WELKER

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL
WELKER FIXED ODORANT MONITOR

OdorEyes by WELKER

MODEL
FOMB

DRAWING NUMBERS
OE109.3
OE109.4E
OE109EL

MANUAL NUMBER
IOM-201

REVISION
Rev. A, 12/05/2017

TABLE OF CONTENTS

IMPORTANT SAFETY INFORMATION
READ ALL INSTRUCTIONS

Notes emphasize information and/or provide additional information to assist the user.

Caution messages appear before procedures that could result in damage to equipment if not observed.

Warning messages appear before procedures that could result in personal injury if not observed.

This manual is intended to be used as a basic installation and operation guide for the Welker OdorEyes Fixed Odorant Monitor, FOMB. For comprehensive instructions, please refer to the IOM Manuals for each individual component. A list of relevant component IOM Manuals is provided in Appendix A of this manual.

The information in this manual has been carefully checked for accuracy and is intended to be used as a guide for the installation, operation, and maintenance of the Welker OdorEyes equipment described in this manual. Correct installation and operation, however, are the responsibility of the end user. Welker reserves the right to make changes to this manual and all products in order to improve performance and reliability.

BEFORE YOU BEGIN

Read these instructions completely and carefully.

IMPORTANT – Save these instructions for local inspector's use.

IMPORTANT – Observe all governing codes and ordinances.

Note to Installer – Leave these instructions with the end user.

Note to End User – Keep these instructions for future reference.

Installation of this Fixed Odorant Monitor is of a mechanical and electrical nature.

Proper installation is the responsibility of the installer. Product failure due to improper installation is not covered under the warranty.

If you received a damaged Fixed Odorant Monitor, please contact a Welker representative immediately.

Phone: 281.491.2331
Address: 13839 West Bellfort Street
Sugar Land, TX 77498

SECTION 1: PRODUCT INFORMATION

1.1 Introduction

We appreciate your business and your choice of Welker products. The installation, operation, and maintenance liability for this equipment becomes that of the purchaser at the time of receipt. Reading the applicable *Installation, Operation, and Maintenance* (IOM) *Manuals* prior to installation and operation of this equipment is required for a full understanding of its application and performance prior to use.*

If you have any questions, please call Welker at 1-281-491-2331.

**The following procedures have been written for use with standard Welker OdorEyes parts and equipment. Assemblies that have been modified may have additional requirements and specifications that are not listed in this manual.*

1.2 Product Description

The Welker OdorEyes *FOMB* Fixed Odorant Monitor is a gas process monitor designed to provide real-time readings of the concentration levels of sulfur blend mercaptan in a natural gas system.

The catalytic sensor and incorporated SmartMax®II Monitor/Transmitter enable the FOMB to sense the total amount of sulfur blend mercaptan in a natural gas system and provide real-time pounds per million cubic feet (lb/MMcf) readings for the system. The real-time readings allow the operator to ensure that the correct concentration of sulfur blend mercaptan is dispersed in the natural gas system. Ensuring mercaptan level is a safety feature, as the odor can indicate a leak.

The SmartMax®II is programmed to periodically collect samples from the natural gas system to monitor the concentration levels of sulfur blend mercaptan. The FOMB signals the customer's Programmable Logic Controller (PLC) or other signal control device when the levels of sulfur blend mercaptan are too high or too low. When not sampling, the FOMB is in self-cleaning mode, which purges any residue from the process line using the air pump, thus extending the life of the catalytic sensor and maintaining accurate calibration.

For this manual, the term "Programmable Logic Controller" (PLC) will refer to the PLC, DCS, or other signal control provided and used by the customer.

Welker may custom design the FOMB to suit the particular application and specifications of each customer.

1.3 Safety Warning

Wherever hazardous gases or vapor-producing liquids are used, transported, or stored, the potential for an accidental leak exists. Continuous monitoring of these hazards is essential to ensure personnel safety.

1.4 FMRC Approval

Factory Mutual Research Corporation (FMRC) approval of 4–20 mA inputs to the SmartMax®II does not include or imply approval of the gas detection monitor/transmitter connected to the instrument. To maintain FMRC approval of the system, all 4–20 mA or current loop gas detection instruments connected to the SmartMax®II must also be FMRC approved.

FMRC approval allows the presence and operation of serial communications software in the SmartMax®II; however, the communications functions provided by the SmartMax®II are not included in the FMRC approval.

1.5 Important Wiring Information

The FOMB was designed for use in NEC Class I, Div. 1, Groups C & D hazardous locations in accordance with *National Electric Code® (NEC®),* ANSI/NFPA 70, Article 500 for hazardous (classified) locations, with emphasis on explosion-proof installations. Ensure that the field technician installing the FOMB is proficient in performing these types of installations. Use the appropriate components for this type of installation, such as rigid metal conduit, conduit seals, and Chico® Sealing Compound. Ensure that the unit is properly grounded.

1.6 Factory SmartMax®II Settings

Table 1: FOMB Factory Settings

	Setting	Value	Adjustable
CAL MENU	**FULLSCLE** (Full Scale of the System)	200	Yes, Between 50–200
	CAL TIME (Required Calibration Time)	4 Minutes	No
	CAL RDNG (Standard Calibration Gas)	2.00 (2.00 lb/MMcf)	Yes, Between 0.25–2.00 lb/MMcf
ALARM MENU	**HI MERC** (High Mercaptan Alarm)	1.80 (1.80 lb/MMcf)	Yes
	LOW MERC (Low Mercaptan Alarm)	0.40 (0.40 lb/MMcf)	Yes
COM PORT MENU	**BAUDRATE**	9600 Bd	Yes, Between 300–9600 Bd

Welker recommends the Welker Calibration Kit, which includes a calibration gas of 2.00 lb/MMcf, for use with this unit. If a calibration gas other than 2.00 lb/MMcf is used, the FULLSCLE and CAL RDNG must be adjusted on the SmartMax®II and the unit must be recalibrated.

1.7 Specifications

The specifications listed in this section are generalized for this equipment. Welker can modify the equipment according to your company's needs. **Please note that the specifications may vary depending on the customization of your equipment.**

Table 2: FOMB Specifications	
Application	Monitoring Odorant Levels in Natural Gas Systems
Maximum Allowable Operating Pressure	250 psig @ 41 °F to 104 °F (*17 barg @ 5 °C to 40 °C*)
Power	DC 24 V, 20 W
Analog Output	4–20 mA Into 250 Ω Maximum + 25 Ω Loop Resistance
Digital Output	RS-485 Modbus Half-Duplex
Connections	**Ambient Air Intake:** ¼" FNPT **Calibration Gas Inlet:** ¼" FNPT **Natural Gas Inlet:** ¼" FNPT
Utility Requirements	Ambient Air for Purge **Temperature Range:** 41 °F to 104 °F (*5 °C to 40 °C*) **Humidity Range:** 5–95% RH, Non-Condensing
Electrical Connections	DC 24 V, 4–20 mA Output, ½" FNPT
Panel Dimensions	22.17" x 22.17" (Height x Width)
Features	3-Way Solenoid Valve Catalytic Sensor Explosion-Proof Box Inline Filter Indicator Lights Instrument Regulator Programmable High and Low Odorant Level Alarm SmartMax®II Monitor/Transmitter Two (2) Flame Arrestors
Electrical Area Classification	NEC Class I, Div. 1, Groups C & D
Options	2" Vertical Pipe Mounting Floor Flange Insulated Heated Enclosure Panel Mount

1.8 Equipment Diagrams

Figure 1: FOMB Connections Diagram

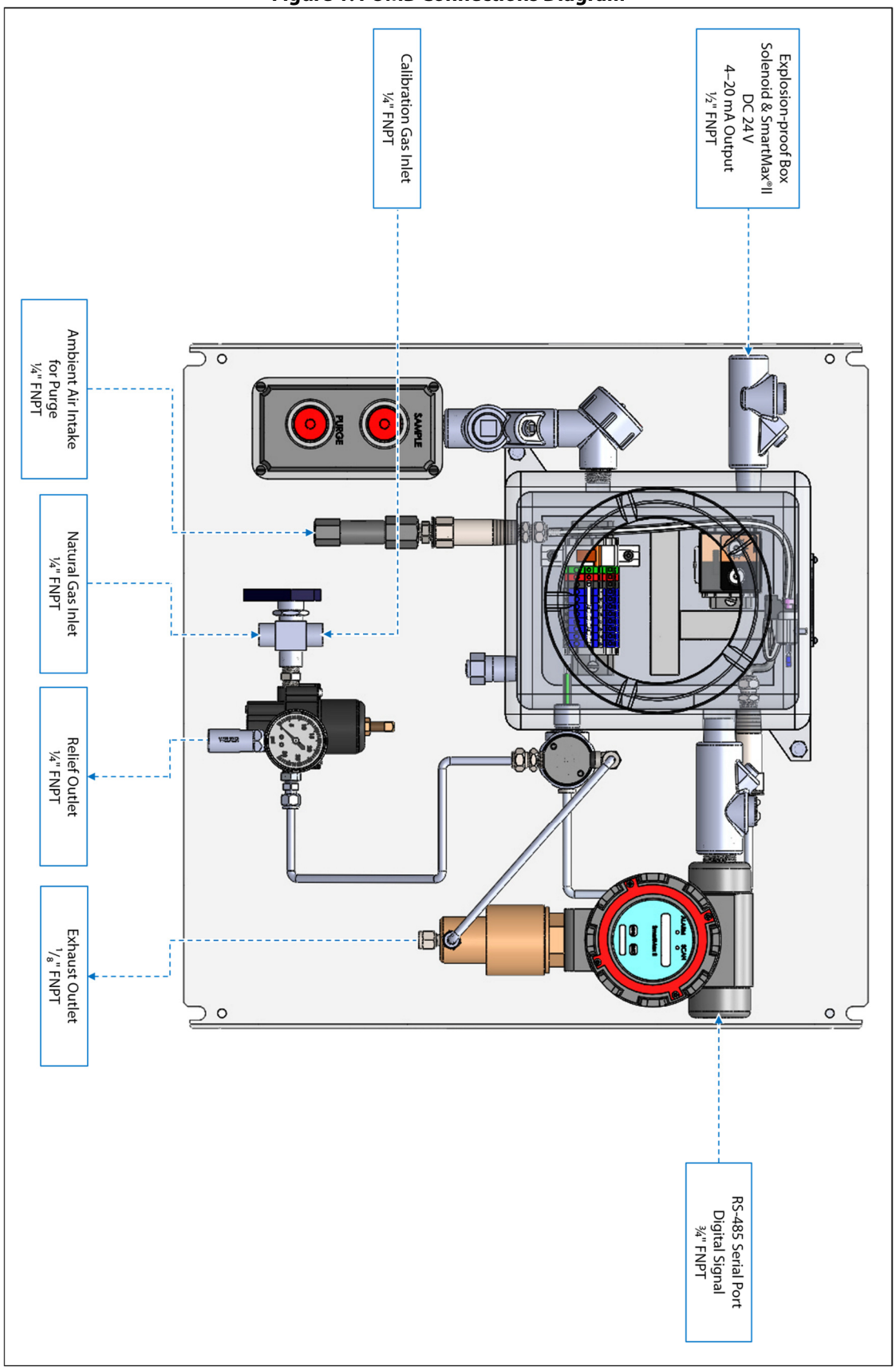
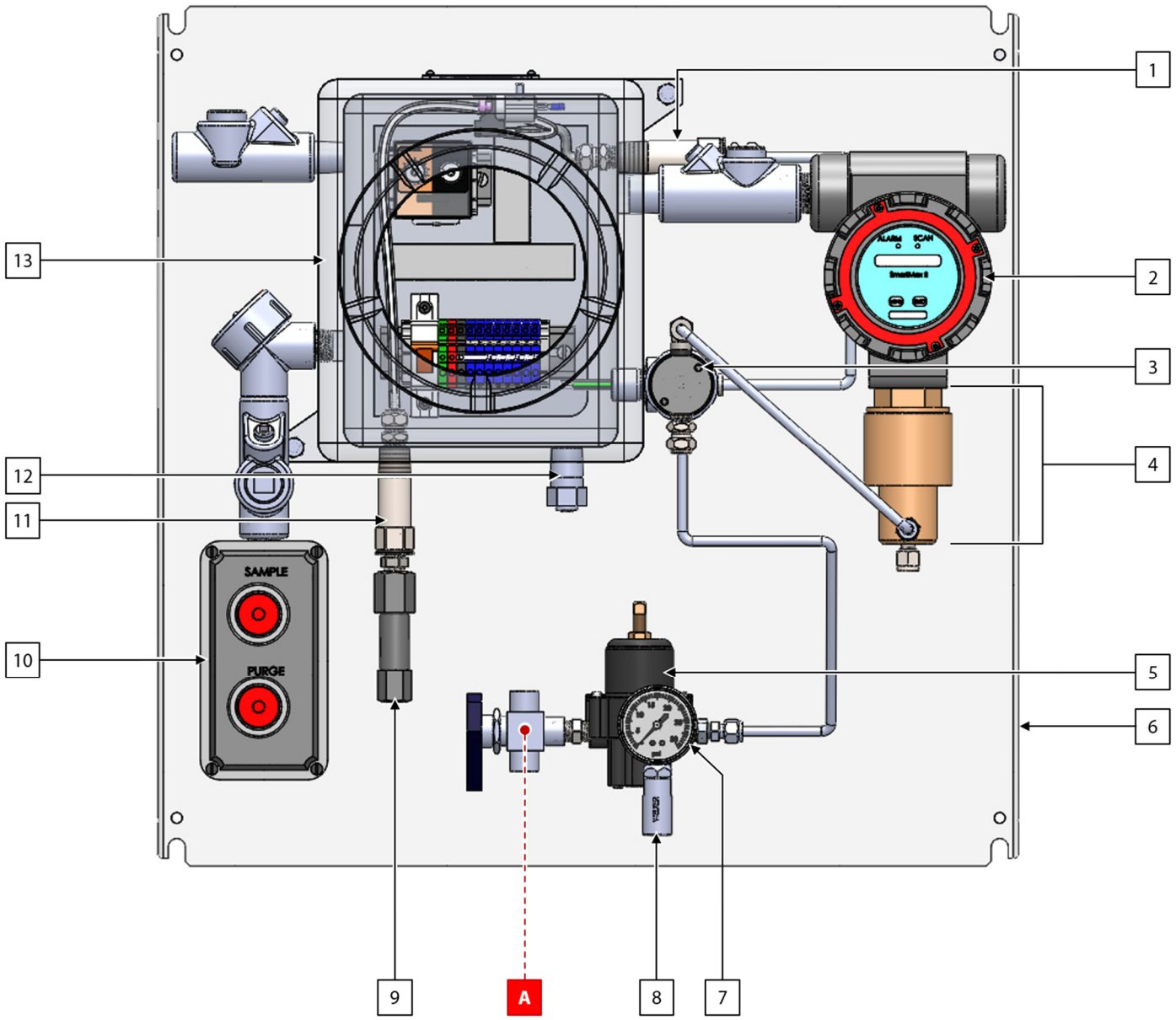


