MSA
The Safety Company

Operating Manual

Bacharach® X Series - X10, X30, X50 Refrigerant Gas Monitor

Fixed Gas Monitor

Order No.: 10253483/02

Print Spec: 10000005389 (EO)

CR: 800000074231

1.888.610.7664 www.calcert.com sales@calcert.com

WARNING!

These instructions must be provided to users before use of the product and retained for ready reference by the user. Read this manual carefully before using or maintaining the device. The device will perform as designed only if it is used and maintained in accordance with the manufacturer's instructions. Otherwise, it could fail to perform as designed, and persons who rely on this device could sustain serious injury or death.

The warranties made by MSA with respect to the product are voided if the product is not installed and used in accordance with the instructions in this manual. Please protect yourself and your employees by following the instructions.

Please read and observe the WARNINGS and CAUTIONS inside. For additional information relative to use or repair, call 1-800-MSA-2222 during regular working hours.

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Contents

1 Introduction **4**
1.1 General Safety 4
1.2 Policies 4
1.3 Notices 5

2 Product Descriptions **8**
2.1 Intended Uses 8
2.2 Product Configuration Details 8
2.3 Power Options 8
2.4 Configurable Output Signals 8
2.5 Output Signals 8
2.6 User Interface 9
2.7 X30 & X50 Gas Monitors Technical Specifications 9
2.8 X10 Remote Gas Sensor Technical Specification 11
2.9 Components 12
2.9.1 X30 PCB Layout and Components 12
2.9.2 X50 PCB Layout and Components 13
2.9.3 X10 PCB Layout and Components 13

3 Installation **14**
3.1 Installation Recommendations 14
3.2 Mechanical Installation 14
3.3 Electrical Installation 15
3.4 Relay Wiring 16
3.5 Installation of Remote Sensing Head 17
3.6 Connecting to MGS Series Detection Controllers 17
3.7 Confirming Instrument Functionality 17

4 Operation **18**
4.1 Applying Power and Start-up Sequence 18
4.2 Verifying Analog Signals 18
4.3 Verifying the Modbus Signal 19
4.4 Switch Functions 19
4.5 Reset System to Factory Default Settings 20
4.6 MSA Bacharach X-Series Smartphone Application 20

5 Care and Maintenance **22**
5.1 Maintenance Intervals 22
5.2 Sensor Maintenance 22
5.3 Troubleshooting 23
5.4 Calibration Instructions 24
5.5 Cleaning the Instrument 24

6 Additional Information **25**
6.1 Sensor Principle 25
6.2 Ingress Protection Ratings 25
6.3 Sensor Specifications 25
6.3.1 Refrigerant Gas List 26
6.3.2 R-744 (Carbon Dioxide) Gas Monitoring 26

7 Order Information **27**
7.1 Part Numbers 27

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1 Introduction

To ensure operator safety and the proper use of the X-Series Refrigerant Monitors, please read the contents of this manual for important information on the operation and maintenance of the instrument.

1.1 General Safety

WARNING!

- Before using this product, carefully read and strictly follow the instructions in the manual. Ensure that all product documentation is retained and available to anyone operating the instrument.
- Use this product only for the purposes specified in this document and under the conditions listed.
- DO NOT use it in hazardous (classified) locations. This instrument has NOT been designed to be intrinsically safe for use in areas classified as being hazardous locations.
- Units have been factory calibrated. After installation of the monitor, a bump test must be performed to confirm instrument functionality. A full calibration is recommended at the time of commissioning.
- The gas diffusion path can become occluded (moisture, dust, debris, frozen condensation) over time resulting in reduced or complete lack of gas monitoring and alarming function. Routine visual inspection of the device and bump testing are required to help ensure proper gas monitoring and alarm function
- A user may perform recommended maintenance and installation of authorized replacement parts. Additional user modification to the circuit board, sensor, or enclosure may void the warranty.
- Operator assumes responsibility for complying with all laws, rules and regulations governing the use of this product.
- Use only genuine MSA parts and accessories. Failure to comply may impair the operation of the product and / or void the warranty.
- The equipment is intended for analytical purposes or measurement information to determine status with no safety related functions including shutting down equipment.

Failure to follow these warnings can result in serious personal injury or death.

1.2 Policies

Warranty Policy

MSA warrants that this product will be free from mechanical defects and faulty workmanship for one (1) year from the date of shipment, provided it is maintained and used in accordance with MSA's instructions and/or recommendations. This guarantee shall not exceed the indicated warranty period plus six months from the date of manufacture. It is expressly agreed that the product user's sole and exclusive remedy for breach of the above warranty, for any tortious conduct of MSA or for any other cause of action, shall be the repair or replacement, at MSA's option, of the product or its components that after examination by MSA is shown to be defective in either workmanship or mechanics, or refund where repair or replacement is not possible.

MSA warrants to Purchaser that it will convey good title to this product. MSA's liability and Purchaser's remedy under this warranty of title are limited to the removal of any title defects or, at the election of MSA, to the replacement of this product or parts thereof that are defective in title.

Replacement equipment and/or components will be provided at no cost to Purchaser, F.O.B. MSA's plant. Replacement parts and repairs are warranted for ninety (90) days from the date of repair of the product or sale of the replacement part, whichever occurs first. Failure of MSA to successfully replace any nonconforming equipment or components or parts shall not cause the remedy established hereby to fail of its essential purpose.

MSA shall be released from all obligations under this warranty in the event that repairs or modifications are made by persons other than its own or authorized service personnel, or if the warranty claim results from normal wear and tear, product physical abuse, accident, alteration, misuse, or neglect. No agent, employee or representative of MSA has any authority to bind MSA to any affirmation, representation or modification of the warranty concerning the components. No agreement varying or extending the foregoing warranties, remedies or the following is limitation will be binding upon MSA. unless in writing, signed by a duly authorized officer of MSA.

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The remedies of the buyer shall be limited to those provided herein to the exclusion of any and all other remedies, MSA expressly disclaims any and all liability for economic, special, incidental, or consequential damages or losses of any kind whatsoever in any way connected with the sale, use, or nonoperation of the product, including, but not limited to, loss of anticipated profits.

Service Policy

MSA may choose to offer non-warranty service for this product at a factory or regional service center. Some MSA distributors or agents may also have repair facilities, but MSA assumes no liability for service performed by anyone other than MSA personnel. Should your device require repair outside of the warranty period, please contact the distributor or MSA to inquire about available services.

