30-0954RK-209D Series Sample Draw Aspirator Adapter with M2s for CH_4 (%Volume) and H_2S Operator's Manual

Part Number: 71-0339

Revision: A

Released: 4/30/15

WARNING

Read and understand this instruction manual before operating detector. Improper use of the detector could result in bodily harm or death.

Periodic calibration and maintenance of the detector is essential for proper operation and correct readings. Please calibrate and maintain this detector regularly! Frequency of calibration depends upon the type of use you have and the sensor types. Typical calibration frequencies for most applications are between 3 and 6 months, but can be required more often or less often based on your usage.

Product Warranty

RKI Instruments, Inc. warrants gas alarm equipment sold by us to be free from defects in materials, workmanship, and performance for a period of one year from the date of shipment from RKI Instruments, Inc. Any parts found defective within that period will be repaired or replaced, at our option, free of charge. Parts must be returned to RKI Instruments, Inc. for repair or replacement. This warranty does not apply to those items which by their nature are subject to deterioration or consumption in normal service, and which must be cleaned, repaired or replaced on a routine basis. Examples of such items are:

a) Pump diaphragms and valves

b) Fuses

c) Batteries

d) Filter elements

Warranty is voided by abuse including mechanical damage, alteration, rough handling, or repair procedures not in accordance with instruction manual. This warranty indicates the full extend of our liability, and we are not responsible for removal or replacement costs, local repair costs, transportation costs, or contingent expenses incurred without our prior approval.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY AND ALL OTHER WARRANTIES AND REPRESENTATIONS, EXPRESSED OR IMPLIED, AND ALL OTHER OBLIGATIONS OR LIABILITIES ON THE PART OF RKI INSTRUMENTS, INC. INCLUDING BUT NOT LIMITED TO, THE WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL RKI INSTRUMENTS, INC. BE LIABLE FOR INDIRECT, INCIDENTAL OR CONSEQUENTIAL LOSS OR DAMAGE OF ANY KIND CONNECTED WITH THE USE OF ITS PRODUCTS OR FAILURE OF ITS PRODUCTS TO FUNCTION OR OPERATE PROPERLY.

This warranty covers instruments and parts sold to users only by authorized distributors, dealers and representatives as appointed by RKI Instruments, Inc.

We do not assume indemnification for any accident or damage caused by the operation of this gas monitor and our warranty is limited to the replacement of parts or our complete goods. Warranty covers parts and labor performed at RKI Instruments, Inc. only, and does not cover field labor or shipment of parts back to RKI.

Table of Contents

Chapter 1: Introduction

Overview

This manual describes the 30-0954RK-209D Series sample draw aspirator adapter supplied with an M2 for 0 - 100 %volume CH_4 and an M2 for 0 - 100 ppm H_2S. The 30-0954RK-209D may be used with a variety of detector heads. This manual describes the %volume CH_4/H_2S M2 combination. It also describes how to install, use, and maintain the adapter. A spare parts list at the end of this manual lists replacement parts.

Specifications

Table 1 lists specifications for the Sample Draw Aspirator Adapter.

Table 1: Specifications

Target Gas/Detection Range	• Methane (CH_4): 0 - 100 % volume, 1% increments • Hydrogen Sulfide (H_2S): 0 - 100 ppm, 1 ppm increments
Alarm Settings (Alarm 1/Alarm 2)	• Methane: 100 %volume / 100 %volume • Hydrogen Sulfide: 10 ppm / 50 ppm
Input Power	19 - 30 VDC
Signal Output	• 4 to 20 mA, 500 ohms impedance max • RS-485 Modbus
Maximum Compressed Air Supply Pressure	140 PSI
Outlet Pressure to Aspirator	5 - 50 PSI adjustable (determined by required flow rate)
Recommended Sample Flow Rate	3 SCFH (standard cubic feet per hour)
Recommended H_2S Detector Dilution Flow Rate	0.6 SCFH (standard cubic feet per hour)
Accuracy	IR CH_4: ± 5% of reading or ± 2% of full scale (whichever is greater) Hydrogen Sulfide: ± 5% of reading or ± 2 ppm H_2S (whichever is greater)

WARNING: ***When using the 30-0954RK-209D Series, you must follow the instructions and warnings in this manual to assure proper and safe operation of the 30-0954RK-209D Series and to minimize the risk of personal injury. Be sure to maintain and calibrate the 30-0954RK-209D Series as described in this manual.***

Chapter 2: Description

Overview

This version of the 30-0954RK-209D sample draw aspirator adapter consists of an aspirator panel with a 65-2615RK-05 M2 series H_2S detector and a 65-2628RK-CH4 M2 series methane detector installed. Fresh air dilution is used for the sample going to the H_2S detector. The sample draw aspirator adapter uses compressed air flowing through a venturi to draw air into a sample chamber for each detector. A flow diagram for the system is shown below.

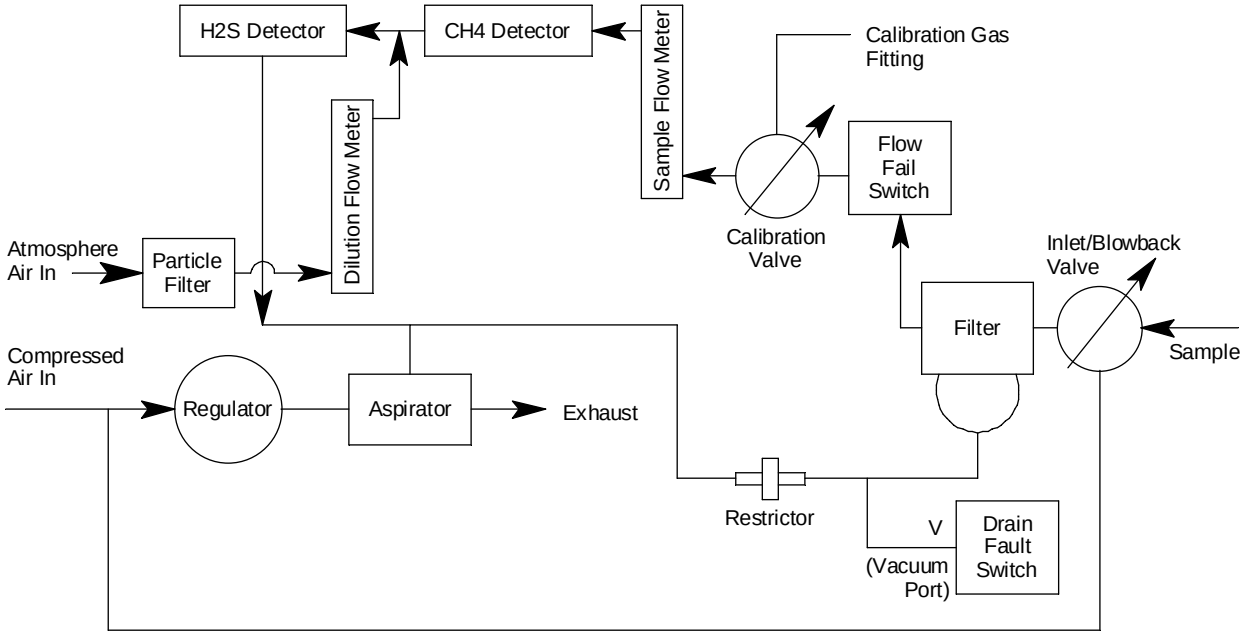

Figure 1: Flow Diagram

Aspirator Panel

The sample draw adapter consists of thirteen major components (see Figure 2): the detector heads (described in "M2 Series H_2S and CH_4 Detector Heads" on page 6), regulator, aspirator, detector adapter, detector chambers, sample flowmeter, H_2S dilution flowmeter, particle filter, calibration valve, inlet/blowback valve, low flow switch, drain fault switch, and low flow and drain fault contact housing.

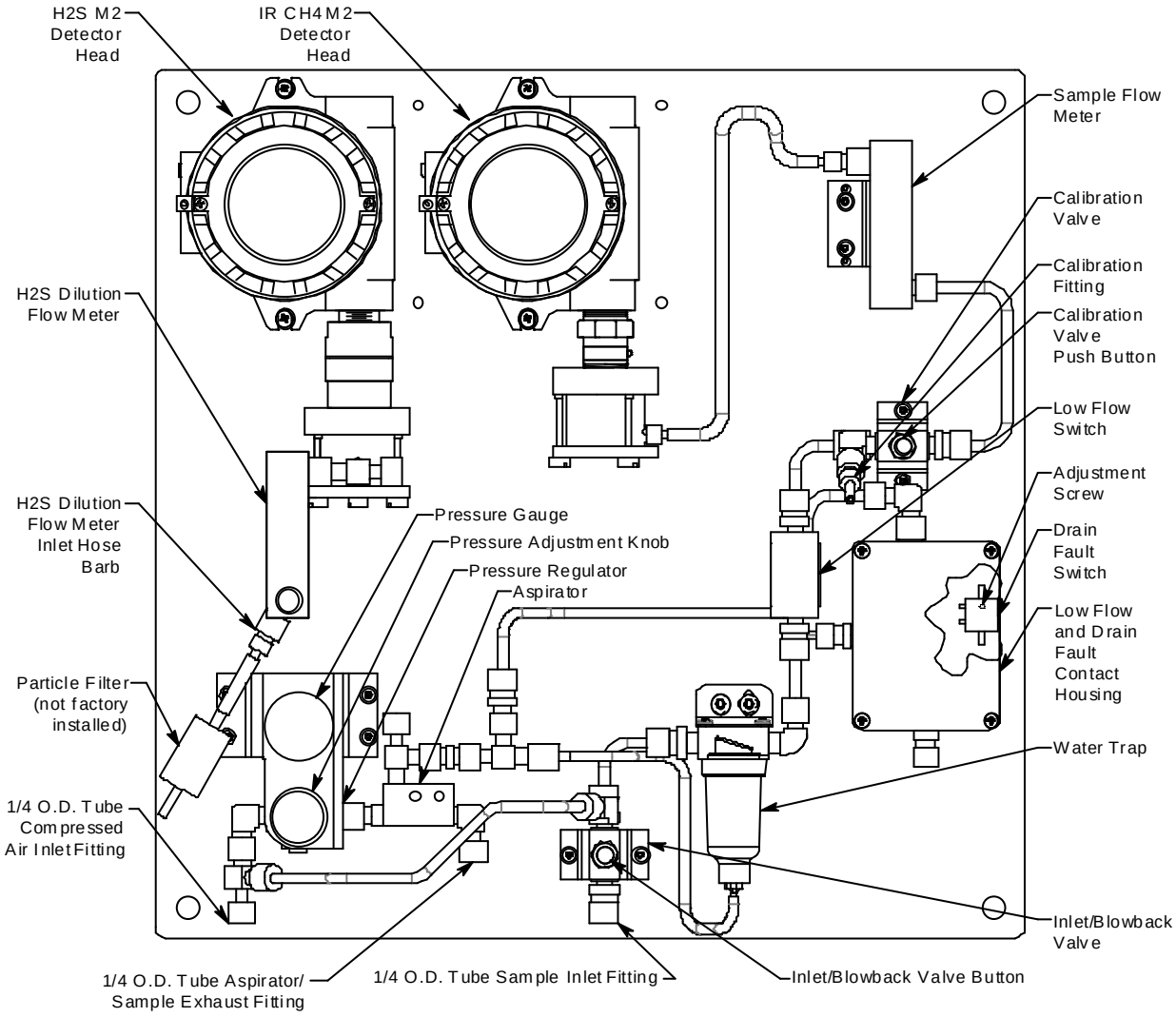

Figure 2: Component Location

Detector Heads

Figure 2 above shows the location of the two detector heads. Please see "M2 Series H_2S and CH_4 Detector Heads" on page 6 for a complete description of the detector heads.

Regulator

The regulator has an inlet port on its left side with a 1/4” tube fitting. The maximum allowable inlet pressure is 140 PSI. A gauge at the bottom of the regulator indicates the output pressure. The output pressure, and detector flow, can be adjusted using the knob on the front of the regulator. The detector flow rises or falls as the output pressure is increased or decreased.

Aspirator

The aspirator inlet is connected to the output port on the right side of the regulator and the vacuum port on top is connected to the detector chamber. It has a venturi orifice inside it which generates a vacuum at its top port when compressed air flows through it. The compressed air and the air drawn from the detector chamber into the top port of the aspirator both exhaust at the right side of the aspirator.

Detector Adapter

The infrared (IR) CH_4 detector and the H_2S detector each have a detector adapter screwed onto the bottom of the detector. The detector adapters are installed hand tight and have a gasket inside that seals against the detector. When removing the detector adapter to change the detector, be sure not to lose this gasket. The IR CH_4 and H_2S detectors each require their own specific detector adapter. The IR CH_4 detector adapter cannot be installed on the H_2S detector and vice versa.

Detector Chamber

Each detector has a detector chamber. The chamber has three thumbscrews which fasten it to the detector adapter. An O-ring at the top of the chamber seals the chamber/adapter interface. The inlet of each chamber is on the side and the exhaust of each chamber is on the bottom. The IR CH4 detector’s inlet is connected to the exhaust of the sample flowmeter. The IR CH_4 sensor’s exhaust is routed to the inlet of the H_2S detector’s chamber. The exhaust of the H_2S detector’s chamber is connected to the vacuum port of the aspirator.

Sample Flowmeter

The flowmeter indicates the flow to the IR CH_4 detector. It has a 1/4” OD tube fitting at its inlet and exhaust port. The exhaust port of the flow meter is connected to the IR CH_4 detector’s detector chamber. The flowmeter’s indication range is 0.5 - 5 SCFH. It has no flow adjustment valve because the flowrate is controlled by the regulator setting.

H_2S Dilution Flowmeter

The H_2S dilution flowmeter indicates the flow rate of fresh air entering the sample stream. It has a 1/4” OD tube fitting at its exhaust port. The exhaust port of the flowmeter is connected to the sample line before it enters the H_2S detector’s detector chamber. The H_2S dilution flowmeter’s inlet port has a hose barb fitting installed. The H_2S dilution flowmeter’s indication range is 0 - 1.0 SCFH and it has a flow adjustment valve. The flow to the H_2S detector is the sum of the sample flow and the dilution flow.

Particle Filter

A particle filter with a piece of gray tubing on each end is shipped with the aspirator adapter but is not factory installed. The particle filter must be attached to the H_2S dilution flowmeter’s inlet port using the gray tubing during installation. If tubing from a fresh air area needs to be routed to the particle filter, that fresh air line can be connected to the gray tubing on the open end of the particle filter or the gray tubing can be removed and the fresh air line can be connected directly to the open end of the particle filter. If the particle filter gets clogged, the flowrate through the flowmeter will decrease. The flowrate should be monitored, as a change in flowrate will affect the accuracy of the H_2S reading.

Calibration Valve

The calibration valve is a manual operation spring return valve with a push button actuator. This valve is used to switch from sample flow to calibration gas during the calibration process. When the button is pushed and held, the sample port is closed and the calibration port is opened.

Inlet/Blowback Valve

The inlet/blowback valve is a manual operation spring return valve. A push button actuator is located on the front of the valve. This valve is used to switch from sample flow to blow back in the event of a clogged sample line. When the push button is pressed and held, the valve diverts the compressed air supply back through the sample line to clear obstructions.

WARNING: ***The blowback pressure can be as high as 140 PSI. Make sure that all personnel and equipment are clear of the sample line inlet end to avoid personal injury or equipment damage if a sample line obstruction is blown out of the sample line.***

Low Flow/Drain Fault Contact Housing

The low flow switch provides open contacts in normal operation in the low flow/drain fault contact housing that close in the event of a low flow condition. Two contact wires protrude from the side of the switch and enter the low flow contact housing through a plastic cable bushing on the left side of the housing. Terminals are provided in the low flow/drain fault contact housing for field connection to the switch contacts.

The drain fault switch senses a break or very low flow in the water drain line and provides open contacts in normal operation in the low flow/drain fault contact housing which close when the switch senses a break, a very low drain flow, or a shut down.

Connecting monitoring devices to the low flow and drain fault contact terminals provides the user with a notification of a contact closure. Each set of contacts may have their own monitoring device or they may share one. See “Installation” on page 13 for instructions to wire these terminals using the two scenarios.

A second plastic cable bushing on the bottom of the low flow/drain fault contact housing allows for cable entry to the housing. The size range of the cable which can be routed through the second cable bushing is .064’’ - .210’’ OD.

M2 Series H_2S and CH_4 Detector Heads

This section describes the external and internal components of the M2 series H_2S and CH_4 detector heads that are installed on this version of the 30-0954RK-209D aspirator panel. Other versions may have different detectors installed.

External Description

This section describes the junction box and all external components of the M2 transmitter.

