



INSTALLATION, OPERATION, AND MAINTENANCE MANUAL
WELKER FIXED ODORANT MONITOR



MODELS

FOMO
FOMA

DRAWING NUMBERS

OE109
OE109.1
OE109EL

MANUAL NUMBER

IOM-176

REVISION

Rev. 0, 12/05/2017

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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 Monitors, FOM0 and FOMA. 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

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 *FOM0* and *FOMA* Fixed Odorant Monitors are gas process monitors designed to provide real-time readings of the concentration levels of sulfur blend mercaptan in natural gas systems.

The catalytic sensor and incorporated SmartMax®II Monitor/Transmitter enable the FOM 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 FOM 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 FOM 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 FOM0 and FOMA 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 Factory SmartMax®II Settings

| Table 1: FOM 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.

1.6 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: FOM Specifications | |
|---|---|
| Maximum Allowable Operating Pressure | 250 psig @ 41 °F to 104 °F (17 barg @ 5 °C to 40 °C) |
| Power | AC 110 V, 20 W DC 24 V, 20 W |
| Analog Output | 4–20 mA Into 250 Ω Maximum + 25 Ω Loop Resistance |
| 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 | Standard: DC 24 V, 4–20 mA Output, ½" Conduit Hub With Optional Power Supply: AC 110 V, 4–20 mA Output, ½" Conduit Hub |
| Enclosure Dimensions | 12" x 12" x 8" (Height x Width x Depth) |
| Features | 3-Way Solenoid Valve Catalytic Sensor Indicator Lights Instrument Regulator NEMA 4X Enclosure With Window Programmable High and Low Odorant Level Alarm SmartMax®II Monitor/Transmitter |
| Options | 2" Vertical Pipe Mounting Floor Flange Power Supply |