Figure 2: FOMB Panel Diagram



No.	Description
1	Flame Arrestor
2	SmartMax®II Monitor/Transmitter
3	3-Way Solenoid Valve
4	Catalytic Sensor Assembly
5	Instrument Regulator
6	Mounting Panel
7	Regulator Pressure Gauge

No.	Description
8	Welker RV-1 Relief Valve
9	Inline Filter
10	Indicator Lights
11	Flame Arrestor
12	Drain/Breather
13	Explosion-proof Box (See *Figure 5*)
A	Inlet Valve

Figure 3: FOMB With Electric Heater Connections Diagram

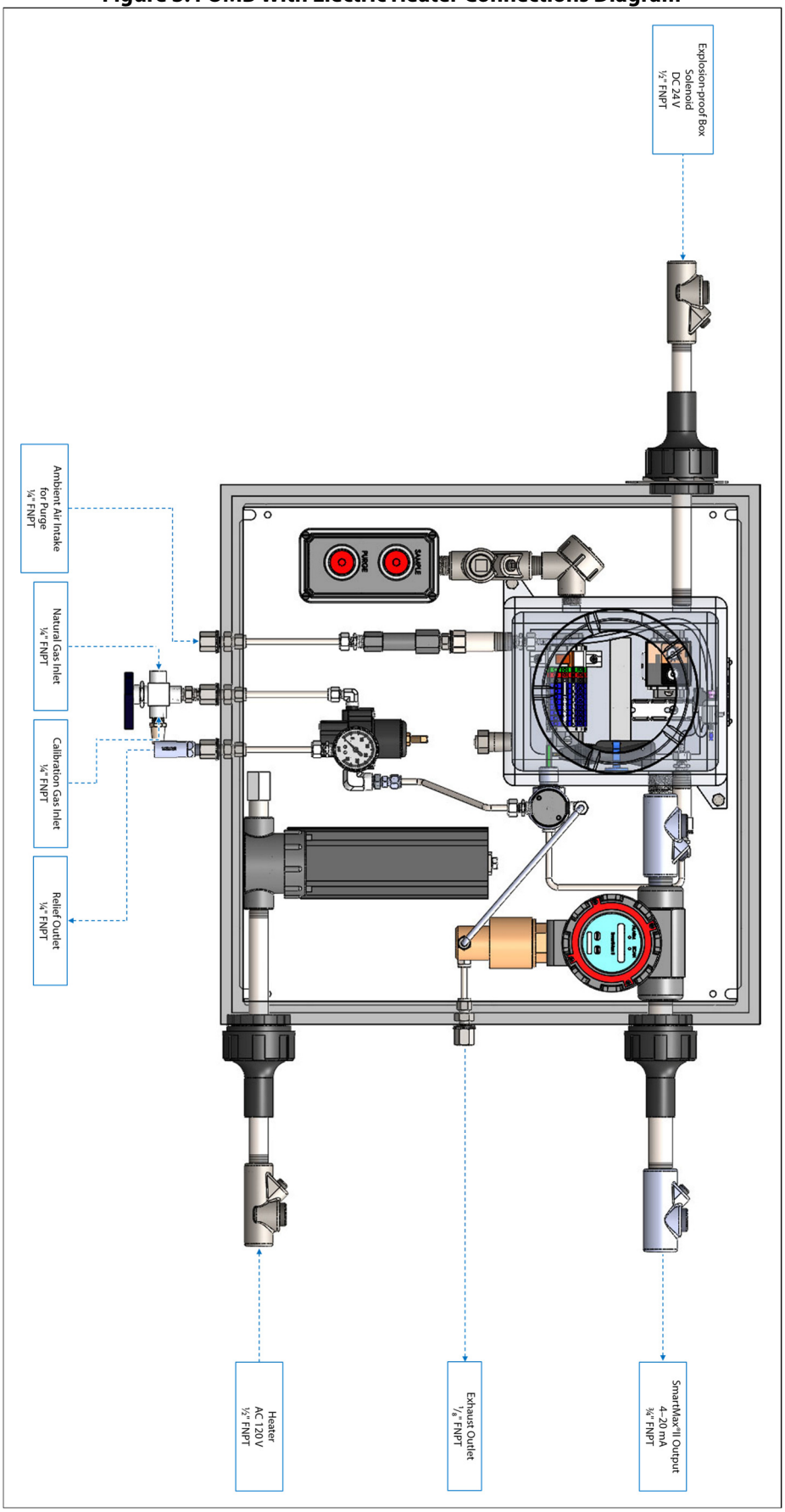
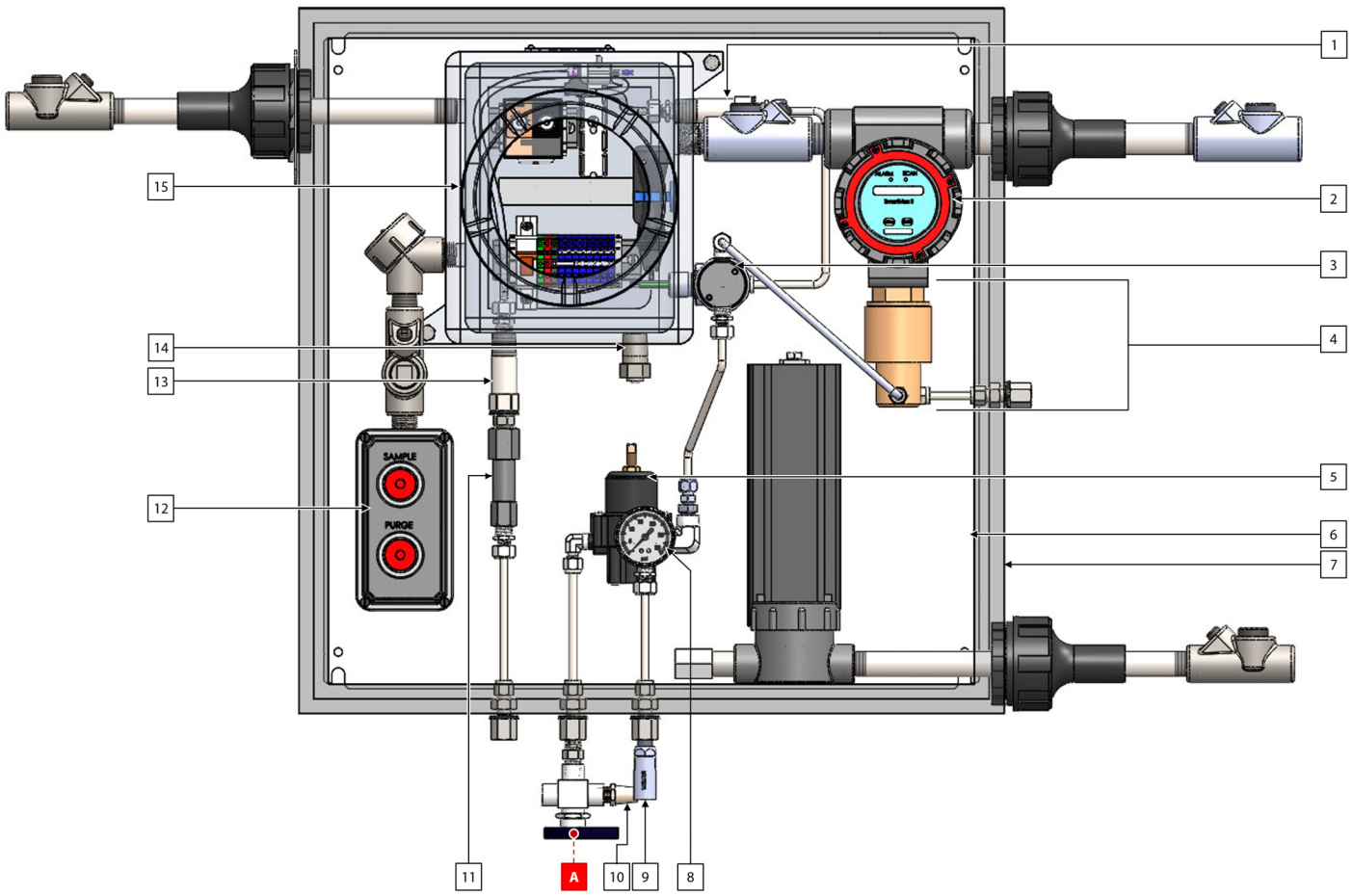