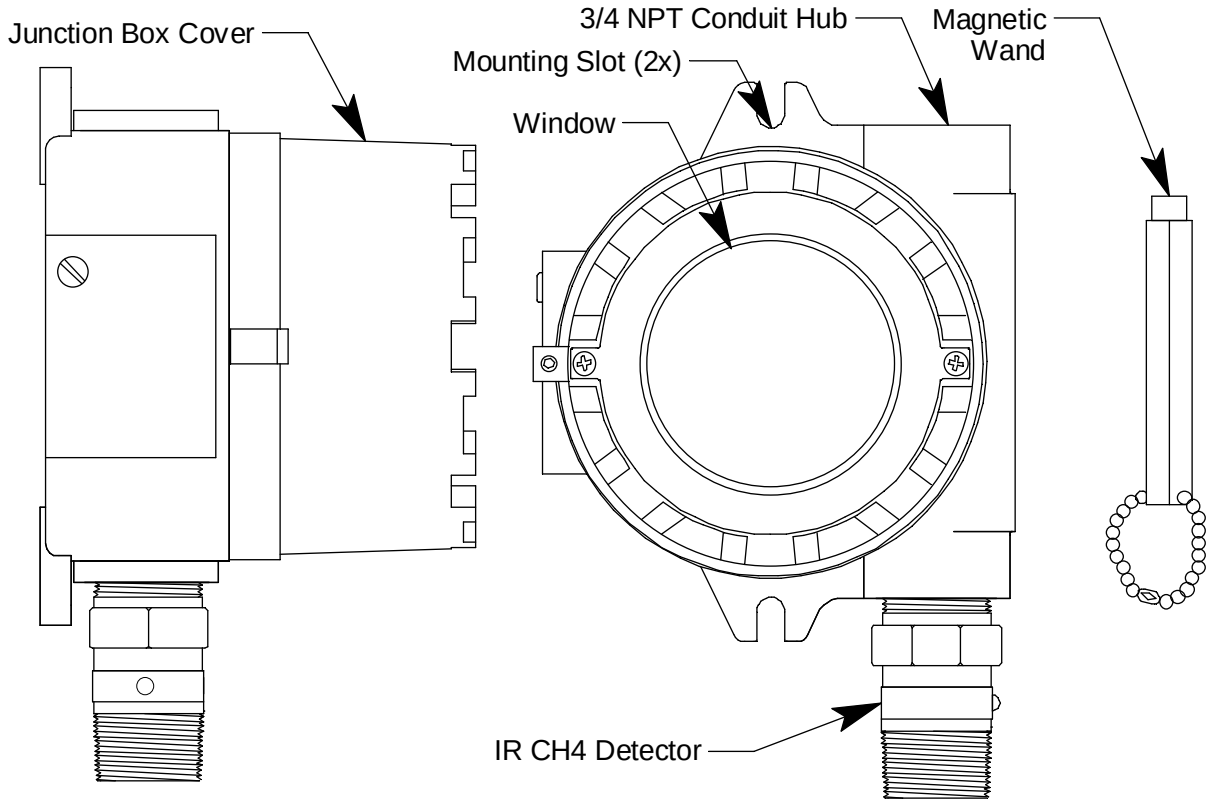

Figure 3: M2 External Components, IR CH4 Detector

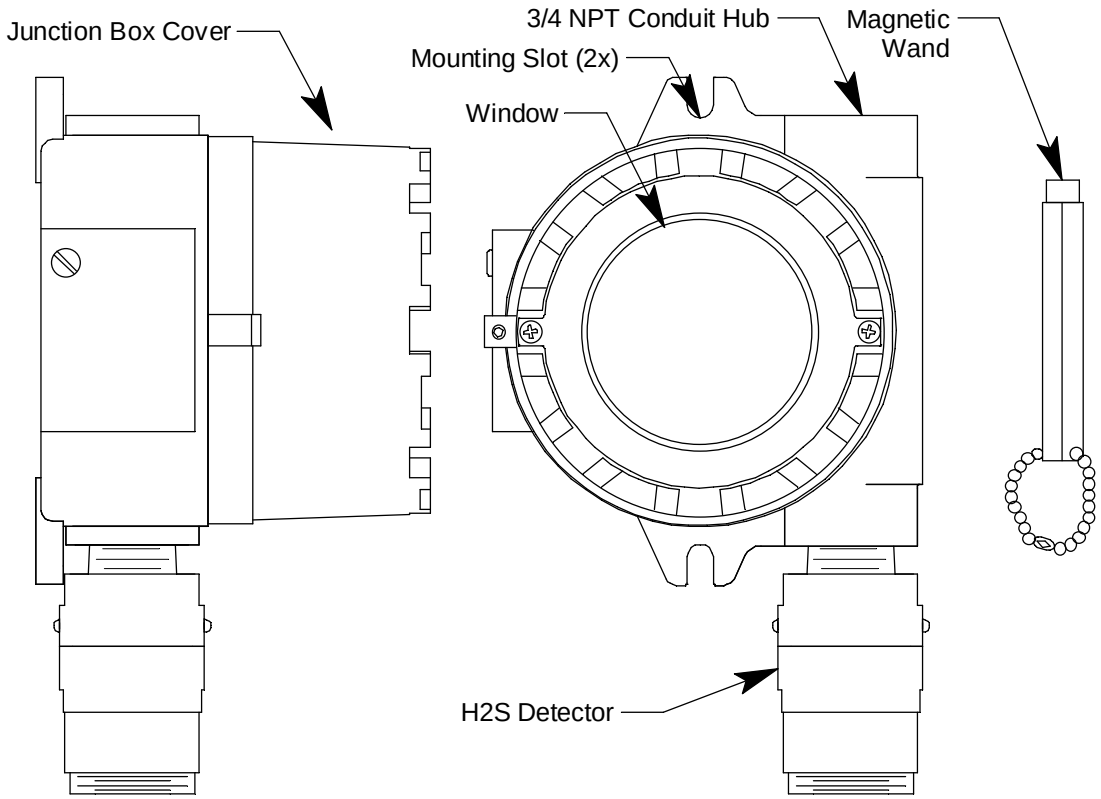

Figure 4: M2 External Components, H2S Detector

Junction Box

The M2's cast aluminum junction box is dust and weather resistant. The junction box also protects the M2 and all connections made to it. Use the two 3/4 in. conduit hubs to mount the detector to the junction box (factory installed in the bottom hub) and connect wiring from an external device (top hub).

The junction box's two mounting holes are used to mount the M2 to the aspirator panel. The window in the cover on the front of the junction box allows you to view the LCD display and use the magnetic wand to actuate the magnetic control switches so you can perform non-intrusive calibration. Removing the cover allows you to access the interior of the junction box.

Magnetic Wand

The magnetic wand is a short plastic rod with a magnet in one end. It is used to actuate the magnetic control switches on the control PCB while the junction box cover is still installed so that non-intrusive calibration can be performed.

Infrared (IR) CH_4 Detector

An IR CH_4 detector is generally used instead of the catalytic combustible detector in applications where there may be catalyst poisons such as silicone present or where oxygen is not present in the monitoring environment.

The IR CH4 detector is made up of a miniature infrared methane %volume detector housed and encapsulated in a pipe nipple. The pipe nipple has 3/4" NPT threads on each end and a 1 1/4" hex that allows removal or installation of the detector with a wrench. A porous flame arrestor that is coated with a hydrophobic film that repels liquids is on one end of the detector and allows sample

gas to enter the detector. Four color coded leads, red, white, green, and black, extend from the other end of the detector. The leads allow you to connect the detector to the amplifier.

H_2S Detector

The H_2S detector has a replaceable plug-in sensor inside the detector housing. A rubber boot and a spacer help ensure that the sensor remains plugged into the detector housing body.

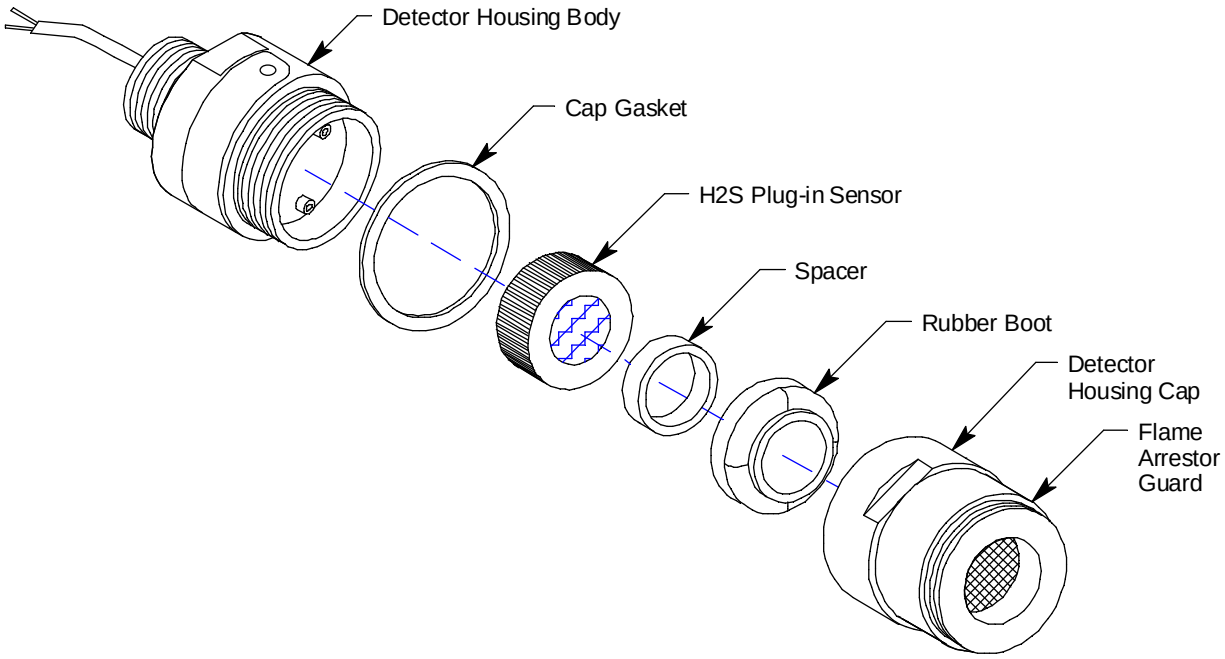

Figure 5: 65-2423RK-05 H_2S Detector, CSA

Internal Description

This section describes the internal components of the M2. The internal components of the M2 include the terminal PCB which provides for all the wiring connections to the M2 and the control PCB which displays the gas reading and has the control buttons.

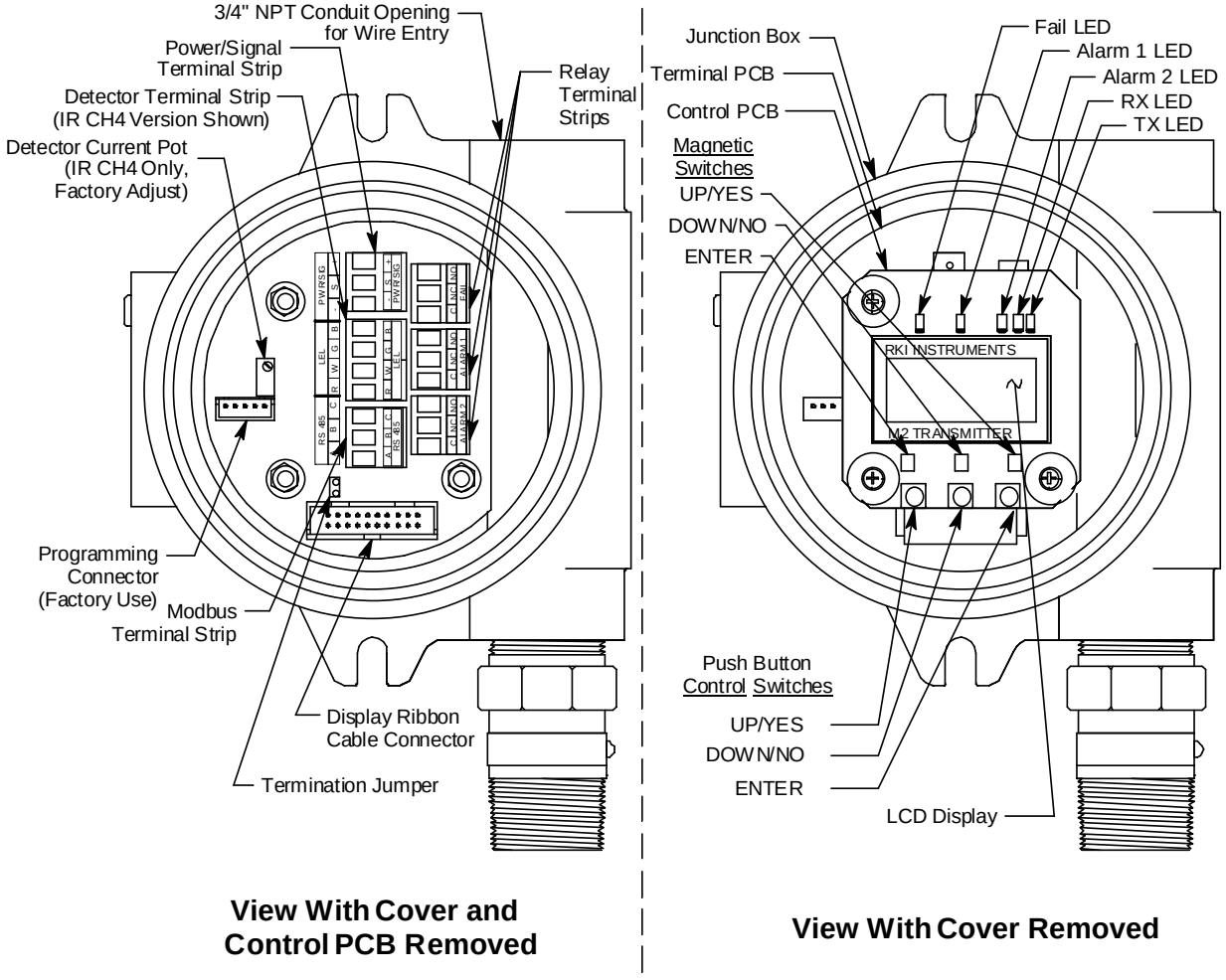

Figure 6: M2 Internal Components

Terminal PCB

The terminal PCB is encapsulated in epoxy for protection against moisture and physical damage. It is mounted into the rear of the junction box with three standoffs and rests on a thin layer of foam. A banana jack is screwed into each of the standoffs and used for mounting the control PCB. The terminal PCB converts the electrical output from the detector to a signal which can be displayed by the LCD display, a 4 - 20 mA signal (that is proportional to the detection range), and an RS-485 Modbus output signal. The 4 - 20 mA signal may be used by a recording device, gas monitor controller, or programmable controller. The Modbus output may be used to connect the M2 to a Modbus network. The terminal PCB also controls three relays, one fail and two gas alarm relays.

Two columns of plug-in style terminal strips are used to make all wiring connections to the M2. The column on the left consists of the power/signal, detector, and Modbus terminal strips. The column on the right consists of the relay terminal strips. A 20 position connector at the bottom of the terminal PCB is used to connect the terminal PCB to the control PCB with a ribbon cable. A 5 position connector on the left side of the terminal PCB is used by factory or field service personnel

to program the M2. On the combustible and CO_2 versions of the M2, a factory adjust pot just above the programming connector is used to set the detector current.

Power/Signal Terminal Strip

The power/signal terminal strip is a three position plug-in style terminal strip located at the top of the left terminal column. It is used to connect 24 VDC power to the M2 and to connect the 4 - 20 mA output signal to a device.

The signal output, the S terminal, does not have to be connected for the M2 to function. The S terminal is used if you want to connect the 4 - 20 mA output signal to another device such as a gas monitoring controller, chart recorder, or programmable controller (PLC).

Detector Terminal Strip

The detector terminal strip is a four position plug-in style terminal strip and is the middle terminal strip in the left terminal column. For the IR CH_4 detector, all four terminals are used to connect the detector to the M2. For the H_2S detector, only two of the terminals are used for connecting a detector.

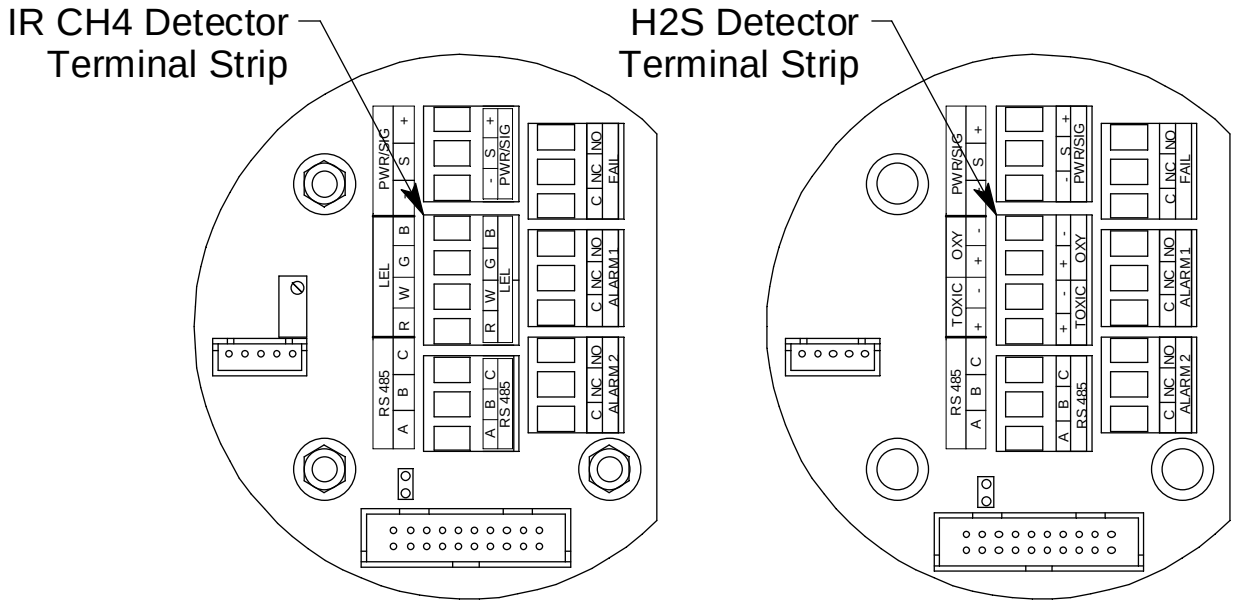

Figure 7: Detector Terminal Strip

NOTE: The detector is factory-wired to the M2. See "Wiring" on page 14. for all wiring procedures related to M2.

