Operating Manual

ULTIMA® X5000

Gas Monitor

MSA

The Safety Company

1000 Cranberry Woods Drive
Cranberry Township, PA 16066
USA

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1 Safety Regulations

1.1 Correct use

The ULTIMA X5000 Gas Monitor, hereafter also called device, is a gas monitor for measuring toxic and combustible gases as well as oxygen. Using sensors, the device tests the ambient air and triggers the alarm as soon as the gas exceeds a specific concentration level.

> ⚠ **WARNING!**

Read this manual carefully. The device will perform as designed only if it is used, installed, and maintained in accordance with the manufacturer's instructions. Otherwise, it could fail to perform as designed and persons who rely on this device for their safety could sustain serious personal injury or death.

> ⚠ **WARNING!**

Do not use silicone-type lubricants in assembling the device and do not allow silicone vapors to be drawn into the flow system while in operation. Silicone can desensitize the combustible gas sensor, thereby giving erroneously low readings.

Use only genuine MSA replacement parts when performing any maintenance procedures on the device. Substitution of components can seriously impair performance.

Failure to follow the above can result in serious personal injury or loss of life.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- device may not cause harmful interference, and
- device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at the user's expense.

> *NOTICE*

This is a Class A product in accordance with CISPR 22. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

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FCC Warning Statements

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

Industry Canada (IC) Warning Statements

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population; consult Safety Code 6, obtainable from Health Canada's website www.hc-sc.gc.ca.

1.2 Product Warranty

ITEM	WARRANTY PERIOD
ULTIMA X5000 Gas Monitor	MSA warrants that this product will be free from mechanical defects and faulty workmanship for the period specified in this table for each component, provided it is maintained and used in accordance with MSA's instructions and/or recommendations. Guarantee shall not exceed the indicated warranty period plus six months from the date of manufacture.
Main Transmitter Housing and PCBA	3 years if equipped with a Sunshield. 2 years if not equipped with a Sunshield.
XCell Sensors	3 years from date of shipment.
XIR PLUS	5 years on electronics. 10 years on IR source bulb.

This warranty does not cover filters, fuses, etc. Certain other accessories not specifically listed here may have different warranty periods. This warranty is valid only if the product is maintained and used in accordance with Seller's instructions and/or recommendations. 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 this product. 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 SPECIFI-CALLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.**

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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 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 replace any nonconforming equipment or parts shall not cause the remedy established hereby to fail of its essential purpose.

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 non-operation of the goods. This exclusion is applicable to claims for breach of warranty, tortuous conduct or any other cause of action against seller.

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2 Description

2.1 Display

The ULTIMA X5000 utilizes an Organic LED (OLED) display which is capable of being seen from a distance of more than 50 ft (15 m). The OLED display provides clear and crisp information in a variety of languages. The gas reading gauge, which wraps around the live reading area, mimics the reading as a percent of full scale and is also used as a progress bar during operations which require a countdown.
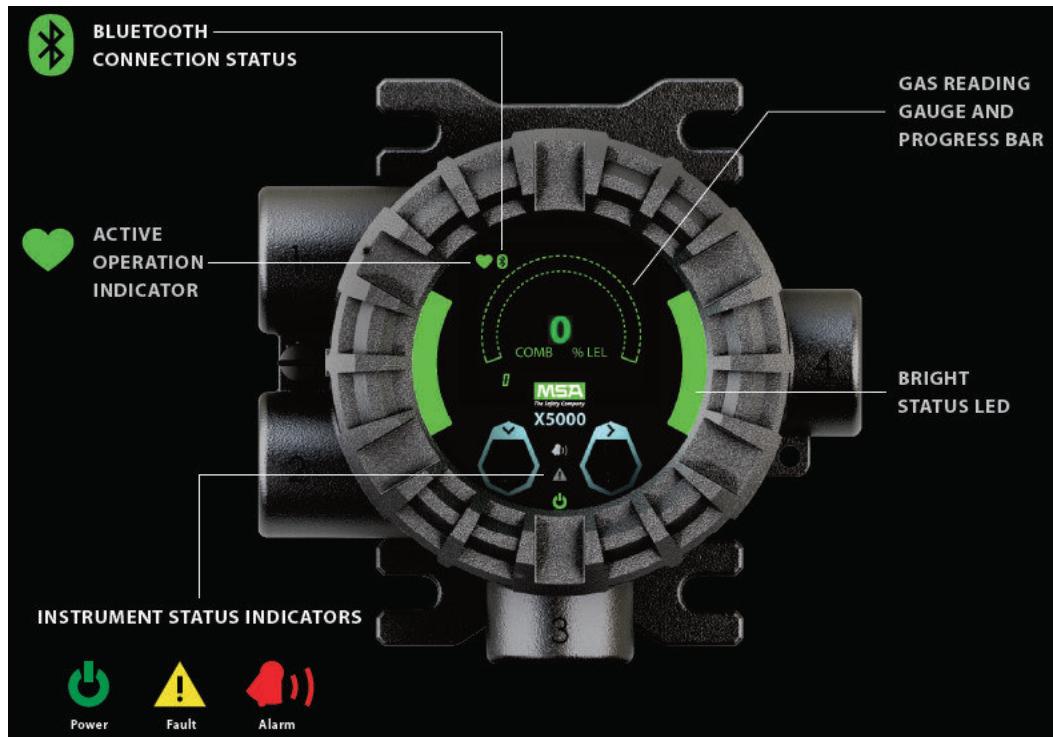
Fig. 1   OLED Display

In addition to the OLED display, the ULTIMA X5000 also employs green, yellow and red LEDs on the side and lower middle of its face. These are used to signal normal operating conditions, fault conditions and alarm conditions.

The ULTIMA X5000 will go into "Eco-Mode" after 3 minutes of no interaction and if not in an alarm condition. While in Eco-Mode, the main display will power down and the status LED's will remain illuminated to determine that the device is not in an alarm condition. The OLED display can be powered up by touching either of the two EZ touch buttons on the front display.

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2.2 No Tool Interface

The ULTIMA X5000 does not require any tools or third party devices to change settings, reset alarms or perform any maintenance feature. The EZ touch buttons work through the glass and do not require opening the explosion proof enclosure. The EZ touch buttons work with bare fingers or with gloved hands, so long as the gloves are not black. The down arrow is used for scrolling, while the right arrow is used for selecting options. See section 4 for more information on navigating the menu with the EZ touch buttons.

Fig. 2   ULTIMA X5000 Interface

2.3 Bluetooth® Wireless Technology

The ULTIMA X5000 can be ordered with Bluetooth communication. Using the X/S Connect App on an appropriate smart phone or tablet, you are able to interface with the ULTIMA X5000 in a larger and more user friendly setting. Connecting via Bluetooth enables communication with transmitter up to 70 feet (21 m) away.

> ⚠ **WARNING!**
>
> Bluetooth Operation is dependent upon signal availability of the wireless service(s) necessary to maintain the communication link. Loss of wireless signal will prevent communication of alarms and other information to linked devices. Take appropriate precautions in the event a loss of wireless signal occurs.

> ℹ If the device was not ordered with Bluetooth it cannot be upgraded.
>
> If ordered with Bluetooth, the device will be shipped with Bluetooth enabled. See section 4 for instructions on disabling Bluetooth.

The ULTIMA X5000 and user provided communication device will need to be paired. This requires both devices to be in range and for a pairing sequence inputting a 6 digit pairing code. The instructions will be displayed on both the ULTIMA X5000 and communication device.

> ℹ There are communication devices capable of being used in classified areas. Please contact your MSA representative for additional information.

2.4 Dual Sensing

The ULTIMA X5000 is capable of communicating with and displaying information for two sensors at a time. There are no restrictions to the type of sensors connected to the device.

The ULTIMA X5000 Gas Monitor generates two discrete analog outputs; one for each sensor connected to the transmitter. The analog output associated with Sensor 1 also has the digital HART (Highway Addressable Remote Transducer) communication superimposed on the analog signal. If two sensors are connected, the digital HART communication carries information for both sensors.

2.5 Retrofit Installations

The ULTIMA X5000 has the conduit entries located in the exact same orientation and distance from the wall and the mounting holes for attaching to a wall are identical to the Ultima X.

2.6 XCell Sensors Optimized for Fixed Gas Applications

XCell toxic and combustible cat bead sensors are developed and manufactured by MSA to be the most shelf-stable and longest lasting sensors available. The XCell non-consuming reaction chemistry is tried-and-true, with over 600,000 used in MSA's portable gas detectors. Now optimized for fixed gas applications, the XCell sensor platform is available in the ULTIMA X5000 and provides multiple benefits, including a standard 3-year warranty on all XCell sensors.

One important optimization for fixed gas was incorporating the GM catalytic bead in the XCell digital housing. When it comes to catalytic bead technology, bigger is definitely better. The GM cat bead is the largest in the industry, providing market leading expected life time and stability.

Lead-based Oxygen sensors are notorious for short life times and poor stability. The XCell sensor does not use lead, but rather a non-consuming reaction chemistry. The XCell Oxygen sensor is expected to last well over 3-years and can be safely stored on the shelf for at least 1 year without sensor performance degradation.

2.7 TruCal Sensing Technology for CO and H_2S Electrochemical Sensors

TruCal saves time and money by doing the hard work for you. Using patented pulse check technology and proprietary Adaptive Environmental Compensation (AEC) algorithms, XCell sensors with TruCal provide peace of mind for electrochemical sensors like never before.

Automated pulse checks are the muscle behind the TruCal technology. Every six hours, an electrical pulse stimulates the XCell sensor similar to having actual calibration gas applied, providing a snapshot of the sensor's sensitivity at the time of the pulse. Using this sensitivity snapshot, the sensor can diagnose sensor failures like electrode poisoning, electrolyte leaking, or electrical connectivity issues. The sensitivity snapshots are mapped over time to provide an overall Life & Health status as either "Good" or "Fair" if the sensor is approaching end of life.

But that's not all. The brains of the TruCal technology lie within the proprietary Adaptive Environmental Compensation (AEC) algorithms. AEC uses the sensitivity snapshots provided by the pulse check to adjust sensor output, compensating for environmental impacts on sensor accuracy. If the AEC adjustment is greater than expected based on typical environmental impact variations, the transmitter LED's will slow flash GREEN, indicating that the sensor should be calibrated to reset the AEC cycle. The result is a sensor that actively self-monitors for operation and accuracy, with far fewer manual calibrations.

Actual TruCal sensor performance will depend on the application, background gas exposure, and environment. To validate XCell sensors with TruCal, it is recommended that users follow their regular calibration cycle and record the "as found" and "as left" values. This data can be used to extend the time between calibrations depending on the required specification of the application.

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2.8 SafeSwap

The ULTIMA X5000 comes with patented SafeSwap technology, which allows users to change or replace XCell sensors without needing to power down the instrument. For added convenience, the ULTIMA X5000 comes with Swap Delay enabled by default; a feature that gives users a 2 minute window to change sensors without triggering a fault condition. For more information on SafeSwap and Swap Delay, see section 6.

2.9 Housing

The ULTIMA X5000 comes in 316 Stainless Steel for the highest corrosion resistance. Both ¾" NPT and M25 conduit entries are available. To attach a sensor to an M25 housing, an M25 adapter is required and will be included with the shipment. An integral surface mount bracket can be used to mount directly into the wall surface or used with a U-Bolt for mounting to a 2" pipe. Custom tags are available and easily attach to an integral ring.
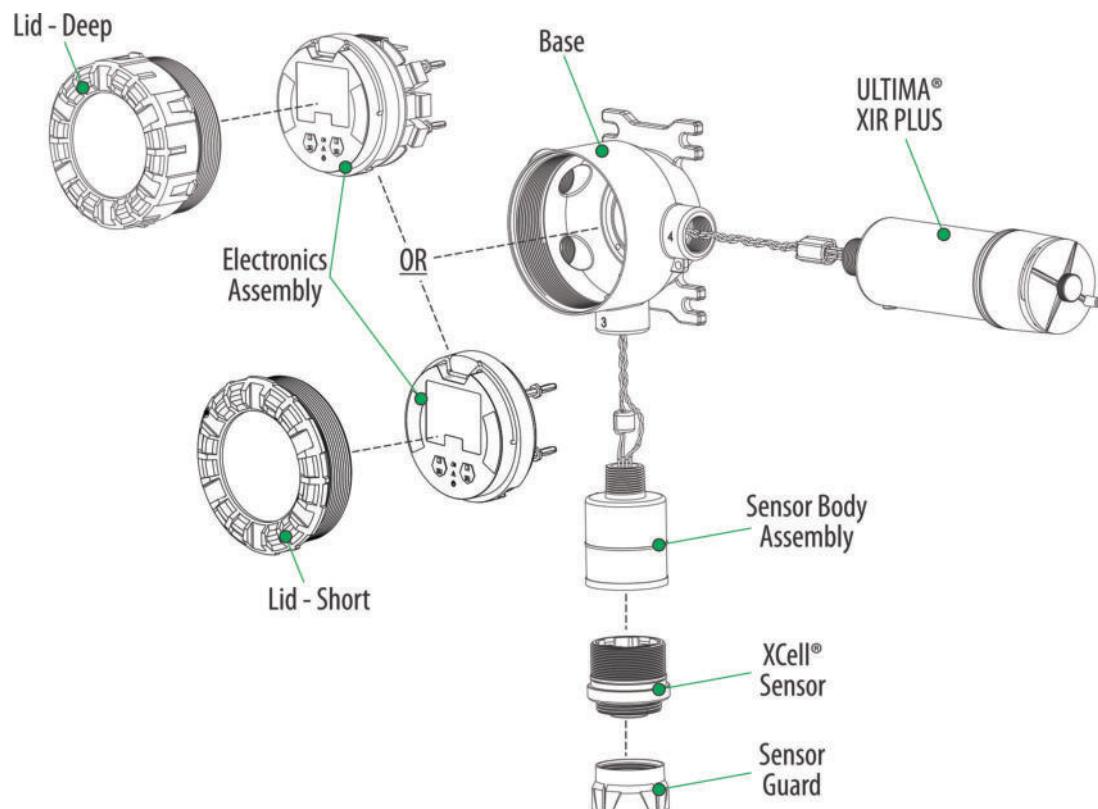
2.10 Component Overview

Fig. 3   Component Overview

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3   Installation

3.1   Installation Warnings - Read before Installation

> ⚠ **WARNING!**
>
> ULTIMA X5000 digital sensors labeled for Class I Hazardous (Classified) locations and installed in a Class I Hazardous (Classified) location only may be changed under power. To change, unscrew sensor three full turns, wait 10 seconds, and then remove the sensor completely. Failure to follow this warning can result in the ignition of a hazardous atmosphere.
>
> For ULTIMA X5000 digital sensors marked Class II or III and installed in a Class II or III hazardous location, the atmosphere must be free of dust or fibers or filings and the power removed from the unit before the sensor cap can be removed from the housing. Failure to follow this warning can result in the ignition of a hazardous atmosphere.
>
> Do not paint the device. Avoid painting in areas where the ULTIMA X5000 and remote sensor junction box are located. If painting is required in an area where an ULTIMA X5000 or remote sensor has been installed, exercise caution to ensure paint is not deposited on the sensor inlet fitting. Paint solvents can also cause an alarm condition to occur or potentially poison electro-chemical sensors.
>
> Protect the device from extreme vibration.
>
> Do not mount the sensing head in direct sunlight without a sunshield (Part Number 10180254).
>
> The ULTIMA XIR PLUS Sensor contains no user- or field-serviceable parts and must be returned to the factory for repair. Any attempt to open the sensor will damage the unit and void the warranty.

> ⚠ **WARNING!**
>
> When installing the XIR PLUS sensor, under no circumstances should a pry-bar be applied to the two legs that support the unit's reflectors during installation or removal of the sensor. Applying force to the legs can permanently damage the XIR PLUS sensor.