1.7 Equipment Diagrams

Figure 1: FOM Connections Diagram

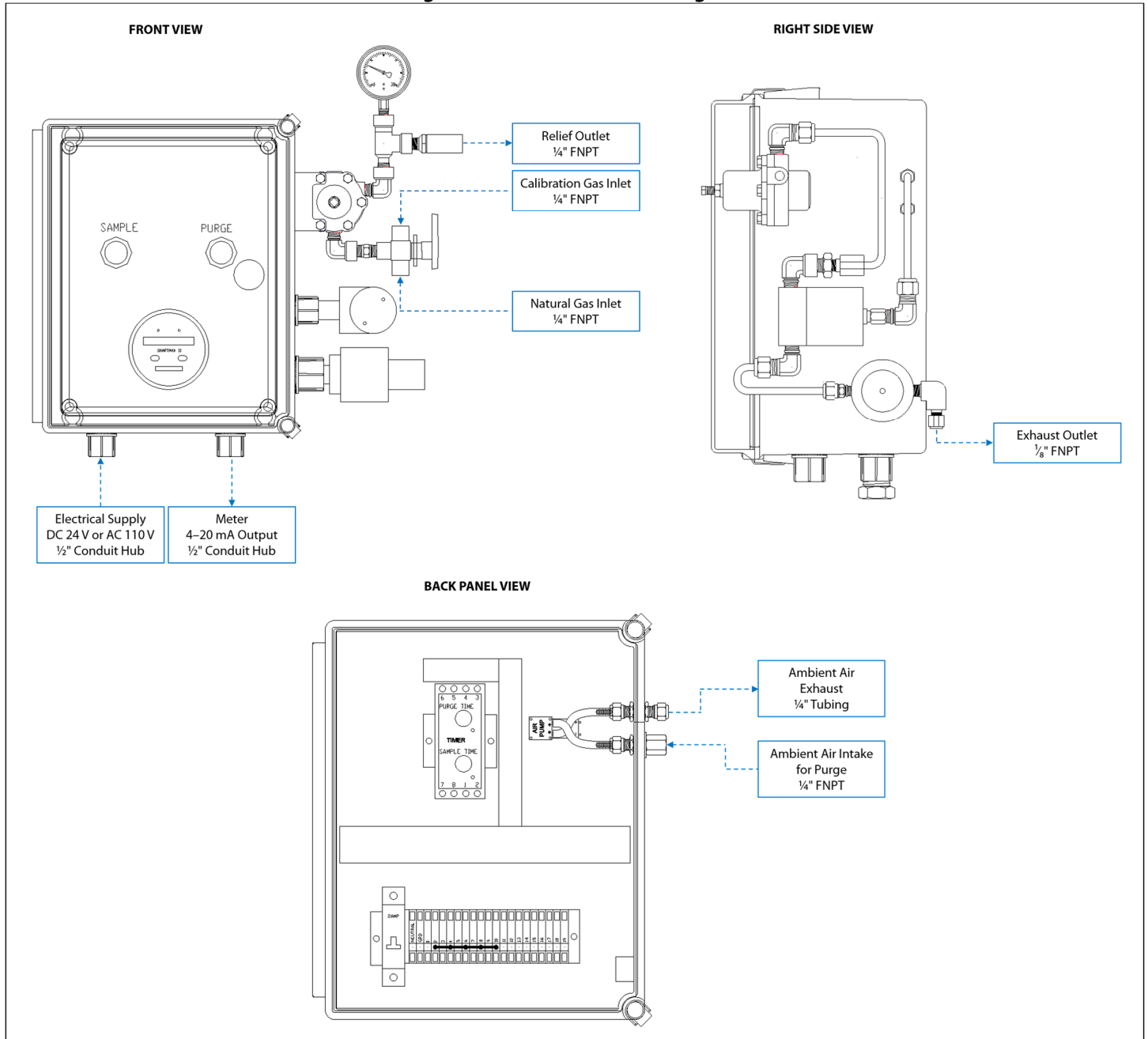


