IAQRAE
PGM-5210

INDOOR AIR QUALITY MONITOR

Operation & Maintenance Manual

Document Number: 049-4003-000
Revision B, May 2005

RAE SYSTEMS

ISO 9001 CERTIFIED

- READ BEFORE OPERATING -

This manual must be carefully read by **ALL** individuals who have or will have the responsibility for using, maintaining, or servicing this product. The product will perform as designed only if it is used, maintained, and serviced in accordance with the manufacturer's instructions.

When the IAQRAE Monitor (PGM-5210) is removed from the transport case and turned on for the first time, there may be residual organic or inorganic vapor trapped inside the detector chambers. The initial PID or toxic gas sensor reading may indicate a few ppm. Ensure an area free of organic or toxic vapors and turn the monitor on. After running the monitor for several minutes, the residual vapor in the detector chamber should clear, and the reading should return to zero.

The battery of the IAQRAE Monitor will slowly drain even when it is not on. If the monitor has not been charged for 5-7 days, the battery voltage will be low. Therefore, it is good practice to charge the monitor before each use. It is also recommended to fully charge the monitor for AT LEAST 10 HOURS before initial use. See Section 3.1 for more information on battery charging and replacement.

CAUTION!

To reduce the risk of electric shock, turn the power off before removing the monitor cover. Disconnect the battery before removing sensor module for service. Never operate the monitor when the cover is removed. Remove monitor cover and sensor module only in an area known to be non-hazardous.

⚠ WARNINGS ⚠

Use only RAE Systems battery packs designed for the IAQRAE Monitor (PGM-5210). **This instrument is designed for use in ordinary locations only!**

STATIC HAZARD: Clean only with a damp cloth.

For safety reasons this equipment must be operated and serviced by qualified personnel only. Read and understand the instruction manual completely before operating or servicing.

Any rapid up-scale reading followed by a declining or erratic reading may indicate a gas concentration beyond upper scale limit which may be hazardous.

The calibration of all newly purchased RAE Systems instruments should be tested by exposing the sensor(s) to known concentration calibration gas before the instrument is used or put into service. For maximum safety, the accuracy of the IAQRAE should be checked by exposing the sensor(s) to known concentration calibration gas before each day's use.

⚠ AVERTISSEMENT ⚠

Utiliser seulement des batteries de RAE Systems spécifié pour le Moniteur IAQRAE (PGM-5210). L'usage du **Le moniteur IAQRAE (PGM-5210) est pour l'utilisations dans des locations ordinaire seulement !**

DANGER RISQUE D'ORIGINE ELECTROSTATIQUE: Nettoyer uniquement avec un chiffon humide.

Pour des raisons de sécurité, cet équipement doit être utilisé, entretenu et réparé uniquement par un personnel qualifié. Étudier le manuel d'instructions en entier avant d'utiliser, d'entretenir ou de réparer l'équipement.

Toute lecture rapide et positive, suivie d'une baisse subite au erratique de la valeur, peut indiquer une concentration de gaz hors gamme de détection qui peut être dangereuse.

La calibration de toute instruments de RAE Systems doit être testé en exposant l'instrument à une concentration de gaz connue par une procédure dietalonnage avant de mettre en service l'instrument pour la première fois. Pour une sécurité maximale, la sensibilité du IAQRAE doit être vérifié en exposant l'instrument à une concentration de gaz connue par une procédure dietalonnage avant chaque utilisation journalière.

Acronyms used throughout manual:

EC - Electrochemical
HT - Humidity Temperature
LCD - Liquid Crystal Display
LED - Light Emitting Diode
PC - Personal Computer
PID - Photo-Ionization Detector
ppm - Parts Per Million
VOC - Volatile Organic Compound

1. General Information

The IAQRAE multi-gas monitor is a portable instrument that provides real time measurements and activates alarm signals when exposure exceeds preset limits. The programmable monitor contains up to five sensors that will monitor volatile organic compounds (VOC) gas, a toxic gas, carbon dioxide, humidity and temperature for measurements of Indoor Air Quality (IAQ). Depending on the type of sensor installed, the IAQRAE is capable of monitoring:

- **Organic Vapors**
  PID Sensor using 10.6 eV UV lamp
- **Carbon Dioxide**
  A miniature Non Dispersive Infrared (NDIR) Sensor
- **Toxic Gas**
  One interchangeable Electrochemical Sensor
- **Humidity**
  Capacitive Humidity Sensor
- **Temperature**
  Precision Thermistor

Note: The humidity and temperature sensors are physically packaged together as an HT Sensor.

The IAQRAE (PGM-5210) consists of:

- IAQRAE monitor with five sensors
- Calibration adapter
- Quick Reference Guide
- Operation and Maintenance manual
- Shoulder strap
- Rechargeable Lithium-Ion battery pack
- 120/240 AC/DC wall adapter
- Spare alkaline battery pack
- Ten spare water and dust trap filters
- Three-inch inlet probe
- Hard transport case with pre-cut foam
- Fifteen feet (5 meters) of Teflon® tubing
- Tool kit
- Lamp cleaning kit, for monitors equipped with a PID sensor

1.1 General Specifications

Table 1.1 IAQRAE Monitor Specification

Dimensions	9.25” L x 5.0” W x 9.25” H (23.5cm L x 12.7cm x 23.5cm)
Weight	8.9 lbs (4.03 kg) with battery
Detectors	Up to five sensors: • PID Sensor w/ 3/8 od 10.6 eV lamp • Electrochemical Sensor • NDIR Sensor for CO_2 • Humidity Sensor • Temperature Sensor
Battery	Rechargeable, 7.4V/7.2 Ah, Lithium-Ion battery pack with built-in charger (less than 10 hours charge time) Six C-cell alkaline battery pack
Operating Time	Up to 36 hours of continuous operation
Display	Two-line, 16-character LCD with manual LED backlight
Keypad	• [MODE] – operation & programming • [Y/+] – operation & programming key • [N/-] – operation & programming key • [RADIO] – not used • [VOICE] – not used • [UP/DOWN] – not used
Direct Readout	• Up to five instantaneous values • Sensor name • High and low values all sensors • Battery voltage • Elapsed time
Alarm Settings	Separate alarm limit settings for Low and High alarm
Visible Alarm	100 dB buzzer at 10 cm (typical)

Audible Alarm	Flashing red LED cluster to indicate exceeded preset limits, low battery, or sensor failure
Calibration	Two point field calibration for fresh air and standard reference gas (except for the temperature sensor)
Attachments	Shoulder strap, optional tripod/wall mounting bracket
Sampling Pump	Internal integrated diaphragm pump with adjustable duty cycle ratio of pump on (>400 cc/min) and off
Protection	Password protected calibration settings, alarm limits, and data
EM Immunity	No effect when exposed to 0.43 mW/cm^2 RF interference (5 watt transmitter at 12 inches)
Data Storage	Optional 20,000 readings (64 hours, 5 channels at 1-minute intervals) in non-volatile memory
Datalog Interval	Programmable 1-3600 seconds
External Alarm	Optional plug-in, pen-size vibration alarm or earphone
Communication	Upload data to PC and download monitor setup from PC through RS-232 link to serial port on PC
Temperature	0^oC to 50^oC (32^oF to $122^o F$)
Humidity	0 % to 95% relative humidity (Non-condensing)

Table 1.1 Range, Resolution & Response Time (t_{90})

Sensor	Range	Resolution	t_{90}
VOC	0-9.99 ppm	0.01 ppm	10 seconds
	10.0-99.9 ppm	0.1 ppm	
	100-999 ppm	1 ppm	
CO_2	0-20,000 ppm	10 ppm	60 seconds
CO	0-500 ppm	1 ppm	25 seconds
H_2S	0-100 ppm	1 ppm	30 seconds
SO_2	0-20.0 ppm	0.1 ppm	15 seconds
NO	0-250 ppm	1 ppm	20 seconds
NO_2	0-20.0 ppm	0.1 ppm	25 seconds
Cl_2	0-10.0 ppm	0.1 ppm	60 seconds
HCN	0-100 ppm	1 ppm	60 seconds
NH_3	0-50 ppm	1 ppm	150 seconds
PH_3	0-5.0 ppm	0.1 ppm	60 seconds
Temp	32.0˚F-122.0˚F	0.1˚F	300 seconds
	0˚C-50.0˚C	0.1˚C	
RH	5-95%	1% RH	60 seconds

Note: t_{90} values for most electrochemical sensors are based on vendors' specification. Actual monitor responses may be longer depending on measuring conditions.

2. Operation of IAQRAE

The IAQRAE multi-gas exposure monitor is a compact, portable instrument that provides real time measurements and activates alarm signals when exposure exceeds preset limits. Prior to factory shipment, the IAQRAE is preset with default alarm limits, and sensors are pre-calibrated with standard calibration gas. However, the user should calibrate the instrument before the first use. After the monitor is fully charged and calibrated, it is ready for immediate operation.

