Foxcroft FX-Mini

Single Channel

Toxic Gas Detector

Operating Manual

Document OMFXMINI032017

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Introduction

The Foxcroft Equipment & Service Co. Inc. FX-Mini is a compact fixed point monitoring system designed to detect and alarm to toxic gases or low oxygen levels in ambient air.

Intended as a low cost device, it includes audible and LED visual alarm notification with 10A form C relays to signal remote monitors and to actuate external alarm devices such as a beacon, horn, or exhaust fan. No 4-20mA output or display of concentration is included.

The detector includes two alarm set points which are non-adjustable to prevent tampering or accidental setting to an improper and possibly unsafe level. Upon sensing a gas concentration at an alarm set point the detector will illuminate the appropriate color coded LED indicator light, sound the integral audible buzzer (at the danger level only) and energize the appropriate relays that have been assigned.

The electrochemical gas sensing cell generates a voltage that is converted to a 4-20mA signal by an analog circuit board. The signal is transmitted to the detector control circuit board, which correlates the signal to parts per million (ppm) or percentage volume of oxygen level. The gas sensor and its signal output are not controlled, manipulated or changed by the detector software.

The FX-Mini can be supplied with any of the following gas sensors, gas alarm trip levels below are fixed to prevent tampering, non-standard ranges and trip levels are available. Values are in PPM except Oxygen:

Gas Sensor	Standard Range	Warning	Danger
Chlorine	0-10 ppm	0.5	1.0
Sulfur Dioxide	0-10 ppm	1.0	3.0
Ammonia	0-100 ppm	35	50
Oxygen	0-25%	18%	16%
Carbon Monoxide	0-500 ppm	35	50
Chlorine Dioxide	0-1 ppm	0.1	0.3
Hydrogen Sulfide	0-10 ppm	1.0	3.0
Ozone	0-2 ppm	0.05	0.1
Nitric Oxide	0-50 ppm	15	25
Nitrogen Dioxide	0-10 ppm	1.0	3.0
Hydrogen Cyanide	0-10 ppm	1.0	3.0
Hydrogen Chloride	0-10 ppm	0.7	2.0

Warnings, Limitations

WARNING: **NEVER attempt to calibrate a chlorine gas sensor with bleach, pool chlorinating chemicals, or by producing chlorine gas with a mixture of bleach and an acid. Any sensor adjustment made with such gases or fumes, or without the proper known concentration of gas will cause the sensor to not alarm at all or to alarm at incorrect and unsafe levels. This can create a life threatening situation in which the detector may not alarm during a chlorine gas leak.**

Warning
If the alarm buzzer sounds a loud pulsating sound and you are not testing the gas detector, it has sensed a gas leak. The alarm buzzer is warning of a possibly serious situation and it requires your immediate attention.

Warning
All functions of this gas detector must be checked and verified on a regular basis.
The ability for the gas sensor to sense toxic gas or low oxygen levels must be verified on a regular basis. It is recommended that the gas sensor be tested by means of a **certified gas standard at least once every six months.**

Warning
If the FX-Mini is altered in any way the warranty will be voided.
Example; drilling additional holes in the enclosure to mount conduits, changing operating range of the gas sensor and altering the gas alarm trip points.

Warning
Never disconnect an electrically powered gas detector to stop nuisance alarms. The source of the problem must be corrected.

FX-Mini Gas Detectors are not foolproof. Like all other electronic devices, the FX-Mini Gas Detectors have limitations. Detectors cannot be expected to sense a dangerous toxic gas leak or low oxygen levels if the cavity is blocked by debris or the detector is tampered with by personnel.

The FX-Mini has a limited life. This equipment contains many parts. Just as with any other device any one of these parts could fail at any time. Therefore, you must test your detector on a regular basis. Be sure to have it repaired or replaced when it fails to test properly. In no case should the detector be used for more than 10 years. All functions of this detector must be checked and verified on a regular basis.

FX-Mini Gas Detector Illustration
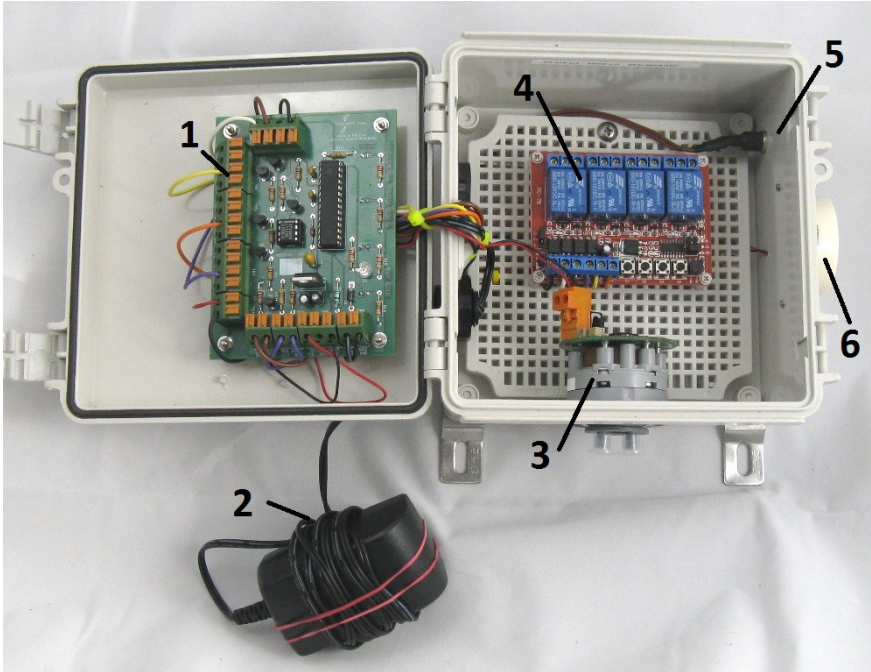
1. Main Circuit board. **2**. Power Supply **3**. Gas Sensor.

4. 10A relay card. **5.** Silence & Reset Button **6**. Buzzer

Detector Component Description

Following is a description of the system's major components.

Main Circuit Board

The main circuit board is microprocessor based and operates on 12 VDC. It is not possible to make any field adjustments or repairs to the circuit board. The microprocessor can be replaced with a new or upgraded chip. The circuit board's processor does not control the gas sensor response or signal output in any way, it simply receives output from the sensor and energizes the alarm functions. All terminals accept 18 to 22 AWG wire

> **CAUTION:** the sensor printed circuit board is sensitive to Electro-Static Discharge. It can be irreparably damaged by static electricity, causing partial or total operational failure. You must take the following precautions before *touching or making any connections to the circuit board.*
>
> *Before touching the circuit board touch an earth grounded metal surface such as the detector's power supply guard, a metal pipe or conduit to discharge any static electricity from your body, or wear an anti-static wrist strap connected to an earth ground.*

Factory Default Wiring

The FX-Mini is pre-wired at the factory as follows. Field wiring to the circuit board is unnecessary unless you are connecting a NC remote reset switch.

