

Model SA-PCA

Installation and Service Manual

Portable Combustion Monitoring System



Model SA-PCA
Rev: 00
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1. SAFETY INFORMATION

-  The SA-PCA Portable Combustion Monitoring system, as described in this manual, must be installed, operated, and maintained in accordance with the information contained within this manual. Installation in a non-hazardous area must comply with all applicable restrictions, requirements, and guidelines.
-  It is the customer's responsibility to ensure that the SA-PCA is suitable for the intended use, installed correctly, and complies with all applicable electrical standards.
-  The SA2 sensors are designed and constructed to measure the level of certain gases in ambient air. Accuracy in atmospheres containing steam or inert gases cannot be guaranteed.
-  Bump test or calibrate with the target gas at startup and check on a regular schedule based on sensor type, sensor location, and as-found test results over time.

2. GENERAL INFORMATION

2.1 Description

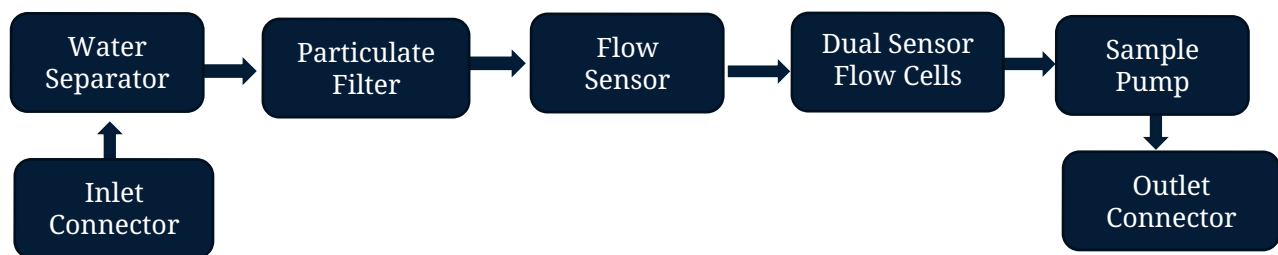
The SA-PCA Portable combustion monitor is a modified version of the Safeguard SA2-XES monitoring system. It provides all the standard features of the XES while creating a rugged, compact, and versatile assembly for on-the-go testing and datalogging. The user can switch between sampling and ambient air manually to expose the device to measure up to eight gases using the integrated pump. Users will have full control over the test protocol with the manual valve assembly. On-board high-density datalogging allows for ease of use and testing. The device comes with a long-lasting battery and can charge while in run mode.

2.2 Features

- Up to 8 SA2 smart sensors
- Safeguard Auto-Configuration
- 20Ahr Battery and Charging
- Water Separator
- Coalescing Filter
- Color HMI
- High-Density Data Logging
- Pump Flow Fault Supervision
- Manual Sampling Control
- Cellular Modem

2.3 Principle of Operation

Sampling System Flow Diagram



Model SA-PCA gas measurement systems use an internal sample pump to draw a gas sample into a series of flow cells that are fitted with customer-selected gas sensors. The sample is routed through a flow sensor, then through dual sensor flow cells. Smart Sensor modules measure user-targeted gas types. Real-time readings are connected to the system controller through a MODBUS slave connection. Readings include the sample flow rate. External access is via a serial MODBUS slave port or datalogger.

3. SPECIFICATIONS

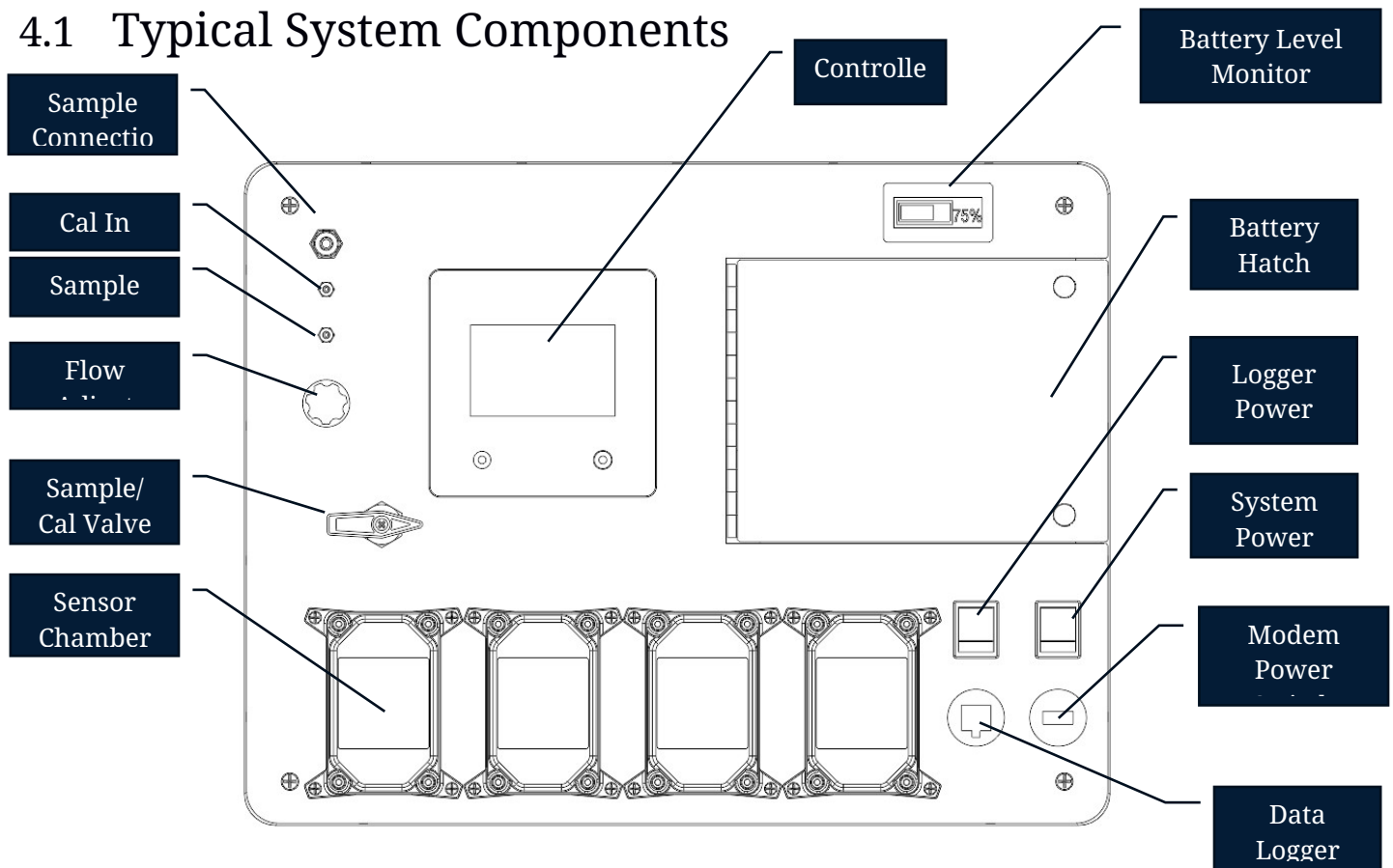
System	
Detection Method	Aspirated
Local Display	High-visibility color LCD HMI
Status Indicators	Green - normal operation Amber - alert level 1 Red - alert level 2 Blue - fault condition
User Interface	Magnetic & Push Button
Serial Output	MODBUS RTU 115200/9600
Environmental	-30°C to +50°C (w/ LCD heater) 15 to 95 % RH (non-condensing)
Warranty	2 years