Figure 2: FOM Diagram

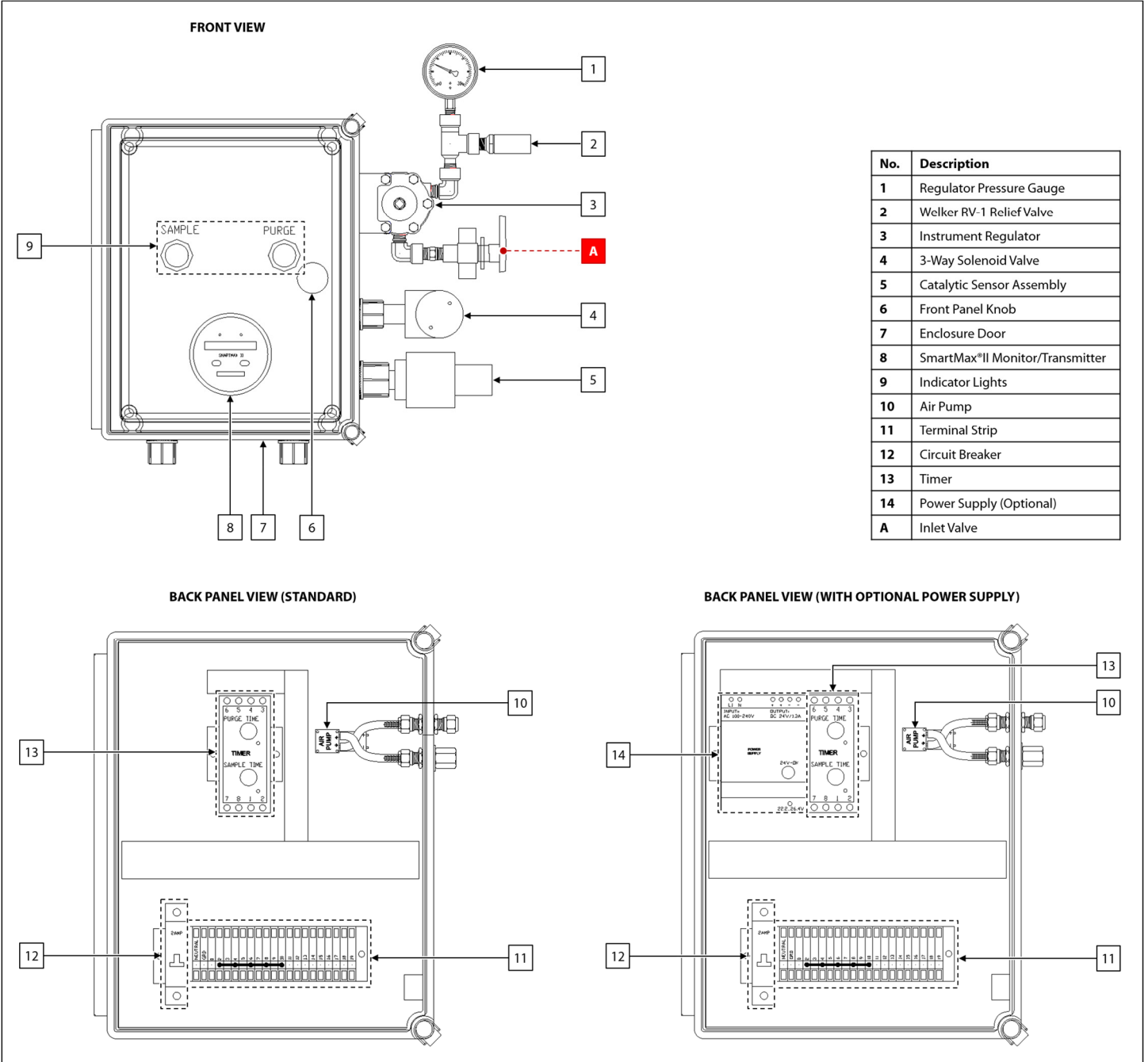
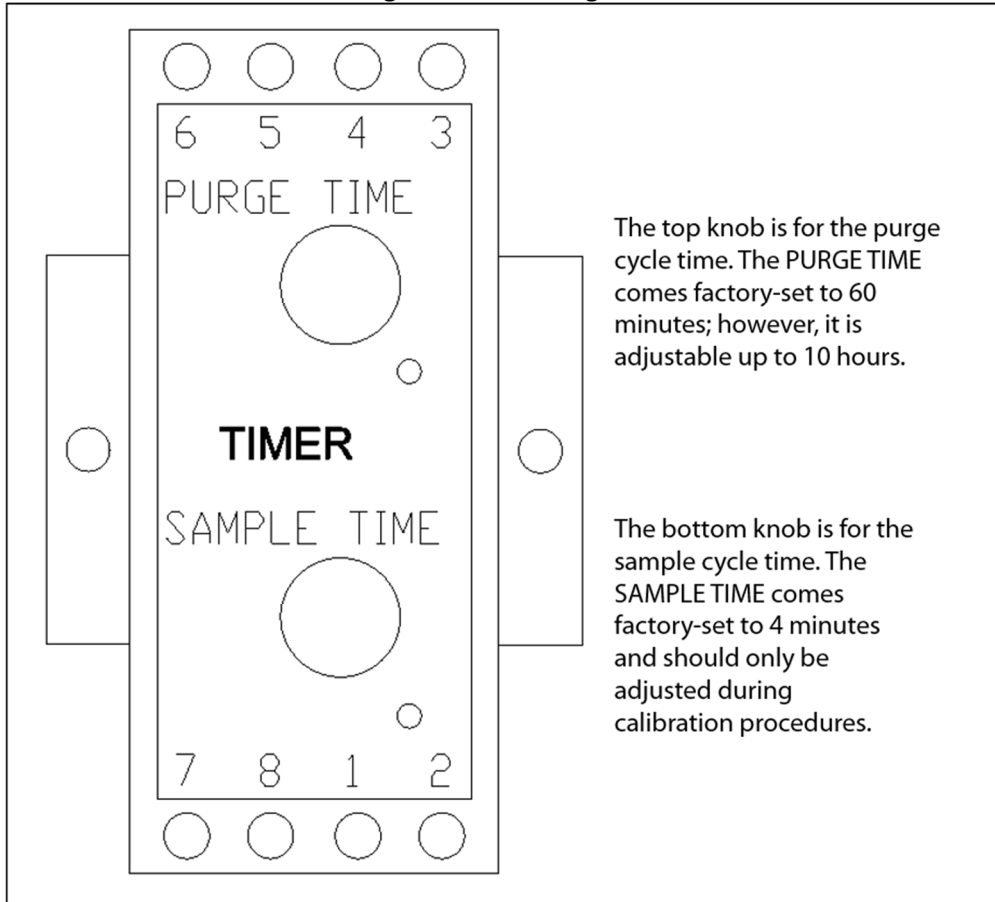