2.1 Physical Description

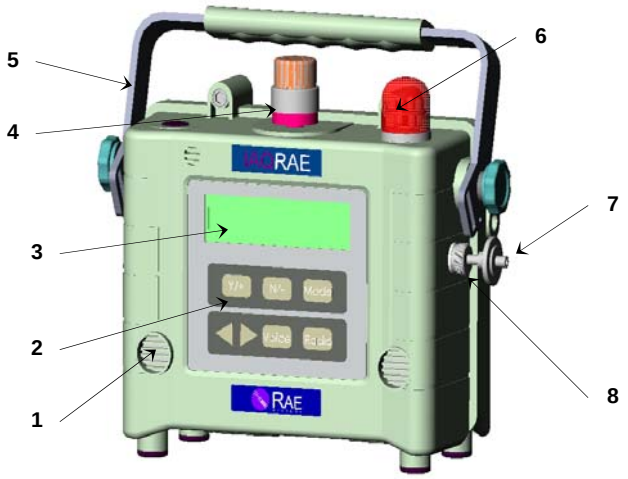


Figure 2-1 Front View - Main Components of IAQRAE

1. Audible Alarm Port
2. Keypad

   [MODE] – operation key & programming key
   [Y/+] – operation & programming key
   [N/-] – operation & programming key
   [RADIO] – not used
   [VOICE] – not used
   [UP/DOWN] – not used
3. LCD with Backlight
4. Humidity-Temperature Sensor
5. Handle
6. Red LED Alarm Light
7. Water / Dust Filter
8. Gas Entry Port

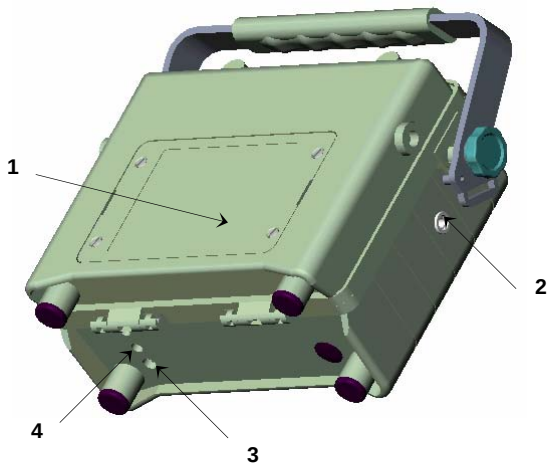


Figure 2-2 Back View - Main Components of IAQRAE

1. Battery pack - IAQRAE monitors are equipped with interchangeable rechargeable Lithium-Ion and alkaline battery packs
2. Gas exit port
3. Charger port – power jack connects IAQRAE to external DC for charging
4. Serial communication port for PC interface

2.2 Keys and Display

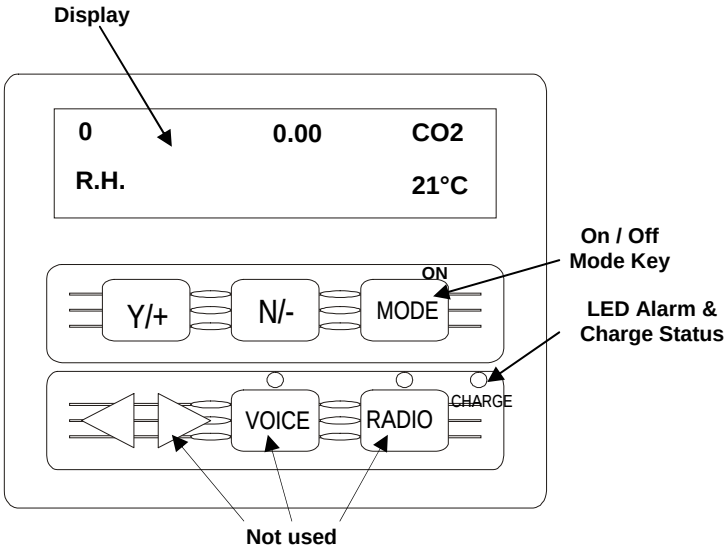


Figure 2-3 IAQRAE Display and Keypad

Table 2.1 Key Functions During Normal Operation	
Key	**Function**
[MODE]	Turn power on/off Choose different display mode
[N/-]	Toggle backlight on/off Answer “No” Decrease values
[Y/+]	Alarm test and alarm acknowledgment Turn latched alarm off Turn pump on Answer “Yes” Increase values

2.3 Turn Power On/Off

The Charge LED at the front of the monitor will light up when the monitor is plugged into the AC charger. When the LED is red, the battery is still charging. When the LED is green, the battery is fully charged and IAQRAE is ready for use.

To turn ON

Press [MODE]. The audio buzzer will beep once, and the screen will display the following, in order:

- "Multi-gas Monitor Version n.nn" (the software version)
- Custom power-on-name, which can be changed by the customer using the ProRAE Suite Software
- Model number, serial number, current date & time, and temperature
- Each sensor socket to check if a valid sensor is installed If a new sensor is installed, a message to remind the user to calibrate the sensor will be displayed followed by a message that the alarm limits have been reset to the default values for the new sensor. If a sensor reaches its expected end of life, a "Warranty Expired" message will be displayed.
- Last calibration date
- Preset alarm limits for each sensor
- Battery voltage
- Shut off voltage
- User mode
- Alarm mode
- Available data storage memory (in hours)
- Datalog mode
- Datalog period (60 seconds)
- Instantaneous reading of the gas concentration in ppm

To turn OFF

Press and hold [MODE] for 5 seconds. The monitor will beep once every second during the power-down sequence. A countdown timer will show the remaining seconds. After that, the screen will flash "Off!" and then go blank, indicating the monitor is off.

2.4 Data Protection

When the monitor is turned off, all the current real time data including peak, minimum, and elapsed time are erased. However, the datalogged data are preserved in non-volatile memory. Even if the battery is disconnected, the datalogged data will not be lost. When the monitor is off, the real time clock will continue to operate until the battery is completely drained (usually in 5-7 days without any charging).

If the battery is completely drained or is disconnected from the monitor, the real time clock will continue to operate for another 30 days. When the real time clock is lost, the information needs to be re-entered. (See Section 4.5.5 Change Real Time Clock)

Datalog monitor versus Non-Datalog monitor

There are two versions of the PGM-5210 Multi-Gas Monitors: Datalog monitors and Non-Datalog monitors. A Datalog monitor allows the user to store the gas concentration readings. (See Section 2.10 Datalogging)

During the power on sequence, a letter “D” following the version number indicates that the monitor is configured as a Datalog monitor. The absence of a letter “D” indicates a Non-Datalog monitor.

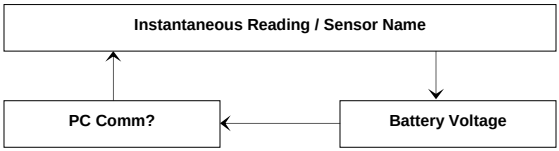
The user may upgrade a Non-Datalog monitor to a Datalog monitor. Call the factory for information on how to order the upgrade kit.

2.5 Normal Mode Operation

The IAQRAE offers two levels of user operation:

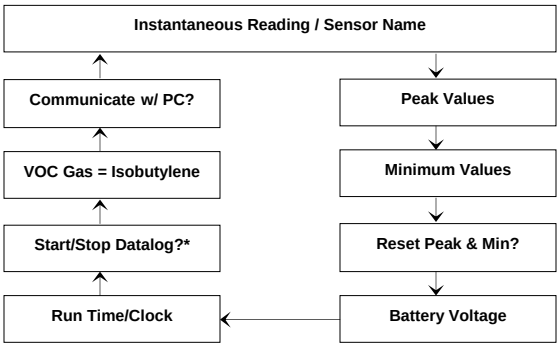
1. Basic

The monitor will display the sensor name after the monitor is turned on. Press [MODE] to view the functions illustrated in the round robin sequence. The user may enter Calibration Mode to perform calibrations, but may not change the other parameters.



2. Advanced

The Advanced level includes the same functions from the Basic level with additional functions listed in the round robin sequence. The user also has access to Calibration Mode to calibrate or change any parameters. Press [MODE] to access each display:



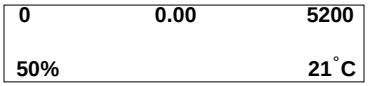
***Start/Stop Datalog will only appear when Datalogging is set to manual mode.**

Time Out Intervals

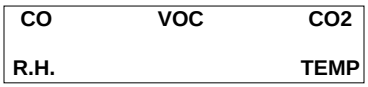
A time out interval occurs when nothing is pressed after one minute. The LCD will automatically return to the instantaneous reading/sensor name from either user mode.

Definitions of Basic and Advanced Functions

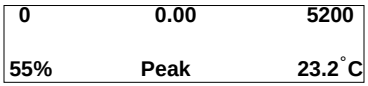
1. The **Instantaneous Reading / Sensor Name** function alternately displays the instantaneous reading and the sensor name. The instantaneous reading is the actual gas concentration in parts per million (ppm) for carbon dioxide, toxic or VOC gases, % RH for humidity, and Celsius (˚C) or Fahrenheit (˚F) for temperature. Readings are updated every second:



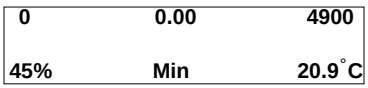
   The sensor names are displayed as follows:
   CO, H2S, etc. – one toxic gas sensor
   VOC - PID sensor
   CO2 – carbon dioxide sensor
   RH – humidity sensor
   TEMP – temperature sensor



2. The **Peak Value** is the highest reading of each gas concentration since the monitor was turned on. Readings are updated every second:

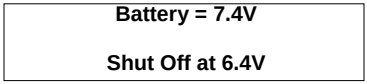


3. The **Min Value** is the lowest reading of each gas concentration since the monitor was turned on. Readings are updated every second:



4. **Reset Peak and Min?** allows the user to reset the Peak and Minimum values for the instantaneous gas concentration readings. To skip this function, press [N/-] or [MODE]. To reset the values, press [Y/+] to start recording new Peak and Minimum values.