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1.3 Notices

Approvals subject to change without notice and may differ based on configuration, part number and/or country. Contact Customer Service or check the approval label on the product for specific approval information.

1.3.1 Bluetooth SIG Statement

The design is listed as "Refrigerant Gas Monitor", Declaration ID Q369275.

https://qualification.bluetooth.com/ListingDetails/306550

1.3.2 Radio Information

US Federal Communications Commission (FCC) notice

United States Federal Communications Commission ID

FCC ID: P9R-MSAXSeries

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

1. This device may not cause harmful interference
2. The device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

1.3.3 EMC

Class A

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 in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

RF exposure safety

This device complies with the FCC RF exposure limits and has been evaluated in compliance with portable/mobile exposure conditions with minimum distance of 20 cm of the human body.

1.3.4 Innovation, Science, Economic Development Canada notice

ISED Canada (formerly known as IC – Industry Canada)

Certification Number: IC: 324C-MSAXSeries

This device complies with Industry Canada License-exempt RSS standard(s). Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. The device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence.L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage.
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.

RF exposure safety

This device complies with the ISED RF exposure limits and has been evaluated in compliance with portable exposure conditions with minimum distance of 20 cm of the human body.

CAN ICES-003

Les changements ou modifications non expressément approuvés par la partie responsable de la conformité peuvent annuler le droit de l'utilisateur à utiliser l'équipement.

Sécurité d'exposition aux RF

Cet appareil est conforme aux limites d'exposition RF d'ISED et a été évalué conformément aux conditions d'exposition portable à une distance minimale de 20 cm du corps humain.

CAN NMB-003

Cet appareil numérique de classe B est conforme à la norme canadienne NMB-003.

1.3.5 European Conformance CE mark

This device has been evaluated against the essential requirements of the Radio Equipment Directive 2014/53/EU (RED). In order to satisfy the essential requirements of the RED, the device is compliant with the following standards:

Electromagnetic Compatibility (Article 3.1b):

- EN 301 489-1
- EN 301 489-17

Radio Spectrum Efficiency (Article 3.2):

- EN 300 328

Protection against network harm and service degradation (Article 3.3 d):

- EN 18031-1

Health and Safety (Article 3.1a):

- EN 61010-1
- EN 62311

Radiofrequency radiation exposure Information:

This device complies with radiation exposure limits and has been evaluated in compliance with portable exposure conditions with minimum distance of 20 cm of the human body.

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2 Product Descriptions

2.1 Intended Uses

The MSA Bacharach X30 & X50 Fixed Refrigerant Gas Monitors are intended to be installed in non-classified, non-hazardous, permanent locations for the purpose of continuously monitoring indoor ambient air for the following gas types:

- HCFC, HFC, and HFO Refrigerants
- Carbon Dioxide (R-744)
- Hydrocarbon Refigerants (R290)

2.2 Product Configuration Details

The X-Series Refrigerant Monitors may be purchased in the following configurations:

Table 1 X-Series Device Characteristics

	X30	**X50**	**X10 Remote Sensor** *(used with X50 only)*
Enclosure	IP66	IP66	IP66
Relays	1	4	No Relays
Digital Communication	Modbus	Modbus	Modbus
Signal Output	Analog	Analog	-
Sensor	Integrated	Integrated, Remote, or Dual	Integrated

2.3 Power Options

X30 & X50 Refrigerant Monitors are designed to utilize 24V DC or AC power. Installations with X-Series devices utilizing DC power must use a certified Class II SELV / Class 2 (power limited) power supply. Detailed power specifications and wattage requirements can be found in 2.7 X30 & X50 Gas Monitors Technical Specifications and on the I/O Drawing, available on the MSA Website.

NOTE: Installations with MGS-Series and X-Series devices utilizing AC power must have an isolation transformer separating them due to mixed Full-Wave and Half-Wave Rectification. See X-Series AC Power technical note or contact MSA for additional information.

2.4 Configurable Output Signals

X30 & X50 Refrigerant Monitors may be connected to an MGS-401 Entrance Monitor, an MGS-402 Controller, an MGS-408 Controller, or a third-party device capable of accepting digital and/or analog outputs from the refrigerant monitor, such as a Building Management System (BMS) or Programmable Logic Controller (PLC).

With the integrated audio-visual indicators, an instrument can be operated as a stand-alone unit (with additional local signaling as required). Default warning levels are set at 50% and 90% of the full scale range. Configurable output signal options include the following:

- X10: Modbus RTU digital output - communicates directly to an X50 device only
- X30: 1x Relay 1x Analog Output (4 to 20 mA, 1 to 5 V, 2 to 10 V), Modbus RTU digital output, Bluetooth (BLE)
- X50: 4x Relay (fault, low alarm, high alarm, configurable), 2x Analog Output (4 to 20 mA, 1 to 5 V, 2 to 10 V), Modbus RTU digital output, Bluetooth (BLE)

2.5 Output Signals

X30 & X50 Refrigerant Monitors feature a multicolor LED which utilizes red, yellow, green, and blue colors, in combination with an audible alarm, to communicate the status of the instrument. An X30 gas monitor contains a single LED to correspond with one available gas sensing channel. On an X50 dual sensor configuration, each sensor's status is represented by an individual channel LED.

If only one sensor is populated on an X50, a single LED will illuminate to communicate status of the utilized channel. The X50 model also features an LED perimeter ring that illuminates to serve as a strobe indicator. The LED strobe will illuminate only during Alarm/Warning conditions with red color.

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Please refer to the table below for indication patterns shown by the channel status LEDs:

- X30 models contain only one relay, which is common for low/high/fault (not according to table below).
- Relay status will depend on user configuration for normally open/normally closed
- Relay #4 on X50 models is configurable for purpose
- Blue LED flashing indicates Bluetooth advertising and connection

State	LED	Buzzer	Relay 1 *(LOW)*	Relay 2 *(HIGH)*	Relay 3 *(Fault)*
Warm-up			OFF	OFF	OFF
Normal			OFF	OFF	OFF
Warning 1 (Low Alarm)			ON	OFF	OFF
Warning 2 (High Alarm)			ON	ON	OFF
Offline			OFF	OFF	OFF
Fault			OFF	OFF	ON
Zero Calibration			OFF	OFF	OFF
Span Calibration			OFF	OFF	OFF
Calibration Recovery			OFF	OFF	OFF

2.6 User Interface

The X30 and X50 monitors allow users to interface directly with the instrument via the following:

- Bluetooth® Communication using the X-Series App allows users to configure the refrigerant monitor, initiate calibration, conduct a bump test, operate functional test modes, and view status information. See Section 4.6 MSA Bacharach X-Series Smartphone Application
- Front Face Push Buttons to initiate Bluetooth communications, mute buzzer, reset to factory defaults, and acknowledge alarms
- Modbus RS-485 commands for read and write to available registers through a compatible polling program. (See Modbus & System Implementation Guide PN: 10254069 for further detail, available on the MSA website.)

