



Model IR2100

Infrared Point Detector for
Hydrocarbon Gas Applications



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Instruction Manual

10-05

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**Part No.
Revision**

**MANIR2100
F/01-06**

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Quick-Start Guide

Mounting and Orientation

The Model IR2100 should be mounted horizontally (Figure 1) to reduce the likelihood of dirt and dust build-up on the windows. For optimum performance, the splashguards should be located on the top and bottom as shown in Figure 1. Apply the supplied thread lubricant/sealant to all conduit entries before use to prevent binding.

Wiring Connections

To make the power and analog connections to the Model IR2100 Infrared Point Detector, see below:

TERMINAL	WIRE COLOR	SIGNAL
1	BLACK	COM
2	GREEN	FG
3	RED	+24V
4	WHITE	4-20mA
5	BLUE	MOD1+
6	WHT/BLU	MOD1-
7	BROWN	CAL
8	-	MOD2+
9	-	MOD2-
10	-	-

Table 1: Wiring Chart

NOTE: Power should remain disconnected until all other wiring connections are made.

Power Connections

To supply power to the Model IR2100 connect the red lead from the IR2100 to the +24VDC terminal on the power supply. Connect the black lead from the IR2100 to the power supply Common. Refer to the manual of the power source being used, for more detailed instructions.

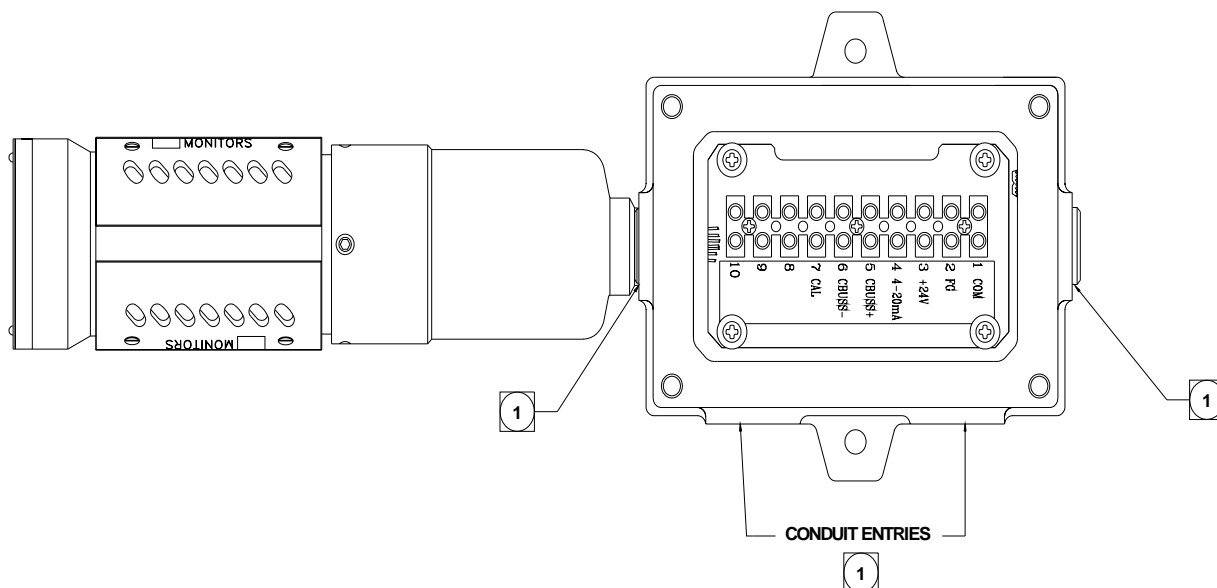
NOTE: If the Model IR2100 is being used with a +24VDC power supply and an industrial analog to digital (A/D) converter, then the negative supply (Common) of all three must be connected.

Applying Power

Before applying power to the system for the first time, all wiring connections should be checked for correctness. Upon initial power-up or after a fault condition has been corrected, the unit will enter a start-up mode for 120 seconds before returning to normal operation (Analog output will be 0 mA).

After power is applied, the Model IR2100 should be allowed to stabilize for approximately 60 minutes while the unit attains the proper operating temperature. After stabilization, it is

recommended that the Model IR2100 be zeroed, per the procedure in Section 4.1 (step 1 only). A gas check should then be performed to ensure that the unit is operating properly. Use the General Monitors Gas Check Kit (P/N 31468) to perform this check.



1 Apply Supplied Lubricant/Sealant to Threads to Prevent Binding

Figure 1: IR2100 with Junction Box

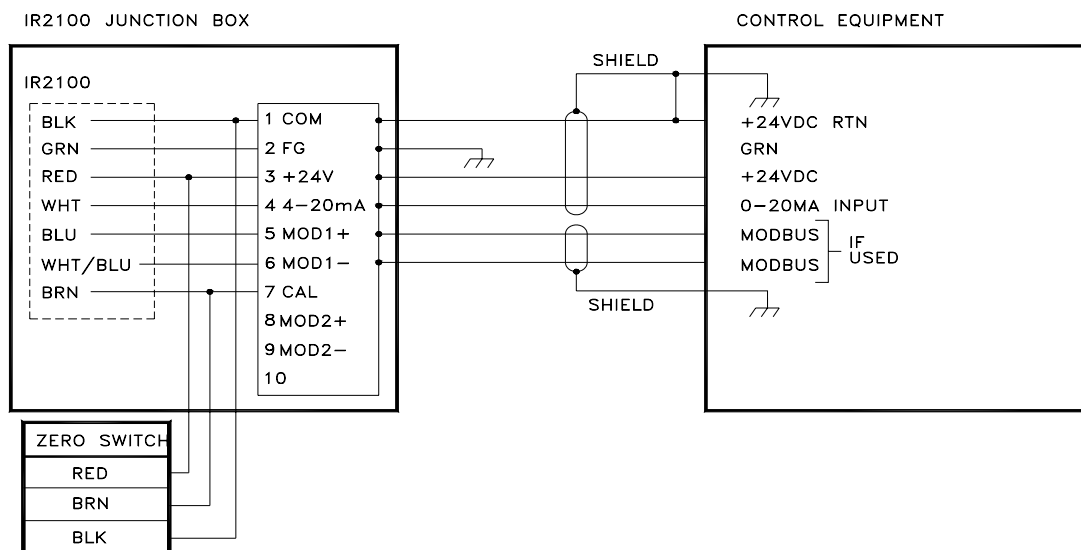


Figure 2: Switch LED Sequence Chart

The instrument is now ready to operate. Please consult the manual for more information on the instrument's many features.

Worldwide service is available by calling:

**Lake Forest, California
(24 hr. service)**

Toll Free: +1-800-446-4872
Phone: +1-949-581-4464
Fax: +1-949-581-1151

Houston, Texas

Phone: +1-281-855-6000
Fax: +1-281-855-3290

Ireland

Phone: +353-91-751175
Fax: +353-91-751317

Singapore

Phone: +65-6748-3488
Fax: +65-6748-1911

United Arab Emirates

Phone: +971-4-8815751
Fax: +971-4-8817927

United Kingdom

Phone: +44-1625-619583
Fax: +44-1625-619098

1.0 Introduction

1.1 Protection for Life

General Monitors' mission is to benefit society by providing solutions through industry leading safety products, services, and systems that save lives and protect capital resources from the dangers of hazardous flames, gases, and vapors.