1	**Power in**
2	**Sensor input**
3	**Remote reset with jumper ***
4	**Silence / Reset button**
5	**Buzzer**
6	**Danger alarm relay 2**
7	**Sensor fail relay**
8	**Warning alarm relay**
9	**Danger alarm relay 1**
10	**Microprocessor**
11	**Microprocessor "heartbeat" status LED indicator**
	***Do not remove jumper if a remote reset button is not connected**

A jumper wire is factory installed in the remote reset terminal block; this jumper must remain in place if a remote reset switch is not connected.
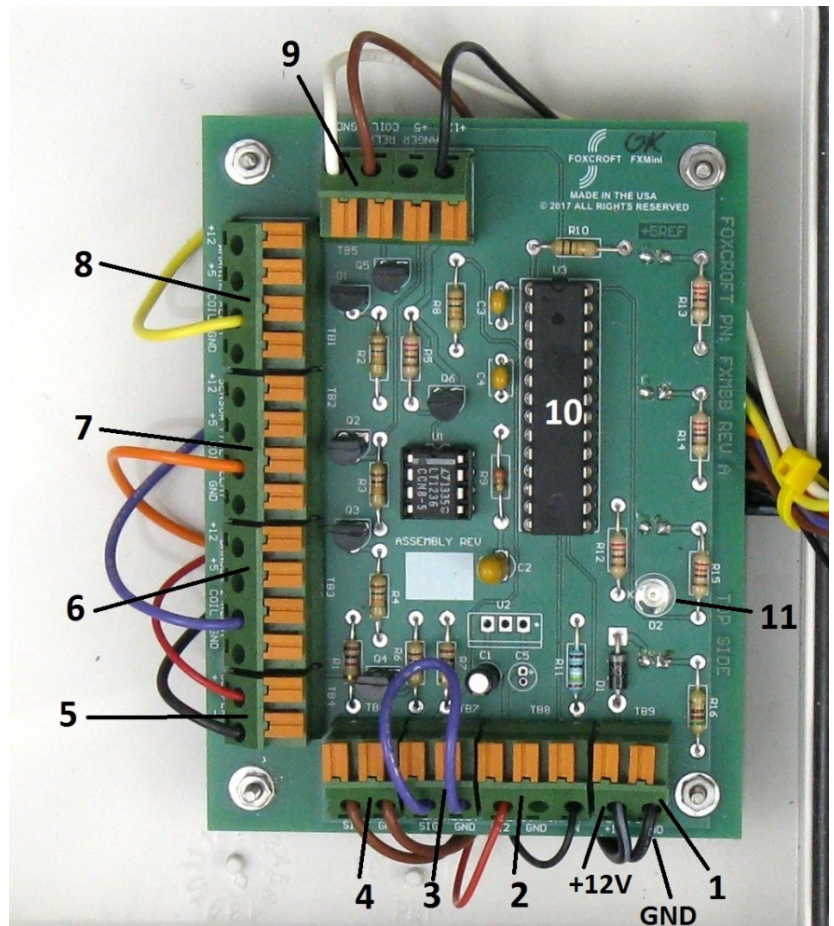
Detector Component Description

Terminal connections are provided for both +12VDC and +5VDC power input to the relays. 12VDC coils are standard. The 5VDC terminals are not used as standard and should be ignored.

Remote Reset

A terminal (supplied with a factory installed jumper) is provided on the main circuit board to connect a normally closed (NC) remote reset switch. Remove the jumper only if connecting a remote switch.

Power Supply

The detector uses a switching AC to 12VDC power supply that accepts universal voltage input of 88-264 VAC 47-63Hz. Rating: 6W max output power; output current 0.5A; short circuit, over voltage, overload protection; 2 pole USA plug, 4-ft cord, Class II power, Agency Approvals: CE/CUL/CB/FC

The power cord plugs into a standard NEMA 5-15R receptacle.

WARNING: Applying 120V AC line power directly to the circuit board will destroy the detector and void the warranty

Battery Power Operation

 For battery powered operation the detector requires (1) high quality 12 volt DC battery. The detector power consumption is about 100mA. Using a 50 amp/hour rated battery the expected battery life would be 4-6 months.

10VDC is the minimum voltage required to energize the 10A alarm relays.

A DC volt meter may be installed to monitor battery output.

Detector Component Description

10 Amp Relay Card

The FX-Mini gas detector includes a separate card containing (4) 10A Form C relays. The 10A relays are unpowered when the detector is not in alarm state; they energize upon reaching an alarm set point. The relays are rated as follows: form C, resistive load 10A @125 VAC, 7A @ 24VDC, 7A @ 240VAC

> **WARNING:**
>
> - The 10A relays are not fused. Any external load connected to the relay must have a current limiting device installed to limit current to the relay to less than 10 amps.

Relays #1 & #2 by default are not adjustable in any way; they trip at the Danger level and are latching (they must be reset or de-energized manually). Relay #3 is non-latching and assigned to the Warning alarm level; relay #4 is non-latching and assigned to Sensor Fail.

Relay #1 = Danger
Relay #2 = Danger
Relay #3 = Warning
Relay #4 = Sensor Fail
O = Relay red LED
O = Relay card power on LED
Relay test buttons - yellow highlight
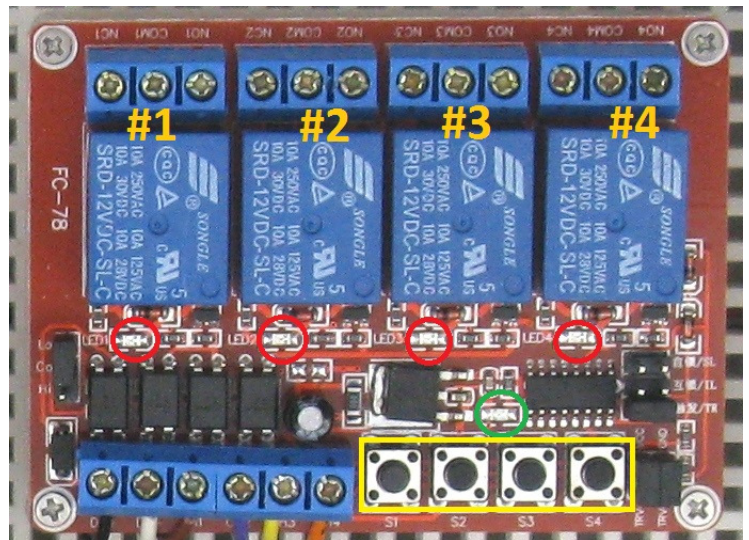
To add additional danger relays: Either of the relays assigned to Warning or Sensor Fail can be made to function at the Danger alarm level by re-wiring. Take the wire from the desired Warning or Sensor Fail relay terminal on the main circuit board and connect it to the "Coil" terminal on a Danger relay terminal block on the main circuit board. This relay will then actuate at the Danger level and be latching.