5. The **Battery Voltage** is the current battery voltage (V) reading. The reading is updated every second and is shown with the shut off voltage:



Note: A fully charged battery pack should show 7.7 volts or higher. When the battery voltage falls below 6.6 volts, a flashing "Bat" will appear as a warning message. This means, there will be approximately 20-30 minutes of operating time remaining before the monitor automatically turns off as the battery voltage falls below 6.4 V.

6. The **Run Time/Clock** is the accumulated time in hours and minutes the monitor has been on. The reading is updated in every minute and is displayed with the current date and time.

7. If the manual datalog mode is selected, the **Start/Stop Datalog** menu will prompt the user to turn datalogging on or off. When "Start Datalog?" displays, press [Y/+] to turn datalogging on. Likewise, when "Stop Datalog?" displays, press [Y/+] to turn it off.

8. **VOC Gas** displays the current compound selected by the user. A correction factor will be calculated relative to that compound to provide readings for it.

9. **Communicate with PC?** allows the user to upload data from the IAQRAE to their PC or download configuration information from a PC to the IAQRAE. Press [Y/+] and the message “Datalog Paused…” reminds the user that during PC communication there is no real time monitoring.

   The monitor automatically enters communication standby mode*. The “Ready...” display will appear. Connect the monitor to the serial port on a PC. The monitor is ready to receive any command from the PC.

   Press [MODE] again to return to the first display Instantaneous Reading/Sensor Name.

   ***Note:** When the monitor is in communication standby mode, it stops monitoring the gas concentration and stops datalogging. Datalogging must be manually restarted when exiting communication standby mode, unless it is in automatic datalogging mode.

2.6 Alarm Signals

The built-in microprocessor continually updates and monitors gas concentrations. It also compares the readings with programmed low and high instantaneous gas concentration alarm limit settings. When the concentration exceeds any of the preset limits, the buzzer and red LED will immediately warn the user of the alarm condition. Additionally, the IAQRAE will alarm if one of the following conditions occur:

- Battery voltage falls below a pre-set voltage level (6.6V)
- Failure of UV lamp (in PID sensor)
- Pump stalls
- Datalog memory is full.

When the low battery alarm occurs, there will be approximately 20-30 minutes of operating time remaining before the monitor automatically turns off as the battery voltage falls below 6.4 V.

Alarm Signal Disabled

It is extremely important to note that the alarm signals are disabled during the following conditions:

- PC Communication standby mode
- Calibration mode.

During these levels of operation, real time monitoring gas concentration stops. Gas concentrations, including peak and minimum values will not be calculated.

Latching Alarm Signal

The default alarm signal is the auto reset mode. However, it is possible to setup the IAQRAE in latching mode so that when an alarm condition occurs, the alarm signals remain on even after the alarm condition is no longer present. The user may change the alarm mode from a PC or while the IAQRAE monitor is in Advanced User level (See Section 4.5.3 Change Alarm Mode)

Table 2.2 Alarm Signal Summary		
Condition	**Alarm Signal**	**Message on LCD Screen**
Gas exceeds High Alarm limit	3 beeps & flashes per second	“High”
Gas exceeds Low Alarm limit	2 beeps & flashes per second	“Low”
Negative Drift	3 beeps & flashes per second	“NEG”
Over Range	3 beeps & flashes per second	“OVR”
Pump failure	3 beeps & flash per second	“Pump”
PID lamp failure	3 beeps/flash per second	“Lamp”
Low battery	1 beep per minute	“Bat”
Memory full	1 flash per second	“Mem”

Alarm Signal Testing

Under normal conditions, it is possible to test the LED, buzzer, and backlight by momentarily pressing [Y/+]. The buzzer will beep once, and the LED and backlight will flash once to indicate alarm signals are functioning correctly.

⚠WARNING⚠

Because alarm signals are disabled during PC Communication and Calibration modes, it is highly recommended to use these modes only in areas known to be non-hazardous, in order to reduce the risk of exposure to hazardous atmospheres.

2.7 Backlight

The LCD is equipped with a backlight to assist reading under poor lighting conditions. When the monitor is in normal operation, the backlight may be manually turned on by pressing and holding [N/-] for one second. Press [N/-] a second time to turn off. If [N/-] is not pressed, the backlight will automatically turn off to save power. The backlight will automatically activate during alarm condition(s).

Note: The LED backlight consumes a significant amount of energy from the battery and shortens the operating time of the monitor by 20 - 30%.

2.8 Alarm Limits & Calibration

IAQRAE is factory calibrated with standard calibration gas, and is programmed with default alarm limits as listed below. (See Section 4.2 Calibration and Section 4.3 Change Alarm Limits)

Sensor	Cal Gas / Balance	Unit	Low	High
CO_2	5000 / N_2	ppm	5000	8000
VOC*	10 / Air	ppm	5.00	10
Temp	-	-	-	-
RH	90/Air	%RH	-	-
CO	50 / Air	ppm	35	200
H_2S	25 / N_2	ppm	10	20
SO_2	5 / N_2	ppm	2	10
NO	25 / N_2	ppm	25	50
NO_2	5 / Air	ppm	1	10
Cl_2	10 / N_2	ppm	0.5	5
HCN	10 / N_2	ppm	4.7	50
NH_3	50 / N_2	ppm	25	50
PH_3	5 / N_2	ppm	1	2
***Note:** 10 ppm isobutylene gas is used for VOC gas calibration, and may also be used to zero calibrate the CO_2 sensor.				

2.9 Integrated Sampling Pump

The IAQRAE includes an internal integrated sampling pump with programmable high and low pump speed settings:

A **low pump speed** of ~300 cc per minute is the factory default. This rate increases battery life by about 5%. (See Section 4.5.9 Change Pump Speed).

In some cases, it is better to program the monitor to a **high pump speed** of ~400 cc per minute, which is required for vapors that are especially reactive or easily absorbed by instrument surfaces. Such vapors include, but are not limited to: Cl_2, PH_3, NH_3, HCN, and semi-volatile organic compounds like diesel fuel and jet fuels. Some suggestions for monitoring heavy organic compounds are listed below:

- Remove the water trap filter for normal calibration and operation, which increases the pump speed.
- Use inert connecting or sampling tubing, such as Teflon® instead of Tygon; make tube connections as short as possible.

Pump Duty Cycle

The duty cycle function allows the user to control the time the pump is one for a specified ten-second period. A 70% duty cycle means that the instrument turns the pump on for seven seconds, and then turns the pump off for three seconds. (See Section 4.5.8 Change Pump Duty Cycle)

Currently, users may only set the duty cycle from 50% (five seconds) to 90% (nine seconds) with 10% (one-second) increments. Decreasing the duty cycle gives the instrument more time to clean its PID lamp, reducing lamp contamination, which slows the rate of signal degradation. It also reduces pump wear and filter contamination, and saves battery power.

Under certain conditions, the duty cycle is automatically disabled, meaning that the pump is always one. The pump duty cycle is disabled when the PID reading is higher than 2.0 ppm and is enabled when the reading drops below 1.6 ppm. The duty cycle is also disabled during system warm-up, PC communication, calibration, in diagnostic mode, or when any sensor (including CO_2 or toxic gas) is in alarm condition.

The ultraviolet light in PID sensors generates a very low level of ozone. Stoppages of flow allow the ozone to build up in the sensor housing. Since ozone is very reactive, it is quite efficient in scrubbing contaminants out of the PID sensor when the pump is off. This cleaning cycle does not reduce lamp life. It is important to set the duty cycle as low as possible to allow for some PID-cleaning, because the self-contained sensor cannot be manually cleaned.

Unlike some other RAE products, the self-cleaning function is not operative when the unit is turned off and plugged into the charger. Self-cleaning is best performed by turning the unit on in normal operating mode, setting it in a clean environment (<2 ppm VOC response) and setting the Duty Cycle to 50%.

Pump Stall

If liquid or other substance is sucked into the water filter through the gas entry port and causes the pump to strain, the monitor will immediately detect the obstruction and shut down the pump. The alarm will activate, and user will see the flashing “Pump” error message. After the filter is changed or obstacles are removed, press [Y/+] to restart the pump. There are different pump stall thresholds, which may be adjusted. (See Section 7.1 Diagnostic Mode)

2.10 Datalogging

The IAQRAE Multi-Gas Monitor calculates and stores gas readings based on the user-specified datalogging period and type of measurement. Two types of gas measurements, average or peak concentration may be stored for each sensor for any datalogging interval. Datalogging intervals may be programmed from one second to sixty minutes in one-second increments. In addition, time stamp, user ID, site ID, serial number, last calibration date, and alarm limits are also stored. Since all data is retained in non-volatile memory, the user may download information to their PC at a later time.

