Ultima® Gas Monitor

instruction manual

⚠ WARNING

THIS MANUAL MUST BE CAREFULLY READ BY ALL INDIVIDUALS WHO HAVE OR WILL HAVE THE RESPONSIBILITY FOR USING OR SERVICING THE PRODUCT. Like any piece of complex equipment, the unit will perform as designed only if it is installed, used and serviced in accordance with the manufacturer's instructions. OTHERWISE IT COULD FAIL TO PERFORM AS DESIGNED AND PERSONS WHO RELY ON THIS PRODUCT FOR THEIR SAFETY COULD SUSTAIN SEVERE PERSONAL INJURY OR DEATH.

The warranties made by Mine Safety Appliances Company with respect to the product are voided if the product is not used and serviced in accordance with the instructions in this manual. Please protect yourself and others by following them. We encourage our customers to write or call regarding this equipment prior to use or for any additional information relative to use or repairs.

In the U.S., to contact your nearest stocking location, dial toll-free 1-800-MSA-INST. To contact MSA International, dial 1-412-967-3354.

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Manufactured by
MSA INSTRUMENT DIVISION
P.O. Box 427, Pittsburgh, Pennsylvania 15230

(L) Rev 12 **813161**

MSA Instrument Warranty

1. **Warranty-** Seller warrants that this product will be free from mechanical defect or faulty workmanship for a period of eighteen (18) months from date of shipment or one (1) year from installation, whichever occurs first, provided it is maintained and used in accordance with Seller's instructions and/or recommendations. This warranty does not apply to expendable or consumable parts whose normal life expectancy is less than one (1) year such as, but not limited to, non-rechargeable batteries, sensor elements, filter, lamps, fuses etc. The Seller shall be released from all obligations under this warranty in the event repairs or modifications are made by persons other than its own or authorized service personnel or if the warranty claim results from physical abuse or misuse of the product. No agent, employee or representative of the Seller has any authority to bind the Seller to any affirmation, representation or warranty concerning the goods sold under this contract. Seller makes no warranty concerning components or accessories not manufactured by the Seller, but will pass on to the Purchaser all warranties of manufacturers of such components. **THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, AND IS STRICTLY LIMITED TO THE TERMS HEREOF. SELLER SPECIFICALLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.**

2. **Exclusive Remedy-** It is expressly agreed that Purchaser's sole and exclusive remedy for breach of the above warranty, for any tortious conduct of Seller, or for any other cause of action, shall be the repair and/or replacement at Seller's option, of any equipment or parts thereof, which after examination by Seller is proven to be defective. Replacement equipment and/or parts will be provided at no cost to Purchaser, F.O.B. Seller's Plant. Failure of Seller to successfully repair any nonconforming product shall not cause the remedy established hereby to fail of its essential purpose.

3. **Exclusion of Consequential Damage-** Purchaser specifically understands and agrees that under no circumstances will seller be liable to purchaser for economic, special, incidental or consequential damages or losses of any kind whatsoever, including but not limited to, loss of anticipated profits and any other loss caused by reason of nonoperation of the goods. This exclusion is applicable to claims for breach of warranty, tortious conduct or any other cause of action against seller.

General Warnings and Cautions

⚠ WARNINGS

1. The Ultima Gas Monitors described in this manual must be installed, operated and maintained in strict accordance with their labels, cautions, warnings, instructions, and within the limitations stated.
2. To prevent ignition of a hazardous atmosphere, the cover of an explosion-proof model of the Ultima Gas Monitor must be kept tightly closed when power is applied. Before removing the cover for maintenance or calibration, ensure the surrounding atmosphere is and remains free of toxic or combustible gases until the cover is closed.
3. The Ultima Gas Monitor is designed to detect gases or vapors in air. It cannot measure the concentration of gases or vapors in steam or inert or oxygen-deficient atmospheres. The oxygen sensor can measure oxygen-deficient atmospheres.
4. Electrochemical sensors are sealed units which contain a corrosive electrolyte. Should a sensor develop leakage, it must be immediately removed from service; then, remove it from the sensing head and discard it properly. Caution must be exercised so that the electrolyte does not contact skin, eyes, clothing or circuitry; otherwise, serious personal injury (burns) and/or equipment damage may result.
5. Use only genuine MSA replacement parts when performing any maintenance procedures provided in this manual. Failure to do so may seriously impair instrument performance. Repair or alteration of the Ultima Gas Monitor, beyond the scope of these maintenance instructions or by anyone other than an authorized MSA service personnel, could cause the product to fail to perform as designed and persons who rely on this product for their safety could sustain serious personal injury or death.
6. Do not locate the general-purpose enclosure models in an area which may contain a flammable mixture of gas and air; otherwise, an explosion may occur. The general-purpose Ultima Gas Monitors can be a source of ignition and must not be mounted in an area where a flammable mixture of combustible gas and air may be present; otherwise, an

explosion may occur. If such a location must be monitored, use an explosion-proof Ultima Gas Monitor model.

7. The Ultima IR combustible gas monitor detects the presence of most combustible gases by identifying the difference in the amount of infrared light energy absorbed during the presence of these gases. This monitor, however, does NOT detect the presence of hydrogen gas and should never be used to monitor for hydrogen gas.

Failure to follow the above can result in serious personal injury or death.

⚠ CAUTIONS

1. As with all gas monitors of these types, high levels of, or long exposure to, certain compounds in the tested atmosphere could contaminate the sensors. In atmospheres where an Ultima Gas Monitor may be exposed to such materials, calibration should be performed frequently to ensure that operation is dependable and display indications are accurate.
2. The Ultima Gas Monitor must not be painted. If painting is done in an area where a Monitor is located, care must be exercised to ensure that paint is not deposited on the sintered, metal flashback arrestor in the inlet fitting of the Ultima Gas Monitor, if so equipped. Such paint deposits would interfere with the diffusion process, whereby a sample of the atmosphere being monitored diffuses into the Monitor.
3. The only absolute method to ensure proper overall operation of an Ultima Monitor is to check it with a known concentration of the gas for which it has been calibrated. Consequently, calibration checks should be included as part of the routine inspection of the system.
4. Protect the Ultima Gas Monitor from extreme vibration. Do not mount the sensing head in direct sunlight as this may cause overheating of the sensor.

Failure to follow the above can result in injury, product damage and/or an unsafe condition.

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Chapter 1
Set-up

Unpacking Your Unit

Several cartons may arrive with your order; locate the carton(s) marked as the Ultima Gas Monitor or Ultima Gas Monitor/Less Sensor. Upon receipt, ensure that your package contains:

- Ultima Gas Monitor (FIGURE 1-1)
- Ultima Gas Monitor Instruction Manual (P/N 813161). If your unit is an Ultima Gas Monitor with Digital Output, there will be an additional manual (P/N 710471)
- Ultima Remote Sensor Module, if equipped as a dual module model (FIGURE 1-2)

General Description

The Ultima Gas Monitor is designed to sample the environment where mounted and alert you to potentially dangerous levels of your target gas, depending on your particular model:

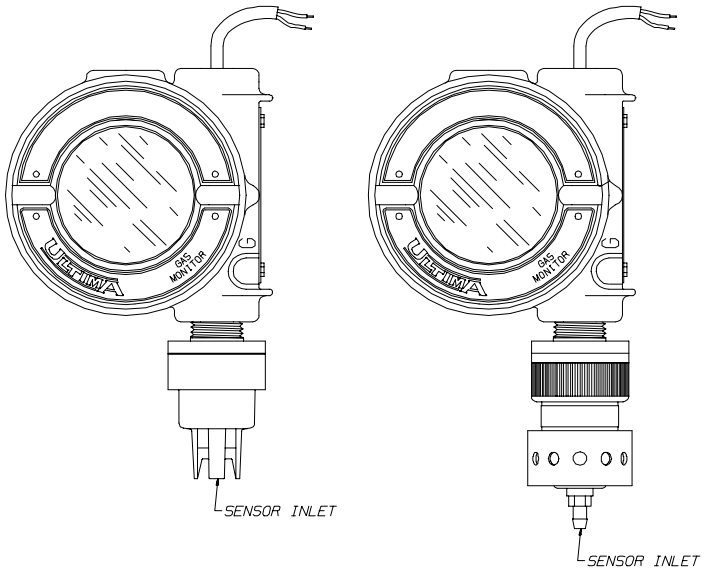


Figure 1-1.
Toxic Gas or Oxygen General-Purpose Models

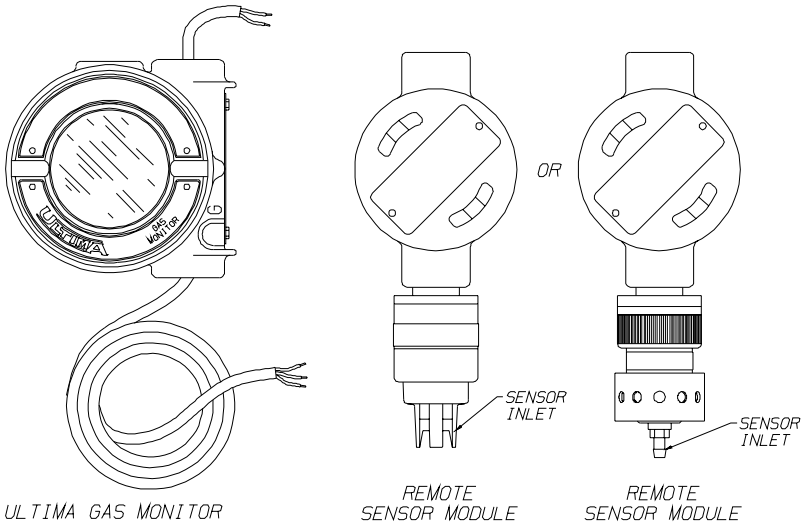


Figure 1-2.
Remote Sensor Model

The unit is shipped ready for installation via an external wiring harness. This harness is to connect to power and any output signals, eliminating the need to open the enclosure for installation or operation.

Identifying Your Unit

All models of the Ultima Gas Monitor, all housed in rugged, aluminum enclosures are designed to meet NEMA 4X. These versions with milliamp or frequency output can be installed as Intrinsically Safe for Classification I, Groups B, C and D, Division, 1, Hazardous Locations; the catalytic combustible gas version can be installed as Intrinsically Safe for Classification I, Groups C and D only. The combustible IR models are not installable as intrinsically safe. These approvals also cover areas classified as Class I, Division 2 and are noted on the unit label.

Check the identifying label (see FIGURE 1-7) to be sure the version you are installing is rated as Intrinsically Safe when installed according to the drawing specified on the label.

IF YOUR UNIT IS:	REFER TO:
To be used with the optional Ultima Duct Mount Kit	Appendix A
Powered with the Optional Power Supply Module	Appendix B
contains internal relay	Appendix C

- Two models are available in GENERAL-PURPOSE housings (FIGURE 1-1):
    - Toxic Gases
    - Oxygen
- Three models are available in EXPLOSION-PROOF housings certified for Classification I, Groups B, C and D, Division 1, Hazardous Locations.
    - Combustible Gas (FIGURE 1-3):
    - Certain Toxic Gases (FIGURE 1-4):
    - Oxygen (FIGURE 1-4):

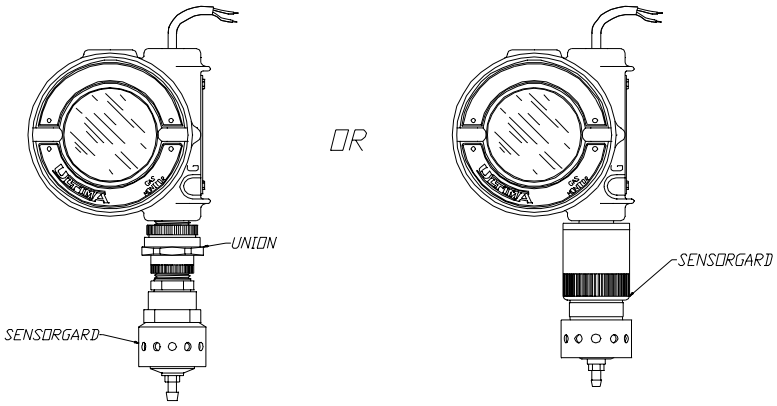


Figure 1-3.
Combustible Gas Explosion-proof Model

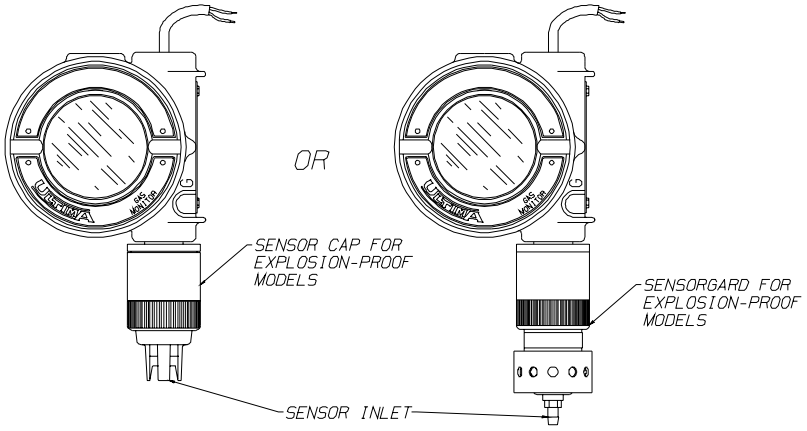


Figure 1-4.
Toxic Gas or Oxygen Explosion-proof Model

- All five models are available as Remote Sensor models (FIGURE 1-2).

To determine your sensor type and options, check the shipping carton (FIGURE 1-5) and sensor ID label located on the sensor cover or on the body of the module enclosure (FIGURE 1-6). Items which are checked are included in the carton.

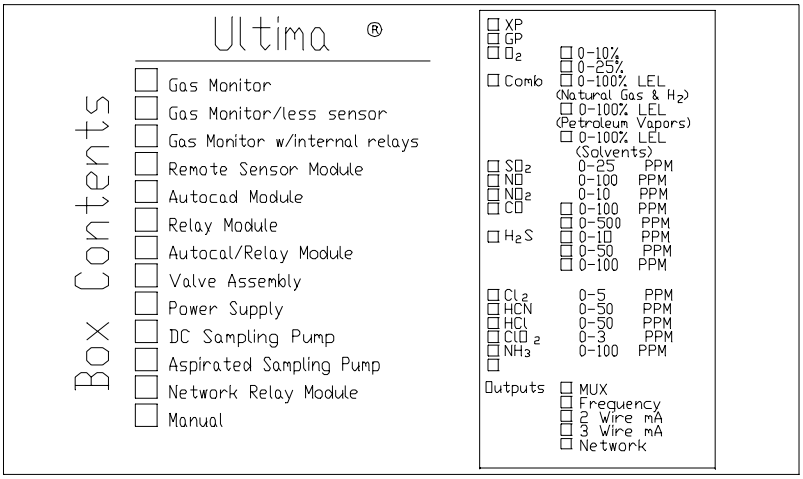


Figure 1-5.
Shipping Carton Label Identifying Sensor Type

This label identifies:

- Sensor supplied (Ultima Gas Monitor, Ultima Gas Monitor Less Sensor, or Ultima Remote Sensing Module)
- Type of gas (combustible gas, toxic gas or oxygen)
- Range [% LEL, PPM (parts per million), or %]
- Output (frequency, multiplex, digital, 2 or 3 wire, 4 to 20 mA)

  NOTE: The Ultima Digital Output Gas Monitor has its own manual; consult the Ultima Digital Output Gas Monitor Manual (P/N 710471) for more details.

- Any options such as internal relays

Hazardous Area Rating

IMPORTANT NOTE: Some models of the Ultima Gas Monitor can be used in hazardous atmospheres. These models are in explosion-proof enclosures and must be installed according

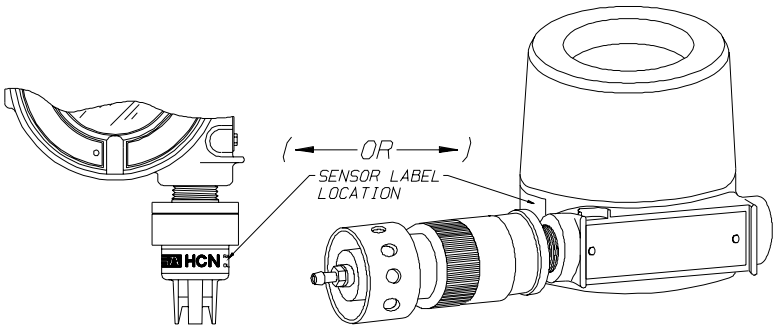


Figure 1-6.
Sensor Label Identifying Sensor Type

to the National Electric Code. Some Ultima Gas Monitor enclosures are rated for Class I, Division 1, Groups B, C and D areas, while others can only be used in Groups C and D areas. The larger, metal Approval Label on the Ultima Gas Monitor (FIGURE 1-7) will indicate the rating of your particular model and if it is approved for use in hazardous areas. The second approval label indicates the unit is also classified for Class I, Division 2 operation.

The Ultima Gas Monitor may be equipped with thread protectors; all thread protectors must be removed before installation. All units have cable harnesses. The unit must **not** be carried by these harnesses; otherwise, unit will be damaged.

If the unit is to be mounted in a general-purpose or intrinsically safe area, a cable grip can be used (FIGURE 1-8). A cable grip **cannot** be used when the unit is installed in an area classified as explosion-proof. Follow applicable wiring and installation codes.