3.2   Reviewing Shipment and Identifying Product Model

To determine your sensor type and options, check the shipping carton.

The device is not shipped with the sensors attached to the housing. The XIR PLUS is a one piece sensor, but all other sensors are comprised of two parts; the Sensor Body Assembly and the XCell Sensor. Check the sensor details before attaching to the device housing to ensure that the correct sensor type is being installed. The sensor details are listed on the inside of the XCell Sensor.

Unscrew the XCell Sensor from the Sensor Body Assembly and check the label on the inside for gas type, range, replacement ATO configuration, serial number, and firmware revision number.

3.3 Product Installation Check List
Before Installation
- Review national electrical codes
- Review local procedural and building codes
- Determine optimum transmitter placement
- Determine wire requirements
- Determine mounting hardware requirements

Mounting
- Attach appropriate sensor to housing or junction box
- Mount transmitter or junction box using appropriate mounting hardware
- Confirm free air flow around the sensor

3.4 Mounting

3.4.1 Sensor Mounting Location
The best location for the transmitter and the sensor may not be the same location. Sensors should be placed in a location where a gas leak is most likely to be detected. When the best sensor placement would not allow the transmitter display to be easily viewed or accessed, a remote junction box can be used to mount the sensor remotely from the transmitter, allowing both to be installed in the optimum location.

Two main factors should be considered when choosing a sensor location. The first is the density of the target gas relative to the air. Gases, such as propane, that are heavier than air should be placed near ground level while gases that are lighter than air should be placed above potential leak sources.

Optimum sensor placement will depend on the surrounding processing equipment, such as pipes, valves, or turbines. MSA offers a gas and flame mapping service that systematically evaluates potential sources of leaks and recommends detector quantity and placement to create the most effective detection system.

3.4.2 Transmitter Mounting Location
The transmitter display should be mounted so that the screen is visible and easily accessed after installation. The electronics assembly inside the metal enclosure can be repositioned in any of the four self-aligning interior holes to ensure the display is properly oriented and to provide maximum flexibility for using conduit entries.

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3.4.3 Sensor Orientation

Sensor orientation will depend on the sensor type. If mounting an ULTIMA XIR PLUS sensor, whether locally on the transmitter or via remote junction box, the sensor should be mounted horizontally. If the ULTIMA XIR PLUS sensor is not mounted horizontally, the sensor will be prone to more frequent beam blocking issues due to accumulated dust and condensation on the surface of the ULTIMA XIR PLUS sensor. Fig. 5 shows the correct and incorrect mounting orientations for the ULTIMA XIR PLUS.
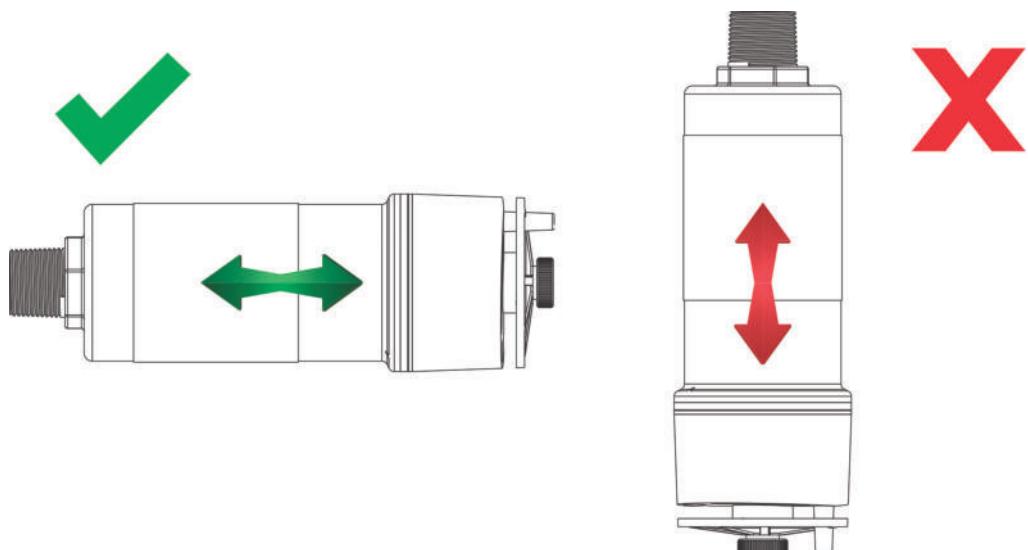
Fig. 4   Correct and Incorrect Mounting Orientations for ULTIMA XIR PLUS Sensor

All other sensors including electrochemical, combustible catalytic bead, and oxygen sensors should be mounted vertically, with the gas inlet pointed downward. If the sensor is not mounted with the gas inlet facing down, it is more likely to become clogged with particulate matter or liquids. Fig. 5 shows the correct and incorrect mounting orientation for XCell sensors.
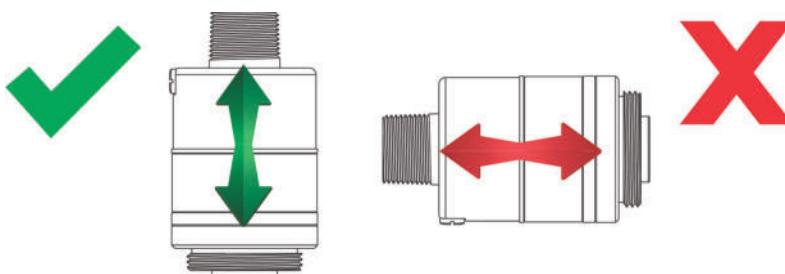
Fig. 5   Correct and Incorrect Mounting Orientation for XCell Sensors

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3.4.4 Connecting Sensor to Transmitter Housing or Remote Junction Box

Sensors are not shipped attached to the main enclosure or junction box. All sensor modules interface with the transmitter via a digital four-terminal connection. Up to two sensors can be connected to a single transmitter, with each sensor getting a dedicated analog (4-20 mA) output. Consider the sensor dimensions when choosing a mounting location for the transmitter or junction box.

To connect the sensor:

(1)   Turn the transmitter or junction box lid counterclockwise to remove

(2)   Pull on the metal bail to remove the board stack and expose wiring connections.

(3)   Route the cable from the sensor through a conduit entry hole in the enclosure so that the sensor is oriented in the correct position (see section 3.4.3 for details).

(Repeat to attach a second sensor to the ULTIMA X5000 transmitter).

(4)   Connect the sensor to the "Sensor 1" position on the electronics assembly.

a) If using a second sensor, connect it to the "Sensor 2" position.

> ⚠ **CAUTION!**

If only using one sensor, and it is connected to "Sensor 2" position, the ULTIMA X5000 will enter *Sensor Missing* fault. See Disable Sensor in Section 4.2.2 for details on how to clear this fault.
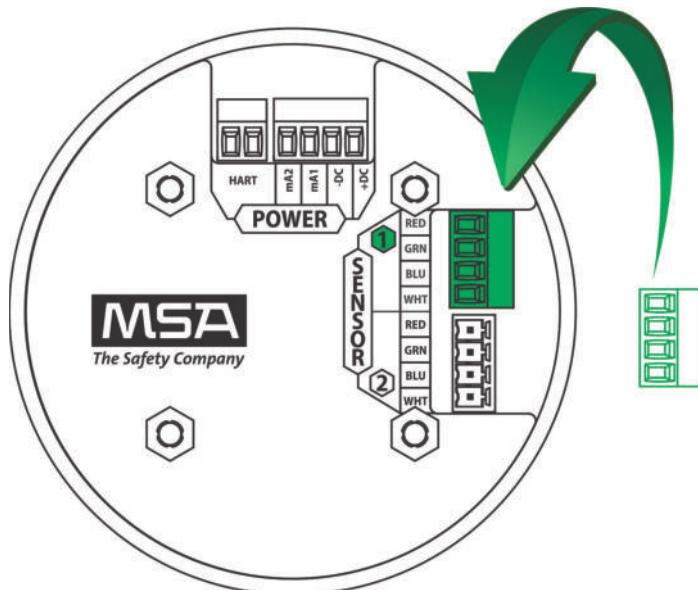
Fig. 6   Connecting Sensor to the Stack
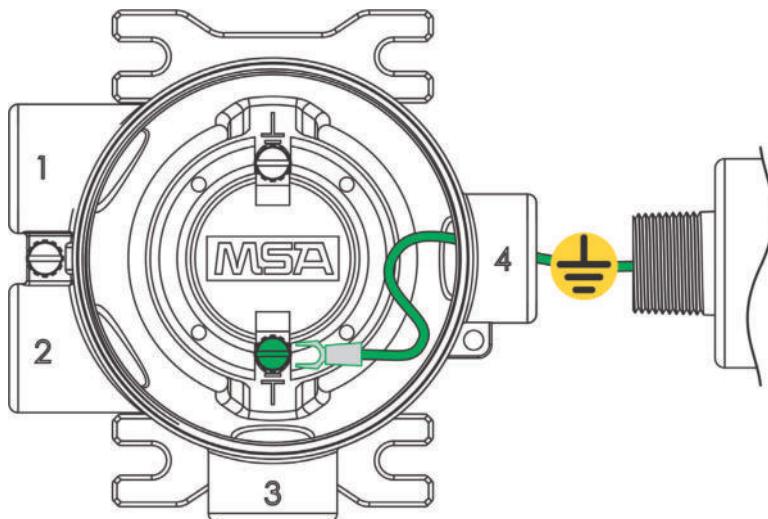
Fig. 7   Grounding Sensor to Transmitter Housing

(5)   Verify the sensor connector is firmly seated on the terminal board.

(6)   Attach the sensor's ground to either of the grounding screws inside the ULTIMA X5000 housing.

(7)   Replace the board stack legs into the four depressions in the housing. Push firmly on the board stack where indicated (see Fig. 8).
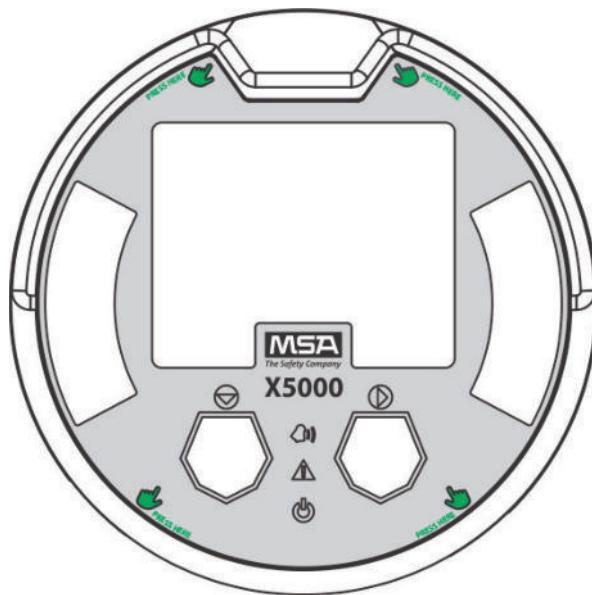
Fig. 8   Highlighted Areas Show Where to Press when Replacing a Board Stack

NOTICE

Avoid pressing on the left and right areas where the LEDs are located. Pressing directly on the display will damage the display and will void the warranty.
Ensure that the electronics assembly is fully engaged in the mounting holes. If not fully seated, the user interface buttons may not function properly.

(8)   Replace the cover by turning clockwise.

3.4.5 Integrated Mounting Points

The ULTIMA X5000 transmitter can be surface mounted without any additional brackets using the integrated mounting tabs.
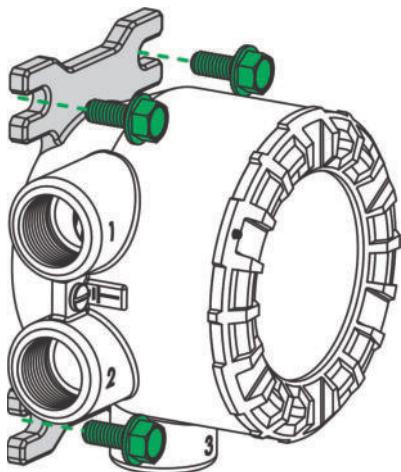
Fig. 9   Internal Mounting Tabs (not compatible with ULTIMA XIR PLUS Sensors)

An supplementary mounting bracket is required for surface mounting the ULTIMA X5000 with an attached ULTIMA XIR PLUS sensor.
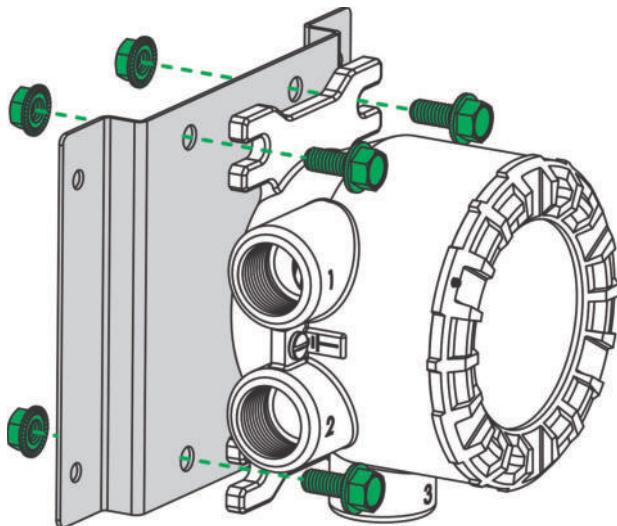
Fig. 10   Mounting Bracket for ULTIMA X5000 (compatible with ULTIMA XIR PLUS Sensors)

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3.4.6 2" (50.8 mm) Pipe Mount

The integrated mounting tabs on the device housing can be mounted to a 2" (50,8 mm) pipe using a standard U-bolt. MSA provides U-bolts as an optional accessory (Part Number 10179873), however any 2" (50.8 mm) pipe U-bolt rated for the weight and dimensions of the ULTIMA X5000 can be used.
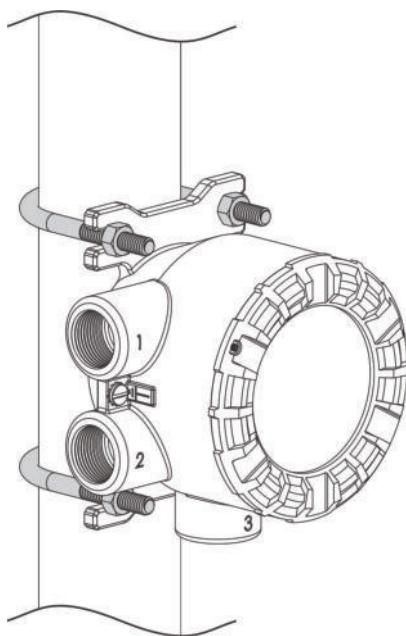
Fig. 11   2" Pipe Mount with U-Bolt

3.4.7 Adjustable Pipe Mount

A Universal Pipe Mount Kit (Part Number 10176946) can be used to mount the ULTIMA X5000 on pipes ranging from 1-6" (20-150 mm) in diameter. Two brackets are mounted over top of the integrated mounting tabs and fitted with an adjustable pipe band (not included).
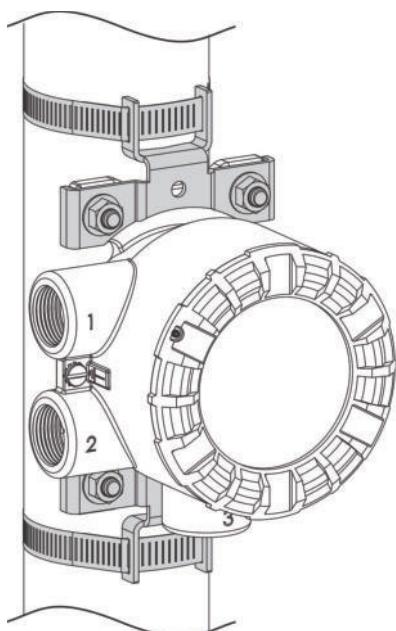
Fig. 12   Adjustable Pipe Mount

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3.4.8 Duct Mount

Duct mount kits are available for monitoring atmosphere inside flat or round ducts. Round duct mount kits are available for small ducts 12-20" (305-508 mm) in diameter (Part Number 10179124) and large ducts 20-40" (508-1016 mm) in diameter (Part Number 10179321). The flat duct mount (Part Number 10176947) is universal for flat ducts.