Detector Component Description

Gas Sensor

The detector includes one electrochemical gas sensor that transmits a 4-20mA signal to the detector electronics. The calibration nose fitting is used only for calibration, not for normal operation.

Test Button

Unlike the previous model FX-1, **the FX-Mini does not include a test button.** In all Foxcroft gas detectors the test button has only tested electrical continuity and functions of components such as the buzzer, LED's, and relays.

Contrary to popular belief by those who did not read the operating manual, the test button has never tested the ability of the gas sensor to respond to gas.

We believe it is safer to require full functional testing using calibration gas rather than include a test button that can provide a false sense of security in an electrically functional gas detector that may have a non-functional gas sensor.

Contents, Serial Number

Unpacking

The detector is shipped with a piece of cardboard that covers and protects the gas sensor, remove this prior to installation.
After unpacking, it is recommended to save the shipping carton and packing materials if the instrument must be stored or re-shipped. Inspect the equipment and packing materials for signs of shipping damage. If there is any evidence of damage, notify the delivery carrier immediately.

The shipping container consists of the following:

1 - FX-Mini Single Channel Toxic Gas Detector

1 – AC to 12VDC power supply with 4-ft cord prewired to main circuit board

WARNING:

- **The gas sensor has a 6 month shelf life if stored unpowered.**

1 Bag containing:
      1 - Calibration nose fitting with O-ring and (2) sealing caps
      1 – Sensor blue millivolt test connector with wire leads (see photo page 21)
      1 - Set of Four Mounting Feet. **#10 mounting screws are not provided.**
      1 - Instruction Manual with calibration instructions

Serial Number
The detector serial number label is located both inside and outside of the detector enclosure. The gas sensor has a separate serial number on a label on the sensor itself.

Installation, Mechanical

Sensor Placement Guidelines

The FX-Mini Gas Detector is a fixed, single point type that can only sense toxic gas or oxygen that diffuses into the sensing chamber of the gas sensor.

Proper placement of the sensor in the potential hazard area is essential to the operation of the gas detector. Improper location can cause alarm delay or failure to warn of hazardous conditions. There are various factors to consider in placing the gas sensor.

One of the main factors is the weight of the gas being monitored relative to the weight of ambient air. Generally, gases that are lighter than air such as ammonia should be located near the ceiling, or in some applications in the breathing zone 4-6 feet from the floor. Gases that are heavier than air such as chlorine or sulfur dioxide should generally be placed 6"-12" from the floor.

Air flow patterns and the size of the room to be monitored must be considered in addition to the vertical placement of the sensor. It's possible that air flow patterns or lack of ventilation may carry heavier gases such as chlorine to a higher level such as the breathing zone. It's possible that one sensor may not provide sufficient protection.

- Locate the sensor with the sensing chamber opening pointing down toward the floor near the gas source where the normal air flow pattern will carry the gas to the sensor.
- Do not install in dusty or dirty areas. Dust and dirt can build up in the sensing chamber, making it overly sensitive. Dirt can block openings to the sensing chamber and keep the gas detector from sensing toxic gas or low oxygen levels.
- Do not install in areas of wash down. The gas detector should not be washed with water or mounted in areas where water is used for cleaning.
- Take into account ventilation air flow patterns, the gas sensor may not detect a gas leak in the room in which it's mounted due to air flow patterns.
- Do not mount the sensor in a "dead air" space such as a corner.
- Do not install near fresh air vents, next to doors or drafty areas, failure to detect gas and excessive sensor drift can occur.
- If installing in an outdoor area, the sensor should generally be placed downwind of the potential gas source. More than one system may be needed to efficiently protect some outdoor locations.
- Do not install in insect-infested areas. If insects enter a sensing chamber, they may cause a nuisance alarm. Also they can block the sensing chamber and prevent toxic gas or oxygen from entering the chamber.
- Never mount the FX-Mini Gas Detector in direct sunlight.
- Place on a surface or wall that is not subject to vibration or shock.

Installation, Mechanical, Dimensions

1. Attach the wall mounting feet to the rear of the enclosure using # 10 diameter screws. Mounting screws are not included.
2. Mount the detector near the potential leak source; taking into account the location of a potential leak, weight of the target gas and air flow patterns.
3. Remove the cardboard protecting the gas sensor.
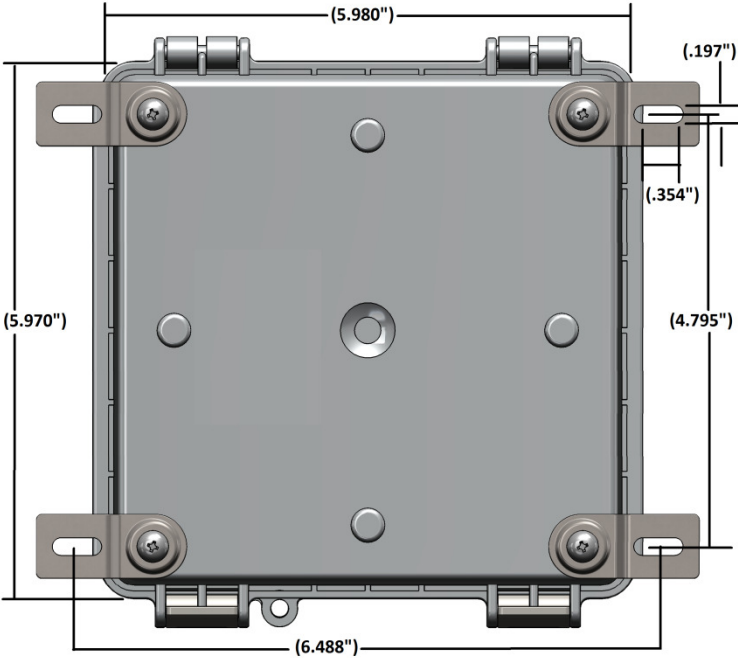
Installation, Wiring

 WARNING: The alarm relays are not fuse protected. You must install a current limiting device to limit current to the relays to less than their resistive current rating.