Datalog Options

Most of the datalogging options may be programmed from the monitor. When the monitor is connected to a PC, additional options may be programmed and then downloaded to the monitor. There are four options:

1. Automatic: automatically starts and stops datalogging when the monitor is turned on and off, respectively.
2. Manual: user manually starts and stops datalogging. User may also set the timer for datalog run times.
3. Periodic: datalogging is scheduled on a daily basis with a preset parameter in hours and minutes.
4. Schedule: datalogging is scheduled for a preset date (month/day) and time (hour/minute).

Start/Stop Datalogging Manually

1. Press [MODE] to toggle through the normal operation menu until “Start Datalog?” appears.
2. Press [Y/+] to start datalogging.
3. Press [Y/+] again, and “Stop Datalog?” will appear.
4. Press [Y/+] a third time to stop datalogging.

Other Datalog options will automatically start and stop:

Datalogging Event

Each time a datalogging operation is initiated, a datalog event is created. Information, such as start time, datalogging period, alarm limits, etc. are recorded in the event header, followed by the measurement data.

Datalogging Pause

Datalogging automatically pauses under the following conditions:

1. Upon entering Program Mode. Datalogging resumes upon exiting Program Mode.
2. Upon entering PC Communication standby mode. Datalogging resumes upon exiting PC communication standby mode, only if datalogging mode was set to automatic.

In both cases a new datalog event is created when Datalogging resumes.

3. Operation of Accessories

The accessories for IAQRAE include:

- Wall mount AC adapter for charging battery
- Li-Ion battery pack
- Alkaline battery adapter
- Water trap filter
- Remote sampling probe
- Calibration adapter

⚠WARNING⚠

To reduce the risk of ignition of hazardous atmospheres, recharge battery only in area known to be non-hazardous. Remove and replace battery only in area known to be non-hazardous.

Ne charger les batteries que dans l'emplacement désigné non dangereux.

3.1 Interchangeable Battery Packs

⚠ WARNING ⚠

To reduce the risk of ignition of hazardous atmospheres, recharge battery only in an area known to be non-hazardous. Remove and replace battery only in area's known to be non-hazardous.

When the display shows a flashing message "Bat", the battery requires recharging. The battery may be replaced in the field if required. It is recommended to recharge the IAQRAE monitor upon returning from fieldwork.

A fully charged battery powers an IAQRAE monitor for up to 36-hours continuous operation. The charging time is less than 10-hours for a fully discharged battery. The built-in charging circuit is controlled by two-step constant voltage/constant current charging to prevent over-charging.

An alkaline battery adapter is supplied with each IAQRAE kit. It may be used in place of the rechargeable Lithium-Ion battery pack. The alkaline pack holds 6 C-size alkaline batteries. Use only DURACELL Mn1400 or ENERGIZER E93 C-size batteries with the IAQRAE alkaline battery pack.

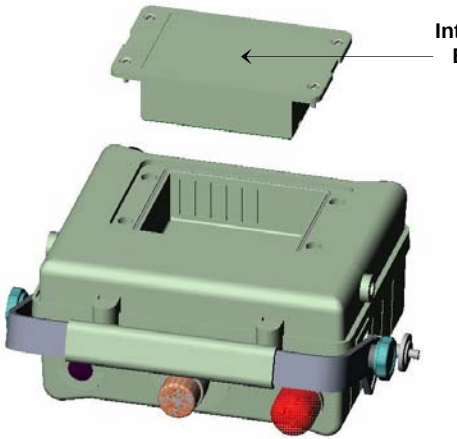


Figure 3-1. Interchangeable Battery Pack

Recharging the Lithium-Ion Battery Pack

1. Turn IAQRAE off.
2. The charging circuit of the IAQRAE is built into the monitor. It requires a regular AC to 15V DC adapter (a wall mount transformer) to charge the monitor.
3. Connect the AC adapter (or the optional automotive charging adapter) to the charger connection port on the IAQRAE monitor.
4. When the Charge LED located on the front of the monitor is red, the battery is charging. A completely drained IAQRAE will be fully charged within 10 hours.
5. When the LED turns green, the battery is fully charged.

Note: The rechargeable Lithium-Ion IAQRAE battery pack will slowly drain even when the monitor is off. If the monitor has not been charged for several days, the battery voltage may be low.

The factory-supplied battery is designed for up to 36 hours of normal operation, without alarm conditions or backlight usage. As the battery ages or is subjected to adverse conditions, such as cold ambient temperature, the battery capacity may significantly reduce.

Removing or Replacing the Alkaline Battery Adapter

1. **Before** removing or replacing the battery pack, please make sure the IAQRAE monitor is located in a non-hazardous area and is not connected to the charger.
2. To remove the battery pack, unscrew the four screws that secure the battery pack to the IAQRAE housing.
3. Remove and replace drained alkaline batteries.
4. Match the battery polarity as indicated by the diagram inside the battery holder.
5. Reattach the battery pack to monitor.

Note: The internal charging circuit will automatically detect the alkaline battery adapter and will not charge the battery adapter.

3.2 Water Trap Filter

The external water trap/dust filter is made of a PTFE (Teflon®) membrane with a 0.2 micron pore size to prevent liquid water from being sucked into the sensor manifold, which would cause extensive damage to the monitor. It also prevents dust from entering the monitor and prolongs the sensors' operating life.

To install the water trap filter, slide the Tygon tubing onto the ribbed inlet port of the monitor. A male Luer connector fits into the female Luer of the filter. To remove the filter, disconnect the Luer connector.

There are some vapors that are especially reactive or easily absorbed by instrument surfaces; they include, but are not limited to: Cl_2, PH_3, NH_3, HCN, and semi-volatile organic compounds like diesel fuel and jet fuel. For these compounds the high pump speed setting should be used. (See Section 2.9 Integrated Sampling Pump) It is also more desirable to use inert connecting and sampling tubing, such as Teflon® instead and to make tube connections as short as possible.

3.3 Remote Sampling Probe or Teflon® Tubing

A 15-foot (5M) length of Teflon® tubing is supplied as a standard accessory with every IAQRAE detector. An optional 6-foot Teflon® remote sampling probe with a telescoping handle is also available for hard-to-reach areas such as ceilings, storage tanks, underground manholes, etc.

Connect the male Luer connector to the end of the remote sampling probe or the Teflon® tubing to the female Luer connector on the water trap filter. The remote sampling probe or the Teflon® tubing is ready for operation.

3.4 Calibration Adapter

The IAQRAE should be calibrated with the external water trap/dust filter in place. The IAQRAE calibration adapter is designed to slip over the filter. During calibration, connect the calibration adapter to the cylinder of the calibration gas. Then insert adapter into filter and allow the gas to flow to sensors.

4. Programming of IAQRAE

The IAQRAE is built with a microprocessor to provide programming flexibility for the user. The user may access the programming functions depending on the user operation level and the security level. (See Table 4.1 Programming Mode Functions)

There are two levels of user operation: **Basic** and **Advanced**. (See Section 2.5 Normal Mode Operation)

There are three levels of security for each operation level in the Programming Mode to prevent unauthorized changes to specific settings. The user may set security levels by using ProRAE Suite Software.

Level 0 allows the user to enter Programming Mode without a password. A user may still perform calibrations, but has limited access to most programming functions.

Level 1 requires a four-digit password to enter Programming Mode and to gain full access to all programming functions available at that user operation level.

Level 2 allows the user to enter Programming Mode without a password and gain full access to all programming functions available at that user operation level.

Note: Real time monitoring of gas concentrations continues during Programming Mode. However, real time monitoring pauses during calibration, when the user is reviewing Datalog data, or when the user enters Programming Mode. Datalogging resumes upon exiting Programming Mode.

Table 4.1 Programming Mode Functions

User Operation Level	Basic			Advanced		
Security Level	0	1	2	0	1	2
Calibrate Monitor?						
Fresh Air Calibration?	×	✓*	✓	✓	✓*	✓
Multiple Sensor Calibration?	×	✓*	✓	✓	✓*	✓
Single Sensor Calibration?	×	✓*	✓	✓	✓*	✓
Modify Span Gas Value?	×	×	×	×	✓*	✓
Change VOC Span Gas?	×	×	×	×	✓*	✓
Change Alarm Limit?						
Change High Alarm Limit?	×	×	×	×	✓*	✓
Change Low Alarm Limit?	×	×	×	×	✓*	✓
Change Datalog Setting?						
Clear All Data?	×	×	×	×	✓*	✓
Change Datalog Period?	×	×	×	×	✓*	✓
Select Datalog Mode?	×	×	×	×	✓*	✓
Enable/Disable Datalog?	×	×	×	×	✓*	✓
Select Memory Full Type?	×	×	×	×	✓*	✓
Change Monitor Setup?						
Change Site ID?	×	×	×	×	✓*	✓
Change User ID?	×	×	×	×	✓*	✓
Change Alarm Mode?	×	×	×	×	✓*	✓
Change User Mode?	×	✓*	✓	✓	✓*	✓
Change Real Time Clock?	×	✓*	✓	✓	✓*	✓
Change Light and Buzzer Mode?	×	×	×	×	✓*	✓
Change Password?	×	×	×	×	✓*	✓
Change Pump Speed?	×	×	×	×	✓*	✓
Change Pump Duty Cycle?	×	×	×	×	✓*	✓
Change Display Language?	×	×	×	×	✓*	✓
Set Temperature Unit?	×	×	×	×	✓*	✓
Change Sensor Configuration?						
Change VOC gas? (measurement)	×	×	×	×	✓*	✓
Edit Correction Factor?	×	×	×	×	✓*	✓
Enable/Disable Sensor?	×	×	×	×	✓*	✓

× - Not Available **✓ - Available** *** - Need Password**

4.1 Enter & Exit Programming Mode

Table 4.2 Programming Keys	
[MODE]	Exit menu when pressed momentarily Exit data entry mode when pressed and held for one second
[Y/+]*	Increase numerical value for data entry Answer “yes”
[N/-]*	Decrease numerical value for data entry Answer “no”

* For rapid scrolling, press and hold these keys.