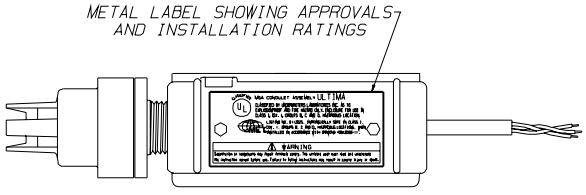


Figure 1-7.
Label Indicating Enclosure Classification

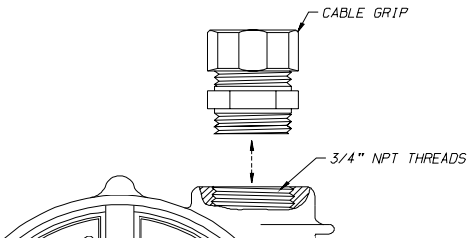


Figure 1-8.
Cable Grip for General-Purpose or Intrinsically Safe Installations

Intrinsically Safe Rating

Some models of the Ultima Gas Monitor can be used in hazardous atmospheres as intrinsically safe and must be installed according to the National Electric Code and the appropriate control drawings. Intrinsically safe installations of the Ultima Gas Monitor require the use of electrical barriers which are available from MSA. The proper use of these electrical barriers are outlined on the appropriate control drawings. Select the control drawing (available from MSA (1-800-MSA-INST) applicable to your unit:

ULTIMA GAS MONITOR	CONTROL DRAWING
Toxic or oxygen models, Milliamp or Frequency output	DSK3098-11
Combustible catalytic type model, Milliamp or Frequency output	DSK3098-13

⚠ WARNING

Do not use an intrinsically safe Ultima Gas Monitor with its electrical barriers beyond its area classification ratings; otherwise, an explosion may occur.

Refer to the larger, metal Approval Label located on the main enclosure of the Ultima Gas Monitor (FIGURE 1-7) for rating information. Some Ultima Gas Monitor enclosures are rated for Class I, Division 1, Groups B, C and D areas, while others can only be used in Groups C and D areas.

All intrinsically safe Ultima Gas Monitors operate at 12 volts only. The Multiplex and the Digital Output models are not capable of operating in an intrinsically safe manner with any type of electrical barrier.

If options such as internal relays are installed or accessories such as the Remote Relay Module or the Autocal Module are used, the Ultima Gas Monitor will not be rated as Intrinsically Safe. Refer to the metal Approval Label (FIGURE 1-7).

Mounting Your Gas Monitor

Generally, the unit or the remote sensing module should be mounted close to the area where a leak is likely to occur or where the gas is expected. The Ultima Gas Monitors or the remote sensing module should be installed at a high level (ceiling) or low level (floor), depending on the density of the gas most likely to be found. Mount the unit so that the front display of the unit is not blocked or hidden from view.

⚠ CAUTION

Mount the Ultima Gas Monitor or the remote sensing module with its sensor inlet fitting (FIGURE 1-1 or 1-2) pointed downwards; otherwise, the inlet may become clogged with particulate matter or liquids. Do not paint the Ultima Gas Monitor. If painting is done in an area where a sensor is located, exercise CAUTION to ensure paint is not deposited on the sensor inlet fitting. Such paint deposits would interfere with the diffusion process, whereby a sample of the monitored atmosphere diffuses into the sensor. In addition, solvents in the paint may cause an alarm condition to occur.

Protect the Ultima Gas Monitor from extreme vibration. Do not mount the sensing head in direct sunlight as this may cause overheating of the sensor.

⚠ WARNING

Do not locate the general-purpose enclosure models in an area which may contain a flammable mixture of gas and air; otherwise, an explosion may occur.

The general-purpose Ultima Gas Monitors can be a source of ignition and must not be mounted in an area where a flammable mixture of combustible gas and air may be present; otherwise, an explosion may occur. If such a location must be monitored, use an explosion-proof Ultima Gas Monitor model.

Mounting Guidelines for the Explosion-Proof Ultima Gas Monitor

An explosion-proof model of the Ultima Gas Monitor can be mounted in Class I, Groups B, C and D, Division 1, Hazardous Locations defined by Article 500 of the National Electrical Code (NEC). The term "explosion-proof" is used as defined by the NEC, Article 100:

> **“Explosion-Proof” Apparatus: Apparatus enclosed in a case that is capable of withstanding an explosion of a specified**

gas or vapor which may occur within it and of preventing the ignition of a specified gas or vapor within, and which operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby."

Mounting Guidelines for the General-Purpose Gas Monitor

The general-purpose gas model is designed to meet NEMA 4X requirements, suitable for many damp, wet and/or outdoor locations.

Mounting Guidelines for the Ultima Gas Monitor/Less Sensor

The Ultima Gas Monitor/Less Sensor is used with the Ultima Remote Sensor Module. It is mounted at a convenient, accessible location while the Remote Sensor Module is mounted where the gas is expected.

Mounting the Unit

Use one of the following three methods to mount the Ultima Gas Monitor/Less Sensor or the Ultima Gas Monitor.

Three Mounting Methods

- Via the 3/4-inch NPT threads: install the Ultima Gas Monitor to the end of a rigid conduit (FIGURE 1-9).
- Via the optional mounting strap (P/N 697281) that can be attached to the rear holes of the Ultima Gas Monitor (FIGURE 1-10)
- For mining applications, via the optional hanger bracket (P/N 814513) that can be attached to the rear holes of the Ultima Gas Monitor (FIGURE 1-11).

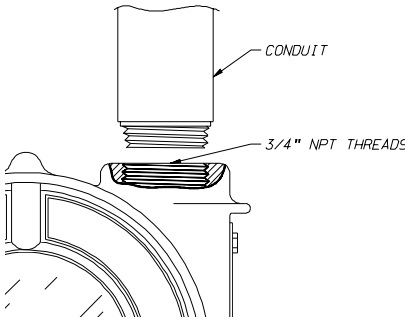


Figure 1-9.
NPT Thread Mounting Method

Mounting the Ultima Remote Sensor Module

The Ultima Remote Sensor Module is mounted where the gas is expected to exist. It is mounted with the sensor pointing downward via the 3/4" NPT threads. These threads are located on the end of the module, opposite the sensor (FIGURE 1-12). It can also be mounted with the mounting strap (P/N 655700); see

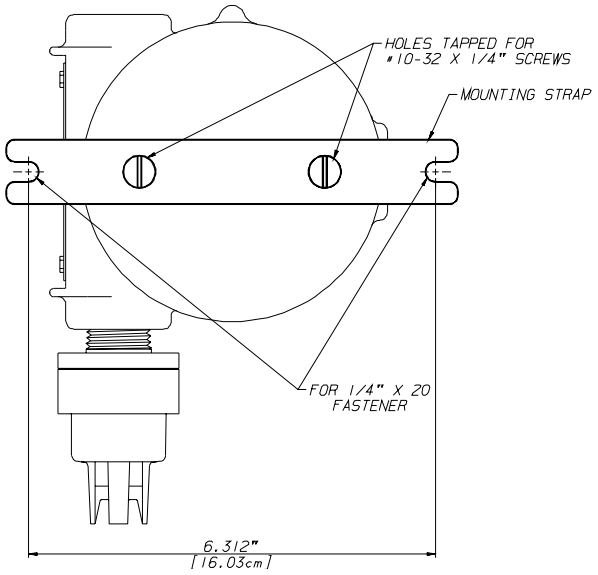


Figure 1-10.
Mounting Strap Mounting Method

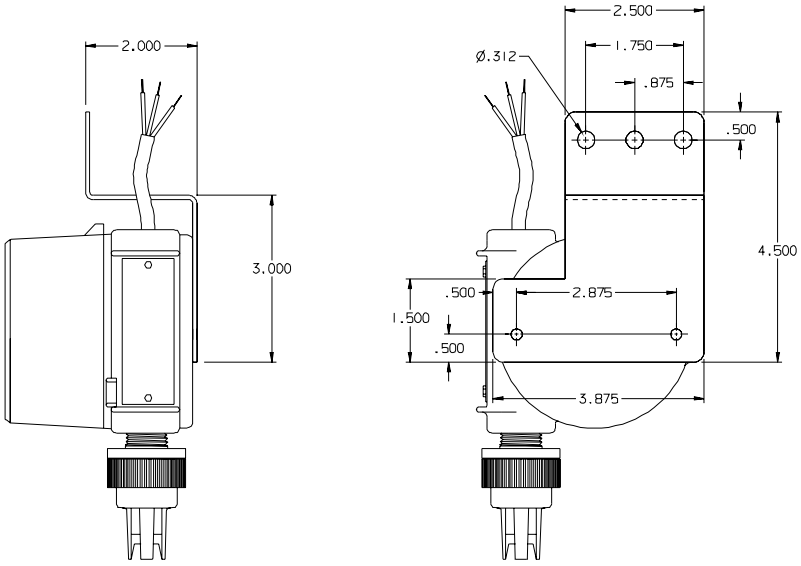


Figure 1-11.
Mining Mounting Method

FIGURE 1-13. The sensor module wiring is routed to the Ultima Gas Monitor which does not contain a sensor.

Permanently connect 1/4" OD tubing to the center post of the sensor inlet. Route this tubing to the Ultima Gas Monitor, ensuring that there are no kinks, leaks or other obstructions. Secure this tubing near the monitor; it is used to deliver check gas to the sensor module during calibration.

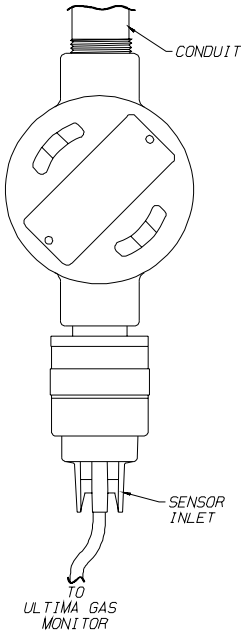


Figure 1-12. Ultima Remote Sensor Module

Electrical Connections for Ultima Gas Monitors

⚠ WARNING

Before wiring the Ultima Gas Monitor, disconnect power source supplying the monitor; otherwise, electrical shock could occur.

Before removing the cover of an explosion-proof Ultima Gas Monitor, verify the surrounding area does not contain a flammable mixture of combustible gas and air since a source of ignition is exposed; otherwise, an explosion may occur if a metal object contacts the circuitry and produces sparks.

NOTE: For Ultima with Digital Output Gas Monitors, see manual (P/N 710471) for wiring instructions.

NOTE: For Ultima units with internal relays, see Appendix C.

There is no need to open the enclosure during a typical installation because the Ultima Monitor design eliminates:

- Internal jumpers (except IR versions)
- Potentiometers
- Dip switches or other types of adjustments.

All electrical connections to the Ultima Monitor can be made via the factory- installed wiring harness (FIGURES 1-14 and

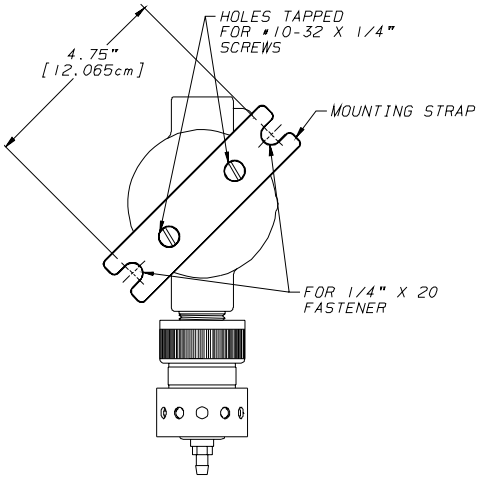


Figure 1-13. Remote Sensor Mounting Method

1-15). This assembly is marked to identify power, ground and signal connections. This wiring harness can contain two or three wires, depending on sensor type and/or output selected (see FIGURE 1-6 for sensor type):

- A **two-wire** connection is required for certain:
  - Toxic Gas models with 4 to 20 mA output
  - Oxygen models with 4 to 20 mA output
- A **three-wire** connection is required for all:
  - Combustible Gas models
  - Multiplex models
  - Frequency Output models
  - Three-wire Toxic and Oxygen Models with 4 to 20 mA output, that are to be operated in connection with Ultima accessory functions (relays, pumps, etc.).

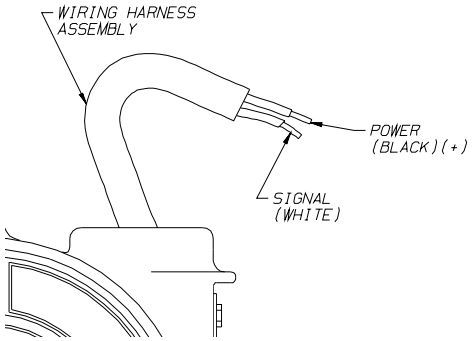


Figure 1-14.
Two-Wire Harness Assembly

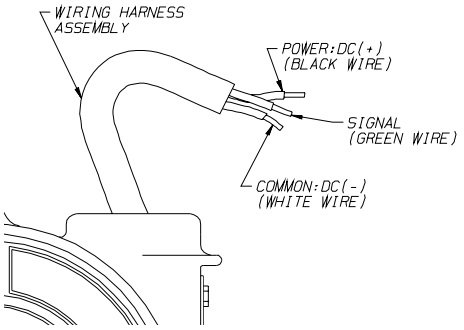


Figure 1-15.
Three-Wire Harness Assembly

If it is not possible to use the wiring harness, open the unit and disconnect the wiring harness from terminal block TB1 on the lower printed circuit board; see FIGURE 1-16 for wiring details.

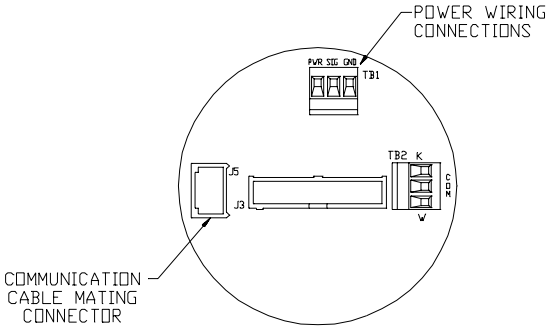


Figure 1-16.
Bottom Circuit Board

Wiring for all Models (except digital output models)

- For digital output models, see instruction manual P/N 710471.

In these installations, twisted-pair, instrument quality cable is required. Shielded cable is recommended for cable runs where interferences from radio frequency interference (RFI), electromagnetic interference (EMI) or other noise sources exist (such as motors, welding equipment, heaters, etc.).

NOTE: Installations using shielded wire should have the shield drain wire grounded at only one end of the connection. The preferred grounding point for the drain wire is at the Controller and not at the sensor.

Conduit may also be needed in areas where large amounts of electrical noise is expected.

Use caution when selecting a cable size. All of the following tables express the maximum cable length when only using the Ultima Gas Monitor. The Ultima options (e.g., Alarm Module, Calibration Module, Multiplex Control Relay, etc.) take additional power which requires a heavier cable or a short cable run. Refer to the particular manual for precise cabling information.

When selecting cable size, consider future needs (i.e., addition of sensors and/or options available with the Ultima Monitor). For all models, ensure that there is at least 7 volts DC at the sensor for proper operation.

NOTE: 10 VDC minimum required for Combustible IR models.

Ensure that water and dirt are not able to enter the unit via the wire or conduit. If the unit is installed in a location known to be wet or damp, it is good practice to loop or bend the entry into the unit that prevents water incursion.

TABLES 1-1 through 1-7 do not apply to Ultima Gas Monitors with Internal Relays. If Internal Relays exist, see Appendix C.

For Frequency Outputs

The Ultima Gas Monitor must be connected to an MSA controller (Models 5000, 6000 or Toxgard monitors). All sensor power is derived from the monitor. TABLES 1-1 through 1-3 show appropriate cable length and wire size for proper installation.

For Multiplex Output

For multiplex outputs, consult MSA as wiring procedures vary with applications.

Table 1-1. Cable Length and Wire Size, Toxic Gas or Oxygen Sensor, Frequency Signal Output

In all installations twisted, three-conductor instrument quality cable is required. In applications where interferences from RFI or EMI or other noise sources exist, shielded cable is recommended.

WIRE SIZE	MAXIMUM CABLE LENGTH IN FEET
22 AWG	10,000

Ensure that there is at least 7 volts DC at the sensor for proper operation (10 VDC required for Combustible IR models).

Table 1-2. Cable Length and Wire Size, Combustible Gas Sensor, Frequency Signal Output

In all installations twisted, three-conductor, instrument quality cable is required. In applications where interferences from RFI or EMI or other noise sources exist, shielded cable is recommended.

WIRE SIZE	MAXIMUM CABLE LENGTH IN FEET
22 AWG	350
18 AWG	950
16 AWG	1,500
12 AWG	4,000

For all models, ensure that there is at least 7 volts DC at the sensor for proper operation (10 VDC required for Combustible IR models).

Table 1-3. Cable Length and Wire Size,IR Combustible Sensor

In all installations twisted, three-conductor, instrument quality cable is required. In applications where interferences from RFI or EMI or other noise sources exist, shielded cable is recommended.

WIRE SIZE	MAXIMUM CABLE LENGTH IN FEET
22 AWG	100
18 AWG	800
16 AWG	1,100
12 AWG	2,800

10 volts DC required at the sensor for proper operation of Combustible IR models.

For Milliamp Output

The Ultima Gas Monitor may be connected to any device capable of accepting 4 to 20 mA analog signals such as the:

- Model 5000 unit (with 4 to 20 mA inputs)
- MSA Quad Gas unit
- Programmable controllers
- DCS's, etc.

An external power supply is required. The 4 to 20 mA output version of the Ultima Gas Monitor requires 7 to 30 VDC at the sensor input for proper operation (10 VDC required for Combustible IR models). All connections should be made by following appropriate wire code procedures. For direct mA output modules, ensure minimum and maximum power requirements are met.

- See TABLES 1-4 through 1-7 for typical cable length and wire size for installation.

⚠ WARNING

When using any of the the Ultima accessories (such as the Auto-Calibration Module or Relay Module) with the 4 to 20 mA output Ultima Gas Monitor, the three-wire unit must be used. Failure to use a three-wire unit will damage the electronics within the Ultima Gas Monitor which can result in serious personal injury or death.

When installing in a hazardous area, be sure to install your Ultima Gas Monitor according to National Electrical and local procedural codes. Failure to do so can result in an unsafe condition.

Table 1-4. Cable Length and Wire Size (Toxic Gas or Oxygen) Sensor, 4-20 mA Signal Output (Two Wire Sensor)

In all installations twisted-pair, instrument quality cable is required.
In applications where interferences from RFI or EMI or other noise sources exist, shielded cable is recommended.