> **NOTICE**
>
> Consider the sensor type before choosing a duct mount location. ULTIMA XIR PLUS sensors should be mounted horizontally and all other sensors should be mounted vertically.

> **NOTICE**
>
> Air flow in the duct must be zero to ensure proper calibration.
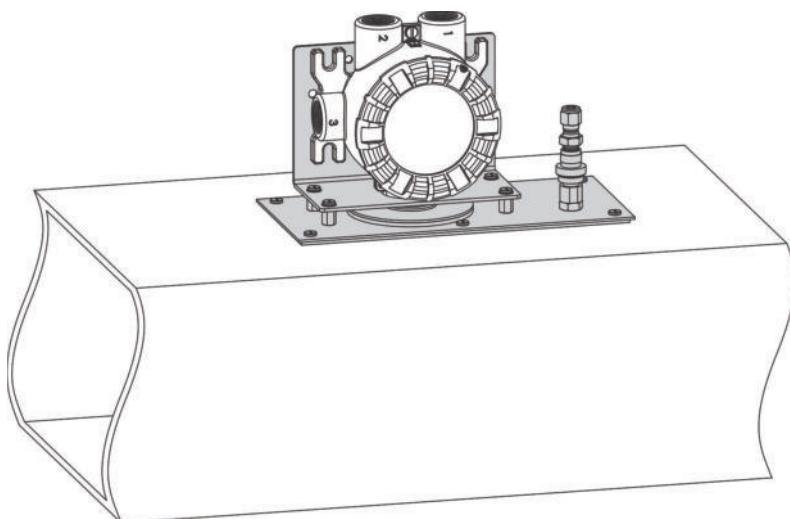
Fig. 13   Flat Duct Mount
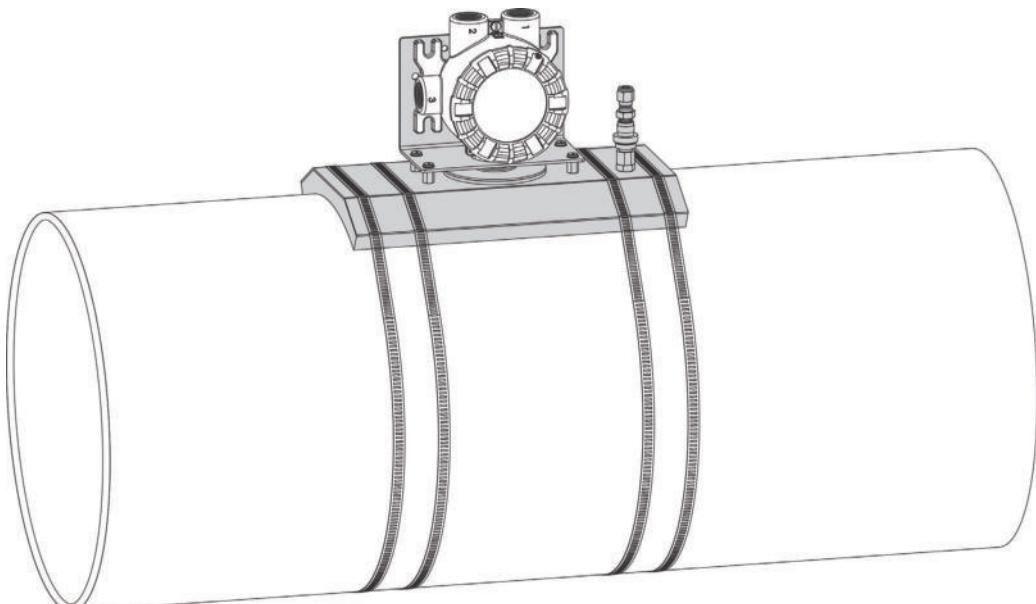
Fig. 14   Round Duct Mount

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3.4.9 Mounting with a Sunshield

A sunshield is recommended to protect the ULTIMA X5000 from direct sun light (Part Number 10180254). The sunshield can be used in any of the mounting configurations.
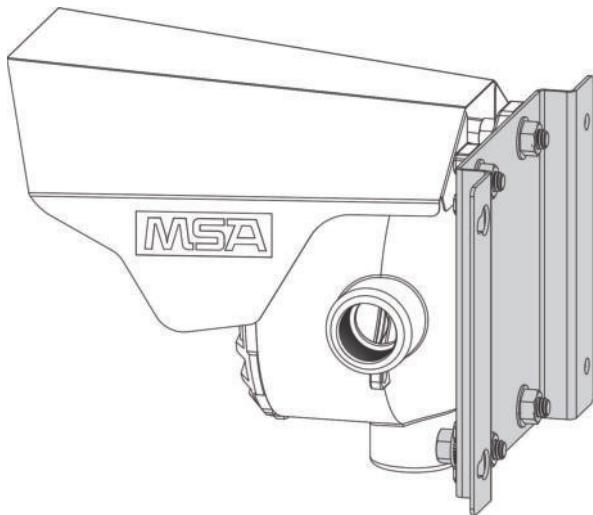
Fig. 15   Sunshield with Wall Mounting Bracket
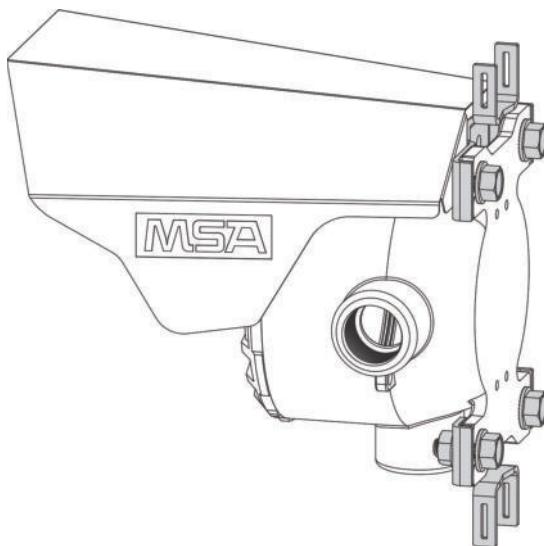
Fig. 16   Sunshield with Universal Pipe Mount

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3.5 Installing a Remote Sensor Junction Box

Sensors mounted remotely must use the ULTIMA X5000 junction box. Only one sensor can be connected to each junction box. The junction box housing is the same construction as the ULTIMA X5000 transmitter. The mounting options and instructions for connecting the sensor are the same for sensors connected directly to the ULTIMA X5000 transmitter housing. The junction box is available in 316 Stainless Steel.

Sensors can be remoted up to 328 ft (100 m) from the transmitter housing, as long as the ULTIMA X5000 transmitter is mounted within maximum distance from the power supply, as indicated in Tab. 1 . The junction box does not have an illuminated display and has two connectors: a single sensor input and an output connecting to the transmitter. A 16 AWG (1.31mm2) 4 element cable with a braided shield should be used for the electrical connection between the junction box and the ULTIMA X5000 transmitter. Specific cable recommendations are Alpha wire 3248 or equivalent.

Fig. 17   Junction Box
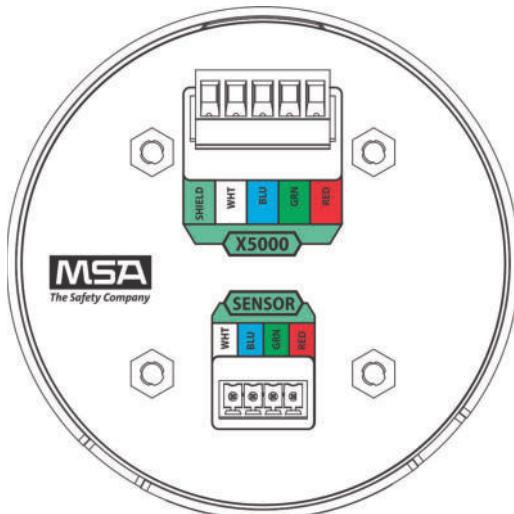
Fig. 18   Junction Box Electrical Connections

If the remote sensor is not easily accessed, it is best practice to install tubing that can be used to apply calibration gas from the device display. Route the tubing to the ULTIMA X5000 Gas Monitor, ensuring that there are no kinks, leaks or other obstructions. Secure this tubing near the monitor.

3.6   Electrical Power Connections
3.6.1   Electrical Warnings - Read before Connecting Power

⚠ **WARNING!**

Before wiring the ULTIMA X5000 transmitter, disconnect the power source supplying the transmitter and ensure no hazardous atmosphere present; otherwise, electrical shock or ignition of a hazardous atmosphere could occur.

- Install wiring in accordance with the electrical code of the country in use, the local authority having jurisdiction and these installation instructions, as applicable.
- Do not make any connections to the ULTIMA X5000 main board or junction box input, output, and relay connections while under power. Failure to do so could lead to electrical shock or ignition of a hazardous atmosphere.
- 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.
- The internal grounding terminal located in the base of the transmitter enclosure must be used for equipment grounding. The external grounding terminal is only to be used as a supplemental bonding connection where local authorities permit or require such a connection.
- ULTIMA X5000 digital sensors labeled for Class I hazardous (classified) locations and installed in a Class I hazardous (classified) location may be changed under power. To change, unscrew three full turns from its fully engaged position, wait 10 seconds, and then remove the cap completely. Failure to follow this warning can result in the ignition of a hazardous atmosphere.
- For ULTIMA X5000 digital sensors marked Class II or III and installed in a Class I or III hazardous location atmosphere must be free of dust or fibers/flyings and the power removed from the unit before the sensor cap can be removed from the housing. Failure to follow this warning can result in the ignition of a hazardous atmosphere.

3.6.2   Electrical Hardware Requirements
Braided shielded, twisted pair, instrument quality wire or cable should be used to minimize the possibility of noise interference and contact with other voltages. Selection of shielded cable must comply with local requirements.

Conduit, in addition to braided shielded wire, may also be needed in areas where large amounts of electrical noise is expected. All cable shields should be terminated to earth ground at one end only.

The ULTIMA X5000's (RED) power connector terminals can accommodate up to 14 AWG (2.08 mm2). Four conductors are also required for the ULTIMA X5000 remote junction boxes.

Incoming power and signal cables should be a braided shield cable such as Alpha Wire 3248 or equivalent. The braided shield must be terminated to the instrument housing with a 360 degree connection to earth ground as shown in Figure 19 or alternatively, the earth ground at the user's power source location.An external Class 2 power supply is required to supply 10-30 VDC to the ULTIMA X5000. Incoming power and signal cables should be a braided shield cable such as Alpha Wire 3248 or equivalent.

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3.6.3 Power Load Requirements and Maximum Mounting Distances

Consider future needs when selecting cable size and power supply. The maximum distance between the X5000 transmitter and the power supply depends on the sensor configuration (sensing technology and one or two sensors), wire gauge, and the power supply voltage.The tables below outline the maximum transmitter mounting distances. First determine if the sensor(s) will be locally or remotely mounted. Then choose sensor type(s). The corresponding nominal maximum power and mounting distances by wire gauge are shown.

Sensor Mounting	Sensor 1	Sensor 2	Nominal Max. Power[3] (W)	Max. Distances (ft)			
				12 VDC Supply		24 VDC Supply	
				16 AWG	14 AWG	16 AWG	14 AWG
Locally mounted	Toxic	None	2.8	330	530	3410	5340
		Toxic	3.6	300	480	3200	5095
		Catalytic	5.3	180	320	2270	3671
		XIR PLUS	7	131	237	1680	2735
	Catalytic	None	5.5	230	370	2370	3771
		Catalytic	10.6	170	270	1752	2790
		XIR PLUS	9.6	170	240	1285	1990
	XIR PLUS	None	6.7	181	287	1780	2835
		XIR PLUS	11.6	120	190	1185	1890
One sensor remote (328 ft max)	Toxic	None	2.8	290	470	3116	4963
		Toxic	3.6	290	470	3116	4963
		Catalytic	5.3	90	190	1682	2705
		XIR PLUS	7	8	80	1110	1830
	Catalytic	None	5.5	90	190	1682	2705
		Catalytic	10.6	90	190	1682	2705
		XIR PLUS	9.6	8	80	1110	1830
	XIR PLUS	None	6.7	8	80	1110	1830
		XIR PLUS	11.6	8	80	1110	1830

Tab. 1   American Units Power Load Requirements and Maximum Mounting Distances[1,2]

[1] Values listed are only for one transmitter and the indicated sensor options. The total number of transmitters needs to be considered when specifying a power supply.

[2] Assumes transmitter was ordered with relays

[3] When sizing a system's 24 V supply, a 1 A inrush current with a 1 ms duration should be considered for each ULTIMA X5000 on the power supply.

US

Sensor Mounting	Sensor 1	Sensor 2	Nominal Max. Power[3] (W)	Max. Distances (meters)			
				12 VDC Supply		24 VDC Supply	
				1.31 mm^2	2.08 mm^2	1.31 mm^2	2.08 mm^2
Locally mounted	Toxic	None	2.8	100	161	1039	1627
		Toxic	3.6	91	146	975	1553
		Catalytic	5.3	55	97	691	1119
		XIR PLUS	7	40	72	512	833
	Catalytic	None	5.5	70	112	722	1149
		Catalytic	10.6	52	82	534	850
		XIR PLUS	9.6	52	73	391	606
	XIR PLUS	None	6.7	55	87	542	864
		XIR PLUS	11.6	37	58	361	576
One sensor remote (100 m max)	Toxic	None	2.8	88	470	949	1512
		Toxic	3.6	88	470	949	1512
		Catalytic	5.3	27	58	512	824
		XIR PLUS	7	24	24	338	557
	Catalytic	None	5.5	27	58	512	824
		Catalytic	10.6	27	58	512	824
		XIR PLUS	9.6	2	24	338	557
	XIR PLUS	None	6.7	2	24	338	557
		XIR PLUS	11.6	2	24	338	557

Tab. 2   Metric Units Power Load Requirements and Maximum Mounting Distances [1,2]

[1] Values listed are only for one transmitter and the indicated sensor options. The total number of transmitters needs to be considered when specifying a power supply.

[2] Assumes transmitter was ordered with relays

[3] When sizing a system's 24 V supply, a 1 A inrush current with a 1 ms duration should be considered for each ULTIMA X5000 on the power supply.

US

3.6.4 Instructions for Power and Analog Output

> ⚠ **CAUTION!**
>
> Read all electrical warnings and wiring requirements before connecting power to the ULTIMA X5000.

The red colored (4-pin) connector interfaces power and analog outputs 1 and 2. The HART interface is a separate, green colored (2-pin) connector.
The green colored (4-pin) connectors interface sensors one and two.
Using shielded cable is recommended. The cable shield should be terminated internal to the instrument enclosure using the crimp terminal provided (see Fig. 20).

(1)   Remove the ULTIMA X5000 cover by turning counter-clockwise.

(2)   Pull on the metal bail, removing electronics, to expose sensor and power connections.

(3)   Remove the red colored power connector.

(4)   Use a small, flat head screw driver to open wire entries on the connector.

(5)   Strip cable jacket to expose shield and the four individual wires.