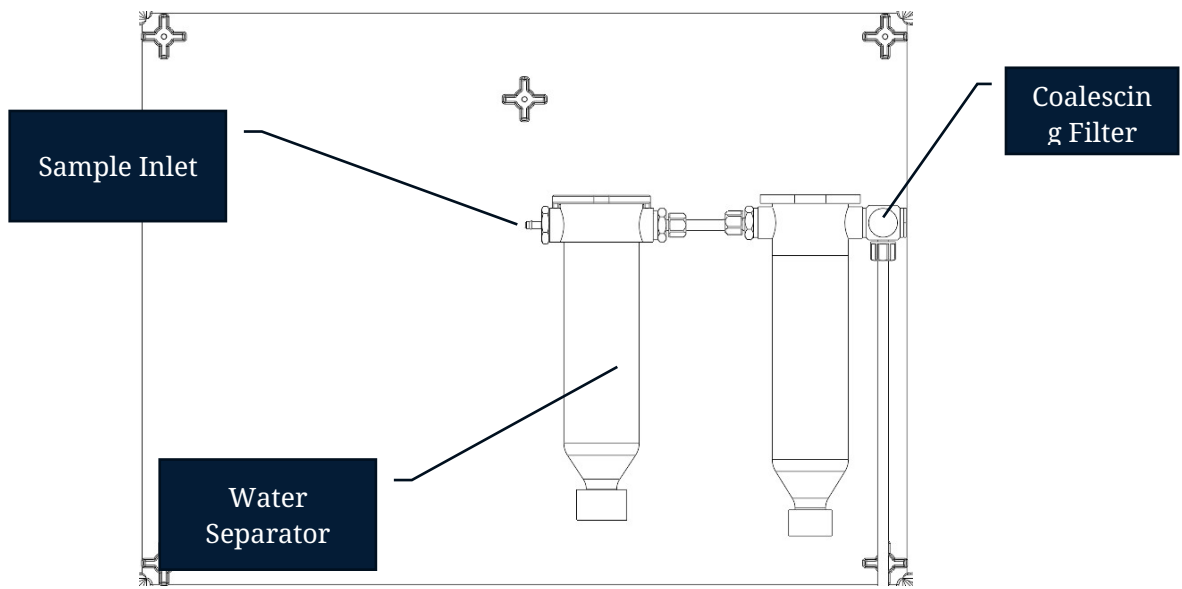
Electrical	
Input Voltage	12V Battery (AC Charging Cable)
Power Consumption	5 to 7 watts (sensor dependent)
Cold Weather	+ 10 watts w/heater
Area Classification	General-purpose safe area NEMA 4X weatherproof
Mechanical	Polycarbonate w/hinged cover
SA-PCA	20.66 x 17.2 x 8.4 in (52.5 x 43.7 x 21.3 cm)

*Specifications subject to change without notice

4. SYSTEM COMPONENTS

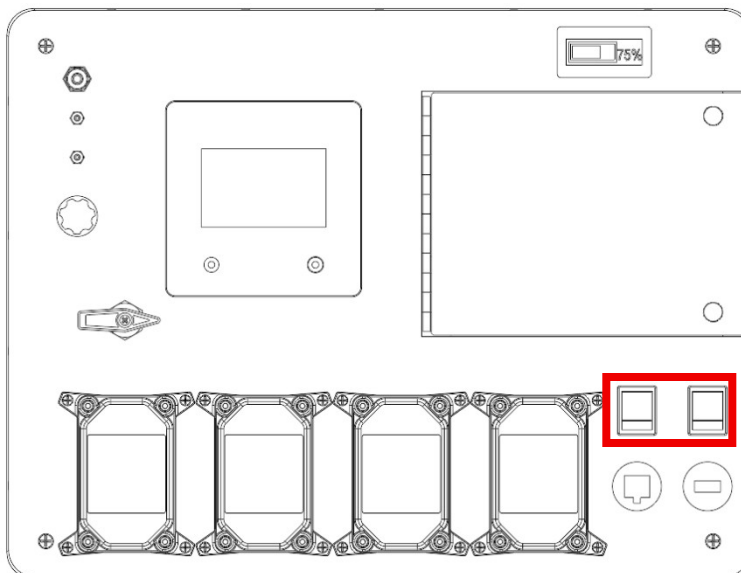
4.1 Typical System Components



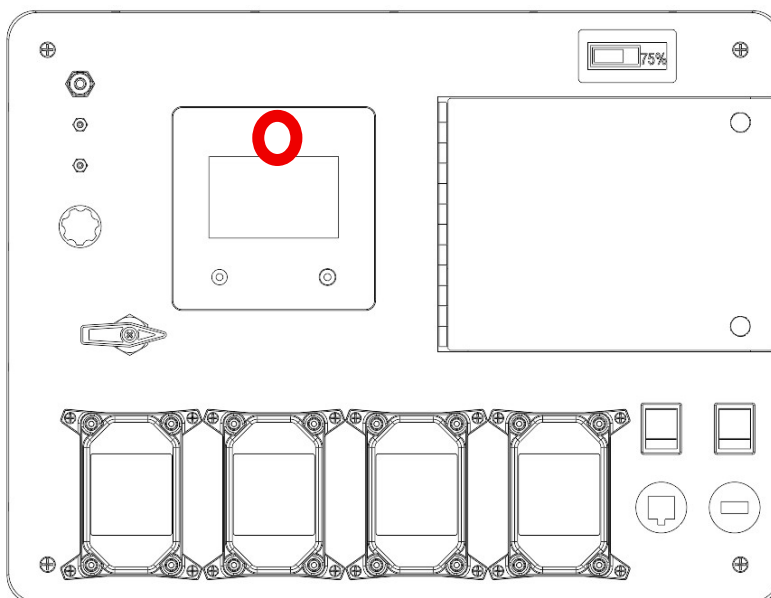


5. QUICK START

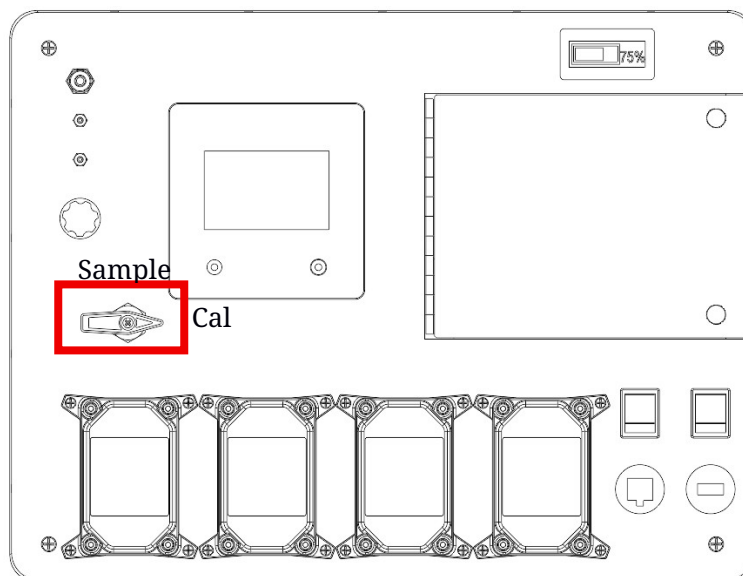
1. Power on the unit and the datalogger using the rocker switches on the unit panel.