Modbus Terminal Strip

The Modbus terminal strip is a three position plug-in style terminal strip and is the bottom terminal strip in the left terminal column. It allows connection of the M2 into a Modbus network.

Relay Terminal Strips

The right column of terminal strips consists of, from top to bottom, the fail, alarm 1, and alarm 2 relay terminal strips. They are three-position plug-in style terminal strips. The relay terminal strips are used to connect devices such as lights and horns that are controlled by the relay contacts. The relay contacts are rated at 115 VAC, 5 amps. The relay contacts may also be used to control higher rated relays.

Termination Jumper

A two pin header with a termination jumper installed is located below the Modbus terminal strip. The jumper has no function unless the M2 is wired into a Modbus installation. See “Chapter 8: RS-485 Modbus Output” on page 44 for a description of using the M2 in a Modbus system.

Control PCB

The LCD display and control switches are located on the control PCB. It is installed on top of the terminal PCB by lining up its three spacing standoffs with the banana jacks in the terminal PCB mounting standoffs and pushing it onto the banana jacks. The jacks retain the control PCB.

LCD Display

The LCD display is located at the top of the control PCB. It indicates the current gas reading and displays messages and parameters in the M2’s programs.

Control Buttons

The M2 includes three push button switches that allow you to enter the M2’s operating modes, navigate through the modes, update settings, and save changes to the settings. The push button switches are located along the bottom edge of the control PCB (see Figure 6). The UP/YES button is on the left, the DOWN/NO button is in the middle, and the ENTER button is on the right.

Table 2: M2 Control Button Functions

Switch	Function
UP (YES)	• Saves settings • Changes the displayed setting • Enters the Calibration Program • Enters Gas Type Mode (press with DOWN/NO button) • Enters Configuration Mode (press with ENTER button)
DOWN (NO)	• Cancels setting changes • Changes the displayed setting • Enters Gas Type Mode (press with UP/YES button) • Enters Modbus Mode (press with ENTER button) • Displays the Information Screen
ENTER	• Initiates operations • Enters Configuration Mode (press with UP/YES button) • Enters Modbus Mode (press with DOWN/NO button) • Functions as an alarm reset switch

Just above each push button switch is a magnetic switch with the same function as the push button switch below it. The magnetic switches are for use in non-intrusive calibration. They are actuated by bringing the magnetic wand close enough to them to actuate them. Although the magnetic switches have the same functions as the push button switches, it is not practical to use them for operations other than calibration because it is not possible to actuate two magnetic switches at once with only one magnetic wand. Since displaying the Information Screen only requires the use of one switch, the wand may be used to show the Information Screen (see “Information Screen” on page 21).

Status LEDs

The M2 includes five status LEDs that are located above the display (see Figure 6).

- Fail LED

  The fail LED turns on when the M2 is experiencing a fail condition. A fail condition can be caused by a detector failure or low detector signal.

- Alarm 1 LED

  The alarm 1 LED is on when the M2 is experiencing an alarm 1 condition.

- Alarm 2 LED

  The alarm 2 LED is on when the M2 is experiencing an alarm 2 condition.

- RX & TX LED's

  These LED's indicate data being received (RX) and transmitted (TX) when the M2's Modbus output is operating.

Chapter 3: Installation and Startup

Overview

This section describes installation and startup procedures for the sample draw aspirator adapter.

Installation

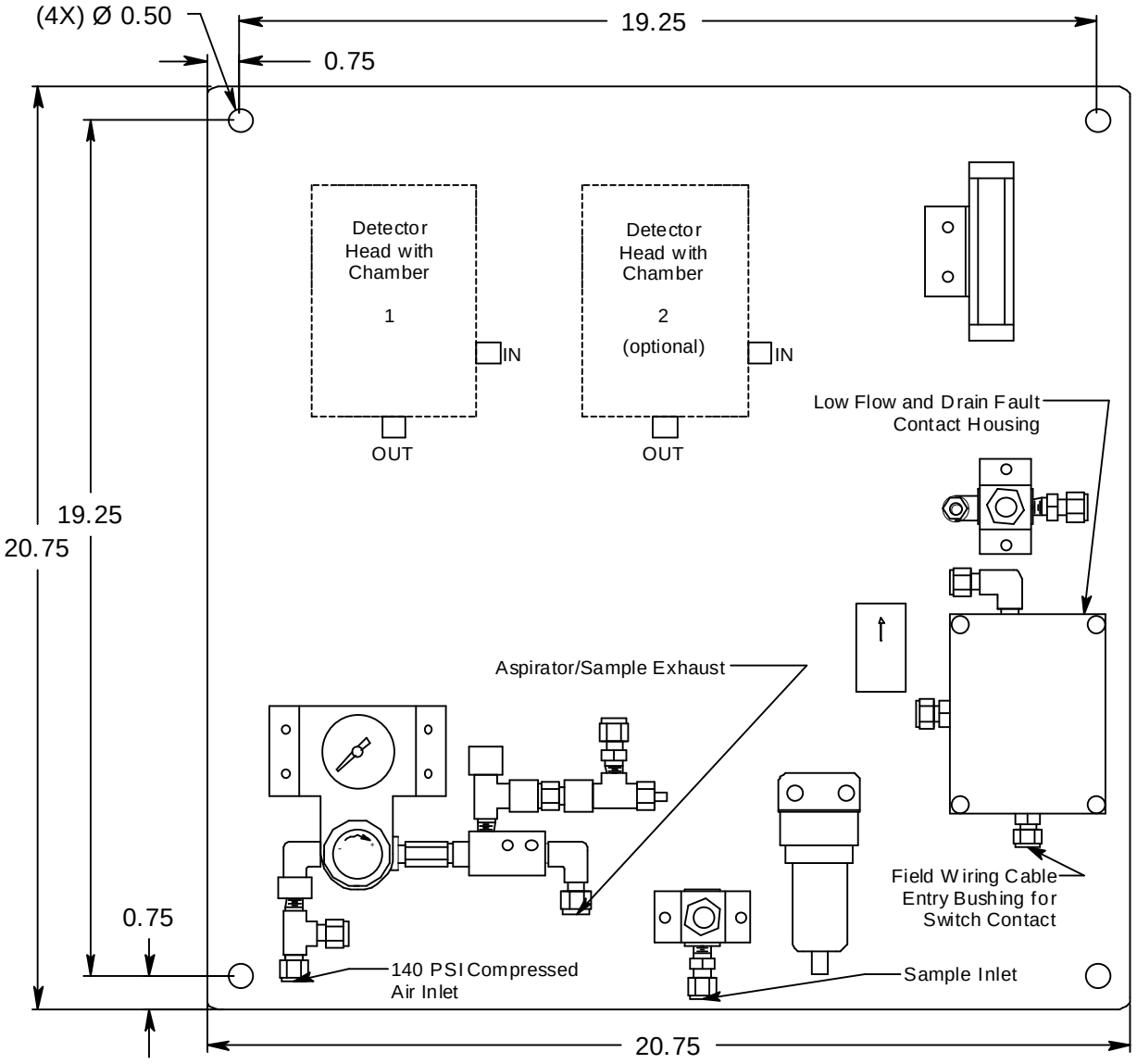

Figure 8: Outline & Mounting Dimensions

1. Install the mounting panel to a flat vertical surface using the four mounting holes (0.50'' diameter) in the corners of the panel. Make sure that sufficient space is allowed to remove the detector head's cover, and to bring power/signal wiring to the detector head. Also provide sufficient clearance for routing of sample, compressed air, and exhaust lines.

Wiring

WARNING: ***Always verify that the power source is OFF before making any wiring connections.***

1. Remove the junction box cover.
2. Grasp the control PCB by its edges.
3. Gently pull until the control PCB is pulled away from the banana jacks. Take care not to pull too hard and damage the cable which connects the control and terminal PCB's.
4. Let the control PCB hang by the cable. The terminal strips are now visible on the terminal PCB. The control PCB may be left hanging while wiring is done. If desired, the control PCB may be disconnected from the cable and set aside while wiring.
5. The detector leads are factory wired. Verify that the detector leads are wired to the detector terminal strip as shown in the applicable figure below:

   - IR CH_4 Detector

     Red wire to terminal labeled LEL R, white wire to terminal labeled LEL W, green wire to terminal labeled LEL G, black wire to terminal labeled LEL B.

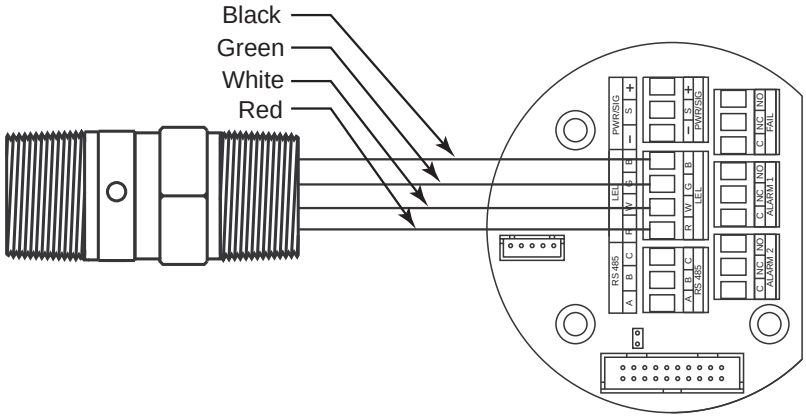

Figure 9: IR CH_4 Detector Wiring

   - H_2S Detector

     Red wire to terminal labeled TOXIC +, black wire to terminal labeled TOXIC -.

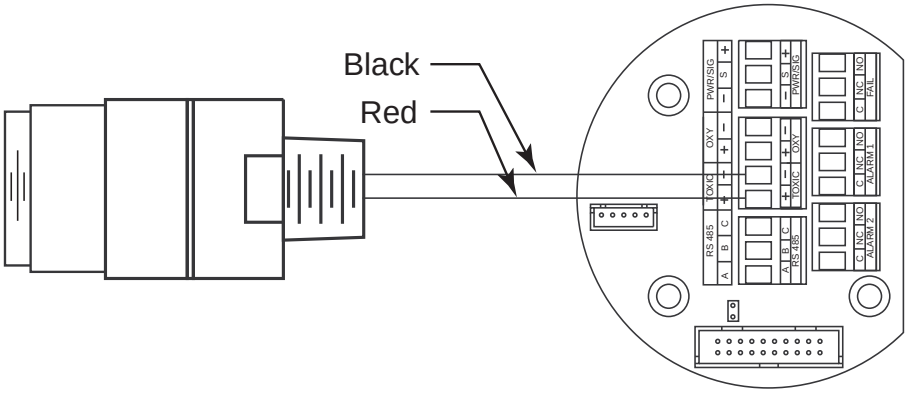

Figure 10: H_2S Detector Wiring

6. To gain access to a plug-in terminal strip for wiring, pull it out of its socket by grasping the wall between two terminal positions with needle nose pliers and pulling. Be careful not to exert too much force on the wall to avoid damage to the terminal strip. The detector terminal strip and the alarm 1 relay terminal strip may be removed by grasping them with your fingers if the adjacent terminal strips have been removed.

WARNING: ***If the M2 is installed in a hazardous location, use appropriately rated conduit, conduit fittings, and appropriate construction technique that complies with the local electrical code.***
In addition, use appropriately rated conduit, conduit fittings, and appropriate construction technique to maintain the NEMA 4 environmental rating of the junction box and avoid water entering the junction box at the conduit hubs.

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7. Guide multi conductor shielded cable or cables or wires in conduit through the top conduit hub of the junction box. The number of cables or wires needed will depend on whether the M2 is wired to a gas monitoring controller or just to power, whether any relays are used, and whether the Modbus output is used.

NOTE: If the M2 is being wired to a PLC or DCS device, see “Appendix B: PLC and DCS Device Wiring” on page 56, then continue with step 8.

Use the following recommendations to determine how to wire the M2:

- If Modbus connections will not be used and only the PWR/SIG connections will be used, use a two or three conductor shielded cable or two or three wires in conduit for connections to the power/signal terminal strip depending on whether or not the signal (S) terminal is used. The S terminal has a 4 - 20 mA output, but if you do not need to monitor this signal and do not connect to the S terminal to access this signal, the M2 will still function completely.

Table 3: Wire Size for PWR/SIG Connections

Max Distance to Controller w/18 Gauge Wire	Max Distance to Controller w/ 16 Gauge Wire	Max Distance to Controller w/14 Gauge Wire
2,500 ft.	5,000 ft.	8,000 ft.

- If the PWR/SIG connections and one or more relays are used, route the connections to the M2 in conduit. Use shielded cable in the conduit for the PWR/SIG connections and unshielded cable or individual wires for the relay connections. Make sure any wire or cable used for relay wiring is appropriately rated for the power that it will carry.

NOTE: If shielded cable is used for the PWR/SIG connections, leave the cable shield’s drain wire insulated and disconnected at the M2. You will connect the opposite end of the cable’s drain wire at the controller or device.

- If the M2 will be wired into a Modbus network, see “Chapter 8: RS-485 Modbus Output” on page 44.

See Figure 11 below for field wiring connections to the M2.

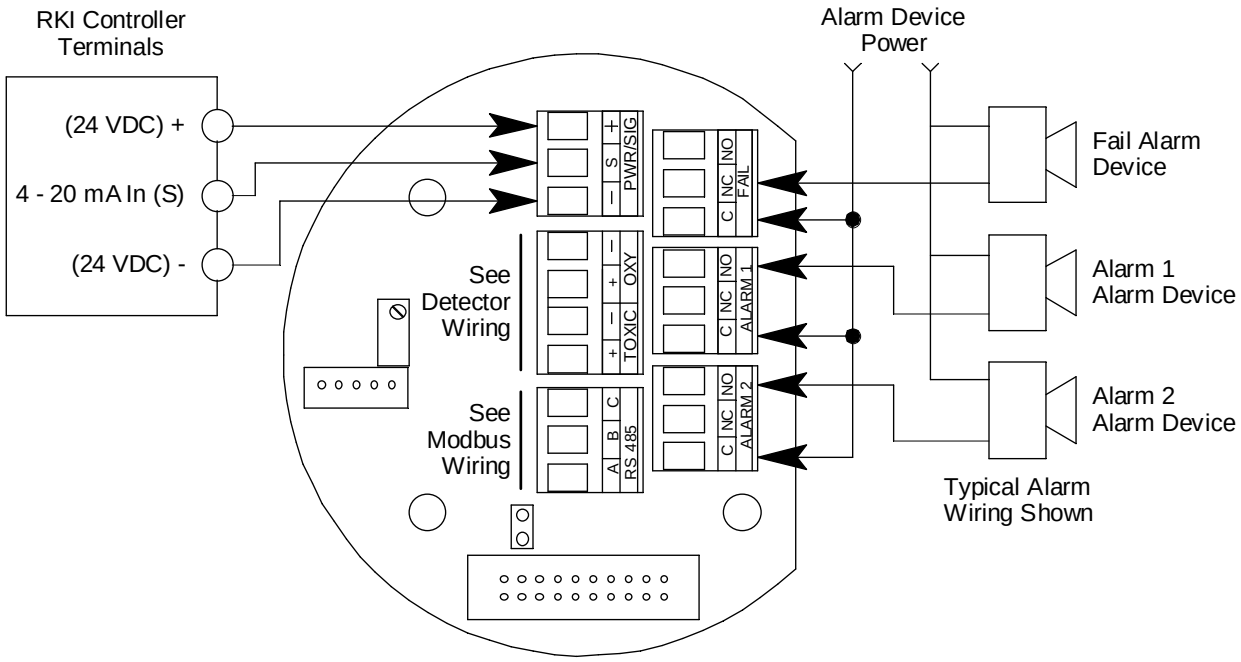


Figure 11: Wiring the M2 to a Controller and Alarm Devices

8. Re-install the control PCB (and ribbon cable if necessary). Be sure the ribbon cable is routed down below the control PCB so it will not be damaged by the cover when it is screwed back on.
9. Secure the junction box cover to the junction box.
10. Make controller, device, and relay connections as appropriate. If shielded cable is used for the PWR/SIG connections, connect the cable shield's drain wire to an available chassis ground at the gas monitoring controller, recording device, or programmable controller.

11. Connect a contact monitoring device to the low flow and drain fault contact terminals inside the low flow and drain fault contact housing using the field wiring cable entry bushing. The contacts may be wired individually or in parallel. When wired individually, you will need one monitoring device for each set of contacts. When a specific monitoring device goes into alarm, you will immediately know which set of contacts closed and what the problem is. When wired in parallel, only one monitoring device is needed to monitor both sets of contacts. However, when that device goes into alarm, it will be unclear which set of contacts closed without further investigation. Wiring diagrams for each scenario are shown below.