WIRE SIZE	MAXIMUM CABLE LENGTH IN FEET @ 24 VDC	MAXIMUM LOAD RESISTANCE	MAXIMUM CABLE LENGTH IN FEET @ 12 VDC	MAXIMUM LOAD RESISTANCE
22 AWG	7,000	600 Ohms	4,000	100 Ohms

Table 1-5. Cable Length and Wire Size Combustible Gas Sensor, 4-20 mA Signal Output (Three Wire Sensor)

In all installations twisted, three-conductor, instrument quality cable is required.
In applications where interferences from RFI or EMI or other noise sources exist, shielded cable is recommended.

WIRE SIZE	MAXIMUM CABLE LENGTH IN FEET @ 24 VDC	MAXIMUM LOAD RESISTANCE	MAXIMUM CABLE LENGTH IN FEET @ 12 VDC	MAXIMUM LOAD RESISTANCE
22 AWG	1,000	600 Ohms	---	250 Ohms
18 AWG	2,500		900	
16 AWG	4,200		1,400	
12 AWG	10,000		3,600	

Table 1-6. Cable Length and Wire Size (Power Supply 24 VDC) (Toxic Gas or Oxygen) Sensor, 4-20 mA Signal Output (Three Wire Sensor)

In all installations twisted three-conductor, instrument quality cable is required. In applications where interferences from RFI or EMI or other noise sources exist, shielded cable is recommended.

WIRE SIZE	MAXIMUM CABLE LENGTH IN FEET	MAXIMUM LOAD RESISTANCE
22 AWG	12,000	600 Ohms

Table 1-7. Cable Length and Wire Size IR Combustible Gas Sensor, 4-20 mA Signal Output (Three Wire Sensor)

In all installations twisted, three-conductor, instrument quality cable is required. In applications where interferences from RFI or EMI or other noise sources exist, shielded cable is recommended.

WIRE SIZE	MAXIMUM CABLE LENGTH IN FEET @ 24 VDC	MAXIMUM LOAD RESISTANCE	MAXIMUM CABLE LENGTH IN FEET @ 12 VDC	MAXIMUM LOAD RESISTANCE
22 AWG	2,000	600 Ohms	100	250 Ohms
18 AWG	5,500		800	
16 AWG	8,000		1,100	
12 AWG	16,000		2,800	

Typical Wiring of the Ultima Gas Monitor

- Two-wire 4 to 20 mA Ultima Monitors operate in the current mode (FIGURE 1-17)
- Three-wire Ultima Monitors operate in the current source, frequency, or multiplex frequency mode, depending on your model. For 4 to 20 mA current source output, see FIGURE 1-18. For multiplex and frequency output models see FIGURE 1-19.

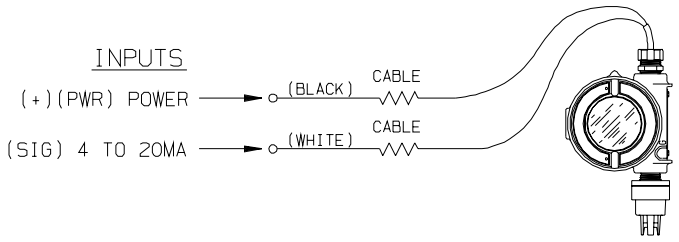


Figure 1-17.
Two-Wire Monitor Operation

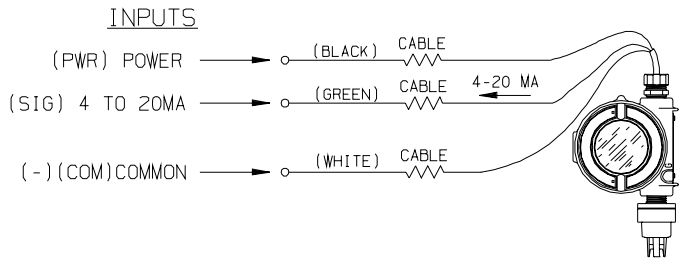


Figure 1-18.
Three-Wire 4 to 20 mA Monitor Operation

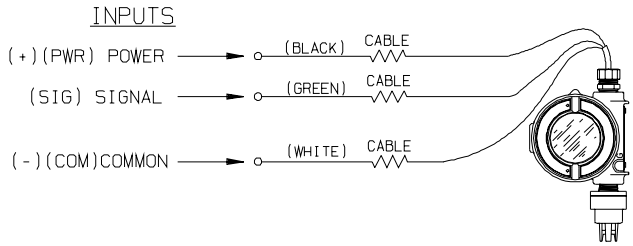


Figure 1-19.
Three-Wire Frequncy or MUX Monitor Operation

Electrical Connections for the Ultima Remote Sensor Module

⚠ WARNING

Before wiring the Ultima Remote Sensor Module, disconnect the power source feeding the Remote Sensor Module and the Ultima Gas Monitor/Less Sensor; otherwise, electrical shock could occur.

Before removing the cover of an explosion-proof Ultima Remote Sensor Module or Ultima Gas Monitor/Less Sensor, verify that the surrounding area does not contain a flammable mixture of combustible gas and air, since a source of ignition is exposed; otherwise, an explosion may occur if a metal object contacts the circuitry and produces sparks.

All Ultima Remote Sensor Modules (except the catalytic combustible model) are supplied with 50 feet of cable. This cable has a connector on one end which plugs into its mate within the Ultima Gas Monitor/Less Sensor. The other end of the cable can be cut to the exact length needed.

⚠ CAUTION

When installing an Ultima Remote Sensor Module with its mating Ultima Gas Monitor/Less Sensor, follow National Electrical and local procedural Codes; failure to do so can result in an unsafe condition.

For Catalytic Type Combustible Models

Three conductors are required for the Combustible Remote Sensor Module. The Ultima unit has a three-wire terminal strip with a pre-attached 18-inch harness pigtail to accommodate #12 AWG conductors; the sensor has a similar terminal strip.

The resistance of each conductor must not exceed that of 50 feet of #12 AWG wire (.08 Ω). For other distances, consult TABLE 1-8.

Table 1-8. Wire Gauge Vs. Distance

DISTANCE (MAX)	WIRE GAUGE
20 FEET	#12, 14 or 16 AWG
30 FEET	#12 or 14 AWG
50 FEET	#12 AWG

NOTES: White and black wires (terminals 1 and 3) must be the same size. The green wire (terminal 2) may be #16 AWG for any distance. Splices must be soldered and insulated or made via screw-clamp terminals.

Most installations require metal pipe or metallic conduit. In these cases, separate conductors or unshielded, three-wire cable may be used. Standard 120 VAC power rated wire or cable is adequate since maximum system voltage is 30 VDC.

For open wiring, shielded wire or cable must be used to minimize the possibility of noise interference and contact with other voltages. Selection of this shielded cable must comply with local requirements.

The preferred colors of the conductors to the remote sensors are white (to terminal #1), green (to terminal #2), and black (to terminal #3). TABLE 1-9 provides suggested cables for Ultima installations; there are other cables available which are also adequate.

Table 1-9. Remote Sensor Wiring Cable	
THE FOLLOWING CABLES ARE THREE-CONDUCTOR, 12-AWG, .625" OD	
CABLE SUPPLIERS	CATALOG NUMBER
CAROL CABLE CO.	02725
ALPHA WIRE CORP.	1937/3
BELDEN WIRE & CABLE CO.	19206

If splices are needed, solder and insulate each connection with electrical tape. Insulated, screw-clamp type inter-connect terminals are also acceptable.

At the Ultima Gas Monitor/Less Sensor Location

Appropriate wiring conduit should be used between the Ultima Gas Monitor and the Ultima Remote Sensor. The cable must be routed through the conduit.

There are two ways to wire the catalytic combustible Ultima Gas Monitor, Less Sensor:

- Using the 18-inch wiring harness
- Using the internal terminal block.

It is better to use the 18-inch wiring harness to connect additional wiring to the Ultima Gas Monitor/Less Sensor. It does not require opening the unit or partial disassembly of the internal assemblies.

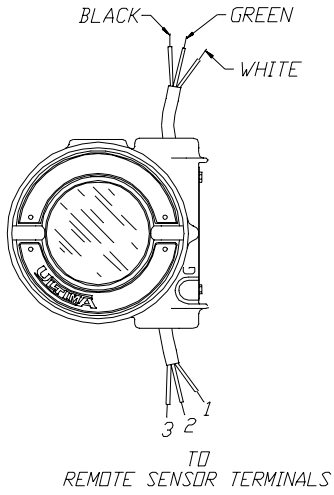


Figure 1-20.
Combustible Catalytic Ultima Gas Monitor

Wiring the Ultima Gas Monitor/Less Sensor Using the 18-inch Wiring Harness

Splice up to 50 feet of additional cable to the wiring harness coming from the Ultima Gas Monitor. Use a properly-rated junction box to make all of the connections. There is no need to open the Ultima enclosure.

The wiring harness conductors are marked as follows:

BLACK (K)	3
GREEN (G)	2
WHITE (W)	1

Identify each conductor of the spliced cable to enable proper connection at the remote sensor.

Wiring the Ultima Gas Monitor/Less Sensor Using the Internal Terminal Block

1. Unscrew the cover of the Ultima Gas Monitor/Less Sensor.

⚠ WARNING

Before removing the cover of an explosion-proof Ultima Gas Monitor/Less Sensor, verify that the surrounding area does not contain a flammable mixture of combustible gas and air, since a source of ignition is exposed; otherwise, an explosion may occur if a metal object contacts the circuitry and produces sparks.

2. Remove the two screws securing the front label assembly (FIGURE 1-21).
3. Pull up and remove the front label assembly and the two printed circuit boards attached to it.

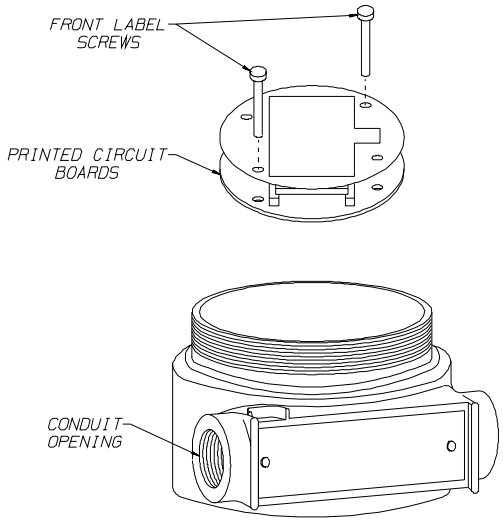


Figure 1-21.
Accessing the Wiring Terminal Block

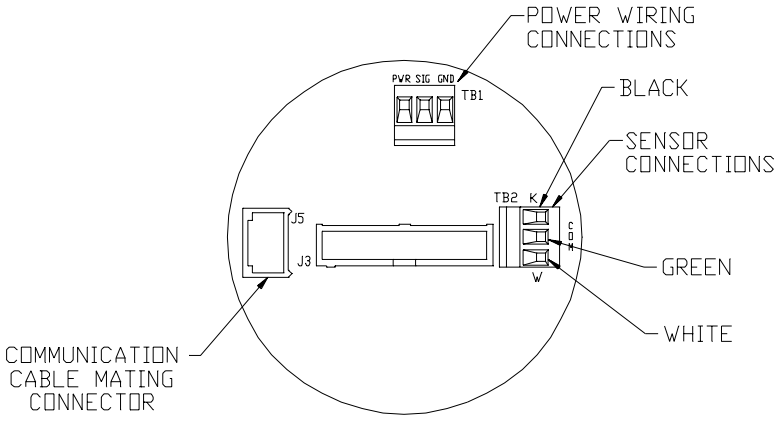


Figure 1-22.
Sensor Wiring Connections

4. Remove the cable from terminal block TB2 (FIGURE 1-22) and pull it through the conduit opening; discard this cable.
5. Route the cable through the conduit opening and wire it to terminal block TB2 on the circuit board that remains in the bottom of the unit. If shielded wire is used, connect the shield to the field wiring shield.
6. Identify each conductor of the cable to enable proper connection at the remote sensor.
7. Re-install the front label assembly and the two printed circuit boards attached to it.
8. Re-install the two screws that secure the front label assembly (FIGURE 1-21).
9. Screw the conduit onto the conduit opening and pull the cable away from the unit to relieve any excess slack.
10. Re-install the cover of the Ultima Gas Monitor/Less Sensor.

⚠ WARNING

Do not let the cover remain off of an explosion-proof Ultima Gas Monitor/Less Sensor. Since a source of ignition is exposed, an explosion may occur if a metal object contacts the circuitry and produces sparks in an atmosphere of combustible gas.

At the Ultima Remote Sensor Location

1. Open the Ultima Remote Sensor cover by unscrewing it.

⚠ WARNING

Before removing the cover of an explosion-proof Ultima Remote Sensor, verify that the surrounding area does not contain a flammable mixture of combustible gas and air since a source of ignition is exposed; otherwise, an explosion may occur if a metal object contacts the circuitry and produces sparks.

2. Route the cable from the Ultima Gas Monitor through the conduit opening and wire it to the terminal block in the bottom of the sensor.
3. Verify the identity of each conductor of the cable and connect the wire to the terminal block (FIGURE 1-23).

TERMINAL BLOCK LOCATION

3
2
1

If shielded wire is used, cut the shield wire short. Do not connect the shield at the remote sensor.

4. Screw the conduit into the conduit opening and relieve any excess slack in the cable.
5. Re-install the cover of the Ultima Remote Sensor.

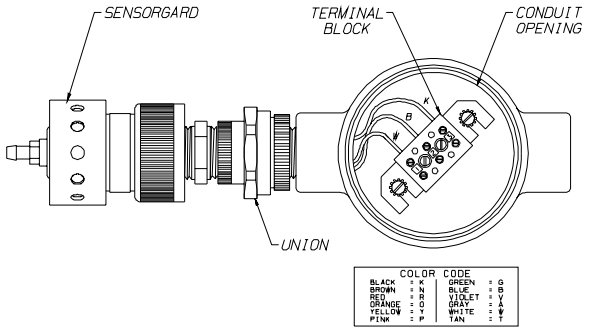


Figure 1-23.
Catalytic Combustible Remote Sensor

⚠ WARNING

Do not let the cover remain off of an explosion-proof Ultima Gas Sensor. Since a source of ignition is exposed, an explosion may occur if a metal object contacts the circuitry and produces sparks in an atmosphere of combustible gas.

For Oxygen Models

Fifty feet of four-conductor cable is supplied with the unit. This cable has a connector on one end which plugs into its mate within the Ultima Gas Monitor/Less Sensor. The other end of the cable can be cut to the exact length needed. Do not run more than 50 feet of cable or splice on any additional cable.

Conduit may also be needed in areas where large amounts of electrical noise is expected.

At the Ultima Gas Monitor/Less Sensor Location

If your installation is in an explosion-proof classified area, see FIGURE 1-24. Appropriate wiring conduit must be used between the Ultima Gas Monitor and the Ultima Remote Sensor. The cable must be routed through the conduit.

If your installation is in a general-purpose area, you can use a sensor cable grip. Follow your local electrical wiring codes. Cut the wire to the proper length needed for your installation. Then, trim back the insulation, shield and the un-insulated wire. Note that there are four wires needed out of the six within the cable.

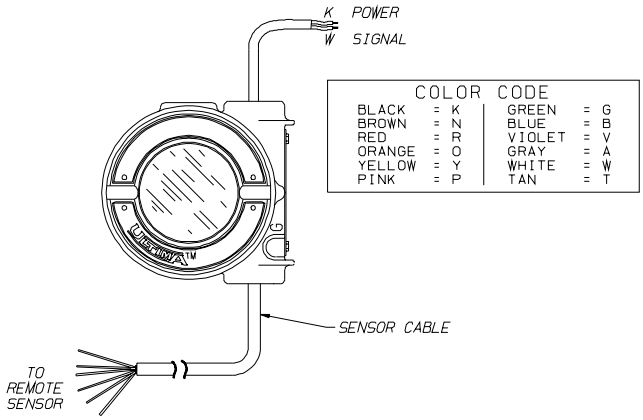


Figure 1-24.
Oxygen and Toxic Ultima Gas Monitor Less Sensor

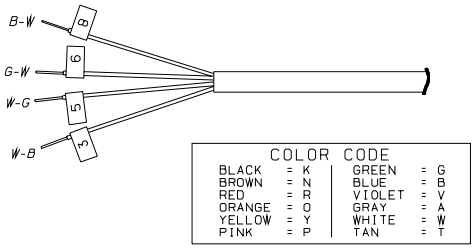


Figure 1-25.
Oxygen Remote Sensor Cable

Use the markings on the conductors at the end of the original cable or see FIGURE 1-25 for the colors of the wires that are needed.

At the Ultima Remote Sensor Location

1. Open the Ultima Remote Sensor cover by unscrewing it.

⚠ WARNING

Before removing the cover of an explosion-proof Ultima Remote Sensor, verify that the surrounding area does not contain a flammable mixture of combustible gas and air since a source of ignition is exposed; otherwise, an explosion may occur if a metal object contacts the circuitry and produces sparks.

2. Route the Ultima Gas Monitor cable through conduit opening and wire it to the terminal block in the bottom of the sensor.
3. Verify the identity of each conductor cable and connect the wire to the terminal block (FIGURE 1-26).

CONDUCTOR ID	TERMINAL BLOCK LOCATION
WHITE WITH BLUE	3
WHITE WITH GREEN	5
GREEN WITH WHITE	6
BLUE WITH WHITE	8

The other wire within the cable is not used. Also, it is unnecessary to connect wire to the other terminal positions within the remote sensor. Do not connect the shield at the remote sensor.

4. Screw the conduit or cable grip or gland into the conduit opening. Relieve any excess slack in the cable.

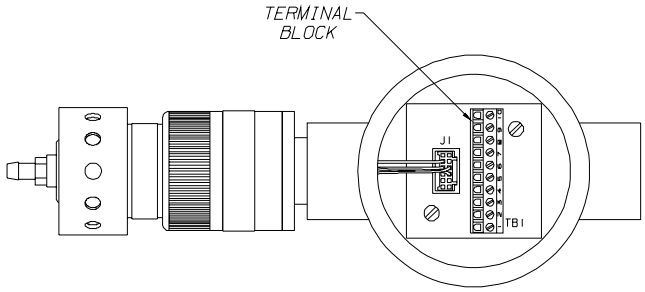


Figure 1-26.
IR Combustible, Oxygen, and Toxic Remote Sensor

5. Re-install the cover on the Ultima Remote Sensor.

⚠ WARNING

Do not let the cover remain off of an explosion-proof Ultima Gas Sensor. Since a source of ignition is exposed, an explosion may occur if a metal object contacts the circuitry and produces sparks in an atmosphere of combustible gas.