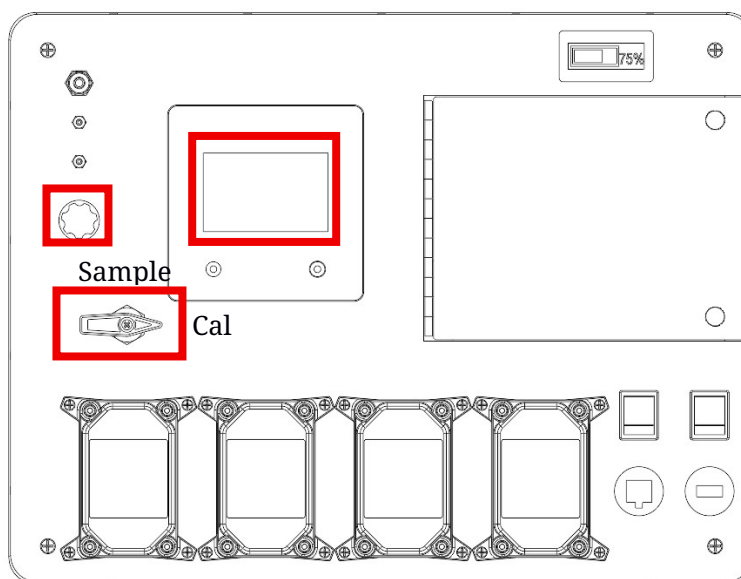
2. The HMI will load the current sensor configuration if a configuration change has been made run an Auto-config from the configuration menu. The menu can be accessed by holding the provided magnet over the Safeguard logo on the display. Use the two push-button switches to navigate the menu



- Before testing, ensure the test valve is set to 'cal' so that it pulls in ambient air before flowing exhaust gases. Attach the sample line to the sample inlet port of the water separator.



- Prep testing flow rate. Turn the test valve to sample and adjust the flow rate using the potentiometer knob to 600-800mL/min on the HMI. Turn the test valve back to cal until ready for testing.



Unit is now ready for testing.

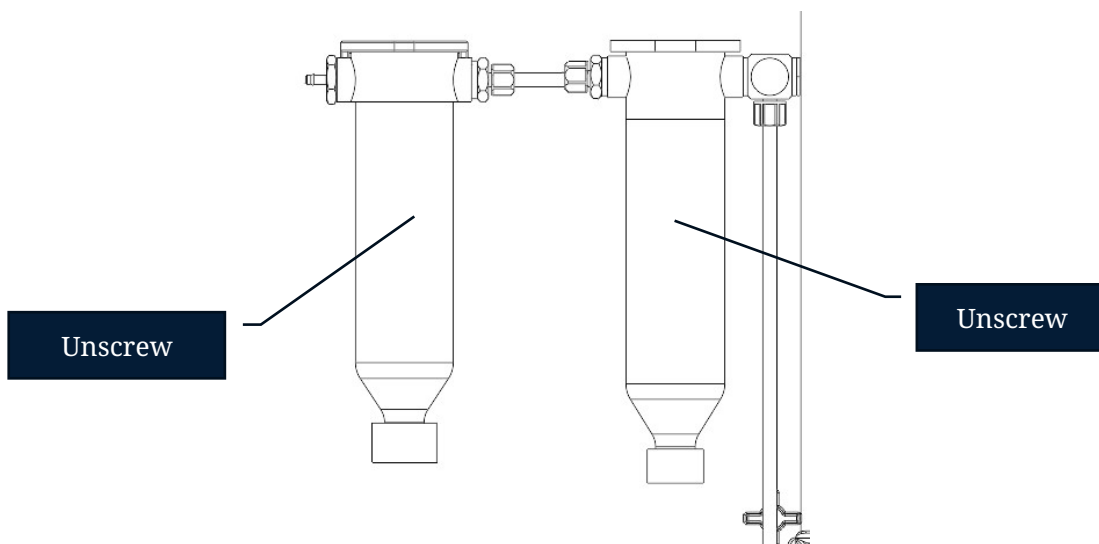
WARNING:

Electrochemical sensors (NO, NO₂, CO) require O₂ to properly function and should not be exposed to O₂-free environments **for longer than 15-30 minutes MAX**. After this period of testing under low O₂ exhaust, turn the test valve back to ambient for at least 10-15 minutes before running the next

test. Keeping the sensors under low O₂ will cause the O₂ to dissolve in their cells, leading to calibration drift.

Water and Particulate Management:

Condensate traps are Manual Drain. DO NOT attempt to close the case with water still in the water separator or coalescing filter. The user can unscrew the glass body and manually dump the contents prior to shutting the system down to complete deployment.

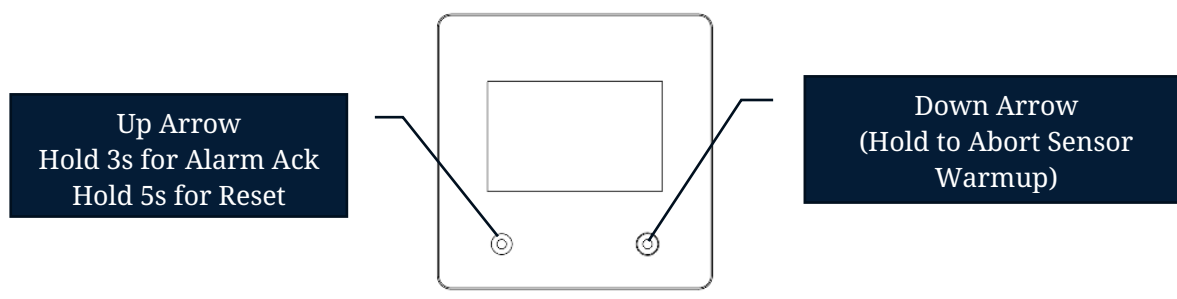


6. OPERATION

6.1 Controller Operation:

User interface featuring a series of either momentary “push” buttons and “push-hold-release” actions to navigate various menus and access system configuration. An upper magnetic switch is used to enter configuration menus. Hold the magnet over the switch until the screen switches to the configuration menu. Two momentary-contact push-button switches are used to navigate various configuration functions. The momentary contact switches function as a single action to select configuration topics. Hold and release is used to enter the selected setting.





