BACHARACH

MGS-400

Fixed Gas Detectors

for Safety Compliance Applications

Refrigerant Leak Detection

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User Manual

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1. Introduction

1.1 About this Manual

Thank you for investing in a Bacharach MGS-400 gas detector. To ensure operator safety and the proper use of the gas detector, please read the contents of this manual for important information on the operation and maintenance of the instrument.

1.2 Conventions

1.2.1 Short Form Instructions

This document uses a short form for describing steps *(e.g. executing a command)*.

Example:

Accessing sensor calibration.

Short Form Instructions:

To select access sensor calibration: Home Tab → Calibrate → enter Unlock Code

Steps Required:

1. Open the Home Tab.
2. Select Calibrate.
3. When prompted, enter the Unlock Code to access calibration screen.

1.2.2 Iconography

Alert	Icon	Description
Danger		Imminently hazardous situation which, if not avoided, will result in death or serious injury.
Warning		Potentially hazardous situation which, if not avoided, could result in death or serious injury.
Warning		Potential electrical shock hazard which, if not avoided, could result in death or serious injury.
Caution		Potentially hazardous situation which, if not avoided, could result in physical injury or damage to the product or environment. It may also be used to alert against unsafe practices.
Important		Additional information on how to use the product.

1.3 General Safety Statements

	**IMPORTANT:** 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.
	**DANGER:** This instrument is neither certified nor approved for operation in oxygen-enriched atmospheres. Failure to comply may result in personal injury or death.
	**WARNING:** Use this product only for the purposes specified in this document and under the conditions listed.
	**WARNING:** This instrument has not been designed to be intrinsically safe for use in areas classified as being hazardous locations. For your safety, DO NOT use it in hazardous *(classified)* locations.
	**WARNING:** In the event of an alarm or over-range condition, the sensor must be recalibrated to ensure continued accuracy.
	**WARNING:** This product must be recalibrated if installed in a non-room condition environment *(i.e. temperature or humidity extremes)*.
	**WARNING:** The gas diffusion path can become occluded *(moisture, dust, debris, frozen condensation)* over time resulting in reduced or complete lack of gas detection and alarming function. Routine visual inspection of the gas detector and bump testing are suggested to ensure proper gas detection and alarm function.
	**CAUTION:** Except for maintenance detailed in this manual, these products should only be opened and / or serviced by authorized Bacharach personnel. Failure to comply may void the warrant.
	**CAUTION:** Operator assumes responsibility for complying with all laws, rules and regulations governing the use of this product.
	**CAUTION:** Use only genuine Bacharach parts and accessories. Failure to comply may impair the operation of the product and / or void the warranty.
	**CAUTION:** Only operate the product within the framework of a risk-based alarm signaling concept.

1.4 Safe Connection of Electrical Devices

WARNING: Before connecting this instrument to electrical devices not mentioned in this manual, consult the manufacturer or a qualified professional. Failure to comply may result in injury and / or damage to the product.

2. Product Descriptions

2.1 Intended Uses / Applications

MGS-400 gas detectors are to be installed in non-classified, non-hazardous, permanent locations for the purpose of continuously monitoring ambient air *(indoor or outdoor)* for the following gas types:

- Refrigerants
- Oxygen
- Toxic and combustible gases

WARNING: This instrument is neither certified nor approved for operation in oxygen-enriched atmospheres. Failure to comply may result in EXPLOSION.

WARNING: This instrument has not been designed to be intrinsically safe for use in areas classified as being hazardous locations. For your safety, DO NOT use it in hazardous *(classified)* locations.

2.2 Transmitter Construction

MGS-400 gas detectors may be purchased in the following configurations:

	MGS-410	MGS-450	MGS-450	MGS-460
Enclosure	IP66	IP41	IP66	IP66
Relays	-	3	3	3
Communication	Modbus	Modbus	Modbus	Modbus
Output	-	Analog	Analog	Analog
Sensor	Integrated	Integrated	Integrated	Remote

2.3 Power Options

MGS-400 gas detectors may use the following power options:

- 24 VAC
- 19.5 to 28.5 VDC

2.4 Diagnostic / Status LED

MGS-400 gas detectors feature a three-color LED *(green, orange and red)* which are used, in combination with an audible alarm, to communicate the status of the instrument.

2.5 Configurable Output Signals

MGS-400 gas detectors may be connected to a Bacharach's MGS-408 Gas Detection Controller or a third-party device capable of accepting digital and/or analog outputs from the gas detectors, such as a Building Management System *(BMS)* or Programmable Logic Controller *(PLC)*. With the integrated audio-visual alarm indication, an instrument can be operated as a stand-alone unit *(with additional local alarm signaling as required)*. Configurable output signal options include the following:

- MGS-410, MGS-450, MGS-460 – Digital Output *(Modbus RTU signal)*
- MGS-450, MGS-460 – 3× Relays *(high alarm / low alarm / fault)*
- MGS-450, MGS-460 – 1× Analog Output *(4 to 20 mA, 0 to 5 V, 0 to 10 V, 1 to 5 V, 2 to 10 V)*

2.6 User Interface

MGS-400 gas detectors allow users to interface directly with the instrument via the following:

- Bluetooth® Communication *(MGS-400 App allows users to configure the gas detector, initiate calibration, bump test / functional test modes and view status information.)*
- Tactile / Magnetic Switches *(A non-intrusive magnetic wand allows users to initiate calibration of the device.)*

2.7 Technical Specifications

Category		Specifications
Signals to Central Controller	Analog Current	Normal operation:..... 4 to 20 mA
		Drift below zero:..... 3.8 mA
		Measuring range exceeded:..... 20.5 mA
		Instrument fault:..... ≤ 1.2 mA
		Fault on analog interface:..... > 21 mA
		Offline mode/Maintenance signal:..... 3 mA steady signal

Signals to Central Controller	Analog Voltage	0 to 5V; 1 to 5V; 0 to 10V; 2 to 10V *(selectable)*. During fault condition, 1 to 5V and 2 to 10V outputs are 0V.
	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	19.5 to 28.5 VDC; 24 VAC ± 20%, 50/60 Hz
	Inrush Current	1.5 A
	Operating Current, Max.	MGS-410: 2W, 85mA @ 24VDC MGS-450/60: 4W, 170mA @ 24VDC
	Relay Rating	3 SPDT 1A at 30 VAC/VDC, resistive load
	Audible Alarm	Internal Buzzer ≥72 dB at 4" *(10 cm)*
	Alarm Delay	0 to 15 minutes *(selectable)*
Wiring	Power and Analog Signal	2-core shielded cable, 16 to 20 AWG *(0.5 to 1.5 mm^2)*
	Modbus Network	3-core, 2 twisted pair + ground, shielded cable with 120 Ω characteristic impedance, 16 to 24 AWG *(0.2 to 1.5 mm^2)*.
	Cable Gland	M20, 10-14mm cable outer diameter M16, 4-8mm cable outer diameter

Physical Specifications	Enclosure Protection	IP41 / IP66
	Enclosure Size *(W×H×D) (Approx.)*	MGS-410: 5.1×5.1×2.7” *(130×130×68 mm)* MGS-450 IP41: 6.5× 6.5×3.0” *(165×165×77 mm)* MGS-450 IP66: 6.5×6.5×3.4” *(165×165×87 mm)* MGS-460: 6.5×6.5×3.4” *(165×165×87 mm)* MGS-460 Remote: 4.5× 5.4×2.7” *(115×136×68 mm)*
	Weight *(Approx.)*	MGS-410: 9.2oz *(260 g)* MGS-450: 1lb, 1oz *(480 g)* MGS-460: 1lb, 11.7oz *(758 g)*
Environmental	Temperature	- 40 to 120 ºF *(-40 to 50 ºC)*
	Storage Temperature	- 5 to 100 ºF *(-20 to 40 ºC)*
	Humidity	5 to 90 %RH, non-condensing *(15 to 90 %RH, non-condensing, EC sensors excl. O_2)*
	Pressure	23.6 to 32.5 inch Hg / 800 to 1,100 mbar
	Elevation	0 to 10,000 ft. *(3,050 m)* altitude
	Sensors	See Section 6.3 for sensor specifications.
	Influences	For influences on the measurement performance and restrictions of a particular sensor see sensor data sheet.
Agency Approvals	CE, EN 50270:2015, UL/CSA/IEC/EN 61010-1	

2.8 Components

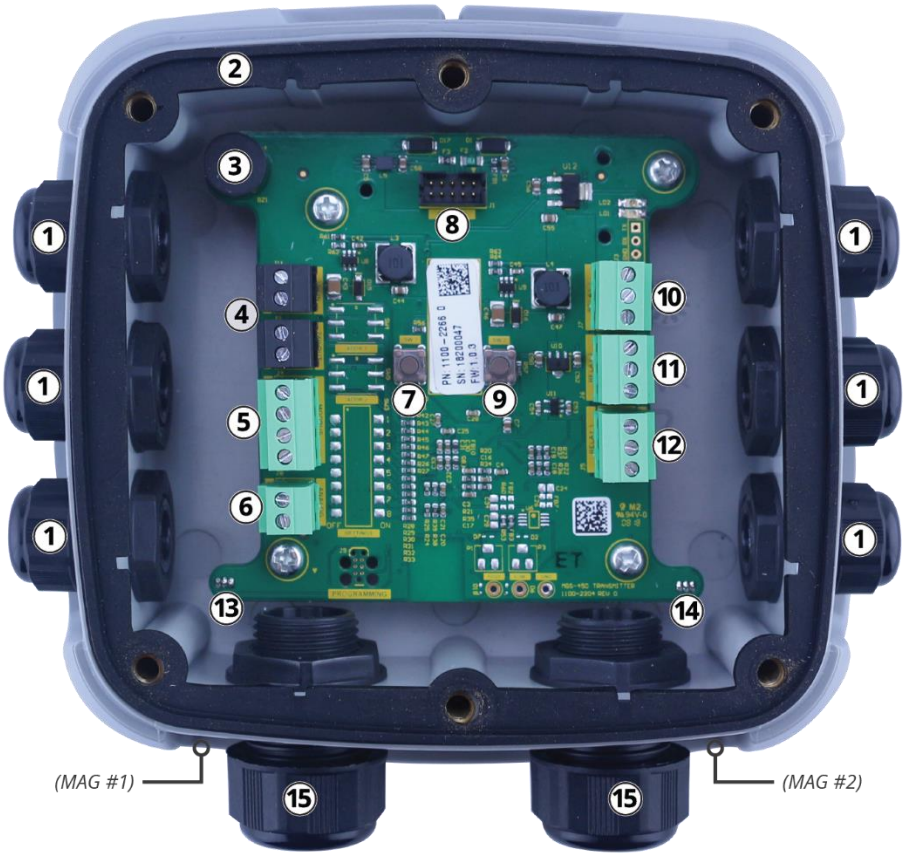
CAUTION: This product uses semiconductors which can be damaged by electrostatic discharge *(ESD)*. When handling the printed circuit boards *(PCBs)*, observe proper ESD precautions so that the electronics are not damaged.