2.7 X30 & X50 Gas Monitors Technical Specifications

NOTE: The tables below details specifications for X30 & X50 models. For information on sensors and detected gases, see 6.3 Sensor Specifications

Mode of Operation	Analog Output State	1-5V	2-10V	4-20mA
Manual / Test Mode	Manual - 0	1-5V	2-10V	4-20mA
Instrument Fault	Fault - 1	≤ 0.3V	≤ 0.6V	≤ 1.2mA
Offline Mode / Maintenance	Offline - 2	0.75V	1.5V	3mA
Drift Below Zero	Underflow - 3	0.95V	1.9V	3.8mA
Measuring Range Exceeded (Over range)	Overflow - 4	5.12V	10.25V	20.5mA
Normal Operation	Normal - 5	1-5V	2-10V	4-20mA
Disable Sensor (X50 only)	Zero - 6	0V	0V	0mA

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Category	Specifications			
Output Signal Specifications	Modbus RTU over RS-485	Baud rate:		9,600 or 19,200 (selectable)
		Start bits:		1
		Data bits:		8
		Parity:		None, odd, even (selectable)
		Stop bits:		1 or 2 (selectable)
		Retry time:		500 ms, min time between retries
		End of message:		Silent 3.5 characters
Power Supply and Relays	Operating Voltage	24 VDC +/- 20% 24 VAC +/- 20%, 50/60 Hz		
	Inrush Current	1.5 A		
	Operating current, max.	X30 - 8 W, (333 mA @ 24 VDC) X50 - 14 W, (583 mA @ 24 VDC)		
	Relay rating	X30: 1x SPDT, 12 VDC, 2A Max X50: 4x SPDT, 12 VDC, 2A Max		
	Audible alarm	Internal Buzzer >90 dB at 4” (10 cm)		
	Alarm delay	0 to 15 minutes (selectable)		
Wiring	Power and analog signal	2-Wire shielded cable, 16 to 20 AWG (0.5 to 1.5 mm^2)		
	Modbus network	3-Wire, twisted pair + ground, shielded cable with 120 Ω characteristic impedance, 16 to 24 AWG (0.5 to 1.5 mm^2)		
	Cable Fittings	M16 or M20 metric size cable glands 1/2" and 3/4" NPT plastic and metal conduit Not intended for use with threaded metal conduit / hubs		
	Temperature	Installation requires the use of field wiring cable with temperature limit >60C		
Physical Specifications	Enclosure and sensor housing	Enclosure Housing: Polycarbonate Sensor Housing: ABS		
	Enclosure Ingress Protection	IP66 Type 4 6.2 Ingress Protection Ratings		
	Weight (Approx.)	X30: 13.7 oz (388 g) X50: 16.6 oz (471 g)		
	Enclosure Size (WxHxD) (Approx.)	X30: 164 x 132 x 76 mm X50: 164 x 160 x 84 mm		

Category	Specifications	
Environmental	Operating temperature	- 40° to 122 ºF (-40 to 50 ºC)
	Storage temperature	- 4° to 104 ºF (-20 to 40 ºC)
	Humidity	5 to 90 %RH, non-condensing
	Pressure	23.6 to 32.5 inch Hg / 800 to 1,100 mbar
	Elevation	0 to 10,000 ft. (3050 m) altitude
	Sensors	See 6.3 Sensor Specifications
	Influences	For influences on the measurement performance and restrictions of a particular sensor see sensor data sheet.
Product Approvals	UL / CSA / EN 61010-1, CE (EMC Directives)	
Product Design Standards	EN 14624 (Indicating Device), EN 50270. Testing performed to FM TD 221.	
Industry Codes & Regulations	Supports ASHRAE 15, CSA B52.2, EN 378, F-Gas Regulation, IIAR CO2	

2.8 X10 Remote Gas Sensor Technical Specification

NOTE: The X10 Remote Gas Sensor is not a standalone device. Power and communications specifications intended to reflect connection to X50 base transmitter.

Category	Specifications		
Output Signal Specifications (Connected to X50 device and unable to be modified by user)	Modbus RTU over RS-485		
		Baud rate:	9,600
		Start bits:	1
		Data bits:	8
		Parity:	None
		Stop bits:	1
		Retry time:	500 ms, min time between retries
		End of message:	Silent 3.5 characters
Power Supply and Relays	Operating Voltage	12VDC (to be supplied from X50 transmitter only)	
Wiring	Power and Communication	4-Wire shielded cable, 18AWG (0.75mm^2)	
	Cable Fittings	M16 metric size cable glands or 1/2" NPT plastic and metal conduit. Not intended for use with threaded metal conduit/hubs.	
	Temperature	Installation requires the use of field wiring cable with temperature limit >60C	
Physical Specifications	Enclosure and sensor housing	Enclosure Housing: Polycarbonate Sensor Housing: ABS	
	Enclosure Ingress Protection	IP66 TYPE 4 6.2 Ingress Protection Ratings	
	Weight (Approx.)	6.4 oz (181 g)	

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Category	Specifications	
	Enclosure Size (WxHxD) (Approx.)	106 x 82 x 55 mm
Environmental	Operating temperature	- 40° to 122 ºF (-40° to 50 ºC)
	Storage temperature	- 4° to 104 ºF (-20° to 40 ºC)
	Humidity	5 to 90 %RH, non-condensing
	Pressure	23.6 to 32.5 inch Hg / 800 to 1,100 mbar
	Elevation	0 to 10,000 ft. (3050 m) altitude
	Sensors	See 6.3 Sensor Specifications
	Influences	For influences on the measurement performance and restrictions of a particular sensor see sensor data sheet.
Product Approvals	UL / CSA / EN 61010-1, CE (EMC Directives)	
Product Design Standards	EN 14624 (Indicating Device), EN 50270. Testing performed to FM TD 221	
Industry Codes & Regulations	Supports ASHRAE 15, CSA B52.2, EN 378, F-Gas Regulation, IIAR CO2	

2.9 Components

⚠ CAUTION!