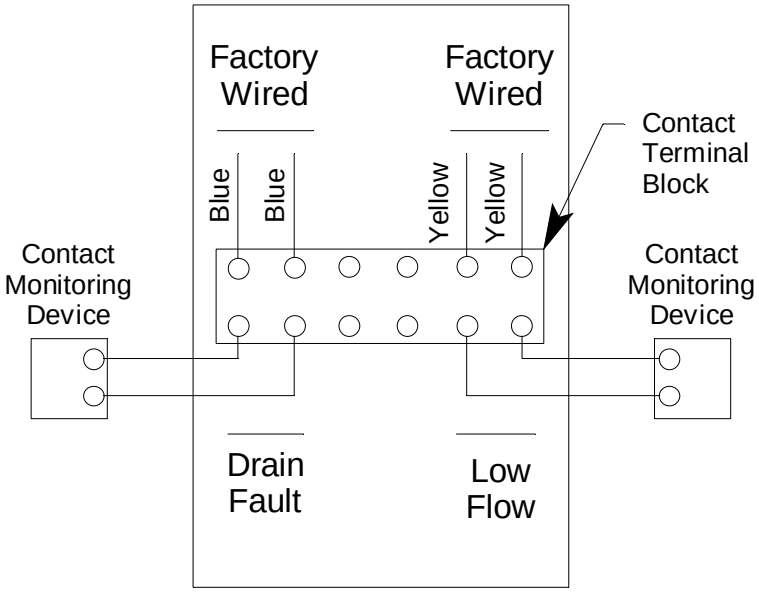


Figure 12: Low Flow and Drain Fault Wiring, Independent Wiring

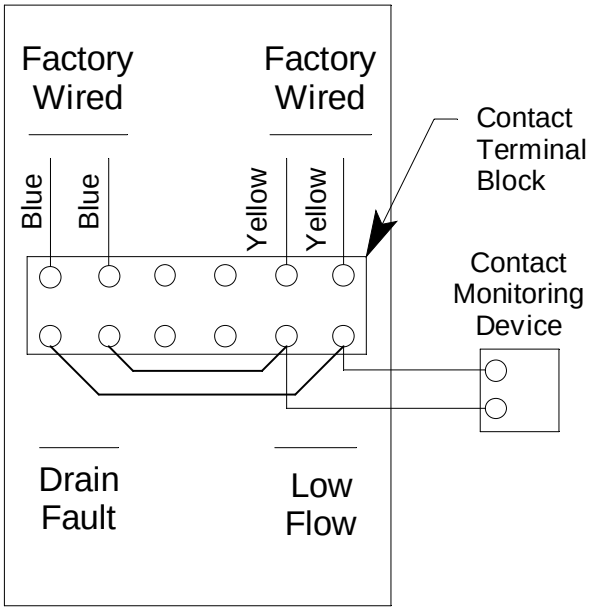


Figure 13: Low Flow and Drain Fault Wiring, Parallel Wiring

Making Tubing Connections

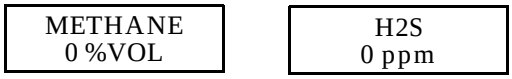
1. Connect a sample line from the area to be sampled to the sample inlet fitting at the bottom right of the panel. The fitting accepts 1/4" OD rigid tubing such as aluminum, stainless steel, Teflon, or polypropylene tubing. Be sure to use tubing appropriate for the target gas.

NOTE: If the sample draw aspirator adapter is installed in a cold area, the sample line will need to be heated in order to prevent condensation and possible freezing of the moisture in the gas sample line or sample draw aspirator adapter.

2. A particle filter is provided with the aspirator adapter but is not factory installed. Connect the particle filter to the hose barb fitting on the bottom of the H_2S dilution flowmeter using the gray tubing that's installed on the filter. The arrow on the particle filter should be pointed toward the H_2S dilution flowmeter fitting.
3. If the aspirator panel is not installed in a fresh air area, route tubing from a fresh air area to the open end of the particle filter. The fresh air line can be connected to the gray tubing on the open end of the particle filter or the gray tubing can be removed and the fresh air line can be connected directly to the open end of the particle filter.
4. The aspirator exhaust includes the sample air. It may be routed to a different area where it can be exhausted safely by running tubing from the aspirator exhaust fitting to the "safe" area. The aspirator exhaust fitting is a 1/4'' OD tubing fitting.

Start Up

1. Complete the installation procedures described earlier in this manual.
2. Verify that all wiring connections are correct and secure.
3. Verify that all tubing connections are correct and secure.
4. Turn on the incoming power.
5. The LCD display will indicate the firmware version when each M2 is first powered up and will then count down a one minute warm-up period before normal operation begins. During normal operation, the display will indicate the target gas and current gas reading. Verify that the display for each M2 is indicating the target gas and current gas reading after the warm-up period is complete and normal operation begins.



6. Turn the regulator adjustment knob completely counterclockwise and then turn it one turn clockwise so that the flow will start out at a low level when the compressed air is connected and turned on.
7. Connect a compressed air source up to a maximum of 140 PSI to the inlet of the regulator. Although the regulator is rated up to 300 PSI inlet pressure, other components are rated to a maximum of 140 PSI.

NOTE: The compressed air used for the sample draw aspirator adapter must be dry (free from humidity). If wet air is used, at low temperatures, the moisture in the air may freeze in the aspirator and cause the sample draw aspirator adapter to function improperly.

8. Adjust the regulator adjustment knob so that the flowmeter indicates 3 SCFH. The regulator exhaust pressure indicated by the regulator gauge will vary for a particular flow depending on the length of the sample line and other restrictions such as filters. Typically the pressure will be between 5 and 10 PSI for short sample runs. It will be higher for longer sample runs and if filters are used.
9. Use the adjustment knob on the H_2S dilution flowmeter to set the dilution flow to 0.6 SCFH.

NOTE: Allow the M2's detector to warm up for 15 minutes before you continue with the next section, "Setting the Fresh Air Reading."

Setting the Fresh Air Reading

When the aspirator adapter is shipped from RKI Instruments, Inc., the detectors are factory calibrated. If a full calibration is desired at startup, see "Calibration" on page 36.

Verify that the aspirator adapter is in a fresh air environment (environment known to be free of the target gas and combustible or toxic gas vapors and of normal oxygen content, 20.9%).

CAUTION: *If you suspect the presence of combustible gas or H_2S, use the calibration kit and the zero air calibration cylinder to introduce "fresh air" to the detector and verify an accurate fresh air setting. See the "Calibration" on page 36 for instructions on how to use a zero air cylinder when performing a fresh air adjustment.*

Non-Intrusive Fresh Air Signal Adjustment

If the aspirator adapter is installed in a classified area and non-intrusive zero adjustment is required, follow the instructions below, **but do not remove the junction box cover**. Use the magnetic wand accessory to actuate the magnetic switches instead of pushing the control switch buttons. To actuate a magnetic switch and perform the same operation as pressing a control switch button, touch the magnet in the end of the magnetic wand to the M2's glass cover directly over the magnetic switch you wish to actuate. Touching the glass and removing the wand is the same as pressing and releasing a button. Touching the glass and keeping the wand in place is the same as pressing and holding a button.

WARNING: ***The M2 is not an active gas monitoring device during the fresh air adjustment procedure. The 4-20 mA output signal will "freeze" at 3.5 mA, and all relays will remain in their non-alarm state while the M2 is in Calibration Mode. The output signal will not indicate current readings and the relays will not resume operating normally until the M2 is in normal operation again.***

NOTE: While in the calibration program, if there is no switch activity for the calibration time-out period the unit will return to normal operation. The factory set time-out is 15 minutes. If you want a different time-out period, see "Viewing & Changing M2 Parameters" on page 26 for instructions to change the calibration time-out.

Adjusting the Fresh Air Reading

Perform the following procedure for each M2 on the aspirator panel.

1. While in normal operation, press and hold the UP/YES button for 5 seconds to enter Calibration Mode. Release the button when the following screen appears**.**

   ```
   Calib?
   YES/NO
   ```

2. Press and release the UP/YES button to continue. The display will indicate the target gas and **CAL Mode** for a few seconds before showing **FreshAir Adjust?**.
3. Press and release the UP/YES button. **ENTER** will alternate with **FreshAir** on the top display line and the current gas reading will be on the bottom display line.
4. Press and release the ENTER button. The M2 will perform a zero operation and the display will indicate **SPAN w/Cal Gas?**.
5. Press and release the DOWN/NO button. The display will indicate **Leaving CAL Mode** and the M2 will return to normal operation.

Chapter 4: Operation

Overview

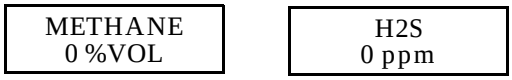
This chapter describes the aspirator adapter's M2 detector heads in normal operation. This chapter also describes the M2 in alarm 1, alarm 2, and fail conditions and suggests responses to these conditions.

Normal Operation

Normal operation for the IR CH_4 and H_2S M2s is defined as follows:

- The start-up procedure is complete.
- The M2 is not indicating an alarm 1, alarm 2, or fail condition.
- The M2 is not in Calibration, Configuration, or Gas Type modes.

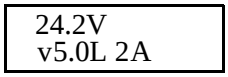
During normal operation, each M2 simultaneously displays the current gas reading, unit of measure, and target gas.



Information Screen

The Information Screen displays the M2's operating voltage and firmware and hardware information. To display the Information Screen, do the following:

1. Press and hold the DOWN/NO button for 3 seconds. The Information Screen will appear.



2. Continue holding the DOWN/NO button to keep the Information Screen on the display. The top line indicates the operating voltage that is connected to the M2. The second line indicates the firmware that is running, version 5.0 in this example, and the M2's hardware version, version 2A in this example. This information may be useful if you need to contact the factory with questions about the M2.
3. Release the DOWN/NO button when you are done viewing the Information Screen. The display will return to the normal operation screen within a couple of seconds.

4 - 20 mA Signal Output Operation

The output at the S terminal of the power/signal terminal strip of each M2 is a 4 - 20 mA signal that corresponds to the detection range of the M2. During normal operation, this signal tracks the gas concentration on the LCD.

There are several circumstances where the signal output will not track the display reading but will behave as follows:

- When the M2 is in its warm-up period, the signal output will be fixed at 3.5 mA (zero).
- When the M2's gas type is changed, the M2 will enter Configuration Mode for you to verify the parameter settings. When you exit Configuration Mode, the display will indicate **NEEDS CALIBRATION** and will continue to indicate this until Calibration Mode is entered and a calibration is performed. In this situation, the signal output will be fixed at 3.5 mA from the time Gas Type Mode is entered until the M2 is calibrated and returns to normal operation.
- If you enter Calibration Mode, Configuration Mode, Gas Type Mode, or Modbus Mode, the signal output will be fixed at 3.5 mA until the M2 returns to normal operation.
- If the M2's input power decreases below 18.5 volts so that the M2 is in a low power alarm, the signal output is fixed below 2.4 mA until the low power alarm is cleared.
- If the M2 goes into a fail condition, after a 30 second delay, the signal output is fixed below 2.4 mA until the fail alarm is cleared. During the 30 second delay, the signal output follows the detector output. In the case of a downscale reading, the display and the signal output continue to track the reading down to -99% of full scale (1.15 mA).

Alarm Indications

NOTE: The M2 includes alarm on and alarm off delay settings for alarm 1 and alarm 2. The alarm indications described in this section operate according to the factory set alarm settings. See Table 5 on page 27 for all the factory settings.

Table 4: Visual and Audible Alarm Indications

Condition	Cause	Visual Indication(s)
Alarm 1[1]	Increasing gas reading at or above the alarm 1 setpoint	• A1 LED is on • Gas reading alternates with **ALARM-1** message
Alarm 2[1]	Increasing gas reading at or above the alarm 2 setpoint	• A2 LED is on • Gas reading alternates with **ALARM-2** message
Fail	• Disconnected or misconnected detector wiring • Display reading at -10% of full scale or lower • Defective components	• F LED is on • **FAIL** message replaces gas reading *NOTE: There is a 30 second delay on the fail condition.*

Table 4: Visual and Audible Alarm Indications

Condition	Cause	Visual Indication(s)
Low Power	DC power source less than 18.5 volts.	• F LED is on • **LowPower** message and actual voltage of incoming DC power
* [1]*If the M2 is in both an alarm 1 and an alarm 2 condition, both alarm LEDs are on and the display alternates between the gas reading and the ALMS 1&2 message.*		

NOTE: You can select normally energized (N. EN) or normally de-energized (N. DE-EN) alarm 1 and alarm 2 relay settings in Configuration Mode. The following sections describe the standard factory setting for these relays which is N. DE-EN.

The fail relay is factory set as N. EN and is not user-adjustable.

Alarm 1 Condition

Alarm 1 Condition Indications

When the gas reading reaches the alarm 1 setpoint, the M2 senses an alarm 1 condition. The M2 alerts you to an alarm 1 condition as follows:

- The A1 LED turns on.
- The gas reading alternates with the **ALARM-1** message.
- The alarm 1 relay energizes.

Responding to an Alarm 1 Condition

1. Follow your established procedure for a low level combustible or toxic gas condition.
2. After the gas reading falls below the alarm 1 setpoint, press the ENTER button to reset the alarm 1 circuit. Resetting the alarm 1 circuit turns off the A1 LED, resets the LCD, and de-energizes the alarm 1 relay.

NOTE: If the ENTER button is pressed while the M2 is in an alarm 1 condition, the A1 LED will flash but all other indications will remain unchanged.

You cannot de-energize the alarm 1 relay until the gas reading falls below the alarm 1 setpoint.

Alarm 2 Condition

Alarm 2 Condition Indications

When the gas reading reaches the alarm 2 setpoint, the M2 senses an alarm 2 condition. The M2 alerts you to an alarm 2 condition as follows:

- The A2 LED turns on.
- The gas reading alternates with the **ALARM-2** message.
- The alarm 2 relay energizes.

NOTE: If the M2 is in both an alarm 1 and alarm 2 condition, both the A1 and A2 LEDs will be on, the gas reading will alternate with the **ALMS 1&2** message, and both alarm relays will energize**.**

Responding to an Alarm 2 Condition

1. Follow your established procedure for a high level combustible or toxic gas condition.
2. After the gas reading falls below the alarm 2 setpoint, press the ENTER button to reset the alarm circuit. Resetting the alarm circuit turns off the A2 light, resets the LCD, and de-energizes the alarm 2 relay.

NOTE: If the ENTER button is pressed while the M2 is in an alarm 2 condition, the A2 LED will flash but all other indications will remain unchanged.

You cannot de-energize the alarm 2 relay until the gas reading falls below the alarm 2 setpoint.

Fail Condition

Fail Condition Indications

The M2 indicates a fail condition for any of the following:

- The detector wiring is disconnected or incorrectly connected.
- The display reading is -10% of full scale or lower.

When the M2 senses a fail condition, it alerts you as follows:

- The F LED turns on.
- The gas reading is replaced by the **FAIL** message.
- The fail relay de-energizes.

NOTE: The fail alarm has a 30 second delay.

Responding to a Fail Condition

1. Verify that the detector wiring is correctly and securely connected.
2. If the M2 has a replaceable plug-in sensor, verify that the replaceable plug-in sensor in the detector housing is properly installed.

Low Power Alarm

Low Power Alarm Indications

The M2 senses a low power condition when the DC power source is 18.5 volts or less.

WARNING: While in a low power condition, the M2 is not an active gas monitor.

When the M2 senses a low power condition, it alerts you as follows:

- The F LED turns on.
- The message **LowPower** is indicated on the top line of the LCD and the input voltage is displayed on the bottom line of the LCD.
- The fail relay de-energizes.

NOTE: The low power alarm cannot be cleared using the ENTER button.

When the voltage increases to 19.0 volts, the low power alarm is cleared and the M2 will begin its warm-up sequence.

Responding to a Low Power Condition

1. Determine and correct the cause of the low power condition.
2. When the input power increases above 19.0 volts, the M2 will begin its warm-up sequence.
3. Verify that the M2 enters normal operation after its warm-up sequence. If necessary, perform a fresh air adjustment. See “Setting the Fresh Air Reading” on page 19.

Chapter 5: Configuration Mode

Overview

This chapter describes how to view and change M2 parameters using Configuration Mode. It is accessed using the program buttons.

NOTE: The Configuration Mode parameters are factory set and should not need user adjustment.

Configuration Mode includes a 5-minute time-out feature. If you do not press a control button for 5 minutes, the M2 automatically returns to normal operation.

NOTE: If the M2 returns to normal operation because of a time-out, it enters a warm-up period just as it does when it is first turned on.

If you are installing a new M2, it has been setup at the factory. Use Configuration Mode only if you want to change the M2's setup. If you want to change the detector type see "Chapter 6: Gas Type Mode" on page 29.

Viewing & Changing M2 Parameters

1. While in normal operation, simultaneously press and hold the UP/YES and ENTER buttons for 5 seconds to enter Configuration Mode. Release the buttons when the following screen appears.

   Enter
   Config?

2. If you want to exit Configuration Mode, press and release the DOWN/NO button and the M2 will return to normal operation.