To Enter

1. Turn the IAQRAE monitor on.
2. Press and hold [MODE] and [N/-] simultaneously for three seconds to enter Programming Mode. This delay prevents the user from entering Programming Mode by accident.
3. Security Level 0 or Level 2 - the monitor will enter Programming Mode and the first menu item “Calibrate Monitor?” will display.
4. Security Level 1 - “Enter Password = 0000” will display with the far left digit flashing. The user enters password starting from the flashing digit.

   Note: Prior to factory shipment, the IAQRAE monitor was installed with “0000” as the default password. For added security, “0000” is always displayed instead of the actual password.

5. If the digit value is not “0”, use [Y/+] or [N/-] to increase or decrease digit value. Press [MODE] to confirm digit value. Display shows actual digit entered and moves the flashing cursor to the next digit to the right.
6. Repeat Step 5 until all four digits are entered. Then press and hold [MODE] for one second.

7. If the entered password is correct, the monitor enters the programming menu. The first menu item “Calibrate Monitor?” will display.
8. If the password is incorrect, the display shows “Wrong Password???” and returns to the regular display of instantaneous gas readings.
9. If the monitor user operation is set to Basic level, Security Level 0, the message “Display Only! Cannot enter....” will appear.

To Exit

1. Press [MODE] once.
2. The display will show an instantaneous reading for normal operation.
3. To exit Programming Mode from most submenus, press [MODE] twice. In some cases it is necessary to first acknowledge a “save?” or “OK?” display by using [MODE] to move to that query and then [Y/+] to accept.
4. To return to Programming Mode, press and hold [MODE] and [N/-] at the same time for 3 seconds.

4.2 Calibration Menu

⚠ WARNING ⚠

The calibration of all newly purchased RAE Systems instruments should be tested by exposing the sensor(s) to known concentration calibration gas before the instrument is put into service for the first time. For maximum safety, the accuracy of the IAQRAE should be checked by exposing the sensor(s) to known concentration of calibration gas before each day's use.

In Programming Mode, the user may calibrate sensors in the IAQRAE monitor using a two-point calibration process with zero or low concentration gas as the first point of reference and a standard higher concentration gas as the second point of reference. Zero air contains no detectable VOCs or toxic gases, and is used to establish the zero point for the PID and toxic gas sensor. A standard reference gas (also known as span gas) contains a known concentration of a given gas. The two-point calibration procedure is detailed on the next page. Zero calibration should be done before performing span calibration of single or multiple sensors.

Fresh ambient air cannot be used to zero the VOC, CO2, or RH sensors because of the background presence of these components. The PID zero should be performed using a cylinder of dry zero-VC air or nitrogen, or the single-use VOC zeroing tubes (P/N 025-2000-010). If any of these are not available, the PID can be zeroed in outdoor air as a secondary choice. The PID is preferably span calibrated with 10 ppm isobutylene.

The CO2 sensor zeroing requires a CO2-free gas source, such as a cylinder of dry air, nitrogen, or 10 ppm isobutylene. The CO2 sensor is typically spanned with 5,000 ppm CO2.

The RH and temperature sensor s need far less frequent calibration than the other sensors. The RH sensor uses dry gas (10% relative humidity) as the zero gas, such as dry air, nitrogen, or 10 ppm isobutylene. The span calibration uses >90% RH gas, obtained by bubbling the gas supply through pure water.

The temperature sensor does not need zero calibration. The span temperature is set to the ambient temperature as measured by a thermometer.

The Calibration Menu contains the following submenus:

Fresh Air Calibration?

Multiple Sensor Calibration?

Single Sensor Calibration?

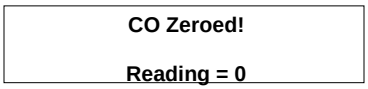
Modify Span Gas Value?

Change VOC Span Gas?

4.2.1 Fresh Air Calibration

This procedure determines the zero point of the sensor calibration curve for the PID and toxic gas sensor. The CO2, RH, and temperature sensors must be zeroed in the single sensor calibration menu. To perform fresh air calibration, one of the zero gas options described in the previous section should be used.

1. When the “Calibrate Monitor?” screen appears, press [Y/+] to start calibration. The first submenu “Fresh Air Calibration?” will appear.
2. If a bottle of zero air is being used, attach the calibration adapter to the gas inlet port. Connect the other end of the tube to the bottle of zero air. If a bottle of zero air is not available, place the monitor in a contaminant-free area outdoors or attach a single-use zeroing tube.
3. Press [Y/+] to start zero air calibration. The display will show “calibration...in progress” followed by the name and reading of the CO and VOC sensors, and the message “zeroed.” The display should show a reading “0.0,” or a very small number for both sensors.



4. After a two-second pause, the display will show “Zero Cal Done!” and flash sensor readings for about ten seconds before moving to the next submenu “Multiple Sensor Calibration?”

4.2.2 Multiple Sensor Calibration

This function simultaneously determines the second point of the calibration curves for multiple sensors in the monitor. Mixed standard reference gases are needed to perform this procedure. The user may choose several gas mixtures to be used in multiple sensor calibration.

1. Continuing from Step 4 of the previous section, the next display “Multiple Sensor Calibration?” will appear. Press [Y/+] and the display will ask “OK?” for the pre-selected gases indicated by an asterisk. To accept the multiple sensor selection, press [Y/+] to start calibrating. To abort calibration, press [N/-] and move to the next submenu, Single Sensor Calibration.

   To modify the default setting, press [MODE] to move from one sensor to the next. Press [Y/+] to select a sensor and [N/-] to deselect a sensor. The selected sensors will have an asterisk (*) next to the name. Repeat, until all sensors that need to be calibrated are selected. To confirm the new selection, press [MODE] to move the cursor to “OK?”, then press [Y/+] to accept the changes and advance to the next step. To discard the changes, press [N/-] to exit the submenu.

***CO**	**VOC**	***CO_2**
RH	**OK?**	**Temp**

2. After pressing [Y/+] in step 1, the monitor will ask the user to apply mixed gas to the sensors. The calibration adapter allows any excessive gas to escape without over-pressurizing the pump which supplies gas to the sensors. The adapter lets the pump draw gas at the same rate atmosphere is usually provided to by the pump to the sensors.

Note: The 350 ppm CO_2 present in ambient air is not enough to calibrate the CO_2 sensor. Therefore, if the CO_2 sensor is enabled in the instrument and no gas flow exists, there will not be a span signal and the “no gas flow” message will appear.

3. This completes the Multiple Sensor Calibration procedure and moves to the next submenu item, Single Sensor Calibration.
4. Turn off gas flow. Disconnect calibration tube from monitor.
5. If the sensor failed the calibration, the sensor name and an error message “failed” will appear and after ten seconds flashing will proceed to next submenu. In this case, the calibration data for the current sensor are not changed.

Cross Sensitivity

Some sensors may show cross sensitivity to other gases. Therefore, it is important to choose the gas mixture carefully for the multiple sensor calibration to avoid erroneous calibration due to cross sensitivity. For example, some VOC gases are known to cause erroneous readings by the CO sensor. In general, it is recommended to calibrate the toxic gas sensor and VOC sensor separately.

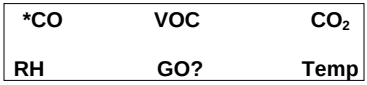
Calibration Time Stamp

When a multiple sensor calibration is performed, a timestamp will be stored in the nonvolatile memory. This information will be included in the Datalogging report.

4.2.3 Single Sensor Calibration

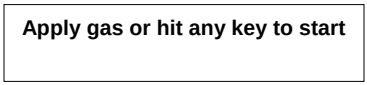
This procedure determines the second point of the sensor calibration curve for a single sensor. A standard reference gas (span gas) is needed to perform this procedure. Table 2.2 (Alarm Limits and Conditions) shows the standard calibration gas which is typically used as the span gas at the factory.

1. At the “Single Sensor Calibration?” screen, press [Y/+]. The display shows the sensors installed in the monitor with the cursor blinking at “GO?” Press [Y/+] to select a sensor and start the calibration. Or press [MODE] to move to the next sensor location.