Follow proper ESD precautions when handling the printed circuit boards. This device uses semiconductors which can be damaged by electrostatic discharge.

Failure to follow this caution can result in minor or moderate injury.

2.9.1 X30 PCB Layout and Components

Table 2 X30 PCB Components Description

1	Analog Connection (Out)	5	Digital Connection, Modbus (In/Out)
2	Power Connection (In)	6	Relay Connection
3	Power Connection (Out)	7	Termination Switch (Standalone, End of Line)
4	Local Sensor Connection		

2.9.2 X50 PCB Layout and Components

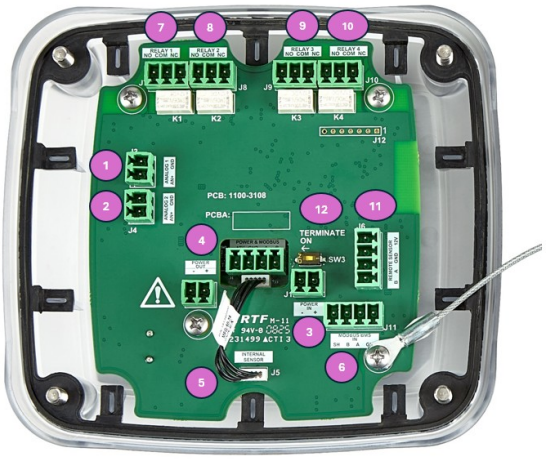

Table 3 X50 PCB Components Description

1	Analog Connection, Channel 1 (Out)	9	Relay Connection 3
2	Analog Connection, Channel 2 (Out)	10	Relay Connection 4
3	Power Connection (In)	11	Remote Sensor (X10) Connection, Power & Comms
4	Power Connection (Out)	12	Termination Switch (Standalone, End of Line)
5	Local Sensor Connection		
6	Digital Connection, Channel 2, Modbus (In/Out)		
7	Relay Connection 1		
8	Relay Connection 2		

2.9.3 X10 PCB Layout and Components

Table 4 X10 PCB Components Description

1	Power Connection (In)	3	Termination Switch (Standalone, End of Line)
2	Modbus Connection (In/Out)		

3 Installation

WARNING!

- Consult local codes and regulations when selecting the minimum wire AWG for connection to bonding terminal. Protective conductor connections to bonding bar must be independent of 24V AC/DC - Input and DC Common
- Remove power and confirm device is unpowered before performing installation, maintenance, or service activities.
- Only one cable entry location is to be used on the X10 enclosure as the conduit grounding bar is provided within the X50 transmitter enclosure assembly. Any required bonding of metal conduit shall be done within the transmitter.
- The manufacturer of this product requires that a bump test or calibration be performed following installation to verify instrument functionality.
- Use of metal conduit requires proper termination, per applicable electrical codes, to internal grounding bar.

Failure to follow this warning can result in serious personal injury or death.

3.1 Installation Recommendations

Installation site selection is critical to ensuring system performance and effectiveness. In order to achieve compliance, users must consider several aspects of the installation process, including, but not limited to the following:

- Federal or national regulations, as well as local, state, and national building codes that govern the installation of gas monitoring equipment.
- Electrical codes that govern the routing and connection of electrical power and signal cables to gas monitoring equipment
- The full range of environmental conditions to which the instruments will be exposed
- The physical characteristics of the gas or vapor to be monitored
- The specifics of the application and airflow path of the monitored space (e.g., possible leaks, air exchanges, etc.)
- The degree of accessibility required for maintenance purposes
- The types of optional equipment and accessories that will be used with the system
- Any limiting factors or regulations that would affect system performance or installations

3.2 Mechanical Installation

The MSA Bacharach X10, X30, and X50 devices MUST be installed indoors on a permanent, flat, and stable surface not subject to excessive vibration.

The installation location must have appropriate supply power available for the instrument as according to the technical specifications and listed requirements.

To open enclosure entries:

- Loosen the faceplate screws with a 4mm (5/32") hex key or Allen wrench. Remove lid and electronics from the device before drilling.

  NOTE: The lid may be retained by the lanyard internal to the unit; however it is recommended to remove the lid completely. This may be done by separating the lanyard from the grounding bar, with a Phillips head screwdriver.
- Hold or otherwise stabilize and secure the back enclosure on a surface to prepare for drilling.
- Identify which entry points on the enclosure are optimal for electrical wiring of inputs and outputs based on the application.

  NOTE: Consult the I/O Drawing, available on MSASafety.com for recommendations.
- Position a drill in one of the molded dimples to fasten the bit and promote a clean drill entry. Dimples have been positioned for installation of fittings and proximity to connections on the circuit board.
- Utilize an appropriate drill bit to drill an entry through the plastic. Do not apply excessive force to the housing. Utilize a deburring tool if needed to ensure that fittings will seal properly to the housing.

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- When using a step drill bit, the step length should be at least 3.5 mm for X10/X30 bases and 3.7 mm for X50 bases.

Table 5 Allowable Sizes for Cable and Conduit Fittings Based on Monitor Model

Instrument	Side Entries	Bottom Entries
X10	M16 or 1/2" NPT	None
X30	M16 / M20 or 1/2" NPT	M16 / M20 or 1/2" NPT
X50	M16 / M20 or 1/2" NPT	M16 / M25 or 3/4" NPT / M20 or 1/2" NPT

NOTE: Suppliers of cable glands and conduit fittings may specify a recommended hole diameter for an optimal seal, based on o-ring or gasket size.

Mounting Instructions: X10, X30, or X50 Monitors

Mount the monitor vertically and free of obstruction on the selected surface with appropriate hardware.

- The mounting tabs in the X10, X30, and X50 enclosures are sized for clearance with an M4 or #6 screw.
- The OD of a washer or integral flange on a screw head should be less than 14.5 mm or .57” for the X30 and X50 and less than 8.5 mm or .33” for the X10.
- The thickness of the mounting flanges is 3.5 mm or .14”.

The monitor should be secure on the mounted surface, accessible to the airflow of the room, and within the potential leak path for the monitored gas.

3.3 Electrical Installation

⚠ WARNING!