For Toxic Gas and IR Combustible Models

Fifty feet of cable is supplied with the unit. This cable has a connector on one end which plugs into its mate within the Ultima Gas Monitor/Less Sensor. The other end of the cable can be cut to the exact length needed. Do not run more than 50 feet of cable or splice on additional cable.

At the Ultima Gas Monitor/Less Sensor Location

If your installation is in an explosion-proof classified area, see FIGURE 1-24. Appropriate wiring conduit must be used between the Ultima Gas Monitor and the Ultima Remote Sensor. The cable must be routed through the conduit.

Conduit may also be needed in areas where large amounts of electrical noise is expected.

If your installation is in a general purpose area, you can use a sensor cable grip. Follow your local electrical wiring codes. cut the wire to the proper length needed for your installation. Trim back the insulation, shield and the un-insulated wire. Use the markings on the conductors at the end of the original cable or see FIGURE 1-27 or FIGURE 1-28 for colors of wires that are needed.

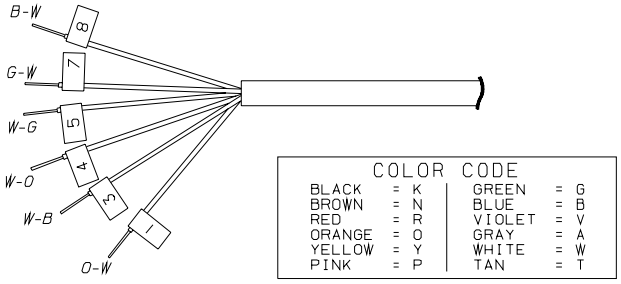


Figure 1-27.
Toxic Gas Remote Sensor Cable

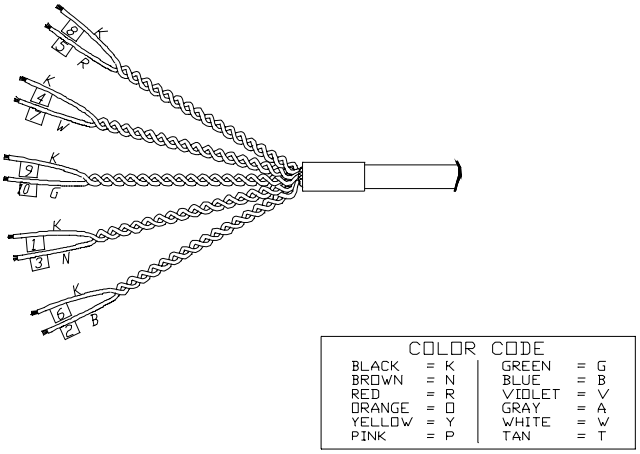


Figure 1-28.
IR Combustible Remote Sensor Cable

At the Ultima Remote Sensor Location

1. Open the Ultima Remote Sensor cover by unscrewing it.

⚠ WARNING

Before removing the cover of an explosion-proof Ultima Remote Sensor, verify that the surrounding area does not contain a flammable mixture of combustible gas and air since a source of ignition is exposed; otherwise, an explosion may occur if a metal object contacts the circuitry and produces sparks.

2. Route the cable from the Ultima Gas Monitor through the conduit opening and wire it to the terminal block in the bottom of the sensor.
3. Verify the identity of each conductor cable and connect the wire to the terminal block (FIGURE 1-26).

   For Toxics, there are no connections to positions 2 and 6 of the terminal block within the remote sensor.

   Do not connect the shield at the remote sensor.
4. Screw the conduit or cable grip or gland into the conduit opening. Relieve any excess slack in the cable.
5. Re-install the Ultima Remote Sensor cover.

⚠ WARNING

Do not let the cover remain off of an explosion-proof Ultima Gas Sensor. Since a source of ignition is exposed, an explosion may occur if a metal object contacts the circuitry and produces sparks in an atmosphere of combustible gas.

Chapter 2
Start-up

Initial Start-up

The Ultima Gas Monitor is factory-calibrated and ready for immediate use. Its range and output are preset. Once power is applied to the unit, the LCD shows a test of all display words. The software version number displays; then, a 25-second warm-up countdown for sensor stability begins (a blank screen appears between each second of countdown time).

- There is no signal output during this warm-up time.

Another test of the LCD is done along with the software version number.

The Monitor then begins to display the gas concentration and corresponding unit of measurement (FIGURE 2-1):

- ppm
- % Gas (for oxygen only)
- % LEL

NOTE: Before calibrating, the Ultima Gas Monitor must be powered for a minimum of one hour to allow the sensor to settle into its new environment for Ethylene Oxide (ETO).

⚠ CAUTION

Before attempting a calibration, power the unit at least one full hour.

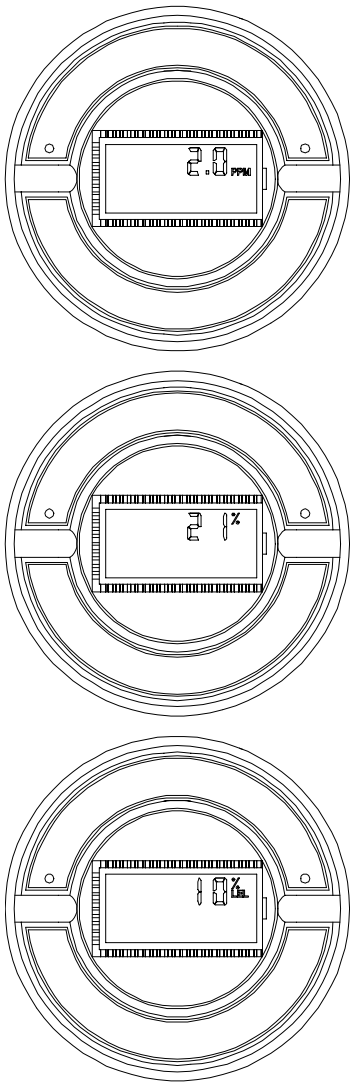


Figure 2-1. LCD Gas Concentration Display

⚠ CAUTION

To ensure a fully functional sensor, perform a calibration check and adjustments at initial start-up.

After initial start-up, the Ultima Gas Monitor also displays a calibration flag as a reminder to perform a field calibration (FIGURE 2-2). While this message is displayed, the Ultima Gas Monitor is functioning within factory-set calibration parameters. Once the first successful field calibration is performed, the calibration flag turns off.

During normal operation, the Ultima Monitor displays the gas concentration of the surrounding environment. The corresponding output signal can be transmitted to a controller. For a complete listing of display and output conditions other than normal operation, see TABLE 4-1.

NOTE: The catalytic combustible model of the Ultima Gas Monitor is capable of detecting concentrations of certain combustible gases above 100% LEL. When exposed to these concentrations, the Ultima Gas Monitor will display one of two modes:

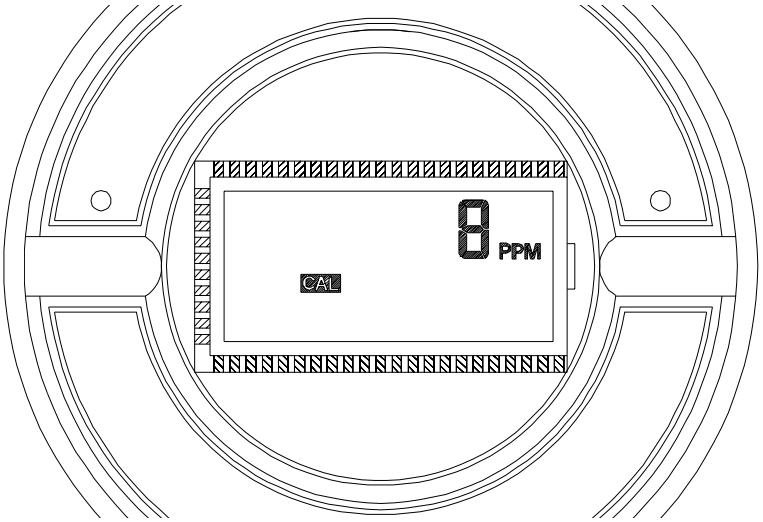


Figure 2-2.
Calibration Flag Display

- + LOC % LEL - The Ultima Gas Monitor has been exposed to a high concentration of gas (above the LEL) and there is a *possibility* that the over-range condition may still exist.

- + 100 % LEL - The Ultima Gas Monitor has been exposed to a high concentration of gas (above the LEL) and the over-range condition *definitely* still exists.

⚠ CAUTION

In either mode, correct the condition causing the excessive gas level and vent or purge the area before attempting the following.

In the + LOC % LEL mode, the output signal will also be locked at full-scale. If this condition occurs, the Ultima Gas Monitor must be unlocked by performing a "Zero Function" with the Ultima Gas Monitor Calibrator or Controller. (See the Ultima Gas Monitor Calibrator or Controller manual for details of "Zero Function"). The Ultima Gas Monitor will not revert to a normal condition until a successful zero operation has been performed. This is an exclusive safety feature of the Ultima Gas Monitor which pre-empts the possibility of ambiguous readings when the sensor is exposed to concentration of gas above 100% LEL.

In the +100% LEL mode, the combustible gas is over the 100% LEL range. It will return to normal operation when the gas concentration level falls below 100% LEL.

Calibration

As with any type of gas monitor, the only true check of its performance is to apply gas directly to the sensor. The frequency of the calibration gas tests depends on the operating time and chemical exposures of the sensors. New sensors should be calibrated more often until the calibration records prove sensor stability. The calibration frequency can then be reduced to the schedule set by the safety officer or plant manager. Before calibrating the sensors, it is good practice to apply power to the unit to allow the sensor to adapt to the new environment.

Sensors should be powered at least one full hour before any calibration attempt is made.

Non-combustible Chemicals that Reduce Catalytic Sensor Sensitivity

Catalytic Combustible sensors located in areas where non-combustible chemicals may leak, particularly ones known to reduce the sensitivity (see following list) should be calibrated after such exposures.

- Silanes, Silicates, Silicones and Halides (compounds containing Fluorine, Chlorine, Iodine or Bromine)
- TABLE 2-1 (at the end of this chapter) lists interferants for electrochemical sensors.

When it is determined that calibration adjustments are required, the Ultima Gas Monitor provides a one-man, non-intrusive method of adjustment at the unit.

To calibrate the unit, one of the following accessories is necessary:

- Ultima Gas Monitor Calibrator P/N 809997 (FIGURE 2-3)
- Ultima Gas Monitor Controller P/N 809086 (FIGURE 2-4)

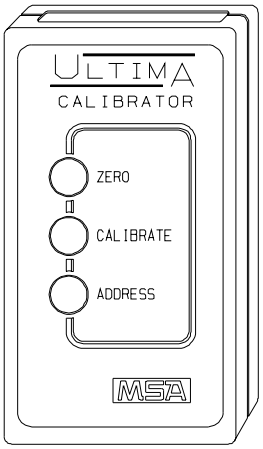


Figure 2-3.
Ultima Gas Monitor Calibrator

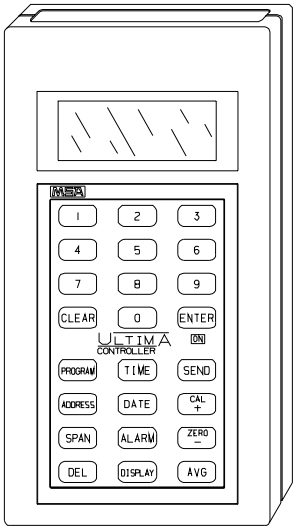


Figure 2-4.
Ultima Gas Monitor Controller

Ultima Gas Monitor Calibrator

The Ultima Calibrator allows the following functions:

- Zero
- Calibration (zero and span)
- Changing of Multiplex address for multiplex output models.

Ultima Gas Monitor Controller

The Ultima Gas Monitor Controller also provides the above functions and access to the additional following features:

- Automatic calibration at timed intervals when used with MSA Ultima Gas Monitor auto-calibration module.
- Three levels of alarm and relays when used with an MSA Ultima Gas Monitor Relay module
- Date of last successful calibration
- Maximum gas readings over selected time periods
- Average gas readings over selected time periods
- Changing of span gas value from factory-set value
- Access to real-time clock for a time and date stamp

See the instruction manual for your Ultima Gas Monitor Calibrator (P/N 813167) or Ultima Gas Monitor Controller (P/N 813379) for proper calibration procedures.

Note on Resetting Latched Alarms

When an Ultima Gas Monitor has an active latched alarm (indicated by a flashing alarm display):

- An infrared (IR) remote device (such as the Ultima Calibrator or Ultima Controller) may be used to reset this alarm.
- The next IR command it receives from a calibration device will reset the latched alarm (if it is not beyond the alarm threshold). The intended IR command will be ignored and interpreted as an 'alarm reset.' When the latching alarm function is inactive, other valid IR commands may be used.

Ultima Gas Monitor Calibration Output Signal

The Ultima Gas Monitor is shipped with the calibration output signal disabled so the output signal will track the gas concentration value during the calibration process. In some applications, it may be desirable to disable or lock the output to a pre-determined output value to prevent activation of alarm devices. The calibration signal can be enabled using the Ultima Controller. When the calibration signal is enabled, the output signal is 12 KHz for frequency and MUX output models; output signal is 3.75 milliamps for the 4 to 20 milliamp output models.

NOTE: For the range of 25% oxygen, the calibration signal will be 21 mA.

Table 2-1. Sensor Response to Interferants

INTERFERANT	CONCEN-TRATION (PPM)	CO	H_2S	SO_2	HCN	NO_2	CL_2	NO	CLO_2
Acetone	1000	0	0	0	0	0	No Data	No Data	No Data
Acetylene	12000	No Data	0	No Data	No Data	0	No Data	No Data	No Data
Ammonia	100	0	0	No Data	0	0	-1.0	No Data	0
Benzene	20	0	0	0	0	0	0	No Data	0
Carbon Dioxide	5000	0	0	0	2.5	0	1.0	No Data	0
Carbon Disulfide	15	2	0	No Data	0.1	No Data	0	No Data	0
Carbon Monoxide	100	100	7	0.2	1	0	0	-3	0
Chlorine	5	0	0	-6	-0.2	4	5	0	2.5
Dimethyl Sulfide	5	2	0.4	3	-0.2	0	0	No Data	0
Ethanol	100	115	0	0	0	0	0.0	No Data	No Data
Ethylene	50	99	0.1	0	-0.3	0	0	No Data	0
Ethyl Ether	400	3	No Data	No Data	No Data	0	No Data	No Data	No Data
Freon 12	1000	-2	0	No Data	2	0	0	No Data	0
Freon 113	1000	1	0	No Data	2.4	No Data	No Data	No Data	No Data
Freon 12Bl	1000	0	0	No Data	No Data	No Data	No Data	No Data	No Data
Freon 13Bl	1000	0	0	No Data	No Data	No Data	No Data	No Data	No Data
Hexane	500	0	0	0	0	0	0	No Data	0
Hydrogen	500	28	0.5	15	0	-15	0	No Data	0
Hydrogen Chloride	50	0	0	No Data	No Data	0	0.0	4	No Data
Hydrogen Cyanide	10	5	0	3	10	0	0.1	0	0
Hydrogen Sulfide	10	0	10	0	50	-8	-1.4	4	-0.25
Isopropanol	50	40	0	0	0	0	0	No Data	0
Mercaptan (Ethyl)	5	7	2.7	No Data	6.5	No Data	0	No Data	0
Mercaptan (Methyl)	5	7	4.5	No Data	6	No Data	No Data	No Data	No Data
Methane	50000	0	0	0	1	0	0	No Data	0
Methanol	50	130	0	0	0.1	0	0	No Data	0
Methyl Amine	100	0	No Data	No Data	No Data	0	No Data	No Data	No Data
Methyl Bromide	500	0	No Data	0	No Data	0	No Data	No Data	No Data
Methyl Ethyl Ketone	200	0	No Data	0	No Data	0	No Data	No Data	No Data
Nitric Oxide	100	10	2.2	2	-3	3	0.0	100	1
Nitrogen Dioxide	10	-2	-8.4	-10	-20	10	0.1	2	6
Sulfur Dioxide	150	1	4.7	NA	400	0	0	7.5	0
Tichloroethylene	1000	0	No Data	0	No Data	No Data	No Data	No Data	No Data

Table 2-1. Sensor Response to Interferants (continued)

INTERFERANT	CONCEN-TRATION (PPM)	Br_2	F_2	SiH_4	PH_3	AsH_4	GeH_3	B_2H_6	HCL
Ammonia	25	0	0	No Data	No Data	No Data	No Data	No Data	0
Arsine	1	No Data	No Data	1	0.7	1	1	5	1
Bromine	2	2	3	No Data	No Data	No Data	No Data	No Data	0
Butane	100	0	0	0	0	0	0	0	0
Carbon Dioxide	2000	0	0	0	0	0	0	0	0
Carbon Monoxide	100	0	0	0	0	0	0	0	0
Chlorine	2	2.5	4	No Data	No Data	No Data	No Data	No Data	0
Diborane	20	No Data	No Data	4	3.5	5	5	20	0
Fluorine	5	1.5	5	No Data	No Data	No Data	No Data	No Data	0
Germane	1	No Data	No Data	1	0.7	1	1	5	1
Hydrogen	400	No Data	No Data	0.2	0.1	0.2	0.2	0.1	0
Hydrogen Chloride	40	0	0	No Data	No Data	No Data	No Data	No Data	40
Hydrogen Cyanide	10	0	0	No Data	No Data	No Data	No Data	No Data	0
Hydrogen Sulfide	10	0	0	20	3	7	7	50	40
Methane	2.5%	0	0	0	0	0	0	0	0
Nitrogen Dioxide	5	0	0	No Data	No Data	No Data	No Data	No Data	0
Nitrogen Oxide	50	0	0	No Data	No Data	No Data	No Data	No Data	20
Phosgene	10	0.5	1.5	0	0	0	0	0	0
Phosphine	0.5	No Data	No Data	0.7	0.5	1	1	3	2
R134A	10	0	0	0	0	0	0	0	0
Silane	5	No Data	No Data	5	0.1	0.2	0.2	15	7
Sulfur Dioxide	10	0	0	15	2.5	5	5	40	0