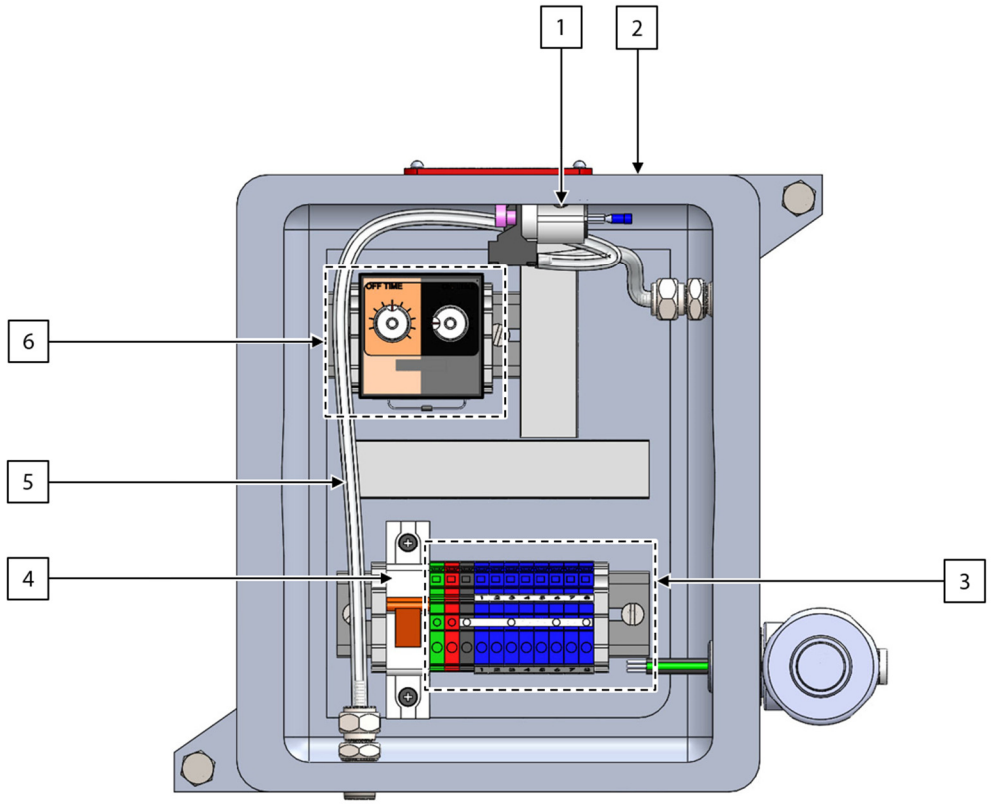
Figure 4: FOMB With Electric Heater Diagram



No.	Description
1	Flame Arrestor
2	SmartMax®II Monitor/Transmitter
3	3-Way Solenoid Valve
4	Catalytic Sensor Assembly
5	Instrument Regulator
6	Mounting Panel
7	Insulated Enclosure
8	Regulator Pressure Gauge
9	Welker RV-1 Relief Valve

No.	Description
10	Muffler
11	Inline Filter
12	Indicator Lights
13	Flame Arrestor
14	Drain/Breather
15	Explosion-proof Box (See *Figure 5*)
A	Inlet Valve
Shown Without Enclosure Door for Clarity	

Figure 5: Explosion-proof Box Diagram



No.	Description
1	Air Pump
2	Explosion-proof Box
3	Terminal Block
4	Circuit Breaker
5	Vinyl Tubing
6	Timer (See *Figure 6*)

Figure 6: Timer Diagram

The OFF TIME is the purge cycle time. The OFF TIME comes factory-set to 60 minutes; however, it is adjustable up to 10 hours.

The ON TIME is the sample cycle time. The ON TIME comes factory-set to 4 minutes and should only be adjusted during calibration procedures.

SECTION 2: INSTALLATION & OPERATION

2.1 Before You Begin

After unpacking the unit, check the equipment for compliance and any damage that may have occurred during shipment. Immediately contact a Welker representative if you received damaged equipment.

When sealing fittings with PTFE tape, refer to the proper sealing instructions for the brand used.

The Welker FOMB Fixed Odorant Monitor will ship "hard-tube" connected with manufacturer-supplied fittings and hardware. However, the customer will need to supply some tubing and fittings in order to complete the installation.

2.2 Installation

Welker recommends installing the FOMB in an enclosed, protected area to prevent tampering by unauthorized personnel.

1. Using customer-supplied mounting hardware, mount the FOMB vertically to a wall or bracket as close to the pipeline as possible. Ensure that there is sufficient clearance around the FOMB for customer connections.

The sample line should be as short as possible to ensure that the FOMB is supplied with fresh sample and to prevent flow rates from affecting sampling times and accuracy. If ⅛" tubing is used, Welker recommends that sample lines be no further than 20 ft from the pipeline connection.

If the FOMB is installed outside, Welker recommends installing a muffler to the calibration gas inlet to prevent dust and/or insects from entering through the port.

<u>Tubing Connections</u>

Welker recommends using stainless steel tubing for all natural gas process lines, as plastic tubing can absorb odorant from the gas, which can result in erroneous readings.

2. Using ¼" customer-supplied tubing, connect from the pipeline to the natural gas inlet (*Figure 1* or *Figure 3*).

Smaller tubing, such as ⅛", may be used to achieve longer runs for the inlet draw; however, clogging may occur in the line if the sample contains impurities or moisture.

3. Using ¼" customer-supplied tubing, connect from an ambient air source to the ambient air intake (*Figure 1* or *Figure 3*).

Welker recommends against using instrument air to purge the sensor cell, as the air pump requires low levels of humidity and oxygen. Not using instrument air can extend the life of the sensor cell to one year or more.

Welker recommends that the ambient air source be in a location free from significant levels of hydrocarbons and contaminants and that provides protection from rain, snow, dust, and insects.

4. Using ⅛" customer-supplied tubing, tube from the exhaust outlet on the catalytic sensor to an area away from personnel and equipment.

Though natural gas will be released only during Sample Mode, hydrogen sulfide is a deadly gas. Ensure that the exhaust outlet is not restricted and that the exhaust tubing terminates in an area away from personnel and equipment.

Welker recommends that ¼"–⅜" tubing from the exhaust outlet be no longer than 15 ft and that vertical run segments be avoided, as these conditions could lead to backups in the exhaust line and cause higher than normal readings. Hydrogen sulfide is considered a heavy gas and tends to back up inside exhaust tubing that extends vertically for too great a distance.

If the exhaust outlet tubing will terminate outdoors, Welker recommends installing a screen or muffler to prevent dust and insects from entering the tubing and restricting flow.

Electrical Connections

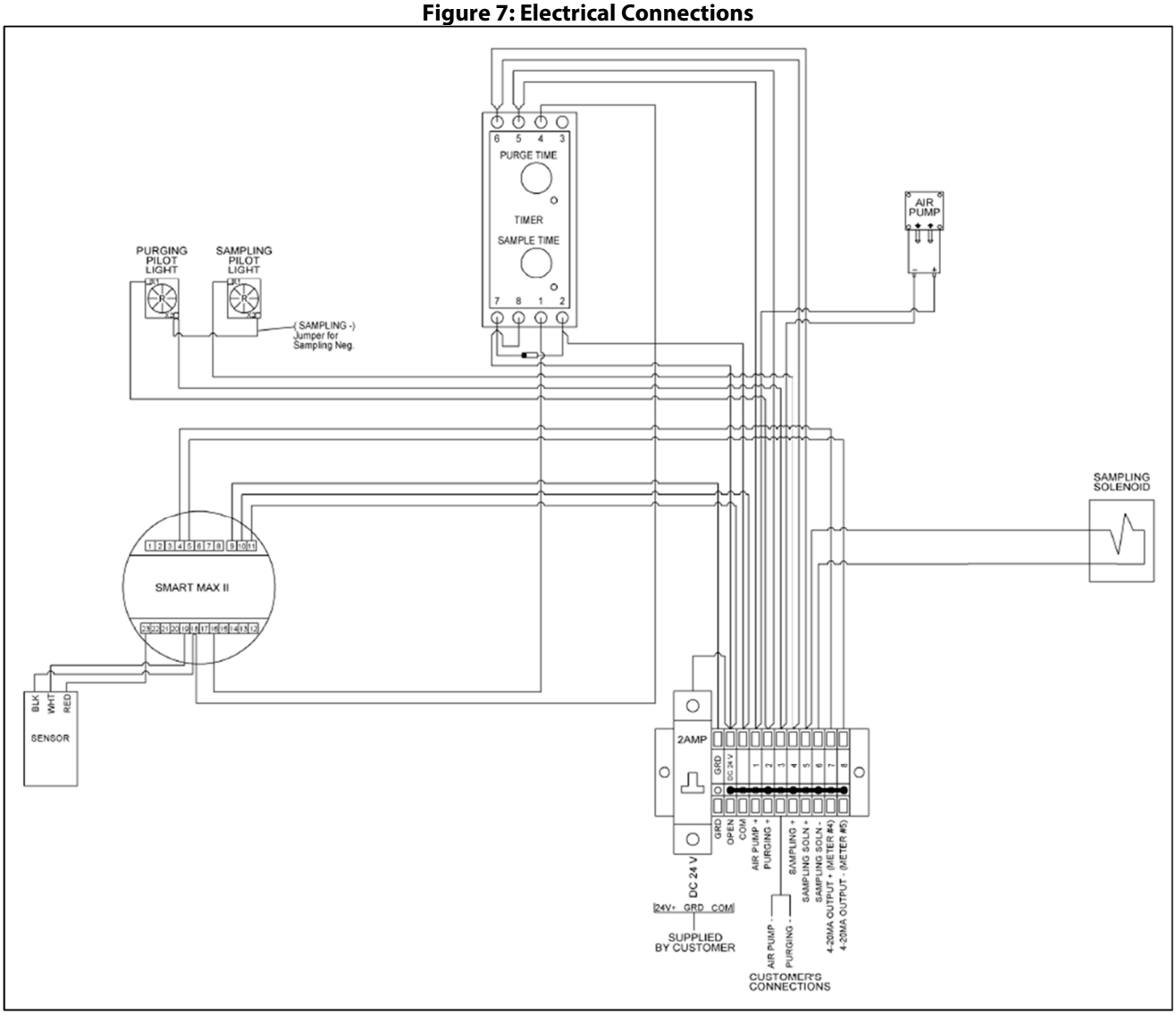
Turn OFF the electrical supply prior to making any electrical connections.

Electrical power must be supplied to the FOMB 24 hours a day, 7 days a week. Ensure that the electrical supply to the FOMB cannot be turned off accidentally. Turning power off at any time will result in a warm-up time of several hours and operating problems.

Welker strongly recommends using 16 AWG wire for runs 100–500 ft and 14 AWG wire for runs 500–1000 ft.

5. Remove the cover from the explosion-proof box.
6. Connect a DC 24 V electrical supply to the explosion-proof box (*Figures 1* or *Figure 3* and *Figure 7*).

Figure 7: Electrical Connections



7. Return the cover to the explosion-proof box.

RS-485 Connection (Optional)

The SmartMax®II can be connected to a PLC so that the FOMB can be monitored remotely in real time.

Do not splice wires together without maintaining proper shielding.

The PLC connection should be wired so that all pluses (+) are tied together, all minuses (-) are tied together, and all grounds (GRD) are tied together in a daisy chain configuration with short lengths and termination resistors.

8. Connect a 120 Ω ½ W termination resistor to the beginning and end of shielded, low capacitance 22 AWG twisted triple wire to prevent reflected signals.
9. Connect the shielded 22 AWG twisted triple wire to the SmartMax®II according to *Table 3*.

If the twisted triple wire is longer than 4000 ft, install an RS-485 repeater.