2.8.1 MGS-410 Components

#	Component Description
1	M16 Cable Glands *(×4)*
2	Rubber Gasket
3	Digital Connection / Modbus *(In)*
4	Digital Connection / Modbus *(Out)*
5	Tactile Switch #1
6	Tactile Switch #2

#	Component Description
7	Ribbon Cable Connection *(To Sensor)*
8	Power Connection *(In)*
9	Internal Alarm Buzzer
10	Power Connection *(Out)*
11	Magnetic Switch #1
12	Magnetic Switch #2

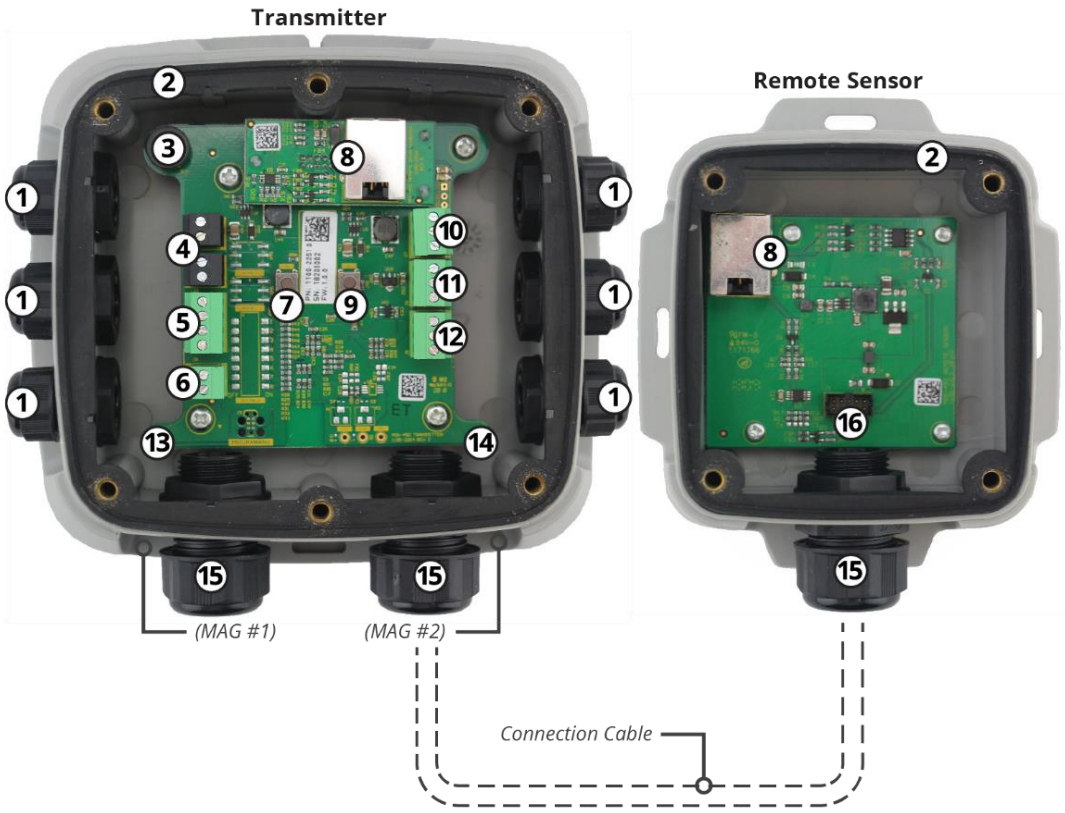
2.8.2 MGS-450 Components



#	Component Description
1	M16 Cable Glands *(×6)*
2	Rubber Gasket *(IP66 Version Only)*
3	Internal Alarm Buzzer
4	Power Connections *(×2)*
5	Digital Connection *(Modbus)*
6	Analog Connection
7	Tactile Switch #1
8	Ribbon Cable Connection *(To Sensor)*

#	Component Description
9	Tactile Switch #2
10	Relay 3 Connection *(FAULT)*
11	Relay 2 Connection *(HIGH)*
12	Relay 1 Connection *(LOW)*
13	Magnetic Switch #1
14	Magnetic Switch #2
15	M20 Cable Glands *(×2)*

2.8.3 MGS-460 Components



#	Component Description
1	M16 Cable Glands *(×6)*
2	Rubber Gasket *(×2)*
3	Internal Alarm Buzzer
4	Power Connections *(×2)*
5	Digital Connection *(Modbus)*
6	Analog Connection
7	Tactile Switch #1
8	RJ45 Connects *(×2)*

#	Component Description
9	Tactile Switch #2
10	Relay 3 Connection *(FAULT)*
11	Relay 2 Connection *(HIGH)*
12	Relay 1 Connection *(LOW)*
13	Magnetic Switch #1
14	Magnetic Switch #2
15	M20 Cable Glands *(×3)*
16	Ribbon Cable Connection *(To Sensor)*

3. Installation

IMPORTANT: The manufacturer of this product requires that a bump test or calibration be performed following installation to verify instrument functionality.

3.1 General Information

Installation site selection is critical to ensuring system performance and effectiveness. Strict compliance and considerable thought must be given to every detail of the installation process, including, but not limited to the following:

- Regulations as well as local, state, and national 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 detected
- The specifics of the application *(e.g., possible leaks, air movement/draft, 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
- Wiring details, including:

	MGS-410	MGS-450	MGS-460
M16 Cable Glands (4-8mm cable diameter)	4	6	6
M20 Cable Glands (10-14mm cable diameter)	-	2	1

- Secondary circuit must be supplied from an isolating source
- 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 should be used
- 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.).*

3.2 Restrictions

The installation location must have appropriate supply power available for the instrument *(i.e., 19.5 to 28.5 VDC or 24 VAC)*. This ultimately determines the distance the instrument can be mounted from the controller or power supply.

3.3 Mechanical Installation

WARNING: DO NOT allow the lid / sensor to hang from the ribbon cable. Failure to comply may result in damage to the product.

1. Using the provided hardware, securely mount the MGS-400 gas detector according to the product dimensions, maximum wiring lengths and following considerations:
    a. Environment: the full range of environmental conditions when selecting a location.
    b. Application: the specifics of the application *(possible leaks, air movement / draft, etc.)* when selecting a location.
    c. Accessibility: the degree of accessibility required for maintenance purposes when selecting a location.
    d. Target Gas: the specific gravity of the target gas when selecting the height of the instrument.
2. Using a 5/32″ *(4 mm)* hex key / allen wrench *(not included)* remove the lid and disconnect the ribbon cable from the base.
3. Set the lid and rubber gasket *(IP66-rated enclosures only)* aside to be reinstalled later.

3.4 Electrical Installation

3.4.1 Preparations

IMPORTANT: If analog output is configured for 4 to 20 mA output, ensure that the current loop is connected to a sinking current loop monitor before powering on the instrument. Otherwise, a fault may be displayed indicating an open loop condition. If analog output is unused, ensure it is configured as a voltage output *(default: 1-5V)* to prevent an open loop fault condition. The analog output is designed as sourcing.

CAUTION: Ensure wiring for relays and connections for sensor*(s)* are made before applying power.

CAUTION: This product uses semiconductors which can be damaged by electrostatic discharge *(ESD)*. When handling the printed circuit boards *(PCBs)*, observe proper ESD precautions so that the electronics are not damaged.

3.4.2 Power & Signal Wiring

1. Locate the relevant connections *(Power, Analog, Modbus)* and remove the terminal block from the PCBA. *(The PCB terminal blocks are pluggable type and may be removed to aid termination.)*

Connection	Description	Label	Wiring Termination
Power	24 VDC/VAC IN	24V IN: -	24 VDC/VAC neutral / ground
		24V IN: +	24 VDC positive / VAC live
	24 VDC/VAC OUT *(power daisy chain terminal)*	24V OUT: -	24 VDC/VAC neutral / ground
		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 ground
		ANALOG: +	Analog output signal *(+)*

2. Remove plugs from the corresponding M16 cable glands.
    - The product comes with cable glands and plugs pre-installed. *(The power entry cable gland is shipped from the factory without a plug.)*
3. Using the appropriate cable glands, insert wires into the enclosure.
4. Secure the wires in each terminal block and, pressing firmly, reinstall the terminal block into the PCBA.
    - Polarity must not be reversed.
    - 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.

3.4.3 Relay Wiring

WARNING: Relays are rated for 0 to 30V AC/DC. DO NOT apply mains power onto these relays.

1. Locate the relevant connections *(Relay 1, Relay 2, Relay 3)* and remove the terminal block from the PCBA.

Relay	Function
1	Low Alarm
2	High Alarm
3	Fault Alarm

2. Remove plugs from the corresponding M16 cable glands.
3. Using the appropriate cable glands, insert wires into the enclosure.
4. Secure the wires in each terminal block and, pressing firmly, reinstall the terminal block into the PCBA.
5. Remove all excess cable from the housing before securing the cable glands.

When configured according to the factory default settings, the relays are de-energized during normal operation *(not fail-safe)*. Fail-safe mode can be configured. 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

3.4.4 Installation of Remote Sensing Head

IMPORTANT: Non standard cable lengths less than 5 meters may be used. Where non standard remote cables are used these must be shielded to comply with EMI regulations.

IMPORTANT: Remote sensor is automatically recognized and registered by the instrument after a power cycle.

The MGS-460 features a remote sensor, which allows users to detect the presence of gases in inaccessible locations. Standard RJ45 “Cat 5E STP” Ethernet cable up to 5 meters long *(included)* may be used with the remote sensor.