- Disconnect or isolate power (whichever is needed) prior to performing any electrical work.
- Ensure wiring for relays and connections for sensor(s) are made before applying power.
- Follow proper ESD precautions when handling the printed circuit boards. This device uses semiconductors which can be damaged by electrostatic discharge.
- Do not operate the device with open conduit or cable gland access points. Plug all knocked out entries with a suitable conduit plug or cable gland rated to maintain the ingress rating. See 6.2 Ingress Protection Ratings for full definition of ingress protection on the device.
- The wiring for the relays must be selected and fused according to the rated voltages, currents, and environmental conditions.
- If stranded conductors are used, a ferrule must be used.

Failure to follow these warnings can result in serious personal injury or death.

NOTE: To comply with RFI immunity regulations, it is necessary to ground the shield of the communications cable at the PLC, GDA controller, front-end controller, or Building Management System (e.g., the chassis, the ground bus-bar, etc.).

3.3.1 Power and Signal Wiring

NOTE: Please see the I/O Drawing for detailed information on electrical connections for X30 & X50 devices. An isolation transformer must be used for MGS and X-Series mixed installations.

1. In order to wire the device for power and signal, locate the relevant connections (Power, Analog, Modbus) and from the PCBA.

Connection	Description	Label	Wiring Termination
Power	24 VDC/VAC IN	24V IN: -	24 VDC negative / VAC neutral
		24V IN: +	24 VDC positive / VAC live
	24 VDC/VAC OUT (power daisy chain terminal)	24V OUT: -	24 VDC negative / VAC neutral
		24V OUT: +	24 VDC positive / VAC live
Digital Output	Modbus Network Communications	MODBUS: B	RS-485 “B” (inverted)
		MODBUS: A	RS-485 “A” (non-inverted)
		MODBUS: GND	RS-485 GND
		MODBUS: SH	RS-485 Shield
Analog Output	Voltage or Current Output	ANALOG: -	Analog output negative (-)
		ANALOG: +	Analog output signal (+)

2. Select the cable / conduit entries to be accessed for wiring
3. Insert wires into the enclosure through the selected drilled entries.
4. Secure the wires in each terminal block and, pressing firmly, reinstall the terminal block into the PCBA.
   - For 24 VAC installations in a daisy-chain configuration, the neutral polarity must be maintained for all instruments.
5. Remove all excess cable from the housing before securing the cable glands or conduit fittings.
6. Place the lid back on and tighten and faceplate screws to a torque of 10 in-lbs or 1.13 Nm

NOTE: Analog communications are set to VOLTAGE output from the factory. To modify the analog signal range, connect to the mobile application as detailed in 4.6 MSA Bacharach X-Series Smartphone Application

3.4 Relay Wiring

⚠ WARNING!

Relays are rated for 0 to 24V AC/DC. DO NOT apply mains power onto these relays.

Failure to follow this warning can result in serious personal injury or death.

1. Locate the relay connections and remove the terminal block from the PCBA.

Relay	Model	Function
1	X30 / X50	X30: Warning 1 Alarm (Low), Warning 2 Alarm (high), Fault X50: Warning 1 Alarm (Low)
2	X50	Warning 2 Alarm (High)
3	X50	Fault
4	X50	Configurable to Low, High, or Fault

2. Insert wires into the enclosure through the selected drilled entries. Insert wires into the enclosure.
3. Secure the wires in each terminal block and, pressing firmly, reinstall the terminal block into the PCBA.
4. Remove all excess cable from the housing before securing the Seal entry with the appropriate cable gland plug and/or conduit fitting.
5. Install cable glands or conduit fittings over the wires.

When configured according to the factory default settings, the relays are set for fail-safe operation (see table below). When configured for fail-safe operation, relays are energized during normal operation. Fail-safe operation ensures relays are triggered in cases of power failure at the instrument. In failsafe operation normally open and normally closed terminals are reversed as indicated by the following table:

Terminal	Normal Operation	Failsafe Operation
NC	Normally Closed	Normally Open
COM	Common	Common
NO	Normally Open	Normally Closed

3.5 Installation of Remote Sensing Head

⚠ WARNING!

- Only one cable entry location is to be used on the X10 enclosure as the conduit grounding bar is provided within the X50 transmitter enclosure assembly. Any required bonding of metal conduit shall be done within the transmitter.

Failure to follow this warning can result in serious personal injury or death.

The X50 refrigerant monitor features a remote sensor, which allows users to detect the presence of gases in difficult-to-access locations.

The X10 Remote Gas Sensor can be mounted up to 100m away from the X50 base unit, when installed with the specified cable or equivalent.

The X10 Remote Sensor may be used with an X50 monitor as the sole sensor of the X50 monitor or combined with a local sensor within the device. The device may be configured for either of these arrangements via modbus or the mobile app upon installation. Please see the I/O Drawing for further details on proper electrical connections to the X10.

To install the X10 remote sensor:

1. Obtain suitable cable and cable gland/conduit fittings for wiring.
2. Drill a hole on the selected side of the enclosure using available dimples
3. Insert wire leads into the marked connection terminal block plug on the X50 device.
4. Connect other end of the wire leads to the X10 power and digital communication terminal block plugs.
5. Change configuration to "External-Only" or "Dual Sensors" to initiate X50 device to recognize the installed sensor on the X-Series mobile app. See 4.6 MSA Bacharach X-Series Smartphone Application

3.6 Connecting to MGS Series Detection Controllers

MGS Controllers, including the MGS-402, MGS-408, and MGS-401 Entrance Monitor, support both the MGS-400 Series and X-Series Monitors. For wiring and configuration information, please refer to the product manual available for the specific controller that will be installed.

NOTE: At the central control system, connect the shield of the wires to the earth ground of the controller (e.g., the chassis, the ground bus-bar, etc.).

NOTE: Some limitations may exist with content displayed on the MGS Series Controller from an X30 or X50 device. Refer to each controller's product manual for additional details. Consult the I/O Drawing available on MSASafety.com for important considerations regarding electrical load supported by each controller.

3.7 Confirming Instrument Functionality

After all wiring has been completed, re-install the lid, power on the transmitter, and perform a calibration or bump test to verify instrument functionality:

1. Using a 5/32″ (4 mm) hex key / Allen wrench (not included) tighten the lid screws in an “X” tightening pattern. Each screw should be tightened to a torque of 10 in-lb to maintain ingress protection rating.
2. Switch power on.
3. Allow the instrument to complete its start-up sequence and sensor warm-up.
4. Perform a calibration or bump test to confirm instrument functionality. (For instructions on performing a calibration, see 5.4 Calibration Instructions.)