Table 2-1. Sensor Response to Interferants (continued)

INTERFERANT	CONCENTRATION (PPM)	NH_3	ETO	H_2	CO_2
Ammonia	25	25	0	No Data	No Data
Carbon Monoxide	100	0	No Data	2	No Data
Carbon Monoxide	300	No Data	No Data	No Data	0
Chlorine	10	0	0	0	No Data
Ethylene	50	0	No Data	No Data	No Data
Hydrogen Chloride	40	0	No Data	0	No Data
Hydrogen Cyanide	10	0	0	0	No Data
Hydrogen Sulfide	40	2	No Data	0	No Data
Methane	2.5%	No Data	No Data	No Data	0
Nitric Acid	50	0	No Data	3	No Data
Nitrogen Dioxide	10	0	0	0	No Data
Pentane	0.75%	No Data	No Data	No Data	0
Phosphine	0.5	0	0	0	No Data
Propane	0.6%	No Data	No Data	No Data	0
Sulfur Dioxide	10	0	No Data	0	No Data

Chapter 3
Specifications

Table 3-1. Performance Specifications

GAS TYPES		Combustibles, Oxygen & Toxics	
TEMPERATURE RANGE	**TOXICS & OXYGEN**	**OPERATING RANGE:**	0 to 40°C (32 to +104°F)
		***EXTENDED RANGE:**	-20 to +50°C (-4 to +122°F)
	HYDROGEN	**OPERATING RANGE:**	10 to 40°C (50 to 104°F)
		***EXTENDED RANGE:**	-20 to +50°C (-4 to +122°F)
	AMMONIA	**OPERATING RANGE:**	10 to 40°C (50 to 104°F)
		***EXTENDED RANGE:**	-10 to +50°C (-14 to +122°F)
	CATALYTIC COMBUSTIBLES	**SINGLE MODULE:**	-40 to +50°C (-40 to +122°F)
		DUAL MODULE:	-40 to +90°C (-40 to +194°F)
	IR COMBUSTIBLES		-20 to +50°C (-4 to +122°F)
	IR CARBON DIOXIDE	**OPERATING RANGE:**	0 to 40°C (32 to +104°F)
		***EXTENDED RANGE:**	-10 to +50°C (-14 to +122°F)
DRIFT	**ZERO DRIFT**		Less than 5%/year, typically
	SPAN DRIFT		Less than 10%/year, typically
NOISE		Less than 1% FS	

***EXTENDED RANGE** = The sensor may not meet all of the accuracy parameters listed. Calibrate within operating range.

Table 3-1. Performance Specifications

	GAS	LINEARITY	REPEATABILITY
ACCURACY	CARBON MONOXIDE	the greater of ±2% full scale (FS)	±1% FS or 2 ppm
	OXYGEN	±2% FS	±1% FS
	HYDROGEN SULFIDE	±10% FS or 2 ppm	±1% FS or 2 ppm
	CHLORINE	±10% FS or 2 ppm	±5% FS or 1 ppm
	SULFUR DIOXIDE	±10% FS or 2 ppm	±1% FS or 2 ppm
	NITRIC OXIDE	±10% FS or 2 ppm	±1% FS or 2 ppm
	NITROGEN DIOXIDE	±10% FS or 2 ppm	±4% FS or 1 ppm
	HYDROGEN CYANIDE	±10% FS or 2 ppm	±4% FS or 2 ppm
	HYDROGEN CHLORIDE	±10% FS or 2 ppm	±10% FS or 2 ppm
	CATALYTIC COMBUSTIBLE GAS	±2% of scale	±1% FS
	IR COMBUSTIBLE GAS	<60% LEL - ±3% >60% LEL - ±5%	±1% FS
	IR CARBON DIOXIDE	±10% FS	±5% FS
	CHLORINE DIOXIDE	±10% FS or 2 ppm	±5% FS or 1 ppm
	ETHYLENE OXIDE	±10% FS	±5% FS
	AMMONIA	±10% FS	±5% FS
	HYDROGEN	±5% FS	±5% FS

Table 3-1. Performance Specifications

STEP CHANGE RESPONSE	**TIME TO REACH 20% OF SCALE:**	
	OXYGEN & TOXICS	Less than 12 seconds (typically 6 seconds)
	ETHYLENE OXIDE	Less than 20 seconds
	TIME TO REACH 50% OF SCALE:	
	OXYGEN & TOXICS	Less than 30 seconds (typically 12 seconds)
	ETHYLENE OXIDE	Less than 45 seconds
	COMBUSTIBLES	Less than 10 seconds
	IR CARBON DIOXIDE	Less than 25 seconds
	SULFUR DIOXIDE	Less than 22 seconds
	TIME TO REACH 90% OF SCALE:	
	ETHYLENE OXIDE	Less than 120 seconds
	COMBUSTIBLES	Less than 30 seconds
	IR CARBON DIOXIDE	Less than 60 seconds
	SULFUR DIOXIDE	Less than 195 seconds
HUMIDITY	**OXYGEN & TOXICS**	15 to 95% RH, non-condensing, 24 hours or less
		35 to 95% RH, long term
	COMBUSTIBLE IR CARBON DIOXIDE	0 to 95%

Table 3-1. Performance Specifications

SENSOR LIFE	**CATALYTIC COMBUSTIBLES**	3 years, Typically	
	IR CO_2 & COMBUSTIBLES	5 years, Typically	
	OXYGEN &TOXICS	2 years, Typically	
	FULL REPLACEMENT WARRANTY	1 year; 2 years for IR Combustibles & CO_2	
HAZARDOUS AREA RATING	**EXPLOSION-PROOF MODELS**	Class I, Div. 1, Groups B, C & D	
	NEMA 4X	For explosion-proof models only	
	INTRINSICALLY SAFE	**COMBUSTIBLE, OXYGEN & TOXICS**	frequency and milliamp outputs only
WIRING REQUIREMENTS	**mA OUTPUT**	**OXYGEN & TOXICS**	2-wire or 3-wire
		COMBUSTIBLES & CO_2	3-wire
	FREQUENCY & MULTIPLEX OUTPUTS		3-wire
POWER INPUT **(for power input with internal relays, see Appendix C)**	**mA VERSIONS**	**OXYGEN & TOXICS**	7-30 VDC @ 41 mA max.
		CATALYTIC COMBUSTIBLES	7-30 VDC @ 450 mA maximum
		IR COMBUSTIBLES & CO_2	10-30 VDC @ 200 mA maximum
	FREQUENCY & MULTIPLEX VERSIONS	Supplied by MSA controllers	

Table 3-1. Performance Specifications

SIGNAL OUTPUT	**4-20 mA**	**COMBUSTIBLES**	3-wire current source
		OXYGEN & TOXICS	2-wire current sink or 3-wire current source
	FREQUENCY & MULTIPLEX VERSIONS	4-9 khz	
PHYSICAL	**SIZE**	9 x 6 x 5 inches (228.5 x 152.4 x 127 cm)	
	WEIGHT	4.5 pounds (2.041 kilograms)	

Chapter 4
Maintenance

General

The only routine maintenance item is the sensing element itself, which has a limited lifetime. When the Ultima Gas Monitor's read-out indicates that the sensor must be changed, there is very little sensor lifetime remaining. It is good practice to obtain a replacement sensing element before the sensing element within your unit becomes inoperative.

The Ultima Gas Monitor is constantly performing a self-check. When a problem is found, it displays the appropriate error code. (TABLE 4-1, "Troubleshooting Guidelines"). When any of these errors are detected within the unit, the output signal falls to its lowest possible output.

- For frequency output units: lowest possible output is 0 KHz
- For 4 to 20 milliamp output models: lowest output is <3.75 mA
- The "Change Sensor" indication is not an error and does not affect the output.

Replacing the Sensor

Typically, the Ultima Monitor LCD display shows a maintenance message when the sensor is due for replacement (FIGURE 4-1).

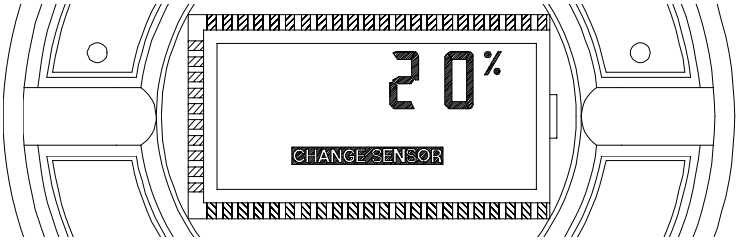


Figure 4-1.
Change Sensor Flag

Hydrogen Cyanide and Hydrogen Chloride Sensors

NOTE: This NOTE and the following CAUTION apply to the Ultima Series sensors for Hydrogen Cyanide (HCN) and Hydrogen Chloride (HCL) only.

The Ultima Series product line contains a sensor detection function to alert the user of a sensor disconnection problem by displaying "ERR 1" on the LCD display.

⚠ CAUTION

The sensor detection function is NOT present in the HCN, HCL, or SO_2 version of the Ultima series. Therefore, an HCN, HCL, or SO_2 sensor disconnection will NOT be indicated by an "Err 1" display. A periodic check with a known concentration of calibration gas must be performed regularly to ensure proper sensor function. See "Calibration" portion of Chapter 2 in this manual for calibration instructions.

1. To replace the sensor, remove power from the Ultima Monitor.

⚠ WARNING

Handle the sensor carefully; the electrochemical version is a sealed unit which contains a corrosive electrolyte. If electrolyte is leaking from the sensor, exercise CAUTION to ensure the electrolyte does not contact skin, eyes or clothing, thus avoiding burns. If contact occurs, rinse the area immediately with a large quantity of water. In case of contact with eyes, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

⚠ CAUTION

Do not install a leaking sensor in the sensing head assembly. The leaking sensor should be disposed of in accordance with local, state and federal laws. To obtain a replacement sensor, contact MSA at the address given under "Obtaining Replacement Parts."

⚠ WARNING

Before removing the cover of an explosion-proof Ultima Gas Monitor, sample the area around the enclosure with a portable combustible gas indicator (such as the MSA Passport® Personal Alarm) to make sure the surrounding area does not contain a flammable mixture of combustible gas and air. When the enclosure is open and connected to power, a source of ignition exists which could cause the explosion of combustible gas, resulting in damage, serious personal injury and death.

2. There is no need to open the main enclosure; simply unscrew the cap located on the bottom of the Ultima Gas Monitor main assembly (FIGURES 4-2 through 4-4). For catalytic

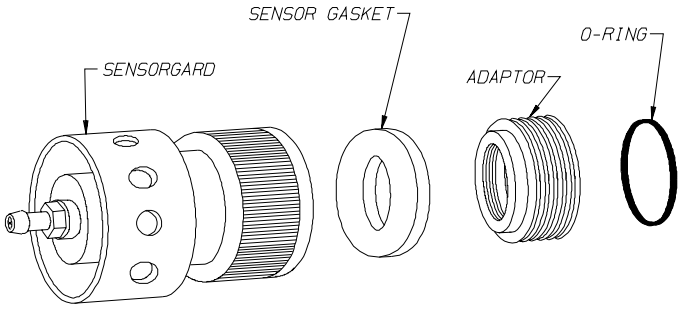


Figure 4-2.
Cap for Catalytic Combustible Gas Explosion-proof Model

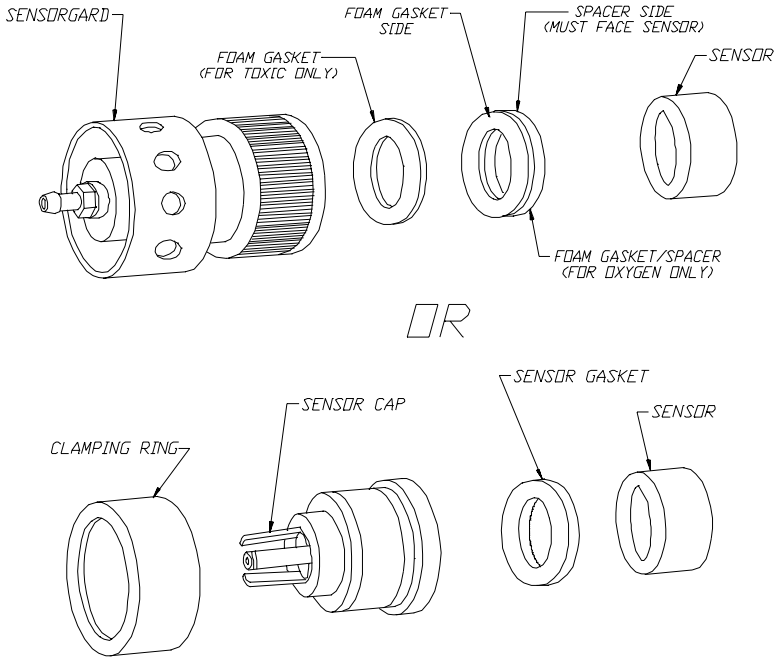


Figure 4-3.
Cap for Toxic Gas or Oxygen General-purpose Model

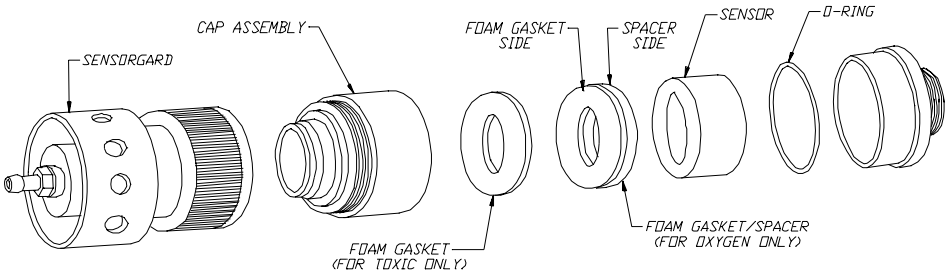


Figure 4-4.
Cap for Toxic Gas, Oxygen, or Combustible IR Explosion-proof Model

combustible versions, unscrew the gas-tight union [(if present) FIGURE 1-23].

3. Identify the sensor element needed and obtain the same type of sensor element.
4. **Toxic, Oxygen, or Combustible IR Sensors:**
   Unplug the sensor by pulling it straight down; dispose of sensor properly.

   Catalytic Combustible Sensors:

   - Catalytic Combustible units have a three-pin connector; release the locking clip and pull apart the connector (FIGURE 4-5).
5. **Toxic, Oxygen, or Combustible IR Sensors:**
   Before installing the sensor, check the pins of the sensor for a shorting clip; remove the shorting clip and the label beneath the clip before installing the sensor. Install the new sensor by aligning the pins; do not force onto pins.

   Catalytic Combustible Sensors:
   Connect the three-pin connector on the new sensor (FIGURE 4-5). Carefully reconnect the union, taking care not to pinch the wires.

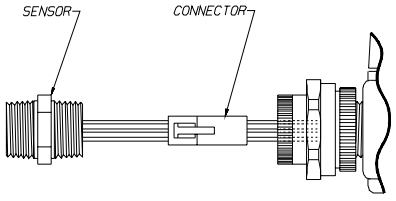


Figure 4-5.
Catalytic Combustible Three-Pin Connector

6. Replace gortex disc (if necessary) and gasket located in the bottom of the cap with the new disc and gasket supplied with the sensor; push the cap onto the sensor.
7. In a clockwise direction, screw the end cap retaining ring back onto the sensor housing.

⚠ CAUTION

Do not over-tighten the sensor on the inlet fitting; otherwise, damage to the sensor may result.

8. Re-apply power to the Ultima Gas Monitor.
9. Perform the ***INITIAL*** Calibration Procedure as outlined in the Ultima Gas Monitor Calibrator or Ultima Gas Monitor Controller instruction manual. This procedure differs slightly from a standard calibration procedure. Use of the ***INITIAL*** calibration procedure upon installation of a new sensor ensures the Ultima Gas Monitor will perform a successful calibration. Failure to do so may result in a CAL FAULT reading (FIGURE 4-6).

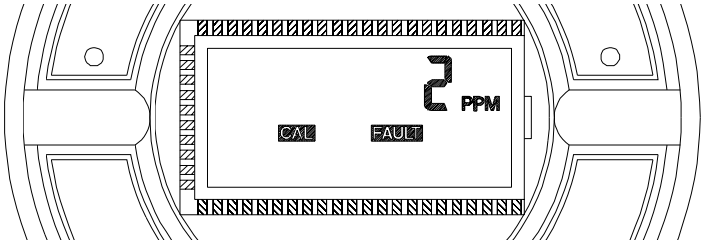


Figure 4-6.
CAL FAULT Reading

It is recommended that all other maintenance be performed at an MSA factory-authorized service center. See TABLE 4-1 for troubleshooting guidelines.

Table 4-1. Troubleshooting Guidelines

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
Unit will not power up properly	Insufficient voltage or current from power supply. Incorrect wiring connections. Wire strands touching at input terminal block.	Check power supply and interconnecting wires.
Display shows **CAL FAULT**	Cell signal too low or too high during calibration. Unstable calibration signal.	Check calibration gas and flow system; then, recalibrate (valid calibration or Initial Calibration will clear display).
	Old or damaged cell.	Replace cell and perform **Initial** Calibration. (If original cell is new, an **Initial** Calibration alone may solve the problem.)
	Failed autocal calibration	If unit is incorrectly set up for autocal, disable the autocal mode by setting Future Calibration Date to 12-31-1993; check the autocal flow system.
	Jumper setting changed.	For IR Combustibles, check Jumper JP1 on the printed circuit board with power connection. JP1 should not be installed for methane detection. JP1 should be installed for non-methane hydrocarbon detection. Incorrect setting may lead to a CAL FAULT.
Display shows **CAL**	Sensor cell replacement was detected or display was factory-set.	Perform **Initial** Calibration if unit is new or cell was replaced. Perform regular calibration if same cell was re-installed.
Display flashes **Err 1***	Sensor cell detected as missing.	Inspect cell for proper placement. After recovery, see above SYMPTOM: "Display shows **CAL**".
	Damaged sensor body	Replace sensor body and perform **Initial** Calibration.