1. Remove the bottom right M20 cable gland plug and gland cap, and carefully remove the gland rubber insert. *(The rubber insert is split to allow it to be installed around the provided RJ45 cable.)*
2. Slip the cable gland nut over one end of the terminated RJ45 cable.
3. Apply the split rubber insert onto the cable so that it is between the gland nut and the end of the cable.
4. Feed the RJ45 connector through a cable gland and into the enclosure, taking care to not damage the PCB.
5. Remove all excess cable from the housing before securing the cable gland. *(Confirm that the RJ45 cable is not binding or stressing the PCB terminal block.)*
6. Plug the RJ45 connector into the provided RJ45 socket.

3.4.5 Connecting to MGS-408 Gas Detection Controller

For wiring and configuration information, please refer to the manual which is included with the MGS-408 *(P/N: 1100-2295)*.

- 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.)*.
- For 24 VDC installations, the input is protected. If the polarity is reversed, the instrument will not power-up.
- For 24 VAC installations in daisy-chain, the neutral polarity must be maintained for all instruments.

3.4.6 Modbus RTU RS-485 Interface

For the Modbus RS-485 network use a 16 to 24 AWG *(0.2 to 1.5 mm^2)* 3-core, 2 twisted pair + ground, shielded cable with 120 Ω characteristic impedance. *(Recommended: Belden 3106A or equivalent.)*

The Modbus address, baud rate, stop bit, parity and slave termination is configured through the setup menu. No jumpers or hardware switch settings are required.

Ensure that the communication parameters within the network, including the Building Management System, are configured identically.

To ensure optimal performance of the Modbus network, ensure the following guidelines are implemented:

- Instruments are configured in a single bus topology, connecting multiple buses in parallel or branching multiple units from the main bus, may introduce impedance mismatches, reflections and/or signal distortions.
- Avoid long stubs when connecting instruments to the bus *(stubs should be less than 1 meter in length)*.

- Instruments at end of bus have 120Ω terminating resistor enabled. Terminating resistors may be enabled via the MGS-400 App *(refer to Section 4.2.3.6 for more information)*.
- A/B signal polarity is maintained throughout RS-485 network.
- Connect cable shield drain to physical earth or ground at the controller only.
- Connect cable shield drain to *(SH)* terminal at instrument.
- Cable shield integrity is maintained throughout RS-485 network.
- Do not use shield connection for signal ground. Use cable that provides dedicated ground conductor for signal ground. Connect signal ground to *(GND)* terminal of instrument.

3.4.7 Confirming Instrument Functionality

After all wiring has been completed, power the transmitter and perform a calibration / bump test to verify instrument functionality:

1. Switch power on.
2. Allowing the instrument to complete its start-up sequence and the sensor to stabilize.
3. Perform a calibration or bump test to confirm instrument functionality. *(For instructions on performing a calibration or bump test, see Section 5.2.)*
4. After verifying instrument functionality, reinstall the enclosure lid.
    - Reinstall the rubber gasket in the transmitter and / or remote sensor. Ensure that it is seated correctly before replacing lid. *(Note that the IP41-rated configurations do not include a rubber gasket.)*
    - Using a 5/32″ *(4 mm)* hex key / allen wrench *(not included)* tighten the lid screws in an “X” tightening pattern. *(Tightening torque should be limited to hand tight, and should be uniform.)*

4. Operation

4.1 Overview of Normal Operation

WARNING: Before leaving the instrument for normal operation, check the configuration for proper settings and check calibration.

4.1.1 Applying Power & the 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 and warm-up phase:
    - Green LED will blink at 0.5 HZ for about 5 minutes.
    - Modbus flag for warm-up is set.
    - Buzzer is off.
    - Relay state is “no alarm.”
    - Gas reading is invalid.
3. Observe normal operation:
    - Green LED is steady on.
    - Modbus flag for warm-up is cleared.
    - Buzzer is off.
    - Relay state is “no alarm.”
    - Gas reading is valid.

4.1.2 Verifying Analog Signals

MGS-450 / 460 gas detectors feature a single configurable analog output. 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	0-5V	2-10V	0-10V	4-20mA
0%	1V	0V	2V	0V	4 mA
50%	3V	2.5V	6V	5V	12 mA
100%	5V	5V	10V	10V	20 mA

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

Mode of Operation	1-5V	0-5V	2-10V	0-10V	4-20mA
Instrument Fault	≤ 0.3V	N/A	≤ 0.6V	N/A	≤ 1.2 mA
Offline Mode / Maintenance	0.75V	N/A	1.5V	N/A	3 mA
Drift Below Zero	0.95V	N/A	1.9V	N/A	3.8 mA
Normal Operation	1-5V	0-5V	2-10V	0-10V	4-20 mA
Measuring Range Exceeded	5.12V	5.12V	10.25V	10.25V	20.5 mA
Fault on Analog Interface	> 5.25V	> 5.25V	> 10.5V	> 10.5V	> 21mA

4.1.3 Verifying the Modbus Signal

The MGS-400 gas detectors provide a Modbus RTU digital interface. All status messages and most parameters can be accessed and / or configured via the MGS-400 App *(Bluetooth® communications)* or via a Building Management *(Modbus network)*.

4.1.4 Status Indication

The MGS-400 gas detectors provide external indication of their current operational state via audible and visual feedback. *(MGS-450 / 460 gas detectors also provide relays outputs.)* Visual indication of the instrument status is provided by a single tri-color LED *(Green / Red / Orange)* as indicated below:

State	LED	Buzzer	Relay 1 *(LOW)*	Relay 2 *(HIGH)*	Relay 3 *(Fault)*
Warm-up			OFF	OFF	OFF
Normal			OFF	OFF	OFF
Low Alarm			ON	OFF	OFF
High Alarm			ON	ON	OFF
Offline			OFF	OFF	OFF
Fault			OFF	OFF	ON
Negative Gas Fault			OFF	OFF	ON
Zero Cal. Fault			OFF	OFF	OFF
Span Cal. Fault			OFF	OFF	OFF

4.1.5 Switch Functions

User interaction with the MGS-400 gas detector is accomplished through the use of two magnetic switches located on the bottom of each unit. To actuate a magnetic switch *(referred to as MAG#1 or MAG#2)*, apply the supplied magnetic wand *(P/N: 1100-1004)* to the relevant switch location as indicated below:

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

- To carry out a tap function, tap the relevant switch location for 1 second, until a single “chirp” is heard, remove wand to confirm a “TAP.”
- To carry out a hold function, do not remove the magnetic wand after the first chirp but continue to hold for >5 seconds, until a double “chirp” is heard, remove wand to confirm a “HOLD.”
- If either switch is held for >30s, a stuck switch fault will be indicated.

To interact with the instrument without use of the magnetic wand, two internal push button tactile switches may be used. Remove lid without removing ribbon cable to access. Internal switches TACT#1 and TACT#2 mirror the functions of MAG#1 and MAG#2.

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

State	Switch 1 (Tap)	Switch 1 (Hold)	Switch 2 (Tap)	Switch 2 (Hold)
Warm-up	Enable Bluetooth® Connectivity	-	Disable Bluetooth® Connectivity	-
Normal		Start Zero Calibration		Start Span Calibration
Low Alarm		Mute Buzzer		Ack. Latched Alarm
High Alarm		Mute Buzzer		Ack. Latched Alarm
Offline		-		-
Fault		Mute Buzzer		Ack. Latched Fault
Negative Gas Fault		Mute Buzzer		Start Zero Calibration
Zero Cal. Fault		Acknowledge Fault		-
Span Cal. Fault		-		Acknowledge Fault

4.1.6 Reset System to Factory Default Settings

To reset system to factory defaults, remove lid and hold TACT#1 and TACT#2 simultaneously for 30 seconds. Instrument will restart to confirm factory reset. Alternatively, see Section 4.2.3.4 “Reset to Factory Defaults”, for instructions on resetting instrument configuration via the MGS-400 App.

4.2 MGS-400 Smartphone Application

To download the MGS-400 App, visit www.mybacharach.com/apps. The companion smartphone application allows users to perform a variety of functions to configure and interact with the MGS-400 gas detector, including:

- View real-time measurements
- Configure instrument
- Test outputs
- Calibrate / bump test instrument
- Generate customizable calibration certificates

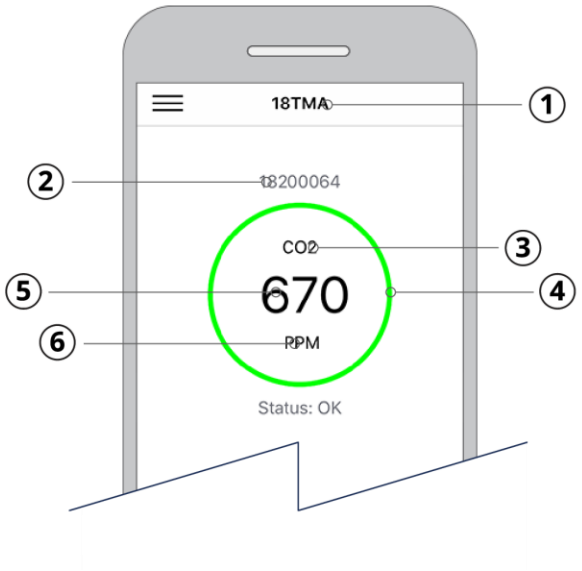
4.2.1 Enable Bluetooth® Connection

1. Enable Bluetooth® discovery by tapping MAG#1 for 1-second. *(After 10-seconds, device will indicate that it is discoverable with audible heartbeat until it has been paired, discovery has timed-out or has been cancelled.)*
2. Launch the MGS-400 App and click the Bluetooth® icon at the bottom of the screen to initiate a scan.
3. Select the instrument from the list of available Bacharach gas detectors.
    - MGS-410 default alias is “18TMA-DT”
    - MGS-450 / 460 default alias is “18TMA”
4. When prompted, enter the passkey *(default is “123456”)*.

WARNING: Default alias, passkey and unlock code can be changed via the MGS-400 App’s configuration menu. Default values should be changed after instrument installation for security purposes.

4.2.2 Checking Status

Current instrument status can be viewed from the Home tab, including the following:



#	Description
1	**Alias** - user configured instrument name
2	**Serial Number** - instrument 8 digit serial number
3	**Gas** - gas type currently detected by instrument
4	**Status Ring** - provides visual indication of various instrument states *(expanded on below)*
5	**Live Measurement** - current measurement in given measurement units
6	**Measurement Unit** - displayed measurement unit *(PPM / PPB / %LEL / %VOL)*

State	Status Ring	Description
Warm-up	Green	Gas detector stabilizing after power on or restart
Normal	Green	Normal operation
Low Alarm	Yellow	Gas measurement has exceeded low alarm setpoint
High Alarm	Red	Gas measurement has exceeded high alarm setpoint
Offline	Orange	Gas Detector in maintenance mode and is not actively monitoring gas
Fault	Orange	A fault has been detected
Negative Gas Fault	Orange	Gas detector calibration has drifted below zero, requires zero calibration
Zero Cal. Fault	Orange	Error occurred during zero calibration. Zero calibration has not be updated. Zero calibration required.
Span Cal. Fault	Orange	Error occurred during span calibration. Span calibration has not be updated. Span calibration required.