(6)   Connect the power and analog output wires. Wire locations are marked on the cover plate (see Fig. 19):

    a.   +DC
    b.   -DC
    c.   mA1 - *analog output of sensor 1*
    d.   mA2 - *analog output of sensor 2*
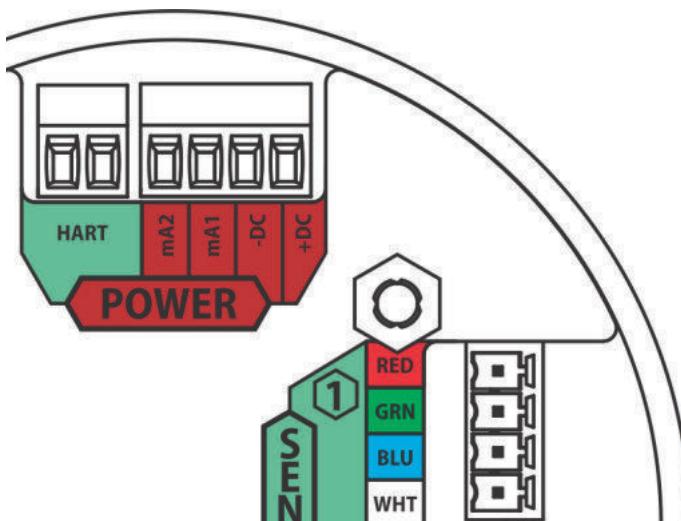
Fig. 19   Power, HART, and Sensor Inputs

(7)   Tighten screws on connector and tug gently on wires to ensure they are secure.

US

(8)   Connect shield of cable to base of instrument housing (see Fig. 20).
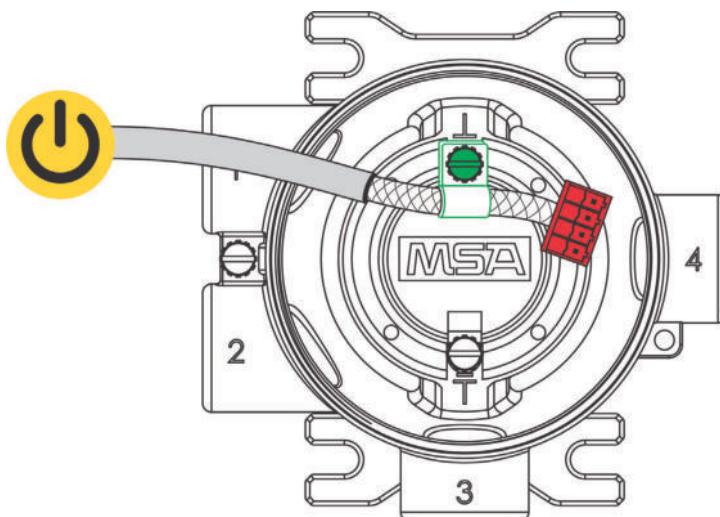
Fig. 20   Connecting Power and Grounding Cable

(9)   Attach the connector to the board stack, making sure the appropriate wires are in the correct terminals.

(10)   Connect HART wires (for optional local HART port).

(11)   Connect an XCell or XIR PLUS sensor using the green connector. Sensor wires are already connected as shown on the cover plate (see Fig. 21):

a.   +DC (RED)
b.   RS485 Com + (GRN)
c.   RS485 Com - (BLU)
d.   -DC (WHT)
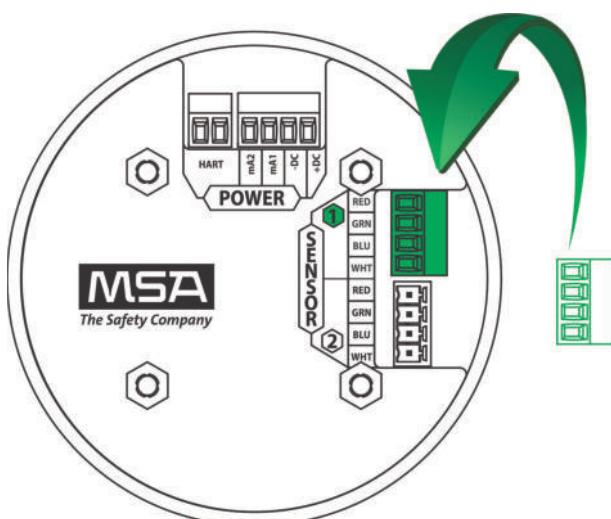
Fig. 21   Connecting a Sensor to the Board

Note: Leaving exposed wire from the connector can electrically short the system.

(12) Replace the board stack by aligning the four metal standoffs with the four holes inside the ULTIMA X5000housing. Push firmly on the board stack where indicated (see Fig 22).
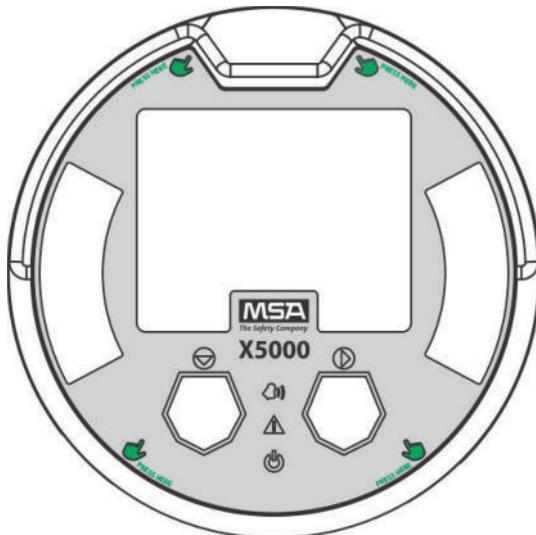
Fig. 22   Highlighted Areas Show Where to Press when Replacing a Board Stack

> ⚠ **CAUTION!**

Ensure that the electronics assembly is fully engaged in the mounting holes. If not fully seated, the touch interface performance can be negatively affected

> *NOTICE*

Avoid pressing on the left and right areas where the LEDs are located. Pressing directly on the display will damage the display and will void the warranty.
Care must be taken to insure the X5000 inside glass surface is free of smudges/dirt and grease. Dirt and grease can interfere with the touch interface of the display.

ULTIMA X5000 Installation Outline Drawings

Model	Document No.
ULTIMA X5000	SK3015-1051

Tab. 3   Installation Outline Drawings

US

3.6.5 Relay and Power Connections
Relay Board Stack Overview

The ULTIMA X5000 can be purchased with three relays. Two of the relays can be configured for either de-energized (default) or energized and latching or non-latching (default). The third relay is a dedicated fault relay.

All electrical connections to internal relays can be made directly on the PC board. The board is labeled for Normally Open (NO) and Normally Closed (NC) de-energized state.
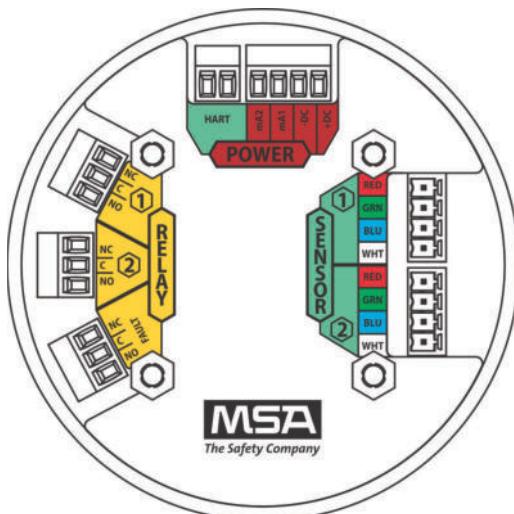
Fig. 23   PC Board with Relays

Relay Specifications

Relays	SPDT (Single Pole Double Throw)
Fault	Normally Energized
Warning	Configurable
Alarm	Configurable
Relay Rating	
125 or 250 VAC (Resistive)	5A, 100K Cycles 1.6 HP @ 250 VAC
30 VDC (Resistive)	5A

Tab. 4   Relay Specifications

If using AC power, the relay wires should not be run within the same conduit or cable tray as the DC power supplied to the ULTIMA X5000 or the ULTIMA X5000 junction box connection. A separate wire entry on the device should be used for AC power connected to the relays. The ULTIMA X5000 is built with an additional wire entry to allow this.

> ℹ️ Exceeding the volt-amp rating of the relay can cause damage to the switching contacts.

US

Relay Connections to Inductive Loads

If connecting the relays to motors, fluorescent lighting, or other inductive loads, it is necessary to suppress any sparks or inductive feedback that may occur at the relay contact. These effects may render the unit inoperative.

One way to reduce these effects is to install a Quencharc® (Part Number 630413) across the load being switched.

Fault Relay Wiring and Configurations

The Fault relay state in non-fault operating condition is Energized and terminal connections are supplied for Normally Closed and Normally Open.

The energized fault relay setting provides an electrical path for fail-safe relay operation. In the event of any failure, including loss of power, the relay will change to the de-energized state to indicate a fault condition.

The Fault relay state cannot be reconfigured.

Relay Energy State and Terminal Connections

The ULTIMA X5000 relays can be selected as energized or de-energized on the device. The default configuration is the De- Energized state. The preferred relay energy state should be determined before making connections. Table 5 shows the terminal connections by energy state and is applicable to both relay 1 and relay 2.

Energy State	NC (Normally Closed)	NO (Normally Open)
De-Energized (default)	Closed	Open
Energized	Open	Closed

Tab. 5   Relay Terminal Connections by Energy State

US

4 Operation

The ULTIMA X5000 Series transmitter is factory calibrated and shipped with the most common default options to minimize set up effort. Any of the default settings can be changed to meet the user's individual needs via the EZ touch buttons on the display of the ULTIMA X5000.

4.1 Startup
4.1.1 Initial Startup

The first time the ULTIMA X5000 is powered on, the analog output goes to the Maintenance Mode setting (default 3.5 mA) and the following will appear on the display while the LEDs cycle from GREEN, to RED, to AMBER, then to GREEN:

• ULTIMA X5000 Logo with Software Version No.

• Tachometer countdown

• MSA Logo

XCell oxygen and carbon monoxide (CO) sensors require a 30 minute start-up time before being fully functional. During this time the analog output signal will be at its maintenance (3.5 mA) level while the display indicates the 30 minute countdown. All other XCell sensors have a 2 minute countdown time during which the analog output signal will be at its maintenance (3.5 mA) level. A full calibration is recommended after one hour of a sensor being installed and acclimated to the environmental conditions. See section 5 for calibration details.

4.2 Settings

The ULTIMA X5000 is a tool free transmitter. The two EZ touch buttons on the face of the display can be used to navigate through the menu structure. The buttons are designed for use with fingers with a "press" and "release" action, and work best without gloves.

Button	Function
left button (↓)	scrolling through each menu
right button (→)	selecting a particular menu option

Tab. 6   Navigating through the menu structure

Changing a value

(1)   Select the relevant option with →.

The arrow disappears and the first digit to change appears underlined.

(2)   Scroll through the numbers with ↓.

(3)   Use → to move on to the next digit.

When the arrow reappears, the value changing is finished.

When entering a new value, remember the following to ensure settings are saved:

• Use *SAVE* before exiting or settings will be lost.

• Use *BACK* to go back to previous screen.

• Use *CANCEL* to go back to main settings menu (i.e. BACK).

• Use *HOME* to return to gas reading display.

US

4.2.1 Instrument Settings
The following settings are saved to the device memory and will not change if the sensor type is changed.

(1) Scroll to Settings.

(2) Select Instrument.

(3) Select to enter the menu.

Setting		Default	Menu 1 Options	Menu 2 Options
Relay Setup	Relay State	De-energized (Fault Relay always energized)	Relay 1 Relay 2	De-energized Energized
	Mapping	Common	Relay 1 Relay 2	Common Discrete Horn
Analog Settings (see Tab. 8)		Custom 2 (see Tab. 8)	3.5mA with HART 1.25mA with HART Custom 1 Custom 2	Custom Settings Calibration Cleaning mode[1] Fault Maintenance
Bluetooth		Enabled	Bluetooth Status Reset All	Enable Disable Reset All
Min/Max/Avg		1h	Interval (1h, 8h, 24h) Start Hour (0-23h)	
Swap Delay		Enabled	Enable Disable	
Set Date		UTC-5 (Factory Date and Time)	Year (2000-2999) Month (Jan-Dec) Day (0-31) Time (0:00-23:59)	
Password		Disabled	0000-9999, incr. 0001	
Controller Data Reset		N/A	Controller Data Reset	
Display Units		Sensor Dependent (see Tab. 9)	PPM mg/m^3 µMol	
Tag #		Blank	Only configurable via HART and Bluetooth	
Reset Main Unit		N/A	Reset Main Unit	

Tab. 7   Default Device Settings

[1] Cleaning mode not available

US

Setup Relay State for Energized or De-Energized

Relays 1 and 2 are default De-energized. Relay 3 is a fault relay that is set to Energized and cannot be changed.

To set Alarm Relay State:

(1)   Scroll to Settings.

(2)   Select Instrument.

(3)   Select Relay Setup.

(4)   Select Relay State.

(5)   Select Relay 1 or Relay 2.

(6)   Select Energized or De-Energized.

Relay Mapping

Relay 1 and Relay 2 can be configured for common, discrete, and horn modes via the device display menu or X/S Connect app.

Common mode is the default relay mapping setting. In Common mode, Relay 1 is actuated by Alarm 1 on either sensor, and Relay 2 is actuated by Alarm 2 on either sensor.
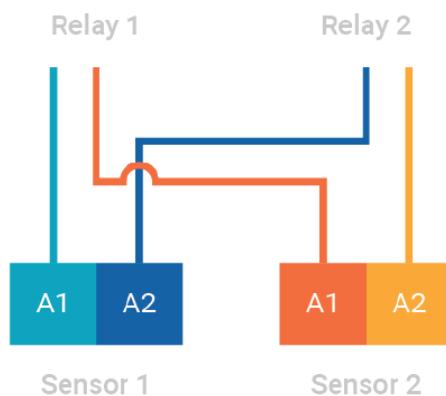
Fig. 24   Common Mode Relay Map and Alarm Actuation

Discrete mode allows a separate action for each sensor. Relay 1 is actuated by Sensor 1 alarms and Relay 2 is actuated by Sensor 2 alarms.
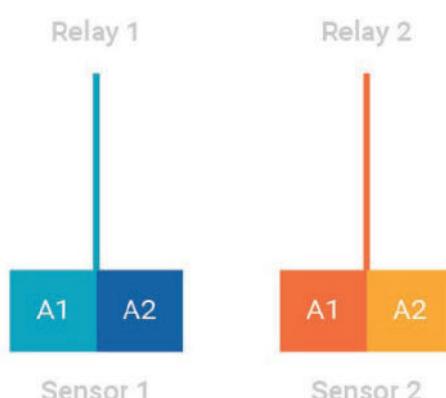
Fig. 25   Discrete Mode Relay Map and Alarm Actuation

Horn mode is designed to allow local acknowledgment of a relay-triggered horn, while the alarm state is still present. All alarms on both sensors trigger both relays, however the first relay can be acknowledged by pressing one finger over each of the EZ touch buttons and holding for 1 second before releasing.
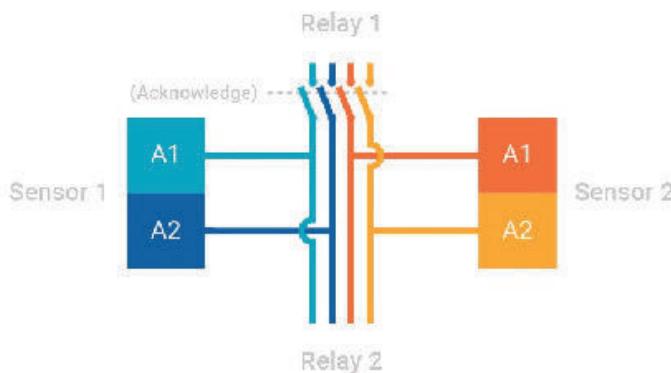
Fig. 26   Horn Mode Relay Map and Alarm Actuation

Analog Output Settings for Fault Conditions

Analog outputs can be set to 3.5 mA and 1.25 mA with HART, or to custom output values as listed in Tab. 8. Output settings for oxygen sensors are not configurable. The Maintenance analog output is used during start up, Reset Main Unit, and Controller Data Reset..