Figure 3: Timer Diagram



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 FOM Fixed Odorant Monitor will ship mounted in an enclosure and “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 FOM in an enclosed, protected area to prevent tampering by unauthorized personnel.

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



The sample line should be as short as possible to ensure that the FOM is supplied with fresh sample and to prevent flow rates from affecting sampling times and accuracy. If 1/8" tubing is used, Welker recommends that sample lines be no further than 20 ft from the pipeline connection.

Tubing Connections



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 1/4" customer-supplied tubing, connect from the pipeline to the natural gas inlet (*Figure 1*).



Smaller tubing, such as 1/8", 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 1/4" customer-supplied tubing, connect from an ambient air source to the ambient air intake (*Figure 1*).



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 1/8" 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 1/4"-3/8" 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.



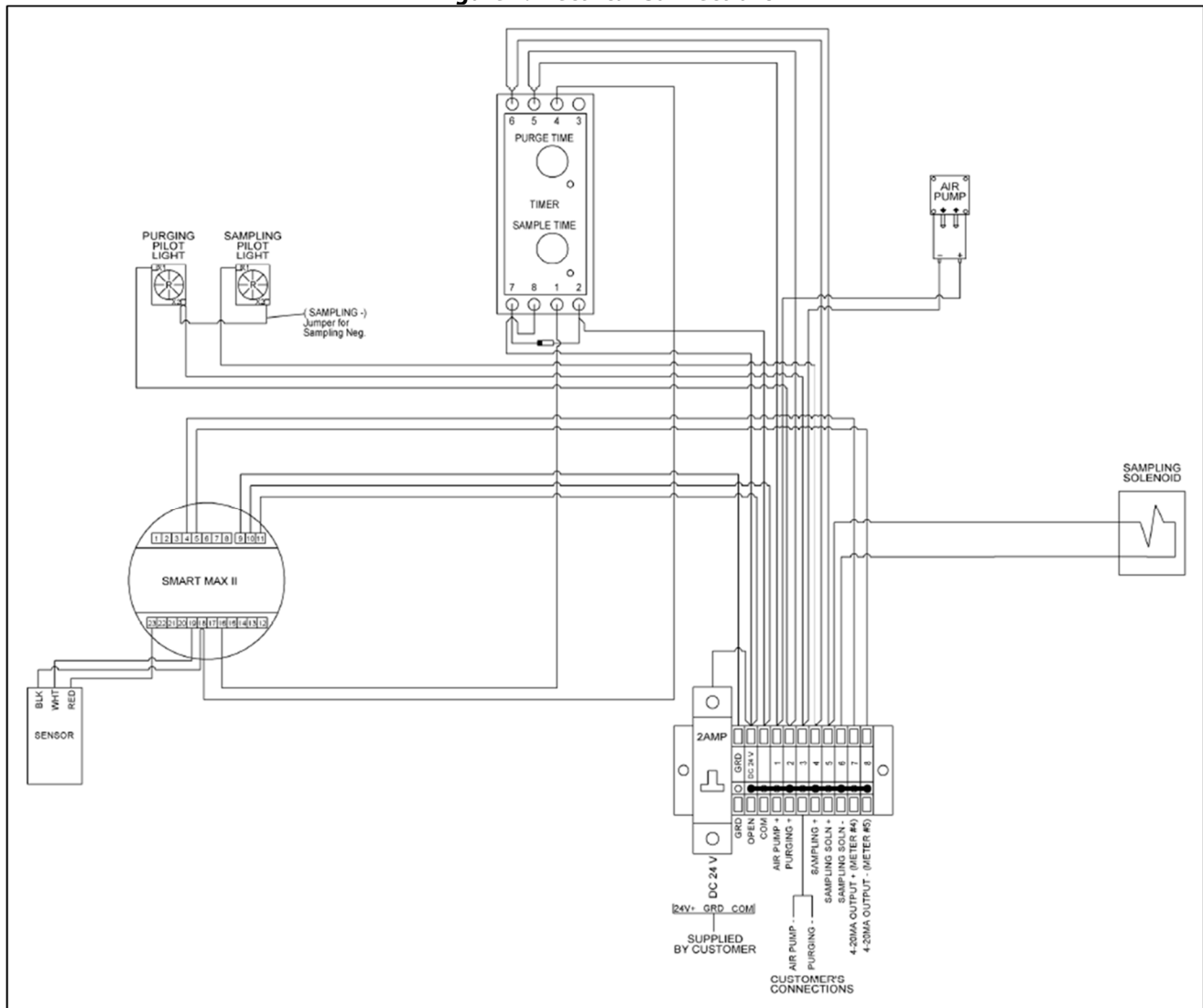
Electrical power must be supplied to the FOM 24 hours a day, 7 days a week. Ensure that the electrical supply to the FOM cannot be turned off accidentally. Turning power off at any time will result in a warm-up time of several hours and operating problems.



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

- Connect a DC 24 V electrical supply to the terminal block (Figure 1 and Figure 4). If the FOM is equipped with the optional power supply, connect an AC 110 V electrical supply to the terminal block instead.

Figure 4: Electrical Connections



RS-485 Connection (Optional)



The SmartMax®II can be connected to a PLC so that the FOM 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.

6. 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.
7. 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.

8. Seal conduit connectors using an 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.

9. 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.

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*).
3. Manually change the PURGE TIME setting on the timer to its maximum value (*Figure 3*). 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.

4. Verify that the SAMPLE TIME is set to 4 minutes (*Figure 3*).
5. Ensure that the power switch on the SmartMax®II is in the ON position.
6. At the end of the purge cycle manually set the PURGE TIME setting on the timer to the desired time (*Figure 3*). This will be the length of the purge cycle.



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

7. 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*).
8. Open the outlet valve on the customer's natural gas supply.
9. The FOM is now in operation and will cycle ON/OFF according to the timer settings.

3.1 Understanding the SmartMax®II Display

Figure 5: SmartMax®II Display

| | | | |
|--|--|--|--|
| | <p>The red ALARM status light will flash during any alarm.</p> <p>The red ALARM status light will continue to flash until the operator acknowledges the alarm.</p> | | <p>The green SCAN status light flashes during normal operation.</p> <p>The green SCAN status light will flash rapidly during optional MODBUS communications.</p> |
| | <p>Press the MENU push button to scroll through menu items, which are shown above on the alphanumeric display.</p> | | <p>Press the SELECT push button to select a menu item or enter a submenu.</p> |
| | <p>The alphanumeric display shows menus, submenus, and SmartMax®II settings.</p> | | <p>The phototransistors allow most of the commands in the COMMANDS menu to be activated in a non-intrusive manner.</p> |

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 FOM. Please Disregard This Menu.) |
| OUTPUTS | Adjust the Accuracy of the 4–20 mA Output Signal (Not Applicable for the FOM. 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.



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 FOM 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 FOM. See *Section 4.6, SmartMax®II Troubleshooting*, for instructions on troubleshooting the FOM.



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 FOM. 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 FOM 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 FOM. 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 FULLSCLC 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 FULLSCLC 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 FOM 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 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: Solenoid



Should the solenoid need to be replaced, contact Welker for a replacement part.

4.3 Maintenance: Indicator Light Bulbs

1. Turn the circuit breaker to the OFF position (*Figure 3*).
2. Remove the colored lens(es) of the indicator light(s) from the operator(s) (*Figure 2*).
3. Remove the burnt light bulb(s).
4. Install replacement light bulb(s) to the operator(s).
5. Return the colored lens(es) to the indicator light operator(s).
6. Turn the circuit breaker to the ON position (*Figure 2*).

