB + H₂, Category 2G. Dust Ignition Protection by Enclosure with level of protection 'tb' and Equipment Protection Level 'Db' for Equipment Group IIIC, Category 2D.

7.2.6 Cable Requirements

It is the responsibility of the facilities engineer to comply with all regulatory, legal, and safety issues concerning appropriate wiring for the facility.

The sample calculations are for reference only. Customers must derive the distance from supply to device based on cable specifications, expected maximum ambient temperature and cable temperature rise, estimated connection losses, allowances for error in distance measurement, and other variables particular to the customer installation.

Sample Calculations for Power Cable

V_{supply} = 24 VDC, V_{device} = 20 VDC, I_{Receiver_max} = 0.50 A, cable resistance per meter = 9.00 ohms per meter at maximum ambient temperature for 2.5 mm² cable.

Maximum distance from supply to Receiver = (1/2) x (V_{supply} – V_{device}) / (I_{device_max} x cable resistance per meter)

$$\text{Maximum distance} = (1/2) \times (24 - 20) / (0.50 \times 9.00 / 1000) = 444 \text{ meters}$$

Sample maximum distances from supply to device

Terminal Type	Push	Screw	Push	Screw
Max Wire Size	16 AWG	14 AWG	1.5 mm ²	2.5 mm ²
Typical Resistance	5.00 ohms / 1000 ft	3.00 ohms / 1000 ft	16.0 ohms / 1000 m	9.00 ohms / 1000 m
Source	625 feet	1040 feet	195 meters	347 meters
Receiver	800 feet	1330 feet	250 meters	444 meters

Table 5: Distances from Power Supply to Source and Receiver

Sample Calculations for Analog Output Cable

Maximum load is 700 ohms. If an external device has an input impedance of 600 ohms, the cable resistance must not exceed 100 ohms, where maximum load = device load + cable resistance. For 16 AWG cable with resistance of 5 ohms / 1000 feet, the maximum distance from IR5500 and AO device is $((100 / 5) / 2) \times 1000$ feet = 10,000 feet.

AWG	Ohms/1000 ft	Feet	Meters
#20	11	4,550	1,390
#18	7	7,140	2,180
#16	5	10,000	3,050

Table 6: Distances from Receiver to Analog Output Load

7.3 Spare Parts and Accessories

To order spare parts or accessories, please contact your nearest MSA Representative or MSA directly and give the following information:

- Configuration Number
- Description
- Quantity

7.3.1 Spare Parts

329071-1	Pan-Tilt Base Assembly
329073-1	Pan-Tilt Arm Assembly
329123-1	Basic Mounting Arm Assembly
329083-1	Methane Test Gas Film Kit
329084-1	Propane Test Gas Film Kit
329113-1	Attenuator
329118-1	Lamp Replacement Kit
954-021	5 mm T-handle hex key. Used for instrument-mounting screws and cover-locking screw.

Recommended Spare Parts for one (1) year:

30060-2	Magnet Assembly
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7.3.2 Accessories

329071-1	Pan-Tilt Base Assembly
329073-1	Pan-Tilt Arm Assembly
329123-1	Basic Mounting Arm Assembly
329082-1	Long Range Alignment Kit (includes scope)