WARNING: Make all connections before you apply power to the detector.

1. **Relay Wiring:** Install a watertight conduit connector into the 7/8" dia. Hole in the left side of the enclosure. Route cables for the alarm relays through the connector and wire to the 10A relays as either normally open or normally closed as required. Relays #1 & #2 are factory set as Danger, latching manual reset and are non-adjustable. By default relay #3 is configured as non-latching auto reset to alarm at the Warning level. Relay #4 is configured as non-latching to alarm at the Sensor Fail level.

    Tip: Test your wiring by pushing the test buttons on the relay card.

    Tip: If you think the warning alarm level may trigger nuisance alarms, do not assign a relay to this level.

    Tip: If you need an additional danger alarm relay, take the wire from the desired Warning or Sensor Fail relay terminal on the main circuit board and connect it to the "Coil" terminal on a Danger relay terminal block on the main circuit board. This relay will then actuate at the Danger level and be latching.

2. **Remote Reset Switch**: To connect a remote reset switch first remove the gray jumper wire from the remote reset terminal on the main circuit board. Connect the switch to this terminal. A NC switch is recommended so that a break in the circuitry can be easily detected.

3. **Power:** Simply plug the supplied power cord of the power adapter into a standard NEMA 5-15R 120VAC wall receptacle.

Startup

1. Remove the cardboard covering the gas sensor opening.

    a. **NOTE:** You must never operate the detector with the calibration nose installed, it is used only for calibration.
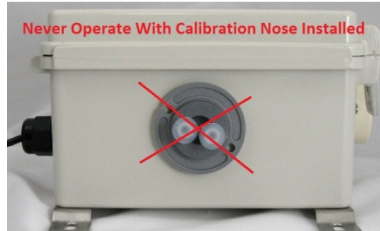
2. Power Up: Turn on power to the detector by plugging the power adapter into a standard 120VAC eletrical outlet. The detector will take 60 seconds to warm up; none of the alarm indicator LED's will illuminate during the warm up period. The main circuit board power on green LED and relay card power on green LED will be illuminated.

3. **Sensor Warm Up & Acclimation:** The gas sensor requires a warm up and acclimation period during which the sensor may drift and set off false alarms until it stabilizes. Allow the sensor to warm up for about 20 minutes. Allow 1 to 12 hours depending on conditions and the sensor type for the sensor to fully stabilize and acclimate to the environment before calibrating or putting the detector into service.

4. **Calibration Check:** Although every gas sensor is factory tested and calibrated before shipment, differences in air pressure, temperature and relative humidity at the installation site may cause the zero point and consequently the alarm trip points to shift slightly.

5. The sensor after acclimating should be fully calibrated to your local conditions by adjusting the zero point if necessary and applying a low level target calibration gas that matches the range of your detector and adjusting the sensor as required. See the calibration section for the procedure for instructions to bump test and calibrate.

6. **Test Sensor and Alarm Functions.** It is best to use a known concentration calibration gas to bump test the detector and check its functions. **Do not test detector function with a signal generator.**

    a. You may also use a mixture of 1 part (teaspoon) vinegar and 2 parts (teaspoons) of household bleach in a squeeze bottle held under the sensor opening. **Warning:** doing so risks exposing the gas sensor to excessively high concentrations that can damage the gas sensor if not done carefully. Squeeze the bottle gently to emit only a brief modest amount of vapor. Do not allow liquid to contact the sensor membrane and do not overload the sensor with chlorine fumes.

Startup

7. The LED's on the detector should illuminate as alarm trip levels are reached, the buzzer should sound at the Danger alarm level, the relays should energize upon reaching alarm levels (the LED's next to each relay should illuminate red upon actuation) and external devices connected to the relays should function. The silence button should turn off the alarm buzzer, but pushing the button a second time will not reset the detector or relays until the sensor output falls below the danger alarm level. If any of the alarm notifications do not occur during the test return the detector to the factory.

8. After calibration and testing the detector is operational.

Normal Operation and Alarm Conditions

Normal Operation

NOTE: The gas sensor and its signal output are not controlled, manipulated or changed by the detector software or hardware.

Under normal operating conditions you will see the green "power on" LED illuminated on the face of the detector, the red "heartbeat" LED indicator flashing on the main circuit board and a green power on LED illuminated on the relay card.

Alarm Set Points and Conditions

The FX-Mini includes two gas alarm set points and a sensor fail alarm set point:

Warning: an alarm set point set to OSHA, NIOSH and ACGIH recommendations.

Danger: an alarm set point set to OSHA, NIOSH and ACGIH recommendations.

Sensor Fail: indicates signal output from the sensor is at 3.84mA or less. Sensor signal output in ambient air with no gas present is 4mA.

NOTE: Alarm notifications cannot be caused by a software malfunction. An alarm signals a potentially dangerous condition. You must determine the cause of the alarm and take appropriate action. Attempting to reset the gas detector by powering off and on will not stop or reset an alarm notification or correct a dangerous condition or component failure.

Warning Alarm

When this alarm set point is reached the LED indicator will illuminate orange and the relay assigned to alarm at this level will energize, the red LED below the relay will illuminate. The buzzer will not sound. By default Warning relay #3 will auto reset, or de-energize, when the gas concentration falls below the alarm set point.

Normal Operation and Alarm Conditions

Danger Alarm

When the gas concentration reaches the Warning level its alarm LED will illuminate orange. When the Danger alarm set point is reached the Warning indicator will go out, and the red LED indicator on the face of the detector will illuminate, manual reset latching relays #1 and #2 will energize and their LED's will illuminate, any additional relay configured to alarm at this level will energize and the piezo buzzer will sound.

If the sensor fails during a danger alarm condition the sensor fail blue LED will illuminate, the Danger alarm LED will continue to illuminate and the Danger relays will remain energized until the unit is reset after and only after the gas concentration falls below the Danger alarm threshold.

The latching relay can only be reset after the measured concentration falls below the designated alarm set point. If you touch the reset button while the concentration is at or above the alarm set point the detector will remain in alarm and relays will remain energized until safe levels are measured.

Attempting to reset the gas detector by powering off and on will not stop or reset an alarm notification; the detector will return to the danger alarm state upon power restore or system reset if gas concentrations are in fact detected as being at or above the alarm level.

If a sensor fail alarm occurs during a danger alarm, the detector will continue to display the danger alarm notification as well as the sensor fail notification.