This manual provides instructions for installing and operating General Monitors' Model IR2100 infrared point detector for hydrocarbon gas detection. While the IR2100 is easy to install and operate, this manual should be read in full and the information contained herein understood before attempting to place the system in service.

The safety products you have purchased should be handled carefully and installed, calibrated, and maintained in accordance with the respective product instruction manual. Remember these products are for your safety.



1.2 Special Warnings

The Model IR2100 Point IR Detector contains components, which can be damaged by static electricity. Special care must be taken when wiring the system to ensure that only the connection points are touched.

Toxic, combustible and flammable gases & vapors are very dangerous. Extreme caution should be used when these hazards are present.

1.3 System Integrity Verification

Commissioning Safety Systems

Before power up, verify wiring, terminal connections and stability of mounting for all integral safety equipment including, but not limited to:

- Power supplies
- Control modules
- Field detection devices
- Signaling / output devices
- Accessories connected to field and signaling devices

After the initial application of power (and any factory specified warm-up period) to the safety system, verify that all signal outputs, to and from devices and modules, are within the manufacturer's specifications. Initial testing should be performed per the manufacturer's recommendations and instructions.

Proper system operation should be verified by performing a full, functional test of all component devices of the safety system, ensuring that the proper levels of alarming occur. Fault/Malfunction circuit operation should also be verified.

Periodic Testing of Field Devices

Periodic testing/calibrating should be performed per the manufacturer's recommendations and instructions. Testing/Calibrating procedures should include, but not be limited to:

- Verify integrity of all optical surfaces and devices
- For flame detectors, use the appropriate test lamp

When testing produces results outside of the manufacturer's specifications, replacement of the suspect device(s) should be performed as necessary. Maintenance intervals should be independently established through a documented procedure, including a maintenance log maintained by plant personnel or third party testing services.

Periodic System Verification

The following system verifications should be performed at least annually:

Verify wiring, terminal connections and stability of mounting for all integral safety equipment including, but not limited to:

- Power supplies
- Control modules
- Field detection devices
- Signaling / output devices
- Accessories connected to field and signaling devices

2.0 Product Description

2.1 General Description

The Model IR2100 Infrared Point Detector is a microprocessor-based combustible gas detector. The IR2100 is calibrated at the factory and needs no routine field calibration. Applying a test gas to the unit can check the sensitivity of the Model IR2100. It is also relatively maintenance free, requiring only a periodic cleaning of the windows to ensure dependable performance.

The Model IR2100 Infrared Point Detector continuously monitors combustible gases in the Lower Explosive Limit (LEL) range* and provides a 4 to 20mA analog signal proportional to the 0 to 100% LEL concentration. A MODBUS Communications Interface is also provided for informational/programming purposes. Sensor data and status information from the Model IR2100 can be transmitted to a variety of General Monitors' readout units.

The IR2100 operates from an unregulated +24 volt DC supply, which must be supplied by the customer, or is supplied by General Monitors' Model DC110 or Model DC130 readout units.

***NOTE:** May also be monitored in the % by volume range, in which case all references to 0 to 100% LEL should be read as 0 to 100% by volume.



Figure 3: Model IR2100

2.2 Features and Benefits

This is a partial list of features and benefits for the Model IR2100 Infrared Point Detector:

- No routine calibration required
- Fail- to- safe operation
- 4-20 mA output
- MODBUS communications link
- Heated optics to eliminate condensation
- Dirty optics indication
- Reading not affected by air velocity
- Immune to typical poisons (e.g. silicones, halides, lead, sulfur)
- Works in oxygen deficient environments
- Able to operate in constant hydrocarbon environment without adverse effects
- IP66 & NEMA TYPE 4x rating
- Interfaces directly with existing DC1x0 Controllers & TA102A Trip Amplifiers

2.3 Applications

This is a partial list of applications suitable for the Model IR2100 Infrared Point Detector:

- Drilling and Production Platforms
- Fuel Loading Facilities
- Compressor Stations
- Oil Well Logging
- Liquefied Natural Gas/Liquefied Petroleum
- Gas Processing and Storage Facilities
- Wastewater Treatment
- Gas Turbines
- Solvent Vapors
- Refineries
- Chemical Plants

2.4 Detector Assembly

2.4.1 Signal Processing

Most gases absorb infrared radiation in specific wavelengths or bands that are characteristic of the chemical structure of molecules in the gas. All hydrocarbon gases absorb infrared radiation, but to differing degrees. Gases, to be infrared active, must have an electric dipole moment.

The Model IR2100 is based on measuring absorption of infrared radiation passing through a volume of gas. Absorption of the radiation follows the Beer - Lambert Law, which states "the transmittance T of radiation through an absorbing medium decreases exponentially by the product of the extinction coefficient A , the concentration C and the path length L ":

$$T = \exp(-ACL)$$

The Model IR2100 uses a dual source, single detector measurement method. One source operates at a wavelength where absorption of a specific gas (or gases) occurs (the active wavelength). The reference source operates at a wavelength that is adjacent to the active wavelength but not absorbed by the gas (or gases). By comparing the signals from these two sources the concentration of the gas can be measured using the differential absorption technique.

This method of gas detection comes under what is commonly known as the non-dispersive infrared (NDIR) absorption principle. The reference wavelength is chosen suitable to compensate for any interference that can otherwise occur from atmospheric variation (e.g. humidity, dust, snow, fog, steam, temperature, etc.).

2.5 Control Electronics

The Model IR2100 operates from an unregulated +24VDC (nominal) input, which is fed to an onboard power-supply that produces all of the necessary voltages within the unit. The microprocessor constantly monitors the infrared wavelengths and performs mathematical operations on these values in conjunction with values obtained during the factory set-up process.

The microprocessor generates output information and feeds it to the digital analog converter to produce a 4 to 20 milliampere (mA) signal that is proportional to the 0 to 100% LEL concentration of gas at the sensor. The microprocessor program also monitors other conditions such as the supply voltage and the optical path integrity.

The Model IR2100 also provides a two-wire RS485 addressable communications link conforming to the MODBUS protocol that is used to monitor the IR2100's status and settings in order to simplify installation and maintenance.

3.0 Installation

3.1 Receipt of Equipment

All equipment shipped by General Monitors is packaged in shock absorbing containers, which provide considerable protection against physical damage. The contents should be carefully removed and checked against the packing list. If any damage has occurred or there is any discrepancy in the order, please notify General Monitors as soon as possible. All subsequent correspondence with General Monitors must specify the equipment part number and the serial number.

3.2 Detector Location Considerations

There are no standard rules for detector placement, since the optimum detector location varies with the application. The customer must evaluate conditions at the facility to make this determination. If practical, the Model IR2100 Infrared Point Detector should be easily accessible for occasional integrity checks. The unit should be mounted horizontally so that dirt and dust do not build-up on the windows. Although the IR2100 is RFI resistant, it should not be mounted close to radio transmitters or similar equipment.

NOTE: The Model IR2100 cannot detect Hydrogen (H₂) gas.

Some other factors to consider when selecting a detector location:

- Emission temperature and vapor density of the gas. The IR2100 should be located near the floor for gas vapors, which are heavier than air.
- Locate the IR2100 where prevailing air currents contain the maximum concentration of gas.
- Locate the IR2100 as near as possible to the likely source of a gas leak.
- Observe the temperature range of the IR2100 and locate the unit away from concentrated sources of heat or light.
- Mount the IR2100 away from sources of excessive vibration.