7.4 Engineering Documentation

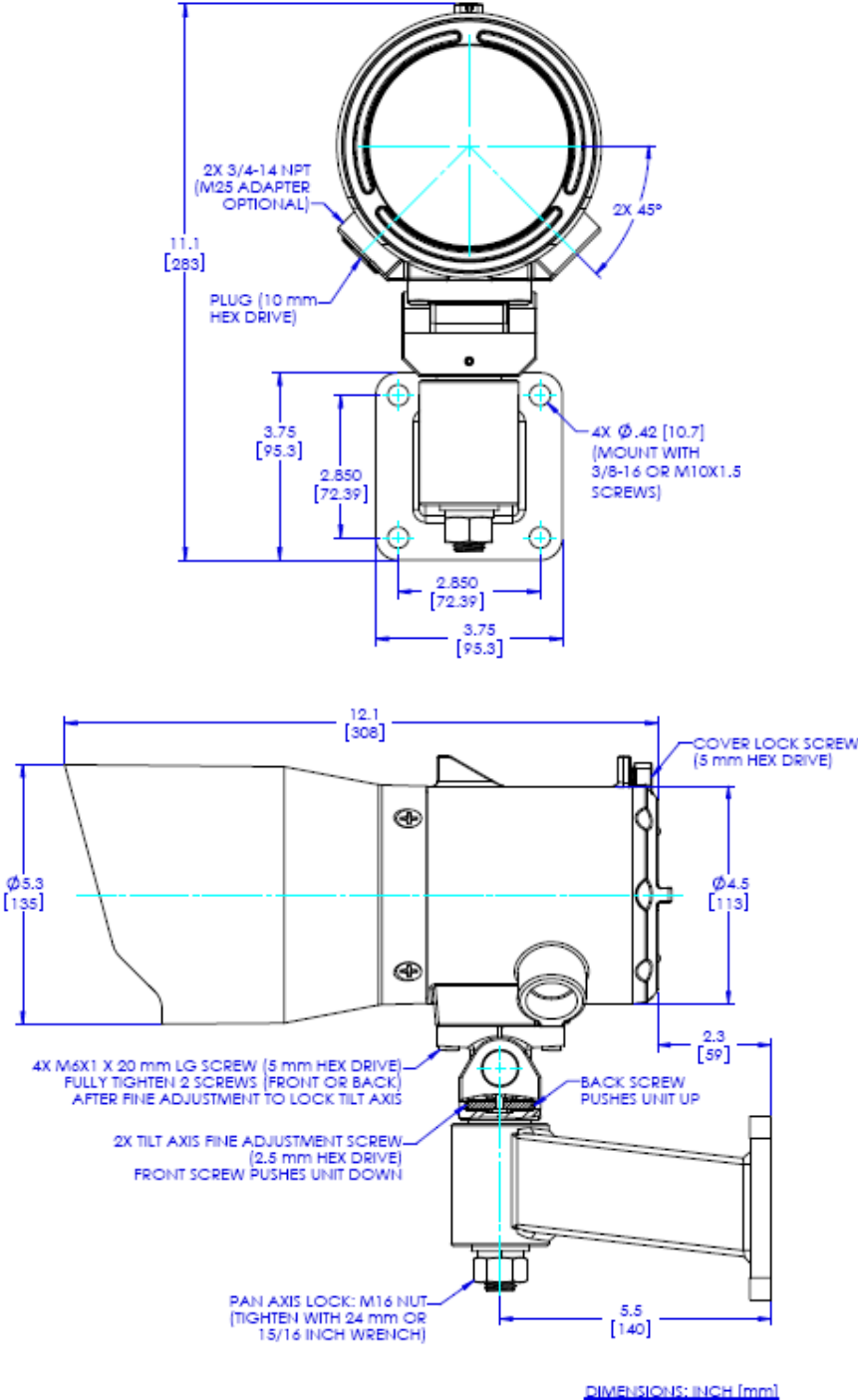


Figure 13: Outline Drawing

8.0 Appendix A

8.1 Split-Range Analog Output Option

NOTE: This section is intended to be read and understood by a systems integration engineer. It is not necessary to understand this in order to safely use the Ultima OPIR-5 Detector. The split-range analog output option is turned off by default and should be left off unless you are certain the control room PLC is properly configured.

If the split-range mode is turned on and the PLC is not set to calculate the analog output this way, the system will fail-to-safe because the analog is interpreted as representing a higher concentration than is present. This may cause the PLC to falsely indicate alarms.

The Ultima OPIR-5 Detector can be set through the SE menu to operate in split-range analog output mode. This mode gives the advantages of very high sensitivity of the ppm•m range and the full range detection of the LEL•m scale. The analog output range from 4 to 20 mA is split so that values from 4 to 12 mA represent 0 – 5,000 ppm•m and values from 12 to 20 mA represent 0 – 5.0 LEL•m.

For the heavy hydrocarbon version of the Ultima OPIR-5 Detector the ranges are 4 to 12 mA represent 0 – 2,000 ppm•m and values from 12 to 20 mA represent 0 – 1 LEL•m.

This mode is intended for use with a PLC which will convert the analog current back to both ppm•m and LEL•m readings.

The conversion equations for the PLC are:

$$\text{ppm}\bullet\text{m} \% \text{ F.S.} = (\text{Analog Output} - 4.00) / 0.08$$

$$\text{LEL}\bullet\text{m} \% \text{ F.S.} = (\text{Analog Output} - 12.0) / 0.08$$

where Analog Output is the current measured by the PLC in units of mA.

To display the value in ppm•m or LEL•m the following conversion should be used:

For methane detectors
$\text{ppm}\bullet\text{m} = \text{ppm}\bullet\text{m} \% \text{ F.S.} * 50$
$\text{LEL}\bullet\text{m} = \text{LEL}\bullet\text{m} \% \text{ F.S.} / 20$

For propane detectors
$\text{ppm}\bullet\text{m} = \text{ppm}\bullet\text{m} \% \text{ F.S.} * 20$
$\text{LEL}\bullet\text{m} = \text{LEL}\bullet\text{m} \% \text{ F.S.} / 100$

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