> **Note:** After a Danger alarm has occurred and the gas concentration falls to zero, the gas sensor output may momentarily fall below the 3.85mA limit before stabilizing. As sensor output passes through this threshold the blue LED will illuminate and you will hear the sensor fail relay energize or "chatter" while the sensor reaches its normal state. This is normal.

> **Note:** In some cases of sensor failure the current output can raise up to maximum, in which case the danger alarm will trip even though no gas is present.

Sensor Fail Alarm

The sensor fail alarm indicates that signal output from the sensor has fallen below the limit of 3.85mA either temporarily or permanently. Signal loss can be caused by sensor failure, breakage in the normally closed sensor circuitry, or temporary signal loss caused by normal sensor drift.

> **Note:** Sensor signal loss is not produced or controlled by the detector electronics or software.

During normal operation the zero point of an electrochemical gas sensor can drift up or down over time and in response to changes in temperature, humidity or air pressure. Drift can also occur if the sensor is directly exposed to wind or air flow.

The sensor output must be at or below 3.84mA before the sensor fail alarm will trip. In this mode the Sensor Fail LED will illuminate blue and the 10A alarm relay will energize. The buzzer will not sound. If sensor output rises back up to 4mA during a sensor fail alarm relay will automatically reset and the LED will go out. The sensor fail alarm cannot be reset manually until sensor output reaches 4 mA.

Normal Operation and Alarm Conditions

If a sensor fail alarm occurs during a danger alarm, the detector will continue to display the danger alarm notification as well as the sensor fail notification.

> **Note:** While the detector is in Sensor Fail mode its alarms and relays remain fully functional in the event that the sensor fail alarm is tripped due to a brief disruption and not an actual sensor failure.

Sensor Fail Alarm with Oxygen Sensors

The Sensor Fail alarm is not available with Oxygen sensors because the Oxygen and Sensor Fail alarms both trip in the same sensor output range. Given the possibility of being unable to *positively* distinguish between the two alarm types due to sensor drift or environmental factors, it's prudent to assume a sensor output of 4 mA or less signifies an Oxygen deficiency. If testing with a separate instrument demonstrates safe Oxygen levels then the sensor functionality can be tested and the sensor replaced if needed.

Gas Sensors

General Information & Environmental Effects

The responsiveness of electrochemical sensors will vary with environmental conditions. Sensor response may be higher or lower depending on actual environmental conditions.

Gas Exposure

The electrochemical gas sensors used in FX-Mini gas detectors are strictly designed and intended for occasional intermittent exposure to the target gas. Under no circumstances will the sensor survive continuous exposure to target gas. The only exception to this is Oxygen sensors.

Sensor Serial Number and Date Code

Each gas sensor has an eight digit serial number followed by a 3 digit date code. The first two digits of the date code signify the month, the third is the year of shipment from the factory.

Humidity

Gas sensors are relatively unaffected by humidity if conditions are not condensing within a range of 15% to 90% RH. The sensor will show a transient response to rapid changes in humidity which should go away after 30 seconds.

The gas sensor includes an aqueous electrolyte and a porous diffusion barrier. The means the sensor can both absorb water from the atmosphere and dry out. At continuous operation at high temperatures and 90%-100% RH the sensor can become prone to leakage as the free space in the sensor slowly fills

Gas Sensors

General Information & Environmental Effects

with water. The sensor can gradually be restored to balance without permanent damage by exposure to lower relative humidity.

Likewise, continuous operation at 0-15%RH will cause the sensor to dry out, which can cause the acid electrolyte to attack the seals. This occurs if the volume of electrolyte decreases by more than 40%. If not left in this condition too long the sensor can be restored by exposing the sensor to RH humidity above 15%.

Temperature

Both the baseline (zero point) and output span are affected by temperature. The baseline approximately doubles with every 10°C increase in temperature. The output span will increase slightly up to about 10% before leveling off with gradual increase in temperature. A transient spike can occur with rapid changes in temperature; this should go away after 30 seconds.

Maximum Overload

The gas sensor maximum overload rating, for chlorine it is 250 ppm, is specified in terms of maintaining a linear response over a 10-minute exposure and recovering quickly. At higher levels the sensor will progressively become more non-linear and take increasingly longer to recover as the sensing electrode is unable to consume all the gas diffusing to it.

If the gas level is increased even further gas will build up inside the sensor and diffuse into the internal spaces where it may interact with the reference electrode, altering its potential. If this happens the sensor may take several days to recover once placed in clean air.

Sensor Zero Point Drift

Over time all gas sensors will experience a shift of the zero, or reference point. When this happens the gas concentration readings will also shift accordingly, producing inaccurate readings.

Note that sensor responsiveness will vary with environmental conditions.

Typically gas exposure mentioned throughout this document refers to the target gas, however exposure to interfering gases can cause similar effects as target gas exposure.

Causes of gas sensor zero point drift include:

- Chemical degradation of the sensor over time.
- Temperature, affecting both the span and zero point
- Repeated use in extreme high or low temperature or humidity conditions, or environments with high levels of airborne particles. Temperatures above the rated limit stress the seals, which will cause electrolyte leakage.

Gas Sensors

Sensor Zero Point Drift (cont.)

- Exposure to high levels of gas, or exposure to concentrations that exceed the range of the sensor.
- Low level gas exposure for extended periods of time.
- Continuous exposure to solvent vapors or highly corrosive gases.
- Rough handling or jolting of the sensor and electronics

Exposure to these conditions may damage the sensor to the point that it can no longer operate properly over its full range or be able to calibrate properly.

Calibration

Calibration Frequency

The only way to guarantee that an instrument will detect gas accurately and reliably is to test it with a known concentration of gas. Regular testing and calibration is the only way to be certain that a detector is fully functional.

A calibration or gas sensor can only be as accurate as the test gas used to perform the calibration.

1. The gas sensor should undergo a sensor response, or bump test, at least once per month. If the sensor fails the bump test then full calibration is required.
2. The gas sensor should undergo a full calibration at least once every 6 months and after the sensor detects a gas leak.

   NOTE: A sensor may require more frequent calibration depending on the effects of local conditions such as temperature, humidity, presence of gas or vapors that can poison the sensor, or by local regulations.

3. It is important to keep a log of sensor tests, calibrations and results.

CAUTION: Although it is common for operators to test chlorine sensor response with bleach, pool chlorinating chemicals, or by producing chlorine gas by mixing bleach with an acid, doing so risks exposing the gas sensor to excessively high concentrations that can damage the gas sensor.