To change Analog outputs settings:

(1)   Scroll to Settings.

(2)   Select Instruments.

(3)   Scroll and Select Analog Settings.

(4)   Select 3.5, 1.25, Custom 1 or Custom 2.

(5)   Select Save.

(6)   (Only Custom) Select Fault, Calibration, or Maintenance.

(7)   (Only Custom) Enter desired output levels (options in Tab. 8).

(8)   (Only Custom) Select Save.

(9)   (Only Custom) Repeat for remaining outputs.

(10) Select Save.

Output Setting (mA)	3.5 mA[1]	1.25 mA	Custom 1 Default	Custom 2 Default	AO Range Options
Fault	3.5^2	1.25^2	2.0	2.0	Range: 0.000-3.750 Increment: 0.025
Calibration (excl. O_2)	3.5^2	1.5^2	3.0	3.0	Range: 0.000-3.750 Increment: 0.025
Cleaning Mode (NOT ENABLED)	3.5^2	2.0^2	2.5	2.5	Range: 0.000-3.750 Increment: 0.025
Maintenance	3.5^2	3.5^2	3.5	3.5	Range: 0.000-3.750 Increment: 0.025
O_2 Calibration	3.5^2	1.5^2	21.7^3	Same as Calibration	Range: 0.000-3.750 Increment: 0.025

Tab. 8   Analog Output Setting Options

[1] Default factory setting
[2] Not configurable
[3] For an O_2 sensor, 21.7 mA is the default Custom 1 setting and is not configurable.

US

Enable Bluetooth Communications
Every ULTIMA X5000 ordered with Bluetooth comes with the communications enabled by default. Bluetooth must be enabled for any Bluetooth functions to operate. A compatible Bluetooth host with the X/S Connect app is needed for connection.

To disable Bluetooth:

(1)   Scroll to Settings.

(2)   Select Instrument.

(3)   Scroll and select Bluetooth.

(4)   Select Bluetooth Status.

(5)   Select Disable.

(6)   Select Save.

Bluetooth Pairing
The instrument memory has the ability to store up to 25 mobile devices in its memory.
As a visual indication, the green LEDs will toggle and quickly flash when a device is paired. Once paired with an X5000, the user will be able to connect to the same X5000 remotely and without needing to enter a pairing code, unless over 25 other devices are paired with the same X5000 afterwards.

To pair with the X5000:

(1)   Download the X/S Connect App from the Google Play Store.

(2)   Open the X/S Connect App.

(3)   Select "Connect" for the X5000 that you would like to connect with.

(4)   (First Time Only) When prompted, tap EZ touch button to display a 6-digit pass code.

(5)   Enter Pairing Code shown on X5000 display.

Bluetooth Security
The Bluetooth connection is encrypted and secured with a unique six digit pin that must be confirmed on the mobile device and acknowledged on the detector display. All of the previously paired devices can be erased from the X5000 to provide additional security and control.

To Reset All device pairings:

(1)   Scroll to Settings.

(2)   Select Instrument.

(3)   Scroll and select Bluetooth.

(4)   Scroll and select Reset All.

(5)   Select Continue.

> ⚠ **WARNING!**

Reset All will delete all paired device memory. All devices will have to re-initiate pairing at the device.

Bluetooth Tag ID
See section 4.3 to view Bluetooth Tag ID.

US

Min/Max/Average

The minimum, maximum, and average gas readings can be set for a user-defined interval. For example, if the interval is set to 24 and the start hour is set to 6, the Min/Max/Avg values will update every 24 hour period starting at 6 am.

The default interval is set to 1h and start hour is 0. The Interval and Start Hour are driven by the Time and Date of the transmitter.

To change Min/Max/Average interval and time:

(1)   Scroll to Settings.

(2)   Select Instrument.

(3)   Scroll and select Min/Max/Average.

(4)   Select Set Interval.

(5)   Enter Interval (1h, 8h, 24h) and Save.

(6)   Scroll to Set Start Hour.

(7)   Enter Start Hour (0-24h) and Save.

Swap Delay

Swap Delay allows the user a brief window to change an XCell sensor without the device going into a fault condition. Once a sensor is disconnected from the transmitter, the user will have 2 minutes to reconnect a sensor. During this time, the device analog output will go to its Mainte-nance level. If a sensor is reconnected or replaced during the 2 minute window, the new sensor's countdown sequence will begin and the analog output will remain at the Maintenance level. After the sensor countdown is complete, the analog output will return to reporting a live gas reading. If a sensor is not reconnected after the 2 minute window, the ULTIMA X5000 will enter a "Sensor Missing" fault condition. All XCell Sensors have SafeSwap and do not need to be disconnected from power while changing sensors. For more details on how to change sensors, see section 6.2 . Swap Delay is enabled on all ULTIMA X5000 transmitters by default.

NOTICE

The transition to maintenance mode during the 2 minute Swap Delay window and sensor count-down will not trigger the Fault Relay. The Fault Relay will only be triggered when the device enters a fault condition.

To enable or disable Swap Delay:

(1)   Scroll to Settings.

US

(2)   Select Instrument.

(3)   Scroll and select Swap Delay.

(4)   Select Enabled or Disabled.

(5)   Select Save.

Time and Date Setup

Time and date are set at the factory in GMT. When selected, the current date is displayed. Select Change to edit date and time. The user must save to move onto the next date setting. The Min/Max/Average settings are driven by the date and time and should be changed to local time for data accuracy.

To change Time and Date:

(1)   Scroll to Settings.

(2)   Select Instrument.

(3)   Scroll and select Set Date.

(4)   Scroll and Select Change.

(5)   Select Year and Save.

(6)   Select Month and Save.

(7)   Select Day and Save.

(8)   Set Time and Save.

Enable Password

Enabling password will require the user to enter the password before entering any of the settings menu. The password entry screen defaults to 0000 and is disabled by default.

When the password is enabled, a lock icon will appear in the top right corner of the display.

If the password is lost, call MSA Customer Service at 1-800-672-2222.

To enable the password:

(1)   Scroll to Settings.

(2)   Select Instrument.

(3)   Scroll and select Password.

(4)   Select Enable Password.

(5)   Scroll and select Save.

(6)   Confirm the Password (password is default 0000 until changed).

Change Password

A password can be changed whether or not the password is enabled.

If the password is lost, call MSA Customer Service at 1-800-672-2222.

US

To change the password:

(1)   Scroll to Settings.

(2)   Select Instrument.

(3)   Scroll and select Password.

(4)   Select Change Password.

(5)   Enter desired password.

(6)   Select Save.

(7)   Scroll and select Save to confirm password.

Language

The X5000 main display can be viewed in multiple languages. Available Languages are: English, French, Spanish, Portuguese, Italian, Dutch, Russian, Chinese, and German.

The X/S Connect App is only available in English, and does not change when the display language on the ULTIMA X5000 is changed.

To change the display language:

(1)   Scroll to Settings.

(2)   Select Instrument.

(3)   Scroll and select Language.

(4)   Select English, French, Spanish, Portuguese, Italian, Dutch, Russian, Chinese, or German.

(5)   Scroll and select Save.

Controller Data Reset

Controller Data Reset will reset all of the settings in the main PCBA to their factory defaults and cycle power to the unit.

To reset data to factory default values:

(1)   Scroll to Settings.

(2)   Select Instrument.

(3)   Scroll and select Controller Data Reset.

(4)   Select Continue.

The unit will reboot, and the analog output will go to the values entered for Maintenance.

Display Units

The default display units are dependent on the sensor type. See Tab 9 for default sensor units. Only % LEL is available for combustible sensors. Only % is available for oxygen sensors.

To change display units:

(1)   Scroll to Settings.

(2)   Select Instrument.

(3)   Scroll and select Units.

(4)   Select PPM, mg/m^3 or µMol.

(5)   Scroll and select Save.

US

Tag Number

Displays current tag. Default is blank. Below are the valid characters one can enter to identify their unit. Entering the tag is only available via the X/S Connect App and HART. When changed, this will be the name used by the transmitter for advertising Bluetooth signal.

@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
SP	!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?

Fig. 27   Valid Characters

Reset Main Unit

Reset Main Unit will cycle power on the instrument, without changing any of the settings.

To reset the main unit:

(1)   Scroll to Settings.

(2)   Select Instrument.

(3)   Scroll and select Reset Unit.

(4)   Select Continue.

The unit will reboot, and the AO will go to the values entered for Maintenance.

4.2.2 Sensor Settings

The following settings are saved to the ULTIMA X5000 so that if the sensor is replaced with the same sensor type (gas and range), the settings will remain the same. If a different sensor type and range is used to replace the previous sensor, the new sensor's default settings will upload to the device.

To change sensor settings:

(1)   Scroll to Settings and select it.

(2)   Select Sensor.

(3)   Select an option to enter the menu.

Alarm Set Points

There are two configurable alarm set points for each sensor. Alarm set point maxima are limited to the full scale range of the sensor. Alarm minima are listed in Tab. 36.

To change alarm set points:

(1)   Scroll to Settings and select it.

(2)   Select Sensor.

(3)   Select Alarm Setup.

(4)   Select Alarm Set Points.

(5)   Enter desired alarm set point (this will be limited by sensor range).

(6)   Scroll and select Save.

US

Alarm Actions

Relays can be triggered by an alarm threshold as gas readings increase or decrease. Most applications require increasing alarm thresholds, except for Oxygen monitoring, which is most often a decreasing alarm.

Relays can also be triggered such that the relays are latched in the alarm state until a user acknowledges the alarm by placing one finger over each of the EZ touch buttons and holding for 1 second before releasing. If the alarm relay state is chosen to be Non-Latching, the relay will reset once the alarm condition (gas value) returns to a value outside of the alarming condition. A user can also disable alarms in the Alarm Actions menu.

To change alarm actions:

(1)   Scroll to Settings and select it.

(2)   Select Sensor.

(3)   Select Alarm Setup.

(4)   Scroll and select Alarm Actions.

(5)   Select Sensor 1 or Sensor 2.

(6)   Select Alarm 1 Actions or Alarm 2 Actions.

(7)   Select Disabled, Increasing/Non-Latching, Increasing/Latching, Decreasing/Non-Latching, or Decreasing/Latching.

(8)   Scroll and select Save.

Span Value

The span value is used to set the calibration point. The default span values are approximately half of the total range of the sensor as purchased (see Tab. 36). If the range is changed, the span value should also be changed to increase accuracy over the full scale range.

Before changing the span value, the user should ensure that the appropriate concentration of calibration gas is available. The concentration of the calibration gas should match the span value, except if using propane to calibrate a combustible sensor to a different gas cross reference value.

To change the span value:

(1)   Scroll to Settings and select it.

(2)   Select Sensor.

(3)   Scroll and select Span Value.

(4)   Current Span Value is displayed.

(5)   Enter desired span value.

(6)   Scroll and select Save.

US

Default and range of available span values depends on the sensor type. See table 36 for default and range of span values.

Sensor Range

All XCell sensors have adjustable sensor ranges. The sensor range cannot be set below the current alarm set points. The user may need to first lower alarm set points and/or span value in order to adjust sensor range to desired level. The user should also consider adjusting the span value to accommodate the changed sensor range so that the span is in the center of the range.

To change the sensor range:

(1)   Scroll to Settings and select it.

(2)   Select Sensor.

(3)   Scroll and select Sensor Range.

(4)   Current sensor range is displayed.

(5)   Enter desired sensor range.

(6)   Scroll and select Save.

Changing the sensor range will change the analog output values for alarm levels.

Gas Table

The ULTIMA X5000 XIR PLUS sensor can be calibrated to a wide range of compounds, see section 9 for a list of gases, span values, and gas table values.

Gas Table #	Target Gas
1	Methane
2	Propane
3	Ethane
4	Butane
5	Pentane
6	Hexane
7	Cyclopentane
8	Ethylene

US

Reset Sensor

The sensor default values can be restored by resetting the sensor. If Swap Delay is enabled, during a sensor reset the analog outputs will behave the same as if a sensor were replaced. See the section on Swap Delay for details. If Swap Delay is disabled the analog outputs will first go into a fault condition, followed by the maintenance condition for the duration of the sensor's count-down.

> ⚠ **CAUTION!**
>
> The sensor goes into a Sensor Configuration Reset fault and must be calibrated after a sensor reset. There will be four dashes displayed where the current reading should be.
> All settings, including Alarm Set Point and Calibration Values, will be returned to factory defaults.

To Reset Sensor to factory default:

(1)   Scroll to Settings and select it.

(2)   Select Sensor.

(3)   Scroll and select Reset Sensor.

(4)   Select Continue.

> *Note: Sensor Reset can take 10 seconds to initiate the sensor's countdown.*

(5)   Calibrate the sensor to clear Sensor Configuration Reset fault.

Disable Sensor

When removing a sensor from the transmitter while under power, the ULTIMA X5000 will enter a Sensor Missing fault condition after the two minute Swap Delay period has expired (if enabled). If Swap Delay is disabled, the transmitter will go into Sensor Missing fault immediately. If the system is off at the time a sensor is removed, the transmitter will go into fault after its startup sequence. This fault condition can be removed by disabling the affected sensor position.

Disabling a sensor removes the fault and stops communications with the sensor, the sensor's reading on the display is removed, and the mA channel for that sensor position is set to 0 mA. By default, the ULTIMA X5000 has the Sensor 2 position disabled. If at any time a sensor is connected to a position that is disabled, the ULTIMA X5000 will automatically enable that sensor position.

To disable the sensor after removal:

(1)   Scroll to Settings and select it.

(2)   Select Sensor.

(3)   Scroll and select the sensor you want to disable (Sensor #1 or Sensor #2).

(4)   Scroll and select Disable Sensor.

> ℹ   Only one sensor can be disabled at a time. The transmitter will not allow both sensor positions to be disabled simultaneously.
>
> The ULTIMA X5000 only allows a sensor to be disabled after the transmitter has gone into Sensor Missing fault.

Gas (Code)	Range Default	Unit Default	Alarm 1 Default	Alarm 2 Default	Alarm Action Default	Span Value Default	Alarm Min	Alarm Max	Range Min	Range Max	Span Value Min	Span Value Max
Carbon Monoxide (10)	0-100	PPM	10	30	Increasing Non-Latch	60	10	1000	0-10	0-1000	5	FS[1]
Carbon Monoxide (11)	0-500	PPM	50	150	Increasing Non-Latch	300	10	1000	0-10	0-1000	5	FS[1]
Carbon Monoxide (12)	0-1000	PPM	100	300	Increasing Non-Latch	400	10	1000	0-10	0-1000	5	FS[1]
Carbon Monoxide H_2 Resistant (14)	0-100	PPM	10	30	Increasing Non-Latch	60	10	1000	0-10	0-1000	5	FS[1]
Catalytic Bead 5% Methane (60)	0-100	% LEL	10	30	Increasing Non-Latch	50	5	60	0-20[2]	0-100	10	100
Catalytic Bead 4.4% Methane (65)	0-100	% LEL	10	30	Increasing Non-Latch	57	5	60	0-20[2]	0-100	10	100
Catalytic Bead 2.1% Propane (61)	0-100	% LEL	10	30	Increasing Non-Latch	29	5	60	0-20[2]	0-100	10	100
Catalytic Bead 1.7% Propane (66)	0-100	% LEL	10	30	Increasing Non-Latch	36	5	60	0-20[2]	0-100	10	100
Hydrogen Sulfide (20)	0-10.0	PPM	1.0	3.0	Increasing Non-Latch	5.0	1.0	100	0-10	0-100	5	FS[1]
Hydrogen Sulfide (21)	0-50.0	PPM	5.0	15.0	Increasing Non-Latch	40.0	1.0	100	0-10	0-100	5	FS[1]
Hydrogen Sulfide (22)	0-100.0	PPM	10.0	30.0	Increasing Non-Latch	40.0	1.0	100	0-10	0-100	5	FS[1]
Oxygen (16)	0-25.0	% VOL	19.5	18.0	Increasing Non-Latch	20.8	5.0	25.0	5.0-25	5.0-25	15.0	25.0
XIR PLUS 5% Methane (AA)	0-100	% LEL	10	20	Increasing Non-Latch	50	10	60	0-20	0-100	1	100
XIR PLUS 4.4% Methane (AC)	0-100	% LEL	10	20	Increasing Non-Latch	57	10	60	0-20	0-100	1	100
XIR PLUS 2.1% Propane (AB)	0-100	% LEL	10	20	Increasing Non-Latch	27	10	60	0-20	0-100	1	100
XIR PLUS 1.7% Propane (AD)	0-100	% LEL	10	20	Increasing Non-Latch	35	10	60	0-20	0-100	1	100

Tab. 9   Default Sensor Settings

[1] FS = Full Scale Range.
[2] The Range Max value on catalytic bead cannot be set below 20%.