WARNING: Each IR2100 is completely tested at the factory. However, a complete system checkout is required upon initial installation and start-up to ensure system integrity.

NOTE: The Model IR2100 is factory calibrated and needs no routine calibration. However, if the IR2100 is to be installed at altitudes greater than 1000 ft (308m), it must be re-calibrated on-site (Section 4.1).

3.3 Mounting and Orientation

The Model IR2100 should be mounted horizontally (Figure 4) to reduce the likelihood of dirt and dust build-up on the windows. For optimum performance, the splashguards should be located on the top and bottom as shown in Figure 4. Apply the supplied thread lubricant/sealant to all conduit entries before use to prevent binding.

3.4 Wiring Connections

To make the power and analog connections to the Model IR2100 Infrared Point Detector, see Table 2:

TERMINAL	WIRE COLOR	SIGNAL
1	BLACK	COM
2	GREEN	FG
3	RED	+24V
4	WHITE	4-20Ma
5	BLUE	MOD1+
6	WHT/BLU	MOD1-
7	BROWN	CAL
8	NOT USED	MOD2+
9	NOT USED	MOD2-
10	NOT USED	-

Table 2: Wiring Chart

NOTE: Terminals 8, 9, and 10 are reserved for future design use.

The IR2100 operates on nominal power of +24VDC. The customer must provide Primary DC voltage power, unless a General Monitors' readout/relay display module with an internal power supply is used. Since the IR2100 is designed to continuously monitor for leaks of hydrocarbon gas, a power switch is not included to prevent accidental system shut down.

NOTE: Power should remain disconnected until all other wiring connections are made.

The maximum distance between the IR2100 and the power source is specified in the Appendix (Section 8.2.4).

3.4.1 Power Connections

To supply power to the Model IR2100 connect the red lead from the IR2100 to the +24VDC terminal on the power supply. Connect the black lead from the IR2100 to the power supply Common. Refer to the manual of the power source being used, for more detailed instructions.

NOTE: If the IR2100 is being used with a +24VDC power supply and an industrial analog to digital (A/D) converter, then the negative supply (Common) of all three must be connected.

An internal diode protects the system in the event of inadvertent supply reversal.

3.4.2 4- 20mA Output

A 4 to 20mA output signal is provided by the Model IR2100 and can be sent to a General Monitors' readout/relay display module or any industrial device that can accept a 4 to 20mA signal for computer based multi-point monitoring. The Analog Output connection provides a signal for use in displaying current LEL readings, special operation or fault conditions. The maximum distance between the IR2100 and the device connected to the Analog Output Signal is specified in the Section 8.2.4.

To access the 4-20 mA signal, connect the white lead from the IR2100 to the signal-in terminal of the input unit. Refer to the manual of the display or other device being used for detailed instructions.

Connect the black lead from the IR2100 to the device Common. The Common connection serves both the analog signal and the power connections.

3.4.3 MODBUS Interface

To access the MODBUS (MODBUS-RTU) interface, connect the blue lead from the IR2100 to the RS-MODBUS (+) terminal and the blue/white lead to the RS-MODBUS (-) terminal on the customer's MODBUS capable device. For a description of the data available from the IR2100 and the programming interface, please refer to Section 7.0.

3.4.4 Magnetic Switch

The Model IR2100 also provides a lead for connecting a +24VDC powered magnetic switch.

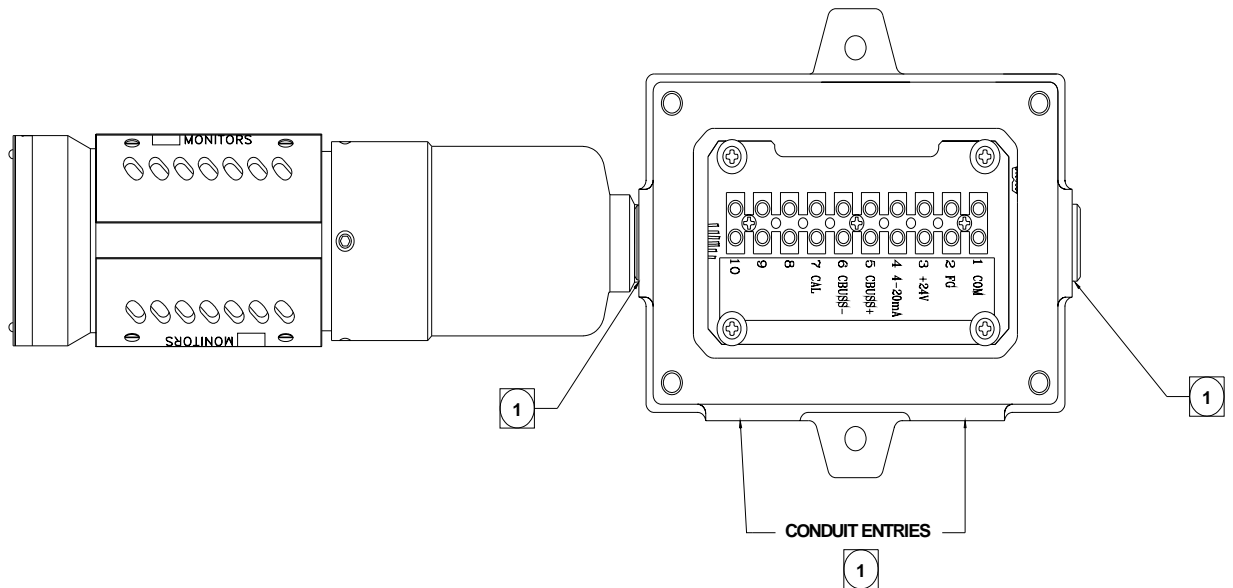
The brown lead from the IR2100 must be connected to the powered side of the switch so that when the switch is activated, the brown lead is grounded. General Monitors can supply a junction box with an integral magnetic switch to ease the connection of the IR2100 in the field (Figure 4).

3.5 Applying Power

Before applying power to the system for the first time, all wiring connections should be checked for correctness. Upon initial power-up or after a fault condition has been corrected, the unit will enter a start-up mode for 120 seconds before returning to normal operation (Analog output will be 0 mA).

After power is applied, the Model IR2100 should be allowed to stabilize for approximately 60 minutes while the unit attains the proper operating temperature. After stabilization, it is recommended that the IR2100 be zeroed, per the procedure in Section 4.1 (step 1 only). A gas check should then be performed to ensure that the unit is operating properly. Use the General Monitors' Gas Check Kit (P/N 31468) to perform this check. If the unit does not respond properly, calibrate per the procedure in Section 4.1 (steps 1-4).

- When connecting the Model IR2100 to a safety system, the +24VDC (Red) wire should be the last wire connected and first wire disconnected when removing unit to protect the system from shorting.
- If the analog (4-20 mA) output is not used, then the white signal wire must be connected to ground to prevent a fault condition.