4.2.3 Instrument Configuration

For security, access to configuration and calibration options are restricted to authorized users only. Access to these functions require use of an unlock code. To unlock instrument configuration:

- Configure Tab → When prompted, enter unlock code to access device configuration. *(The instrument's default code is "1234")*. Instrument will remain unlocked until Bluetooth® connection has ended.

WARNING: Default alias, passkey and unlock code can be changed via the MGS-400 App's configuration menu. Default values should be changed after instrument installation for security purposes.

4.2.3.1 Change Alias

To allow easy identification of a given instrument, an alias can be assigned to each instrument. This alias is displayed when searching for an instrument via Bluetooth®, on calibration cert and in home tab. To set alias:

- Configure Tab → Alias, Enter required alias for instrument, select OK.
- Instrument must be restarted for change to take effect. Home Tab → Restart, will reboot device.
- Reconnect to instrument to confirm alias has been updated.

4.2.3.2 Change Unlock Code

To prevent unauthorized access to instrument configuration and calibration, default instrument unlock code should be changed during commissioning. To change unlock code:

- Configure Tab → Modbus Unlock Code, enter new 4-digit unlock code for instrument, select OK.
- Instrument must be restarted for change to take effect. Home Tab → Restart, will reboot device.
- Reconnect to instrument to confirm unlock code has been updated.

IMPORTANT: If custom unlock code is forgotten, unlock code may be reset to default value (1234) by resetting system to factory defaults. Refer to section 4.1.6 for system reset procedure. Note system reset will return all custom system configurations to defaults

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4.2.3.3 Change Bluetooth Passcode

To prevent unauthorized access to instrument status, default instrument Bluetooth® passcode code should be changed during commissioning. To change Bluetooth® passcode:

- Configure Tab → Bluetooth Passcode, enter new 6-digit passcode for instrument, select OK.

- Instrument must be restarted for change to take effect. Home Tab → Restart, will reboot device.
- Reconnect to instrument to confirm unlock code has been updated.

IMPORTANT: If custom passcode is forgotten, unlock code may be reset to default value *(123456)* by resetting system to factory defaults. Refer to section 4.1.6 for system reset procedure. Note system reset will return all custom system configurations to defaults.

4.2.3.4 Reset to factory defaults

Instrument configuration may be reset to factory defaults via the smartphone application:

- Configure Tab → Reset to factory default, select OK to confirm.
- Instrument will automatically restart and disconnect from smartphone application.

WARNING: Resetting system to factory defaults will remove all custom system configuration including unlock code and Bluetooth passcode. After system reset custom unlock and Bluetooth passcodes should be configured to prevent unauthorized access and reconfiguration of instrument.

4.2.3.5 Alarm Configuration

Low Alarm Setpoint

Value above which a low alarm condition occurs. Low alarm setpoint must be less than the high alarm setpoint and greater than the low alarm limit. The low alarm limit is the fixed minimum limit that is sensor–specific and not editable.

Range of acceptable setpoints is displayed when updating parameter. To update setpoint:

- Configure Tab → Alarm → Low Alarm Setpoint, enter new setpoint, select OK to confirm.

IMPORTANT: In instruments with an oxygen sensor installed, low alarm behavior operates in a depletion mode where gas measurements BELOW the low alarm setpoint initiate a low alarm. This allows monitoring of oxygen displacement and enrichment scenarios.

IMPORTANT: To prevent intermittent alarm operation at the setpoint due to measurement noise this instrument implements hysteresis at the setpoint. Once the alarm level is exceeded, the gas measurement must return a fixed percentage below the alarm threshold before the alarm is disabled. Typical hysteresis value is set at 5% of full scale however this is sensor specific and non-editable.

High alarm Setpoint

Value above which a high alarm condition occurs. High alarm setpoint must be less than the sensor full scale range and greater than the low alarm setpoint.

Range of acceptable setpoints is displayed when updating parameter. To update setpoint:

- Configure Tab → Alarm → High Alarm Setpoint, enter new setpoint, select OK to confirm.

IMPORTANT: To prevent intermittent alarm operation at the setpoint due to measurement noise this instrument implements hysteresis at the setpoint. Once the alarm level is exceeded, the gas measurement must return a fixed percentage below the alarm threshold before the alarm is disabled. Typical hysteresis value is set at 5% of full scale however this is sensor specific and non-editable.

Alarm Latching

Enabling alarm latching will maintain alarm or fault condition even after the alarm or fault condition is no longer active. When latched, the alarm or fault condition must be manually acknowledged before the condition will be cleared. This allows transient alarm or fault conditions to be identified.

If an alarm is latched, i.e. the condition has occurred but is no longer active, an acknowledgement button will appear on the home screen. Select this button to acknowledge the latched condition and clear the alarm or fault.

When disabled the alarm or fault status clears automatically as soon as the condition is no longer active. To configure:

- Configure Tab → Alarm → Alarm Latching, select enable/disable, select OK to confirm

4.2.3.6 Modbus Configuration

Address

Sets instrument address for connection to RS-485 Modbus interface. *(Default: 1)*.

To set address:

- Configure Tab → Modbus → Address, select 1-247, select OK to confirm

IMPORTANT: Ensure all instruments on RS-485 bus have been configured with unique node addresses. If two instruments have been configured with same address, bus contention will occur preventing communications with these instruments via the RS-485 interface.

Baud Rate

Sets instrument baud rate for connection to RS-485 Modbus interface. *(Default: 9600 baud)* To set baud rate:

- Configure Tab → Modbus → Baud Rate, select 9600/19200, select OK to confirm

Stop Bits

Sets instrument stop bits for connection to RS-485 Modbus interface. *(Default: 1 stop bits)* To set number of stop bits:

- Configure Tab → Modbus → Stop Bits, select 1 or 2, select OK to confirm

Parity

Sets instrument parity for connection to RS-485 Modbus interface. *(Default: None)* To set parity:

- Configure Tab → Modbus → Parity, select None/Odd/Even, select OK to confirm

IMPORTANT: Stop bits must be set to 1 where parity is odd or even.

Enable 120Ω Termination

For optimal communication reliability, in RS-485 Modbus networks the last instrument physically connected to the RS-485 bus must include a 120Ω termination resistor. This is to reduce the potential for electrical signal reflection on long buses due to impedance mismatches.

Typically, this requires a physical resistor with the same characteristic impedance of the bus cable to be installed on the bus.

MGS-400 instruments include this termination resistor on all instruments and allow this termination to be enabled via this configuration setting without the need for an external physical resistors. To enable this termination resistor:

- Configure Tab → Modbus → Enable 120Ω Termination, select enable/disable, select OK to confirm

IMPORTANT: Termination resistor should only be enabled on last instrument physically connected to RS-485 bus. An external resistor should not be connected where this is enabled on the instrument.

4.2.3.7 Output Configuration

Analog Output Range

Sets instrument analog output range. Available ranges: 1-5V (Default), 0-5V, 0-10V, 2-10V, 4-20mA. To set range:

- Configure Tab → Outputs → Analog Output Range, select desired range, select OK to confirm

Buzzer

Enable or disable buzzer. Buzzer provides local audible alarm/fault indication. Buzzer is enabled by default. To enable/disable buzzer:

- Configure Tab → Outputs → Buzzer, select enable/disable, select OK to confirm

Relay Failsafe

Enable or disable Relay Failsafe operation. 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 in Section 3.4.3.

Relays are configured as non-failsafe by default. To enable/disable relay failsafe:

- Configure Tab → Outputs → Relay Failsafe, select enable/disable, select OK to confirm

Alarm Delay

Sets delay in minutes before instrument will indicate an alarm condition after low or high alarm threshold has been exceeded. May be used to prevent short transient alarm conditions from activating alarms. Alarm delays may be set for 0-15 minutes. Alarm delay is configured as 0 minutes by default. To set alarm delay:

- Configure Tab → Outputs → Alarm Delay, enter desired delay in minutes *(0-15)*, select OK to confirm.

Analog Zero Adjust

Analog zero adjust applies a fixed offset to the analog output. This allows removal of small errors in the output between the gas detection instrument and the measurement at the controller due to cable resistance when using voltage outputs.

NOTE: MGS-408 controller uses digital interface, this analog adjustment is only required where using third party controller using analog interface for gas concentration and status monitoring.

To apply adjustment ensure instrument is outputting fixed voltage (default 1V at zero ppm or use output test function to set specific voltage value), monitor remote measurement and adjust zero offset until remote measurement matches expected voltage output.

Adjustment is limited to ±10% full scale To set analog zero adjustment:

- Configure Tab → Outputs → Analog Zero Adjust, use slider to set desired offset adjustment.
- Alternatively, tap “Analog Zero Adjust (X.X%)” text and enter specific offset required *(-10 to 10)*

Analog Span Range

Analog span range scales the FSD *(full-scale deflection)* of the analog output. The selected range determines the equivalent gas measurement at the analog output maximum range.

Example: R134A 1000 ppm, 0-5V analog output. If Analog Span Range is set to 20%, the full analog output range only covers the first 20% of the gas measurement range, i.e 0-200 ppm will output 0-5V, above 200 ppm the output will be truncated to 5V.

Note, sensor resolution stays at the value for the max range.

Adjustment is limited to between 20%-100% FSD, Default is set to 100%. To set analog span range:

- Configure Tab → Outputs → Analog Span Range, use slider to set desired range
- Alternatively, tap “Analog Span Range (X.X%)” text and enter specific range required.

5. Care & Maintenance

5.1 Maintenance Intervals

Interval	Function
During Commissioning	Check calibration.
	Check LEDs for proper operation.*
	Check for proper buzzer and relay operation.*
	Check signal transmission to the BMS/BAS *(central controller)* if connected.*
Every 6-12 Months**	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 Bacharach for sensor exchange with factory- calibrated sensor.
As Required	Replace sensor module*(s)*

* Feature may be activated via Modbus commands or MGS-400 App.