***Hydrogen Cyanide, Hydrogen Chloride, and Sulphur Dioxide Sensors**

NOTE: This NOTE and the following CAUTION apply to the Ultima Series sensors for Hydrogen Cyanide (HCN), Hydrogen Chloride (HCL), and Sulphur Dioxide (SO_2) only. The Ultima Series product line contains a sensor detection function to alert the user of a sensor disconnection problem by displaying "ERR 1" on the LCD display.

⚠ CAUTION

The sensor detection function is NOT present in the HCN, HCL, NH_3, 100 ppm H_2S, or SO_2 version of the Ultima series. Therefore, an HCN, HCL, NH_3, 100 ppm H_2S, or SO_2 sensor disconnection will NOT be indicated by an "Err 1" display. A periodic check with a known concentration of calibration gas must be performed regularly to ensure proper sensor function. See "Calibration" portion of Chapter 2 in this manual for calibration instructions.

Table 4-1. Troubleshooting Guidelines

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
Display flashes **Err 2**	Invalid cell type.	Replace or repair display board.
Display flashes **Err 3**	Non-volatile memory not detected.	Cycle power or repair unit.
Display flashes **Err 4**	Non-volatile memory reset or not initialized (cell type changed).	Perform **Initial** Calibration.
	Damaged sensor or sensor body	Replace sensor or sensor body and perform **Initial** Calibration.
Display flashes **Err 5**	Internal relay inoperative.	Repair or replace internal relay board.
		Add noise suppression device (see Appendix C, "Relay Connections" for details).
Display flashes **Err 6, 7, 10**		Reserved
Display flashes **Err 8**	Communication error (IR only)	System will attempt automatic recovery. If error persists, reduce any excessive electrical noise; replace printed circuit board with power connection.
Display flashes **Err 9**	Sensor out of range, math error (IR only)	Perform Initial Calibration.
	Low input voltage	Correct input voltage (see TABLE 3-1)
Display flashes **Err 11**	Communication error (IR only)	System will attempt recovery. If error persists, replace printed circuit board with power connection.
Display flashes **Err 12**	New EEPROM installed (IR only)	Perform Initial Calibration.
Output signal not present	Address not set properly (MUX only).	Set MUX address.
	Sensor cell missing.	See SYMPTOM: "Display flashes **Err 1**".
	Sensor signal is under-range.	See SYMPTOM: "Display shows **UND**".
	Error detected.	See "Symptom" column for specific error.
Display shows CHANGE SENSOR	Sensor cell output is below acceptable signal level.	Replace sensing cell and perform an **Initial** Calibration.

Table 4-1. Troubleshooting Guidelines

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
No response to manual ZERO or CAL command	Unit is set up for AUTOCAL use, and autocal unit or gases are not present.	De-activate AUTOCAL mode by setting Future Calibration date to 12-31-1993.
Display shows UND	Cell signal is under-range.	Perform regular calibration. If calibration fails, see above SYMPTOM: "Display shows **CAL FAULT**". If UND persists, replace cell and perform **Initial** Calibration. NOTE: Although sensor output is not present during **UND** condition with no gas present, output will correctly respond to the presence of gas. When gas is no longer present, output will no longer be present. This function serves to alert the user that an abnormal condition exists and calibration or other maintenance is required.
Low gas reading	Clogged sensor water stop disc.	Clean or replace disc.
	Misaligned stop disc.	Re-align disc and gasket.
	Poor gas flow or damaged cell.	See SYMPTOM "Display shows **CAL FAULT**".

Obtaining Replacement Parts

See TABLE 4-2 for replacement sensor kits. To obtain a replacement sensor, address the order or inquiry to:

Mine Safety Appliances Company
Instrument Division
P.O. Box 427, Pittsburgh, PA 15230-0427

or call, toll-free, 1-800-MSA-INST.

⚠ WARNING

Use only genuine MSA replacement parts when performing any maintenance procedures provided in this manual. Failure to do so may seriously impair sensor performance. Repair or alteration of the Ultima Gas Monitor, beyond the scope of these maintenance instructions or by anyone other than authorized MSA service personnel, could cause the product to fail to perform as designed and persons who rely on this product for their safety could sustain serious personal injury or death.

Table 4-2. Replacement Parts

REPLACEMENT SENSOR KITS	
GAS	**SENSOR KIT PART NO.**
Phosphine, 2 ppm	10018081
Arsine, 2 ppm	10018082
Silane, 25 ppm	10018083
Diborane, 50 ppm	10018084
Germane, 3 ppm	10018085
Fluorine, 5 ppm	10012903
Bromine, 5ppm	10012904
Carbon Monoxide, 100 ppm	813613
Carbon Monoxide, 500 ppm	
Sulfur Dioxide, 25 ppm	813615
Hydrogen Sulfide, 10 ppm and 50 ppm	813616
Hydrogen Sulfide, 100 ppm	813618
Nitrogen Oxide, 100 ppm	813619
Nitrogen Dioxide, 10 ppm	813620
Chlorine, 5 ppm or Chlorine Dioxide, 3 ppm	710967
Hydrogen Cyanide, 50 ppm	711284
Hydrogen Chloride, 50 ppm	813623
Oxygen, 0-25%	813723
Catalytic Combustible Gas, 100% LEL	813624
IR Combustible Gas, 100% LEL	10018974
Ammonia	10018903
Hydrogen	10022383
IR Carbon Dioxide	10029338
Ethylene Oxide	10022385
SENSORGARD REPLACEMENT PARTS	
Carbon Monoxide - General Purpose	710222
Carbon Monoxide - General Purpose - Duct Mount	710260
Carbon Monoxide - Explosion-proof	710224
Carbon Monoxide - Explosion-proof - Duct Mount	710262
Oxygen - General Purpose	710225
Oxygen - General Purpose - Duct Mount	710261

Table 4-2. Replacement Parts	
Oxygen - Explosion-proof	710224
Oxygen - Explosion-proof - Duct Mount	710262
Hydrogen Sulfide - General Purpose	710222
Hydrogen Sulfide - General Purpose - Duct Mount	710260
SENSORGARD REPLACEMENT PARTS	
Hydrogen Sulfide - Explosion-proof	710224
Hydrogen Sulfide - Explosion-proof - Duct Mount	710262
Chlorine - General Purpose	812075
Sulfur Dioxide - General Purpose	710222
Sulfur Dioxide - General Purpose - Duct Mount	710260
Nitric Oxide - General Purpose	710222
Nitric Oxide - General Purpose - Duct Mount	710260
Nitric Oxide - Explosion-proof	710224
Nitric Oxide - Explosion-proof - Duct Mount	710262
Nitrogen Dioxide - General Purpose	812075
Nitrogen Dioxide - Explosion-proof	812074
Hydrogen Cyanide - General Purpose	812075
Hydrogen Cyanide - Explosion-proof	812074
Hydrogen Chloride - General Purpose	812075
Chlorine Dioxide - General Purpose	812075
Combustible Gas - Explosion-proof	710346
Combustible Gas - Explosion-proof - Duct Mount	710347
Combustible Gas IR - Methane - Explosion-proof	710224
Combustible Gas IR - Methane - Explosion-proof - Duct Mount	710262
Combustible Gas IR - Non-Methane - Explosion-proof	710224
Combustible Gas IR - Non-Methane - Explosion-proof - Duct Mount	710262
Phosphine - General Purpose	710222
Phosphine - General Purpose - Duct Mount	710260
Phosphine - Explosion-proof	812074
Phosphine - Explosion-proof - Duct Mount	710262
Arsine - General Purpose	710222
Arsine - General Purpose - Duct Mount	710260
Arsine - Explosion-proof	812074
Arsine - Explosion-proof - Duct Mount	710262

Table 4-2. Replacement Parts	
Silane - General Purpose	710222
Silane - General Purpose - Duct Mount	710260
Silane - Explosion-proof	812074
SENSORGARD REPLACEMENT PARTS	
Silane - Explosion-proof - Duct Mount	710262
Germane - General Purpose	710222
Germane - General Purpose - Duct Mount	710260
Germane - Explosion-proof	812074
Germane - Explosion-proof - Duct Mount	710262
Diborane - General Purpose	710222
Diborane - General Purpose - Duct Mount	710260
Bromine - General Purpose	812075
Fluorine - General Purpose	812075

Appendix A
Optional Ultima Duct Mount Kit

General

The Ultima Duct Mount Kit (FIGURE A-1) provides convenient Ultima Gas Monitor sampling of gas within an air duct.

- This Kit enables duct gas sampling even when flow rate within the duct is at a high velocity.
- The user can calibrate the sensor via a calibration port without disassembling or removing the sensor from the duct.
- The sensor and the Kit are sealed to the duct to prevent gas within the duct from escaping.

  NOTE: The Ultima Duct Mount Kit will not fit the Ultima Gas Monitor with internal relays.

- If relays are necessary, the Ultima Gas Monitor remote sensor must be used.
- All Ultima remote sensors fit into the remote sensor model of the Ultima Duct Mount Kit.

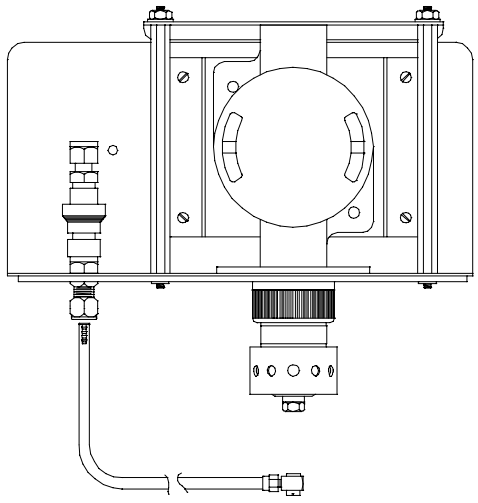


Figure A-1.
Ultima Duct Mount Kit

There are two types of Duct Mount Kits:

- Single Module Model
- Dual Module Model

The Single module Duct Mount Kit:

- Places the entire Ultima Gas Monitor on the duct. The sensor is then wired to the controller, ventilation or other safety equipment.

The Remote Sensor Module Duct Mount Kit:

- Allows the sensor portion of the unit to be mounted on the duct (perhaps in an inaccessible location), while the read-out and calibration portion are placed in an easily accessible location to:
    - save valuable maintenance time and money
    - enhance calibrator safety.

If moving an existing, installed Ultima Gas Monitor to a duct with a Duct Mount Kit, additional parts are necessary. Contact MSA to obtain the additional materials.

Mounting

General

Mounting the Ultima Gas Monitor on a duct is easily done with the Duct Mount Kit. The proper location on the duct will permit your sensor to operate up to its potential.

Choose a location on the duct:

- Where the duct is flat or level:
    - The Duct Mount Kit will not mount on a diameter of less than eight inches (203 mm) of rounded or curved duct work.
    - Additional gasketing may be necessary to properly seal the unit.
- As far away from any bends or tees as possible, as those locations may have additional turbulence
- Where reasonable access is possible to enable sensor replacement
- That keeps the sensor pointing downward:
    - It is good practice to mount the sensor on horizontal run of the duct.

- Mount the sensor on ***top*** of the duct to allow water and dirt to naturally drip off the sensor within the duct and prevent clogging.

- That allows the dual module sensor calibration gas tubing to be routed to the read-out module. Any gas-compatible tubing can be used (not supplied in Kit).
    - Keep this tubing as straight and short as possible.
- Beyond any filter or cleaning unit.
- Away from the lowest point on the duct, which tends to collect additional dirt and dust.
- Away from any fans or blowers.

The Ultima Gas Monitor with Duct Mount Kit requires some assembly before mounting. It is necessary to temporarily remove the sensor from the module housing and install the sealing gaskets. All necessary hardware is provided in the Kit.

Mounting the Single Module Model

1. Locate the duct to be sampled.
2. Using dimensions from FIGURE A-2, cut a rectangular hole [8.875 by 2.7 inches (225 by 68.5 mm)] in the duct.
    - The gasket on the bottom of Duct Mount Kit must sit flat on the duct.
    - If necessary, pre-drill the fastener holes.
    - Do not remove the gasket paper lining on the Duct Mount Kit at this time

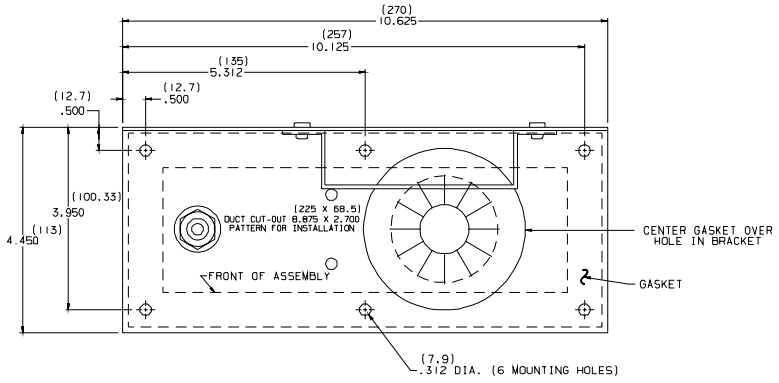


Figure A-2.
Duct Template

- On rounded ducts, additional gasketing may be required for proper sealing.

3. Locate and identify all of the component parts that are in the Duct Mount Kit (TABLE A-1).

Table A-1. Single module Duct Mount Kit Parts List

DESCRIPTION	PART NUMBER	FIGURE
Ultima Gas Monitor Mounting bracket	814634	A-3
Quantity of 4 of #10-32 X 5/16 screw	634054	
Quantity of 4 of #10 lock washers	627852	
Quantity of 2 of Ultima Gas Monitor spacers	710768	A-4
Ultima Gas Monitor clamp	710771	A-5
Ultima Gas Monitor enclosure gasket	710770	A-6
Ultima Gas Monitor plate	710769	A-7
Ultima Gas Monitor Duct Mount Kit base plate	814633	A-8
Quantity of 2 of 1/4 inch hex nut	631357	
Quantity of 2 of 1/4 inch lock washers	655245	

4. Locate the Ultima Gas Monitor to be installed in the duct.
5. Unscrew the Ultima Gas Monitor cover and set aside.

⚠ WARNING

Before removing the cover of an explosion-proof Ultima Gas Monitor, verify that the surrounding area does not contain a flammable mixture of combustible gas and air, since a source of ignition is exposed; otherwise, an explosion may occur if a metal object contacts the circuitry and produces sparks.

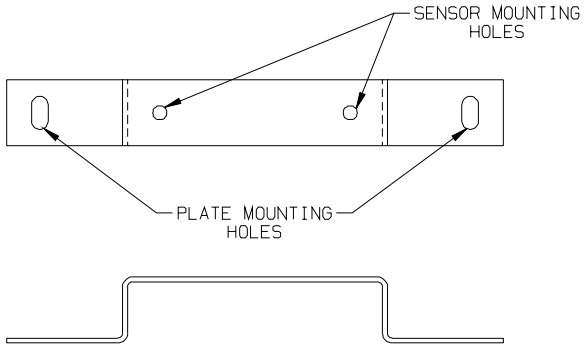


Figure A-3.
Ultima Gas Monitor Mounting Bracket

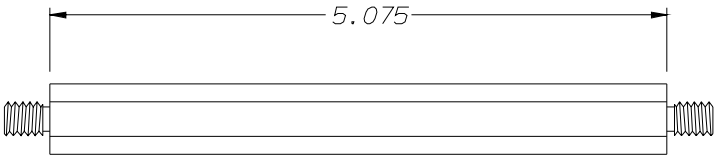


Figure A-4.
Ultima Gas Monitor Spacers

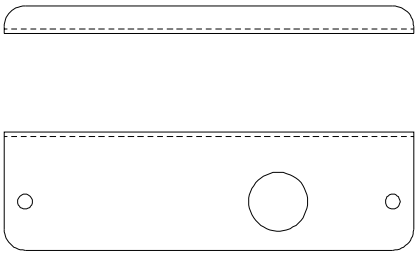


Figure A-5.
Ultima Gas Monitor Clamp

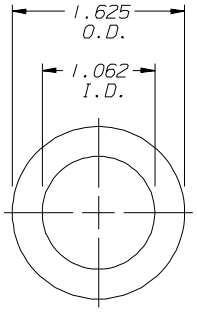


Figure A-6.
Ultima Gas Monitor Enclosure Gasket

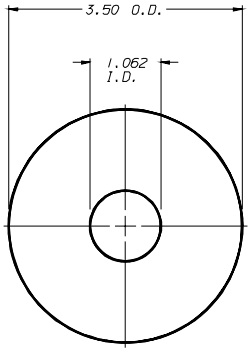


Figure A-7.
Ultima Gas Monitor Plate

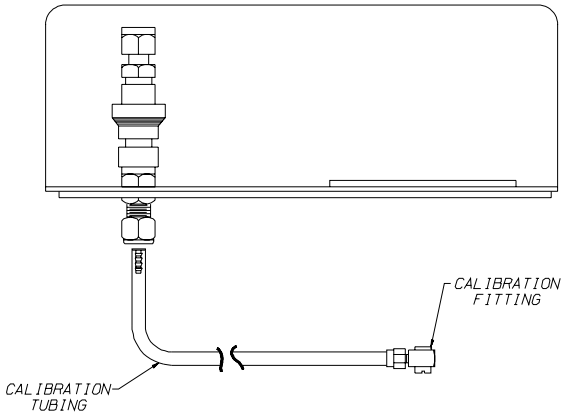


Figure A-8.
Duct Mount Kit Base Plate

6. Remove the two screws securing the front label assembly (FIGURE 1-20).
7. Pull up and remove the front label assembly and the two attached printed circuit boards.
   - The termination printed circuit board remains in the enclosure.
8. **For Toxic, Oxygen, or Combustible IR Ultima Gas Monitors:**

   To disconnect the sensor wiring from the termination printed circuit board in the module, pull up on the connector inserted into J4 (FIGURE A-9).