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4 Operation

WARNING!

Verify configuration and settings of the device. Apply gas to the unit to verify performance prior to leaving the device unattended for normal operation.

Failure to follow this warning can result in serious personal injury or death.

4.1 Applying Power and Start-up Sequence

After applying power, the instrument will go through a start-up sequence (initialization, audible/visual test and self-test sequence). After start-up sequence completes, the instrument will enter a warm-up period to allow the sensor element to stabilize before reporting a valid output.

1. Switch power on.
2. Observe the start-up sequence:
   - All status LEDs cycle through green, yellow, red, and blue.
   - For X50 models, the perimeter LEDs will also cycle red and blue.
     - The buzzer will sound
     - Relay state is “no alarm.”
     - Analog output readings shows 0mA
3. Observe the warm-up sequence:
   - Modbus flag for warm-up is set.
   - Buzzer is off.
   - The sensor status LED will blink green.
4. Observe normal operation:

   NOTE: Up to 2 LEDs, modbus flags, and gas readings for X50 dual sensor (Internal + Remote)
   - Green LED is steady on.
   - Modbus flag for warm-up is cleared.
   - Buzzer is off.
   - Relay state is “no alarm or fault.”
   - Gas reading is valid.
   - Analog output readings will show a reading depending on the amount of gas detected.

NOTE: If the start-up sequence does not follow this pattern or cannot be confirmed in normal operation status, refer to 5.3 Troubleshooting of the manual or contact MSA Technical Support for commissioning assistance.

4.2 Verifying Analog Signals

X30 Refrigerant Monitors feature a single configurable analog output. X50 Refrigerant Monitors feature a configurable analog output per active sensor channel, up to two outputs maximum. During normal operation, the analog output of the instrument is proportional to the detected gas concentration. Output level is proportional to the gas level as shown below:

Gas Concentration	1-5V	2-10V	4-20mA
0%	1V	2V	4mA
50%	3V	6V	12mA
100%	5V	10V	20mA

The instrument may also enter several special states, these are indicated by the specific analog output levels indicated below:

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Mode of Operation	1-5V	2-10V	4-20mA
Instrument Fault	≤ 0.3V	≤ 0.6V	≤ 1.2 mA
Offline Mode / Maintenance	0.75V	1.5V	3 mA
Drift Below Zero	0.95V	1.9V	3.8 mA
Normal Operation	1-5V	2-10V	4-20 mA
Measuring Range Exceeded	5.12V	10.25V	20.5 mA

4.3 Verifying the Modbus Signal

The X30 and X50 Refrigerant Monitors provide a Modbus RTU digital interface. All status messages and most parameters can be accessed and / or configured via the X-Series App (Bluetooth® communications) or via a Building Management (Modbus network).

NOTE: Consult the Modbus Manual, PN 10254069 for further details, also available on MSA website.

4.4 Switch Functions

User interaction with the X30 and X50 Refrigerant Monitor is accomplished through the use of two push buttons (i.e. switches) located on the front face of each unit.

Figure 1 Bacharach X30

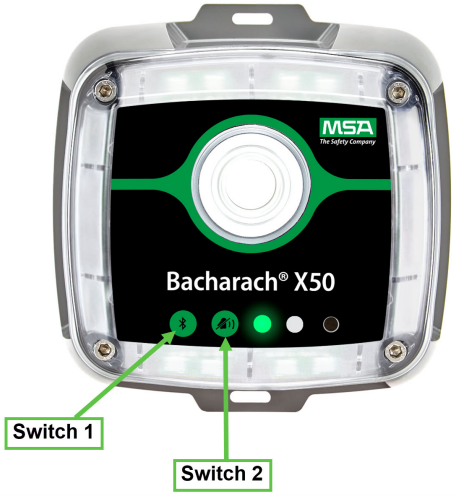

Figure 2 Bacharach X50

Depending on the duration the button is held, a short “TAP” or long “HOLD” will be detected:

- To carry out a tap function, depress the push button with normal force for 1 second, until a single “chirp” is heard.
- To carry out a hold function, depress the push button with normal force and continue to hold for >5 seconds, until a double “chirp” is heard.

The function of each switch depends on the current state of the instrument as indicated in the following table:

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State	Switch 1 (Tap)	Switch 1 (Hold 5+ seconds)	Switch 2 (Tap)	Switch 2 (Hold 5+ seconds)	Switch 1&2 (Hold 15+ seconds)
Warm-up	Enable Bluetooth Advertising	N/A	N/A	N/A	Factory Reset
Normal			N/A	N/A	
Low Alarm			Mute Buzzer	Acknowledge latched alarm	
High Alarm			Mute Buzzer	Acknowledge latched alarm	
Offline			N/A	N/A	
Fault			Mute Buzzer	Acknowledge latched fault	
Calibration Failed		N/A	N/A	Acknowledge failed calibration	
Bluetooth Advertising	Disable Bluetooth Advertising	N/A	N/A	N/A	

4.5 Reset System to Factory Default Settings

To reset system to factory defaults, hold both push buttons in the depressed position simultaneously for 30 seconds. To reset the system to factory default, hold both buttons in the depressed position simultaneously for 15 seconds. The device will beep 3 times. Instrument will restart to confirm factory reset. When a factory reset is conducted, the following parameters are reset to factory defaults:

- Product Configuration
- Low Alarm Set Points
- High Alarm Setpoints
- Modbus Settings
- Specific Relay Settings

4.6 MSA Bacharach X-Series Smartphone Application

To download the MSA Bacharach X-Series App, visit the App Store or Google Play Store on your mobile device. The mobile application can be searched and found under the name "X-Series Gas Detection." The companion smartphone application allows users to perform a variety of functions to configure and interact with the X-Series refrigerant monitor, including:

- View real-time measurements
- Configure the instrument
- Test outputs

- Calibrate / bump test instrument
- Generate customizable calibration certificates

If the mobile app is unavailable for download or bluetooth connection is not supported by a user's device, configuration may be equivalently completed through Modbus by reading and writing to eligible registers. See Modbus Manual for details (PN: 10254069).

4.6.1 Enable Bluetooth Connection

1. Enable Bluetooth® advertising by tapping the push button marked with the Bluetooth symbol (Switch #1). The LED indicator will begin flashing blue to indicate bluetooth advertising. Advertising will continue for 2 minutes before timing out if no device is connected.
2. Launch the MSA Bacharach X-Series App and click the "Connect" button at the bottom of the screen to initiate a scan.
3. Select the instrument from the list of available monitors. Each monitor in range that is advertising will identify itself with a model name and the last four digits of its serial number.