6.1.1 Controller Startup

System Start Up			
v.01.01.02			
rv.01.01.01			
WU	123	SEC	CO
WU	123	MIN	H2S
WU	12	HRS	O2
WU	18	HRS	C4H8
06/01/2023	600ML/M	09:41	▶
0	PPM	CO	
0	PPM	H2S	
20.9	%	O2	
0	PPM	C4H8	
06/01/2023	600ML/M	09:41	▶

The controller will start up and begin to initialize the system. A model splash screen will appear, displaying the firmware version. The controller will then begin loading the configuration from the flash for all sensors in the network.

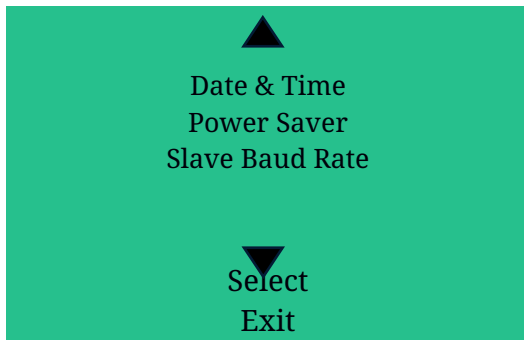
Once all device data is loaded, the system will read the sensors associated with the warmup timer. Each sensor technology can have a range of warm-up times. Once warm-up time is over, the sensor will begin displaying data. If the user wants to skip this warmup period, “push & hold” the right push button until “ABORT WU” flashes on the top of the screen. This cancels all devices' warmup periods until the next power cycle.

Once all warm-up timers have expired or the user has aborted the warm-up, the system is in Normal operation. Sensor Reading, units, and compound are visible in device order. Flow rates are at the bottom of the screen. The indicator in the lower right means there are more viewable sensors. Use the right button to navigate to the next page of sensors. 4 devices per page.

6.1.2 Configuration Menu Options

▲
Calibration
Auto Config
Heater Control
Relay Config
Sensor Config
Cal Fault Reset
▼
Select
Exit

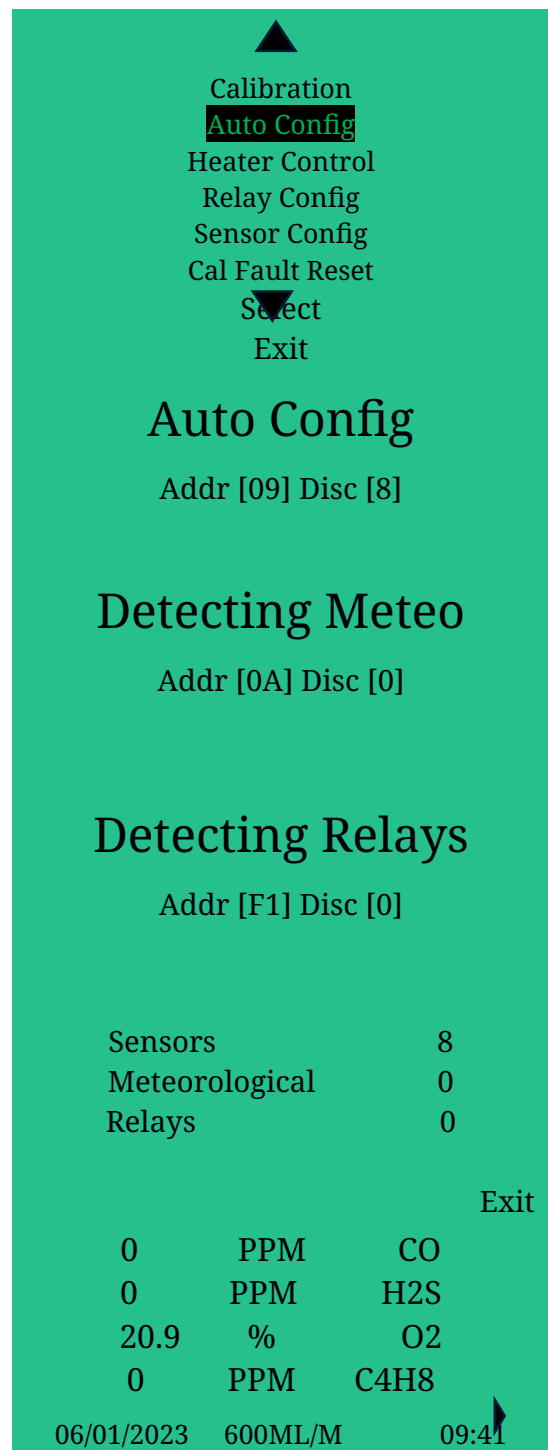
To access configuration menus, hold the programming magnet over the upper magnetic switch for ~ 3s. The panel LEDs will start to blink, and the system will switch to the configuration options. Use the push button panel switches to scroll through the menu list. Push and hold the select button to enter the menu of interest. Press and hold the Exit button to return to real-time mode.



Scrolling up or down past the page limit will take you to the second page, where you can find additional config menu items.

6.1.3 Auto Config

Auto Config is a feature in all Safeguard Analytics control system designs. The controller will cycle through a dedicated list of addresses for the various gas sensors. The auto-configuration feature detects and loads each smart connected device type, measurement range, default alarm levels for each sensor, device status, and current reading.



Enter “Autoconfig” from the configuration menu. It will start its detection scan promptly after selection.

“Auto Config” cycles dedicated sensor inputs that can include gas sensors and the flow sensors in the aspirated systems.

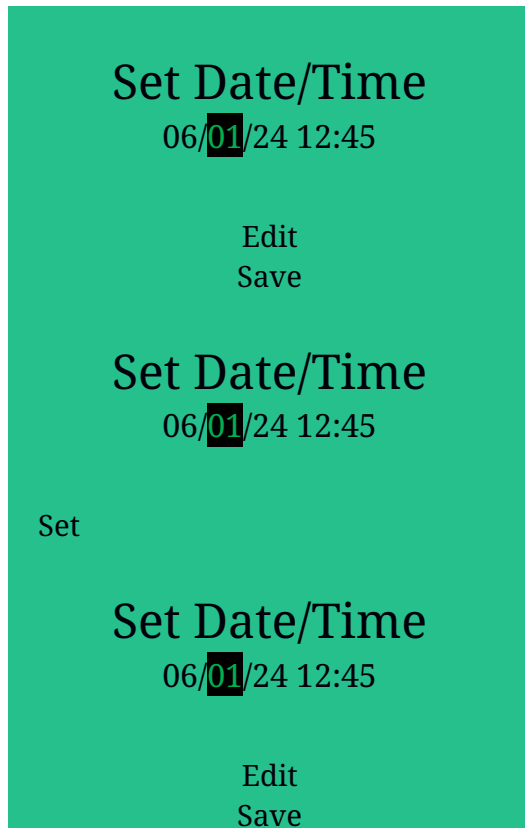
“Config Mode”
Detecting Meteo (Meteorological): Cycles through a pre-programmed list of possible inputs starting with meteorological measurement options. NOTE: A meteorological connection is not part of the Portable configuration.

“Config Mode”
Detecting Relays: Cycles thru a pre-programmed list of possible alarm relays options. F1 for 2ch relay modules, and F2 for 4ch relay module.