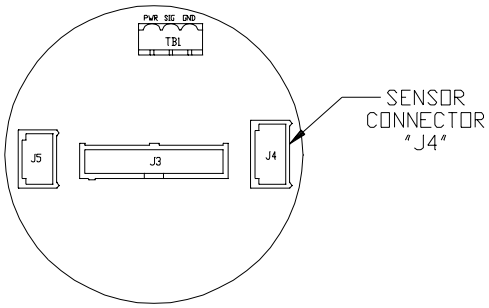


Figure A-9.
Toxic or Oxygen Ultima Gas Monitor Termination Board

For Catalytic Combustible Ultima Gas Monitor:

To disconnect the sensor wiring from the termination printed circuit board within the module, pull up on the connector inserted into TB2 (FIGURE 1-22).

9. To avoid damage, completely remove the black SensorGard by unscrewing the black plastic ring (FIGURE 1-4).
10. Using a strap wrench or pipe wrench, carefully unscrew the sensor body from the module; carefully remove the sensor assembly from the sensor body.
    - Ensure that the wires and connector do not break when removing the sensor body.
11. Place the enclosure plate and gasket from the Duct Mount Kit on the sensor body threads as shown in FIGURE A-10.
12. Carefully feed the sensor wires from the sensor body back into the module opening.
13. Using a strap wrench or a pipe wrench, carefully screw the sensor body back into the module.
    - Ensure gasket is centered, not folded on sensor threads.

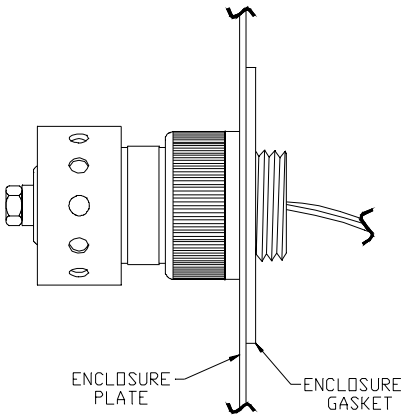


Figure A-10.
Sensor

14. **For Toxic, Oxygen, or Combustible IR Ultima Gas Monitors:**

    Reconnect sensor wiring on the termination printed circuit board in the module by aligning and inserting the connector into J4 (FIGURE A-9).

    For Catalytic Combustible Ultima Gas Monitor:

    Reconnect sensor wiring on the termination printed circuit board in the module by aligning and inserting the connector into TB2 (FIGURE 1-22).

15. Re-install the Ultima Gas Monitor cover.

⚠ WARNING

Do not let the cover remain off of an explosion-proof Ultima Gas Monitor. Since a source of ignition is exposed, an explosion may occur if a metal object contacts the circuitry and produces sparks in an atmosphere of combustible gas.

16. Locate the Ultima Gas Monitor mounting bracket and two #10-32 X5/16 screws and lock washers.
17. Install the mounting bracket onto the back of the Ultima Gas Monitor via the two tapped holes with the two supplied screws; tighten the screws.
18. Push the Ultima Gas Monitor (with bracket attached) through the slit gasket on the Duct Mount base plate (FIGURE A-11).
19. Fasten the mounting bracket to the back of the Duct Mount base plate with the remaining two #10-32 X5/16 screws and lock washers.
    - Do not tighten these screws at this time.
20. Locate the two Ultima Gas Monitor spacers and screw one end of each spacer into the Duct Mount Kit's base plate.
21. Place the Ultima Gas Monitor clamp on top of the spacers.
    - Ensure that the folded part of the clamp is mounted on the back side of the Ultima Gas Monitor; the clamp will only fit one way on the spacers.
22. Ensuring that the Ultima Gas Monitor is level, use the 1/4-inch hex nut and lock washers to secure the clamp onto the spacers (FIGURE A-11). Tighten the two #10-32 screws at the mounting bracket at this time.
23. Fasten the calibration tubing fitting into the center post of the SensorGard (FIGURE A-11).

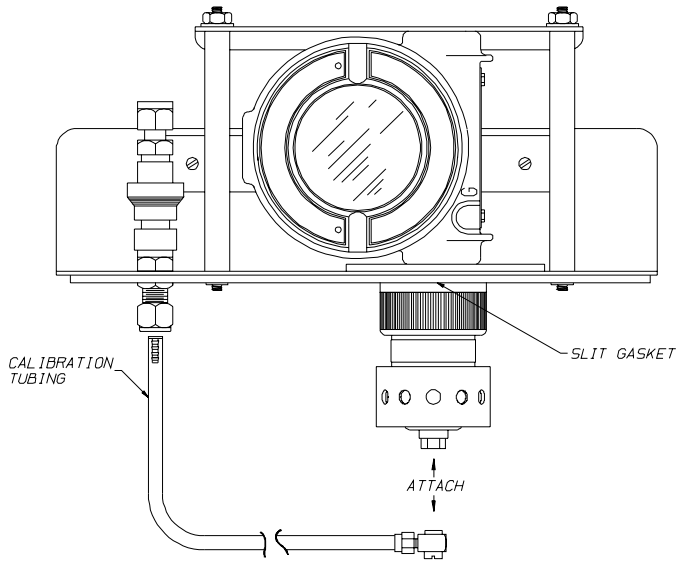


Figure A-11.
Duct Mount Sensor

24. Clean the area around the hole made in step 2, ensuring that no grease, metal shavings or other material is in the area where the gasket will be seated.

25. Remove the protective paper backing from the gasket found on the bottom of the Duct Mounting base.

26. Install the entire assembly on the duct.

    - Use proper fasteners (not provided) to secure the Ultima Gas Monitor to the duct.

27. If necessary, tape or seal around the sensor gasket to prevent leaks.

28. Remove the top half of the calibration fitting and connect it to your calibration tubing.

    - When calibrating, push the calibration fitting into its mate on the Duct Mount base.

29. Refer to the instruction manual for wiring details.

Mounting the Dual module Models

1. Locate the duct to be sampled.
2. Using dimensions from FIGURE A-2, cut a rectangular hole [8.875 by 2.7 inches (225 by 68.5 mm)] in the duct.
   - The gasket on the bottom of Duct Mount Kit must sit flat on the duct.
   - If necessary, pre-drill the fastener holes.
   - Do not remove the gasket paper lining on the Duct Mount Kit at this time.
   - On rounded ducts, additional gasketing may be required for proper sealing.
3. Locate and identify all components in the Duct Mount Kit (TABLE A-2).

Table A-2. Dual module Duct Mount Kit Parts List

DESCRIPTION	PART NUMBER	FIGURE
Two Ultima Gas Monitor Spacers	710779	A-12
Ultima Gas Monitor Clamp	710778	A-13
Ultima Gas Monitor Enclosure Gasket	710770	A-6
Ultima Gas Monitor Plate	710769	A-7
Ultima Gas Monitor Duct Mount Kit Base Plate	814862	A-14
Two 1/4-inch Hex Nuts	631357	
Two 1/4-inch Lock Washers	655245	
Six 10-32 Screws	634054	
Six #10 Lock Washers	627852	

4. Locate the Remote sensor of the Ultima Gas Monitor to be installed in the duct.
5. Unscrew the cover of the Remote sensor and set aside.

⚠ WARNING

Before removing the cover of an explosion-proof Remote Sensor Ultima Gas Monitor, verify that the surrounding area does not contain a flammable mixture of combustible gas and air, since a source of ignition is exposed; otherwise, an explosion may occur if a metal object contacts the circuitry and produces sparks.

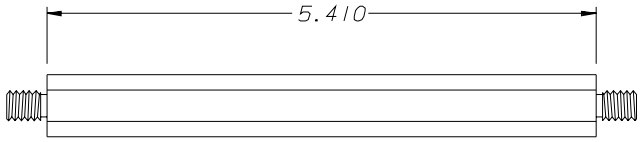


Figure A-12.
Remote Sensor Spacers

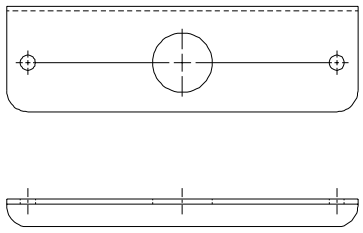


Figure A-13.
Remote Sensor Clamp

6. **For Toxic, Oxygen, or Combustible IR Remote Sensor Ultima Gas Monitors:**

   To disconnect the sensor wiring on the termination printed circuit board in the module, pull up on the connector inserted into J1 (FIGURE 1-26).

   For Catalytic Combustible Remote Sensor Ultima Gas Monitor:

   To disconnect the sensor wiring on the termination printed circuit board in the module, unscrew or loosen the screws on the terminal wiring connector.

   - Before removing the wires, mark the identity of each wire to permit proper replacement (FIGURE 1-23).

7. To avoid damage, completely remove the black SensorGard by unscrewing the black plastic ring (FIGURE 1-4).
8. Using a strap or pipe wrench, carefully unscrew the sensor body from the module.
   - Carefully remove sensor assembly from the sensor body.
   - Ensure that wires and connector do not break when removing the sensor body.

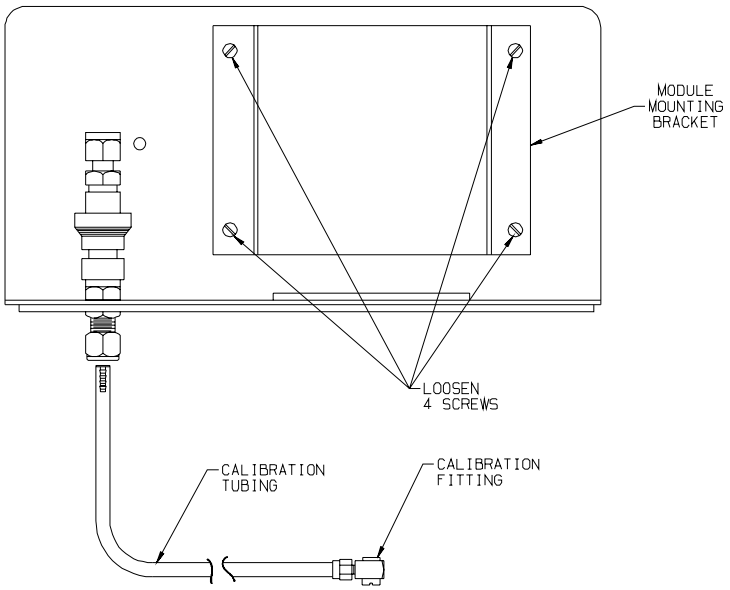


Figure A-14.
Remote Sensor Base Plate

9. Place the enclosure plate and gasket from the Duct Mount Kit on the sensor body threads (FIGURE A-10).
10. Carefully feed the sensor wires from the sensor body back into the module opening.
11. Using a strap or pipe wrench, carefully screw the sensor body back into the module.
    - Ensure that gasket is centered and not folded on the sensor threads.
12. **For Toxic, Oxygen, or Combustible IR Remote Sensor Ultima Gas Monitors:**

    Re-connect the sensor wiring on the termination printed circuit board in the module by aligning the connector and inserting it into J1 (FIGURE 1-26).

    For Catalytic Combustible Remote Sensor Ultima Gas Monitor:

    Re-connect the sensor wiring onto the wiring termination printed circuit board in the module (FIGURE 1-23).

13. Re-install the cover of the Remote Sensor Ultima Gas Monitor.

⚠ WARNING

Do not let the cover remain off of an explosion-proof Remote Sensor Ultima Gas Monitor. Since a source of ignition is exposed, an explosion may occur if a metal object contacts the circuitry and produces sparks in an atmosphere of combustible gas.

14. Locate the Remote sensor Ultima Gas Monitor base plate and two #10-32 screws and lock washers.
15. Remove the four screws holding the module mounting bracket (FIGURE A-14).
16. Fasten the Remote Sensor module to the bracket using two #10-32 screws and lock washers.
    - These screws pass through the bracket and into two tapped holes in the module.
17. Push the Remote sensor Ultima Gas Monitor through the slit gasket on the Duct Mount base plate (FIGURE A-15).
18. Fasten the sensor module bracket to the base plate using the #10-32 screws removed in step 15.
    - Do not tighten completely.
19. Fasten the calibration tubing fitting into the center post of the SensorGard (FIGURE A-15).
20. Locate the two Remote sensor Ultima Gas Monitor spacers. Screw one end of each spacer into the Duct Mount Kit base plate.
21. Place the Remote sensor Ultima Gas Monitor clamp on the top of the spacers.
    - Ensure the folded part of the clamp is mounted on the back side of the Remote Sensor Ultima Gas Monitor.
22. With the 1/4-inch hex nut and lock washers, secure the clamp onto the spacers (FIGURE A-15).
    - Tighten the #10-32 screws that secure the module mounting bracket to the base plate.
23. Clean the area around the hole made in step 2.
    - Ensure that no grease, metal shavings or other material is in the area where the gasket will be seated.

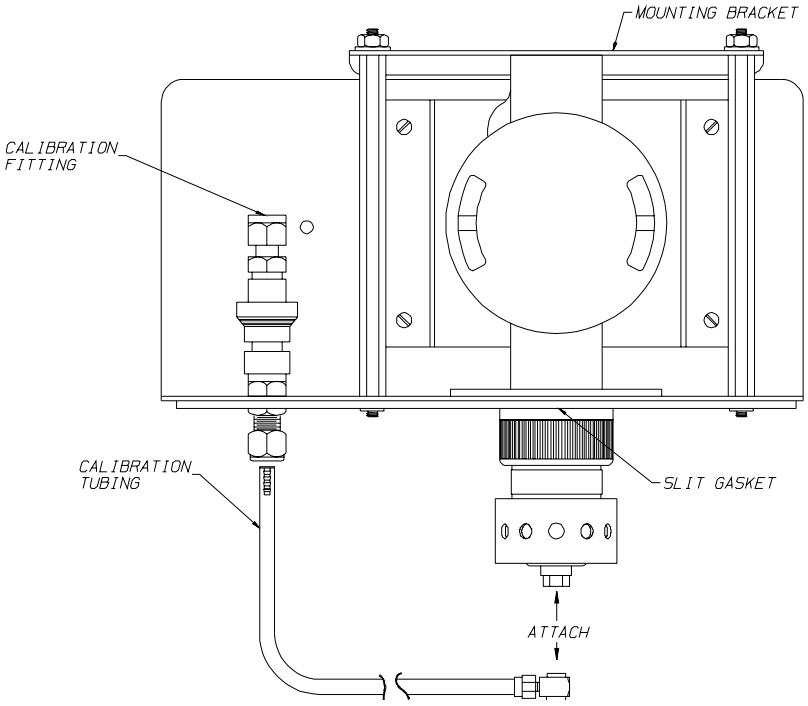


Figure A-15.
Duct Mount and Sensor

24. Remove the protective paper backing from the gasket found on the bottom of the Duct Mounting flange.

25. Install the entire assembly on the duct. Use proper fasteners to secure the Ultima Gas Monitor Duct Mount to the duct.

26. If necessary, tape or seal around the sensor gasket to prevent leaks.

27. Remove the top half of the calibration fitting and connect it to your calibration tubing.

    - When calibrating, push the calibration fitting into its mate.

28. Install the read-out module by following the mounting instructions in the instructions manual for the single module model.
29. Refer to the instruction manual for wiring details.

Appendix B
Optional Ultima Power Supply

General

An optional Power Supply provides DC voltage for the Ultima Gas Monitors. It is particularly useful at remote locations for avoiding excessive DC line drop (where 85 to 265 VAC is available). The Power Supply can be chosen with the following specifications:

OUTPUT	INPUT	PART NO.	NOTE
12 VDC at 1.25 Amps	85 to 265 VAC	815320	Up to two catalytic combustible monitors
24 VDC at .63 Amps	85 to 265 VAC	10003284	One catalytic combustible monitor and/or multiple non-combustible Ultima sensors

Mounting

The Ultima Power Supply can be mounted in Class I, Groups B, C and D, Division 1, Hazardous locations.

1. Locate the power supply module near the Ultima Gas Monitor. Orient the module so that the DC output is easily wired to the Ultima Gas Monitor.
2. Mount the module to a solid structure using appropriate hardware (not supplied).

Wiring

⚠ WARNING

Before wiring the Ultima Power Supply Module, verify that the main power source feeding the module is disconnected or disabled; otherwise, a potential shock hazard exists which may result in injury or death if improperly handled.

Wiring the Ultima Power Supply Module Using the Internal Terminal Block

1. Unscrew and open the Ultima Power Supply Module (FIGURE B-1) cover.

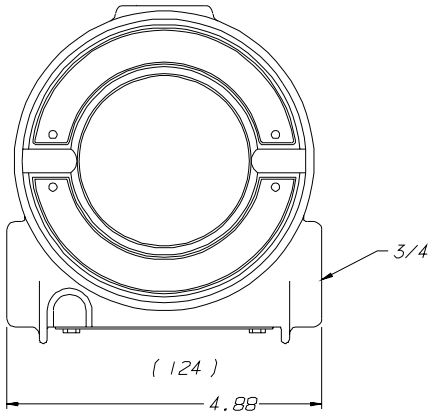


Figure B-1.
Ultima Power Supply Module

⚠ WARNING

Before removing the cover of an explosion-proof Ultima Power Supply Module for any reason, verify that the surrounding area does not contain a flammable mixture of combustible gas and air since a source of ignition is exposed; otherwise, an explosion may occur if a metal object contacts the circuitry and produces sparks.

2. Route the AC supply cable and the DC output cable through the conduit openings.
3. Wire each cable to its labeled terminal block shown in FIGURE B-2.
4. Identify each conductor of each cable for proper connection.
5. If used, screw the conduit into both conduit openings and pull cable away from the unit to relieve any excess slack.
6. Re-install the Ultima Power Supply cover.

⚠ WARNING

Do not let the cover remain off of the Ultima Power Supply Module. Since a source of ignition is exposed, an explosion may occur if a metal object contacts the circuitry and produces sparks in an atmosphere of combustible gas.