** Typical maintenance frequency may vary by sensor type.

Sensor Type	Maintenance Interval	Typical Sensor Lifetime
Electrochemical *	12 months	2-3 years
Catalytic Bead	Zero calibration -1-3 months Span calibration - 6 months	5-7 years
Semiconductor*	6 months after commissioning 12 months thereafter	4-6 years
Infrared	12 months	5-7 years

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

5.2 Adjustments

5.2.1 Introduction

Adjustment of the detector must be performed at regular intervals as required by national standards or regulations *(e.g., EN 378, ASHRAE 15, BREEAM, etc.)*.

Breathing Hazard: Calibration gas MUST NOT be inhaled! See appropriate Safety Data Sheets. Calibration gas should be vented into a fume hood or to the outside of the building.

Zero First, Then Span: For proper operation, never adjust the span *before* completing a zero adjustment. Performing these operations out of order will cause faulty calibration.

IMPORTANT: Bacharach recommends calibrating detectors within the application-specific condition and with target gas. This method of zeroing the detector in the application environment and performing a target gas calibration is more accurate. A surrogate gas calibration may only be performed as an alternative if a target gas calibration is not possible.

IMPORTANT: The sensor should be fully stabilized *(at least 2 hours, preferably 24 hours).*

IMPORTANT: When entering the functions for zero or span adjustment, the detector will automatically enter OFFLINE mode, and will remain OFFLINE until either the OFFLINE mode is canceled by tapping the respective magnetic switch, or the OFFLINE mode times out within 6 minutes *(typical)* after the adjustment has ended.

5.2.2 General Calibration Procedure

WARNING: The MGS-400 Gas Detector MAY NOT be in an alarm or fault condition during calibration. Acknowledge any alarms or faults BEFORE attempting to begin the calibration process.

WARNING: Except for CO_2 or O_2 sensors, calibration gas must be in a balance of air, not nitrogen *(N_2)*.

IMPORTANT: Calibration and / or bump testing requires the MGS-400 calibration adapter kit *(P/N: 6302-9990)*.

IMPORTANT: At elevations higher than 6,560' *(2,000 m)*, calibration will result in a lower reading. Above 6,560', the instrument should be calibrated in the environment of operation.

1. Fit calibration adapter to the gas detector lid.
2. If using a variable flow regulator, adjust the gas flow to approximately 0.3 L/min.

5.2.3 Zero Adjustment

Ambient air can be used to zero the sensor instead of synthetic air only if the area is known to be free of the target gas or any gas to which the sensor may be cross-sensitive. In this case, no cylinder or calibration adapter is needed for the zero adjustment.

WARNING: The MGS-450 MAY NOT be in an alarm or fault condition during calibration. Acknowledge any alarms or faults BEFORE attempting to begin the calibration process.

WARNING: Except for CO_2 or O_2 sensors, ambient air may be used instead of zero gas if the area is know to be free of the target gas or any gases to which the sensor may be cross-sensitive.

IMPORTANT: Calibration and / or bump testing requires the MGS-400 calibration adapter kit *(P/N: 6302-9990)*.

1. Begin zero adjustment:
    a. MGS-400 App: Home Tab → Calibrate → scan barcode on gas cylinder or manually enter values for zero gas.
    b. Manual: hold MAG#1 for >5-seconds. The LED will blink green-green-red when the instrument is ready.
2. Apply zero gas *(or ambient air per warning above)*.
3. Confirm the start of calibration:
    a. MGS-400 App: press the Start Zero button.

b. Manual: tap MAG#1 within 30-seconds or the instrument will time-out and return to normal operation.

4. Complete zero adjustment:
   a. MGS-400 App: app will countdown to completion. If calibration is successful, proceed to Step 5. If calibration is unsuccessful, return to the Home screen and press the Acknowledge button to clear the zero calibration fault.
   b. Manual: the LED will blink green-red, green-red-red, green-red-red-red, etc. until calibration is complete. To abort, hold MAG#1 for >5-seconds, turn off gas flow and remove the calibration adapter. If calibration is successful *(green LED)*, proceed to Step 5. If calibration is unsuccessful *(LED blinks orange @ 2 Hz)*, tap MAG#1 to discard the calibration attempt.
5. Turn off gas flow from zero gas.
6. Replace zero gas with calibration gas in preparation for span adjustment.

5.2.4 Span Adjustment

WARNING: Except for CO_2 or O_2 sensors, calibration gas must be in a balance of air, not nitrogen *(N_2)*.

IMPORTANT: At elevations higher than 6,560' *(2,000 m)*, calibration will result in a lower reading. Above 6,560', the instrument should be calibrated in the environment of operation.

1. Begin span adjustment:
   a. MGS-400 App: scan barcode on gas cylinder or manually enter values for calibration gas.
   b. Manual: hold MAG#2 for >5-seconds. The LED will blink green-green-orange when the instrument is ready.
2. Apply calibration gas at the concentration listed on the calibration gas concentration label *(located on top of the instrument)*.
   - Part Number
   - Serial Number
   - Sensor Type
   - Maximum Range
3. Confirm the start of calibration:
   a. MGS-400 App: press the Start Span button.
   b. Manual: tap MAG#2 within 30-seconds or the instrument will time-out and return to normal operation.
4. Complete span adjustment:
   a. MGS-400 App: app will countdown to completion. If calibration is successful, proceed to Step 5. If calibration is unsuccessful, return to the Home screen and press the Acknowledge button to clear the span calibration fault.

b. Manual: the LED will blink green-orange, green-orange-orange, green-orange-orange-orange, etc. until calibration is complete. To abort, hold MAG#2 for >5-seconds, turn off gas flow and remove the calibration adapter. If calibration is successful *(LED blinks green-orange-red)*, proceed to Step 5. If calibration is unsuccessful *(LED blinks orange @ 2 Hz)*, tap MAG#2 to discard the calibration attempt.

5. Turn off gas flow from calibration gas and remove the calibration adapter.
6. Allow sensor to recover / stabilize before the instrument returns to normal operation *(green LED).*

5.2.5 System Bump Test

IMPORTANT: The manufacturer of this product requires that a bump test or calibration be performed following installation to verify instrument functionality.

A bump test is a live test of the system to verify that the detector responds to gas and all connected alarm devices, BMS, etc. are operating accordingly. It is recommended that all involved persons are informed about the test and certain alarms might have to be inhibited *(e.g., shutdown valves, notification of authorities, etc.).*

1. Connect adapter and gas cylinder according to the instructions in the General Calibration Procedure.
2. If desired, disable / silence external annunciators *(e.g., shutdown valves, notification of authorities, etc.)*:
    a. MGS-400 App: Home Tab → Calibrate → Bump → toggle TAKE OFFLINE to disable communications to external devices.
    b. Manual: Inform building personnel of test so that external devices can be disabled / silenced.
3. Apply a sufficiently high concentration of the target gas to trigger alarms, but NOT pure refrigerant or hydrocarbons *(e.g., do not use a butane lighter)*.
4. Once thresholds have been exceeded, relays should activate, digital outputs should transmit the gas concentration and:
    a. MGS-400 App: gas concentration should be displayed, the instrument status should be “LOW ALARM” or “HIGH ALARM” and alarms states should be “ON.”
    b. Manual: LED status should display “LOW ALARM” or “HIGH ALARM.”
5. Turn off gas flow and remove the calibration adapter.
6. Allow sensor to recover / stabilize before the instrument returns to normal operation *(green LED).*

5.3 Troubleshooting

5.3.1 Hexadecimal Format

All fault codes can be retrieved through the Modbus interface and are shown in hexadecimal *(hex)* format. A hex digit can represent multiple codes as shown below:

Hex Code	Equivalent Error Code(s)
0	0
1	1
2	2
3	1+2
4	4
5	1+4

Hex Code	Equivalent Error Code(s)
6	1+2+3
7	1+2+4
8	8
9	1+8
A	2+8
B	1+2+8

Hex Code	Equivalent Error Code(s)
D	1+4+8
E	2+4+8
F	1+2+4+8

5.3.3 Fault Codes

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

Sensor faults may be decoded using the following table. Note that several faults may be reported at the same time For example, fault code “00000003” is a combination of fault codes 00000001 *(No sensor signal)* and 00000002 *(Voltage out of specification 1V)*.

NOTICE: If a “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 problem has self-healed and no service action is required.

Fault Bit	System Fault	Possible Causes	Required Action(s)
0x00000001	Software fault	Firmware error (e.g. unexpected state)	**Power-cycle. If it re-occurs, call product support**
0x00000002	Voltage out of specification 1V	Voltage rail out of range	**Call product support**
0x00000004	Voltage out of specification 3.3V	Voltage rail out of range	
0x00000008	Voltage out of specification 5V	Voltage rail out of range	
0x00000010	Voltage out of specification 5.4V	Voltage rail out of range	
0x00000020	Voltage out of specification 12V	Voltage rail out of range	
0x00000040	Voltage out of specification VIN	Voltage rail out of range	
0x00000080	System Flash Memory Read Fault	Error reading from internal Flash	**Power-cycle. If it re-occurs, call product support**
0x00000100	System Flash Memory Write Fault	Error writing to internal Flash	
0x00000200	System Flash Memory CRC fault	Error in internal Flash CRC	
0x00000400	System Invalid Configuration	Error in system configuration	
0x00000800	GPIO fault	Error detected on GPIO pin	**Call product support**
0x00001000	Modbus Fault	Error detected in Modbus Communications	**Power-cycle. If it re-occurs, call product support**
0x00002000	Analog Output Fault (MGS-450 Only)	Error updating DAC value	
0x00004000	Bluetooth Fault	Error detected in Bluetooth module	
0x00008000	Stuck switch	Magnetic and/or Tactile switch activated for > 1 minute	**Call product support**
0x00010000	Sensor Element Out	Cannot detect sensor element	**Check sensor connection**
0x00020000	Sensor Element Fault	Fault detected in sensor element	**Replace sensor nodule**
0x00040000	Sensor ADC Sensor Read Fault	Cannot read from sensor ADC	**Check sensor connection/Replace Sensor Module**
0x00080000	Sensor ADC Current Read Fault	Cannot read from current ADC	
0x00100000	Sensor AFE Read Fault (EC only)	Cannot read from EC sensor AFE	
0x00200000	Sensor AFE Write Fault (EC only)	Cannot write to EC sensor AFE	
0x00400000	Sensor AFE Status Fault (EC only)	Error in EC sensor AFE	

0x00800000	Sensor EEPROM Read Fault	Error in reading from sensor EEPROM	**Power-cycle / check sensor connection / replace sensor module**
0x01000000	Sensor EEPROM Write Fault	Error in writing to sensor EEPROM	**Call product support**
0x02000000	Sensor EEPROM CRC Fault	Error in CRC from sensor EEPROM	**Power-cycle / replace sensor module**
0x04000000	Sensor EEPROM Configuration Fault	Error in sensor EEPROM data	**Replace sensor module**
0x08000000	Sensor UART Read Fault	Cannot read from sensor UART	**Check sensor connection / replace sensor module**
0x10000000	Sensor Temperature Fault	Temperature cannot be read or is out of specification	**Ensure sensor is operating within specified temperature range / check sensor connections**
0x20000000	Negative Gas Concentration Fault	Sensor output has drifted too negative	**Initiate zero calibration *(Via App / Hold MAG#2)***
0x40000000	Zero Calibration failure	Zero calibration failed	**Acknowledge failed calibration *(Via App / Hold MAG#1)***
0x80000000	Span Calibration failure	Span calibration failed	**Acknowledge failed calibration *(Via App / Hold MAG#2)***

5.4 Sensor Maintenance

CAUTION: This product uses semiconductors which can be damaged by electrostatic discharge *(ESD)*. When handling the PCB, care must be taken so that the electronics is not damaged.