WARNING: NEVER attempt to calibrate a chlorine gas sensor with bleach, pool chlorinating chemicals, or by producing chlorine gas with a mixture of bleach and an acid. Any sensor adjustment made with such gases or fumes, or without the proper known concentration of gas will cause the sensor to not alarm at all or to alarm at incorrect and unsafe levels. This can create a life threatening situation in which the detector may not alarm during a chlorine gas leak.

Calibration

Setting the Zero Point

The gas sensor zero point will drift over time with changes in temperature, humidity and after a gas leak.

The shift may only be off only slightly or enough to trigger the cell failure or caution alarms. If this has happened to your gas detector, and the reading (or alarm) is stable, you can usually correct the problem with a slight zero adjustment. If the reading is erratic, either there is a gas leak that the sensor is picking up, or the detector is in need of service. Chlorine sensors are stated to have a maximum zero drift of -0.2 ppm equivalent at +20°C to +40°C.

The zero adjustment is done on the sensor itself in ambient air free of the target gas or any interfering gases. Be sure that you don't have any minor gas leaks that would affect the zero setting before performing this adjustment.

The room where the gas sensor is mounted and where the zero point is adjusted should not contain any other forms of chlorine, including calcium hypochlorite, sodium hypochlorite, or various cleaning chemicals and solvents that may or may not contain chlorine. The gas sensor is extremely sensitive and will pickup these sources of chlorine, which will offset the zero calibration to an incorrect value.

To Set the Zero Point:

You will need a millivolt meter, the blue test connector with leads shipped with your detector and a flat blade jeweler's screwdriver. The detector should be powered up. You may also use the detector display for calibration.

1. Remove the cover from the gas sensor enclosure. You may leave the sensor in the housing or remove it for easier access by unscrewing the mounting ring and pulling the sensor out of the enclosure.

    NOTE: Use the orange connector or the gray plastic sensor body to handle the gas sensor. Do not handle the sensor using the mA transmitter circuit board to avoid damage to the board by static electricity.

> **CAUTION:** the sensor printed circuit board is sensitive to Electro-Static Discharge. It can be irreparably damaged by static electricity, causing partial or total operational failure. You must take the following precautions before *touching or making any connections to the circuit board.*
>
> *Before touching the circuit board touch an earth grounded metal surface such as the detector's power supply guard, a metal pipe or conduit to discharge any static electricity from your body, or w*ear an anti-static wrist strap connected to an earth ground.

Calibration

To Set the Zero Point:

2. Ensure the sensor is warmed up and free from the target gas being measured either by purging the sensor with an inert gas, in ambient air free of the target gas or any interfering gases, or by blanking the sensor from the atmosphere with the calibration nose supplied and the caps in place.

3. Locate the blue millivolt test connector CN2 on the sensor transmitter circuit board.
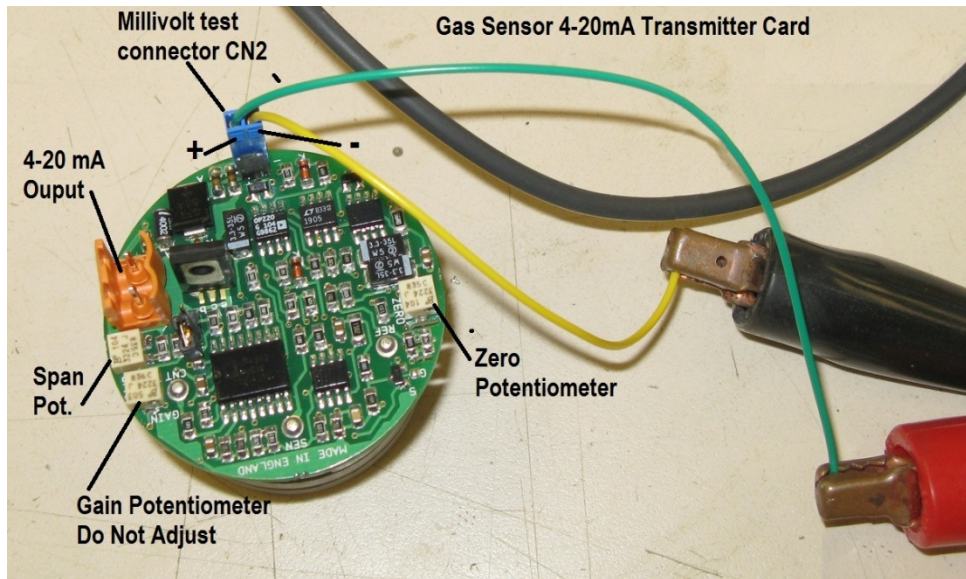
4. Plug the supplied test connector into the circuit board connector CN2. If you don't have the connector, insert to wire leads into the millivolt connector, observe polarity when connecting your meter.

5. In ambient air, the zero reading should be 40 millivolts.

6. The potentiometer is a multi-turn unit, and there is some signal dampening in the circuit, so the signal change may not fully stabilize until after you make the adjustment.

7. Do not adjust the span or gain potentiometers. Span calibration requires a gas standard calibration kit. The gain is factory set and should never be adjusted.

Calibration

Full Calibration, Toxic Gas Sensors

1. Make sure the zero point is set accurately, if not set the zero point as stated above.
2. Insert the calibration nose completely into the sensing chamber of the gas sensor, making sure the O-ring is seated properly to isolate the sensor from the atmosphere.
3. Remove the sealing caps from the calibration nose. One port on the calibration nose is used for gas inlet, **the other port must be left open as a vent.** Either port can serve as an inlet or vent.
4. Install the Teflon tubing connected to the gas regulator supplied with the calibration kit onto the calibration nose.

Warning: The gas regulator and tubing must be dedicated to one type of gas only, do not use a regulator and tubing for chlorine that was used on sulfur dioxide or ammonia, or vice versa.

5. Apply target calibration gas with a known concentration that matches the operating range of the sensor and detector and wait until the readings stabilize on the detector display. The reading will initially go down for several seconds before rising due to differences in humidity and pressure between the gas in the cylinder and the gas sensor.
6. Allow five minutes, sometimes slightly less, for the readings to stabilize.

Calibration

Full Calibration, Toxic Gas Sensors

7. Adjust the span potentiometer on the gas sensor until the correct reading is shown on the display.
8. You may also calibrate by using a millivolt meter:
9. Connect the meter leads, observing polarity, to millivolt test connector CN2.
10. Apply the target gas to the sensor and allow the readings to stabilize as described above.