1 Apply Supplied Lubricant/Sealant to Threads to Prevent Binding

Figure 4: IR2100 with Junction Box

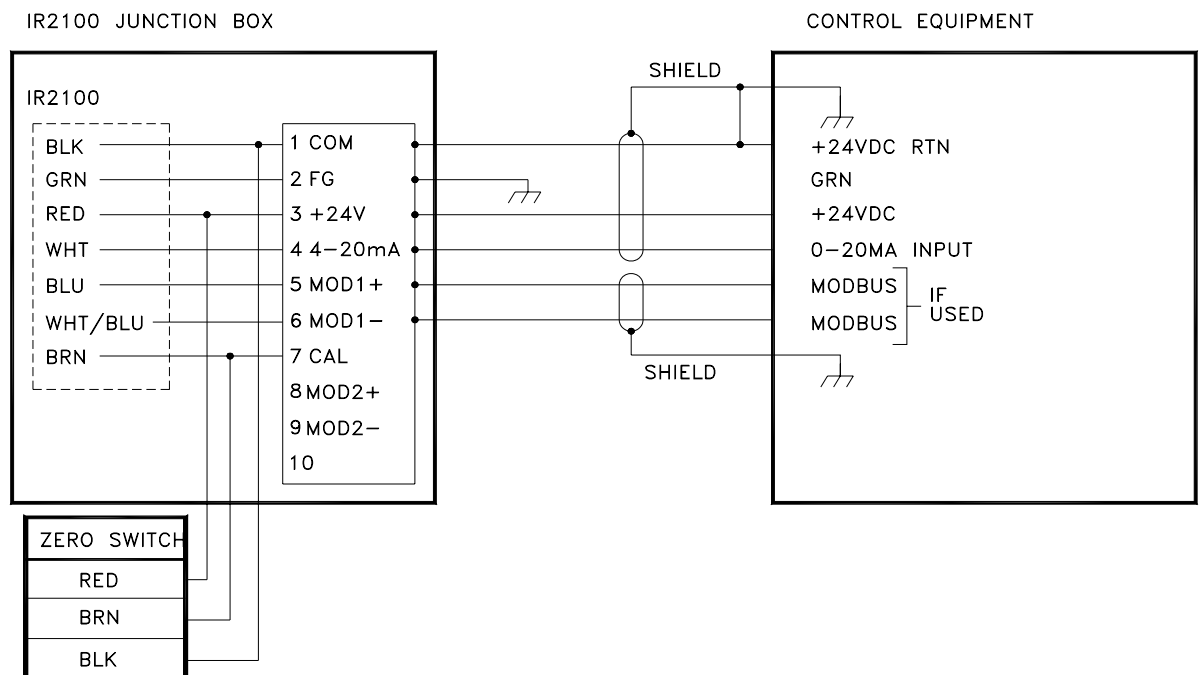


Figure 5: Switch LED Sequence Chart

4.0 Operation

4.1 Zeroing and Re-Calibrating

The Model IR2100 is calibrated at the factory and needs no routine calibration. However, if it is necessary for field personnel to calibrate the unit, a re-calibration sequence is included. The IR2100 may also be zeroed to eliminate any background gas fluctuations. The zeroing/re-calibration procedure is as follows (Figure 6):

1. Apply the General Monitors' magnet, which was included with the unit, to the Magnetic Switch Assembly for approximately three seconds. The LED in the switch will light to show proper placement. Remove the magnet and the LED will flash on for one second and off for one second to indicate that the unit is attaining a zero value.
2. When the unit has finished zeroing, the LED will turn on and flash off quickly once per second for 30 seconds. If a complete re-calibration is required, apply the magnet and the unit will enter the re-calibration mode (if the magnet is not applied, the unit will return to normal operation). The LED will flash off quickly once every half-second while the unit is waiting for gas to be applied.
3. Apply 50% LEL calibration gas. When the unit is seeing gas, the LED will flash on for a half second every one and one-half seconds.
4. Once re-calibration has been completed, the LED will turn on and flash off once every second. Remove the gas and the unit will return to normal operation once the gas has fallen below 5% LEL.

IR2100 Switch LED Sequence

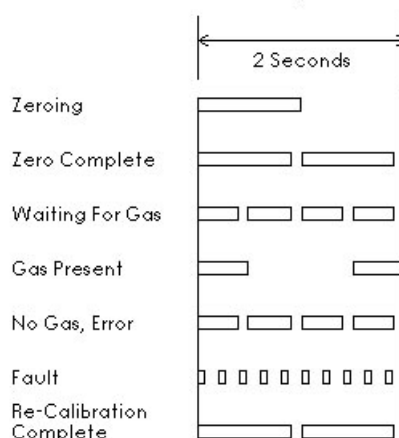


Figure 6: IR2100 Switch LED Sequence

If an error occurs during the zeroing/re-calibration sequence, the LED will flash on and off rapidly.

While in the zeroing/re-calibration mode, the analog output signal will be held at 1.5mA.

4.2 Maintenance

Although the Model IR2100 is calibrated at the factory, periodic cleaning and integrity tests are required to ensure proper operation. The windows should be cleaned by gently wiping them with a soft, clean cloth, which has had a commercial window cleaning solution applied. Integrity checks can be performed using the General Monitors' Gas Check Kit (P/N 31468).

General Monitors recommends that a maintenance logbook be kept for each unit in operation. Since maintenance requirements will vary with each installation, this maintenance record will help to develop an efficient schedule for periodic maintenance.

NOTE: Gassing into the screened splashguard will not provide a stable or accurate reading.



WARNING: Do not clean the windows while the unit is zeroing or in recalibration mode.

The unit must be re-zeroed after the windows have been cleaned.

If an optical fault still occurs after cleaning and re-zeroing is complete, the unit must be returned to the factory for service.

4.3 HazardWatch Mode

The IR2100 is compatible with the General Monitors' HazardWatch System and can be calibrated via the system interface for HazardWatch. To support calibrations initiated in HazardWatch, the IR2100 must be configured in the HazardWatch Mode. This mode prevents aborted calibrations from being recorded as successful calibrations and ensures accurate logging in the HazardWatch System.

To use this feature, purchase a factory configured IR2100 or change the mode via MODBUS. See Section 7.4 for MODBUS commands.

5.0 Customer Support

5.1 General Monitors' Offices

Area	Phone/Fax/Email
UNITED STATES	
Corporate Office: 26776 Simpatica Circle Lake Forest, CA 92630	Toll Free: +1-800-446-4872 Phone: +1-949-581-4464 Fax: +1-949-581-1151 Email: info@generalmonitors.com
9776 Whithorn Drive Houston, TX 77095	Phone: +1-281-855-6000 Fax: +1-281-855-3290 Email: gmhou@generalmonitors.com
UNITED KINGDOM	
Heather Close Lyme Green Business Park Macclesfield, Cheshire, United Kingdom, SK11 0LR	Phone: +44-1625-619-583 Fax: +44-1625-619-098 Email: info@generalmonitors.co.uk
IRELAND	
Ballybrit Business Park Galway, Republic of Ireland	Phone: +353-91-751175 Fax: +353-91-751317 Email: info@gmil.ie
SINGAPORE	
No. 2 Kallang Pudding Rd. #09-16 Mactech Building Singapore 349307	Phone: +65-6-748-3488 Fax: +65-6-748-1911 Email: genmon@gmpacifica.com.sg
MIDDLE EAST	
LOB12, #G20 P.O. Box 61209 Jebel Ali, Dubai United Arab Emirates	Phone: +971-4-8815751 Fax: +971-4-8817927 Email: gmme@emirates.net.ae

Table 3: GM Locations

6.0 Communications

6.1 RS-485 Interface

The Model IR2100 has built-in serial communications in the form of a half duplex RS-485 digital serial interface designed to conform to EIA-485 specifications. The format is in binary data transferred at 9600 baud with 1 start bit, 8 data bits, 1 stop bit and no parity.