5.4.1 Replacing the Sensor Module

MGS-400 gas detectors are compatible with pre-calibrated sensor modules which maintain the sensor's gas type and calibration information. To replace the gas detector's sensor module:

1. Power-down the gas detector.
2. Using a 5/32" *(4mm)* hex key / allen wrench *(not included)*, remove the lid and disconnect the ribbon cable from the sensor module.
3. Remove installed sensor module from 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.
4. 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).*
5. Connect the ribbon cable *(to the sensor module and transmitter)* and close the lid.

6. Ensure gasket is aligned correctly *(IP66 versions only)* and tighten the lid using the supplied hardware in an “X” pattern. Tightening torque should be limited to hand tight and should be uniform.
7. Power-up the gas detector.
8. After start-up sequence has finished, check sensor response *(bump test)*.

5.5 Cleaning the Instrument

Clean the detector with a soft cloth using water and a mild detergent. Rinse with water. Do not use any alcohols, cleaning agents, sprays, polishes, detergents, etc.

6. Additional Information

6.1 Sensor Principle

6.1.1 Electrochemical Sensors

Electrochemical sensors measure the partial pressure of gases under atmospheric conditions. The monitored ambient air diffuses through a membrane into the liquid electrolyte in the sensor. The electrolyte contains a measuring electrode, a counter-electrode and a reference electrode. An electronic “potentiostat” circuit ensures a constant electrical voltage between measuring electrode and reference electrode. Voltage, electrolyte, and electrode material are selected to suit the gas being monitored so that it is transformed electrochemically on the measuring electrode and a current flows through the sensor. This current is proportional to the gas concentration. At the same time, oxygen from the ambient air reacts at the counter electrode electrochemically. The current flowing through the sensor is amplified electronically, digitized and corrected for several parameters *(e.g., the ambient temperature)*.

6.1.2 Catalytic Bead Sensors

A catalytic bead sensor measures the partial pressure of combustible gases and vapors in ambient air. It uses the heat-of-combustion principle.

The monitored air diffuses through the sintered metal disc into the sensor. The mixture of combustible gases, vapors, and air are catalytically combusted at a heated detector element (called a *pellistor*). The oxygen content in the air must be greater than 12 Vol%. Due to the resulting heat-of-combustion, the temperature of the detector element rises. This increase in temperature causes a change of resistance in the detector element, which is proportional to the concentration of the mixture of combustible gases and vapors in the monitored air. In addition to the catalytically active detector element, there is a compensator element. Both elements are parts of a Wheatstone bridge. Thus environmental effects like changes in ambient temperature or humidity are almost entirely compensated.

IMPORTANT: Certain substances in the atmosphere to be monitored may impair the sensitivity of the sensors. Such substances include, but are not limited to:

- Polymerizing substances such as acrylonitrile, butadiene and styrene.
- Corrosive compounds such as halogenated hydrocarbons *(releasing halogens such as bromine, chlorine or fluorine when oxidized)* and halogen hydride acids as well as acidic gaseous compounds such as sulfur dioxide and nitrogen oxides.
- Catalyst poisons such as sulfurous and phosphorous compounds, silicon compounds *(especially silicones)*, and metal-organic vapors.

It may be necessary to check the calibration if the sensor has been exposed for a long time to a high concentration of flammable gases, vapors, or the above-mentioned contaminating substances.

The nature of catalytic bead sensor technology means that sensor drift may typically be up to ±5% LEL per month. Instruments using these sensors should be zeroed regularly following the instructions in section 5 of this manual.

6.1.3 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.

IMPORTANT: Certain substances in the environment to be monitored may impair the sensitivity of the sensors:

- Materials containing silicone or silicone rubber/putty
- Corrosive gases such as hydrogen sulfide, sulfur oxide, chlorine, hydrogen chloride, etc.
- Alkaline metals, salt water spray.

6.1.4 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 Disposing of the Instrument

6.2.1 Disposing of the Electrical & Electronic Equipment

EU-wide regulations governing the disposal of electrical and electronic appliances which have been defined in the EU Directive 2012/19/EU and in national laws have been effective since August 2012 and apply to this device.

Common household appliances can be disposed of using special collecting and recycling facilities. However, this device has not been registered for household usage. Therefore it must not be disposed of through these channels. The device can be returned to your national Bacharach Sales Organization for disposal. Please do not hesitate to contact Bacharach if you have any further questions on this issue.

6.2.2 Disposing of Sensors

Dispose of sensors in accordance with local laws.

DANGER: Do not dispose of sensors in fire due to the risk of explosion and resulting chemical burns.

WARNING: Do not force open electrochemical sensors.

WARNING: Observe the applicable local waste disposal regulations. For information, consult your local environmental agency, local government offices or appropriate waste disposal companies.

6.3 Sensor Specifications

Sensor Information	Electro-Chemical (EC)	Semi-Conductor (SC)	Catalytic Bead (CAT)	Infrared (IR)
Sensor Life (Typical)	2 to 3 years	5 to 8 years	5 years	5 years
Temperature Range	• **NH_3 100 / 1,000 ppm: -40 to 40° C** • **NH_3 5,000 ppm: -20 to 40° C** • **CO 500 ppm: -40 to 50° C** • **NO_2 20 ppm: -20 to 40° C** • **O_2 30% Volume: -20 to 50° C**	-40º to 50º C	-40º to 50º C	-40º to 50º C
	• **NH_3 100 / 1,000 ppm: -40 to 104° F** • **NH_3 5,000 ppm: -4 to 104° F** • **CO 500 ppm: -40 to 122° F** • **NO_2 20 ppm: -4 to 104° F** • **O_2 30% Volume: -4 to 50° F**	-40º to 122º F	-40º to 122º F	-40º to 122º F

6.4 Modbus Registers

IMPORTANT: If items span two registers *(e.g., 1005 and 1006)*, then the registers are “long” or “float” data types. Otherwise, the registers are integer data types or ASCII.

To unlock the Modbus registers:

- Write the correct unlock code to Modbus register 2100 to allow changes to be made to the system configuration. The unlock code is a 4 digit decimal value from 0000-9999 *(default “1234”).* System parameters which require the system be unlocked are indicated in the below table with a lock symbol *(🔒)*.

6.4.1 Integration - Dynamic Sensor Data

Input Register *(Function 04 Read)*

1094	Signed Raw Gas Concentration (PPM/PPB/VOL/LEL)	**Signed Raw Gas Concentration PPM or % VOL or % LEL - no thresholding; used for zero-calibration to see negative values**	32-bit signed Integer
1095			
1096	Signed Raw Gas Concentration (PPM)	**Signed Raw Gas Concentration PPM or % VOL or % LEL - no thresholding; used for zero-calibration to see negative values**	32-bit float
1097			
1098	Sensor Uptime	**Hours since last restart**	16-bit unsigned Integer
1099	Offline Mode Status	**Offline mode status**	
1100	Concentration % FS (0-100)	**Gas concentration in % full-scale**	
1101	Concentration (PPM/PPB/VOL/LEL)	**Concentration in display units**	
1102	Concentration PPM	**Signed Raw Gas Concentration PPM or % VOL or % LEL - no thresholding; used for zero-calibration to see negative values**	32-bit signed Integer
1103			
1104	Sensor Burning Hours	**Hours since last calibration**	16-bit unsigned Integer
1105	PPM Hours	**Accumulated PPM Hours since sensor manufacture (100ppm for 2 hours = 200ppm hours)**	32-bit unsigned Integer
1106			
1107	Temperature (°C)	**Current sensor temperature sensor reading (°C)**	16-bit signed Integer
1108	Fault Code	**Bit packed sensor fault flags currently active (see faults sheet for details of flags)**	32-bit unsigned Integer
1109			
1110	Last Sensor Fault Code	**Sticky faults as above but fault bits remain set after clearing to catch transient faults**	16-bit unsigned Integer
1111	Last System Fault Code	**Sticky faults as above but fault bits remain set after clearing to catch transient faults**	
1112	Calibration Expired Flag	**Calibration expired flag, when set sensor needs recalibration**	Boolean
1113	Sensor Startup Flag	**Set if sensor is still in warm-up stabilization period**	

1114	Low Alarm Flag	**Set if low alarm is active**	Boolean
1115	High Alarm Flag	**Set if high alarm is active**	
1116	Fault Flag	**Set if any fault flag is active**	
1117	Sensor Saturation Flag	**Set if gas concentration exceeds full-scale range**	
1118	Sensor Underflow Flag	**Set if gas concentration falls below zero**	
1119	Auto Cal Zero Time Remaining	**Seconds remaining in auto zero calibration procedure**	Unsigned Integer
1120	Auto Cal Span Time Remaining	**Seconds remaining in auto span calibration procedure**	
1121	Auto Cal Recovery Time Remaining	**Seconds remaining in span recovery**	Unsigned Integer
1122	Maximum Temperature Reported *(°C)*	**Maximum Temperature reported by sensor Temperature sensor**	Signed Integer
1123	Maximum Gas Concentration Reported *(%FS)*	**Maximum Gas Concentration reported by sensor**	Unsigned Integer