4.4 Maintenance: Timer

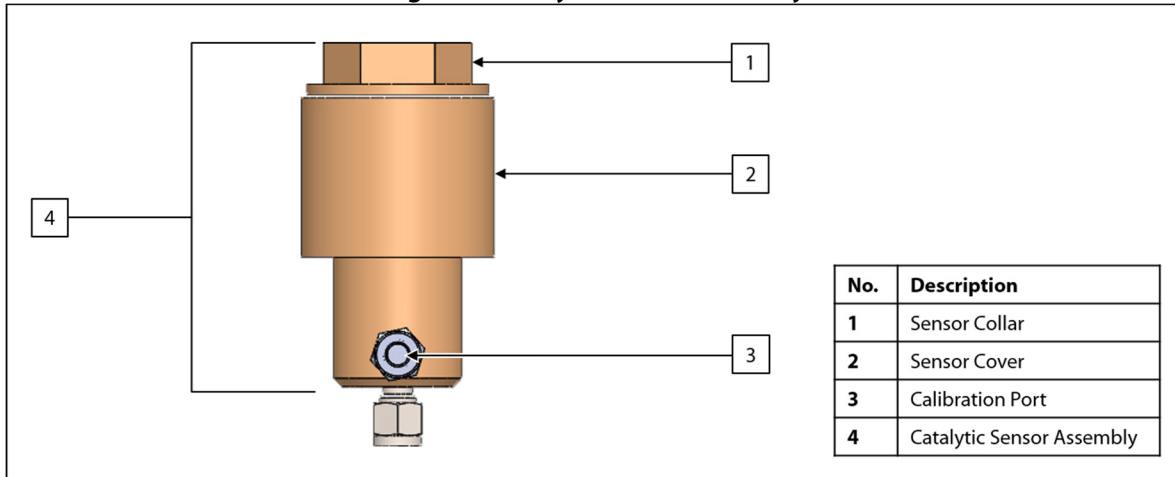
1. Turn the circuit breaker to the OFF position (*Figure 2*).
2. Remove the timer from the enclosure (*Figure 2*).
3. Install a new timer to the timer socket in the enclosure (*Figure 2*).
4. Set the PURGE TIME and SAMPLE TIME on the new timer (*Figure 3*).
5. Turn the circuit breaker to the ON position (*Figure 2*).

4.5 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 6: 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*).
2. Turn the circuit breaker to the OFF position (*Figure 2*).
3. Disconnect the tubing connecting the solenoid to the calibration port (*Figure 2*).
4. Unscrew the sensor cover from the sensor assembly. Set the sensor cover aside.
5. Gently pull the plug-in sensor element from its mount inside the sensor collar.
6. 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.

7. Screw the sensor cover onto the sensor collar.
8. Manually change the PURGE TIME setting on the timer to its maximum value (*Figure 3*). 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.

9. Turn the circuit breaker to the ON position (*Figure 2*).
10. Ensure that the power switch on the SmartMax®II is in the ON position.
11. At the end of the purge cycle or once the sensor has stabilized, the FOM is ready to be calibrated. Refer to *Section B1.3, Calibration Procedures*, in *Appendix B, Calibration Sheet*, for instructions on calibrating the FOM.



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

4.6 SmartMax®II Troubleshooting

Table 10: SmartMax®II Troubleshooting

| Issues | Possible Causes | Solutions |
|---|--|---|
| <p>The SmartMax®II is not working.</p> | <p>The SmartMax®II is not turned on.</p> | <p>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.</p> |
| | <p>An incorrect power type and/or voltage level is supplied to the SmartMax®II.</p> | <p>Ensure that a DC 24 V electrical supply is connected to the terminal strip. If the FOM is equipped with the optional power supply, ensure that an AC 110 V electrical supply is connected to the terminal strip. An incorrect power type and/or voltage can cause permanent damage to the unit.</p> |
| | <p>One or both fuses inside the SmartMax®II may be blown.</p> | <p>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.</p> |
| <p>The sensor is not returning the signal.</p> | <p>Electrical power at the sensor electronics is less than DC 13.5 V.</p> | <p>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.</p> |
| | <p>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.</p> | <p>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.</p> |