General Monitors has available, a Windows-based program that allows the user to configure the IR2100 for use in their facility. The customer must provide access to the RS-485 bus by way of a PLC or other controlling device (bus master) with communications software programmed to provide the following information to the Model IR2100:

The "bus master" sends a command message to the IR2100, which is comprised of 5 bytes of data in the following format: The first byte is the address of the slave device (IR2100). The second byte is the Command Word. The third byte is the Command Data. The last two bytes are a 16-bit checksum calculated by performing a 16-bit addition of the first three bytes of the message and placing the result in the check sum bytes.

A "1" in the most significant bit of the Command Word (byte 2), tells the IR2100 to change the settings to those given in the Command Data (byte 3).

A "0" in the most significant bit of the Command Word (byte 2), tells the IR2100 to return to the current settings. In this case the Command Data (byte 3) will be all "0's".

The IR2100 then responds by sending back a 5-byte message in the following format: The first byte is the address of the IR2100. The second byte is an echo of the Command Word sent by the "bus master". The third byte is the data requested by the Command Word. The last two bytes are the 16-bit check sum.

6.2 Command List

Following are the commands available with the Model IR2100:

Command 0 – Return Status Message

This command returns the unit's current analog output value.

Command 1 – Operating Mode 1

This command is used to change or query the unit as to the current status (Startup, Operation or Re-Calibration Mode).

Command 2 – Operating Mode 2

This command is used to change or query the unit as to the current status (Zeroing, Re-Calibration Proceeding or Gas Check Complete).

Command 10 – Gas of Interest

This command is used to change or query the unit as to the gas to which it is currently calibrated.

Command 11 – ID (Address)

This command is used to change or query the unit as to the current address.

Command 12 – Unit Type

This command is used to determine which type of unit is being communicated with. The IR2100's code is "15" hexadecimal.

Command 13 – Program Revision

This command is used to determine the revision of the microprocessor code.

Command 14 – Fault Word One

This command returns the first fault code that was generated by the IR2100.

Command 15 – Fault Word Two

This command returns the second fault code that was generated by the IR2100.

Command 16 – Fault Word Three

This command returns the third fault code that was generated by the IR2100.

Command 17 – Serial Gain

This command returns the amount of gain being used by the microprocessor to process the signal.

Command 18 – Magnetic Switch LED

This command mimics the LED within the Magnetic Switch (1=on, 0=off).

Command 19 – Serial Re-Calibration

This command will auto-zero the IR2100 then turn on and off an external solenoid to supply gas to the unit.

Command 20 – Serial Solenoid Control

This command is the solenoid control, which can turn an external solenoid on and off (1=on, 0=off).

Command 47 – HazardWatch Mode

This command enables/disables HazardWatch.

7.0 MODBUS RTU

7.1 Serial Communications Protocol for IR2100-Methane & IR2100-Benzene

7.1.1 Baud Rate

The Baud Rate is a selectable setting via the MODBUS Communications Interface. The selectable baud rates are 9600, 4800, or 2400 bits per second.

7.1.2 Data Format

The Data Format is a selectable setting via the MODBUS Communications Interface. The selectable data formats are as follows:

Data Bits	Parity	Stop Bit	Format
8	None	1	8-N-1
8	Even	1	8-E-1
8	Odd	1	8-O-1
8	None	2	8-N-2

Table 4: Data Format

7.1.3 MODBUS Read Status Protocol (Query/Response)

7.1.3.1 MODBUS Read Query Message

Byte	MODBUS	Range	Referenced to IR2100
1st	Slave Address	1-247* (Dec)	IR2100 ID (Address)
2nd	Function Code	03	Read Holding Registers
3rd	Starting Address Hi**	00	Not Used by IR2100
4th	Starting Address Lo**	00-FF (Hex)	IR2100 Commands
5th	No. of Registers Hi	00	Not Used by IR2100
6th	No. of Registers Lo	01	No. of 16 Bit Registers
7th	CRC Hi	00-FF (Hex)	CRC Hi Byte
8th	CRC Lo	00-FF (Hex)	CRC Lo Byte

Table 5: MODBUS Read Query Message

***NOTE:** Address 0 is reserved for broadcast mode and will not be supported at this time.

****NOTE:** Start Address can be a maximum of 9999 Address Locations (0000-270E)

7.1.3.2 MODBUS Read Response Message

Byte	MODBUS	Range	Referenced to IR2100
1st	Slave Address	1-247* (Dec)	IR2100 ID (Address)
2nd	Function Code	03	Read Holding Registers
3rd	Byte Count	02	No. of Data Bytes
4th	Data Hi	00-FF (Hex)	IR2100 Hi Byte Status Data
5th	Data Lo	00-FF (Hex)	IR2100 Lo Byte Status Data
6th	CRC Hi	00-FF (Hex)	CRC Hi Byte
7th	CRC Lo	00-FF (Hex)	CRC Lo Byte

Table 6: MODBUS Read Response Message

7.1.4 MODBUS Write Command Protocol (Query/Response)

7.1.4.1 MODBUS Write Query Message

Byte	MODBUS	Range	Referenced to IR2100
1st	Slave Address	1-247* (Dec)	IR2100 ID (Address)
2nd	Function Code	06	Preset Single Register
3rd	Register Address Hi	00	Not Used by IR2100
4th	Register Address Lo	00-FF (Hex)	IR2100 Commands
5th	Preset Data Hi	00-FF (Hex)	IR2100 Hi Byte Command Data
6th	Preset Data Lo	00-FF (Hex)	IR2100 Lo Byte Command Data
7th	CRC Hi	00-FF (Hex)	CRC Hi Byte
8th	CRC Lo	00-FF (Hex)	CRC Lo Byte

Table 7: MODBUS Write Query Message

***NOTE:** Address 0 is reserved for broadcast mode and will not be supported at this time.

****NOTE:** Start Address can be a maximum of 9999 Address Locations (0000-270E)

7.1.5 MODBUS Write Response Message

Byte	MODBUS	Range	Referenced to IR2100
1st	Slave Address	1-247* (Dec)	IR2100 ID (Address)
2nd	Function Code	06	Preset Single Register
3rd	Register Address Hi	00	Not Used by IR2100
4th	Register Address Lo	00-FF (Hex)	IR2100 Commands
5th	Preset Data Hi	00-FF (Hex)	IR2100 Hi Byte Command Data
6th	Preset Data Lo	00-FF (Hex)	IR2100 Lo Byte Command Data
7th	CRC Hi	00-FF (Hex)	CRC Hi Byte
8th	CRC Lo	00-FF (Hex)	CRC Lo Byte

Table 8: MODBUS Write Response Message

7.2 Function Codes Supported

Function Code 03 (Read Holding Registers) will be used to read status from the slave unit.

Function Code 06 (Preset Single Register) will be used to write a command to the slave unit.