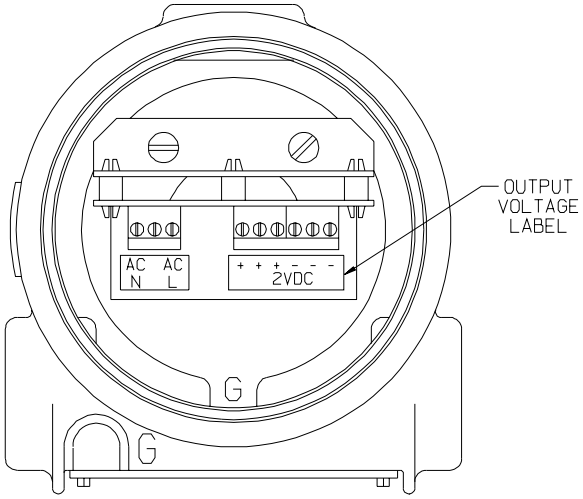


Figure B-2.
Wiring Connections

Appendix C
Internal Relay Option

General Information

The internal relays are designed to enable the Ultima Gas Monitor to control other equipment. There are three relays within the Ultima Gas Monitor's module:

- two alarm relays (Alarms 2 and 3 only)
- one trouble relay.

Once configured, the relays activate when the Ultima Gas Monitor detects an alarm condition. Similarly, the trouble relay de-energizes when a trouble condition is detected.

The Ultima Duct Mount Kit will not fit the Ultima Gas Monitor with internal relays.

- If internal relays are necessary, the Ultima Gas Monitor remote sensor must be used.
- The internal relays will be within the read-out module.
- All Ultima Gas Monitor remote sensors fit into the remote sensor model of the Ultima Duct Mount Kit.

The alarms are enabled in the non-latching mode at the factory.

- To disable or configure the alarms, you need the Ultima Controller (P/N 809086).
- The Trouble relay is normally-energized so the relay de-activates into a fail-safe condition if a trouble or power outage occurs. See the "Fault Relay" description later in this Appendix.

⚠ CAUTION

To prevent false alarms in the following instances, alarms/relays are temporarily disabled:
1) During the first minute from power-up
2) During calibration
3) For two minutes after calibration.

The Ultima Gas Monitor is shipped ready for installation with several external wiring harnesses (FIGURE C-1 or C-2).

- These harnesses provide direct connections to the unit, eliminating the need for opening the enclosure.

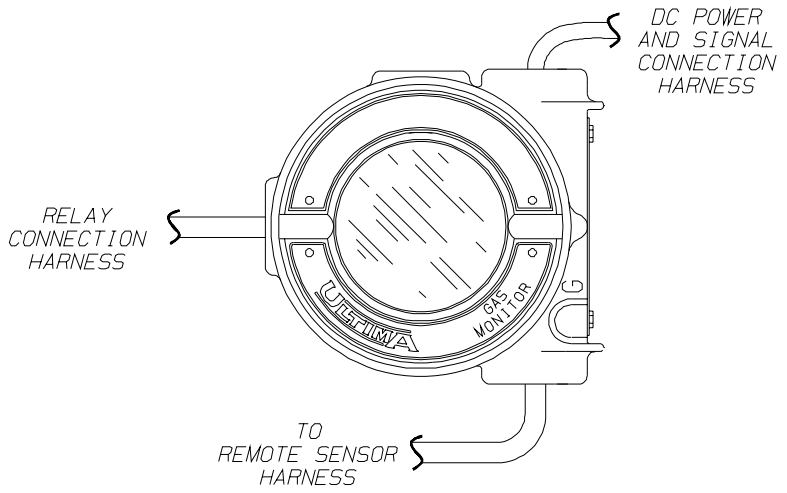


Figure C-1.
Dual module Ultima Wiring Harness

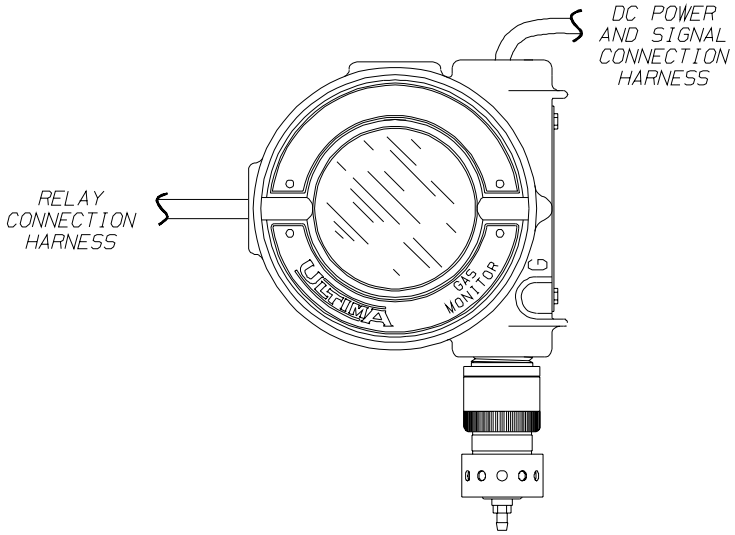


Figure C-2.
Single module Ultima Wiring Harness

- However, if you cannot use these wiring harnesses or wish to install an external reset button, it is then necessary to open the enclosure and wire to the internal connectors.

All Ultima Gas Monitors are rated explosion-proof, certified for Classification I, Groups B, C and D, Division I Hazardous Locations. When using this unit in these hazardous locations, follow all local codes and practices.

⚠ CAUTION

Any Ultima Gas Monitor that has the Internal Relay option selected cannot be installed as Intrinsically Safe.

IMPORTANT NOTE: Some Ultima Gas Monitor models are housed in explosion-proof enclosures and can be used in hazardous atmospheres.

- These models must be installed according to the National Electric Code.
- Some Ultima Gas Monitor enclosures are rated for Class I, Division 1, Groups B, C and D areas while others can only be used in Groups C and D areas.
- The larger metal Approval Label on the Ultima Gas Monitor (FIGURE 1-7) indicates if your particular model is approved for use in hazardous areas and identifies its rating.

Unpacking, Mounting and Wiring the Ultima Gas Monitor with Internal Relays

Unpack, mount and wire the Ultima Gas Monitor according to Chapter 1, "Set-up." All electrical connections to the Ultima Gas Monitor can be made via the clearly marked factory-installed wiring harnesses.

- See FIGURE C-1 for a Dual module Ultima Gas Monitor.
- See FIGURE C-2 for a Single module Ultima Gas Monitor.
- See Ultima Controller instruction manual (P/N 813379) for complete configuration information.

Power cable wiring lengths for the Ultima Gas Monitor ***with*** internal relays differ from models ***without*** internal relays (TABLE C-1).

NOTE: To avoid electrical noise problems, do ***not*** run AC lines from relays in the same conduit as the DC Signal lines.

Table C-1. Power Cable Distances for the Ultima Gas Monitor with Internal Relays (4-20 mA or Frequency Output Models)

SENSOR TYPE	POWER SUPPLY VOLTAGE	WIRE SIZE	MAXIMUM CABLE LENGTH (IN FEET)	MAXIMUM LOAD RESISTANCE (mA OUTPUT ONLY)
CATALYTIC COMBUSTIBLE	12 VDC	16 AWG	900	300 OHMS
CATALYTIC COMBUSTIBLE	24 VDC	16 AWG	3000	600 OHMS
IR COMBUSTIBLE	12 VDC	16 AWG	500	300 OHMS
IR COMBUSTIBLE	24 VDC	16 AWG	3800	600 OHMS
TOXIC OR OXYGEN	12 VDC	16 AWG	2500	300 OHMS
TOXIC OR OXYGEN	24 VDC	16 AWG	8000	600 OHMS

- In all installations, twisted instrument-quality cable is recommended.
- Shielded cable is recommended in situations where radio frequency interference (RFI), electro-magnetic interference (EMI) or other electrical noise sources exist or are anticipated.

Ultima Gas Monitor Internal Relays

Relay Specifications

Table C-2. Relay Specifications

TEMPERATURE RANGE		-20 to +50°C (-4 to +122°F)
HUMIDITY		15 to 95% RH, non-condensing
RELAYS	**2 ALARMS**	SPST (Single pole, single throw)
	FAULT (NORMALLY-ENERGIZED)	SPST (Single pole, single throw)
RELAY RATINGS	**At 125 or 250 VOLTS AC, NON-INDUCTIVE**	5.0 Amps or 5 Amps @ 1/10 Hp
	AT 30 VOLTS DC, NON-INDUCTIVE	5.0 Amps or 5 Amps @ 1/10 Hp
POWER CONSUMPTION (TOTAL UNIT WITH RELAYS)	**OXYGEN AND TOXICS**	7 to 30 VDC @ 220 mA max.
	CATALYTIC COMBUSTIBLES	7 to 30 VDC @ 610 mA max.
	IR COMBUSTIBLE	10 to 30 VDC @ 410 mA max.

Alarm Relays

There are two alarm relays and one fault relay in the Ultima Gas Monitor. The two alarm relays:

- Activate when the Monitor detects a gas concentration level that activates Alarms 2 or 3
    - Alarms 2 and 3 generally default to 20% and 30% of the full-scale reading and are set when the gas reading is above these values.
    - The Oxygen Model is a special case where:
        - Alarm 2 is set to 18% oxygen and activates ***below*** this setpoint
        - Alarm 3 is set to 22% oxygen and activates ***above*** this setpoint.
    - These default setpoints can be changed or verified via the Ultima Controller.
        - See Ultima Controller Manual (P/N 813379).
        - The Controller can also enable the latching alarm function.
- Are factory-set to a normally-open position.
    - Upon activation, the relay contacts close to provide an electrical path. These contacts remain closed as long as:
        - The alarm condition exists within the Ultima Gas Monitor or
        - The latching mode is selected.

Fault Relay

The Fault Relay differs from the Alarm Relays:

- It is a single-pole, single-throw (SPST) relay.
- During normal operation, the two fault contacts are open.
- When a fault is detected or power is cut or turned OFF, these two contacts close and provide an electrical path for fail-safe relay operation. In the event of any failure, including power loss, the relay will connect its two contacts.

The Fault Relay can remain STEADY ON or PULSED. These two different modes can communicate different information to any PLC or DCS connected to the fault relay:

- ***Fault Relay STEADY ON indicates:***

  - Ultima sensor is not connected properly or
  - Ultima Gas Monitor internal fault or
  - An inoperative relay.
- ***Fault Relay PULSED (once per minute) indicates:***
  - Under-range reading on the display or
  - Improper calibration of the Ultima Gas Monitor or
  - Multiplex Ultima Gas Monitor with address set improperly or
  - Ultima Gas Monitor CAL or CAL fault displayed (FIGURE 2-2).

Optional RESET Push-button

General

A RESET button is an optional feature to allow latching relays to be reset at the sensor location.

- This may silence any alarm horns or turn OFF any equipment connected to the relays.
- Latching relays can be configured on the Ultima Monitor via the Ultima Controller. Refer to the Ultima Controller manual (P/N 813379) for explicit instructions.
  - **In a latching configuration:** when the RESET button is pushed and any alarm is latched and not in its active alarm state, the alarm will reset.

NOTE: An IR command can mimic the pushbutton as described in the Controller and Calibrator manuals.

  - **In a non-latching configuration:** the RESET button has no affect on the alarms.

RESET Button Selection

The RESET push-button can be acquired locally and wired to the Ultima Gas Monitor during unit installation. The RESET push-button ratings, however, must meet or exceed the area classification where the button is to be used.

- Install an explosion-proof push-button with the appropriate rating in an area classified as a hazardous area.

⚠ WARNING

Do not install a push-button that is rated for a general-purpose area in a location classified as a hazardous

area; otherwise, an explosion may occur, as sparks may be produced when the button is pressed.

- The RESET push-button must be a normally-open type with a momentary contact when pushed.
- The electrical ratings must be at least 1 amp at 250 volts AC.
- TABLE C-3 lists several sources of push-buttons; you may select one or choose one from an alternative supplier.

Table C-3. RESET Push-button Vendors

VENDOR NAME	CATALOG NUMBER	DESCRIPTION
Appleton Electric Co.	EFDB175-U1	Explosion-proof push-button
Crouse Hindes, Inc.	NCS2110	General-purpose push-button

Relay Connections

Typically, there is no need to open the module during installation because there are no:

- User configurable internal jumpers
- Potentiometers
- Dip switches or other types of adjustments.

All electrical connections to internal relays can be made via the factory-installed wiring harness (FIGURE C-3 and TABLE C-4). It is not necessary to use any of the provided harnesses. If your

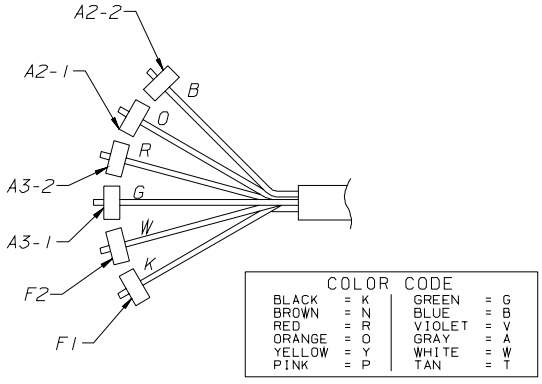


Figure C-3.
Relay Wiring Harness

installation requirements dictate a direct connection, the Ultima Gas Monitor can be opened and wired directly.

If you are connecting the relays to motors, fluorescent lighting or other inductive loads, it is necessary to suppress any sparks that may occur at the relay contact. These sparks will deteriorate or destroy the relay contacts, rendering the relay inoperative or useless. One way to reduce this destructive sparking is to install a *Quencharc® across the contacts. This device is available from MSA as P/N 630413.

When using the wiring harness provided with the module, refer to FIGURE C-3 for relay connection. TABLE C-4 lists wire color and the associated relay function.

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Table C-4. Wire Color and Associated Relay

WIRE COLOR	RELAY	TERMINAL BLOCK CONNECTIONS
B - BLUE	ALARM 2	A2
O - ORANGE	ALARM 2	A2
R - RED	ALARM 3	A3
G - GREEN	ALARM 3	A3
W - WHITE	FAULT	F
K - BLACK	FAULT	F

If the Wiring Harness is Not Used:

- The Ultima Gas Monitor must be disassembled for wiring
- The wiring harness must be discarded
- The following procedure must be performed:

1. Unscrew the Ultima Gas Monitor cover and set aside.

⚠ WARNING

Before removing the cover of an explosion-proof Ultima Gas Monitor, verify that the surrounding area does not contain a flammable mixture of combustible gas and air, since a source of ignition is exposed; otherwise, an explosion may occur if a metal object contacts the circuitry and produces sparks.

2. Remove the two screws securing the front label assembly (FIGURE 1-21).
3. Pull up and remove the front label assembly and the two attached printed circuit boards.
4. Pull on the wiring plugs to disconnect the connectors on the exposed board.

   NOTE: Observe connector locations for later re-insertion.

   Push the wiring plugs and wires to one side of the module.

   NOTE: Do not remove the wires from the wiring connectors.

5. Remove the two screws securing the exposed printed board in the module.
6. Remove this printed circuit board from the module.
7. Locate the relay wiring harness. Remove the cable from the terminal blocks (FIGURE C-4) and pull it through the module opening; discard this cable.
8. Route the desired relay control cable through the module opening and wire it to the terminal block TB1 on the circuit board (FIGURE C-4).
   - If shielded wire is used, connect shield to field wiring shield.

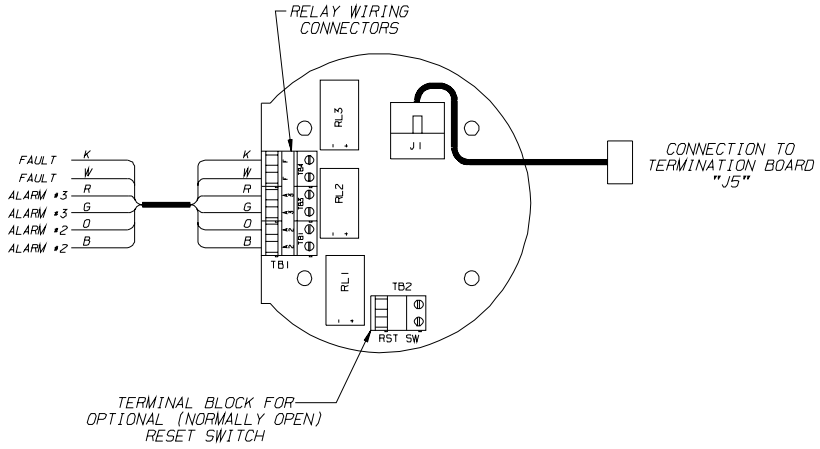


Figure C-4.
Relay Printed Circuit Board

9. Identify each conductor of the cable to enable proper connection at the control equipment.
10. If installing a RESET push-button:
    a. Route a two-conductor cable to terminal block TB2 (FIGURE C-4).
    - Route this cable with DC power to avoid noise interference from relay wiring.

    b. Connect the two-conductor cable to the two positions of terminal block TB2.

    c. Identify the cable to enable proper connection at the button.

    d. Route cable to the push-button location; wire the button.
11. Replace the previously removed printed circuit board in the module.
12. Secure this printed circuit board with the two screws.
    - If removing the power wiring harness, complete that task before further assembly of the unit.
13. Re-install the wiring plugs.
    - Ensure that wiring plugs are firmly seated into their mates.
14. Re-install the front label assembly and the two attached printed circuit boards.
15. Re-install the two screws that secure the front label assembly (FIGURE 1-21).
16. Screw the conduit onto the conduit opening and pull the cable away from the unit to relieve any excess slack.
    - It is important not to have excess wire or cable within the module.
17. Re-install the cover of the Ultima Gas Monitor.

⚠ WARNING

Do not let the cover remain off of an explosion-proof Ultima Gas Monitor. Since a source of ignition is exposed, an explosion may occur if a metal object contacts the circuitry and produces sparks in an atmosphere of combustible gas.