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Gas (Code)	Range	Display Resolution[1]	Unit Default	Alarm 1 Default	Alarm 1 Default AO (mA)	Alarm 2 Default	Alarm 2 Default AO (mA)
Carbon Monoxide (10)	0-100	1	PPM	10	5.6	30	8.8
Carbon Monoxide (11)	0-500	1	PPM	50	5.6	150	8.8
Carbon Monoxide (12)	0-1000	1	PPM	100	5.6	300	8.8
Carbon Monoxide H_2 Resistant (14)	0-100	1	PPM	10	5.6	30	4
Catalytic Bead 5% Methane (60)	0-100	1	% LEL	10	5.6	30	8.8
Catalytic Bead 4.4% Methane (65)	0-100	1	% LEL	10	5.6	30	8.8
Catalytic Bead 2.1% Propane (61)	0-100	1	% LEL	10	5.6	30	8.8
Catalytic Bead 1.7% Propane (66)	0-100	1	% LEL	10	5.6	30	8.8
Hydrogen Sulfide (20)	0-10.0	0.1	PPM	1.0	4.16	3.0	4.48
Hydrogen Sulfide (21)	0-50.0	0.1	PPM	5.0	4.16	15.0	4.48
Hydrogen Sulfide (22)	0-100.0	0.1	PPM	10.0	4.16	30.0	4.48
Oxygen (16)	0-25.0	0.1	% VOL	19.5	16.48	18.0	15.5
XIR PLUS 5% Methane (AA)	0-100	1	% LEL	10	5.6	20	7.2
XIR PLUS 4.4% Methane (AC)	0-100	1	% LEL	10	5.6	20	7.2
XIR PLUS 2.1% Propane (AB)	0-100	1	% LEL	10	5.6	20	7.2
XIR PLUS 1.7% Propane (AD)	0-100	1	% LEL	10	5.6	20	7.2

Tab. 10   Default Alarm Outputs

[1] Display resolution is not a configurable option

4.3 Status Menu

The following settings can be viewed through Status Menu without a password, regardless of whether one is enabled.

(1) Scroll and select Status.

(2) Use ↓ to scroll through the list:

- Tag #
- Software Version
- Sensor Type
- Life and Health
- Previous Calibration Dates Alarm Setup
- Alarm 1 Set Point
- Alarm 1 Actions
- Alarm 2 Set Point
- Alarm 2 Actions
- Relay Setup
- Mapping Energy State
- Bluetooth Tag ID

(3) Use → to go back to the main menu.

4.3.1 Life and Health

The Life and Health information reports the general health of the sensor. The sensor Life and Health can either be "Good" or "Fair". When sensor status turns to "Fair", the remaining sensor life is approximately 2-3 months, and a replacement sensor should be ordered to ensure continuity of gas detection. XCell sensors with TruCal (Hydrogen Sulfide and Carbon Monoxide) calculate remaining sensor life using automated pulse checks. The pulse stimulates the sensor with a response similar to having actual calibration gas applied. The stimulated response is compared to the last calibration and will make adjustments to sensitivity to match the last calibration. When the required adjustment is greater than the accuracy of the algorithm's adjustment, the sensor will call for a calibration. The pulse check tracks the overall degradation in sensitivity and will adjust the Life and Health status from "Good" to "Fair" when loss of sensitivity is due to overall sensor health. TruCal pulse checks will also detect when the sensor is no longer capable of sensing gas, resulting in a Fault condition.

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5   Calibration

Calibration is the process of applying a known quantity of gas to the transmitter so that the transmitter can adjust the precision and accuracy of the measurements made in normal operating mode. This process ensures that gas measurements are as accurate as possible.

Calibration Warnings - Read before Calibrating

Although ULTIMA X5000 sensors are factory calibrated, another calibration is recommended once the unit is installed in its final environmental destination.

> ⚠ **WARNING!**

Use zero gas when zeroing the ULTIMA X5000 transmitter if there is any possibility of background gas. Otherwise, improper calibration could occur.

Always calibrate for the least sensitive gas or vapor (higher number category) expected to be measured. Otherwise, instrument readings may be incorrect.

> ⚠ **CAUTION!**

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

Perform a calibration at initial start-up and at regular intervals to ensure a fully functional sensor.

5.1   Calibration Equipment

A gas cylinder with a known concentration of gas appropriate for the range of measurement is needed. Sensors come with preset span gas values appropriate for the measurement range. See Tab. 36 for Default Span Values by Sensor Type. Calibration kits are available from MSA for calibration of the ULTIMA X5000. The kits come housed in a convenient carrying case and contain all items necessary for a complete and accurate calibration, including a 1 L/min regulator, tubing, and Calibration Caps. See table 11 to select the appropriate kit for the sensor type. The calibration kit can also be ordered without a gas cylinder (Part Number CALKIT1).

Gas Type	Range	Concentration	Cylinder Part Number	P/N with Calibration Kit
Carbon Monoxide	0-100 PPM	60 PPM	710882	710882-KIT1
	0-500 PPM	300 PPM	10027938	10027938-KIT1
	0-1000 PPM	400 PPM	10028048	10028048-KIT1
Hydrogen Sulfide	0-10 PPM	5 PPM	10028084	10028084-KIT1
	0-50 PPM	40 PPM	10028062	10028062-KIT1
	0-100 PPM			
Oxygen	0-25 %	20.8 %	10028028	10028028-KIT1
Combustible (XIR PLUS or Cat Bead)	0-100 % LEL 5 % Methane	2.5 % Methane (50 % LEL)	10028032	10028032-KIT1
	0-100 % LEL 4 % Methane	2.5 % Methane (57 % LEL)		
	0-100 % LEL 2.1 % Propane	0.6 % Propane (29 % LEL)	10028034	10028034-KIT1
	0-100 % LEL 1.7 % Propane	0.6 % Propane (35 % LEL)		

Tab. 11   Calibration Kits

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5.2   Calibration Frequency

The frequency of calibration gas testing depends on the operating time, chemical exposure, and type of sensor. Especially in new installations or applications, it is recommended that the first sensors be calibrated more often to establish the sensor performance in this particular environment.

For this, you typically record the "as found" and "as left" gas values and track the percent adjustment over time. Then, gradually extend calibration intervals until the percent adjustment is greater than the expected accuracy of the sensor.

5.3   Calibration Frequency for XCell Sensors with TruCal (H$_2$S & CO only)

XCell sensors with TruCal actively self-monitor for operation and accuracy with fewer manual calibrations required in order to maintain the equivalent level of performance. When the sensor detects a change in sensitivity outside what is typical for a six hour time interval, the sensor will call for a calibration. The transmitter LED status indicators slowly pulse green, alerting the user that a calibration is recommended to maintain optimum performance. There are no changes to the analog output when TruCal calls for a manual calibration.

Actual TruCal sensor performance will depend on the application, background gas exposure, and environment. To validate XCell sensors with TruCal, it is recommended that users follow their regular calibration cycle and record the "as found" and "as left" values, tracking the percent adjustment over time. Once a baseline is established, the calibration intervals can be extended until the percent adjustment is greater than the expected accuracy of the sensor.

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5.4 Calibration Types: Zero vs. Span

The ULTIMA X5000 has two types of calibration: Zero and Span calibration.

Zero Calibration resets the baseline level reading to zero. If the target gas is suspected to be occasionally present, it is best to also use a zero gas cylinder during the zero calibration. If the target gas is not present in the atmosphere, an additional calibration cylinder is not required.

The "Calibrate" option involves first applying a zero gas followed by the span gas. The span gas is a known concentration of gas which adjusts the accuracy and precision of the transmitter to the known value; this is referred to as the "Span Value. See Figure 28.
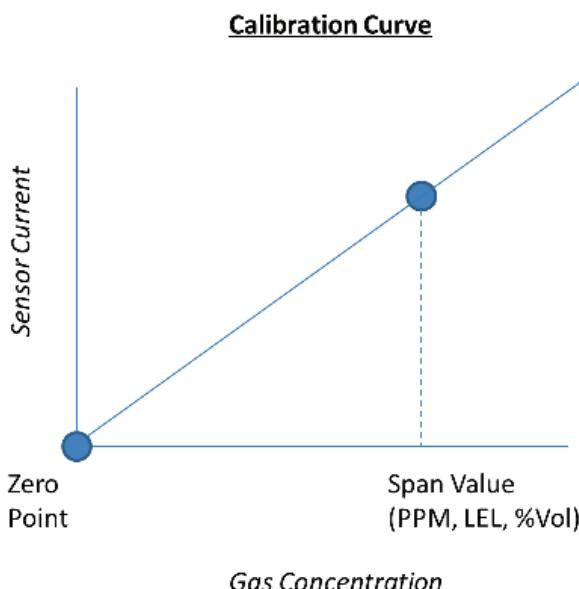
Fig. 28   Calibration Curve

The Sensor Span Value in the device menu should be the same as the concentration listed on the calibration gas cylinder; unless an LEL simulant gas is being used.

The XIR PLUS sensor can be calibrated to a wide variety of gas compounds using either 0.1 % Propane, 0.6 % Propane, or 2.5 % Methane and MSA's gas table. See table 15 for a complete list of gas compounds and corresponding tables and span values.

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5.5   How to Zero Calibrate XCell Sensors

NOTICE

If a password is enabled, you will not be able to proceed with the calibration without the password.

> To abort, press either button on the touchscreen or mobile application at any time during the zero calibration.
>
> In the event that a calibration cannot be completed, the user can acknowledge the FAIL by placing one finger over each of the EZ touch buttons and holding for 1 second before releasing. The unit will revert to the settings of the last successful calibration.

⚠ **WARNING!**

The regulator used with the zero gas cylinder should not be the same as the regulator used for the span gas. The regulator can be contaminated with the target gas over time, and thus raise the detection baseline and make the sensor less sensitive to the target gas.

> If there is no target gas in the atmosphere around the sensor, using a zero gas cylinder is optional.

To Zero calibrate the sensor,

(1)   Attach the Sensor Guard to the bottom of the sensor.

(2)   Place the green Calibration Cap over the Sensor Guard inlet so that it is flush with the bottom of the Sensor Guard and completely covers the Sensor Guard inlet.

(3)   Attach the tubing to the plastic stem protruding through the green Calibration Cap.

(4)   Screw the regulator onto the top of the zero gas cylinder.

> If a password is enabled, you will need to enter it here.

(5)   Scroll and select Calibration.

(6)   Scroll and select *Zero Calibration*.

(7)   Once the screen displays Zero Soaking, turn on zero gas flow by turning knob on the regulator.

(8)   Wait while the device displays the countdown of the Zero Calibration.

(9)   Once the zero calibration is complete, a Zero PASS or FAIL is displayed.
If PASS displays, the procedure is complete.
If FAIL displays, the procedure was unsuccessful.

(10) Remove the Calibration Cap.

> The green Calibration Cap should always be removed after calibration.

5.6   How to Calibrate XCell Sensors
(See section 5.7 for calibrating oxygen sensors.)

NOTICE

If a password is enabled, the user will not be able to proceed with the calibration without the password.

To abort, press either button on the touchscreen or mobile application before Span Calibration begins.

In the event that a calibration cannot be completed, the user can acknowledge the FAIL by placing one finger over each of the EZ touch buttons and holding for 1 second before releasing. The device will revert to the settings of the last successful calibration.

(1)   Attach a regulator to the zero gas cylinder (if using) and the calibration cylinder.

(2)   Attach the Sensor Guard to the bottom of the sensor.

(3)   Place the green Calibration Cap over the Sensor Guard inlet so that it is flush with the bottom of the Sensor Guard and completely covers the Sensor Guard inlet.

(4)   Attach the tubing to the plastic stem protruding through the green Calibration Cap.

(5)   Push the other end of the tubing over the zero cylinder regulator. Ensure the tubing completely covers the gas outlet.

(6)   Scroll and select Calibration.

If a password is enabled, you will need to enter it here.

---

(7)   Select Sensor #1 or Sensor #2.

(8)   Once the screen displays Zero Soaking, turn on zero gas flow by turning knob on the regulator.

(9)   Wait while the device displays the countdown of the Zero Calibration.

(10) Once the zero calibration is complete, remove the tubing from the Sensor Guard inlet.

(11) Attach tubing for calibration gas and turn on the regulator

Display will show "Span in Progress".

"Remove Gas" will show when span is complete.

If PASS displays, the procedure is complete.

If FAIL displays, the procedure was unsuccessful.

(12) Remove the Calibration Cap.

The green Calibration Cap should always be removed after calibration.

US

5.7 How to Calibrate an Oxygen XCell Sensor

An oxygen span gas cylinder is not needed if the sensor is in an area that maintains ambient air conditions. Follow the same process for XCell sensors as described in section 5.6 . When the display prompts "Apply Span Gas", simply allow the countdown to occur without applying gas. If the sensor is located in an area of normally low or enriched oxygen, then a 20.8% oxygen sample must be applied.

5.8 How to Calibrate an XIR PLUS Sensor

A full span calibration is not required for the XIR PLUS sensors. Any degradation of the sensor's performance is associated with slight drifts in its zero response. Restoring the sensor's zero is typically sufficient.

The XIR PLUS Sensor Guard comes attached to the XIR PLUS sensor. The XIR PLUS Calibration Cap is placed over the Sensor Guard so that it is completely covered. Line up the cap so that the Sensor Guard stem protrudes through the Calibration Cap. Zero or calibration gas tubing is then attached to the Sensor Guard via the stem.

> The Calibration Cap must be removed from the XIR PLUS Sensor Guard after completing a zero or span calibration.

5.9 XCell Catalytic Bead LOC Over Range

Catalytic bead sensors require the presence of oxygen in order to sense combustible gas. In the event of very large combustible gas leaks that exceed 100 % LEL, enough oxygen can be displaced so that the sensor's response to gas is no longer proportional to the calibration profile. The XCell catalytic bead has a locking fail safe mechanism that prevents the false reporting of a safe condition while the % LEL concentration is still above 100 % LEL. When the gas concentration exceeds 100 % LEL, the sensor will go into LOC over range.

To clear the LOC over rage, the user needs to acknowledge and calibrate the sensor. To acknowledge LOC over range, place one finger over each of the EZ touch buttons and hold for 1 second before releasing. This will allow a recalibration of the sensor to clear the LOC condition.

⚠ CAUTION!

Ensure that the area has been cleared of gas before acknowledging the LOC Over Range and recalibrating the sensor.

5.10 Calibration Confirmation

The ULTIMA X5000 Gas Monitor records the date of the last successful calibration. This date can then be displayed on the OLED display under the Status Menu.