Table 3: SmartMax®II Wiring

Red (+)	RS-485 (+)
Black (-)	RS-485 (-)
White (GRD)	Ground

DO NOT connect the ground at the same location as motors or generators. Ground to one of the following: a cold water pipe electrode; a power service conduit; a service equipment enclosure; or the grounding electrode of a multi-ground neutral power system.

10. Seal conduit connectors using Chico® Sealing Compound or another appropriate sealing compound.

For systems used in hazardous locations, sealing compound is required to seal all fittings to restrict the passage of gases, vapors, or flames.

To maintain the Division 1 rating, all conduit seals must be sealed.

11. Connect the shielded 22 AWG twisted triple wire to the "COM" port of the PLC.

2.3 Start-Up Procedures

Welker recommends that the system remain energized during start-up procedures, as de-energizing the system forces a cold start. Cold starting the system erases from EPROM memory any programming changes made at the factory or in the field and reverts the SmartMax®II to default programming settings.

The electrical area classification of the FOMB is void whenever the explosion-proof box cover is removed while the system is energized. The electrical area classification of the FOMB will be restored once the cover is returned to the explosion-proof box or the system is de-energized.

1. Inspect all terminal connections for loose wiring and shorts. Correct wiring errors as necessary prior to energizing the system.
2. Ensure that inlet valve A is open to atmosphere. Turn the valve handle so that the arrow on the handle points up toward the calibration gas inlet (*Figure 1* and *Figure 2* or *Figure 3* and *Figure 4*).
3. Remove the cover from the explosion-proof box.

Turn OFF the electrical supply to the explosion-proof box prior to removing the cover.

4. Turn the circuit breaker to the ON position (*Figure 5*).
5. Using a flathead screwdriver, manually change the OFF TIME (purge time) setting on the timer to its maximum value (*Figure 6*). The sensor will stabilize during the purge cycle.

The sensor requires a minimum of thirty (30) minutes to stabilize. The exact amount of time required will vary.

6. Verify that the ON TIME (sample time) is set to 4 minutes (*Figure 6*).
7. Return the cover to the explosion-proof box.
8. Ensure that the power switch on the SmartMax®II is in the ON position.
9. At the end of the purge cycle or once the sensor has stabilized, remove the cover from the explosion-proof box.
10. Using a flathead screwdriver, manually set the OFF TIME (purge time) setting on the timer to the desired time (*Figure 6*). This will be the length of the purge cycle.

Welker recommends setting the OFF TIME to sixty (60) minutes; however, it is adjustable up to ten (10) hours.

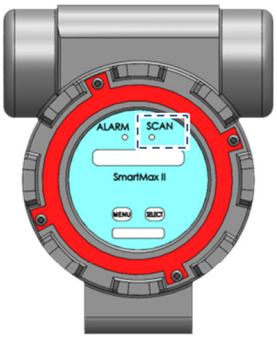
11. Return the cover to the explosion-proof box.
12. Open inlet valve A to the customer's natural gas supply. Turn the valve handle so that the arrow on the handle points down toward the natural gas inlet (*Figure 1* and *Figure 2* or *Figure 3* and *Figure 4*).
13. Open the outlet valve on the customer's natural gas supply.
14. The FOMB is now in operation and will cycle ON/OFF according to the timer settings.

3.1 Understanding the SmartMax®II Display

Figure 8: SmartMax®II Display

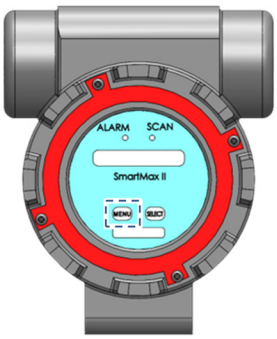
The **red** ALARM status light will flash during any alarm.

The **red** ALARM status light will continue to flash until the operator acknowledges the alarm.

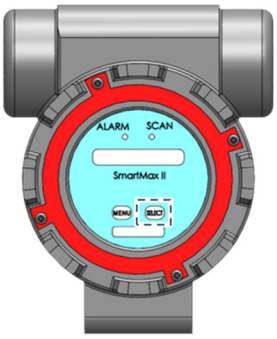


The **green** SCAN status light flashes during normal operation.

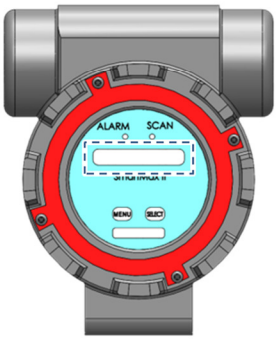
The **green** SCAN status light will flash rapidly during optional MODBUS communications.



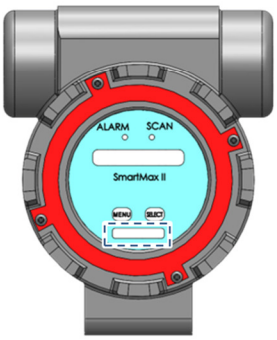
Press the MENU push button to scroll through menu items, which are shown above on the alphanumeric display.



Press the SELECT push button to select a menu item or enter a submenu.



The alphanumeric display shows menus, submenus, and SmartMax®II settings.



The phototransistors allow most of the commands in the COMMANDS menu to be activated in a non-intrusive manner.

Table 4: SmartMax®II Menu Items	
COMMANDS	Conduct Calibrations Save Program Settings Conduct a System Cold Start* (*Cold Starting the System Erases the EPROM Memory. Please Disregard This Submenu.)
READINGS	View the Reading, Status, and Settings of a Selected Sensor
CAL MENU	Set Calibration Times and Span Settings Turn the Speed Reader ON and OFF
ALARMS	Set the Alarm Levels and Status
RELAYS	Set the Function of the Relay Outputs and Control Inputs (Not Applicable for the FOMB. Please Disregard This Menu.)
OUTPUTS	Adjust the Accuracy of the 4–20 mA Output Signal (Not Applicable for the FOMB. Please Disregard This Menu.)
COM PORT	Set the Baud Rate, Address, and ID of the COM PORT
EXIT	Exit the Current Item Without Taking Action

These menu items can be viewed on the alphanumeric display.

Accessing and Changing Menu Items Manually

1. Press MENU to scroll through menu items on the alphanumeric display.
2. Once the desired menu appears on the alphanumeric display, stop pressing MENU, and then press SELECT to enter that menu.
3. As necessary, repeat steps 1 and 2 to access submenu items.
4. If the menu item's parameter is adjustable, it can be adjusted by pressing and holding SELECT until the desired value appears on the alphanumeric display. The value will flash on the display and then be saved.

Only values within predetermined limits are allowed.

If the desired value is passed over, continue to hold SELECT until the desired value reappears on the alphanumeric display.

Exiting a Submenu to Return to Scan

"Scan" refers to the normal (scanning) mode of the SmartMax®II.

The operator can exit a submenu manually or by not taking any action.
To exit a submenu manually, continue to step 5.
To exit a submenu by taking no action, wait until the SmartMax®II has returned itself to Scan. Note that it may take several minutes for the SmartMax®II to return itself to Scan, as the SmartMax®II steps back one (1) menu level after one (1) minute of push button inactivity.

5. To exit a submenu manually, press MENU until EXIT appears on the alphanumeric display.
6. Once EXIT appears on the alphanumeric display, press SELECT to exit the submenu. The SmartMax®II will return to Scan.

Accessing and Changing Command Menu Items Using the Phototransistors

To acknowledge and silence any alarms using the phototransistors, activate the ACK HORN command. Note that this command only appears when using the phototransistors, as any push button activity will acknowledge and silence alarms.

7. Cover the right and left phototransistors with your fingertips.
8. Shine a strong light into the center phototransistor. The COMMANDS submenus will begin to scroll on the alphanumeric display.

The light used must be explosion-proof.

The light must hit the center phototransistor in order to non-intrusively activate a command.

9. Once the desired menu appears on the alphanumeric display, remove the light and your fingertips from the phototransistors. After a few seconds, the command displayed will flash and then be activated.
10. The SmartMax®II will return itself to Scan after at least one (1) minute of push button inactivity.

It may take several minutes for the SmartMax®II to return itself to Scan, as the SmartMax®II steps back one (1) menu level after one (1) minute of push button inactivity.

3.2 Menu Items

COMMAND Menu

Through the COMMANDS menu, the user can access the actions controlled by its submenus as described in *Table 5*.

All commands of the COMMANDS menu except SAVE ALL and CLDSTRT can be activated by the phototransistors. For instructions on activating the COMMANDS menu using the phototransistors, see *Section 3.1, Understanding the SmartMax®II Display*.

Table 5: SmartMax®II COMMAND Menu Submenus

Menu	Submenus	Action
COMMAND	RESET	Reset an Alarm
	ZERO CAL	Perform a ZERO Calibration
	SPAN CAL	Perform a SPAN Calibration
	ZEROTEST	Perform a ZERO Test
	SPANTEST	Perform a SPAN Test
	CLDSTRT	Erase EPROM Memory and Revert to Default Program Settings (Please Disregard This Submenu.)

RESET: Resetting an Alarm

Report any alarms for immediate correction. Acknowledge an alarm but DO NOT reset the alarm until the cause of the alarm has been identified and corrective measures have been taken.

1. Press MENU until COMMAND appears on the alphanumeric display.
2. Once COMMAND appears on the alphanumeric display, press SELECT to enter the COMMAND menu.
3. Press MENU until RESET appears on the alphanumeric display.
4. Once RESET appears on the alphanumeric display, press SELECT to reset the alarm.

ZERO CAL & SPAN CAL: Performing Calibrations

Refer to *Appendix B, Calibration Sheet,* for instructions on performing calibrations.

Calibration is required:

- after the catalytic sensor is replaced;
- if the system has been cold started; and
- if the FULLSCLE and CAL RDNG values have been changed to something other than the factory settings.

During calibration procedures the electrical area classification of the FOMB is void, as the explosion-proof box cover is removed while the system is energized. The electrical area classification of the FOMB will be restored once the cover is returned to the explosion-proof box or the system is de-energized.

While performing a calibration, the alarms and 4–20 mA output are not actively following process changes.

After successfully performing a calibration, the values obtained during the calibration are stored in the EPROM memory and are used for subsequent readings.

ZEROTEST & SPANTEST: Conducting Calibration Checks

Conducting a calibration check is not the same as performing a calibration, as the values are not stored in the EPROM memory.

While conducting a calibration check, the alarms are bypassed.

CLDSTRT: Cold Starting the System

Cold starting the system erases from EPROM memory any programming changes made at the factory or in the field and reverts the SmartMax®II to default programming settings.

If the system is cold started, a full calibration must be performed before the FOMB can return to normal operation. Refer to *Appendix B, Calibration Sheet,* for instructions on performing calibrations.

READINGS Menu

Through the READINGS menu, the user can access the actions controlled by its submenus as described in *Table 6*.

The information in the READINGS menu is helpful when troubleshooting the FOMB. See *Section 4.7, SmartMax®II Troubleshooting,* for instructions on troubleshooting the FOMB.

The values displayed in READING1, ZERO CH1, SPAN CH1, and INPUT 1 have been calculated and stored by the SmartMax®II and cannot be altered.

Table 6: SmartMax®II READINGS Menu Submenus

Menu	Submenus	Action
READINGS	READING1	Check Reading Values
	STATUS1	Check or Change the Status of a Sensor (Not Applicable for the FOMB. Please Disregard This Submenu.)
	ZERO CH1	Check ZERO Output
	SPAN CH1	Check SPAN Output
	INPUT 1	Check the mA Input Signal

READING1: Checking Reading Values

While in Span mode, the readings and status of each sensor will scroll on the alphanumeric display.

All channels with a sensor read continuously. The reading values displayed are in lb/MMcf.

Any channel without a sensor will display a downscale reading and trigger a malfunction alarm unless that channel is bypassed.