   If you want to continue in Configuration Mode, press and release the UP/YES button. The target gas and the full scale will be displayed for a few seconds before the first adjustable parameter, the alarm 1 setpoint, is displayed.

3. If you want to change the currently displayed parameter, use the UP/YES and DOWN/NO buttons to adjust it to the desired setting, then press ENTER to continue to the next parameter.

   If the currently displayed parameter is OK, press the ENTER button to proceed to the next parameter.

   Table 5 lists the M2 parameters you can set. Table 5 also lists the factory set value for each parameter.

Table 5: Configuration Parameters

Parameter (Factory Set Value)	Description
ALARM-1 (level) (See “Specifications” on page 1)	The gas reading at which the M2 initiates an alarm 1 condition.
ALARM-1 (activation) (Increase)	Indicates if the alarm 1 circuit is activated by gas readings increasing (**Increase**) or decreasing (**Decrease**) to the ALARM-1 Level.
ALARM-1 (relay action) (N. DE-EN)	If set as **N. DE-EN**, the alarm 1 relay is de-energized in normal operation and energizes when an alarm 1 condition is initiated. If set as **N. EN**, the alarm 1 relay is energized in normal operation and de-energizes when an alarm 1 condition is initiated.
ALARM-1 (relay reset) (LATCH)	If set as **LATCH**, you must press the ENTER button to reset the alarm 1 circuit after the alarm 1 condition passes. If set as **SELF-RST**, the M2 automatically resets the alarm 1 circuit after the alarm 1 condition passes.
A1 OnDy (alarm 1 on delay) (1 secs)	The amount of time the M2 delays activation of the alarm 1 circuit once an alarm 1 condition is initiated. It can be set in 1 second increments from 0 - 60 seconds, in 1 minute increments from 1 - 15 minutes, and in 15 minute increments from 15 - 60 minutes.
A1 OffDy (alarm 1 off delay) (0 sec.)	The amount of time the M2 delays turning off the alarm 1 circuit once an alarm 1 condition passes. This parameter appears only if the alarm 1 relay reset setting is set to **SELF-RST**. It can be set in 1 second increments from 0 - 60 seconds, in 1 minute increments from 1 - 15 minutes, and in 15 minute increments from 15 - 60 minutes.
ALARM-2 (level) (See “Specifications” on page 1)	The gas reading at which the M2 initiates an alarm 2 condition.
ALARM-2 (activation) (Increase)	Indicates if the alarm 2 circuit is activated by gas readings increasing (**Increase**) or decreasing (**Decrease**) to the ALARM-1 Level.
ALARM-2 (relay action) (N. DE-EN)	If set as **N. DE-EN**, the alarm 2 relay is de-energized in normal operation and energizes when an alarm 2 condition is initiated. If set as **N. EN**, the alarm 2 relay is energized in normal operation and de-energizes when an alarm 2 condition is initiated.
ALARM-2 (relay reset) (LATCH)	If set as **LATCH**, you must press the ENTER button to reset the alarm 2 circuit after the alarm 2 condition passes. If set as **SELF-RST**, the M2 automatically resets the alarm 2 circuit after the alarm 2 condition passes.
A2 OnDy (alarm 2 on delay) (1 secs)	The amount of time the M2 delays activation of the alarm 2 circuit once an alarm 2 condition is initiated. It can be set in 1 second increments from 0 - 60 seconds, in 1 minute increments from 1 - 15 minutes, and in 15 minute increments from 15 - 60 minutes.
A2 OffDy (alarm 2 off delay) (0 sec.)	The amount of time the M2 delays turning off the alarm 2 circuit once an alarm 2 condition passes. This parameter appears only if the alarm 2 relay reset setting is set to **SELF-RST**. It can be set in 1 second increments from 0 - 60 seconds, in 1 minute increments from 1 - 15 minutes, and in 15 minute increments from 15 - 60 minutes.

Table 5: Configuration Parameters (Continued)

Parameter (Factory Set Value)	Description
ZeroSupp (2% of the **detection range** in terms of the detection units)	The zero suppression feature helps prevent “jumpy” readings near the fresh air reading. For example, if the zero suppression setting for the H_2S detector is **2.0% ppm,** the M2 will display a reading of 0 ppm for gas readings from -2 ppm to 2 ppm. It is settable from 0 to 6% of the detection range.
FILTER (5 secs)	The filter feature helps “smooth out” jumpy or noisy signals from the detector. You can set the filter from 0 seconds to 60 seconds in 5 seconds increments. The displayed gas reading is the average reading over the previous time period defined by the filter setting. So if the filter is set to 5 seconds, the displayed gas reading is the average over the past 5 seconds.
CAL Time (15 mins)	The calibration time-out sets the amount of time after the last button push while in Calibration Mode that the M2 will wait before returning to normal operation. If the calibration time-out is set to **15 mins**, then M2 will return to normal operation automatically 15 minutes after the last button push.
Auto Zero (Enabled)	If set to **Enabled**, the M2’s firmware will monitor the zero (fresh air) reading and make automatic zero adjustments under precisely specified conditions if it determines that a reading change is due to normal sensor drift. If set to **Disabled**, the Auto Zero function is turned off.

4. When you have scrolled through all the adjustable parameters, **SAVE IT? YES/NO** appears on the display.
5. If you do not wish to save the adjustments and want to exit Configuration Mode, press and release the DOWN/NO button. The **DO OVER? YES/NO** message will display. Press and release the DOWN/NO button. The **ABORT? YES/NO** message will display. Press the UP/YES button to return to normal operation.

   If you wish to change some of the adjustments made, press and release the DOWN/NO button. The **DO OVER? YES/NO** message will display. Press and release the UP/YES button. The **Re-do Config** message will display and the M2 will return to the first adjustable parameter. Go back to step 3 and continue.

   If you wish to save the adjustments made, press and release the UP/YES button. **Config Saved** is indicated on the display for a few seconds and the M2 returns to normal operation.

Chapter 6: Gas Type Mode

Overview

This chapter describes how to use Gas Type Mode to select the M2's gas type. The gas type determines the target gas and detection range. The combustible gas/CO_2 and toxic/oxygen M2s have a different terminal PCB and run on different firmware. Your M2 will only have gas type choices available that it can support.

NOTE: The Gas Type Mode parameters are factory set and should not need user adjustment.

Gas Type Mode includes a 5-minute time-out feature. If you do not press a button for 5 minutes, the M2 automatically returns to normal operation.

NOTE: If the M2 enters normal operation because of a program time-out, it enters a warm-up period just as it does when it is first turned on.

Selecting the Gas Type

1. While in normal operation or during the warm-up sequence, press and hold the UP/YES and DOWN/NO buttons for five seconds. Release them when the following screen appears.

   ```
   Select
   GasType?
   ```

2. If you want to exit Gas Type Mode, press and release the DOWN/NO button. The display will indicate **NO CHANGE** and the M2 will return to normal operation.

   If you want to continue in Gas Type Mode, press and release the UP/YES button. The top display line will indicate **GasType?** and the bottom display line will indicate the target gas choice.

3. Use the UP/YES or DOWN/NO button to scroll through the choices of target gas. Table 6 and Table 7 below list the choices of target gas for the M2.

Table 6: Combustible Gas/CO_2 Gas Types

Gas Type Choices	Detection Range
HC	0 - 100% LEL
iBUTANE	0 - 100% LEL
PROPANE	0 - 100% LEL
HEXANE	0 - 100% LEL
HYDROGEN	0 - 100% LEL
METHANE	0 - 100% Volume

Table 6: Combustible Gas/CO_2 Gas Types

Gas Type Choices	Detection Range
METHANE	0 - 100% LEL
CO2	0 - 5,000 ppm
CO2	0 - 2,000 ppm
CO2	0 - 100% volume
CO2	0 - 50.0% volume
CO2	0 - 5.00% volume
NH3	0 - 5.00% volume
NH3	0 - 2.00% volume

Table 7: Toxic/Oxygen Gas Types

Gas Type Choices	Detection Range
H2S	0 - 100 ppm
CO	0 - 300 ppm
OXYGEN	0 - 25.0% volume
SIH4	0 - 15.0 ppm
PH3	0 - 1.00 ppm
O3	0 - 1.00 ppm
NO	0 - 100 ppm
HF	0 - 9.00 ppm
HCN	0 - 15.0 ppm
HCL	0 - 15.0 ppm
H2SE	0 - 5.00 ppm
GEH4	0 - 1.50 ppm
F2	0 - 3.00 ppm
CLO2	0 - 1.00 ppm
B2H6	0 - 5.00 ppm
ASH3	0 - 1.50 ppm
SO2	0 - 6.00 ppm
NH3	0 - 200 ppm

Table 7: Toxic/Oxygen Gas Types

Gas Type Choices	Detection Range
NH3	0 - 75.0 ppm
CL2	0 - 3.00 ppm
CL2	0 - 10.0 ppm

NOTE: Consult factory for availability of detectors for toxic M2 types not listed in "Specifications" on page 1.

4. When the desired target gas is on the display, press and release the ENTER button. The display will ask **SAVE IT? YES/NO**.
5. To discard the gas type change, press and release the DOWN/NO button. The display will ask **DO OVER? YES/NO**. Press the DOWN/NO button. The display will ask **ABORT? YES/NO**. Press the UP/YES button. The M2 will return to normal operation without changing the gas type.

   To save the gas type, press and release the UP/YES button. The display will indicate **Gas Type Updated**, the display will indicate the target gas and the detection range for a few seconds, and then the M2 will enter Configuration Mode automatically so that the parameter settings in Configuration Mode can be verified or changed.
6. While in Configuration Mode press and release the ENTER button to accept the displayed parameter setting and move to the next one. Use the UP/YES and DOWN/NO buttons to adjust a setting. See "Chapter 5: Configuration Mode" on page 26 for a complete description of Configuration Mode.
7. When you have reviewed and accepted the last item in Configuration Mode by pressing the ENTER button, display will ask **SAVE IT? YES/NO**.
8. To save the configuration settings, press and release the UP/YES button.The display will indicate **Config Saved** and the M2 will begin its warm-up sequence.

   To discard the settings and review them again, press the DOWN/NO button. The display will ask **DO OVER? YES/NO**. Press the UP/YES button and the display will indicate **Re-do Config**, then display the target gas and the detection range for a few seconds before returning to Configuration Mode. Repeat steps 6 - 8 until the settings are as desired.
9. After the M2 completes its warm-up sequence, the display will indicate **CAL NEEDED**. Since the gas type has been changed, a successful calibration must be performed before the M2 can enter normal operation.
10. Press and release the UP/YES button to enter Calibration Mode. Normally, you must hold the UP/YES button for 5 seconds to enter Calibration Mode, but since a calibration is required, only a momentary push is needed to enter Calibration Mode after changing the gas type.
11. See "Calibration" on page 36 for calibration instructions.

NOTE: When calibrating an M2 after changing the gas type, the M2 will not ask if you want to calibrate, or whether you want to perform a fresh air adjustment, span adjustment or zero adjustment. Since a complete calibration is required, the calibration sequence will proceed without asking if you want to perform certain operations.

Chapter 7: Maintenance

Overview

This chapter describes procedures for performing preventive maintenance, troubleshooting, calibrating the M2, replacing field replaceable parts, performing a blowback operation, setting the drain fault switch, and replacing components of the aspirator adapter.

Preventive Maintenance

This section describes a recommended preventive maintenance schedule to ensure the optimum performance of the M2. It includes daily, monthly, and quarterly procedures.

Daily

1. Verify a display reading of zero. Investigate significant changes in the reading.
2. Verify that the sample flowrate is 3 SCFH and that the H_2S dilution flowrate is 0.6 SCFH.

Monthly

This procedure describes a test to verify that each M2 responds properly to the target gas.

NOTE: Performing a response test on the M2 may cause alarms. If you do not want external alarms to actuate, disable any external alarms during the response test to avoid unwanted external alarm indications.

NOTE: The following procedure assumes the use of a calibration kit which includes a calibration gas cylinder, a demand flow regulator, and a short piece of sample tubing to connect the regulator to the calibration valve.

1. Disable all external alarms if external alarm indications are not desired during the response test.
2. Connect the calibration kit sample tubing to the hose barb calibration fitting on the aspirator adapter's calibration valve.
3. Connect the demand flow regulator to the calibration fitting using the sample tubing.
4. Screw the CH_4 calibration gas cylinder into the demand flow regulator.
5. Push and hold the button on the calibration valve to start the flow of gas through the calibration gas fitting.
6. Use the regulator to adjust the sample flow to 3 SCFH and use the adjustment knob on the H_2S dilution flowmeter to set the dilution flow to 0.6 SCFH.

NOTE: If the flowrates are not adjusted at the beginning of the response test, the response will not be accurate.

7. Allow calibration gas to flow for one minute.
8. Verify that the display reading is within ± 20% of the gas concentration.

NOTE: If the reading is not within ± 20% of the gas concentration, calibrate the M2 as described in “Calibration” on page 36.

9. Release the push button on the calibration valve.
10. Unscrew the CH_4 calibration gas cylinder from the demand flow regulator.
11. Screw the H_2S calibration cylinder into the demand flow regulator.

NOTE: Depending on the size of the CH_4 and H_2S cylinders, you may need a different regulator for each cylinder.

12. Push and hold the button on the calibration valve to start the flow of gas through the calibration gas fitting.
13. Confirm that the sample flowrate is 3 SCFH and that the H_2S dilution flowrate is 0.6 SCFH. If the flowrates are not 3 SCFH and 0.6 SCFH, respectively, use the regulator and the H_2S dilution flowmeter’s adjustment valve to set them.

NOTE: If the flowrates are not correct, the response test will not be accurate.

14. Allow calibration gas to flow for one minute.
15. Verify that the display reading is within ± 20% of the gas concentration.

NOTE: If the reading is not within ± 20% of the gas concentration, calibrate the M2 as described in “Calibration” on page 36.

16. Release the push button on the calibration valve.
17. Unscrew the H_2S calibration cylinder from the demand flow regulator and disconnect the sample tubing from the hose barb calibration fitting on the calibration valve.
18. Use the regulator to adjust the sample flow to 3 SCFH and use the H_2S dilution flowmeter’s adjustment valve to set the dilution flow to 0.6 SCFH.
19. If external alarms have been disabled, enable them when the display returns to a normal fresh air reading.
20. Store the components of the calibration kit in a safe place.

Quarterly

Calibrate the H_2S M2 detector as described in “Calibration” on page 36. See “Calibration Frequency” on page 35 for a discussion of calibration frequency guidelines.

Biannually

Calibrate the IR CH_4 M2 detector as described in “Calibration” on page 36. See “Calibration Frequency” on page 35 for a discussion of calibration frequency guidelines.

Troubleshooting

The troubleshooting guide describes symptoms, probable causes, and recommended action for problems you may encounter with the aspirator adapter.

Table 8: Troubleshooting the Aspirator Adapter

Condition	Symptom(s)	Probable Causes	Recommended Action
No Power	The M2 display backlight is off and the display screen is blank.	• The power wiring is disconnected or misconnected. • The M2 display cable is disconnected or misconnected.	1. Verify that the wiring to the power source or controller is correct and secure. 2. Verify that the ribbon cable connecting the terminal PCB to the control PCB is securely installed. This ribbon cable plugs into a connector on the top edge of the control PCB and on the bottom of the terminal PCB. 3. If the power difficulties continue, contact RKI for further instruction.
Frequent or Suspect Alarms	The M2 alerts you to frequent or suspect alarms while the fresh air readings remain on zero.	• The M2 is experiencing false readings due to RFI or EMI. • The detector wiring is disconnected, misconnected, or intermittent.	1. Verify that the M2 wiring is properly shielded. See “Wiring” on page 14. 2. Verify that the detector wiring is correct and secure. 3. Increase the alarm on delay setting in Configuration Mode. 4. If the frequent or suspect alarm difficulties continue, contact RKI for further instruction.
Flickering Display	The M2 display reading flickers often.	• The M2 is experiencing false readings due to RFI or EMI. • The noise filter setting is too low. • The zero suppression setting is too low. • The display screen is malfunctioning.	1. Verify that the M2 wiring is properly shielded. See “Wiring” on page 14. 2. Verify that the detector wiring is correct and secure. 3. Increase the filter setting in Configuration Mode. 4. Increase the zero suppression setting in Configuration Mode. 5. If the display difficulties continue, contact RKI for further instruction.

Table 8: Troubleshooting the Aspirator Adapter

Condition	Symptom(s)	Probable Causes	Recommended Action
Fail Condition	• M2 indicates a fail condition. • Controller indicates a fail condition	• The detector wiring to the terminal PCB is disconnected or misconnected. • The wiring from the M2 to the controller is disconnected or misconnected. • The detector fresh air signal is low enough to cause a fail condition. • The detector is malfunctioning. • The terminal or display PCB is malfunctioning.	1. Verify that the detector wiring is correct and secure. 2. Verify that the wiring between the M2 and the controller is correct and secure. 3. Calibrate the M2. 4. If the fail condition continues, replace the detector. 5. If the fail condition continues, contact RKI for further instruction.
Slow or No Response/ Difficult or Unable to Calibrate	• M2 responds slowly or does not respond to response test. • Unable to successfully set the fresh air or span reading during calibration. • M2 requires frequent calibration. ***Note:*** *See "Calibration Frequency" on page 35 for calibration frequency guidelines.*	• The calibration cylinder is low, out-dated, or defective. • The detector is malfunctioning. • The terminal PCB is malfunctioning.	1. Verify that the calibration cylinder contains an adequate supply of a fresh test sample. 2. If the calibration/response difficulties continue, replace the detector. 3. If the calibration/response difficulties continue, contact RKI for further instruction.
Insufficient Flow	• Sample flowmeter cannot be adjusted to 3 SCFH • H_2S dilution flowmeter cannot be adjusted to 0.6 SCFH	• Particle filter is clogged. • Compressed air source is insufficient or incorrectly connected.	1. Replace the particle filter. 2. Ensure that the compressed air source is sufficient and that it's correctly connected to the aspirator adapter. 3. If the flow still cannot be set, contact RKI for further instruction.