7.2.1 Exception Responses and Exception Codes

7.2.1.1 Exception Response

In a normal communications query and response, the master device sends a query to the IR2100 and the IR2100 receives the query without a communications error and handles the query normally within the master device's allowable timeout. The IR2100 then returns a normal response to the master. An abnormal communications produces one of four possible events:

1. If the IR2100 does not receive the query due to a communications error, then no response is returned from the IR2100 and the master device will eventually process a timeout condition for the query.
2. If the IR2100 receives the query, but detects a communication error (CRC, etc.), then no response is returned from the IR2100 and the master device will eventually process a timeout condition for the query.
3. If the IR2100 receives the query without a communications error, but cannot process the response to the master within the master's timeout setting, then no response is returned from the IR2100 and the master device will eventually process a timeout condition for the query. In order to prevent this condition from occurring the maximum response time for the IR2100 is 200 milliseconds. Therefore the MASTER'S Timeout Setting should be set to 200 milliseconds or greater.
4. If the IR2100 receives the query without a communications error, but cannot process it due to reading or writing to a non-existent IR2100 command register, then the IR2100 will return an exception response message informing the master of the error.

The exception response message (ref. No. 4 above) has two fields that differentiate it from a normal response:

Byte	MODBUS	Range	Referenced to IR2100
1st	Slave Address	1-247* (Dec)	IR2100 ID (Address)
2nd	Function Code	83 or 86 (Hex)	MSB is set with Function Code
3rd	Exception Code	01 - 06 (Hex)	Appropriate Exception Code (See Below)
4th	CRC Hi	00-FF (Hex)	CRC Hi Byte
5th	CRC Lo	00-FF (Hex)	CRC Lo Byte

Table 9: IR2100 Exception Response Message

7.2.1.2 Exception Code

Exception Code Field: In a normal response, the IR2100 returns data and status in the data field, which was requested in the query from the master. In an exception response, the IR2100 returns an exception code in the data field, which describes the IR2100 condition that caused the exception. Below is a list of exception codes that are supported by the IR2100:

Code	Name	Description
01	Illegal Function	The function code received in the query is not an allowable action for the IR2100.
02	Illegal Data Address	The data address received in the query is not an allowable address for the IR2100.
03	Illegal Data Value	A value contained in the query data field is not an allowable value for the IR2100.
04	Slave Device Failure	An unrecoverable error occurred while the IR2100 was attempting to perform the requested action.
05	Acknowledge	The IR2100 has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the master.
06	Device Busy	The IR2100 is engaged in processing a long-duration program command. The master should retransmit the message later when the slave is free.

Table 10: IR2100 Exception Codes

7.3 IR2100 Command Register Locations

Parameter	Function	Type	Scale	Access	Register Address	Master I/O Address
Analog	0-20mA Current Output	Value	16-Bit	R	0000	40001
Mode	Indicates and Controls Mode	Bit		R/W	0001	40002
Status/Error	Indicates Errors	Bit		R	0002	40003
Gas	Type of Gas Unit is Sensing	Value	Dec	R/W	0003	40004
Type Unit	Identifies the IR2100 in Decimal Value			R	0004	40005
Software Rev	Indicates the Software Revision	ASCII	2-Char	R	0005	40006
Gain	Measure of Dirt on Windows	Value	16-Bit	R	0006	40007
Led Disable	Disables the LED Function	Value		R/W	0007	40008
Sol On/Off	Turns the Solenoid On or Off	Value		R/W	0008	40009
Address	Unit Address	Value		R/W	0009	40010
Adjusted Ratio	Adjusted ratio	Value	15-Bit	R	000A	40011
Baud Rate	Indicates present Baud Rate (2400,4800,9600)	Value	(0-4)	R/W	000B	40012
Data Format	Indicates present Data Format (8-N-1, 8-E-1, 8-O-1, 8-N-2)	Value	(0-3)	R/W	000C	40013
Not Used					000D-0019	
Total Receive Errors	Total # of Receive Errors	Value	8-Bit	R	0020	40033
Bus Activity Rate %	Bus Activity Rate in % of This Addressed Node vs. Other Addressed Nodes	Dec.	(0-100%)	R	0021	40034
Function Code Errors	Total # of Function Code Errors	Value	8-Bit	R	0022	40035
Starting Address Errors	Total # of Starting Address Errors	Value	8-Bit	R	0023	40036
No. of Register Errors	Total # of Register Errors	Value	8-Bit	R	0024	40037
RXD CRC Hi	Total # of RXD CRC Hi Errors	Value	8-Bit	R	0025	40038
RXD CRC Lo Errors	Total # of RXD CRC Lo Errors	Value	8-Bit	R	0026	40039
Overflow Errors	Total # of Overflow Errors	Value	8-Bit	R	0027	40040
Noise Flag Errors	Total # of Noise Flag Errors	Value	8-Bit	R	0028	40041
Framing Errors	Total # of Framing Errors	Value	8-Bit	R	0029	40042
Not Used					002A-002C	40043-40045
Clear Comm Errors	Clear All Comm Errors	Bit	1-Bit	W	002D	40046
HazardWatch	Enable/Disable 0X0E – Enabled, 0X0D - Disabled	Value	E/D	R/W	002F	40048

Table 11: IR2100 Command Register Locations (R –Read / W-Write)

7.4 IR2100 Command Register Details

7.4.1 Analog

A read returns a value, which is proportional to the 0-20mA output current. The current is based on a 16-bit value. The master scaling is 0 - 65535 Decimal which corresponds to the IR2100 scaling which is 0 - 21.7mA.

7.4.2 Mode

A read returns the present mode of the IR2100. A write command changes the mode to the requested mode.

Exception – Returns an Exception Code 01 (Illegal Function) if an illegal write is requested.

A zero or cal command returns an Exception Code 01 (Acknowledge 05). The operation will take a long time to complete.

When in zero mode (Bit-3) and a calibrate command is given, the IR2100 will return an Exception Code 06 (Device Busy) until the IR2100 is ready to go to the calibrate mode (Bit-4).

Function	Bit Position	Access
Slope Mode	8 MSB	Read
Initial Mode	7	Read
Calibration Complete	6	Read
Waiting for Gas	5	Read
Waiting for Calibration Mode	4	Read
Zero Mode	3	Read/Write
Calibration Mode	2	Read/Write
Run Mode	1 LSB	Read/Write

Table 12: Mode

7.4.3 Status/Error

A read returns the errors that are occurring at the present time which are indicated by bit position. The error must exist for 10 seconds before it will be displayed.

Byte	Function	Bit Position	Access
High	EEPROM	16MSB	Read
	Excess Negative	15	Read
	RAM	14	Read
	Checksum	13	Read
	Heater	12	Read
	Lamp Reference	11	Read
	Lamp Active	10	Read
	Loop	9	Read
Low	Failed to Zero	8	Read
	Failed to Calibrate	7	Read
	Low Line Voltage	6	Read
	Sudden Change	5	Read
	IR High	4	Read

	IR Low	3	Read
	Clean Window Lens	2	Read
	IR is Close to Low	1	Read

Table 13: Status/Error

7.4.4 Gas

A read returns the present gas type. A write command changes the IR2100 to the requested gas type. Since the IR2100 is not calibrated for the new gas, the “Fail to Calibrate” error is set. The only way to reset this failure is to calibrate to the new gas or return to the original gas.

Exception – If the gas is not a 0 to 8 the Exception Code 03 (Illegal Data Value) is returned.

Exception – If the EEPROM cannot store the Gas type an Exception Code 04 (Slave Device Failure) is returned.