STATUS1: Checking the Status of a Sensor

The use of multiple sensors with the FOMB is not supported. Please disregard this submenu.

ZERO CH1: Checking Zero Output

The Zero of a sensor is the amount of mA received by the SmartMax®II during the last successful ZERO calibration. This is the amount of mA from the sensor that will represent 0% full scale readings.

The SmartMax®II interprets valid or invalid mA signals and will either pass or fail a ZERO calibration based on the value received.

SPAN CH1: Checking Span Output

The span of a sensor is the amount of mA above zero (0) received by the SmartMax®II during the last successful SPAN calibration. This is the amount of mA from the sensor that will represent the CAL RDNG stored at the time of SPAN calibration.

Based on the sensor type, the SmartMax®II interprets valid or invalid mA signals and will either pass or fail a SPAN calibration based on the value received.

Any changes to the CAL RDNG will require another SPAN calibration before the SmartMax®II can be returned to operational state.

INPUT 1: Checking the mA Input Signal

The input of a sensor is the amount of mA continuously seen by the SmartMax®II for that channel. This signal is then scaled and compared to the signal of the last calibration and is displayed in engineering units as the READING.

CALIBRATION Menu

Through the CALIBRATION menu, the user can access the actions controlled by its submenus as described in *Table 7*.

Table 7: SmartMax®II CALIBRATION Menu Submenus

Menu	Submenus	Action
CALIBRATION	CAL TIME	Set the Calibration Time (Not Applicable for the FOMB. Please Disregard This Submenu.)
	CAL RDNG	Set the Span Reading
	SPEED	Set the Speed Reader Status

CAL TIME: Set the Calibration Time

The CAL TIME comes factory-set to 4 minutes and is not adjustable.

CAL RDNG: Set the Span Reading

The CAL RDNG is the reading you must obtain when the sensor is exposed to the span test gas.

The CAL RDNG comes factory-set to 2.00 lb/MMcf but is adjustable between 0.25–2.00. Welker recommends the CAL RDNG not be changed from the factory setting of 2.00 lb/MMcf. If a calibration gas other than 2.00 lb/MMcf is used, the FULLSCLE and CAL RDNG must be adjusted on the SmartMax®II.

Welker recommends the Welker Calibration Kit, which includes a calibration gas of 2.00 lb/MMcf, for use with this unit. If a calibration gas other than 2.00 lb/MMcf is used, the FULLSCLE and CAL RDNG must be adjusted on the SmartMax®II and the unit must be recalibrated.

SPEED: Setting the Speed Reader Status

The Speed Reader is used to speed up system response time to alarms. The Speed Reader can be turned off or set to run at low, medium, or high speeds.

The Speed Reader is factory-set for optimum sensor performance. Welker recommends the Speed Reader not be changed from the factory setting, as setting the value higher may cause false alarms and setting the value lower will slow response time to alarms.

ALARMS Menu

Through the ALARMS menu, the user can access the actions controlled by its submenus as described in *Table 8*.

Table 8: SmartMax®II ALARMS Menu Submenus

Menu	Submenus	Action
ALARMS	HI MERC	Set Alarm Levels
	LOW MERC	Set Alarm Levels
	FULLSCLE	Set Full Scale
	LATCHES	Make Alarms Latching or Non-Latching
	FAILSAFE	Make Alarms Normally Energized

HI MERC: Set Alarm Levels

The HI MERC alarm comes factory-set to 1.80 lb/MMcf but is adjustable.

LOW MERC: Set Alarm Levels

The LOW MERC alarm comes factory-set to 0.40 lb/MMcf but is adjustable.

FULLSCLE: Setting the Full Scale

The FULLSCLE comes factory-set to 200 but is adjustable from 50–200. Welker recommends the FULLSCLE not be changed from the factory setting of 200. If a calibration gas other than 2.00 lb/MMcf is used, the FULLSCLE and CAL RDNG must be adjusted on the SmartMax®II.

Welker recommends the Welker Calibration Kit, which includes a calibration gas of 2.00 lb/MMcf, for use with this unit. If a calibration gas other than 2.00 lb/MMcf is used, the FULLSCLE and CAL RDNG must be adjusted on the SmartMax®II and the unit must be recalibrated.

LATCHES: Making Alarms Latching or Non-Latching

Alarms are factory-set to non-latching.

Latching alarms require the operator to reset the system.
Non-latching alarms automatically reset once the reading falls below the alarm set point.

All alarms can be programmed to be latching or non-latching. The latching or non-latching "value" can be added to individual alarms or to groups of alarms. Non-latching alarms are indicated with a blank screen when viewed or changed.

If the LOW MERC Alarm is programmed to be non-latching, it MUST be connected to a latching auxiliary device so that an operator is required to respond to a LOW MERC alarm.

FAILSAFE: Making Alarms Normally Energized

Failsafe alarms are energized during normal operations. They are considered failsafe because they will "alarm" if the system loses power.

All alarms can be programmed to be failsafe. The failsafe "value" can be added to individual alarms or to groups of alarms.

Welker recommends setting the Malfunction alarm to be failsafe.

RELAYS Menu

The use of relays with the FOMB is not supported. Please disregard this menu.

OUTPUTS Menu

The settings of the OUTPUTS menu are programmed at the factory. Please disregard this menu.

COM PORT Menu

Through the COM PORT menu, the user can access the actions controlled by its submenus as described in *Table 9*.

Table 9: SmartMax®II COM PORT Menu Submenus

Menu	Submenus	Action
COM PORT	BAUDRATE	Select a Baud Rate for Serial Communications
	ADDRESS	Assign the SmartMax®II an Address for Serial Communication
	ID NBR	Assign the SmartMax®II a Tag Number for Identification

BAUDRATE: Selecting a Baud Rate for Serial Communications

The baud rate is the speed at which the SmartMax®II communicates with the PLC over the RS-485 serial port.

The baud rate is factory-set to 9600 Bd but is adjustable between 300–9600 Bd. If the SmartMax®II can no longer frame transmissions correctly at the set baud rate, it will search through all baud rates until it finds a match.

ADDRESS: Assigning the SmartMax®II an Address for Serial Communication

The SmartMax®II is assigned an address at the factory. If the configuration of the system is altered during installation or if new units are added to an existing system, the address may need to be changed.

Each SmartMax®II must have a unique address so that messages coming from the PLC can be recognized by the correct unit. Up to 255 addresses can be assigned.

As each SmartMax®II contains four (4) channels, each SmartMax®II is assigned four (4) consecutive addresses based on the valve chosen for the first channel. For example, a SmartMax®II assigned address 5 would subsequently be assigned addresses 6, 7, and 8.

ID NBR: Assigning the SmartMax®II a Tag Number for Identification

The tag number is set by the user for internal equipment identification so that individual SmartMax®II controllers can be correctly identified.

The user-specified tag number can be any whole number between 0–65535. The tag number cannot contain letters.

The address and tag number are independent values.

SECTION 4: MAINTENANCE

4.1 Before You Begin

The only maintenance required is replacing the vinyl tubing at least every six (6) months and replacing components in the event of component failure.

Welker recommends having replacement components on hand prior to performing maintenance to minimize system downtime.

4.2 Maintenance: Vinyl Tubing

The vinyl tubing must be replaced every six (6) months under normal operating conditions. In cases of severe service, dirty conditions, excessive usage, or other unique applications that may lead to excessive wear on the vinyl tubing, a more frequent replacement schedule may be appropriate.

The electrical area classification of the FOMB is void whenever the explosion-proof box cover is removed while the system is energized. The electrical area classification of the FOMB will be restored once the cover is returned to the explosion-proof box or the system is de-energized.

1. Remove the cover from the explosion-proof box.

Turn OFF the electrical supply to the explosion-proof box prior to removing the cover.

2. Turn the circuit breaker to the OFF position (*Figure 5*).
3. Disconnect the vinyl tubing from the flame arrestors (*Figure 2* or *Figure 4* and *Figure 5*).
4. Install new vinyl tubing between the flame arrestors.
5. Turn the circuit breaker to the ON position (*Figure 5*).
6. Return the cover to the explosion-proof box.

4.3 Maintenance: Solenoid

Should the solenoid need to be replaced, contact Welker. Welker must replace the solenoid at the factory for the FOMB to maintain its electrical area classification.

4.4 Maintenance: Indicator Light Bulbs

1. Remove the cover from the explosion-proof box.

Turn OFF the electrical supply to the explosion-proof box prior to removing the cover.

2. Turn the circuit breaker to the OFF position (*Figure 5*).
3. Unscrew the four (4) screws on the indicator light assembly, and then remove the indicator light cover (*Figure 2* or *Figure 4*).
4. Replace the burnt light bulb(s).
5. Return the indicator light cover to the indicator light assembly, and then tighten the four (4) screws on the indicator light assembly.
6. Turn the circuit breaker to the ON position (*Figure 5*).
7. Return the cover to the explosion-proof box.

4.5 Maintenance: Timer

1. Remove the cover from the explosion-proof box.

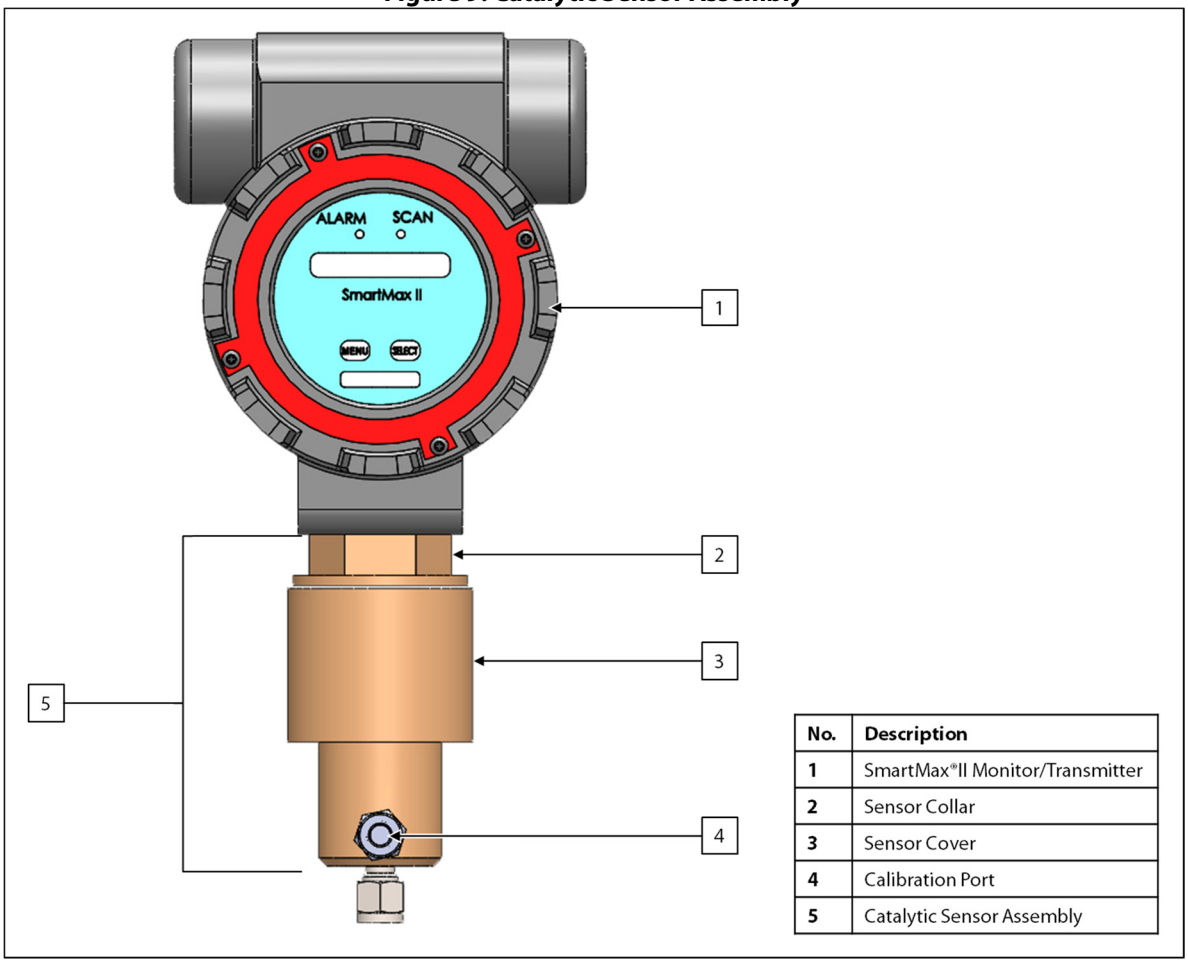
Turn OFF the electrical supply to the explosion-proof box prior to removing the cover.