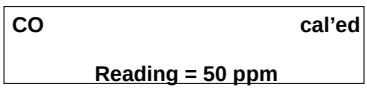


2. Calibration begins at the “Apply CO Gas Span = 50” screen. Turn on the valve of the CO gas bottle to start gas flow. The “Apply CO Gas” display will appear, and the monitor will wait for the calibration gas to reach the sensor.

   If the sensor does not detect any gas after about five seconds, “No gas flow…” will appear and calibration will be aborted. At this point, press any key to resume single sensor calibration.



3. Once the sensor detects the gas the “Calibration in progress… 60” message will appear with the countdown timer showing the remaining seconds. Once the countdown timer reaches zero, the sensor name and calibrated value will appear on the screen:



4. This completes the single gas calibration procedure for one sensor. The monitor will return to the screen showing the sensors installed in the monitor. The asterisk will have automatically advanced to the next sensor.

5. The user may calibrate the next sensor, or press [N/-] move to the next submenu, Modify Span Gas Value.

6. Turn gas flow off. Disconnect calibration tube from monitor.

Calibration Time Stamp

When a single sensor calibration is performed, a time stamp will be stored in nonvolatile memory. This information will be included in the Datalogging report.

CO_2 Sensor Calibration

CO_2 sensor calibration is different from calibrating other sensors. During fresh air calibration, the CO_2 sensor does not do anything. It must be zeroed in the single sensor calibration menu. The CO_2 sensor can be span calibrated in either single sensor mode or multiple sensor mode.

During single sensor calibration, the user should supply pure air or nitrogen gas from a cylinder or 10 ppm isobutylene to zero the CO_2 sensor. The user may also supply a span concentration of CO_2, (~5,000 ppm) to calibrate the CO_2 sensor. When the monitor asks "0% CO_2?" press [Y/+] if CO_2-free gas is being used to zero calibrate the CO_2 sensor.

During either single or multiple sensor calibration, the CO_2 sensor will be calibrated to the span value defined in Section 4.2.4. However, it is good practice to perform zero calibration before span calibration.

Note: After a 0% CO_2 calibration, the user must perform a span calibration to ensure that the CO_2 sensor has been calibrated correctly.

Temperature Sensor Calibration

The temperature sensor does not need zeroing and may be calibrated in either Single Sensor or Multiple Sensor Calibration menus. Annual calibration is usually adequate. To calibrate, first let the monitor equilibrate to the ambient temperature for at least 30 minutes. Measure the ambient temperature with a thermometer, then set the span temperature to the measured value as mentioned in Section 4.2.4.

During single sensor calibration, use [MODE] to select the temperature sensor. Press [Y/+] to start calibration. After 10 seconds, "Temp Cal'ed" and temperature reading will appear.

Relative Humidity Sensor Calibration

Calibrating the Relative Humidity (RH) sensor is different from calibrating other sensors. The RH sensor requires for less frequent calibration than other chemical sensors. Under normal conditions annual calibration may be adequate.

During single sensor calibration, the user needs to supply dry gas (<10%) to zero the sensor. The user also needs to supply a span gas of humidity (>90% relative humidity) to calibrate the RH sensor. This calibration gas can be obtained by bubbling dry gas from a cylinder or ambient air through pure water (See Figure 4-1). When the monitor asks “10% RH?” press [Y/+] if dry gas is being used to zero the RH sensor. Otherwise, press [N/-] to calibrate the RH sensor to span value.

Figure 4-1 Water bubbler connections for span calibration

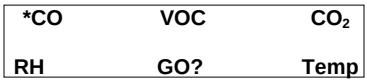
During single or multiple sensor calibration, the RH sensor will be calibrated to the span value defined in Section 4.2.4. However, it is good practice to perform zero calibration before span calibration.

Note: After <10% RH calibration, the user must perform a span calibration to ensure that the RH sensor is calibrated correctly. The sensor response does not change much in the ranges 0-10% and 90-100%. Therefore, any humidity in these ranges can be used to zero and span, respectively the RH sensor.

4.2.4 Modify Span Gas Value

This function allows the user to change the span values of the standard calibration gases.

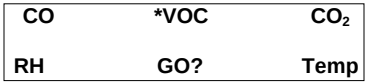
1. When the “Modify Span Gas Value?” screen appear, press [Y/+], and a list of enabled sensors will appear:



   Use [MODE] to select the desired sensor, and the cursor will advance to the next sensor; press [Y/+] to go to step 2.

2. The sensor span value and “Save?” will appear. Use [Y/+] or [N/-] to change the digit values. Press [MODE] to move to the next digit to the left. Repeat until all digits have been entered. Press [MODE] to move the cursor to “Save?”

3. To confirm the new value, press [Y/+] to accept the changes. Press [N/-] to discard the change and move to the next sensor in the sensor selection display.



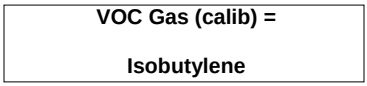
4. Repeat steps 1-3 until all desired sensor span gas values have been modified.

5. To exit the Modify Span Gas menu, use [MODE] to move the cursor to “GO?” and press [N/-].

4.2.5 Change VOC Span Gas

This function allows the user to select a specific VOC gas to be used as the span gas during VOC gas calibration. If a span gas other than isobutylene is used, the correction factor (CF) for the measurement gas will be divided by the CF for the new span gas to obtain a modified factor for the measurement gas. This new factor is automatically applied to the displayed readings.

1. When the “Change VOC Span Gas?” screen appears, press [Y/+]. If the VOC sensor is installed, the display will show the span gas name. If the VOC sensor is not installed, the “No VOC installed” message will appear.



2. To keep the current VOC span gas, press [Y/+] to accept the selection and move to the next menu item.
3. To select a different VOC span gas, first press [N/-], and continue to use [N/-] to scroll up through the list of gas names. For rapid scrolling, press and hold [N/-]. When the desired gas appears, press [Y/+] or [MODE] to save the selection and exit the submenu.

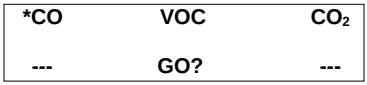
4.3 Change Alarm Limits

The user may change the high or low alarm limits for each sensor in Programming Mode. The submenus are:

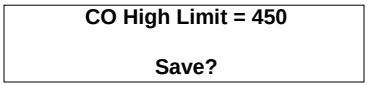
Change High Alarm limit?

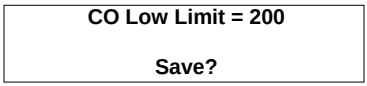
Change Low Alarm limit?

1. Press [N/-] to toggle between these two submenus. When the “Change High Alarm?” or “Change Low Alarm?” screen appears, press [Y/+], and the following display will show the sensors installed in the monitor. The first sensor will be marked with an asterisk (*); the cursor will be over the “OK?” message.



2. To modify any of the sensor limits, press [MODE] to advance to a sensor name. To advance to step 3 press [Y/+], otherwise press [N/-] to accept the previously stored alarm limits and move to the Change High (or Low) Alarm Limit submenu.





3. To modify this limit, press [MODE] to advance to the next digit. Use [Y/+] or [N/-] to change the value. Press [MODE] again to advance to the next digit. Repeat until the new alarm limits have been set.

4. Press [MODE] to move to the “Save?” message. Press [Y/+] to accept the new value and the asterisk (*) will move to the next sensor in the sensor selection screen. Or press [N/-] and the asterisk (*) will move to the next sensor in the sensor selection display.

5. To exit this menu, use [MODE] to move the cursor to “GO?” and press [N/-], and then press [MODE] when the Change High or Change Low Alarm Limit screen appears.

4.4 Change Datalog Setting

The IAQRAE calculates and stores the gas readings at a specified interval. The user may review these stored readings, change the datalog setup, or program additional datalog options by downloading from PC to IAQRAE using ProRAE Suite software. The Change Datalog Setting submenus are:

Clear All Data?

Change Datalog Period?

Select Datalog Mode?

Enable/Disable Datalog?

Select Memory Full Type?

4.4.1 Clear All Data

This function will erase all data stored in the non-volatile datalog memory. This does not change peak or minimum concentration or run time values stored in other locations.

1. When the “Clear All Data?” screen appears, press [Y/+] to clear the data memory. The monitor will show “Data Cleared!” and move to the next submenu.
2. To keep the data memory, press the [N/-] or [MODE] to exit without clearing.

4.4.2 Change Datalog Period

The datalog period can be programmed from 1 to 3,600 seconds (1 hour).

1. When the “Change Datalog Period?” screen appears, press [Y/+], and the display “Datalog Period = 60” will appear; “60” is the previously stored datalog period.
2. To modify this period, press [MODE] to move to the far left digit, and use [Y/+] or [N/-] to change the value. Press [MODE] to advance to the next digit on the right. Repeat until all digits have been entered.
3. Press [MODE] to move the cursor to “Save?” To accept new value and exit this submenu, press [Y/+]. To discard the changes and move to the next submenu, press [N/-].

4.4.3 Select Datalog Mode

Datalogging may be initiated in one of four ways:

Periodic: Set a recurring start and stop time that repeats every day when the unit is on.

Scheduled: Datalogging starts and stops automatically for one set moment.

Automatic: Datalogging is automatically started whenever the monitor is turned on.