Function	Value (Decimal)	Access
Methane	0	Read/Write
Propane	1	Read/Write
Butane	2	Read/Write
Hexane	3	Read/Write
100% by volume	4	Read/Write
TBD	5	Read/Write
Ethane	6	Read/Write
Pentane	7	Read/Write
Other	8	Read/Write

Table 14: IR2100 Methane

Function	Value (Decimal)	Access
Ethylene	0	Read/Write
Benzene	1	Read/Write
TBD	2	Read/Write
TBD	3	Read/Write
TBD	4	Read/Write
TBD	5	Read/Write
TBD	6	Read/Write
TBD	7	Read/Write
Other	8	Read/Write

Table 15: IR2100 Benzene

7.4.5 Type Unit

A read returns the Decimal Value 2100. This identifies the IR2100-Methane 5.0%

A read returns the Decimal Value 2101. This identifies the IR2100-Benzene.

A read returns the Decimal Value 2103. This identifies the IR2100- Methane 4.4%

7.4.6 Software Rev

A read returns the software revision of the IR2100 in 2 ASCII characters.

7.4.7 Gain

A read returns the value of the gain. The difference between the initial value and the present value indicates the dirt on the windows.

7.4.8 LED Disable

When the LED is disabled the LED driver is disabled from blinking error codes etc. It then can be used to drive a solenoid. Thus, the serial bus can activate the solenoid to apply cal gas.

A write command enables/disables the normal LED function. The solenoid function cannot be used until the LED function is disabled.

Function	Value (Decimal)	Access
Disable Normal Function	1	Read/Write
Enable Normal Function	0	Read/Write

Table 16: LED Disable

Exception – If a value other than 0 or 1 is used, then the Exception Code 01 (Illegal Function) is returned. If an EEPROM error occurs, then the Exception Code 04 (Slave Device Failure) is returned.

7.4.9 Solenoid On/Off

This feature is used for Calibration check. In this situation the LED driver is used as a Solenoid Driver. See LED Disable

A write command turns the solenoid output On or Off. A read returns the status of the solenoid output, if the LED is not disabled, a value of 30 will be returned.

Function	Value (Decimal)	Access
On	10	Read/Write
Off	20	Read/Write
Normal Operation	30	Read

Table 17: Solenoid On/Off

Exception – If a value other than 10 or 20 is used, then the Exception Code 03 is returned. If an EEPROM error occurs, then the Exception Code 04 (Slave Device Failure) is returned.

7.4.10 Address

A read returns the address of the IR2100. A write changes the address to the requested address. The range of the address is 1 to 247.

Exception – If the EEPROM write fails, an Exception Code 04 (Slave Device Failure) is returned.

NOTE: By grounding the RESET input during power-up cycle (10 seconds), the Address will default to 1.

7.4.11 Adjusted Ratio

A read returns the unprocessed input data from the IR2100 that indicates that the IR2100 is receiving gas during calibration. This data is a signed 15-bit integer.

7.4.12 Baud Rate

A read returns the baud rate of the IR2100. A write changes the baud rate to the requested baud rate. After the baud rate has been changed to the addressed unit, the MODBUS communications will cease because the baud rate has changed; therefore the master will have to change its baud rate to the slave's new baud rate in order to re-start the communications.

Baud Rate	Low Data Byte	Access
9600	02	Read/Write
4800	01	Read/Write
2400	00	Read/Write

Table 18: Baud Rate

This function is indicated on the Low Data Byte and the High Data Byte is not used.

Exception – If the baud rate is not in range an Illegal data value (03) is returned.

NOTE: By grounding the magnetic switch (holding a magnet over the switch) input during power-up cycle (10 seconds), the IR2100 Baud Rate will default to 9600.

7.4.13 Data Format

A read returns the data format of the IR2100. A write will change the data format to the requested data format. After the data format has been changed, the addressed unit may cease or start producing Comm errors because the data format has changed; therefore, the master will have to change its data format to the slave's new data format in order to re-start or provide proper communications.

Data	Parity	Stop	Format	Low Data Byte	Access
8	None	1	8-N-1	00	Read/Write
8	Even	1	8-E-1	01	Read/Write
8	Odd	1	8-O-1	02	Read/Write
8	None	2	8-N-2	03	Read/Write

Table 19: Data Format

This function is indicated on the Low Data Byte and the High Data Byte is not used.

NOTE: By grounding the magnetic switch input during power-up cycle (10 seconds), the IR2100 Data Format will default to 8-N-1.

Exception – If the baud rate is not in range an Illegal data value (03) is returned.

7.4.14 Total Receive Errors

A read indicates the total MODBUS Comm Receive Errors that occurred in the slave device. The maximum count is 255; the counter will roll over to zero and begin counting again. The total errors are an accumulation of the individual Comm errors listed below.

7.4.15 Bus Activity Rate %

A read indicates the Bus Activity Rate in percent of this Slave's addressed node versus other addressed nodes. Range of this value is in hex (0-64), which translates to decimal (0-100%).

7.4.16 Function Code Errors

A read indicates the number of Function Code Errors that occurred in the slave device. The maximum count is 255; the counter will roll over to zero and begin counting again.

7.4.17 Starting Address Errors

The counter is incremented for each address that does not equal the device address.

A read indicates the number of Starting Address Errors that occurred in the slave device. The maximum count is 255; the counter will roll over to zero and begin counting again.

7.4.18 Number of Register Errors

A read indicates the Number of Register Errors that occurred in the slave device. The maximum count is 255; the counter will roll over to zero and begin counting again.

7.4.19 RXD CRC Hi Errors

A read indicates the number of RXD CRC Hi Byte Errors that occurred in the slave device. The maximum count is 255; the counter will roll over to zero and begin counting again.

7.4.20 RXD CRC Lo Errors

A read indicates the number of RXD CRC Lo Byte Errors that occurred in the slave device. The maximum count is 255; the counter will roll over to zero and begin counting again.

7.4.21 Overrun Errors

A read indicates the number of Overrun Errors that occurred in the slave device. The maximum count is 255; the counter will roll over to zero and begin counting again.

7.4.22 Noise Flag Errors

A read indicates the number of Noise Flag Errors that occurred in the slave device. The maximum count is 255; the counter will roll over to zero and begin counting again.

7.4.23 Framing Errors

A read indicates the number of Framing Errors that occurred in the slave device. The maximum count is 255; the counter will roll over to zero and begin counting again.

7.4.24 Clear Comm Errors

A read or write resets all the MODBUS Comm Error counters to zero.

7.4.25 HazardWatch Options

A read returns the state enabled or disabled. A write of (OE_H) enables HazardWatch mode. A write of (OD_H) disables HazardWatch mode.

8.0 Appendix

8.1 Warranty

General Monitors warrants the Model IR2100 to be free from defects in workmanship or material under normal use and service within two (2) years from the date of shipment. General Monitors will repair or replace without charge any such defective equipment found to be defective during the warranty period.

General Monitors' personnel will make full determination of the nature of, and responsibility for, defective equipment. Defective or damaged equipment must be shipped prepaid to General Monitors' plant or representative from which shipment was made. In all cases this warranty is limited to the cost of the equipment supplied by General Monitors. The customer will assume all liability for the misuse of this equipment by its employees or other personnel.

All warranties are contingent upon proper use in the application for which the product was intended and do not cover products which have been modified or repaired without General Monitors' approval, or which have been subjected to neglect, accident, improper installation or application, or on which the original identification marks have been removed or altered.

Except for the express warranty stated above, General Monitors disclaims all warranties with regard to the products sold, including all implied warranties of merchantability and fitness and the express warranty stated herein are in lieu of all obligations or liabilities on the part of General Monitors for damages including, but not limited to, consequential damages arising out of or in connection with the use or performance of the product.