Upon completion of the “Auto Config” process, press the Exit push button to load configuration data discovered during “Auto Config”

Enter Normal Operation

6.1.4 Set Date and Time



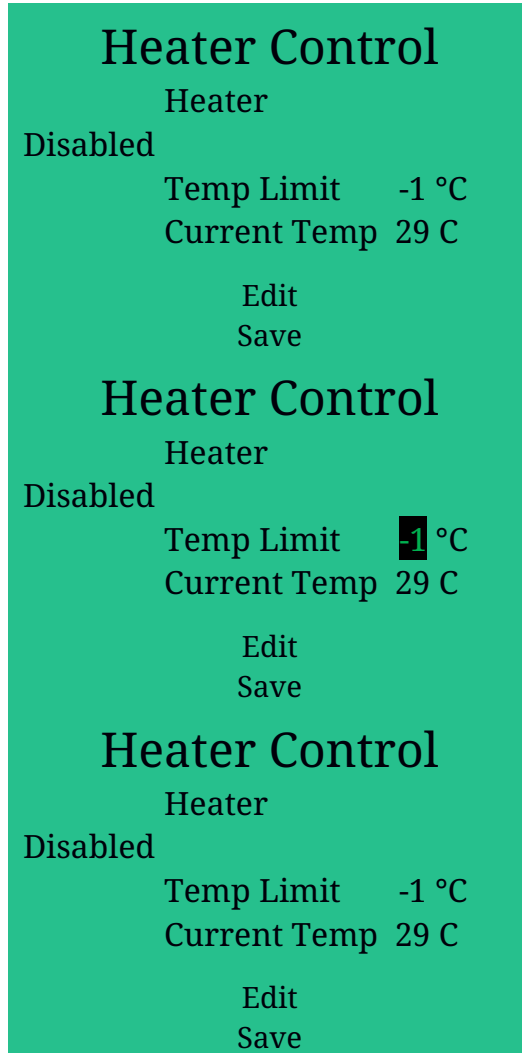
Enter the “Set Date/Time” function from the configuration menu. Push and hold the “Edit” button for a few seconds to initiate changes. The selected field indication appears to have a slow pulse and is backlit.

Use the push buttons to change the setting. Push and hold the up-arrow button to “Set” the new value.

Save the new value by pressing and holding the down arrow push button. “Saving” appears on the screen to confirm the new value. Repeat this procedure for each date/time value.

6.1.5 Heater Control

The system features a built-in heater used to raise the temperature of the LCD HMI above the specified low temperature. In cold-weather applications, the heater is off until activated by pushing either of the panel switches (see Section 4.7, Power Saver). **In extremely cold** conditions, the LCD may appear black or without color. It may take up to 5-10 minutes to heat the display when temperatures are below the set Temp Limit



Enter the “Heater Control” function from the configuration menu. Push and hold the “Edit” button for a few seconds to initiate changes.

With the heater on, the “Temp Limit” setting is the temperature at which the heater is automatically turned on. The heater turns off at approximately 2 degrees above the limit set point.

“Current Temp” is factory configured to represent the approximate temperature inside the controller enclosure. If erroneous compared to the ambient. Correct in the config menu.

Save the new value by pressing and holding the down arrow push button. “Saving” appears on the screen to confirm the new value. Repeat this procedure for each date/time value.

6.1.6 Power Saver Mode

The system features a power-saving function that reduces output power by limiting the HMI output and heater functions during regular operation. This is advantageous in environments where the screen is not needed continuously, allowing the system to turn the heater and screen off unless prompted by a button press. The display will periodically blink green LEDs to indicate it is still running. A button press will reset the timer, return to the run time screen functions, and if the heater logic indicates the heater needs to be on, it will turn back on. Once the timer counts down again, if no interaction with the buttons has taken place, it will return to power saver mode and shut down these high-powered features until prompted again. i.e, a screen saver.



Enter the “Power Saver” function from the configuration menu. Push and hold the “Edit” button for a few seconds to initiate changes. Time-out settings are selectable in 5-minute increments, ranging from “Never” to 60 minutes.

Set a time period for the power saver to initiate screen and heater shutdown and display active heartbeat LED blinks.

Set to “Off” to have the screen always be on.

Press and hold the save button to save configuration settings.

6.1.7 Slave Baud Rate Config

The user can select the system's output baud rate between 115200 and 9600.



Select “Slave Baud Rate” in the config menu by pressing and holding Select.

Edit, change, select, and save the configuration change to the output baud rate.

6.1.8 Cal Fault Reset

In the event that a sensor can't be successfully calibrated and remains in the cal fault state, the user can manually reset the cal fault state in the configuration menu. This will reset all sensors in calibration fault.

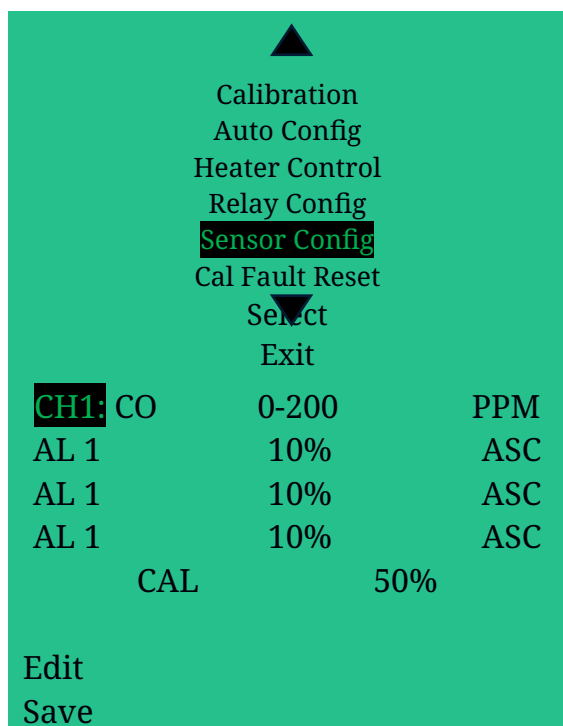


Select “Cal Fault Reset” in the config menu by pressing and holding Select.

The device will send a command to the network to reset any calibration fault status, reverting to the previous calibration settings. Afterwards, the system will return to regular operation.

6.1.9 Sensor Config

Devices in the system come with preconfigured alarm and calibration levels. Users can configure these to fit their application as needed.



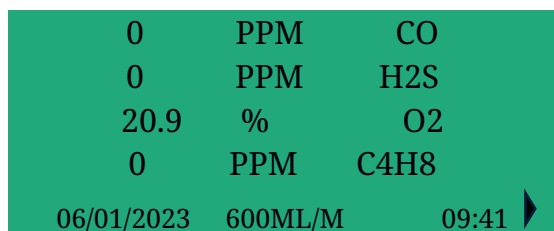
Select “Sensor Config” in the config menu by pressing and holding Select.

Use the arrow buttons to navigate to the field to edit. Options available to edit:

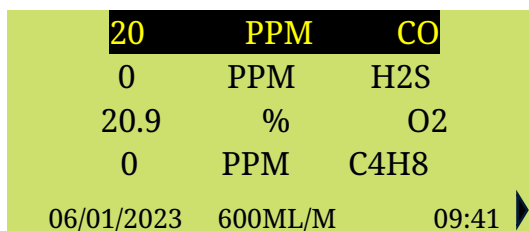
- 1) Channel selection
- 2) Alarm levels (percent of range) and ascending or descending.
- 3) Calibration level: percent of full-scale range

Use the arrows to navigate, edit, and set all necessary fields and channels. Holding “Save” will save all channel configs.