2. Turn the circuit breaker to the OFF position (*Figure 5*).
3. Remove the timer from the junction box (*Figure 5*).
4. Install a new timer to the timer socket in the junction box (*Figure 5*).
5. Set the OFF TIME (purge time) and ON TIME (sample time) on the new timer (*Figure 6*).
6. Turn the circuit breaker to the ON position (*Figure 5*).
7. Return the cover to the explosion-proof box.

4.6 Maintenance: Catalytic Sensor Element

Negative readings, repeated abnormal readings, and sudden low readings are all indications that the catalytic sensor element needs to be replaced. If any of these indications are observed by the operator, additional testing is required to determine if they were triggered by a failed sensor; contact Welker for assistance.

Figure 9: Catalytic Sensor Assembly



No.	Description
1	SmartMax®II Monitor/Transmitter
2	Sensor Collar
3	Sensor Cover
4	Calibration Port
5	Catalytic Sensor Assembly

1. Ensure that inlet valve A is open to atmosphere. Turn the valve handle so that the arrow on the handle points up toward the calibration gas inlet (*Figure 1* and *Figure 2* or *Figure 3* and *Figure 4*).
2. Remove the cover from the explosion-proof box.

STOP

Turn OFF the electrical supply to the explosion-proof box prior to removing the cover.

3. Turn the circuit breaker to the OFF position (*Figure 5*).
4. Disconnect the tubing connecting the solenoid to the calibration port (*Figure 2* or *Figure 4*).
5. Unscrew the sensor cover from the sensor assembly. Set the sensor cover aside.
6. Gently pull the plug-in sensor element from its mount inside the sensor collar.
7. Plug in the replacement sensor element.

The four (4) pins on the replacement sensor element must line up with the four (4) ports in the sensor collar.

8. Screw the sensor cover onto the sensor collar.
9. Using a flathead screwdriver, manually change the OFF TIME (purge time) setting on the timer to its maximum value (*Figure 6*). The sensor will stabilize during the purge cycle.

The sensor requires a minimum of thirty (30) minutes to stabilize. The exact amount of time required will vary.

10. Turn the circuit breaker to the ON position (*Figure 5*).
11. Return the cover to the explosion-proof box.
12. Ensure that the power switch on the SmartMax®II is in the ON position.
13. At the end of the purge cycle or once the sensor has stabilized, the FOMB is ready to be calibrated. Refer to *Section B1.3, Calibration Procedures,* in *Appendix B, Calibration Sheet,* for instructions on calibrating the FOMB.

The FOMB must be calibrated after the catalytic sensor is replaced to ensure accurate readings.

4.7 SmartMax®II Troubleshooting

Table 10: SmartMax®II Troubleshooting		
Issues	**Possible Causes**	**Solutions**
The SmartMax®II is not working.	The SmartMax®II is not turned on.	Ensure that the SmartMax®II is turned on. The power switch is on the rear of the SmartMax®II. The ON position is toward the center of the unit.
	An incorrect power type and/or voltage level is supplied to the SmartMax®II.	Ensure that a DC 24 V electrical supply is connected to the explosion-proof box. An incorrect power type and/or voltage can cause permanent damage to the unit.
	One or both fuses inside the SmartMax®II may be blown.	Inspect the fuses to determine if one or both fuses need to be replaced. Fuse 1 (F1) protects the supplied power output to the sensor; if F1 is blown, that could indicate sensor electronics failure or incorrect wiring. Fuse 2 (F2) protects the electronics of the SmartMax®II; if F2 is blown, that indicates internal SmartMax®II failure, and the SmartMax®II must be returned to the manufacturer for repairs. Repeated blown fuses indicate a problem; the SmartMax®II should be returned to the factory.
The sensor is not returning the signal.	Electrical power at the sensor electronics is less than DC 13.5 V.	The wire installed from the SmartMax®II to the sensor is too light or the distance between the SmartMax®II and the sensor is too great. Increase the gauge of the wire or decrease the distance between the SmartMax®II and the sensor.
	DC output power from the SmartMax®II is not available on TB3, which is on the rear of the SmartMax®II, or is the incorrect voltage.	Ensure that DC output power is available on the TB3 and that it is DC 1 V lower than the input power of the SmartMax®II.

Table 10: SmartMax®II Troubleshooting (Continued)		
Issues	**Possible Causes**	**Solutions**
The sensor will not reach zero with ambient air.	Ambient air used to zero (i.e., purge) contains small amounts of the gas that is being monitored.	Verify that the ambient air used does not contain any of the gas being measured, as contaminated air can cause artificially low readings and unsafe conditions.
	The sensor element is not plugged in all the way and/or the catalytic assembly is not assembled correctly.	Ensure that the sensor element is installed correctly. See *Section 4.6, Maintenance: Catalytic Sensor Element,* for instructions on disassembling the catalytic sensor assembly.
	Sensor wiring and/or voltage across pins 3 and 1 of the sensor's 3-positional terminal block is incorrect.	Ensure that the wiring across pins 3 and 1 is correct and that a minimum of DC 13.5 V is supplied.
The sensor will not span with the application of calibration gas.	Sensor wiring and/or voltage across pins 3 and 1 of the sensor's 3-positional terminal block is incorrect.	Ensure that the wiring across pins 3 and 1 is correct and that a minimum of DC 13.5 V is supplied.
	The concentration of the calibration gas differs from the CAL RDNG and FULLSCLE settings.	Ensure that the type, concentration, and presence of gas during the calibration phase meet the guidelines of the Gas Standard Data Sheet. Ensure that CAL RDNG and FULLSCLE are correct for the calibration gas used.
	The calibration gas supply is not secured to inlet valve A.	Ensure that the calibration gas supply is properly connected to the FOMB at inlet valve A.
	The sensor element might need to be replaced.	Additional testing is required to determine if the sensor has failed; contact Welker for assistance. To replace the sensor element, see *Section 4.6, Maintenance: Catalytic Sensor Element,* for instructions.

APPENDIX A: REFERENCED OR ATTACHED DOCUMENTS

Welker *Installation, Operation, and Maintenance* (IOM) *Manuals* suggested for use with this unit:

- IOM-033: Welker RV-1, RV-2, RV-2CP, and RV-3 Relief Valves

Other *Installation, Operation, and Maintenance* (IOM) *Manuals* suggested for use with this unit:

- Automatic Timing & Controls 422AR Series Flip-Flop 1/16 DIN Flip-Flop Timer (Welker IOM-V204)
- Control Instruments Corporation Hydrogen Sulfide Sensor for SmartMax®II (Welker IOM-V207)
- Control Instruments Corporation SmartMax®II Monitor/Transmitter (Welker IOM-V206)
- Emmerson Process Management Regulator Technologies, Inc. Fisher™ 67C Series Instrument Supply Regulators (Welker IOM-V048)
- Hammond Manufacturing Ltd. Type 4 Mild Steel Wallmount Enclosure with Window Eclipse Series (Welker IOM-V319)
- Hubbell Incorporated Killark® GR Series Enclosures (Welker IOM-V202)
- Hubbell Incorporated Killark® XCS/XS/SWB Series Controls (Welker IOM-V203)
- INTERTEC Instrumentation CP Multitherm C Electric Heater (Welker IOM-V104)
- INTERTEC Instrumentation TS Thermostat (Welker IOM-V105)
- KNF Micro AG Micro Diaphragm Gas Sampling Pumps (Welker IOM-V205)
- Swagelok Company Filters FW, F, and TF Series (Welker IOM-V092)
- Swagelok Company One-Piece Instrumentation Ball Valves 40G Series and 40 Series (Welker IOM-V085)
- Versa Products Company, Inc. Series E Type Valves (Welker IOM-V211)
- WIKA Instrument Corporation Bourdon Tube Pressure Gauges Type 232.53 and Type 233.53 (Welker IOM-V171*)*

Welker drawings and schematics suggested for use with this unit:

- System Drawing: OE109.3 (Standard FOMB)
- System Drawing: OE109.4E (FOMB With Insulated Heated Enclosure)
- Electrical Drawing: OE109EL

APPENDIX B: CALIBRATION SHEET

B1.1 Factory Settings

The FOMB ships from the factory pre-calibrated and programmed with the factory settings listed in *Table B1*.

Table B1: FOMB Factory Calibration Settings

	Setting	Value	Adjustable
CAL MENU	**FULLSCLE** (Full Scale of the System)	200	Yes, Between 50–200
	CAL TIME (Required Calibration Time)	4 Minutes	No
	CAL RDNG (Standard Calibration Gas)	2.00 (2.00 lb/MMcf)	Yes, Between 0.25–2.00 lb/MMcf

Welker recommends the Welker Calibration Kit, which includes a calibration gas of 2.00 lb/MMcf, for use with this unit. If a calibration gas other than 2.00 lb/MMcf is used, the FULLSCLE and CAL RDNG must be adjusted on the SmartMax®II and the unit must be recalibrated.