Calibration Frequency

The CH_4 detector is an IR (infrared) detector. The H_2S detector is an electrochemical detector. The IR CH_4 detector typically needs less frequent calibration as is discussed below.

Although there is no particular calibration frequency that is correct for all applications, a calibration frequency of every 3 to 6 months for the H_2S M2 detector and every 6 to 12 months for the IR CH_4 M2 detector is adequate for most aspirator adapter applications. Unless experience in a particular application dictates otherwise, RKI Instruments, Inc. recommends a calibration frequency of every 3 months for the H_2S M2 detector and every 6 months for the IR CH_4 M2 detector.

If an application is not very demanding, for example detection in a clean, temperature controlled environment where the toxic or combustible target gas is not normally present, and calibration

adjustments are minimal at calibration, then a calibration frequency of every 6 months for the H_2S M2 detector or 12 months for the IR CH_4 M2 detector is adequate.

If an application is very demanding, for example if a combustible or toxic gas is present often and in significant concentrations or the environment is not well controlled, then more frequent calibration than every 3 months for the H_2S M2 detector or every 6 months for the IR CH_4 M2 detector may be necessary.

Calibration

This section describes how to calibrate the IR CH_4 and H_2S M2 detectors. It includes procedures to prepare for calibration, enter Calibration Mode, adjust the fresh air (zero) setting, adjust the span setting, and return to normal operation.

WARNING: ***The M2 is not an active gas monitoring device during the calibration procedure. The 4-20 mA output signal will "freeze" at 3.5 mA and all relays will remain in their non-alarm state while the M2 is in Calibration Mode. The output signal will not indicate current readings and the relays will not resume operating normally until the M2 is in normal operation again.***

Non-Intrusive Calibration

If the M2 is installed in a classified area and non-intrusive calibration is required, follow the instructions below, but do not remove the junction box cover. Use the magnetic wand accessory to actuate the magnetic switches instead of pushing the control switch buttons. To actuate a magnetic switch and perform the same operation as pressing a control switch button, touch the magnet in the end of the magnetic wand to the M2's glass cover directly above the magnetic switch you wish to actuate. Touching the glass and removing the wand is the same as pressing and releasing a button. Touching the glass and keeping the wand in place is the same as pressing and holding a button.

Calibration Gas Response Memory Feature

The M2 has the capability to "remember" the detector's response to the calibration gas after the gas is removed from the detector during the fresh air and span adjustment procedure. This feature enables one person to perform a calibration if the detector is mounted remotely from the M2. When zero air is applied to the M2 during a fresh air adjustment, the M2 will freeze the display reading at the lowest response and the M2 will continue to display this reading and retain it in its memory until the fresh air adjustment procedure is completed. When calibration gas is applied to the M2 during a span adjustment, the M2 will freeze the display reading at the highest response to the calibration gas. The calibration gas can then be removed and the M2 will continue to display this reading and retain it in its memory until the span adjustment procedure is completed.

Preparing for Calibration

NOTE: The following procedure assumes the use of a calibration kit which includes a calibration gas cylinder, a zero air cylinder, a demand flow regulator, and a short piece of sample tubing to connect the regulator to the calibration valve.

NOTE: While in the calibration program, if there is no switch activity for the calibration time-out period the unit will return to normal operation. See "Viewing & Changing M2 Parameters" on page 26 for instructions to set the calibration time-out.

NOTE: The following procedure assumes that the target gas is present in a high enough concentration to affect the fresh air (zero) reading. If a fresh air environment can be verified, applying zero air to the detector is not necessary when setting the zero reading.

1. Connect the calibration kit sample tubing to the hose barb calibration fitting on the aspirator adapter's calibration valve.
2. Connect the demand flow regulator to the calibration fitting using the sample tubing.

Adjusting the Fresh Air Reading

Follow these instructions for each M2.

1. While in normal operation, press and hold the UP/YES button for 5 seconds to enter Calibration Mode. Release the button when the following screen appears.

   ```
   Calib?
   YES / NO
   ```

2. If you want to continue with calibration, press and release the UP/YES button. The display will indicate the target gas and **CAL Mode** for a few seconds before showing **FreshAir Adjust?**.

   If you want to exit Calibration Mode, press and release the DOWN/NO button. The M2 will indicate **Leaving CAL Mode** and the M2 will return to normal operation.

3. To continue with adjusting the fresh air reading, press and release the UP/YES button. **ENTER** will alternate with **FreshAir** on the top display line and the current gas reading will be on the bottom display line.

   To skip adjusting the fresh air reading, press and release the DOWN/NO button. The display will indicate **SPAN w/Cal Gas?**. Skip to the next section, "Adjusting the Span Setting".

4. Screw the zero air cylinder into the demand flow regulator.
5. Push and hold the button on the calibration valve to start the flow of gas through the calibration gas fitting.
6. Use the regulator to adjust the sample flow to 3 SCFH and use the adjustment knob on the H_2S dilution flowmeter to set the dilution flow to 0.6 SCFH.

NOTE: If the flowrates are not adjusted at the beginning of the calibration, the calibration will not be accurate.

7. Allow zero air to flow for two minutes. If there was gas present causing a reading on the M2, the reading should decrease and stabilize after two minutes.
8. Release the push button on the calibration valve. The M2 will continue to display the minimum gas response on the display and retain the response level in its memory.
9. Press and release the ENTER button. The M2 will perform a fresh air adjustment and the display will indicate **SPAN w/Cal Gas?**.
10. If necessary, repeat the fresh air process for the second detector.
11. Unscrew the zero air cylinder from the demand flow regulator.

NOTE: If the fresh air adjustment fails, see "Troubleshooting" on page 34 for recommended actions.

Adjusting the Span Setting

Follow these instructions for each M2.

1. If you want to continue with adjusting the span setting, press and release the UP/YES button. **APPLY** will alternate with **SPAN Gas** on the top display line and the current gas reading will be on the bottom display line.

   If you want to skip adjusting the span reading, press and release the DOWN/NO button. The display will indicate **Leaving Cal Mode** and the M2 will return to normal operation.

2. Screw the calibration gas cylinder into the demand flow regulator.
3. Push and hold the button on the calibration valve to start the flow of gas through the calibration gas fitting.
4. Confirm that the sample flowrate is 3 SCFH and that the H_2S dilution flowrate is 0.6 SCFH. If the flowrates are not 3 SCFH and 0.6 SCFH, respectively, use the regulator and the H_2S dilution flowmeter's adjustment valve to set them.

NOTE: If the flowrates are not correct, the calibration will not be accurate.

---

5. Allow calibration gas to flow for two minutes. The gas reading should be stable after two minutes.
6. Release the push button on the calibration valve.
7. Unscrew the calibration gas cylinder from the demand flow regulator. The M2 will continue to display the maximum gas response on the display and retain the response level in its memory.
8. Adjust the gas reading up or down to match the calibration gas cylinder concentration by using the UP/YES and DOWN/NO buttons, then press and release the ENTER button.
9. The M2 will perform a span operation. The display will indicate **SPAN Gas PASS** for a few seconds, then indicate **SPAN Gas SAVED** before indicating **Leaving CAL Mode** for a few seconds.

NOTE: If the span adjustment fails, see "Troubleshooting" on page 34 for recommended actions.

---

10. The display will now alternate between the normal operation screen and the message **REMOVE CAL GAS** for 1 minute. If the calibration gas has not been removed from the detector, remove it now to avoid unwanted alarms.

    During this 1 minute period, the signal output will remain fixed at 3.5 mA and the relays will remain in their non-alarm state to avoid unwanted alarms while the calibration gas clears from the detector. At the end of the 1 minute period, the **REMOVE CAL GAS** message will stop appearing and the M2 will return to normal operation.

11. If necessary, repeat the calibration process for the second detector.
12. Remove the sample tubing from the hose barb on the calibration fitting of the calibration valve.
13. Store the components of the calibration kit in a safe place.
14. Use the regulator to adjust the sample flow to 3 SCFH and use the H_2S dilution flowmeter's adjustment valve to set the dilution flow to 0.6 SCFH.

Blowback Operation

1. In the event of a clogged sample line, the blowback valve can be used to divert the compressed air supply back through the sample line to clear obstructions.
2. Inspect the sample line first to try to remedy the situation without using the blowback valve. If the line cannot be cleared, operate the blowback valve as described below.
3. Make sure that all personnel and equipment are clear of the inlet end of the sample line.
4. To operate the blowback valve, press and hold the button on the front of the blowback valve. As long as the button is held, compressed air will be applied to the sample line.

WARNING: ***The blowback pressure can be as high as 140 PSI. Make sure that all personnel and equipment are clear of the sample line inlet end to avoid personal injury or equipment damage if a sample line obstruction is blown out of the sample line.***

5. Release the button on the blowback valve. Verify that the sample is now flowing properly through the sample line.

Setting the Drain Fault Switch

The drain fault switch is factory set to detect a break in the drain line or very low drain flow from the water trap during operation. Under normal circumstances, it should not be necessary to adjust the drain fault switch in the field. If the drain fault switch contacts close to indicate a problem in the drain line and no cause can be determined, it may be necessary to adjust the drain fault switch. If the drain fault switch contacts are not operating properly, perform the following procedure to set the drain fault switch. If the drain fault switch contacts continue to operate improperly, contact RKI Instruments, Inc.

NOTE: In order to get an accurate open/close reading on the drain fault switch contacts, the low flow and drain fault switches must not be wired in parallel. Any monitoring device must also be disconnected from the drain fault switch contacts. Remove any jumpers and monitoring device wires from the drain fault switch contacts before setting the drain fault switch.

1. Ensure that the flowmeter reading is 3.0 SCFH.
2. Open the enclosure and connect an ohm meter to the drain fault switch terminals on the terminal block. Check that the contacts are open during normal operation.
3. Using the regulator, adjust the flow down until the flowmeter reads 1.0 SCFH.
4. Carefully adjust the drain fault switch using the adjustment screw until the contacts just close.
5. Adjust the flow back above 1.0 SCFH with the regulator and repeat step 3 until the contacts close between 0.8 and 1.0 SCFH. To increase the setpoint, turn the adjustment screw slightly counterclockwise. To decrease the setpoint, turn the adjustment screw slightly clockwise.
6. Adjust the flow back up above 1.0 SCFH. The contacts should reopen.
7. Adjust the flowrate to 3.0 SCFH.
8. Reconnect any wires that were removed before setting the drain fault switch. Refer to Figure 12 and Figure 13 for wiring diagrams.

Replacing Components of the Aspirator Adapter

This section describes how to replace the particle filter, the IR CH_4 detector, the H_2S plug-in sensor, and the H_2S detector. In most cases it is not necessary to replace the entire H_2S detector.

Replacing the Particle Filter

If the H_2S dilution flowrate decreases, the particle filter may need to be replaced.

1. If tubing is routed from the particle filter to a fresh air area, disconnect the tubing from the particle filter or from the particle filter's gray tubing.
2. Disconnect the particle filter and the gray tubing from the H_2S dilution flowmeter's hose barb.
3. Install a new particle filter on the H_2S dilution flowmeter's hose barb using the gray tubing that's installed on the new filter. Be sure the arrow on the particle filter is pointed toward the hose barb.
4. If tubing is routed from a fresh air area, reconnect the fresh air line to the particle filter's gray tubing or remove the gray tubing and connect the fresh air line directly to the particle filter.

Replacing the IR CH4 Detector

1. Turn off or disconnect power to the M2.
2. Remove the junction box cover.
3. Grasp the control PCB by its edges.
4. Gently pull until the control PCB is pulled away from the banana jacks. Take care not to pull too hard and damage the cable which connects the control and terminal PCB's.
5. Let the control PCB hang by the cable. The terminal strips are now visible on the terminal PCB. The control PCB may be left hanging while wiring is done. If desired, the control PCB may be disconnected from the cable and set aside while wiring.
6. Remove the detector terminal strip from its socket.
7. Disconnect the detector leads from the detector terminal strip. Note the position of the color-coded leads as you remove them.
8. Unscrew the hex nuts from the inlet and exhaust fittings on the IR CH_4 detector chamber.
9. Grasp the detector chamber and unscrew the detector chamber/sensor adapter from the detector.

NOTE: The O-ring between the sensor adapter and the detector can only be used once and will need to be replaced before installing the detector chamber back onto the detector.

10. Unscrew the detector from the junction box.
11. Guide the replacement detector leads through the bottom conduit hub of the junction box, then screw the mounting threads of the detector into the conduit hub.
12. Connect the detector leads to the detector terminal strip as follows: red wire to terminal labeled LEL RED, white to terminal labeled LEL WHT, green wire to terminal labeled LEL GRN, black wire to terminal labeled LEL BLK.
13. Re-install the detector terminal strip into its socket.
14. Re-install the control PCB (and ribbon cable if necessary). Be sure the ribbon cable is routed down below the control PCB so it will not be damaged by the cover when it is screwed back

on.

15. Secure the junction box cover to the junction box.
16. Insert a new O-ring into the top of the sensor adapter.
17. Screw the detector chamber/sensor adapter onto the new detector.
18. Reinstall the inlet and exhaust lines that were removed in step 8 back onto the detector chamber. The inlet line should be coming from the sample flowmeter and the exhaust line should be running to the H_2S detector chamber's inlet fitting.
19. Turn on or reconnect power to the M2.

NOTE: Allow the replacement detector to warm up for 15 minutes before you continue with the next step.

---

20. Calibrate the replacement detector as described in "Calibration" on page 36.

Replacing the H_2S Plug-In Sensor

CAUTION: The sensor contains electrolyte which is a dilute acid. Do not disassemble the sensor when replacing it with a new one. If sensor electrolyte comes in contact with your skin, wash affected area thoroughly with soap and water.

---

1. Turn off or disconnect power to the M2.
2. Remove the junction box cover.
3. Grasp the control PCB by its edges.
4. Gently pull until the control PCB is pulled away from the banana jacks. Take care not to pull too hard and damage the cable which connects the control and terminal PCB's.
5. Let the control PCB hang by the cable. The terminal strips are now visible on the terminal PCB. The control PCB may be left hanging while wiring is done. If desired, the control PCB may be disconnected from the cable and set aside while wiring.
6. Remove the detector terminal strip from its socket.
7. Disconnect the detector leads from the detector terminal strip. Note the position of the color-coded leads as you remove them.
8. Unscrew the hex nut from the exhaust fitting on the H_2S detector chamber.
9. Unscrew the hex nut connecting the top of the H_2S dilution flowmeter to the exhaust of the IR CH_4 detector chamber.
10. If a fresh air line is connected to the bottom of the H_2S dilution flowmeter, remove it.
11. Turn the H_2S dilution flowmeter assembly counterclockwise to unscrew it from the inlet of the H_2S detector chamber.
12. Grasp the detector chamber and unscrew the detector chamber/sensor adapter from the detector.

NOTE: The O-ring between the sensor adapter and the detector can only be used once and will need to be replaced before installing the detector chamber back onto the detector.

---

13. Unscrew the detector from the junction box.

14. Guide the replacement detector leads through the bottom conduit hub of the junction box, then screw the mounting threads of the detector into the conduit hub.
15. Connect the red detector lead to the terminal labeled TOXIC + and connect the black detector lead to the terminal labeled TOXIC -.
16. Re-install the detector terminal strip into its socket.
17. Re-install the control PCB (and ribbon cable if necessary). Be sure the ribbon cable is routed down below the control PCB so it will not be damaged by the cover when it is screwed back on.
18. Secure the junction box cover to the junction box.
19. Insert a new O-ring into the top of the sensor adapter.
20. Screw the detector chamber/sensor adapter onto the new detector.
21. Screw the H_2S dilution flowmeter assembly back into the inlet fitting on the H_2S detector chamber.
22. Reconnect the line from the IR CH_4 detector chamber's exhaust to the top of the H_2S dilution flowmeter.
23. Reinstall the exhaust line that was removed in step 8 back onto the detector chamber.
24. If a fresh air line is being used, reconnect it to the bottom of the H_2S dilution flowmeter.
25. Turn on or reconnect power to the M2.

NOTE: Allow the replacement detector to warm up for 15 minutes before you continue with the next step.

---

26. Calibrate the replacement detector as described in "Calibration" on page 36.

Replacing the H_2S Detector

NOTE: In most cases, it is only necessary to replace the plug-in H_2S sensor.