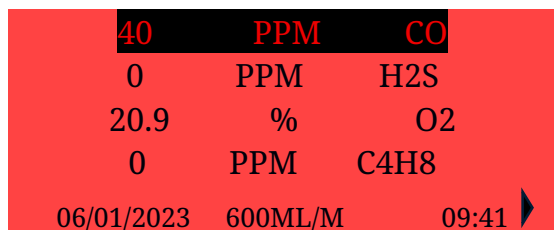
6.1.10 Screen Color Status Indicators



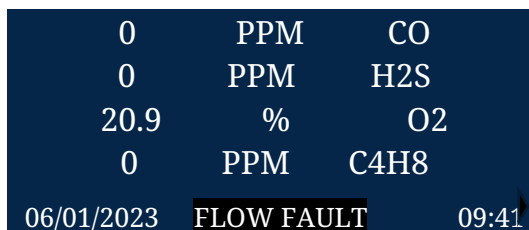
Green Normal Operation



Amber Alert Level 1



Red Alert Level 2



Blue Fault Condition

Device Fault Condition Details:

- a) NO SENSOR – No sensor detected
- b) FAULT – No transmitter detected
- c) CAL FAULT – Calibration Fault
- d) OVER RANGE – Reading >100% FS
- e) UNDER RANGE FAULT – Negative

Cal Fault Condition Details:

- a) Zero Calibration Fault
- b) Span Calibration Response Fault
- c) Span Calibration Stability Fault
- d) Span Calibration Clearing Fault

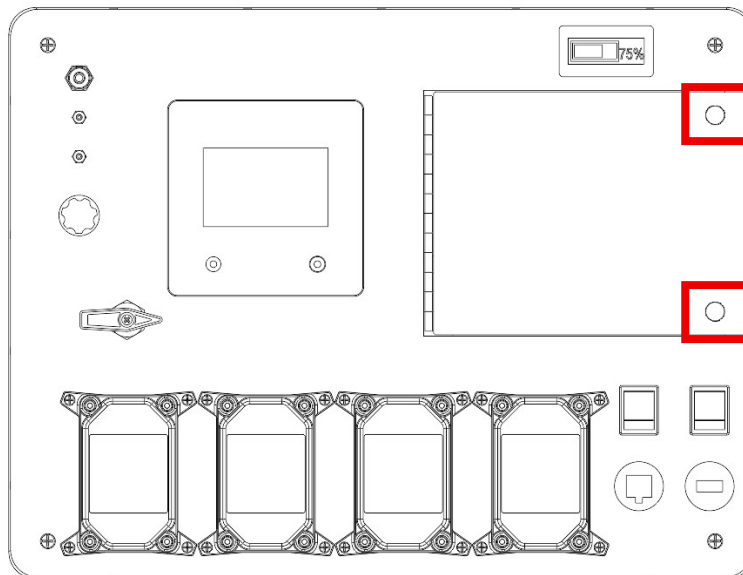
6.2 Installation

Unit comes with a 20Ah lithium-ion battery mounted on the internal base plate. The battery is attached to a smart lithium-ion charger that is panel-mounted to the outer wall of the case. Battery run time is greater than 48 hours continuous and can be charged while in use.

The battery monitor has three modes:

- % mode: shows output in % of life
- Voltage mode: shows output in volts
- Sleep Mode: off

Should the battery ever need to be removed for replacement or for travel purposes, the user must remove the two thumb screws to access the battery. A Phillips-head screwdriver is required to remove the terminals.



7. CALIBRATION

7.1 Calibration Notes

1. All Safeguard Analytics gas detection sensors are thoroughly tested and calibrated prior to shipment.
2. Once installed and commissioned sensors should be zeroed, and bump tested with span gas.
3. Electrochemical sensors may be calibrated with span gas mixtures of the target gas in air or in nitrogen.
4. Use calibration gas cylinders provided by Safeguard Analytics or similarly approved calibration gas standards traceable to the National Institute of Standards and Technology (NIST).
5. Do not use calibration gas that is beyond its expiration date.

7.2 Calibration Frequency

The interval between maintenance and re-calibration varies by technology, gas type and environmental conditions surrounding the gas detector. In low risk areas or clean air environments less frequent maintenance schedules may be suitable. In higher risk or highly corrosive areas more frequent maintenance may be required.

Sensor Technology	Typical Calibration Frequency
Catalytic Pellistor Combustible Sensors	~ 6-12 months
Electrochemical Toxic Sensors	~ 6-12 months
Photo Ionization Detectors	~ 1 month
Non-Dispersive Infrared Sensors	12 months
Metal Oxide Semiconductor Sensors	3-6 months

7.3 Flow Rate

Model SA-PCA systems are designed to operate at aspirated flow rate of ~750ml/m. The flow sensor monitors the constant flow rate with a fault condition if drop below 100ml/m is detected. The flow rate can manually be adjusted with the potentiometer knob located on the panel.

NOTE: The flow rate may be affected by environmental factors such as temperature, humidity, barometric pressure, etc. This is normal behavior and should be monitored and adjusted when flow rate drops below 600ml/m throughout the course of normal operations for testing and calibrations. The flow fault condition will be displayed if the rate drops below 100ml/m.

7.4 Zero and Span Calibration Notes

Zero Calibration sets the zero-gas data point, adjusting the output to 0. Zero calibration can be initiated in either a zero-air atmosphere or by using a zero-air gas cylinder.

NOTE: For 0-25% O₂, zero-air and zero cal set the set point to 20.9% O₂

Span Calibration sets the span gas data point to a factory-set percentage of full scale. Span calibration requires a gas mixture equal to a percentage of the full scale.

Safeguard defaults to 50% of full scale for most gases

Different calibration levels can be requested from factory

Calibration levels can be configured on the device but is not recommended for all ranges and applications

Calibration level changes require a successful span calibration to be initiated

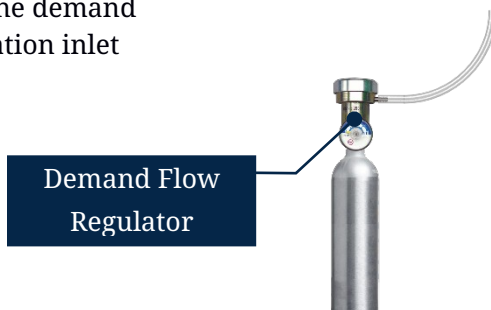
Always confirm and prepare correct calibration gas prior to testing and calibration

- ⚠ Allow sensors to operate and warm up for a period of at least 10 minutes prior to performing a zero or span calibration. This will allow sensors to reach a state of equilibration after a period without power applied.
- ⚠ Some sensors, like NO, have a bias warm up period which can take a long time to settle. Always prepare in advance to account for this warmup prior to field use or calibration by powering the device in advance for best results. These sensors can be unpowered momentarily but if have been offline for long periods may require a full warm up period (some sensors up to +12hrs) to fully stabilize. Monitor the baseline of these sensor types at ambient and allow to settle fully before performing a calibration.