6.4.2 Integration - Static Sensor Data

Input Register *(Function 04 Read)*

1124	Sensor Type Code	**Type code of connected sensor module**	16-bit Unsigned Integer
1125	Display units sensor *(PPM / PPB / VOL / LEL)*	**Indication of connected sensor gas concentration unit *(ppm=1 , ppb =2, vol=3, lel=4)* VOL/LEL scale x10 i.e. 123 = 12.3%**	
1126	Full-scale *(PPM / PPB / VOL / LEL)*	**Full-scale in display units**	
1127	Local Low Alarm Set point *(PPM / PPB / VOL / LEL)*	**Low Alarm in display units *(alias of 2106)***	
1128	Local High Alarm Set point *(PPM / PPB / VOL / LEL)*	**High Alarm in display units *(alias of 2107)***	
1129	Calibration Gas Concentration *(PPM / PPB / VOL / LEL)*	**Sensor Calibration gas concentration in display units**	
1130	Sensor Squelch, Unit dependent	**Value below which gas concentration reads zero to suppress low level noise**	
1131	Low Alarm Behavior	**Low Alarm Behavior Flag, Sensor. 0 => alarm triggered when gas above alarm level; 1 => alarm triggered when gas below alarm level**	Boolean
1132	Sensor cal gas lower limit	**Sensor calibration gas lower limit in display units**	16-bit Unsigned Integer
1133	Sensor cal gas upper limit	**Sensor calibration gas upper limit in display units**	
1134	Sensor Low Alarm Limit	**Sensor Low Alarm Limit in display units. *(The minimum which the level low alarm set point may be set.)***	
1135	% LEL to PPM Conversion Factor	**%LEL to PPM conversion scaled x 10 *(e.g. 44 for gas with 4.4% LEL)***	
1136	Gas Type Text Char 1,2	**Gas Type Characters 1 & 2 *(10 character gas string = "XXXXXXXXXX")***	
1137	Gas Type Text Char 3,4	**Gas Type Characters 3 & 4 *(10 character gas string = "XXXXXXXXXX")***	

1138	Gas Type Text Char 5,6	**Gas Type Characters 5 & 6** ***(10 character gas string = "XXXXXXXXXX")***	16-bit Unsigned Integer
1139	Gas Type Text Char 7,8	**Gas Type Characters 7 & 8** ***(10 character gas string = "XXXXXXXXXX")***	
1140	Gas Type Text Char 9,10	**Gas Type Characters 9 & 10** ***(10 character gas string = "XXXXXXXXXX")***	
1141	Sensor Module SID Char 1,2	**SID Characters 1 & 2** ***(8 character UID string = "XXXXXXXX")***	
1142	Sensor Module SID Char 3,4	**SID Characters 3 & 4** ***(8 character UID string = "XXXXXXXX")***	
1143	Sensor Module SID Char 5,6	**SID Characters 5 & 6** ***(8 character UID string = "XXXXXXXX")***	
1144	Sensor Module SID Char 7,8	**SID Characters 7 & 8** ***(8 character UID string = "XXXXXXXX")***	
1145	Sensor Controller UID Char 1,2	**UID Characters 1 & 2** ***(8 character UID string = "XXXXXXXX")***	
1146	Sensor Controller UID Char 3,4	**UID Characters 3 & 4** ***(8 character UID string = "XXXXXXXX")***	
1147	Sensor Controller UID Char 5,6	**UID Characters 5 & 6** ***(8 character UID string = "XXXXXXXX")***	
1148	Sensor Controller UID Char 7,8	**UID Characters 7 & 8** ***(8 character UID string = "XXXXXXXX")***	
1149	Alias Text Char 1,2	**Alias Characters** ***(16 character alias string = "XXXXXXXXXXXXXXXX")***	
1150	Alias Text Char 3,4		
1151	Alias Text Char 5,6		
1152	Alias Text Char 7,8		
1153	Alias Text Char 9,10		
1154	Alias Text Char 11,12		
1155	Alias Text Char 13,14		
1156	Alias Text Char 15,16		
1157	Software Version Sensor Major	**Major software version level** ***(XX in firmware XX.YY.ZZ format)***	
1158	Software Version Sensor Minor	**Minor software version level** ***(YY in firmware XX.YY.ZZ format)***	
1159	Software Version Sensor Bug fix	**Bug fix software version level** ***(ZZ in firmware XX.YY.ZZ format)***	
1160	Temperature Lower Limit (°C)	**Set Temperature Fault flag when Temp < Temperature Lower Limit**	16-bit Signed Integer
1161	Temperature Upper Limit (°C)	**Set Temperature Fault flag when Temp > Temperature Upper Limit**	

6.4.3 Integration - General System Setup

Holding Register *(Function 03/06 Read / Write)*

2100	Parameter Unlock	**Writing the correct unlock code allows an external controller to change system parameters** ***(0000-9999)***	16-bit Unsigned Integer
2101	RS-485 Node Address	**Modbus address 1-247 (if hardware override - write exception / read Modbus switch state)**	
2102	Baud Rate	**0 = 9600 Baud; 1 = 19200 Baud (if hardware override - write exception / read dip8)**	Boolean

2103	Stop Bits	**Stop bits = 1 or 2**	16-bit Unsigned Integer
2104	Parity	**0 = None, 1 = Odd, 2 = Even**	
2105	Enable 120ohm Termination	**0 = No termination, 1 = termination enabled**	Boolean
2106	Sensor Low Alarm (PPM/PPB/VOL/LEL)	**Low gas alarm in display units *(Local Alarm set points stored on controller, override sensor values)***	16-bit Unsigned Integer
2107	Sensor High Alarm (PPM/PPB/VOL/LEL)	**High gas alarm in display units *(Local Alarm set points stored on controller, override sensor values)***	
2108	Analog output Range	**Set voltage output (0=1-5V, 1=0-5V, 2=0-10V, 3=4-20mA, 4=2-10V) (if hardware override - write exception / read dip 2&3)**	
2109	Analog output Zero Adjust	**Sets Analog output zero offset to allow output calibration (in DAC codes)**	
2110	Analog output Span Adjust	**Sets Analog output scaling factor to allow output calibration (in % scaled by x10 ie 123 = 12.3%)**	
2111	Buzzer disable	**0 = Buzzer normal operation, 1 = Buzzer disabled (if hardware override - write exception / read dip 4)**	Boolean
2112	Relay Contact Behavior / Failsafe	**0 = NO relay, 1 = Failsafe relay (if hardware override - write exception / read dip 5)**	
2113	Alarm Latching Behavior	**0 = Alarms automatically reset, 1 = Alarms must be acknowledged (if hardware override - write exception / read dip 6)**	Boolean
2114	Alarm ON Delay (0-900) seconds	**Alarm on delay in seconds Range (0-900 secs), i.e. (0-15 mins). (if hardware override - write exception/ read dip 7)**	16-bit Unsigned Integer
2115	Alias Text Char 1,2	**Alias Characters (16 char alias string = "XXXXXXXXXXXXXXXX")**	
2116	Alias Text Char 3,4	**Alias Characters (16 char alias string = "XXXXXXXXXXXXXXXX")**	
2117	Alias Text Char 5,6	**Alias Characters (16 char alias string = "XXXXXXXXXXXXXXXX")**	
2118	Alias Text Char 7,8	**Alias Characters (16 char alias string = "XXXXXXXXXXXXXXXX")**	
2119	Alias Text Char 9,10	**Alias Characters (16 char alias string = "XXXXXXXXXXXXXXXX")**	
2120	Alias Text Char 11,12	**Alias Characters (16 char alias string = "XXXXXXXXXXXXXXXX")**	
2121	Alias Text Char 13,14	**Alias Characters (16 char alias string = "XXXXXXXXXXXXXXXX")**	
2122	Alias Text Char 15,16	**Alias Characters (16 char alias string = "XXXXXXXXXXXXXXXX")**	
2123	Unlock code	**4-digit code used to unlock user settings (0000-9999), numeric, can only be read/written if system is already unlocked**	16-bit Unsigned Integer
2124	Bluetooth Passkey	**6-digit Bluetooth passkey (000000-999999), numeric, can only be read/written if system is unlocked, requires power cycle to take effect**	32-bit Unsigned Integer
2125			

6.4.4 Integration – Calibration

Holding Register *(Function 03/06 Read / Write)*

2200	Sensor Calibration gas applied (PPM/PPB/VOL/LEL)	**Concentration of calibration gas applied during calibration (must be set before calibration if using gas != sensor nominal) set to sensor nominal on reset**	16-bit Unsigned Integer

6.4.5 Integration - User Debug Tools

Holding Register *(Function 03/06 Read / Write)*

2800	Offline Mode	**Setting this flag places the unit into offline mode. When offline the unit will not respond to gas events or generate alarm conditions. The flag will remain asserted for the duration of offline mode. Offline mode will end after 30 minutes or by clearing this flag.**	Boolean
2801	Manual override Enable	**Override external outputs to test system functionality. Time out after 30 minutes**	
2802	Relay 1 state (Low Alarm)	**Set state of relay 1 (1 = energized)**	
2803	Relay 2 state (High Alarm)	**Set state of relay 1 (1 = energized)**	
2804	Relay 3 state (Fault)	**Set state of relay 1 (1 = energized)**	
2805	Buzzer state	**Set state of buzzer (1 = active)**	
2806	Green LED State	**Set state of Green LED (1 = on)**	
2807	Red LED State	**Set state of Red LED (1 = on)**	Boolean
2808	Analog Output Value	**Set value of analog output in % full-scale (0% to 100%)**	16-bit Signed Integer
2809	Analog Output Value State	**Set value control state of analog output (0=Manual, 1= Fault, 2 = Offline, 3 = Underflow, 4= Overflow , 5=PPM)**	16-bit Unsigned Integer

6.4.6 MGS Compatibility - Status Flags

Read Input Status *(Function 02 Read)*

3000	Alarm flag (0 or 1 = alarm) for Any Alarm	**Set if low or high alarm state**	Boolean
3001	Relay state (0 or 1=energized) for any Relay	**Set if any relay is active (follows relay logical state not physical if failsafe is active)**	
3002	Sensor fault (0 or 1 = fault) for Any Sensor or System Fault	**Set if any fault flag is active**	
3003	Red LED state (0 or 1=Red LED On)	**Set if Red LED is on**	
3004	Green LED state (0 or 1=Green LED On)	**Set if Green LED is on**	
3005	Saturation (0 or 1= gas outside limits)	**Set if gas concentration exceeds full-scale range**	
3006	Start up (0=normal op 1=starting up)	**Set if sensor is still in warm-up stabilization period**	