Table 10: SmartMax®II Troubleshooting (Continued)

| Issues | Possible Causes | Solutions |
|---|---|--|
| <p>The sensor will not reach zero with ambient air.</p> | <p>Ambient air used to zero (i.e., purge) contains small amounts of the gas that is being monitored.</p> | <p>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.</p> |
| | <p>The sensor element is not plugged in all the way and/or the catalytic assembly is not assembled correctly.</p> | <p>Ensure that the sensor element is installed correctly. See <i>Section 4.5, Maintenance: Catalytic Sensor Element</i>, for instructions on disassembling the catalytic sensor assembly.</p> |
| | <p>Sensor wiring and/or voltage across pins 3 and 1 of the sensor’s 3-positional terminal block is incorrect.</p> | <p>Ensure that the wiring across pins 3 and 1 is correct and that a minimum of DC 13.5 V is supplied.</p> |
| <p>The sensor will not span with the application of calibration gas.</p> | <p>Sensor wiring and/or voltage across pins 3 and 1 of the sensor’s 3-positional terminal block is incorrect.</p> | <p>Ensure that the wiring across pins 3 and 1 is correct and that a minimum of DC 13.5 V is supplied.</p> |
| | <p>The concentration of the calibration gas differs from the CAL RDNG and FULLSCLE settings.</p> | <p>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.</p> |
| | <p>The calibration gas supply is not secured to inlet valve A.</p> <p>The sensor element might need to be replaced.</p> | <p>Ensure that the calibration gas supply is properly connected to the FOM at inlet valve A.</p> <p>Additional testing is required to determine if the sensor has failed; contact Welker for assistance. To replace the sensor element, see <i>Section 4.5, Maintenance: Catalytic Sensor Element</i>, for instructions.</p> |

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 422A Series FLIP-FLOP Multi-Range Repeat Cycle Timer (Welker IOM-V322)
- Control Instruments Corporation Hydrogen Sulfide Sensor for SmartMax®II (Welker IOM-V207)
- Control Instruments Corporation SmartMax®II Monitor/Transmitter (Welker IOM-V206)
- Emerson Process Management Regulator Technologies, Inc. Fisher™ 67C Series Instrument Supply Regulators (Welker IOM-V048)
- IDEC Corporation Switches & Pilot Devices TW Series (Welker IOM-V392)
- KNF Micro AG Micro Diaphragm Gas Sampling Pumps (Welker IOM-V205)
- Parker Hannifin Corporation 3-Way Solenoid Valves Types 71313, 71315, 71335, 71385, 71395, 7131V, and 7133V (Welker IOM-V016)
- Pentair plc Hoffman® Continuous Hinge, Type 4X Enclosures (Welker IOM-V320)
- 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)
- 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 (FOM0, DC 24 V)
- System Drawing: OE109.1 (FOMA, AC 110 V)
- Electrical Drawing: OE109EL

B1.1 Factory Settings

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

| Table B1: FOM 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: FOM Connections Diagram