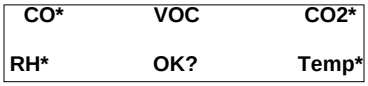
Manual: The user must start Datalogging by toggling to the Start Datalog menu in the main menu loop.

1. When the “Select Datalog Mode?” submenu item appears, press [Y/+], the display shows the current Datalog mode: “Datalog Mode = Manual?”
2. Press [N/-] to switch to the next Datalog mode.
3. Press [Y/+] or [MODE] to accept the current Datalog mode displayed and advance to the next submenu.

4.4.4 Enable/Disable Datalog

The user may enable or disable the datalogging function for each sensor. This allows the user to selectively log certain sensor readings of interest.

1. When the “Enable/Disable Datalog?” appears, press [Y/+]. The display will show all enabled sensors installed in the monitor. All previously selected sensors enabled for Datalog are marked with an asterisk (*). The cursor will be blinking on “OK?”



2. Press [MODE] to move from one sensor location to the next one. Press [Y/+] to enable datalogging for the sensor or [N/-] to disable datalogging. Repeat until all sensors that need to be enabled for datalogging are selected.
3. Use [MODE] to move the cursor to “OK?” To confirm the new selections, press [Y/+] to accept the change. Press [N/-] to discard changes and move to the next submenu.

4.4.5 Select ‘Memory Full’ Type

There are two options for the user when the datalog memory becomes full. The Stop selection automatically stops datalogging once the memory is full. The Wrap-Around selection overwrites the oldest data as the monitor continues datalogging.

1. When the “Select Memory Full Type?” screen appears, press [Y/+] to see the current selection. The Stop selection is the factory default setting.
2. Press [N/-] to toggle between Stop and Wrap-Around selections.
3. Press [Y/+] or [MODE] to accept the selection and move to the next submenu.

4.5 Change Monitor Setup

The user may change the monitor setup or enter user information for the IAQRAE monitor. The Monitor Setup submenus are listed below:

Change Site ID?

Change User ID?

Change Alarm Mode?

Change User Mode?

Change Real Time Clock?

Change Light and Buzzer Mode?

Change Password?

Change Pump Duty Cycle?

Change Display Language?

Set Temperature Unit?

4.5.1 Change Site ID

The user may enter an eight-character site ID, which will be included in the datalog report.

1. At the “Change Site ID?” screen, press [Y/+] and the display will have the current site ID: “Site ID = xxxxxxxx”. Press [MODE] to move the cursor to the left-most digit.
2. Press [Y/+] or [N/-] to cycle through all 26 letters and 10 numerals. Hold down [Y/+] or [N/-] for rapid scrolling. Press [MODE] to advance to the next digit on the right. Repeat until all 8 digits have been entered.
3. Press [MODE] to move the cursor to “Save?” Press [Y/+] to accept the new site ID and exit the submenu. Press [N/-] to discard changes and advance to the next submenu.

4.5.2 Change User ID

The user may enter an eight-character user ID, which will be included in the datalog report.

1. At the “Change User ID?” screen, press [Y/+] and the display will have the current user ID: “User ID = xxxxxxxx”. Press [MODE] to move the cursor to the left-most digit.
2. Press [Y/+] or [N/-] to cycle through all 26 letters and 10 numerals. Hold down [Y/+] or [N/-] for rapid scrolling. Press [MODE] to advance to the next digit on the right. Repeat until all 8 digits have been entered.
3. Press [MODE] to move the cursor to “Save?” Press [Y/+] to accept the new site ID and exit the submenu. Press [N/-] to discard changes and advance to the next submenu.

4.5.3 Change Alarm Mode

There are two different alarm modes in IAQRAE: Auto-Reset and Latched. In Auto-Reset mode, the alarm automatically turns off when the alarm condition no longer exists (e.g. the gas concentration falls below the lower alarm limit). In Latched mode, the alarm remains on even after the alarm condition no longer exists. The alarm must be turned off by pressing [Y/+].

1. When the “Change Alarm Mode?” screen appears, press [Y/+], and the display will show the current alarm mode selection “Alarm Mode = Latch?”
2. Press [N/-] to toggle between the Latch and Auto-Reset modes.
3. Press [Y/+] or [MODE] to accept the current displayed alarm mode and move to the next submenu.

4.5.4 Change User Mode

There are two different user operation levels (or modes): Basic and Advanced. The Advanced Mode allows user access to all programming functions, whereas Basic Mode limits access to certain Calibration and Monitor Setup functions. See Table 4.1 for a detailed list of functions accessible in the two modes.

1. When the “Change User Mode?” screen appears, press [Y/+], and the display will show the current user operation level: “User Mode = Advanced?”
2. Press [N/-] to toggle between the Advanced and Basic modes. Press [Y/+] or [MODE] to accept current user mode and move to the next submenu.

4.5.5 Change Real Time Clock

The IAQRAE monitor is equipped with a real time clock, which the user may change when needed.

1. When the “Change Real time Clock?” screen appears, press [Y/+], and the display will show the current date and time: “16 Apr ’02 04:52”. Press [MODE] to move the cursor to the date.

2. To modify the date and time, use [Y/+] or [N/-] to change the digit value and press [MODE] to advance to the next digit to the right. Repeat until the new date and time have been entered.
3. Press [MODE] to move cursor to “Save?” Press [Y/+] to accept the new value and move to the next submenu. Press the [N/-] to discard the changes and move to the next submenu.

4.5.6 Change Light and Buzzer Mode

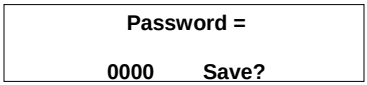
The user has the option to turn the light and buzzer on/off to suit their needs. The factory default setting is saved to have both the light and buzzer turn on during alarm conditions.

1. At the screen “Change Light & Buzzer Mode?” press [Y/+] to view the submenus.
2. Press [N/-] to scroll between the three options: Both On, Light Only, and Both Off.
3. Press [Y/+] or [MODE] to select the desired option and move to the next submenu.

4.5.7 Change Password

The user can modify the password from the monitor.

1. When the “Change Password?” screen appears, press [Y/+] and the display will show the current password:

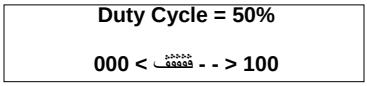


2. Press [MODE] to move the cursor from “Save?” to the left digit. Press [Y/+] or [N/-] to cycle through all 10 numerals. Press [MODE] to move to the next digit. Repeat until all 4-digits of the new password have been entered.
3. Press [MODE] to advance to “Save?” Press [Y/+] to accept the new password and move to the next submenu. To discard changes, press [N/-].

4.5.8 Change Pump Duty Cycle

The duty cycle function allows the user to control the time the pump is one for a specified ten-second period. A 70% duty cycle means that the instrument turns the pump on for seven seconds, and then turns the pump off for three seconds. (See Section 2.9 Integrated Sampling Pump – Pump Duty Cycle for more information.)

1. At the “Change Duty Cycle?” screen, press [Y/+] and the following will appear:



2. Use [Y/+] and [N/-] to adjust the duty cycle to the desired level (between 50 and 90%).
3. Press [MODE] to save changes and advance to the next submenu.

Note: If the VOC readings exceed 2 ppm, the duty cycle will automatically disable.

4.5.9 Change Display Language

Users may choose to view the display menus in English or Spanish. Additional languages may be added in the future.

1. When the “Change Display Language?” screen appears, press [Y/+] to display the current Language “Display Language = English?”
2. Press [N/-] to toggle between English and Spanish (Espanol) modes. Press [Y/+] or [MODE] to accept the current language and move to the next submenu.

4.5.10 Set Temperature Unit

The user may set the temperature unit to either Fahrenheit to Celsius (factory setting).

1. At the “Temperature Unit = Celsius?” display, press [N/-] to toggle between Fahrenheit and Celsius.
2. Press [Y/+] or [MODE] to accept new settings and advance to the next menu option.

4.6 Change Sensor Configuration

The user may change several sensor related configurations. The Change Sensor Configuration contains the following configuration options:

Change VOC Measurement Gas?

Edit Correction Factor?

Enable/Disable Sensors?

Change Custom Gas Name?

Correction Factors

The PID sensor used in IAQRAE responds to a broad range of gases. Typically, the PID sensor shows a different sensitivity to different gases. To measure different gases, a correction factor (CF) can be applied, defined as:

$$CF = \frac{\text{Sensitivity to a measurement gas}}{\text{Sensitivity to isobutylene calibration gas}}$$

When the monitor is calibrated to isobutylene, but used to measure another compound, the CF is multiplied by the reading to obtain the true concentration:

True Concentration = CF x PID reading

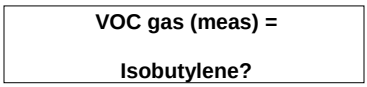
The IAQRAE has a library of 87 correction factors for the 10.6 eV PID sensor relative to isobutylene. The user may also use a different gas than isobutylene to be the calibration gas.

For example, the user may choose benzene as the calibration gas and chlorobenzene as the measurement gas. The IAQRAE monitor will calculate a new correction factor between these two compounds and convert the measured value into the equivalent concentration of chlorobenzene.