B1.2 System Diagrams

Figure B1: FOMB Connections Diagram

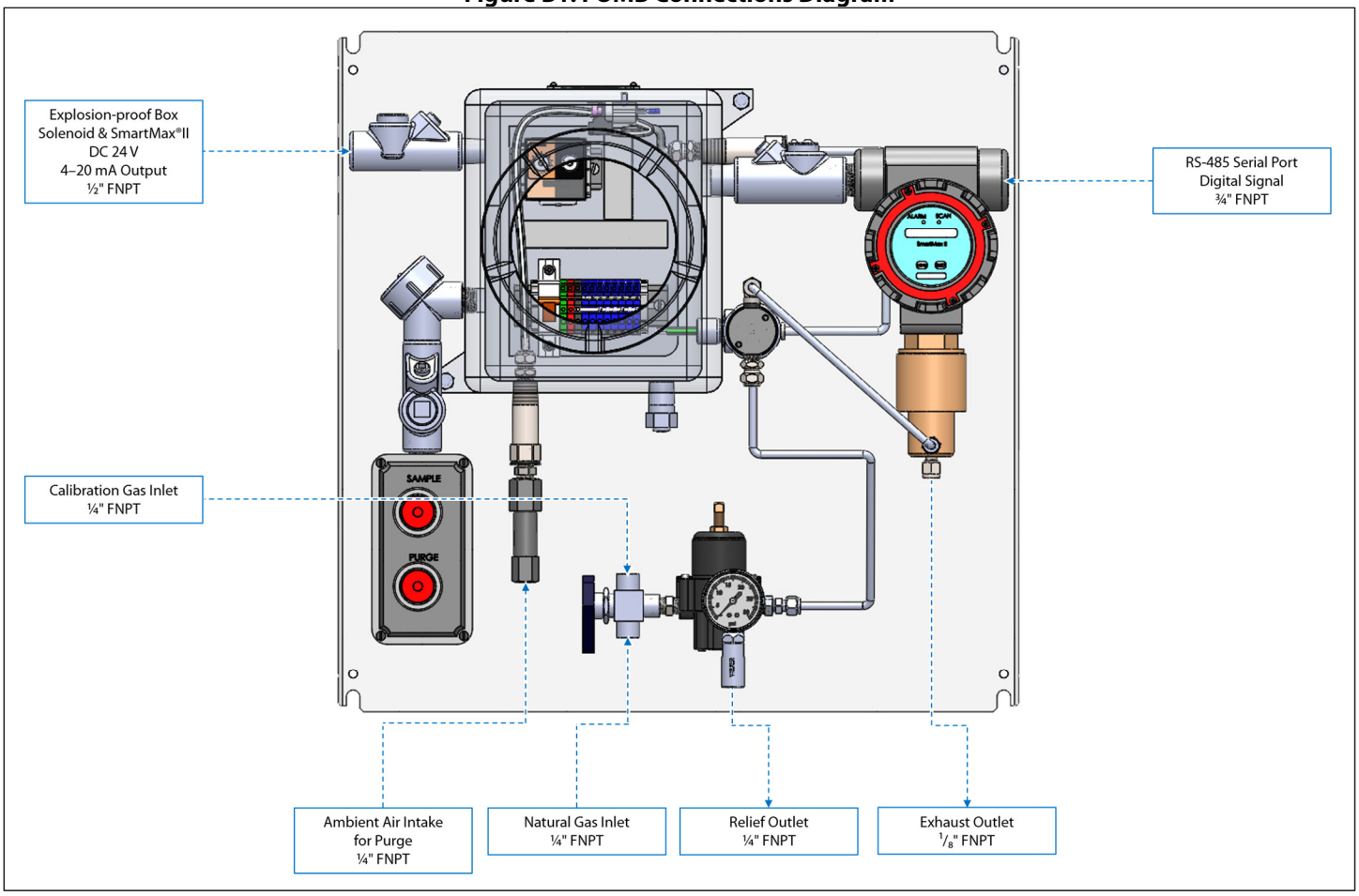
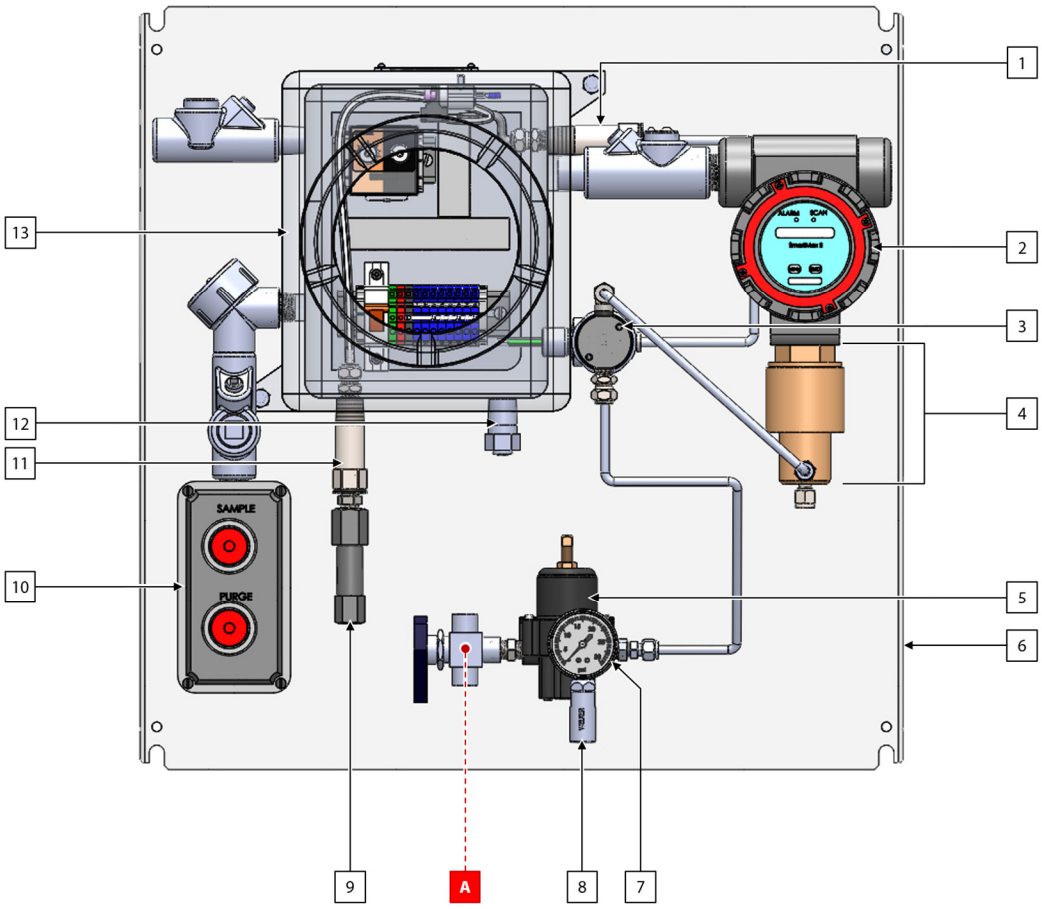


Figure B2: FOMB Panel Diagram



No.	Description
1	Flame Arrestor
2	SmartMax®II Monitor/Transmitter
3	3-Way Solenoid Valve
4	Catalytic Sensor Assembly
5	Instrument Regulator
6	Mounting Panel
7	Regulator Pressure Gauge

No.	Description
8	Welker RV-1 Relief Valve
9	Inline Filter
10	Indicator Lights
11	Flame Arrestor
12	Drain/Breather
13	Explosion-proof Box
A	Inlet Valve

Figure B3: FOMB With Electric Heater Connections Diagram

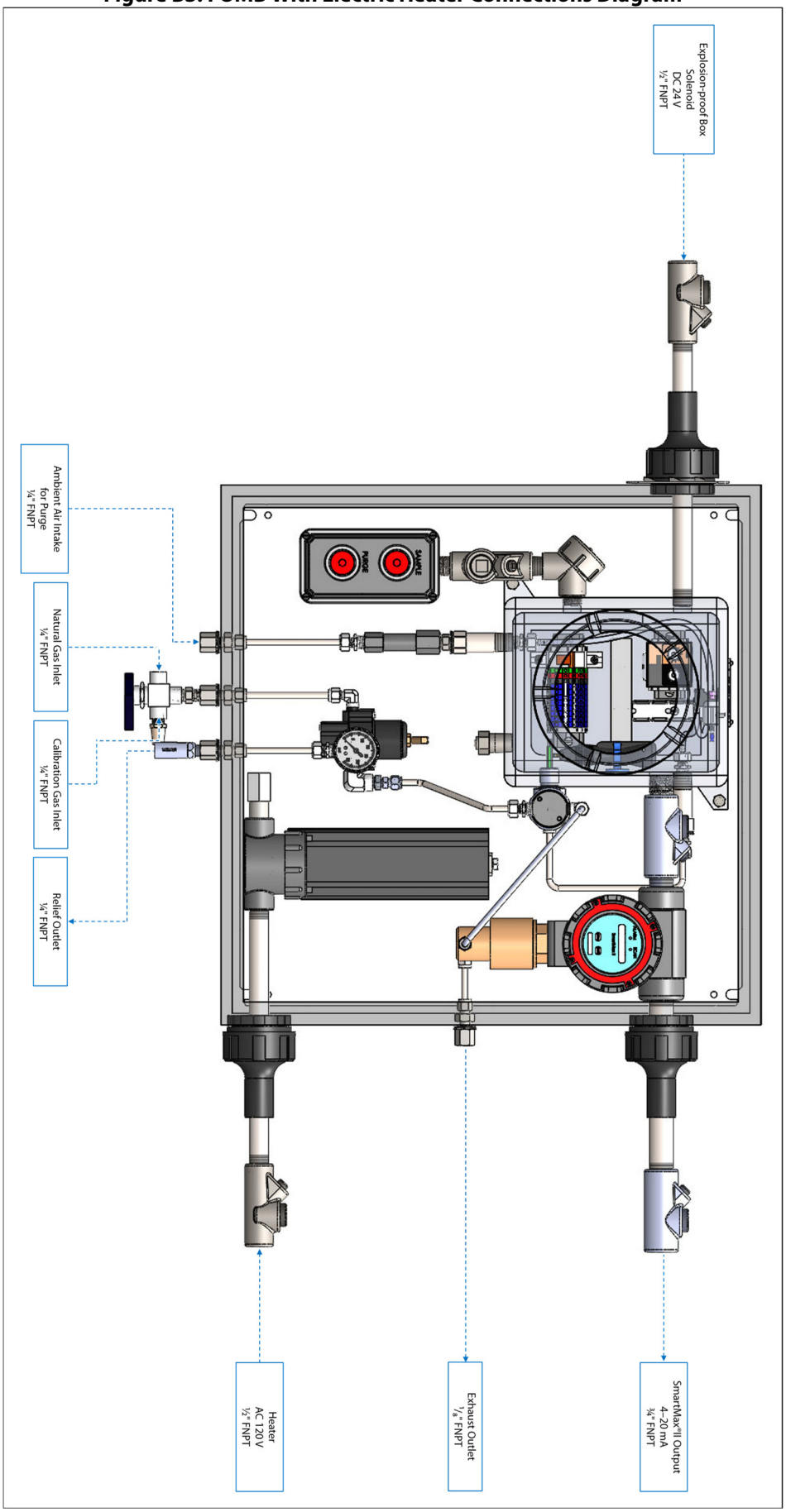
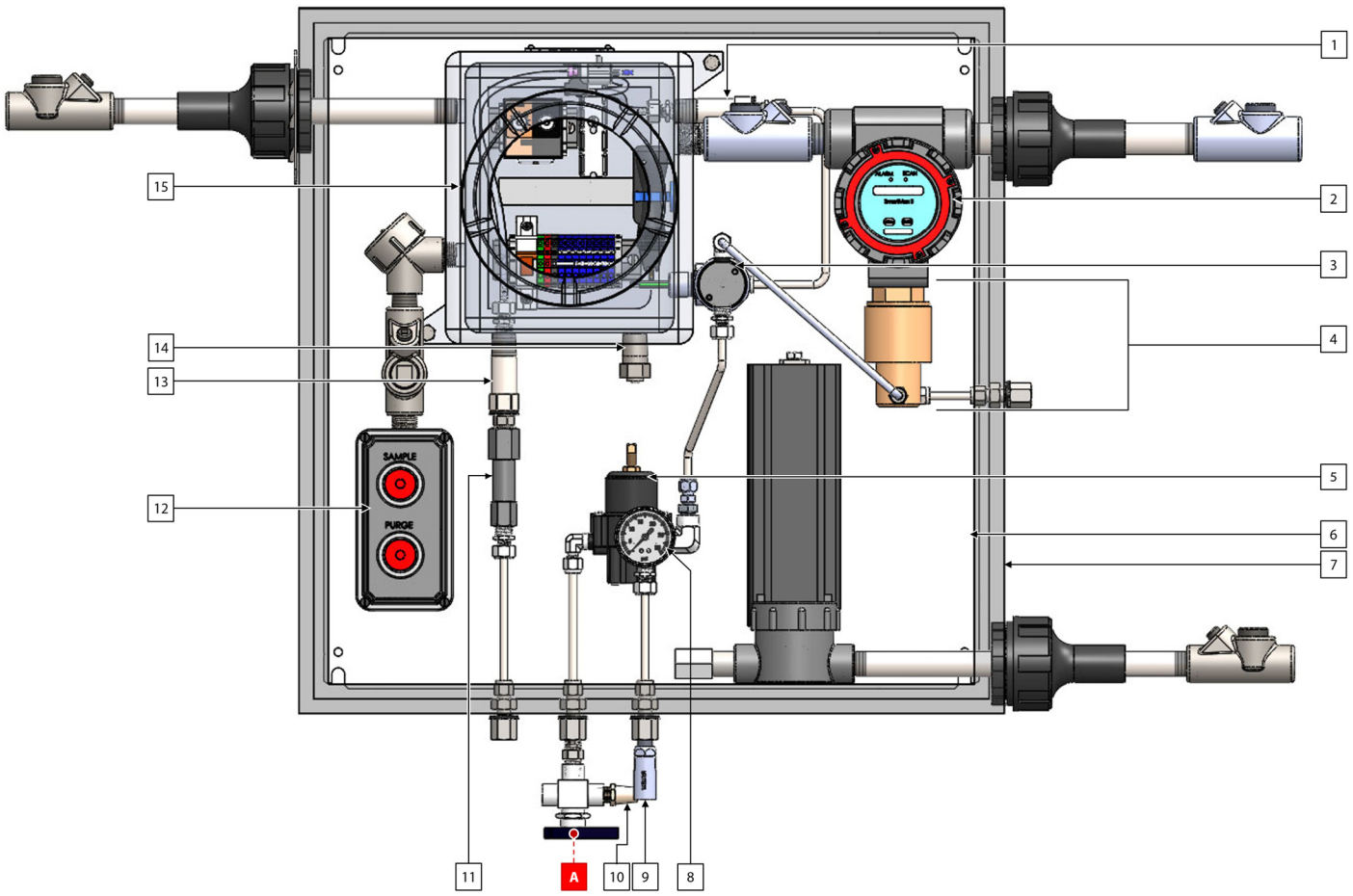