---

1. Turn off or disconnect power to the M2.
2. Remove the junction box cover.
3. Grasp the control PCB by its edges.
4. Gently pull until the control PCB is pulled away from the banana jacks. Take care not to pull too hard and damage the cable which connects the control and terminal PCB's.
5. Let the control PCB hang by the cable. The terminal strips are now visible on the terminal PCB. The control PCB may be left hanging while wiring is done. If desired, the control PCB may be disconnected from the cable and set aside while wiring.
6. Remove the detector terminal strip from its socket.
7. Disconnect the detector leads from the detector terminal strip. Note the position of the color-coded leads as you remove them.
8. Unscrew the hex nut from the exhaust fitting on the H_2S detector chamber.
9. Unscrew the hex nut connecting the top of the H_2S dilution flowmeter to the exhaust of the IR CH_4 detector chamber.
10. If a fresh air line is connected to the bottom of the H_2S dilution flowmeter, remove it.

11. Turn the H_2S dilution flowmeter assembly counterclockwise to unscrew it from the inlet of the H_2S detector chamber.
12. Grasp the detector chamber and unscrew the detector chamber/sensor adapter from the detector.

NOTE: The O-ring between the sensor adapter and the detector can only be used once and will need to be replaced before installing the detector chamber back onto the detector.

---

13. Unscrew the detector from the junction box.
14. Guide the replacement detector leads through the bottom conduit hub of the junction box, then screw the mounting threads of the detector into the conduit hub.
15. Connect the red detector lead to the terminal labeled TOXIC + and connect the black detector lead to the terminal labeled TOXIC -.
16. Re-install the detector terminal strip into its socket.
17. Re-install the control PCB (and ribbon cable if necessary). Be sure the ribbon cable is routed down below the control PCB so it will not be damaged by the cover when it is screwed back on.
18. Secure the junction box cover to the junction box.
19. Insert a new O-ring into the top of the sensor adapter.
20. Screw the detector chamber/sensor adapter onto the new detector.
21. Screw the H_2S dilution flowmeter assembly back into the inlet fitting on the H_2S detector chamber.
22. Reconnect the line from the IR CH_4 detector chamber's exhaust to the top of the H_2S dilution flowmeter.
23. Reinstall the exhaust line that was removed in step 8 back onto the detector chamber.
24. If a fresh air line is being used, reconnect it to the bottom of the H_2S dilution flowmeter.
25. Turn on or reconnect power to the M2.

NOTE: Allow the replacement detector to warm up for 15 minutes before you continue with the next step.

---

26. Calibrate the replacement detector as described in "Calibration" on page 36.

Chapter 8: RS-485 Modbus Output

Overview

This chapter describes the M2's RS-485 Modbus output and how to configure the M2 to make use of it. It also discusses how to wire the M2 into a Modbus system.

The M2 provides an RS-485 serial communications interface. It is a Modbus Slave Device, supporting 2-wire RS-485 Modbus RTU serial communications.

Wiring the M2 in a Modbus System

The M2 is a 2-wire Modbus RTU device. When wiring the M2 into a Modbus system, adhere to standard Modbus wiring practices per the Modbus Over Serial Line Specification and Implementation Guide V1.0 or later. This document can be found online at www.modbus.org/specs.php.

The Modbus protocol supports a maximum of 247 unique slave addresses (1-247). The M2's line driver provides for up to 128 M2s to be connected together without the need for a repeater. Figure 16 & Figure 17 below illustrate typical M2 wiring configurations. If more than 128 M2s need to be connected together, RS-485 repeater(s) should be used such that no more than 128 M2s reside on any given network segment.

CAUTION: *The network segment can only support 128 units if RKI M2s are being used. The use of any other instruments will lower the number of units that may reside on any given network segment.*

NOTE: Only M2s produced after November 2010 have the capability to support a 128-unit segment. M2s produced before November 2010 can only support a 32-unit segment.

The MODBUS terminal strip is located on the terminal PCB (see Figure 6). The following signals are available at the Modbus terminal strip:

Table 9: Modbus Terminal Strip Signals

Modbus Terminal Label (RS-485 Name)	Modbus Signal Name
A	D0
B	D1
C	Common

Recommended Modbus Wiring

The recommended Modbus wiring for the M2 is illustrated in Figure 14 below. In this configuration, 5 wires are used for wiring the M2 into a Modbus system. Figure 14 also illustrates typical alarm device wiring.

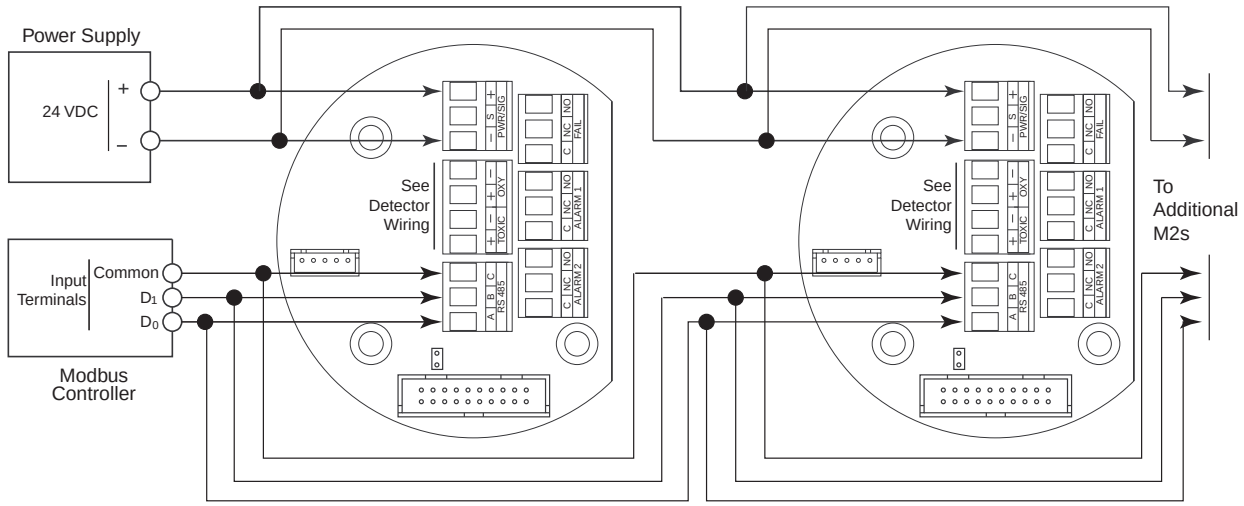


Figure 14: Recommended Modbus Wiring

Alternate Modbus Wiring For Existing Installations

Although the wiring shown in Figure 14 is recommended, it is possible to wire the M2 into a Modbus system with only 4 wires in situations where a pre-existing system is being replaced and wiring is already in place. This should only be done if wiring for a system that is being replaced is already installed and it is not practical to run another wire. See Figure 15 below for this wiring configuration. In this configuration, the wire between the "C" terminal on the M2 and the Common terminal on the Modbus controller is omitted. Instead, the Common terminal on the Modbus controller is connected to the "-" of the 24 VDC power supply.

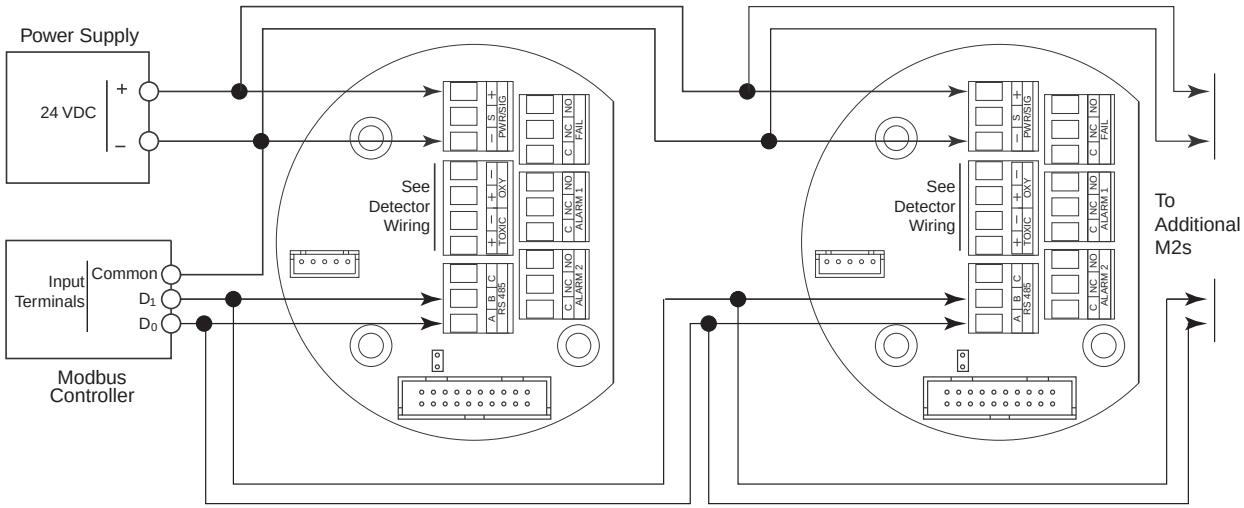


Figure 15: Alternate Modbus Wiring

Termination Jumper

The M2 includes a 2-pin termination header (see Figure 6) that is used when the M2 is used in a Modbus system. Every M2 is supplied with a termination jumper (a jumper block) installed onto this header. If the M2 is not used in a Modbus system, this jumper has no function. When the M2 is installed in a Modbus system, this jumper must be

installed in an M2 that is at the end of a Modbus line. Any M2 in a Modbus system that is not at the end of a line must have the termination jumper removed (see Figure 16 & Figure 17 below).

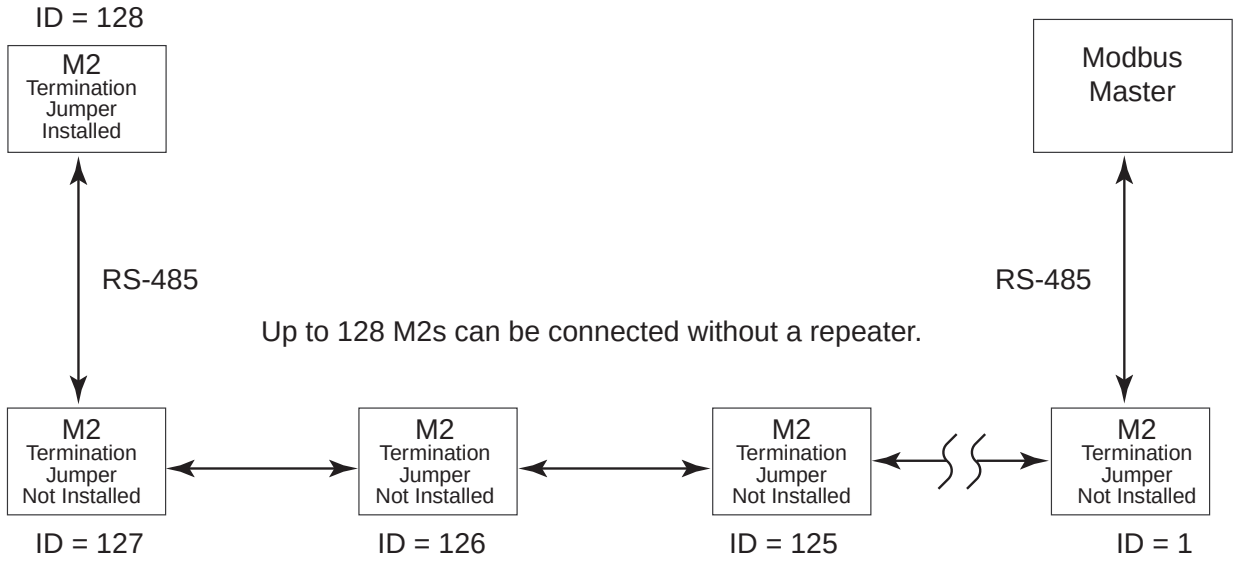


Figure 16: Multiple M2s in a Daisy Chain Configuration

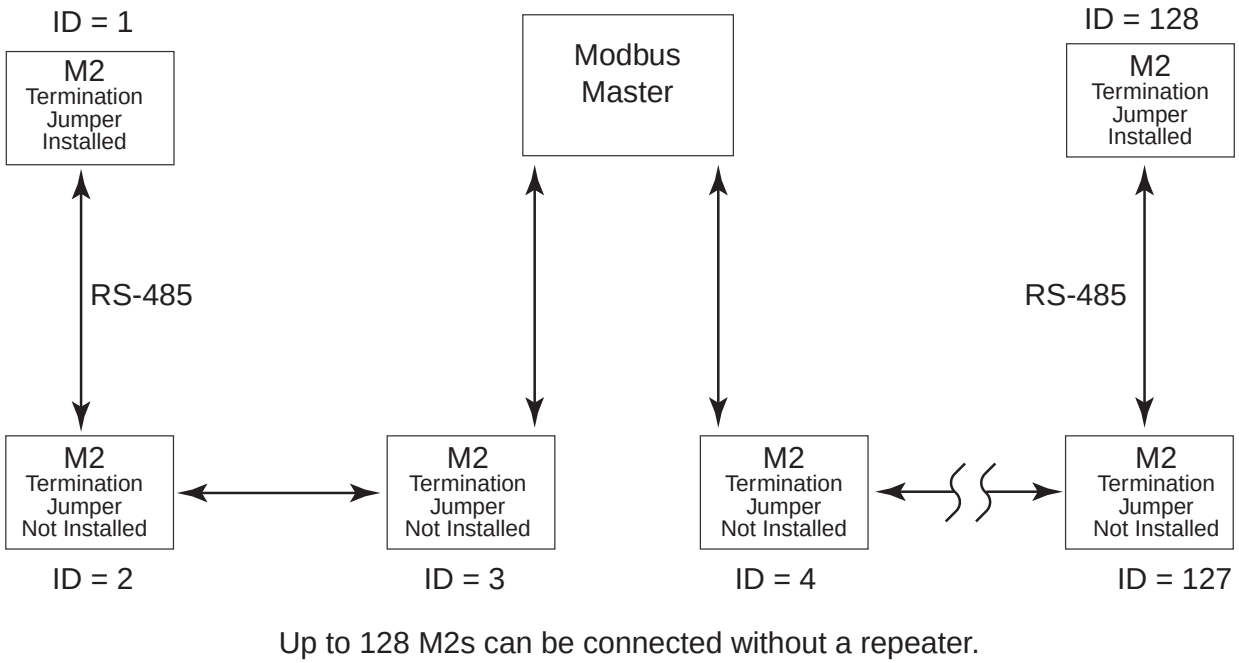


Figure 17: Multiple M2s in a Two Branch Configuration

Using the M2 in a 4-wire Modbus System

Although the M2 is a 2-wire Modbus RTU device, it can be used with a 4-wire Modbus controller if the system wiring is modified as follows:

- Connect the controller's TxD0 and RxD0 wires together and use this connection as the 2-wire Modbus D0 signal.
- Connect the controller's TxD1 and RxD1 wires together and use this connection as the 2-wire Modbus D1 signal.
- Connect these D0 and D1 signals and the common wire from the controller to the 2-wire Modbus Network of M2s.

Modbus Mode

Modbus Mode allows you to configure various parameters relating to the Modbus setup of the M2. Modbus Mode includes a 5-minute time-out feature. If you do not press a control button for 5 minutes, the M2 automatically returns to normal operation.

NOTE: If the M2 returns to normal operation because of a time-out, it enters a warm-up period just as it does when it is first turned on.

1. While in normal operation, simultaneously press and hold the DOWN/NO and ENTER buttons for 5 seconds to enter Modbus Mode. Release the buttons when the following screen appears.

   ```
   Set Up
   Modbus?
   ```

2. To exit Modbus Mode, press and release the DOWN/NO button. The M2 will return to normal operation.

   To continue in Modbus Mode, press and release the UP/YES button. The current ENABLED/DISABLED setting will appear.

3. If you want to change the currently displayed parameter, use the UP/YES and DOWN/NO buttons to adjust it to the desired setting, then press ENTER to continue to the next parameter.

   If the currently displayed parameter setting is OK, press the ENTER button to proceed to the next parameter.

   Table 10 lists the M2 Modbus Mode parameters you can set. Table 10 also lists the factory set value for each parameter.

Table 10: Configuration Parameters

Modbus Mode Parameter	Available Settings & Description
Enabled/Disabled	Can be set to ENABLED or DISABLED (factory setting). Enables or disables the Modbus output.
Slave ID	The Slave ID can be set to values from 1 (factory setting) to 247. The M2 will only receive messages from the Master which are addressed to this Slave ID (except for broadcast messages which are received by all slaves).
Baud Rate	Can be set to 1200, 2400, 4800, 9600 (factory setting), 14440, & 19200.
Parity	EVEN (factory setting), ODD, NONE
Response Delay	The response delay can be set from 0 (factory setting) to 20 mS. This is an optional additional delay inserted by the M2 prior to returning a response message to the Master. It may be helpful in some installations where the Master's preparedness to receive responses might be delayed.

4. When you have scrolled through all the adjustable parameters, **SAVE IT? YES/NO** appears on the display.
5. If you do not wish to save the adjustments, press and release the DOWN/NO button. The **DO OVER? YES/NO** message will display. Press and release the DOWN/NO button. The **ABORT? YES/NO** message will display. Press the UP/YES button to return to normal operation.

   If you wish to change some of the adjustments made, press and release the DOWN/NO button. The **DO OVER? YES/NO** message will display. Press and release the UP/YES button. The **Re-do MB Setup** message will display and the M2 will return to the first adjustable parameter. Go back to step 3 and continue.