WARNING!

- Default alias and unlock code can be changed via the Bacharach X-Series App’s configuration menu.
- Default values should be changed after instrument installation for security purposes.

Failure to follow this warning can result in serious personal injury or death.

5 Care and Maintenance

5.1 Maintenance Intervals

The following maintenance activities are required.

Interval	Function
During Commissioning	Perform bump check or calibration to confirm instrument functionality.
	Check LEDs for proper operation.*
	Check for proper buzzer and relay operation.*
	Check signal transmission to the BMS/BAS (central controller) if connected.*
Periodic Maintenance Interval**	Inspection by trained service personnel.
	Check LEDs for proper operation.*
	Check for proper buzzer and relay operation.*
	Check signal transmission to the BMS/BAS (central controller) if connected.*
	Calibrate the sensor or contact MSA to purchase a factory-calibrated sensor.
As Required	Replace sensor module(s)

* Feature may be activated via Modbus commands or monitor X-Series App.

** Typical maintenance frequency may vary by sensor type.

Sensor Type	Maintenance Interval	Typical Sensor Lifetime (Individual sensor performance can vary based on specifics of sensor usage.)
Semiconductor*	6 months after commissioning 12 months thereafter	~5 years
Infrared	12 months	5+ years

* Sensors should be checked, calibrated, and potentially replaced after exposure to significant concentrations of gas, which can shorten the sensor lifetime and/or reduce its sensitivity.

5.2 Sensor Maintenance

⚠ WARNING!

- Follow proper ESD precautions when handling the printed circuit boards. This device uses semiconductors which can be damaged by electrostatic discharge.
- Remove power before opening, servicing and maintaining the monitor.

Failure to follow these warnings can result in serious personal injury or death.

5.2.1 Replacing the Sensor Module

The X-Series Refrigerant Monitors are compatible with pre-calibrated sensor modules which maintain the sensor's gas type and calibration information. To replace the refrigerant monitor's sensor module:

1. Power-down the refrigerant monitor.
2. Using a 5/32" (4mm) hex key / allen wrench (not included), loosen the faceplate screws and remove the lid.
3. Unplug the INTERNAL SENSOR connection from the main circuit board. See Connection 4 in 2.9.1 X30 PCB Layout and Components for X30 or Connection 5 in 2.9.2 X50 PCB Layout and Components for X50 models.

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4. Using a standard screwdriver head, carefully loosen the screws on the four corners of the PCB, including the one attached to the grounding lanyard. Set carefully to the side in a safe area.
5. Remove the installed sensor module from the lid by holding onto the housing and turning counter-clockwise 90°. Take care not to apply excessive force to the sensor module's circuit board. When the square tab of the sensor housing is aligned with the lock icon, firmly pull the module to remove it from the housing.
6. Install the new sensor module by aligning the square tab with the lock icon before firmly pressing it into the enclosure. Taking care not to apply excessive force to the sensor module's circuit board, rotate the sensor module clockwise 90° (or until the triangle icon aligns with the lock icon on the lid).
7. Feed the black wire from the sensor module through the PCBA opening and insert the connector into the INTERNAL SENSOR terminal. Replace the PCB. Then, tighten the four screws to secure it. Place the lid back onto the base and secure all service loops within the back box.
8. Tighten the lid using the supplied hardware in an "X" pattern. Tightening torque should be uniformly applied at 10 in-lbs or 1.13 Nm.
9. Power-up the refrigerant monitor.
10. After the start-up sequence has finished, check the sensor response with a bump test or full calibration to ensure functionality. If the sensor type has changed from the original selection, refer to the mobile app or modbus registers to modify the sensor configuration setting.

NOTE: For video instructions on how to replace a sensor module, consult MSASafety.com.

5.3 Troubleshooting

X30 & X50 Monitors are designed to communicate device and area status continuously after commissioning and with proper maintenance. If the unit behavior is not as expected or technical issues occur, please reach out to MSA Technical Support to seek additional information and troubleshooting support. Contact information for Customer Service and Technical Support is available on the MSA website.

5.3.1 Fault Codes

NOTE: If a sensor fault occurs during a gas alarm condition, then the fault overrides the alarm condition.

Sensor faults may be decoded using the detailed fault code table in the MODBUS MANUAL, available on MSASafety.com. Note that several faults may be reported at the same time. For example, fault code 0x0003 is a combination of fault codes 0x0001 (software fault) and 0x0002 sensor missing.

NOTE: If the "last fault" attribute indicates that a fault has occurred at some point in time, but the corresponding "current fault" attribute shows no fault, then the fault condition has resolved and no service action is required.

Table 6 Fault Code Examples

0x0400 (Modbus Fault)	0x0001	Modbus server fault	Error in setting new Modbus settings	Modbus settings updated	Send new Modbus settings Factory reset
0x4000 (Span Calibration Fault)	0x0001	Span Calibration Fault	Performing a span calibration failed Sensor does not contain a valid span calibration	Acknowledgment of failed calibration Sensor contains a valid span calibration	Acknowledge failed calibration Perform a successful span calibration

NOTE: Full table of X-Series Fault Codes can be found in the Modbus Manual P/N: 10254069

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5.4 Calibration Instructions

The MSA Bacharach X30 & X50 Monitors must be calibrated upon installation and during regular maintenance intervals. In the case where environmental conditions change, an additional calibration should be conducted.

NOTE: Never conduct a calibration with pure refrigerant gas. For R-Gases, calibration should be conducted with a minimum of 500 ppm calibration gas to a maximum of 1000 ppm concentration, balance of air. For CO2, calibration can be conducted between 50% and 90% of range.

NOTE: The semiconductor sensor requires humidity to successfully calibrate and cannot be calibrated with dry gas. The MSA calibration kit includes nafion tubing, which provides adequate humidity to calibrate the sample.

The Installation & Calibration Kit available for purchase includes a calibration cap, nafion tubing, tygon tubing, and other accessories to aid in conducting a successful calibration. A Regulator Kit (0.3 LPM) is also available for purchase.