Model SA-PCA can be calibrated with span gas cylinders and demand regulators or with positive pressure cylinders with the tubing connected in a flow by "T" arrangement.

DEMAND CALIBRATION OPTION

Demand Regulator: Connect the demand regulator directly to the calibration inlet connector.



POSITIVE PRESSURE CALIBRATION OPTION

Positive Pressure Regulator: Use a fixed flow 1 l/m regulator in a flow by "T" connection.



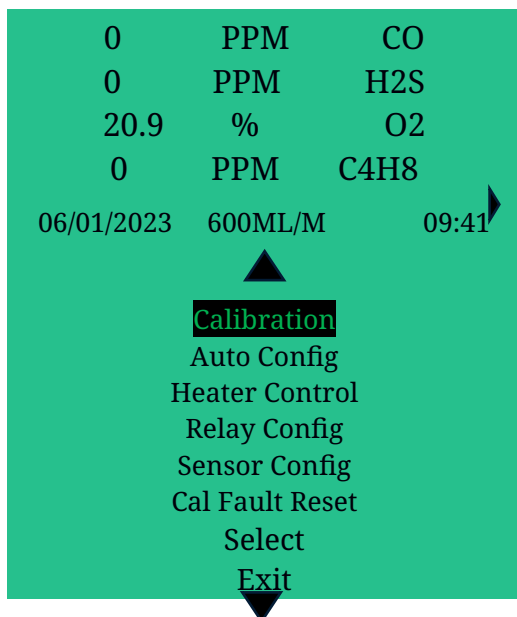
7.5 Zero Calibration

If the atmosphere surrounding the system intake contains no target or interference gases, Zero Calibration can be performed by activating the zero function using a magnet. If the atmosphere surrounding the sensor contains target or interference gases, use a certified zero gas cylinder.

⚠ Caution: The regulator used with the zero-gas cylinder should not be the same as the regulator used for highly reactive span gases.

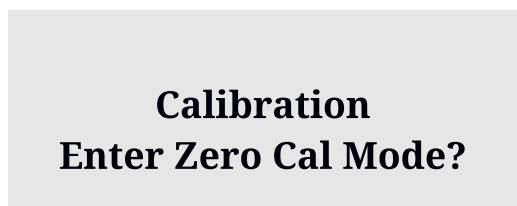
⚠ Caution: The demand regulator is the recommended flow rate for calibrating all SA2 sensors. NOTE: The demand regulator will create a resistance of 50-75mL; adjust the flow as needed.

7.6 Zero Calibration Screen Sequence



To access configuration menus, hold the programming magnet over the upper magnetic switch for ~ 3s. The panel LEDs will start to slow pulse, and the system will switch to the configuration options.

Use the push button panel switches to scroll through the menu list. Push and hold the select button to enter the calibration menu.



Press the Yes button on the panel to enter Zero Cal Mode.

Yes
No

**Select Channel
All?**

Press the Yes button on the panel to zero all active sensors.

Press the No panel button to zero a selected sensor.

Yes
No

**Select Channel
(1) CO?**

Last Cal 05/18/24

Press the Yes panel button to zero calibrate the selected sensor, or press the No panel button to scroll through each connector sensor.

Yes
No

**Zero Cal Mode
Begin Calibration?**

Apply zero gas to the system.

Press the Yes button on the panel to zero-calibrate the selected sensor.

Yes
No

Press the No panel button to exit Zero Cal Mode and revert to the Menu Config screen.

Observe a brief indication that the calibration process has been initiated.

**Zero Cal Mode
(1) Initiated.....**

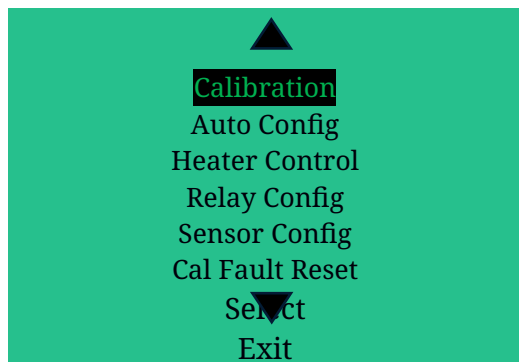
Zero calibration takes approximately 30 seconds, during which various screens indicate the state of progress.

**Zero Cal Mode
Initiated (1).....**

Press the Exit panel button to return to the Configuration Menu screen.

**Zero Cal Mode
Zero Cal Complete**

Exit



Press and hold the Exit panel button to return to regular operation.

7.7 Span Calibration

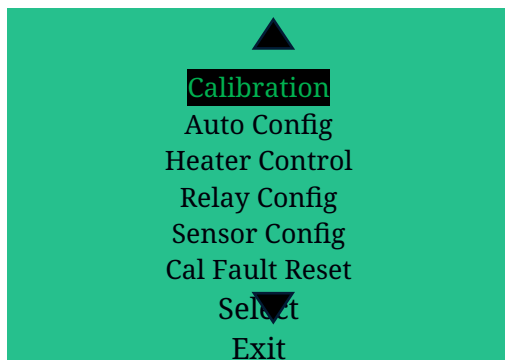
Most SA2 smart sensors are factory set for span cal at 50% of the full-scale range (FSR). Span using a 50% value of FSR of the target gas in a balance of air or nitrogen depending on compound. Refer to the sensor calibration certificate or the sensor configuration page to ensure the correct calibration level when acquiring span gas and when doing a calibration. The Span Calibration process will also prompt you with the correct gas level prior to starting the calibration.

NOTE: Oxygen deficiency sensors are zero air calibrated to a 20.9% value during the system zero calibration process and span to a lower concentration; factory default 10% O₂

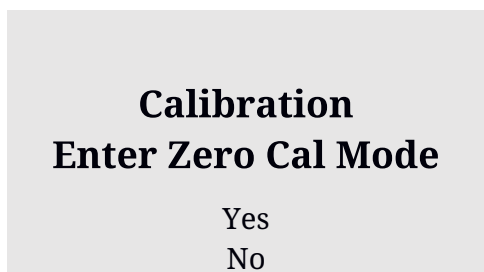
NOTE: Other calibration levels can be implemented by the factory on order. Always confirm calibration levels prior to apply gas for calibration

 The regulator used with the span gas cylinder should not be the same as the regulator used for the zero air cylinder. The regulator can become contaminated with the target gas over time.