The correct voltage output for the target gas being used is determined as follows:

(16 x gas concentration) / range of sensor + 4 x 10mV

   a. *Example: Calibrating a hydrogen sulfide sensor to a range of 0-50ppm using a calibration gas concentration of 20ppm:*

(16 x 20) / 50 + 4 + 10 = 104 mV

11. With the correct reading displayed on the detector calibration is complete, re-assemble the detector.

   Caution: Be sure to remove the calibration nose before placing the detector into service. **Never operate the sensor with the calibration nose inserted.**

   Caution: If the sensor or detector will not allow you to fully adjust the displayed concentration to match that of the calibration gas then you must replace the gas sensor.

Full Calibration, Oxygen Sensors

Calibration should be carried out in ambient air, and is done simply by adjusting the span potentiometer until a reading of 20.9% on a scale of 0-25% is displayed on the LED display.
Oxygen sensors alarm as concentrations, and therefore sensor output, decreases. A 4 mA Oxygen sensor output corresponds to 16% Oxygen by volume, which is the Danger alarm trip point.

Calibration

Sensor Response (Bump) Test

Important

The sensor response test, also known as a "bump" test, is only used to test the gas sensor's ability to respond to a gas leak. This test is not a calibration. <u>Sensor response, or bump tests should only be done with a known target concentration gas.</u>

Note that the Industrial Safety Equipment Association (ISEA) defines a bump test as follows:

Functional (bump) test – A means of verifying calibration by using a known concentration of test gas to demonstrate that an instrument's response to the test gas is within acceptable limits.

It is **very important** that this test sets off all the alarms and that the target concentration gas level is displayed on the LED display.

Full calibration is required if the test fails to set off alarms and the target concentration gas level is not displayed on the LED display.

1. The Remote alarm unit must be at zero on the LED display.

2. Install the calibration nose in the collar plug; be sure the nose is sealed properly and is isolated from the atmosphere.

3. Connect the target calibration gas sample tubing to the nose.

4. Apply target calibration gas with a known concentration, the sensor should begin to alarm within 20 seconds.

5. Wait for a stable reading to be obtained and compare it to the concentration on the calibration gas cylinder. The known target gas concentration level should be indicated on the LED display and all the alarms should be set off including the buzzer.

7. If the target calibration gas level is indicated on the LED display and the alarms are set off including the buzzer, test is complete.

8. Remove calibration nose, LED display should zero in a few minutes. Reset danger alarm.

9. If the target calibration gas level is not indicated on the LED display and or fails to set off all alarms a full calibration is required.

Gas Sensor Replacement

Electrochemical Cell Only

Sensor replacement in the FX-Mini Gas Detector is easily done with minimal tools.

Tools Required:

- Small Jeweler's Screwdriver
- Slotted or Phillips Screwdriver
- Needle nose Pliers

1. Disconnect the AC power from the detector.

2. Remove the sensor enclosure from the wall.

3. Remove the front cover of the sensor enclosure.

4. Carefully pull off the orange wire connector.

5. Flip the enclosure so that you can see the bulk head nut (see page 26 for diagram). Place the tips of a pair of needle nose pliers in the two holes of the sensor bulk head nut. Turn the ring counterclockwise to loosen the ring, and remove the entire sensor from the enclosure.

6. The transmitter PC board is mounted to the sensor with disconnect pins. Hold the PC board by the edges and carefully pull the board off of the sensor.

7. Remove and discard the 3 mounting screws. They are metric. The new sensor will come with 3 new #2-56 screws that match the thread inserts in the new sensor. Keep the collar, membrane, and o-rings. They will be used to mount the new sensor.

8. Install the collar, membrane, and o-rings on the new sensor, using the screws that came with the new sensor.

9. Remove the shorting wire from the gold pins on the new sensor, and carefully line up the 3 gold pins on the new sensor with the (3) sockets on the bottom of the transmitter board. Press evenly on the board until it fully seats on the gold pins.

10. Installation of the completed sensor/transmitter assembly is the reverse of its removal.

11. After completing the sensor replacement procedure, power-up the gas detector and allow it to stabilize for twenty minutes or so (some sensor gas types take up to 24 hours to stabilize). If the cell failure/problem light is blinking, the sensor requires a full sensor calibration.

12. Perform a full calibration, including the zero point calibration.
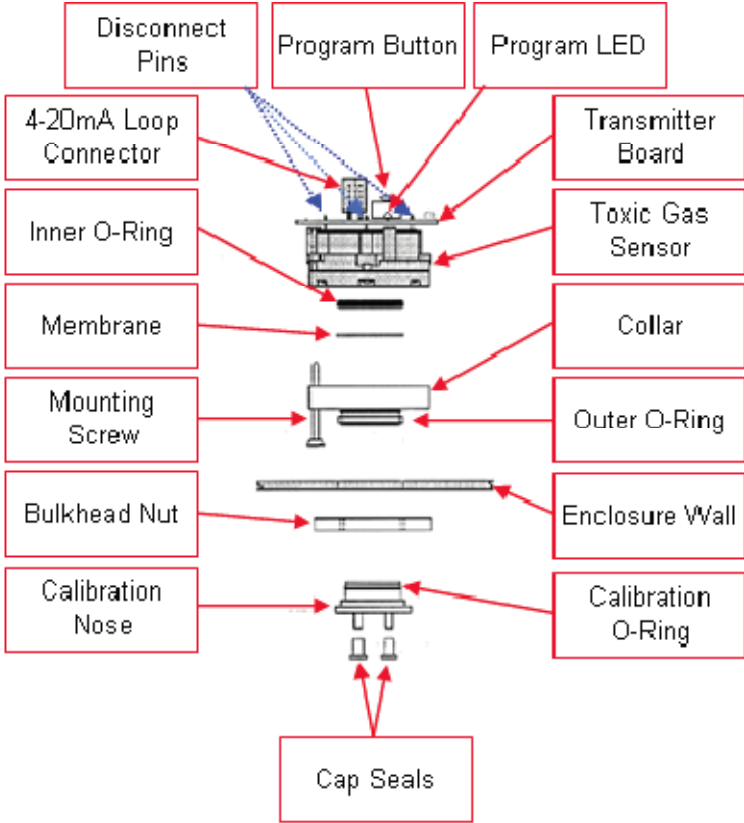
Gas Sensor Replacement

Complete Sensor with 4-20mA Transmitter Board

Tools Required:

- Slotted or Phillips Screwdriver
- Needle nose Pliers

1. Disconnect the AC power from the detector.

2. Remove the sensor enclosure from the wall.

3. Remove the front cover of the sensor enclosure.

4. Carefully pull off the orange wire connector.

5. Flip the enclosure so that you can see the bulk head nut. Place the tips of a pair of needle nose pliers in the two holes of the sensor bulk head nut. Turn the ring counterclockwise to loosen the ring, and remove the entire sensor from the enclosure.