To conduct a calibration, connect to the device via Bluetooth™ and the mobile app:

1. Identify which sensor channel is intended for calibration and select it. Initiate the calibration procedure for the selected sensor by pressing the "Calibrate" button. Enter all relevant information regarding the concentration of calibration gas being used.
2. Begin zero calibration with no gas present in the environment. Allow the zero calibration to complete.
3. Attach the calibration cup by pressing firmly onto the sensor face.
4. Initiate flow of calibration gas by turning the regulator to 0.3 LPM.
5. Begin the Span Calibration and allow the calibration to proceed. Step-by-step instructions and visual aids will appear on the mobile app.

After calibration, the unit may enter an alarm or fault state if the wrong gas type or concentration of gas is applied. To resolve, initiate another calibration with the correct gas. If calibration does not pass, consult troubleshooting methods or contact Technical Support.

5.5 Cleaning the Instrument

Clean the monitor with a soft cloth using water. Inspect the monitor periodically and clean to prevent buildup of ice, dust, dirt, or debris.

NOTE: Do not use any alcohols, cleaning agents, sprays, polishes, detergents, etc, as these may interfere with the readings of the sensor.

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6 Additional Information

6.1 Sensor Principle

6.1.1 Semiconductor Sensors

Semiconductor or metallic oxide sensors (MOSs) are among the most versatile of all broad-range sensors. They can be used to detect a variety of gases and vapors in low ppm or even combustible ranges. The sensor is made up of a mixture of metallic oxides. They are heated to a temperature between 150º and 300º C depending on the gas(es) to be detected. The temperature of operation as well as the “recipe” of mixed oxides determines the sensor selectivity to various toxic gases, vapors, and refrigerants. Electrical conductivity greatly increases as soon as a diffusion process allows the gas or vapor molecules to come in contact with the sensor surface. Water vapor, high ambient humidity, temperature fluctuations, and low oxygen levels can result in higher readings.

⚠ WARNING!

Certain substances in the environment to be monitored may impair the sensitivity of the sensors or influence readings:

- Materials containing silicone or silicone rubber/putty
- Corrosive gases such as hydrogen sulfide, sulfur oxide, chlorine, hydrogen chloride, etc.
- Alkaline metals, salt water spray.
- Aerosols with propellant.
- Cleaning agents and disinfectants.

Failure to follow these warnings can result in serious personal injury or death.

6.1.2 Infrared Sensors

The infrared (IR) gas sensor is designed to measure the concentration of combustible gases and vapors in the ambient air. The sensor principle is based on the concentration-dependent absorption of infrared radiation in measured gases.

The monitored ambient air diffuses through a sintered metal material into the enclosure of an optical “bench”. The broadband light emitted by an IR source passes through the gas in the optical bench and is reflected by the walls from where it is directed towards a dual-element detector. One channel of the detector measures the gas-dependent light transmission, while the other channel is used as a reference. The ratio between measurement and reference signal is used to determine the gas concentration. Internal electronics and software calculate the concentration and produce an output signal.

6.2 Ingress Protection Ratings

With installation of suitably rated cable glands or conduit fittings, X10, X30, and X50 devices are capable of maintaining an IP66 or NEMA Type 4 ingress protection rating.

IP66 devices are certified to be dust-tight and protect against powerful water jets in any direction.

NEMA Type 4 enclosure certification protects against the ingress of windblown dust, rain, splashing water, and hose-directed water.

6.3 Sensor Specifications

NOTE: Additional sensor specification details can be found on the X30 & X50 Sensor Specification Datasheet which can be found on MSASafety.com.

Sensor Information	Semi-Conductor (SC)	Infrared (IR)
Sensor Life (Typical)	~5 years	5+ years
Temperature Range	-40º to 50º C	-40º to 50º C
	-40º to 122º F	-40º to 122º F

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6.3.1 Refrigerant Gas List

Refrigerant gases are monitored using a Broadband group structure for HCFC, HFC, HFO, and HC refrigerant gases using the MOS sensor. Each group has a base gas listed to which the device is factory calibrated. Each gas listed in the group can be monitored in this state. In order to achieve a higher degree of accuracy, the user can initiate a field calibration with the target gas at any time.

Similarly, annual calibrations that are recommended for maintenance can be conducted using the base or target gas

Refrigerant gases are monitored by a metal oxide semiconductor sensor, which has been factory calibrated to one of three base gases.

Group 1

- Base gas: R448A
- Target gases: R290, R32, R410A, R449A, R455A

Group 2

- Base gas: R407A
- Target gases: R1234yf, R1234ze(E), R404A, R407C, R507A, R513A, R515B

Group 3

- Base gas: R454B
- Target gases: R454A, R454C, R1233zd(E)

Group 4

- Base gas: R134a
- Target gases: R134a

NOTE: If the device is installed at higher ambient temperatures (30°C - 50°C), a calibration must be completed upon installation and during maintenance. Warmer temperatures may result in gas readings indicating higher-than-expected values (early side warning).

6.3.2 R-744 (Carbon Dioxide) Gas Monitoring

The specifications below apply to all Carbon Dioxide (R744) non-dispersive infrared sensors within the product:

- Range(s):
  - 5,000 ppm
  - 10,000 ppm
  - 20,000 ppm
- Default Warning Level Settings: 50% and 90% of range (adjustable)
- Maximum Warning Level Setpoint: Varies by range
- Minimum Warning Level Setpoint: Varies by range

7 Order Information

7.1 Part Numbers

Gas	Range	Type	X10 Remote Sensor	X30	X50	Replacement Sensor Module
Broadband R-Gas Group 1	1,000 ppm	SC	10254042	10254040	10254037	10254046
Broadband R-Gas Group 2	1,000 ppm	SC	10254156	10254151	10254034	10254161
Broadband R-Gas Group 3	1,000 ppm	SC	10254157	10254152	10254035	10254162
Broadband R-Gas Group 4	1,000 ppm	SC	10254158	10254153	10254036	10254163
CO_2	5,000 ppm	IR	10254043	10254041	10254038	10254049
CO_2	10,000 ppm	IR	10254159	10254154	10254149	10254164
CO_2	20,000 ppm	IR	10254160	10254155	10254150	10254165

7.1.1 Bacharach X-Series Accessories

The following accessories are available for purchase and use with X-Series Refrigerant Monitors

Description	Part Numbers
X50 Refrigerant Monitor, Base Only (No Local Sensor)	10254039
X50 Plastic Puck, Local Sensor Placeholder	10254031
0.3 LPM Regulator Kit	H0051-3285
Installation and Calibration Kit	See HVAC-R Price List

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