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6 Maintenance

> ⚠️ **WARNING!**
>
> Repair or alteration of the device, beyond the procedures described in this manual or by anyone other than a person authorized by MSA, could cause the unit to fail to perform properly. Use only genuine MSA replacement parts when performing any maintenance procedures described in this manual.
>
> Substitution of components can seriously impair performance of the device, alter intrinsic safety and flameproof/explosion proof characteristics or void agency approvals. Failure to follow this warning can result in serious personal injury or death.

The ULTIMA X5000 Gas Monitor is constantly performing a self-check. When a problem is found, it displays the appropriate error message. When a critical error is detected within the device, the 4-20 mA output signal goes to a fault condition.

6.1 ULTIMA XIR PLUS Cleaning Procedure

The presence of particulate matter, oil films, liquid water, or the residue from water drops on the two monitor windows can adversely affect its performance. The XIR PLUS Sensor Guard is designed to prevent foreign solids or liquids from reaching the monitor's optical system. Additionally, heating elements are incorporated into the device to prevent water condensation. Under severe conditions, however, some material may collect on these surfaces and it may be necessary to occasionally check and clean the windows.

While both windows are made of a highly durable material that is not easily scratched, avoid excessive pressure when cleaning them. Clean, cotton-tipped applicators are the most convenient tool to remove material collected on the windows.

- Use a dry applicator or one moistened with distilled water to wipe the window and remove dust.
- Use an additional clean, dry applicator to remove any residual water.
- Use an applicator moistened with isopropyl alcohol to remove heavy deposits of solids, liquids or oil films. Clean the window again with a second applicator moistened with distilled water; then, dry the window with a final applicator.
- Avoid using excessive amounts of water or alcohol in the cleaning procedure, and inspect the window to ensure that the entire surface is clean.
- The device will go into a "Low Signal" fault during cleaning with an analog output to 2.0 mA. .

To clean the XIR PLUS sensor:

(1) Remove the Sensor Guard.

(2) Place an opaque object (piece of paper, cardboard, etc.) between the light source window and the mirror to completely obscure the light path for two to three seconds.

The ULTIMA X5000 analog output is in a fault condition while sensor is partially blocked.

The display will indicate "Low Signal".

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> ℹ️ While in "Low Signal" fault, the sensor will not respond to the presence of gas.

(3)   When cleaning is done and the objects are removed from the sensor window, the device returns to normal operation. If water or isopropyl alcohol was used, allow the device to operate for 15 minutes to completely dry before replacing the Sensor Guard and continuing to monitor for combustible gas.

(4)   Replace the Sensor Guard or flow cap.

> **ℹ** When the cleaning process is complete, be sure to remove all objects from the light path. It is recommended to check the sensor's response to zero and calibration gas after cleaning.

⚠ WARNING!

Do not place foreign objects in the sensor's analytical region (except for the "ULTIMA XIR PLUS Cleaning Procedure" as described above); otherwise, the infrared beam can be partially blocked, causing the sensor to generate false readings. All objects must be removed from the sensor's analytical region for it to function properly.

6.2   Replacing an XCell Sensor

The only routine maintenance item is the sensing element itself, which has a limited lifetime. The ULTIMA X5000 sensors with TruCal technology will indicate when the sensor is near end of life through the Status Menu. When the Sensor Life & Health status is "Fair", you have approximately 2 months to replace the sensor before it will no longer function. When a TruCal sensor is no longer capable of sensing it will go into fault and LEDs will flash yellow. It is good practice to obtain a replacement sensing element before the sensing element within your unit becomes inoperative.

⚠ WARNING!

Handle the sensor carefully; the electrochemical version is a sealed unit which contains a corrosive electrolyte.

Any leaked electrolyte that comes in contact with skin, eyes or clothes can cause burns.

If any contact with the electrolyte does occur, immediately rinse with a large quantity of water. On contact with the eyes, rinse thoroughly with water for 15 minutes and consult a doctor.

⚠ CAUTION!

Do not install a leaking sensor in the sensing head assembly. The leaking sensor must be disposed of in accordance with local, state and federal laws.

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There is no need to open the main enclosure. Simply unscrew the XCell sensor from the Sensor Body Assembly.

> ⚠️ **WARNING!**

ULTIMA X5000 digital sensors labeled for Class I Hazardous (Classified) locations and installed in a Class I Hazardous (Classified) location only may be changed under power. To change, unscrew sensor three full turns from its fully engaged position, wait 10 seconds, and then remove the sensor completely. Failure to follow this warning can result in the ignition of a hazardous atmosphere.

For ULTIMA X5000 digital sensors marked Class II or III and installed in a Class II or III hazardous location, the atmosphere must be free of dust or fibers and filings and the power removed from the unit before the sensor cap can be removed from the housing. Failure to follow this warning can result in the ignition of a hazardous atmosphere.

Identify the sensor assembly needed via the A-5K-SENS code on the interior sensor label and obtain the appropriate sensor assembly. Screw the replacement XCell sensor onto the Sensor Body Assembly, ensuring that the XCell sensor mates flush against the bottom edge of the Sensor Body Assembly.

ⓘ Alarm set points, span value, full scale limit and alarm direction will not change when replacing a sensor with the same gas and range. Alarm set points, span value, full scale limit and alarm direction will change to the new sensor settings when replacing a sensor with a different gas and/or range.

The ULTIMA X5000 Gas Monitor is shipped with the Sensor Swap Delay enabled. This means that the 4-20 mA output signal and the FAULT relay will hold off a fault indication for two minutes before the missing sensor indication is displayed on the device. This setting allows the operator to exchange sensor modules without a FAULT indication. See Swap Delay in section 4.2.1 for more details.

ⓘ It is recommended that all other maintenance be performed at an MSA factory-authorized service center.

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6.3 Troubleshooting

The following table lists all fault messages, their priority levels, and corrective actions required to resolve them. The faults are listed in alphabetical order. Lower priority messages are output only after the highest priority message is cleared.

Priority[1]	Display Message	Status LEDs (G/Y/R)	Description	Resolution
35	"ACT Fault"	ON/ON/OFF	Indicates an out of range measurement	Replace the sensor.
24	"Beads Off Fault"	ON/ON/OFF	Indicates that the combustible sensors beads are OFF.	Acknowledge or cycle power to the sensor. Let the sensor warmup, then recalibrate the sensor. If this does not resolve the issue, replace the sensor.
23	"Calibration Required"	ON/ON/OFF	Indicates the sensor requires calibration.	Calibrate the sensor(s) attached to the instrument.
25	"Channel Error"	ON/ON/OFF	Indicates that there is an error in the mA output system.	Reset the sensor. Verify sensor configurations (if different from default values). Then recalibrate the sensor. IF this does not resolve the issue, replace the sensor.
7	"Configuration Fault"	ON/ON/OFF	Indicates that an incorrect configuration was detected.	Select Reset Main Unit from Instrument menu. Verify the customer settings. Replace the main PCBA.
4	"EEPROM Fault"	ON/ON/OFF	Indicates there is an error with the EEPROM.	Typically this is a unit with both sensors disabled and no sensor attached. Attach one sensor to the unit.
29	"External Memory Access Error"	ON/ON/OFF	Indicates that an error occured communicating to the EEPROM.	Select Reset Main Unit from Instrument menu. Verify the customer settings. Replace the main PCBA
30	"External Memory Checksum Error"	ON/ON/OFF	Indicates the EEPROM memory is not valid.	Select Controller Data Reset from Instrument menu. Verify any custom settings and re calibrate the instrument.
3	"Flash Checksum Fault"	ON/ON/OFF	Indicates there is something incorrect with the main PCBA's program.	Replace the main PCBA.
8	"General System Error"	ON/ON/OFF	Indicates one of the internal power supplies is out of range.	Adjust the input power supply voltage to within range for the sensor configuration. Replace the main PCBA.
5	"Internal Circuit Fault"	ON/ON/OFF	Indicates a hardware failure on the main PCBA.	Replace the main PCBA.

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Priority[1]	Display Message	Status LEDs (G/Y/R)	Description	Resolution
33	"Lamp Fault"	ON/ON/OFF	Indicates the sensors lamp is not operating properly. (XIR PLUS sensors only)	Replace the sensor.
15	"Life and Health Fault"	ON/ON/OFF	Indicates the sensor is at the end of life.	Recalibrate the sensor to get additional life. If error does not clear after recalibration, replace the sensor.
36	"Low Signal Failure"	ON/ON/OFF	This indicates the sensors output is low.	Clean the optics on the sensor or replace the sensor.
1	"Low Supply Voltage Fault"	ON/ON/OFF	The input power supply is out of the operating range. It may be too low or too high.	Check the input power supply is within range for the sensor configuration.
17	"Negative Drift"	ON/ON/OFF	This indicates the sensor is reading downscale.	Recalibrate the sensor.
26	"Negative Supply Fault"	ON/ON/OFF	Indicates the negative power supply is out of range.	Check the input power supply. If this is within range, then replace the sensor.
N/A	"Over Range"	ON/ON/OFF	An over scale gas reading is present.	Verify the area is clear of gas first then recalibrate the sensor.
31	"Parameter out of range"	ON/ON/OFF	Indicates that a setting is improperly set in the unit.	Select Controll Data Reset from Instrument menu. Verify any customer settings. Then recalibrate the sensor.
2	"RAM Checksum Fault"	ON/ON/OFF	Indicates a bad RAM memory location was detected.	Replace the main PCBA.
34	"Reference Failure"	ON/ON/OFF	Indicates an out of range measurement.	Replace the sensor.
6	"Relay Fault"	ON/ON/OFF	Indicates that a problem with the relays was detected.	Replace the relay options PCBA.
22	"Sensor Configuration Reset"	ON/ON/OFF	Indicates the sensor datasheet was reset.	Calibrate the sensor.
12	"Sensor Element Error"	N/A	Indicates the sensor is broken.	Replace the sensor.
38	"Sensor End of Life Fault"	ON/ON/OFF	Indicates the sensor is at the end of life. (excl. TruCal Sensors)	Recalibrate the sensor/ replace the sensor.
27	"Sensor FLASH Error"	ON/ON/OFF	Indicates there is something wrong with the sensors program.	Replace the sensor.

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Priority[1]	Display Message	Status LEDs (G/Y/R)	Description	Resolution
13	"Sensor Heater Fault"	ON/ON/OFF	Indicates the sensors heater is not working properly.	Replace the sensor.
25-40	"Sensor Internal Fault"	ON/ON/OFF	Indicates the detection of a hardware issue in the sensor.	Replace the sensor.
9	"Sensor Missing"	ON/ON/OFF	Indicates the sensor is no longer detected.	Replace the sensor.
28	"Sensor RAM Error"	ON/ON/OFF	Indicates a bad RAM memory location was detected.	Replace the sensor.
10	"Sensor Supply Voltage Fault"	ON/ON/OFF	Indicates the sensors input voltage is out of range.	Check the input power supply voltage and check the wiring to the sensor module for damage. If this does not resolve the issue, replace the sensor.
20	"Span Calibration Fault"	ON/ON/OFF	Indicates the sensor did not pass the Span calibration operation.	Acknowledge the fault to revert to the previous calibration. Causes for this fault include: 1. Span gas is not applied within the calibration time-out period 2. The incorrect span gas is applied or the span value is not set correctly in the Sensor Settings. 3. The sensor is at its end of life. Check the span gas concentration and the sensor span value setting to ensure that the correct span gas is being used. Go through the calibration process again after verifying. If fault persists, replace the sensor.
14	"TEDS CRC-16 Error"	ON/ON/OFF	Indicates the sensors datasheet is invalid.	Reset the sensor. Verify the sensor settings (if different from default), then recalibrate the sensor.
40	"Unknown Error"	ON/ON/OFF	Indicates that a sensor is returning an unknown error condition.	Replace the sensor or update the main PCBA software.

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Priority[1]	Display Message	Status LEDs (G/Y/R)	Description	Resolution
19	"Zero Calibration Fault"	ON/ON/OFF	Indicates the sensor did not pass the Zero calibration operation.	Acknowledge the fault to revert to the previous calibration. This fault can be caused by 1. A bad sensor 2. The sensor is trying to zero while span gas is being applied. Check the zero gas cylinder is correct and within expiration date. If not using zero gas, ensure that there is not a background concentration of the target gas in the atmosphere. Go through the calibration process again after verifying. If fault persists, replace the sensor.
N/A	Full scale value and "LOC" displayed on the lower display areas per each sensor	ON/ON/OFF	Indicates a combustible sensors over range condition was measured.	Acknowledge the sensor, wait for the warmup time period and recalibrate the sensor.
11	Parameter Fault (Sensor)	ON/ON/OFF	Indicates that a setting is improperly set in the unit.	Reset the sensors datasheets. Verify any customer settings. Then recalibrate the sensor.
N/A	Gas value is still shown.	Both side green LEDs blinking	Indicates that calibration is recommended. (TruCal sensors only)	Calibrate the sensors attached to the unit.

Tab. 12   Troubleshooting

[1] Lower numbers have higher priority

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7 Ordering Information

7.1 Replacement Parts

See table 13 for replacement parts. For a full list of replacement sensors, see A-5K-SENS (currently not part of the manual). To obtain a replacement sensor, address the order or inquiry to:

Mine Safety Appliances Company
1000 Cranberry Woods Drive
Cranberry Township, PA 16066

or call, toll-free, 1-800-672-4678.
Inquiries can also be e-mailed to customer.service@msasafety.com.

⚠ WARNING!

Use only genuine MSA replacement parts when performing any maintenance procedures provided in this manual. Failure to do so may seriously impair sensor and gas monitoring performance. Repair or alteration of the ULTIMA X5000 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 loss of life.