   If you want to save the adjustments made, press and release the UP/YES button. **Modbus Saved** is indicated on the display for a few seconds and the M2 returns to normal operation.

NOTE: All M2s on a Modbus network must be configured with the same baud rate and parity, and each M2 must have a unique slave ID. For an M2 to participate on a network, the ENABLED/DISABLED setting must be set to ENABLE.

Supported Modbus Functions

The M2 supports Function Code 03: Read Holding Registers and Function Code 16: Write Registers. The register assignments detailed below were implemented in M2 firmware version 5.0. Please see revision B of the M2 manual if you have an M2 with a firmware version previous to 5.0.

WARNING: ***Do not attempt to use registers according to the instructions below with units that have firmware versions previous to 5.0. For the Modbus register assignments of M2s with firmware previous to 5.0, see revision B of the M2 Operator's Manual. The firmware version is shown on the Information Screen described on page page 21.***

Function Code 03: Read Holding Registers

There are a total of 40 registers available to be read via this Function Code.

Registers 1 - 2

The format (bit & field assignments) for registers 1 - 2 is shown below in Table 11 - Table 12.

Table 11: Register 1, Numerical Reading with Sign & Decimal Point Bit & Field Assignments

Bit(s)	Value & Field
[15]	Sign of Reading 0 = Positive 1 = Negative
[14:13]	Format of Reading 0 = XXX (no decimal point) 1 = XX.X 2 = X.XX 3 = .XXX
[12:0]	Numerical value of display reading (8000 max)

Table 12: Register 2, Operating State, Alarms & Relays Bit & Field Assignments

Bit(s)	Value
[15:12]	Operating State 0 = Undefined 1 = Initialization 2 = Normal 3 = Warm-up 4 = Fail 5 = Calibration 6 = Post-Calibration 7 = Low Power 8 = Setup
[11]	Gas Type Change 0=Not Changed 1=Changed

Table 12: Register 2, Operating State, Alarms & Relays Bit & Field Assignments (Continued)

Bit(s)	Value
[10]	Configuration Change 0=Not Changed 1=Changed
[9]	Calibration Activity Flag 0=No Calibration Activity 1=Calibration Activity Has Occurred
[8]	Fail Status 0 = Fail Not Asserted 1 = Fail Asserted
[7:6]	Alarm 2 Status 0 = No Alarm 1 = Unacknowledged Alarm 2 = Acknowledged Alarm 3 = Unused Code
[5:4]	Alarm 1 Status 0 = No Alarm 1 = Unacknowledged Alarm 2 = Acknowledged Alarm 3 = Unused Code
[3]	Overscale Status 0 = Not Overscale 1 = Overscale
[2]	Fail Relay Status 0 = Not Energized 1 = Energized
[1]	Alarm 2 Relay Status 0 = Not Energized 1 = Energized
[0]	Alarm 1 Relay Status 0 = Not Energized 1 = Energized

Register 3

Register 3 is the supply voltage (0.1 volt per count).

Registers 4 - 11

The 16 bytes in these registers contain the same ASCII text information that is displayed on the M2's LCD (not NULL Terminated).

Register 12

Register 12 is the range (full scale readout).

Register 13

Register 13 is the alarm 1 set point.
The decimal point location is the same as specified in Register 1.

Register 14

Register 14 is the alarm 2 set point.
The decimal point location is the same as specified in Register 1.

Registers 15 - 19

Registers 15 - 19 are the Gas Name ASCII String (NULL Terminated).

Registers 20 - 22

Registers 20 - 22 are the Gas Units String (NULL Terminated).

Register 23

Register 23 is the alarm 1 trigger.
0=Decreasing
1=Increasing

Register 24

Register 24 is the alarm 1 normal relay state.
0=Normally De-Energized
1=Normally Energized

Register 25

Register 25 is the alarm 1 relay reset.
0=Latching
1=Self-Resetting

Register 26

Register 26 is the alarm 1 ON delay.
Integer values are in seconds.

Register 27

Register 27 is the alarm 1 OFF delay.
Integer values are in seconds.

Register 28

Register 28 is the alarm 2 trigger.
0=Decreasing
1=Increasing

Register 29

Register 29 is the alarm 2 normal relay state.
0=Normally De-Energized
1=Normally Energized

Register 30

Register 30 is the alarm 2 relay reset.
0=Latching
1=Self-Resetting

Register 31

Register 31 is the alarm 2 ON delay.
Integer values are in seconds.

Register 32

Register 32 is the alarm 2 OFF delay.
Integer values are in seconds.

Register 33

Register 33 is zero suppression.
Toxics and LEL: 0%-6% of full scale
Oxygen: 0%-0.7% Oxygen
The decimal point location is the same as specified in Register 1.

Register 34

Register 34 is noise filter.
Integer values in seconds.
0-60 in 5 second increments.

Register 35

Register 35 is calibration timeout in minutes (5, 10, 15, 20, 25, or 30).

Register 36

Register 36 is calibration month (upper byte) and day (lower byte).
This is zero based (e.g. January=0 and the 1st=0).

Register 37

Register 37 is the calibration year.

Register 38

Register 38 is the calibration outcome.
Upper=Gas Operation
Lower=Air Operation

Calibration Outcome Codes:

1=Sensor Missing
2=Sensor Too Weak
3=Signal Too Strong
4=Not Enough Span
5=Negative Reading
6=Span Gas Value Is Not OK
7=Calculated Zero Is Too Low
8=Calculated Zero Is Too High
9=Zero Failure
10=Span Failure
11=Calibration Is Overscale
12=LEL Sensor Offset Is Too High
13=LEL Null Operation Failed
14=Operation Not Performed

Register 39

Register 39 is the auto-zero disable.
0=AutoZero Enabled

1=AutoZero Disabled

Register 40

Register 40 is the remote configuration register access level
0=None
1=Alarm Reset

Function Code 16: Write Registers

There are 21 registers in Function Code 16 that can be used to write to the M2. This manual only describes Register 16 because it can be used to reset an alarm condition. For a complete description of Function Code 16, request Appendix C from RKI Instruments, Inc.

Register 16

Register 16 performs the same function as the ENTER button on the M2. It is useful for remotely silencing alarms. With the M2 in an alarm condition, bit [0] can be used to silence it.

Table 13: Register 16, Button Function

NOTE: Register 40 in Function Code 03, the remote configuration register, must be set to 1 in order for Register 16 to work.

Bit	Value & Field
[0]	ENTER (used for “Alarm Reset”) 0=Not Pressed 1=Pressed

Parts List

Table 2 lists replacement parts and accessories for the sample draw adapter.

Table 14: Parts List

Part Number	Description
06-1248RK-03	Tubing, 3/16 x 5/16, polyurethane, 3 foot length, for calibration kit
07-0033RK	Cap gasket, for CSA type H_2S detector
07-7123RK	O-ring for H_2S detector adapter
07-7218RK	O-ring, 0.734 ID x 0.139, for IR CH_4 detector adapter
07-7225RK	O-ring, 1.243 ID x .139, buna, for detector chamber
13-1070RK	Captive panel screw, 10-32 x 1.75
18-0431RK-02	Junction box
33-0167RK	Particle filter for H_2S dilution flowmeter inlet
33-0413RK-02	Filter element for water trap
33-0413RK-10	Water trap
45-6132RK	Termination jumper
61-0192RK-CH4	CH_4 detector, IR type, 0 - 100% volume
65-2428	H_2S detector assembly, CSA version
81-0013RK-01	Calibration cylinder, 50% volume methane in nitrogen, 34 liter steel
81-0013RK-05	Calibration cylinder, 50% volume methane in nitrogen, 58 liter steel
81-0151RK-02	Calibration cylinder, 25 ppm H_2S in nitrogen, 58 liter aluminum
81-0151RK-04	Calibration cylinder, 25 ppm H_2S in nitrogen, 34 liter aluminum
81-1054RK	Regulator, demand flow, for 58- and 103-liter cylinders
81-1055RK	Regulator, demand flow, for 17- and 34-liter steel cylinders
ES-1537-H2S	H_2S sensor, plug-in

Appendix A: Control Button Quick Reference Guide

The M2's control buttons allow access to operational modes, resetting of alarms, and display of the Information Screen. Table 15 shows which button combinations perform these functions and which parameters are available for adjustment while in the operational modes. While in these modes, display prompts showing a "?" require you to respond by pressing either the UP/YES (for yes) or DOWN/NO (for no) button. To change parameter settings, use the UP/YES and DOWN/NO buttons to get the desired setting, then press and release the ENTER button to accept the setting.

Table 15: Control Button Quick Reference Chart

Mode Entered or Function Performed	Button Combination	Adjustable or Viewable Parameters
Alarm Reset	Press and Release ENTER	n/a
Show Information Screen	Press and Hold DOWN/NO	• Input Voltage • M2 Version/Revision Information
Calibration Mode	Press and Hold UP/YES for 5 seconds	• Fresh Air Adjust • Span (or Zero for Oxygen) Adjust with Calibration Gas
Configuration Mode	Press and Hold UP/YES & ENTER for 5 seconds	• Alarm Levels • Increasing or Decreasing Alarms • Normally Energized or Normally De-energized Relays • Latching or Self-resetting Alarms • Alarm On Delay • Alarm Off Delay (if self-resetting) • Zero Suppression • Noise Filter • Calibration Time-out Period
Gas Type Mode	Press and Hold UP/YES and DOWN/NO for 5 seconds	Gas Type
Modbus Mode	Press and Hold DOWN/NO and ENTER for 5 seconds	• Enable or Disable Modbus • Slave ID • Baud Rate • Parity • Response Delay

Appendix B: PLC and DCS Device Wiring

The M2 can be wired to a PLC or DCS device if desired.

1. Guide multi conductor shielded cable or cables or wires in conduit through the top conduit hub of the junction box. The number of cables or wires needed will depend on whether any relays are used and whether the Modbus output is used. Use the following recommendations to determine how to wire the M2:

    - If Modbus connections will not be used and only the PWR/SIG terminal strip connections will be used, use four conductor shielded cable or four wires in conduit for connections to the power/signal terminal strip.

Table 16: Wire Size for PWR/SIG Connections

Max Distance to Controller w/18 Gauge Wire	Max Distance to Controller w/ 16 Gauge Wire	Max Distance to Controller w/14 Gauge Wire
2,500 ft.	5,000 ft.	8,000 ft.

    - If the PWR/SIG terminal strip connections and one or more relays are used, route the connections to the M2 in conduit. Use shielded cable in the conduit for the PWR/SIG connections and unshielded cable or individual wires for the relay connections. Make sure any wire or cable used for relay wiring is appropriately rated for the power that it will carry.

NOTE: If shielded cable is used for the PWR/SIG connections, leave the cable shield's drain wire insulated and disconnected at the M2. You will connect the opposite end of the cable's drain wire at the controller or device.

    - If the M2 will be wired into a Modbus network, see "Chapter 8: RS-485 Modbus Output" on page 44.

See Figure 18 below for field wiring connections to the M2.

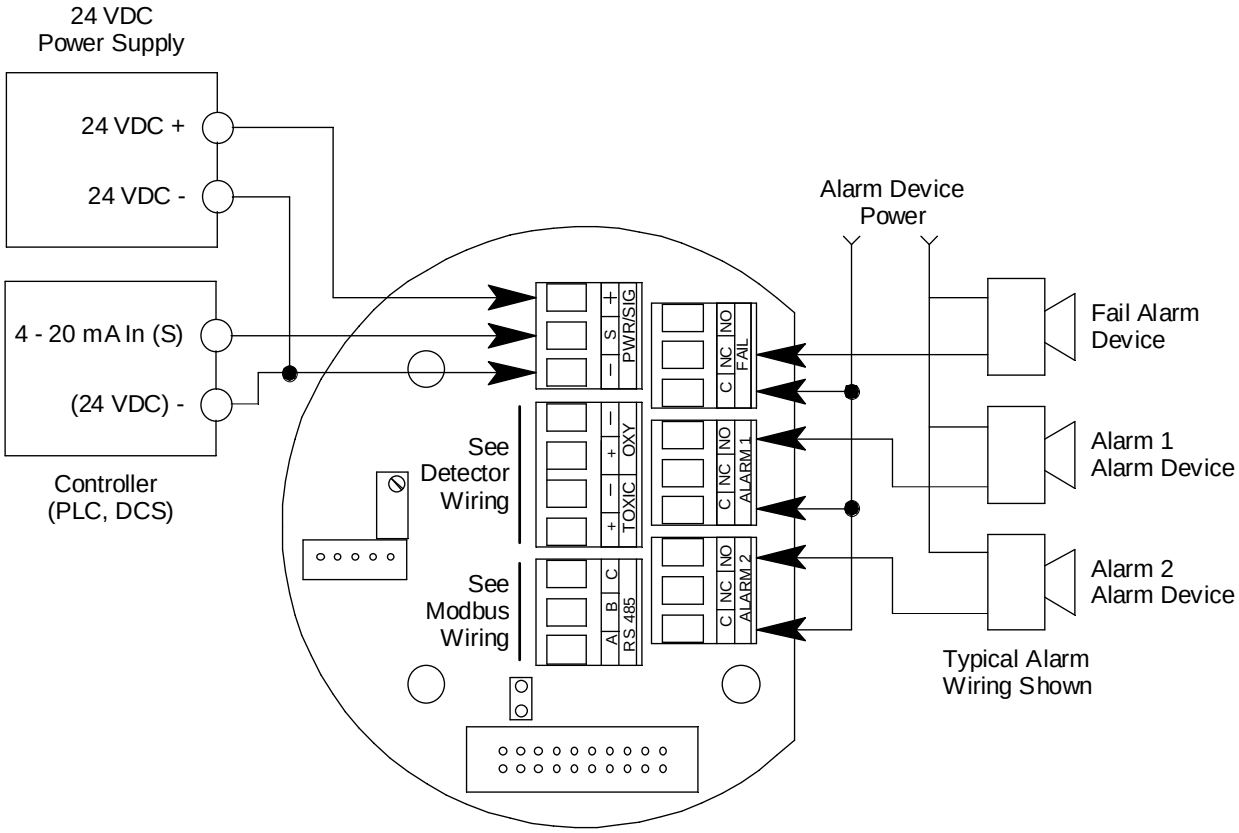


Figure 18: PLC and DCS Device Wiring

Appendix C: Function Code 16 Registers

The M2 supports Function Code 16 that allows writing to the M2. There are 21 registers in this Function Code. The register assignments detailed below were implemented in M2 firmware version 5.0. Please see revision B of the M2 manual if you have an M2 with a firmware version previous to 5.0.

WARNING: ***Do not attempt to use registers according to the instructions below with units that have firmware versions previous to 5.0. For the Modbus register assignments of M2s with firmware previous to 5.0, see revision B of the M2 Operator's Manual. The firmware version is shown on the Information Screen described on page page 21.***

Register 1

Register 1 is the alarm 1 set point.
Value must be an integer. Any decimals are omitted.

Register 2

Register 2 is the alarm 1 trigger.
0=Decreasing
1=Increasing

Register 3

Register 3 is the alarm 1 relay state.
0=Normally De-Energized
1=Normally Energized

Register 4

Register 4 is the alarm 1 relay reset.
0=Latching
1=Self-Resetting

Register 5

Register 5 is the alarm 1 ON delay.
Integer value is in seconds.

Register 6

Register 6 is the alarm 1 OFF delay.
Integer value is in seconds.

Register 7

Register 7 is the alarm 2 set point.
Value must be an integer. Any decimals are omitted.
The decimal point location is the same as specified in Register 1 of Function Code 03.

Register 8

Register 8 is the alarm 2 trigger.
0=Decreasing
1=Increasing

Register 9

Register 9 is the alarm 2 relay state.
0=Normally De-Energized
1=Normally Energized

Register 10

Register 10 is the alarm 2 relay reset.
0=Latching
1=Self-Resetting

Register 11

Register 11 is the alarm 2 ON delay.
Integer value is in seconds.

Register 12

Register 12 is the alarm 2 OFF delay.
Integer value is in seconds.

Register 13

Register 13 is the zero suppression.
Toxics and LEL: 0%-6% Full Scale
Oxygen: 0%-0.7% Oxygen
Value must be an integer. Any decimals are omitted.

Register 14

Register 14 is the noise filter.
Integer value is in seconds (0-60 in 5 second increments).

Register 15

Register 15 is the calibration timeout.
Value is in minutes (5, 10, 15, 20, 25, or 30).

Register 16

Register 16 is explained in “Supported Modbus Functions” in the M2 manual.

Register 17

Register 17 is the calibration month (MSB) and day (LSB).
This is zero-based (e.g. January=0 and the 1st=0).

Register 18

Register 18 is the calibration year.

Register 19

Register 19 is for clearing change flags. When parameters are changed at the M2, a flag is raised at the controller. This register can be used to clear those flags.

Table 17: Register 19, Clear Change Flags

Bit(s)	Value & Field
[15:2]	Unused
[1]	Write “1” to this bit to clear “Gas Type Changed” flag
[0]	Write “1” to this bit to clear “Configuration Changed” flag

Register 20

Register 20 is the AutoZero Disable.
0=AutoZero Enabled
1=AutoZero Disabled

Register 21

Register 21 is the Remote Configuration Register.
0=No Remote Configuration
1=Reset Alarm