6.4.7 Integration - Status Flags

Read Input Status *(Function 02 Read)*

3100	Sensor Startup (0 or 1 = startup)	**Set if sensor is still in warm-up stabilization period**	Boolean
3101	Low Alarm flag (0 or 1 = alarm)	**Set if low alarm is active**	

3102	High Alarm flag (0 or 1 = alarm)	**Set if high alarm is active**	Boolean
3103	Sensor Fault (0 or 1 = fault)	**Set if any fault flag is active**	
3104	Sensor Saturation (0 or 1 = gas outside limits)	**Set if gas concentration exceeds full-scale range**	
3105	Sensor Underflow (0 or 1 = gas less than zero)	**Set if sensor is still in warm-up stabilization period**	
3106	Calibration Due (0 or 1 = cal due)	**Set if burning hours > calibration interval**	

6.4.8 MGS Compatibility - Clear Special States

Read / Force Coil *(Function 01/05 Read / Write)* 🔒

4000 🔒	Mute Buzzer	**Sounder Mute**	Boolean
4001 🔒	Calibration due	**Clear Calibration Due Flag**	
4002 🔒	not implemented - return 0 on read/exception on write	**Reconfigure MGS**	

6.4.9 Integration - User Tasks

Read / Force Coil *(Function 01/05 Read / Write)* 🔒

4100 🔒	Restart	**Force application restart**	Boolean
4101 🔒	Factory Reset	**Restore system settings to defaults**	
4102 🔒	Clear last faults	**Clear any fault flags held in the last fault registers. Any active faults will remain set in the last fault register**	
4103 🔒	Acknowledge latched alarms/faults	**Acknowledge latched alarms/faults**	
4104 🔒	Mute Buzzer	**Mute Buzzer for 60 minutes**	
4105 🔒	Immediate Zero Calibration	**Calibrate zero now**	
4106 🔒	Immediate Span Calibration	**Calibrate span now**	
4107 🔒	Auto Zero Calibration	**Calibrate zero after auto calibration time**	
4108 🔒	Auto Span Calibration	**Calibrate span after auto calibration time**	
4109 🔒	Clear calibration expired flag	**Clear calibration due flag and rest burning hours to 0**	
4110 🔒	Clear Maximum Temperature	**Clear Maximum Temperature**	
4111 🔒	Clear Maximum Gas Concentration	**Clear Maximum Gas Concentration**	
4112 🔒	Bluetooth Enable	**0 = Disable, 1 = Enable**	

7. Ordering Information

7.1 Part Numbers

7.1.1 MGS-400 Gas Detector Configurations

IMPORTANT: In the following table, product configurations include:

- MGS-410 – instrument and one sensing head mounted directly to the instrument enclosure.
- MGS-450 – instrument and one sensing head mounted directly to the instrument enclosure.
- MGS-460 – an instrument and one sensing head mounted to a remote enclosure via 5m of RJ45 cable *(included)*.

Gas	Range	Type	Part Numbers				
			MGS-410	MGS-450 (IP41)	MGS-450 (IP66)	MGS-460	Sensor Module
Butane	0-100% LEL	CAT	6302-0062	6302-1062	6302-2062	6302-4062	6302-9062
CH_4	0-100% LEL	IR	6302-0053	6302-1053	6302-2053	6302-4053	6302-9053
CH_4	0-5,000 ppm	SC	6302-0302	6302-1302	6302-2302	6302-4302	6302-9302
CO	0-500 ppm	EC	6302-0040	6302-1040	6302-2040	6302-4040	6302-9040
CO_2	0-5,000 ppm	IR	6302-0090	6302-1090	6302-2090	6302-4090	6302-9090
CO_2	0-10,000 ppm	IR	6302-0091	6302-1091	6302-2091	6302-4091	6302-9091
CO_2	0-20,000 ppm	IR	6302-0092	6302-1092	6302-2092	6302-4092	6302-9092
CO_2	0-30,000 ppm	IR	6302-0093	6302-1093	6302-2093	6302-4093	6302-9093
CO_2	0-40,000 ppm	IR	6302-0094	6302-1094	6302-2094	6302-4094	6302-9094
CO_2	0-50,000 ppm	IR	6302-0095	6302-1095	6302-2095	6302-4095	6302-9095
Methane	100% LEL	CAT	6302-0063	6302-1063	6302-2063	6302-4063	6302-9063
NH_3 *(-40° F/C)*	0-100 ppm	EC	6302-0026	6302-1026	6302-2026	6302-4026	6302-9026

NH_3 *(-40° F/C)*	0-1,000 ppm	EC	**6302-0028**	**6302-1028**	**6302-2028**	**6302-4028**	**6302-9028**
NH_3	0-5,000 ppm	EC	**6302-0037**	**6302-1037**	**6302-2037**	**6302-4037**	**6302-9037**
NH_3	0-1,000 ppm	SC	**6302-0308**	**6302-1308**	**6302-2308**	**6302-4308**	**6302-9308**
NH_3	0-10,000 ppm	SC	**6302-0309**	**6302-1309**	**6302-2309**	**6302-4309**	**6302-9309**
NH_3	0-100% LEL	CAT	**6302-0070**	**6302-1070**	**6302-2070**	**6302-4070**	**6302-9070**
NO_2	0-20 ppm	EC	**6302-0041**	**6302-1041**	**6302-2041**	**6302-4041**	**6302-9041**
O_2	0-30%	EC	**6302-0003**	**6302-1003**	**6302-2003**	**6302-4003**	**6302-9003**
Propane	0-100% LEL	CAT	**6302-0064**	**6302-1064**	**6302-2064**	**6302-4064**	**6302-9064**
R-1234yf	0-1,000 ppm	SC	**6302-0161**	**6302-1161**	**6302-2161**	**6302-4161**	**6302-9161**
R-1234ze	0-1,000 ppm	SC	**6302-0152**	**6302-1152**	**6302-2152**	**6302-4152**	**6302-9152**
R-134a	0-1,000 ppm	SC	**6302-0101**	**6302-1101**	**6302-2101**	**6302-4101**	**6302-9101**
R-22	0-1,000 ppm	SC	**6302-0109**	**6302-1109**	**6302-2109**	**6302-4109**	**6302-9109**
R-290	0-100% LEL	IR	**6302-0054**	**6302-1054**	**6302-2054**	**6302-4054**	**6302-9054**
R-290	0-2,500 ppm	SC	**6302-0310**	**6302-1310**	**6302-2310**	**6302-4310**	**6302-9310**
R-290	0-5,000 ppm	SC	**6302-0301**	**6302-1301**	**6302-2301**	**6302-4301**	**6302-9301**
R-32	0-1,000 ppm	SC	**6302-0155**	**6302-1155**	**6302-2155**	**6302-4155**	**6302-9155**
R-404A	0-1,000 ppm	SC	**6302-0103**	**6302-1103**	**6302-2103**	**6302-4103**	**6302-9103**
R-407A	0-1,000 ppm	SC	**6302-0105**	**6302-1105**	**6302-2105**	**6302-4105**	**6302-9105**
R-407C	0-1,000 ppm	SC	**6302-0123**	**6302-1123**	**6302-2123**	**6302-4123**	**6302-9123**
R-407F	0-1,000 ppm	SC	**6302-0126**	**6302-1126**	**6302-2126**	**6302-4126**	**6302-9126**
R-410A	0-1,000 ppm	SC	**6302-0107**	**6302-1107**	**6302-2107**	**6302-4107**	**6302-9107**
R-422A	0-1,000 ppm	SC	**6302-0165**	**6302-1165**	**6302-2165**	**6302-4165**	**6302-9165**
R-422D	0-1,000 ppm	SC	**6302-0166**	**6302-1166**	**6302-2166**	**6302-4166**	**6302-9166**
R-427A	0-1,000 ppm	SC	**6302-0167**	**6302-1167**	**6302-2167**	**6302-4167**	**6302-9167**

R-434A	0-1,000 ppm	SC	6302-0159	6302-1159	6302-2159	6302-4159	6302-9159
R-448A	0-1,000 ppm	SC	6302-0156	6302-1156	6302-2156	6302-4156	6302-9156
R-449A	0-1,000 ppm	SC	6302-0169	6302-1169	6302-2169	6302-4169	6302-9169
R-450A	0-1,000 ppm	SC	6302-0160	6302-1160	6302-2160	6302-4160	6302-9160
R-452A	0-1,000 ppm	SC	6302-0157	6302-1157	6302-2157	6302-4157	6302-9157
R-452B	0-1,000 ppm	SC	6302-0163	6302-1163	6302-2163	6302-4163	6302-9163
R-454A	0-1,000 ppm	SC	6302-0164	6302-1164	6302-2164	6302-4164	6302-9164
R-454B	0-1,000 ppm	SC	6302-0171	6302-1171	6302-2171	6302-4171	6302-9171
R-454C	0-1,000 ppm	SC	6302-0170	6302-1170	6302-2170	6302-4170	6302-9170
R-455A	0-1,000 ppm	SC	6302-0172	6302-1172	6302-2172	6302-4172	6302-9172
R-507A	0-1,000 ppm	SC	6302-0111	6302-1111	6302-2111	6302-4111	6302-9111
R-513A	0-1,000 ppm	SC	6302-0158	6302-1158	6302-2158	6302-4158	6302-9158
R-514A	0-1,000 ppm	SC	6302-0162	6302-1162	6302-2162	6302-4162	6302-9162
R-600	0-100% LEL	IR	6302-0052	6302-1052	6302-2052	6302-4052	6302-9052
R-600	0-5,000 ppm	SC	6302-0306	6302-1306	6302-2306	6302-4306	6302-9306
R-600a	0-5,000 ppm	SC	6302-0300	6302-1300	6302-2300	6302-4300	6302-9300

7.1.2 MGS-400 Series Accessories

Description	Part Numbers
Horn + Strobe; 24 V DC *(Blue Lens)*	3015-8041
Horn + Strobe; MP120K 120 V AC Adapter *(Blue Lens)*	3015-8044
Horn + Strobe; 24 V DC *(Red Lens)*	3015-8043
Horn + Strobe; MP120K 120 V AC Adapter *(Red Lens)*	3015-8046
Horn + Strobe; 24 V DC *(Amber Lens)*	3015-8042
Horn + Strobe; MP120K 120 V AC Adapter *(Amber Lens)*	3015-8045