Type	Description	Part Number
PCBA Assemblies		Refer to A-X5000-PCB
Sensor Body		Refer to A-5K-SENS
Sensors, All		Refer to A-5K-SENS
Sensor Guard, XCell	REPLACEMENT SENSOR GUARD FOR XCELL SENSORS	10184683
Sensor Guard, ULTIMA XIR PLUS	REPLACEMENT SENSOR GUARD FOR XIR PLUS SENSORS	10184684
Mounting Bracket Kit	MOUNTING BRACKET, ULTIMA X5000, KIT	10179361
Duct Mount Kit	RECTANGULAR DUCT MOUNT KIT, ULTIMA X5000	10176947
	ROUND DUCT MOUNT KIT, SMALL, ULTIMA X5000	10179124
	ROUND DUCT MOUNT KIT, LARGE, ULTIMA X5000	10179321
Calibration Kit	CALIBRATION HARDWARE (CYLINDER NOT INCLUDED)	CALKIT1
Pipe Mount Kit, Universal	20-150 MM PIPE MOUNT, ULTIMA X5000/S5000	10176946
Pipe Mount Kit, 2" U-Bolt	2" PIPE MOUNT KIT, ULTIMA X5000	10179873
Junction Box	316 STAINLESS STEEL, ¾ NPT, NORTH AMERICAN APPROVALS	10179229
	316 STAINLESS STEEL, ¾ NPT, EUROPEAN APPROVALS	10179509
	316 STAINLESS STEEL, M25, NORTH AMERICAN APPROVALS	10179510
	316 STAINLESS STEEL, M25, EUROPEAN APPROVALS	10179511
Calibration Cap, XCell	CALIBRATION CAP, ULTIMA X5000/S5000, PCKGD	10181450
Calibration Cap, XIR PLUS	CALIBRATION CAP, ULTIMA XIR PLUS, PCKGD	10181461
Sun Shield	SUNSHIELD, ULTIMA X5000/S5000	10180254

Tab. 13   Replacement Parts

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8 Appendix: Specifications

Sensor Options	Toxics	Oxygen	Combustible Catalytic	XIR PLUS
Operating Range	-40°C to +60 °C	-40°C to +60 °C	-40°C to +60 °C	-40 °C to +60 °C
Storage	-40°C to +60 °C	-40°C to +60 °C	-40°C to +60 °C	-40 °C to +60 °C
Zero Drift[1]	<1% FS/year	N/A	< 5 % LEL/year	< 5 % FS/year
Span Drift[1]	<2% FS/year	$\leq$ 0.2 % Vol/year	$\leq$ 5 % LEL/year	< 10 % FS/year
Repeatability[1]	≤10 % FS	$\leq$ 0.3 % Vol	$\leq$ 3 % LEL	2 % FS
Resolution	1 ppm, CO 0.1 ppm, H_2S	0.1 % Vol	1 % LEL	1 % LEL
T90	< 20 s	< 10 s	< 30 s	< 30 s
Humidity	10-95 % RH	10-95 % RH	0-95 % RH	15-95 % RH
Expected Sensor Life	5 years	5 years	5 years	10 years
Enabling Technology	XCell - non-consuming	XCell - non-consuming	XCell - GM cat bead	XIR PLUS
TruCal	Yes	No	No	No
SafeSwap	Yes	Yes	Yes	No
Remote Mount Distance	100 m	100 m	100 m	100 m
Power: Single Sensor	2.8 W	2.8 W	5.5 W	6.7 W
Power: Dual Sensing	3.6 W	3.6 W	10.6 W	11.6 W
HOUSING OPTIONS			STAINLESS STEEL	
Transmitter Weight			Short Lid: 6.5 lb. Deep Lid: 8.8 lb.	
Material Spec			AISI 316 Stainless Steel	

Tab. 14   Specifications

[1] Typical response at room temperature

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Transmitter Dimensions
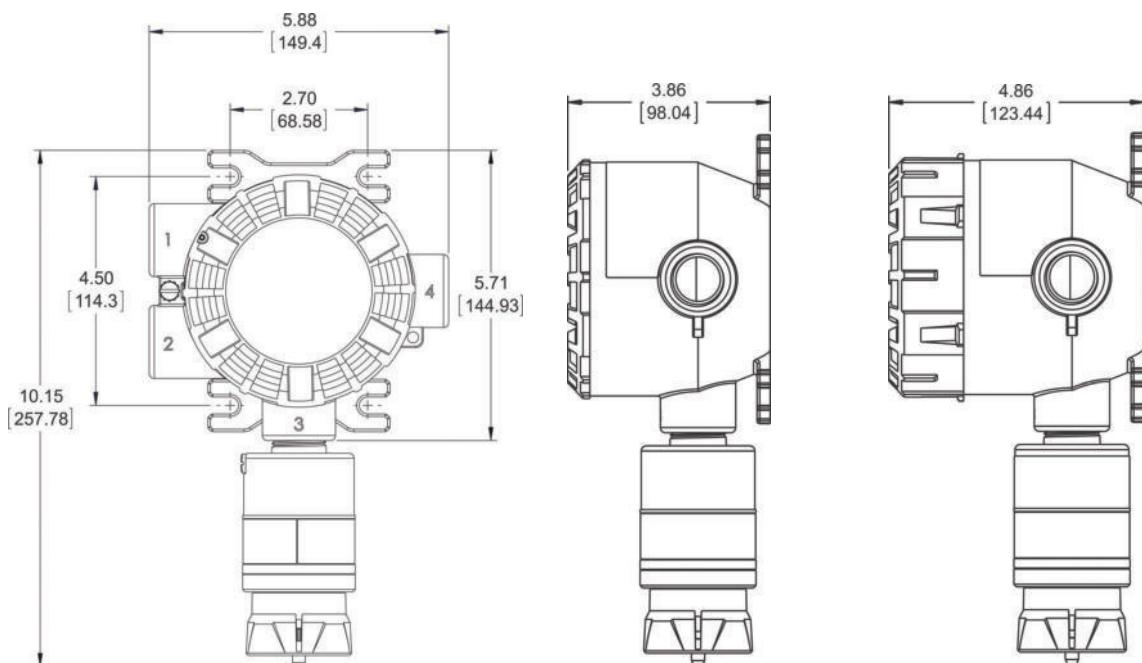
Fig. 29   ULTIMA X5000 Height & Width   Fig. 30   Short Lid Depth   Fig. 31   Deep Lid Depth
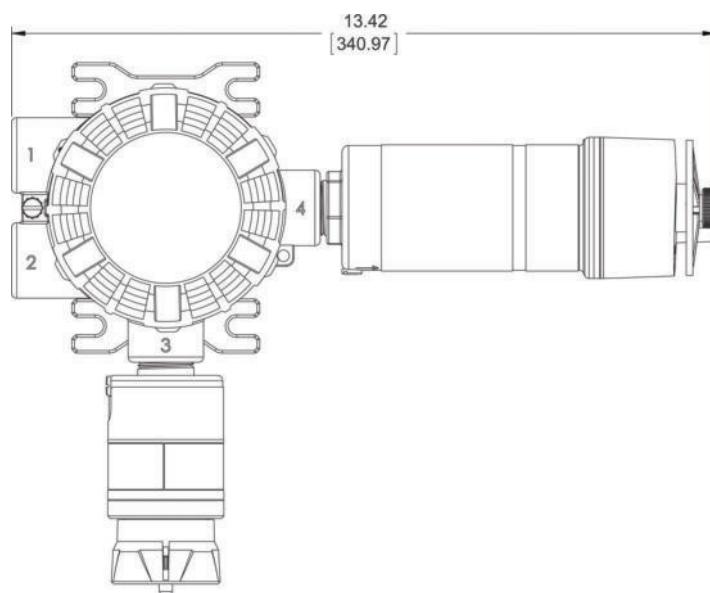
Fig. 32   ULTIMA X5000 Width with XIR PLUS Sensor

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9 Appendix: Calibration Guide for Additional Gases

The ULTIMA XIR PLUS sensor can be calibrated for a wide variety of combustible gas compounds.

> The XIR PLUS sensor is only performance approved for Methane and Propane.

To change the XIR PLUS calibration,

(1)   Scroll and select Settings.

(2)   Select Sensor.

(3)   Scroll and select Gas Table.

(4)   Select the gas table for the target compound.

(5)   Select Save.

(6)   Scroll to Span Value and select (should already be in correct menu after saving Gas Table).

(7)   Enter the span value for the target compound as described in table 15.

(8)   Select Save.

(9)   Go to the home screen.

You can now calibrate the XIR PLUS sensor using the target gas for the target compound in the table 15.

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ATO Code	Compound	Vol % for % LEL	Table	Cal Gas	Span Value
AI	Acetaldehyde	4	8	0.1 % Propane	29 %
AJ	Acetic Acid	4	3	0.6 % Propane	12 %
AK	Acetone	2.5	8	0.1 % Propane	20 %
AL	Acrolein	2.8	8	0.1 % Propane	59 %
AM	Acrylic Acid	2.4	2	0.6 % Propane	10 %
AN	Allyl Alcohol	2.5	1	2.5 % Methane	85 %
AO	Allylamine	2.2	8	0.1 % Propane	18 %
AP	Amyl Acetate	1.1	1	2.5 % Methane	80 %
AQ	t-Amyl Alcohol	1.3	6	0.6 % Propane	41 %
AR	Aromatic 100	0.9	1	2.5 % Methane	75 %
AS	Benzene	1.2	8	0.1 % Propane	42 %
AT	1,3-Butadiene	2	8	0.1 % Propane	23 %
AU	Butane	1.9	4	0.6 % Propane	29 %
AV	Butanol	1.4	6	0.6 % Propane	42 %
AW	Butene	1.6	6	0.6 % Propane	57 %
AX	Butyl Acetate	1.7	6	0.6 % Propane	40 %
AY	Butyl Acrylate	1.5**	6	0.6 % Propane	45 %
AZ	Butyl Methacrylate	2	6	0.6 % Propane	33 %
BA	t-Butyl Peroxide	18	3	0.6 % Propane	10 %
BB	Butyraldehyde	1.4	6	0.6 % Propane	65 %
BC	Cumene	0.9	1	2.5 % Methane	43 %
BD	Cyclohexane	1.3	1	2.5 % Methane	50 %
BE	Cyclohexanone	1.1	6	0.6 % Propane	74 %
BF	Cyclopentane	1.5	7	0.6 % Propane	31 %
BG	Cyclopentanone	1.5**	1	2.5 % Methane	60 %
BH	1,2-Dichloroethane	6.2	8	0.1 % Propane	14 %
BI	Dicyclopentadience (DCPD)	0.8	6	0.6 % Propane	55 %
BJ	Diethylamine	1.8	2	0.6 % Propane	32 %
BK	Diethyl Ether	1.9	2	0.6 % Propane	38 %
BL	Diethyl Ether	6.2	8	0.1 % Propane	20 %
BM	1,1-Difluoroethane (R-152a)	3.7	2	0.6 % Propane	52 %
BN	Diisobutylene	0.8	2	0.6 % Propane	52 %
BO	Diisopropyl Ether	1.4	6	0.6 % Propane	34 %
BP	Dimethylamine	2.8	2	0.6 % Propane	37 %
BQ	Dimethylaminopropylamine (DMAPA)	2.3	2	0.6 % Propane	29 %
BR	Dimethyl Ether	3.4	2	0.6 % Propane	32 %
BS	Dimethylethylamine (DMEA)	2.3	2	0.6 % Propane	22 %
BT	Dimethylisopropylamine (DMIPA)	1.0**	6	0.6 % Propane	47 %
BU	1,4-Dioxane	0	4	0.6 % Propane	42 %
BV	1,3-Dioxolane	2.1	2	0.6 % Propane	35 %

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ATO Code	Compound	Vol % for % LEL	Table	Cal Gas	Span Value
BW	Epichlorohydrin	3.8	6	0.6 % Propane	46 %
BX	Ethane	3	3	0.6 % Propane	25 %
BY	Ethanol	3.3	6	0.6 % Propane	31 %
BZ	Ethyl Acetate	2	6	0.6 % Propane	60 %
CA	Ethyl Acrylate	1.4	8	0.1 % Propane	15 %
CB	Ethyl Benzene	0.8	8	0.1 % Propane	15 %
CC	Ethyl Chloride	3.6	2	0.6 % Propane	27 %
CD	Ethylene	2.7	8	0.1 % Propane	28 %
CE	Ethylene Glycol Monomethyl Ether	1.8	6	0.6 % Propane	60 %
CF	Ethylene Oxide	3	6	0.6 % Propane	52 %
CG	Gasoline (as Hexane)	1.4	6	0.6% Propane	41%
CH	Heptane	1.1	2	0.6% Propane	35%
CI	Hexamethyldisi-loxane (HMDS)	0.5**	8	0.1% Propane	22%
CJ	Hexane	1.1	6	0.6% Propane	41%
CK	Isobutane	1.8	2	0.6% Propane	30%
CL	Isobutyl Alcohol	1.7	6	0.6% Propane	41%
CM	Isobutyl Isobutyrate (IBIB)	1	1	2.5% Methane	25%
CN	Isobutylene	1.8	6	0.6% Propane	62%
CO	Isooctane	1.1	4	0.6% Propane	28%
CP	Isopropanol	2	6	0.6% Propane	47%
CQ	Isopropyl Acetate	1.8	6	0.6% Propane	57%
CR	Isopropyl Amine	2	6	0.6% Propane	41%
CS	JP-5	0.6	6	0.6% Propane	41%
CT	Methanol	6	3	0.6% Propane	23%
CU	Methoxypropylamine	2.3	6	0.6% Propane	55%
C	Methyl Acetate	3.1	5	0.6% Propane	46%
CW	Methyl Acrylate	2.8	6	0.6% Propane	68%
CX	Methacryclic Acid	1.6	2	0.6% Propane	55%
CY	Methyl Amyl Ketone (MAK)	1.1	6	0.6% Propane	51%
CZ	Methyl Cellosolve	1.8	6	0.6% Propane	60%
DA	ethyl Chloride	8.1	6	0.6% Propane	48%
DB	Methyl Chloroform (1,1,1-Trichloro-methane)	0.1	6	0.6% Propane	85%
DC	Methylcyclohexane	1.2	1	2.5% Methane	33%
DD	Methylene Chloride	13	1	2.5% Methane	68%
DE	Methylene Fluoride (R-32)	12.7	6	0.6% Propane	13%
DF	Methyl Ethyl Ketone (MEK)	1.4	1	2.5% Methane	72%
DG	Methyl Formate	4.5	4	0.6% Propane	29%

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ATO Code	Compound	Vol % for % LEL	Table	Cal Gas	Span Value
DH	Methyl Isobutyl Carbinol (MIBC)	1	2	0.6% Propane	25%
DI	Methyl Isobutyl Ketone (MIBK)	1.2	6	0.6% Propane	54%
DJ	Methyl Methacrylate	1.7	6	0.6% Propane	57%
DK	Methyl Propyl Ketone (MPK)	1.5	6	0.6% Propane	54%
DL	Methyl tert-butyl Ether (MTBE)	1.6	2	0.6% Propane	29%
DM	Morpholine	1.4	6	0.6% Propane	59%
DN	Naptha, VM&P	1.2**	6	0.6% Propane	41%
DO	Nitro Methane	7.3	8	0.1% Propane	45%
DP	Pentane	1.5	5	0.6% Propane	33%
DQ	n-Propanol	2.2	2	0.6% Propane	36%
DR	Propionaldehyde (Propanal)	2.6	6	0.6% Propane	69%
DS	Propyl Acetate	1.7	6	0.6% Propane	41%
DT	Propyl Bromide	3.8	2	0.6% Propane	23%
DU	Propyleneimine	1.32**	6	0.6% Propane	72%
DV	Propylene Glycol Methyl Ether (PGME)	1.8	6	0.6% Propane	47%
DW	Prop. Glycol Meth. Ether Acetate (PGMA)	1.5	6	0.6% Propane	67%
DX	Propylene Oxide	2.3	2	0.6% Propane	38%
DY	Pyridine	1.8	8	0.1% Propane	20%
DZ	Stoddard Solvent	0.9	2	0.6% Propane	32%
EA	Styrene	0.9	8	0.1% Propane	45%
EB	Tetrahydrofuran (THF)	2	2	0.6% Propane	40%
EC	Tetrahydropyran (THP)	1.**	6	0.6% Propane	40%
ED	tert-Butanol	2.4	2	0.6% Propane	27%
EE	Toluene	1.1	8	0.1% Propane	18%
EF	1,1,1-Trichloroethane	7.5	8	0.1% Propane	20%
EG	Triethylamine	1.2	6	0.6% Propane	36%
EH	Trimethylamine	2	2	0.6% Propane	38%
EI	Turpentine	0	8	0.1% Propane	20%
EJ	Vinyl Acetate	2.6	8	0.1% Propane	63%
EK	Vinyl Trimethoxysilane	0	2	0.6% Propane	35%
EL	Xylenes (O-Xylene)	0.9	1	2.5% Methane	59%

Tab. 15   XIR PLUS Calibration Guide for Additional Gases

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10 Appendix: General Certification Information

Refer to manual addendum (Part Number 10182779) for Certification Information.

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11 Appendix: HART Specific Information

The ULTIMA X5000 Gas Monitor is available with an optional HART (Highway Addressable Remote Transducer) output communications protocol. With this option, the ULTIMA X5000 complies with HART Protocol Revision 7.

All available status bytes are defined in the X5000 HART Specification found on the product CD. Refer to that document for complete HART command and status definitions. Use the HART digital interface to query the unit to provide additional troubleshooting information.

Manufacturer Name	Mine Safety Appliances, Inc (MSA)	Model Name	ULTIMA X5000
HART ID Code	227 (0xE3)	Device Type Code	46 (0x2E)
HART Protocol Revision	7	Device Revision	1
Number of Device Variables	2		
Physical Layers Supported	FSK		

Tab. 16   Device Identification

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Because every life has a **purpose...**