8.2 Specifications

8.2.1 System Specifications

Detector Type:	Infrared absorption
Detector Life:	Greater than 5 years
Measuring Range:	0 to 100% LEL*
Zero Drift:	< 2% per year
Accuracy @ 25° C:	±3% FS ≤ 50% FS, ±5% FS > 50% FS
Warranty:	Two years
Gases Detected:	Methane, Ethane, Propane, Butane, Hexane, Ethylene, Pentane & Benzene, 100%/Vol. Methane. Optional: Detector bridge output for retrofitting catalytic bead controllers.
Readout/Relay Display Modules:	DC110: Multi-Channel, Rack Mounted DC130: Dual Channel, Rack Mounted TA102A: Single Channel, Zero Two Series
Malfunctions Monitored:	Re-calibration Error EPROM Checksum Error

	Optics Failure/Blockage
	Low Supply Voltage
	EEPROM Checksum Error
	Reference or Active Lamp Failure
	Open Analog Output Loop
	Heater Failure
	Time to Re-zero unit
Response Time:	With 100% LEL * Methane Applied T50 ≤ 7 seconds & T90 ≤ 10 seconds * - Also read as 0 to 100% by volume.
Approvals:	CSA certified to C22.2 No. 152-M1984*, CE Marking, ATEX & GOST Permission For Use

8.2.2 Mechanical Specifications

Length:	10.6 in (269 mm)
Diameter:	2.9 in (74 mm)
Weight:	3 lbs (Al) 1.35 kg 6 lbs (SS) 2.7 kg
Mounting:	3/4" NPT threads
Enclosure:	Aluminum or Stainless Steel; Explosion proof, IP66, TYPE 4x

8.2.3 Electrical Specifications

Electrical Classification	Class I, Division 1, Groups B, C and D EExd, IIB+H2 T5
Power	24 VDC @ 0.4 amp (nominal) 20 to 36 VDC range
Analog Signal Output (600 ohms max @ 24VDC):	Range: 0 to 22 mA Fault: 0 mA Gas Check & Zero: 1.5 mA Dirty Optics: 2 mA Zero Reading: 4 mA ± 0.2 mA 0 to 100% LEL*: 4 to 20 mA prop. Over range: 20 to 22 mA
Modbus Output:	Link up to 128 units, 247 w/repeaters
RFI/EMI Protection:	Complies with EN50081-2, EN50082-2

8.2.4 Recommended Cable Lengths

Power – The maximum distance between the IR2100 and the Power Source varies according to the wire size. (10 – Ohm loop resistance at +24VDC)

AWG	Feet	Meters
22	285	85
20	450	135
18	720	220
16	1145	345
14	1830	555

Table 20: Maximum Distance Between IR2100 and Power Source

Analog Output Signal – The maximum total distance between the IR2100 and a device with a 300-Ohm input impedance varies according to the wire size.

AWG	Feet	Meters
22	800	243
20	1200	365
18	1900	579
16	2600	792
14	4500	1371

Table 21: Maximum Distance Between IR2100 and 300-Ohm Input Impedance

8.2.5 Environmental Specifications

Operating Temperature Range:	-40°F to +167°F (-40°C to +75°C)
Operating Humidity Range:	5 to 100% Relative Humidity (<i>non-condensing</i>)
Storage Temperature Range:	-58°F to +167°F (-50°C to +75°C)

8.3 Engineering Documentation

8.3.1 Outline & Dimensional Drawing

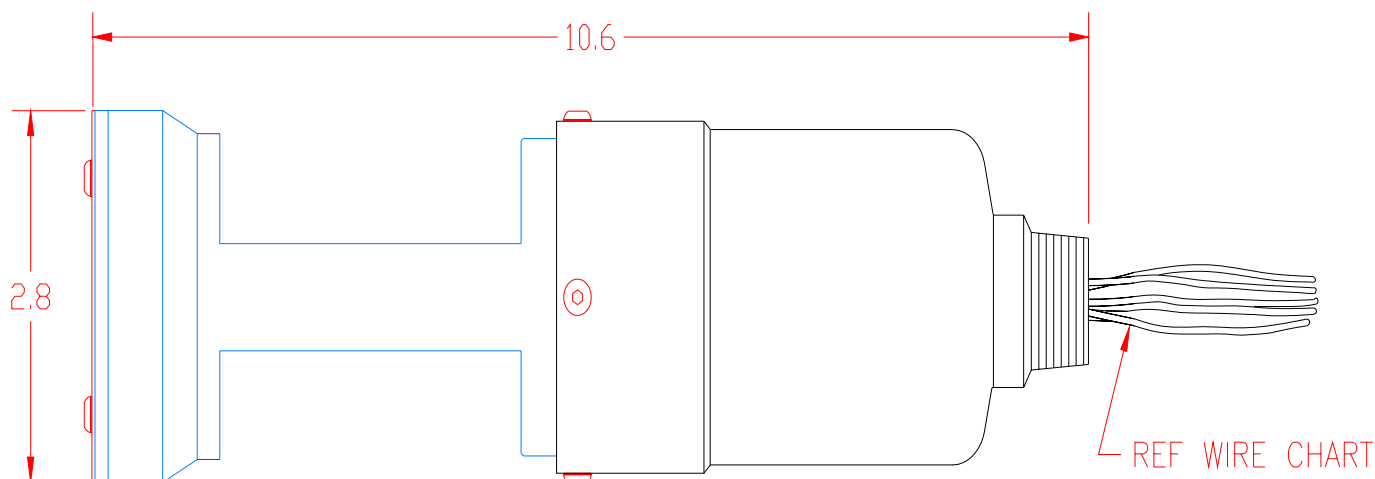


Figure 7: Outline and Dimensional Drawing, IR2100

8.4 Ordering Information

8.4.1 System Components

	<u>Part Number</u>
Model IR2100 Infrared Point Detector Standard (Methane)	IR2100
Instruction Manual - Model IR2100	MANIR2100
DC110 Eight Channel Readout/Relay Display Module, Rack Mounted	DC110
DC130 Dual Channel Readout/Relay Display Module, Rack Mounted	DC130
TA102A Single Channel Zero Two Series Trip Amplifier	TA102A

8.4.2 Spare Parts and Accessories

To order spare parts and/or accessories, please contact the nearest General Monitors' Representative, or General Monitors directly, and give the following information:

1. Part Number
2. Description
3. Quantity

8.4.3 Recommended Spare Parts for One (1) Year

31037-1 Double-Magnet Assembly.

8.4.4 Accessories

8.4.4.1 Junction Box

Housing used to facilitate field wiring and provide a magnetic switch.

- CSA/FM (P/N 31305-1)
- ATEX (P/N 31421-1)

8.4.4.2 Flow Block

(P/N 31420-1) - Used to connect the IR2100 to a gas sampling system.

8.4.4.3 Duct Mount Plate

Used to facilitate mounting in ventilation systems.

US Version (P/N 31306-1)

European Version (P/N 31424-1)

8.4.4.4 Splashguard

Used in areas where occasional moisture may occur.

Outdoor Version (P/N 31465-1)

8.4.4.5 Gas Check Kit

(P/N 31468-Specify Gas) – Gas bottle with regulator and cup.

8.4.4.6 Gas Check Chamber

(P/N 31428-1) – Used when checking the IR2100's response to a Liquid.