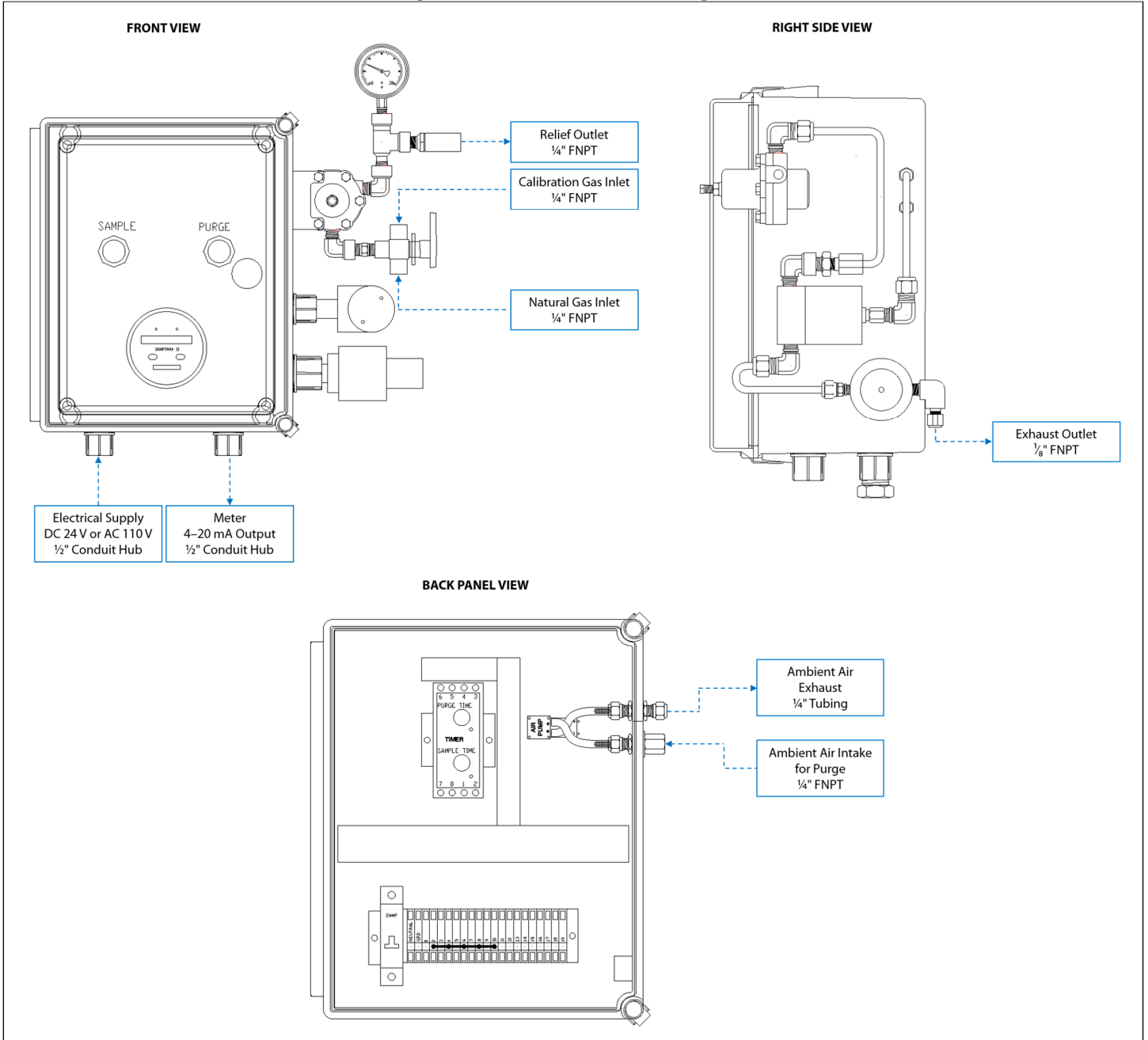
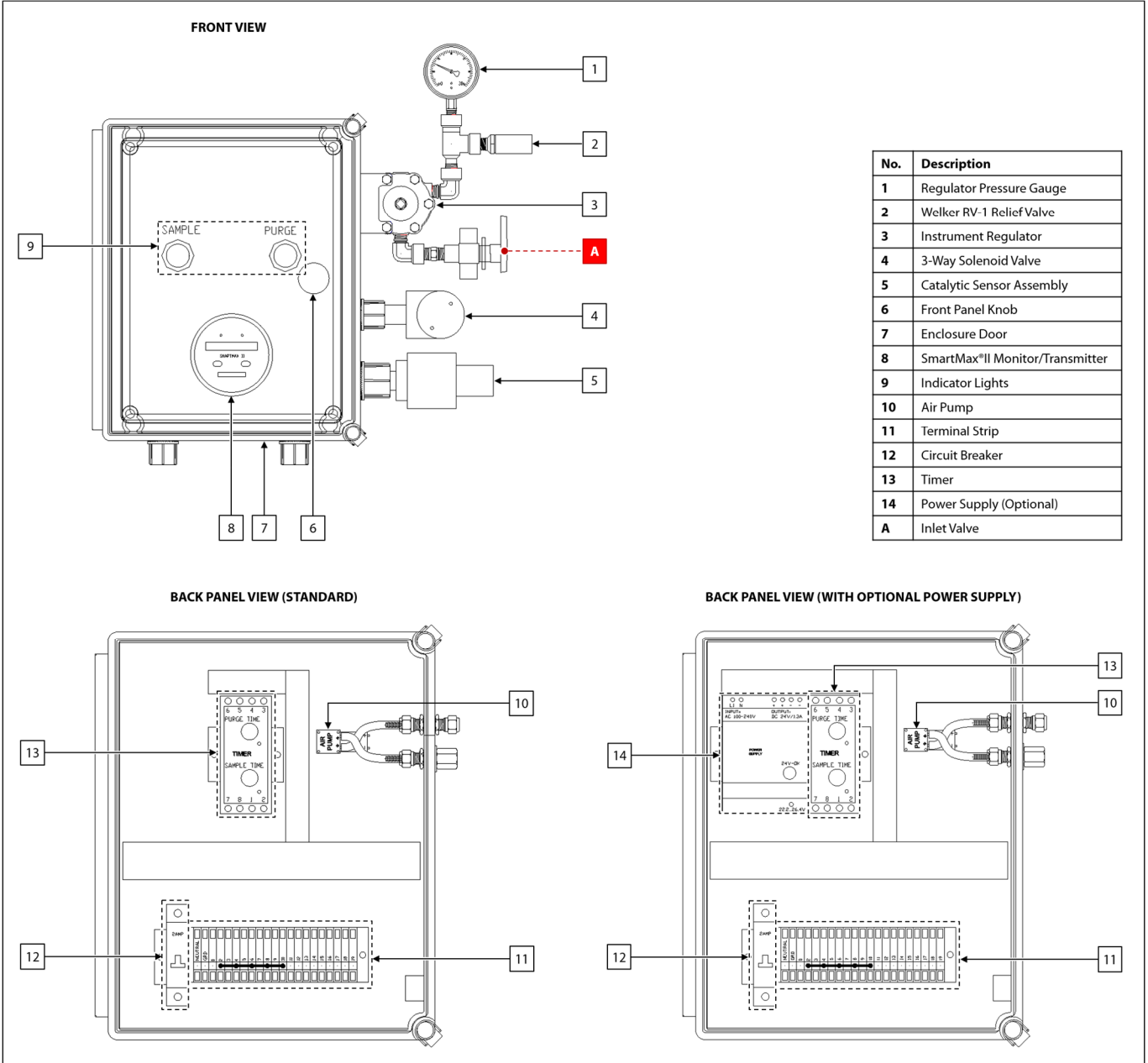


Figure B2: FOM Diagram



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.