6. Reverse this procedure to install the new sensor with transmitter board.

7. After a sufficient warm up period check the zero point of the sensor and adjust if needed.

8. Conduct the sensor response test. If the sensor fails this test a full calibration is required.

Gas Sensor Components

Disconnect Pins	Program Button	Program LED
4-20mA Loop Connector		Transmitter Board
Inner O-Ring		Toxic Gas Sensor
Membrane		Collar
Mounting Screw		Outer O-Ring
Bulkhead Nut		Enclosure Wall
Calibration Nose		Calibration O-Ring
	Cap Seals	

Technical Data, Specifications

Gas Sensor

3-Electrode, electrochemical fuel cell installed in detector enclosure

Response Time (T90)

<60 Seconds at 20°C. Typically <8 seconds to full alarm

Accuracy: 0.1 ppm (@20 degree C)

Resolution: 0.1 ppm

Long-term Sensitivity Drift: <2% signal loss per month

Temperature Range: -20°C to +50°C (-4°F to 122°F)

Humidity Range: 15 - 90 % (non-condensing)

Two Gas Alarm Levels, Non-Adjustable

Danger, Warning (based on OSHA, NIOSH and ACGIH recommendation). Non-standard alarm levels and operating ranges are available optionally

Sensor Fail Alarm

Indicates loss of sensor function if sensor output is below a threshold continuously for a specified period of time, or a break in the sensor circuit

LED Visual Alarm Indication

Danger: Red Flashing

Warning: Orange

Sensor Fail: Blue

LED Visual Power On Indicator: Green

Audible Alarm Notification: 100 dB piezo buzzer

Silence & Reset Button: (1) Dual function NC pushbutton, first push silences the buzzer, the second resets alarms & relays

Operating Voltage: Regulated 12VDC

Power Supply: by included AC-DC power supply below or by 12VDC battery

> AC to DC switching power supply included, 88-264 Volts AC 47/63 Hz input, 12VDC output, 6W max output power; output current 0.5A; short circuit, over voltage, overload protection; 2 pole USA plug, 4-ft cord, Class II power, Agency Approvals: CE/CUL/CB/FC

Numerical Display of Concentration: None

4-20 mA Output: None

Alarm Relays NO/NC

(4) 10A Form C, 10A @125 VAC, 7A @250VAC; 7A @ 28VDC, resistive.

(2) factory-set as Danger latching, (1) Warning, non-latching, (1) Sensor Fail, non-latching

Local Test Button: None, bump testing with gas is required

Remote Reset: Input terminal provided to reset the detector using a remote NC switch

Microprocessor Controlled Electronics: replaceable, flash upgradable microprocessor

Main Enclosure

Hinged door NEMA 4X/IP 66, ABS plastic rated for indoor use, 5.9" wide x 5.9" high x 3.5" deep with stainless steel wall mount feet, plastic hinges and latches. Outdoor rated enclosure is available at additional cost.

Technical Data, Specifications

A separate external battery backup / UPS is available, part #FX-BB110

Sun / Weather Guard

A sun / weather guard is available to protect the detector in outdoor installations.

Gas Sensors Available

Gas Sensor	Standard Range	Warning	Danger
Chlorine	0-10 ppm	0.5	1.0
Sulfur Dioxide	0-10 ppm	1.0	3.0
Ammonia	0-100 ppm	35	50
Oxygen	0-25%	18%	16%
Carbon Monoxide	0-500 ppm	35	50
Chlorine Dioxide	0-1 ppm	0.1	0.3
Hydrogen Sulfide	0-10 ppm	1.0	3.0
Ozone	0-2 ppm	0.05	0.1
Nitric Oxide	0-50 ppm	15	25
Nitrogen Dioxide	0-10 ppm	1.0	3.0
Hydrogen Cyanide	0-10 ppm	1.0	3.0
Hydrogen Chloride	0-10 ppm	0.7	2.0

Other gas ranges and non-standard alarm levels are available optionally.

Contact, Return Policy

Customer Service Department

If you need spare parts, assistance in troubleshooting, or repair service, please contact Foxcroft Customer Service at:

Foxcroft Equipment and Service, Co. Inc.

2101 Creek Road, P.O. Box 39

Glenmoore, PA 19343

Tel: (800) 874-0590
          (610) 942-2888
Fax: (610) 942-2769
Email: sales@foxcroft.com
Website: www.foxcroft.com

Customer Repair / Returns Policy

All systems returned for repair or replacement must be freight prepaid and include the following information:

1. A clearly written description of the malfunction.
2. Name of person to contact and the phone number where they can be reached.
3. Proper return address for shipping system back. Include preferred shipping method.
4. A purchase order if the system is out of warranty to cover costs of repair.
5. A Return Material Authorization Number (RMA) is required before shipping any products for service. Call telephone number above to receive a RMA number.

NOTE: *Returns will only be held at Foxcroft for 90 days. If a decision is not made regarding the repair, the product will be returned.*

Product Warranty

Foxcroft Equipment & Service warrants all products obtained hereunder to be free from defects in material and workmanship for a period of one year from the date of shipment. In the event of a product failure or defect requiring warranty repair, the customer must obtain an RMA number by calling 1-800-874-0590, before returning the product, at the customer's expense to Foxcroft for repair. Warrantor (Foxcroft Equipment and Service) will repair the unit, without charges for parts, labor and return freight.

Foxcroft Equipment & Service is not responsible for damage to its products through improper installation, maintenance, act of God, use or attempts to operate such products beyond their functional capacity, intentionally or otherwise, or for any unauthorized repair.

Buyer agrees to hold Foxcroft Equipment & Service harmless from all claims for damages arising out of injury or death to any person or damage to any facility, or any other property, or loss of use of any such property, whether such person or property is on or off the installation or activity site for which the equipment or material furnished hereunder is destined and whether such damage, loss destruction or loss of use, injury or death results directly or indirectly from a nuclear incident or for any other cause.

Statements and instructions set forth herein are based upon the best information and practices known to Foxcroft Equipment & Service but it should be assumed that every acceptable safety procedure is contained herein. Of necessity this company cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.

FOXCROFT
EQUIPMENT & SERVICE COMPANY, INCORPORATED

Serial Number Label for FX-Mini

Toxic Gas Detector

Foxcroft Equipment & Service Co. Inc.

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Glenmoore, PA 19343

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            (610) 942-2888
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Web: **www.foxcroft.com**