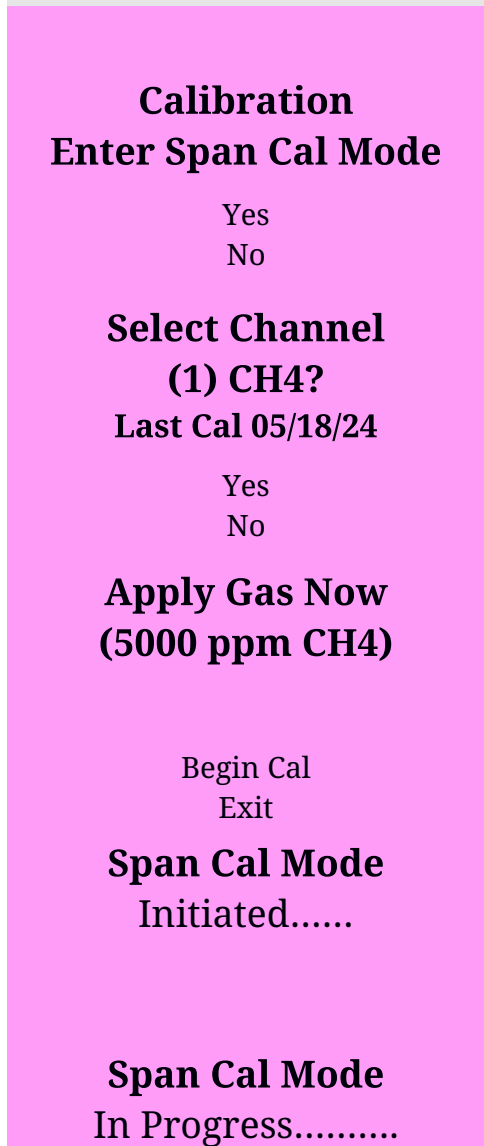
7.8 Span Calibration Screen Sequence



Access the Config Screen. Select the Calibration menu to initiate the Select the calibration process.



Press the No panel button to advance to the Span.



Press the Yes panel button to enter the Span Calibration process.

Press the Yes panel button to calibrate the selected sensor or the No panel button to scroll through the connected sensors.

Ensure the calibration adapter, tubing, or calibration circuit is connected.

Begin flowing gas.

Press the Begin Cal panel button to initiate span calibration. Press Exit to abort.

A brief indication that the span calibration has been initiated.

Follow the sensor response and reading to the applied gas sample.

CH4 2670 ppm
Span Cal Mode
As found has been
updated.

Indication that the as-found reading has been successfully adjusted to the correct reading.

CH4 5000 ppm
Span Cal Mode
Stability Test

An approximate 30s stability test.

Span Cal Mode
Stability Test Complete

A brief indication that the stability test was successful.

Span Cal Mode
Stability Test Complete
Remove Gas

Remove gas.

Once the gas has cleared, the span calibration will be complete.

Press the Exit panel button to return to the Config Menu screen.

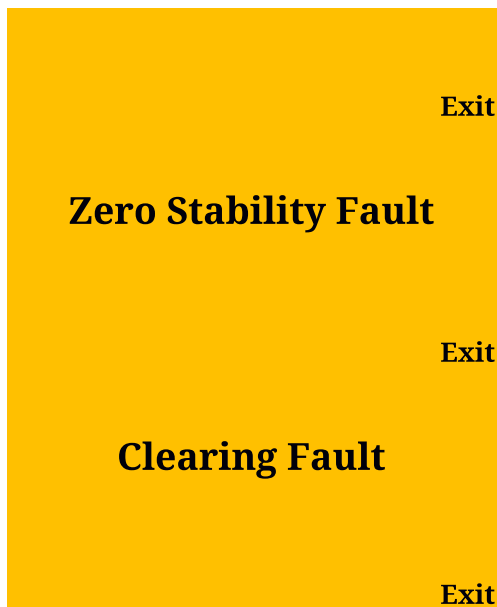
Exit

7.9 Span Calibration Errors

Span calibration - fault conditions may be due to any of the following conditions:

Cal Response Fault

- No gas was applied.
- Span gas blend error or empty cylinder.
- Sensor failure or faulty response.



- Poor seal of the span gas connective.
- Expired or faulty span gas source.
- Sensor failure.

- Failure to remove span gas after 5 minutes.
- Background gas present, not cleared within 5 minutes.
- Sensor failure.

In the event of a calibration error, the system will enter ‘Span Calibration Fault’. Cal Faults can be cleared and the sensor reset to previous calibration points by recalibrating successfully (Zero or Span), using the Cal Fault Reset menu config menu item, or power cycling the device. Selecting “(Exit)” will return the system to the config menu, allowing the user to reattempt calibration or select the calibration fault reset tool. Repeat calibration if a calibration error was made. If the sensor continues to fail calibration or exhibits out-of-spec responses, replace it as soon as possible. If the user exits the config menu without clearing the fault, the system will remain in a cal fault on the screen until the above conditions remove the fault.

8. SPARE PARTS

Part No	Quan	Description
909-10007	01	System controller/display MODBUS Master
909-80006	01	Dual sensor flow cell 316ss housing
909-90019	01	Flow cell O-ring
909-10013	01	MODBUS splitter connector board
909-80010	01	Smart pump assembly
909-80003	01	Inlet filter
909-80004	01	Outlet filter
909-90017	01	Sample tubing (3' length)
909-00001	01	Programming magnet
XXX-XXXXX	01	Water Separator
XXX-XXXXX	01	Coalescing Filter
XXX-XXXXX	01	Modem
XXX-XXXXX	01	Data Logger (SBC)
XXX-XXXXX	01	20Ahr Lithium Ion Battery

9. GAS SENSOR OPTIONS

Model SA2 Smart Sensor modules utilize conventional sensor technologies to create effective detection of a wide range of gas detection options along with various ranges of sensitivity. Current technologies include:

- Catalytic Pellistors (CPS) for the detection of combustible gases (% LEL)
- Molecular Property Spectrometer™ (MPS)* flammable gas sensor (% LEL and ppm)
- Non-dispersive infrared (NDIR) hydrocarbon sensors (% LEL and ppm)
- Non-dispersive infrared (NDIR) carbon dioxide sensors (% and ppm)
- Electrochemical (EC) oxygen deficiency sensors (0 to 25.0%)
- Electrochemical toxic (EC) gas sensors (ppb and ppm)
- Photo ionization detectors (PID) (ppb and ppm)
- Non-dispersive infrared (NDIR) refrigerant gas sensors (% LEL and ppm)

10. WARRANTY

Safeguard Analytics warrants each SA-PCA Portable Combustion Monitoring system to be free from defects in workmanship or material under regular use and service for a period of two (2) years from the date of shipment from the factory. Safeguard Analytics will repair or replace, without charge, any such equipment found to be defective during the warranty period. Faulty or damaged equipment must be shipped prepaid to the Safeguard Analytics plant or the representative from whom the shipment was made. The determination of the nature of, and responsibility for, defective equipment will be made by Safeguard Analytics' factory personnel. In all cases, this warranty is limited to the replacement of the equipment supplied by Safeguard Analytics. The customer will assume all liability for the misuse of this equipment by its employees or other personnel.

All warranties are contingent upon proper use in the application for which the product was intended and do not cover products that have been modified or repaired without Safeguard Analytics approval or that have been subjected to neglect, accident, improper installation or application, or on which the original identification marks have been removed or altered. Except for the express warranty stated above, Safeguard Analytics disclaims all warranties about the products sold, including all implied warranties of merchant ability and fitness and the express warranty stated herein is in lieu of all obligations or liabilities on the part of Safeguard Analytics for damages, including, but not limited to, consequential damages arising out of/or in connection with the use or performance of the products.