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

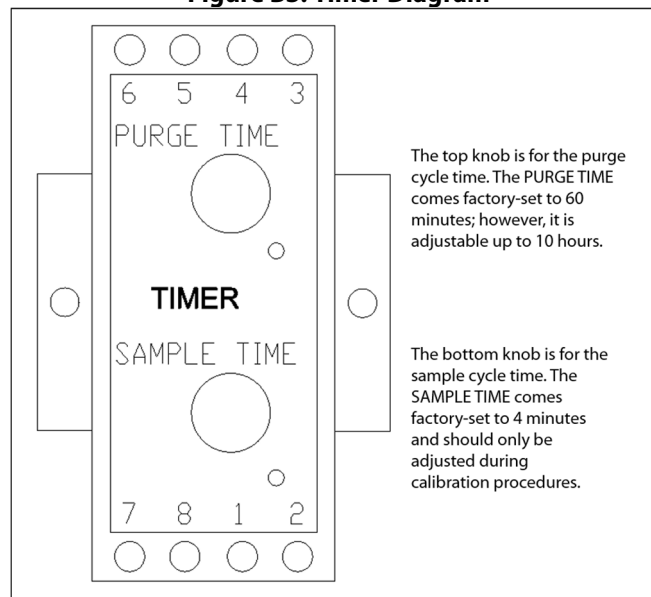


After successfully performing a calibration, the values obtained during the calibration are stored in the EPROM memory and are used for subsequent readings.

ZERO CAL

1. Turn OFF the natural gas supply to the FOM.
2. Manually change the PURGE TIME setting on the timer to its maximum value and the SAMPLE TIME to its minimum value (*Figure B3*).

Figure B3: Timer Diagram



3. Wait approximately 2 minutes for the sensor to switch from safe mode to calibration mode. The alphanumeric display will read CALEND5 during this time.



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

4. Once the sensor has switched to calibration mode, press MENU to scroll through menu items on the alphanumeric display.
5. Once COMMANDS appears on the alphanumeric display, stop pressing MENU, and then press SELECT to enter that menu.
6. Press MENU until ZERO CAL appears on the alphanumeric display.
7. 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.

8. 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.

9. 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.

10. Once CALEND5 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.

11. Turn OFF the air pump.

12. 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.

13. Switch the FOM from purge to sample mode.

14. 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.

15. Connect the calibration gas to inlet valve A (*Figure B1* and *Figure B2*).



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 FULLSCL5 and CAL RDNG must be adjusted on the SmartMax®II and the unit must be recalibrated.

16. Turn the handle of inlet valve A so that the arrow on the handle points up toward the calibration gas inlet (*Figure B2*).

17. Once the sensor has switched to calibration mode, press MENU to scroll through menu items on the alphanumeric display.

18. Once COMMANDS appears on the alphanumeric display, stop pressing MENU, and then press SELECT to enter that menu.

19. Press MENU until SPAN CAL appears on the alphanumeric display.

20. 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.

21. Once the flashing stops, open the outlet valve on the calibration gas.

22. 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.

23. Once CALEND5 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.

24. After the SPAN CAL has been performed, close the outlet valve on the calibration gas.
25. Manually switch the FOM back to purge.
26. Manually change the PURGE TIME setting on the timer from 1 to 10 hours (*Figure B3*).
27. 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 |
|--|---|--|
| <p>The sensor will not reach zero with ambient air.</p> | <p>Ambient air used to zero (i.e., purge) contains small amounts of the gas that is being monitored.</p> | <p>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.</p> |
| | <p>The sensor element is not plugged in all the way and/or the catalytic assembly is not assembled correctly.</p> | <p>Ensure that the sensor element is installed correctly. See <i>Section 4.5, Maintenance: Catalytic Sensor Element</i>, for instructions on disassembling the catalytic sensor assembly.</p> |
| | <p>Sensor wiring and/or voltage across pins 3 and 1 of the sensor's 3-positional terminal block is incorrect.</p> | <p>Ensure that the wiring across pins 3 and 1 is correct and that a minimum of DC 13.5 V is supplied.</p> |
| <p>The sensor will not span with the application of span calibration gas.</p> | <p>Sensor wiring and/or voltage across pins 3 and 1 of the sensor's 3-positional terminal block is incorrect.</p> | <p>Ensure that the wiring across pins 3 and 1 is correct and that a minimum of DC 13.5 V is supplied.</p> |
| | <p>The concentration of the calibration gas differs from the CAL RDNG and FULLSCLE settings.</p> | <p>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.</p> |
| | <p>The calibration gas supply is not secured to inlet valve A.</p> <p>The sensor element might need to be replaced.</p> | <p>Ensure that the calibration gas supply is properly connected to the FOM at inlet valve A.</p> <p>Additional testing is required to determine if the sensor has failed; contact Welker for assistance. To replace the sensor element, see <i>Section 4.5, Maintenance: Catalytic Sensor Element</i>, for instructions.</p> |