Figure B4: FOMB With Electric Heater Diagram



No.	Description
1	Flame Arrestor
2	SmartMax®II Monitor/Transmitter
3	3-Way Solenoid Valve
4	Catalytic Sensor Assembly
5	Instrument Regulator
6	Mounting Panel
7	Insulated Enclosure
8	Regulator Pressure Gauge
9	Welker RV-1 Relief Valve

No.	Description
10	Muffler
11	Inline Filter
12	Indicator Lights
13	Flame Arrestor
14	Drain/Breather
15	Explosion-proof Box
A	Inlet Valve
Shown Without Enclosure Door for Clarity	

B1.3 Calibration Procedures

Calibration is required:

- after the catalytic sensor is replaced;
- if the system has been cold started; and
- if the FULLSCLE and CAL RDNG values have been changed to something other than the factory settings.

The electrical area classification of the FOMB is void whenever the explosion-proof box cover is removed while the system is energized. The electrical area classification of the FOMB will be restored once the cover is returned to the explosion-proof box or the system is de-energized.

While performing a calibration, the alarms and 4–20 mA output are not actively following process changes.

After successfully performing a calibration, the values obtained during the calibration are stored in the EPROM memory and are used for subsequent readings.

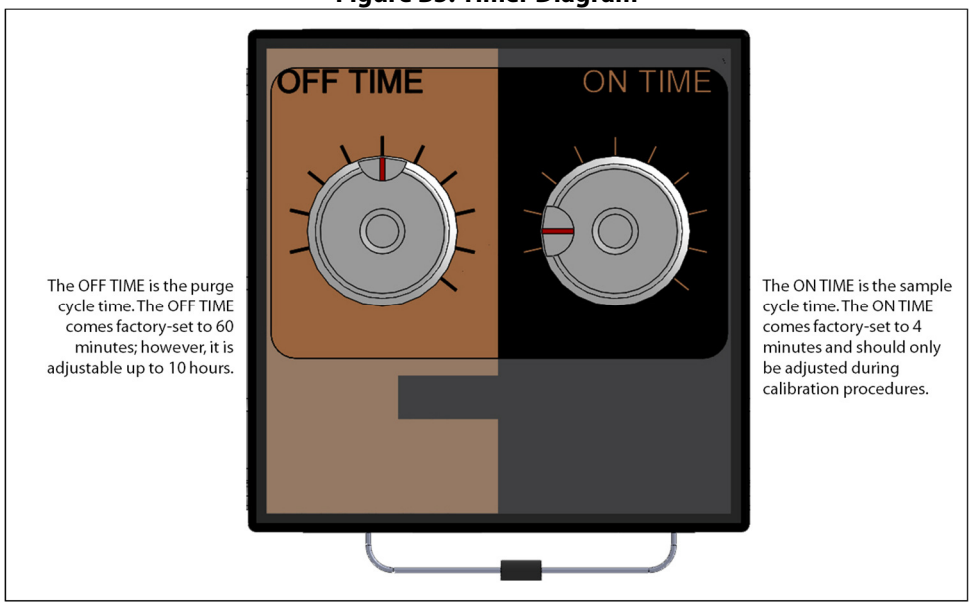
ZERO CAL

1. Turn OFF the natural gas supply to the FOMB.
2. Remove the cover from the explosion-proof box.

STOP Turn OFF the electrical supply to the explosion-proof box prior to removing the cover.

3. Using a flathead screwdriver, manually change the OFF TIME (purge time) setting on the timer to its maximum value and the ON TIME (sample time) to its minimum value (*Figure B5*).

Figure B5: Timer Diagram



4. Turn ON the electrical supply.

5. Wait approximately 2 minutes for the sensor to switch from safe mode to calibration mode. The alphanumeric display will read CALENDS during this time.

The sensor is ready to be calibrated once the RDNG and STATUS1 values begin scrolling across the alphanumeric display.

6. Once the sensor has switched to calibration mode, press MENU to scroll through menu items on the alphanumeric display.
7. Once COMMANDS appears on the alphanumeric display, stop pressing MENU, and then press SELECT to enter that menu.
8. Press MENU until ZERO CAL appears on the alphanumeric display.
9. Once ZERO CAL appears on the alphanumeric display, stop pressing MENU, and then press SELECT. ZERO CAL will begin to flash on the alphanumeric display.
10. Once ZERO CAL stops flashing on the alphanumeric display, turn ON the air pump.

If ambient air is used to perform a zero calibration, ensure that it is free of hydrocarbons.

11. The SmartMax®II will automatically begin a ZERO CAL sequence.

The RDNG and STATUS1 values of the sensor will scroll continuously across the alphanumeric display during calibration.

12. Once CALENDS appears on the alphanumeric display, the calibration sequence has ended.

The CAL TIME comes factory-set to 4 minutes. The calibration sequence will take 4 minutes to complete.

13. Turn OFF the air pump.
14. After the ZERO CAL sequence has been performed, manually switch the timer back to purge.

The purge cycle must run for approximately 2–3 minutes before the second calibration can be performed.

SPAN CAL

During calibration the calibration gas will be injected into the sensor. Calibration should only be performed when it will not interfere with proper operation and safety of the area being monitored. Calibration gas should be properly vented.

15. Switch the FOMB from purge to sample mode.
16. Wait approximately 2 minutes for the sensor to switch from safe mode to calibration mode.

The sensor is ready to be calibrated once the RDNG and STATUS1 values begin scrolling across the alphanumeric display.

17. Connect the calibration gas to inlet valve A (*Figure B1* and *Figure B2* or *Figure B3* and *Figure B4*).

> Welker recommends the Welker Calibration Kit, which includes a calibration gas of 2.00 lb/MMcf, for use with this unit. If a calibration gas other than 2.00 lb/MMcf is used, the FULLSCLE and CAL RDNG must be adjusted on the SmartMax®II and the unit must be recalibrated.

18. Turn the handle of inlet valve A so that the arrow on the handle points up toward the calibration gas inlet (*Figure B1* or *Figure B3*).
19. Once the sensor has switched to calibration mode, press MENU to scroll through menu items on the alphanumeric display.
20. Once COMMANDS appears on the alphanumeric display, stop pressing MENU, and then press SELECT to enter that menu.
21. Press MENU until SPAN CAL appears on the alphanumeric display.
22. Once SPAN CAL appears on the alphanumeric display, stop pressing MENU, and then press SELECT. SPAN CAL will begin to flash on the alphanumeric display.
23. Once the flashing stops, open the outlet valve on the calibration gas.
24. The SmartMax®II will automatically begin a SPAN CAL sequence.

> During calibration the standard span gas reading of 2.00 lb/MMcf will appear on the alphanumeric display.

25. Once CALENDS appears on the alphanumeric display, the calibration sequence has ended.

> The CAL TIME comes factory-set to 4 minutes. The calibration sequence will take 4 minutes to complete.

26. After the SPAN CAL has been performed, close the outlet valve on the calibration gas.
27. Manually switch the FOMB back to purge.
28. Using a flathead screwdriver, manually change the OFF TIME (purge time) setting on the timer from 1 to 10 hours (*Figure B5*).
29. After the purge cycle is complete, conduct a calibration check to ensure there was no drift during calibration. See *Section B1.4, Calibration Checks,* for instructions on conducting a ZEROTEST and a SPANTEST.

B1.4 Calibration Checks

Conducting a calibration check is not the same as performing a calibration, as the values are not stored in the EPROM memory.

While conducting a calibration check, the alarms are bypassed.

ZEROTEST

If ambient air is used to perform a zero test, ensure that it is free of hydrocarbons.

1. Press MENU to scroll through menu items on the alphanumeric display.
2. Once ZEROTEST appears on the alphanumeric display, stop pressing MENU, and then press SELECT to enter that menu.
3. After the ZEROTEST is complete, exit the submenu manually by pressing MENU until EXIT appears on the alphanumeric display.
4. Once EXIT appears on the alphanumeric display, press SELECT to exit the submenu. The SmartMax®II will return to Scan.

SPANTEST

The calibration gas standard should be used for this test. The concentration of the calibration gas should match the CAL RDNG value.

5. Press MENU to scroll through menu items on the alphanumeric display.
6. Once SPANTEST appears on the alphanumeric display, stop pressing MENU, and then press SELECT to enter that menu.
7. After the SPANTEST is complete, exit the submenu manually by pressing MENU until EXIT appears on the alphanumeric display.
8. Once EXIT appears on the alphanumeric display, press SELECT to exit the submenu. The SmartMax®II will return to Scan.

B1.5 Calibration Troubleshooting

Table B2: SmartMax®II Calibration Troubleshooting		
Issues	**Possible Causes**	**Solutions**
The sensor will not reach zero with ambient air.	Ambient air used to zero (i.e., purge) contains small amounts of the gas that is being monitored.	Verify that the ambient air used does not contain any of the gas being measured, as contaminated air can cause artificially low readings and unsafe conditions.
	The sensor element is not plugged in all the way and/or the catalytic assembly is not assembled correctly.	Ensure that the sensor element is installed correctly. See *Section 4.6, Maintenance: Catalytic Sensor Element,* for instructions on disassembling the catalytic sensor assembly.
	Sensor wiring and/or voltage across pins 3 and 1 of the sensor's 3-positional terminal block is incorrect.	Ensure that the wiring across pins 3 and 1 is correct and that a minimum of DC 13.5 V is supplied.
The sensor will not span with the application of span calibration gas.	Sensor wiring and/or voltage across pins 3 and 1 of the sensor's 3-positional terminal block is incorrect.	Ensure that the wiring across pins 3 and 1 is correct and that a minimum of DC 13.5 V is supplied.
	The concentration of the calibration gas differs from the CAL RDNG and FULLSCLE settings.	Ensure that the type, concentration, and presence of gas during the calibration phase meet the guidelines of the Gas Standard Data Sheet. Ensure that CAL RDNG and FULLSCLE are correct for the calibration gas used.
	The calibration gas supply is not secured to inlet valve A.	Ensure that the calibration gas supply is properly connected to the FOMB at inlet valve A.
	The sensor element might need to be replaced.	Additional testing is required to determine if the sensor has failed; contact Welker for assistance. To replace the sensor element, see *Section 4.6, Maintenance: Catalytic Sensor Element,* for instructions.

NOTES

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