4.6.1 Change VOC Gas

The user may choose one of the pre-stored VOC gases in the monitor, which then automatically calculates its correction factor relative to the VOC calibration gas. This correction factor is used during gas measurements calculate and display the equivalent concentration of the selected VOC gas.

1. When the “Change VOC Gas (measurement)?” screen appears, press [Y/+]. If a PID sensor is installed and enabled, the following display will appear:



   Otherwise, the message “No VOC installed” will appear.

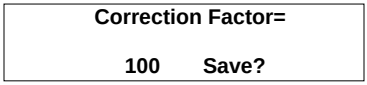
2. To select a different VOC span gas, then press [N/-] to scroll up through the list of gases until the desired name appears. For rapid scrolling, hold down [N/-].

3. Press [Y/+] or [MODE] to select the new gas and exit the submenu.

4.6.2 Edit Correction Factor

The user can modify the correction factor from the monitor.

1. When the “Edit Correction Factor?” screen appears, press [Y/+] the display shows the current correction factor:



2. Press [MODE] to move the cursor from “Save?” to the left digit. Press [Y/+] or [N/-] to cycle through 10 numerals. Press [MODE] to advance to the next digit on the right. Repeat until all digits of have been entered.
3. Press [MODE] to move the cursor to “Save?” Press [Y/+] key accept the new correction factor and exit submenu. To discard changes, press [N/-] and exit submenu.

4.6.3 Enable/Disable Sensor

This function allows the user to selectively enable or disable individual sensors in the IAQRAE monitor. When a sensor is disabled, the sensor still measures the gas but no values are displayed and all alarms for that sensor are rendered non-functional.

1. When the “Enable/Disable Sensors?” screen appears, press [Y/+]. The display will show all the sensors installed in the monitor. An enabled sensor is marked with an asterisk (*); a disabled sensor will have no asterisk. The cursor will blink at the “OK?” message:

***CO**	***VOC**	***CO_2**
***RH**	**OK?**	***Temp**

2. Press [MODE] to move from one sensor location to the next one. Press [Y/+] to enable the sensor and [N/-] to disable the sensor. Repeat until all the sensors that need to be enabled have been selected.
3. Press [MODE] to move the cursor to “OK?” Press [Y/+] to accept the change and move to the next submenu. Press [N/-] to discard the change, and move to the next submenu.

4.6.4 Change Custom Gas Name

This function allows the user to enter a custom gas name.

1. When the “Custom Gas= Save?” screen appears, press [MODE] to advance the cursor from the “?” to the second line “Custom Gas”.

Custom Gas= Save?
Custom Gas

2. To change the custom gas name, press [Y/+] or [N/-] to scroll through the list of letters. Use [MODE] to advance the cursor.
3. To save changes, advance cursor back to “Save?” and press [Y/+] to advance to the next menu option. To discard changes, advance cursor back to “Save?” and press [N/+] and advance to the next menu option.

5. Theory of Operation

The IAQRAE monitor uses one to five different sensors to measure a variety of gases. (See Figure 5-1.) A unique electrodeless discharge UV lamp is used as the high-energy photon source for the PID sensor. The patented PID sensor detects a broad range of organic vapors. A miniaturized non-dispersive infrared (NDIR) sensor measures carbon dioxide levels. An interchangeable electrochemical (EC) sensor measures inorganic toxic gases. Humidity is measured with a polymer-capacitate sensor and temperature with a Thermistor in a combined by a humidity-temperature (HT) sensor.

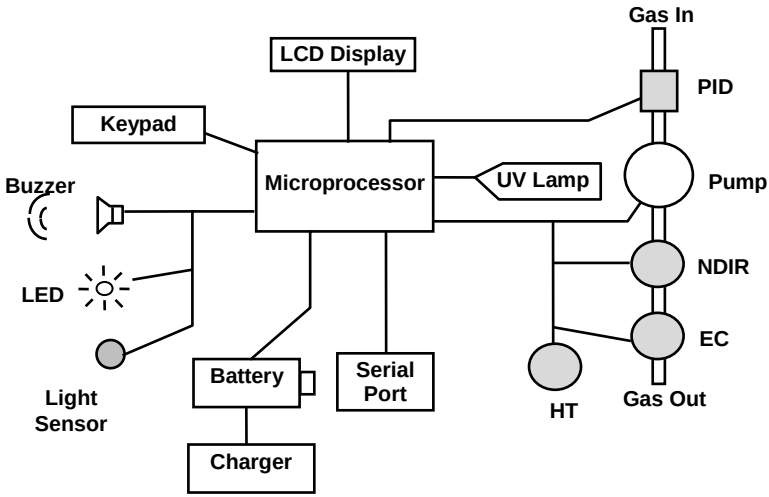


Figure 5-1 Block Diagram of IAQRAE Monitor

The PID sensor for the IAQRAE monitor is the first plug-and-play module with a built-in lamp and electrometer. A diaphragm pump installed in the monitor draws air samples over the PID sensor and to the NDIR and EC sensors. The HT sensor is mounted outside the IAQRAE case for fast response.

A single chip microprocessor is used to control the operation of the alarm buzzer, LED, pump and light sensor. It measures the sensor readings and calculates the gas concentrations based on calibration to known standard gases. The data are stored in non-volatile memory so they may be sent to a PC for record keeping. RS-232 transceivers provide a serial interface between the monitor and the serial port of a PC. A two-line by sixteen-character LCD is used to show the readings. The user interacts with the monitor by using the [Y/+] key, [N/-] key, and [MODE] key on the front membrane panel.

A rechargeable Lithium-Ion battery or a six C cell alkaline battery pack powers the monitor.

Note: The printed circuit board of the monitor is connected to the battery pack even if the power is turned off. Therefore, it is very important to disconnect the battery pack before servicing or replacing sensors or any components inside the monitor. Severe damage to the printed circuit board may occur if the battery pack is not disconnected before servicing the unit.

6. Maintenance

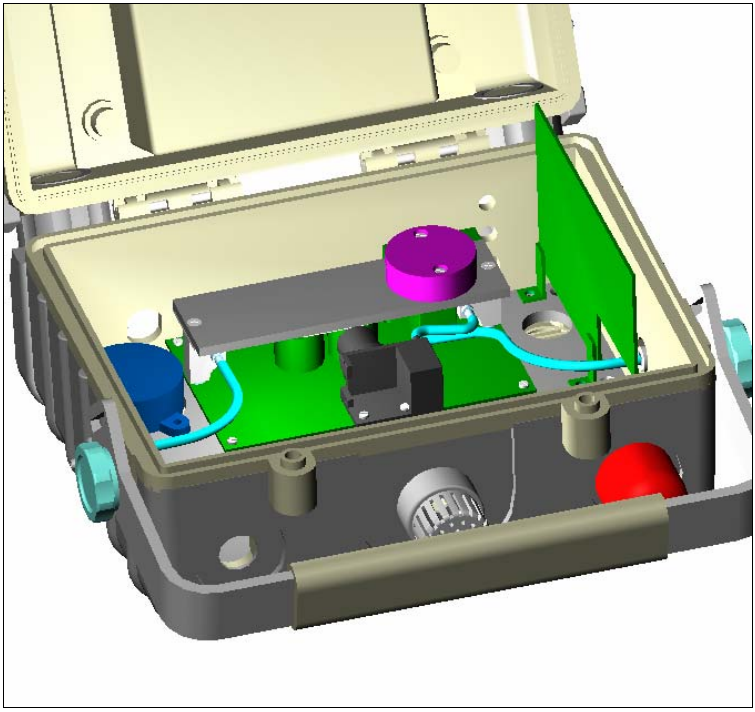


Figure 6-1 Internal Structure of IAQRAE

6.1 Sensor Replacement

The PID, toxic, carbon dioxide, and humidity-temperature sensors all have a limited operating life. Under normal conditions, most sensors will lose their original sensitivity after the expected operating life and will need to be replaced. Each sensor module has non-volatile memory, which records the manufacturing date of the sensor. In the diagnostic mode, the microprocessor checks the date code and displays the warranty expiration date of each sensor. It is suggested that the user should replace the sensor when the current date exceeds the expiration date of a sensor.

Sensor Replacement Procedure

The PID, carbon dioxide, and humidity-temperature sensors each have a unique sensor socket in the IAQRAE monitor. The toxic gas sensor socket allows the user to plug in any of the toxic gas sensors offered by RAE Systems. (Note: The firmware recognizes all sensors except the ClO_2 sensor.)

1. Turn the IAQRAE off.
2. Disconnect the battery cable from the PCB.
3. Refer to Figure 6-1, open the monitor housing by unscrewing the two captured hex screws from the top of the monitor case.
4. Refer to Figures 6-1 and 6-2, carefully unscrew the two No.2 screws that hold down the gas piping plate to the PCB and sensors. Remove the gas piping plate.
5. Identify the location of a specific toxic gas sensor and remove the sensor by gently pulling the sensor upward.
6. Plug a new sensor into the empty sensor socket. Make sure that black line on the sensor label is lined up with the white marker on the PCB and the sensor pins are aligned with the socket before pushing down the sensor.
7. Replace the gas piping plate and tighten the two screws to hold down the sensors. Re-connect the battery pack. Replace the monitor cover.

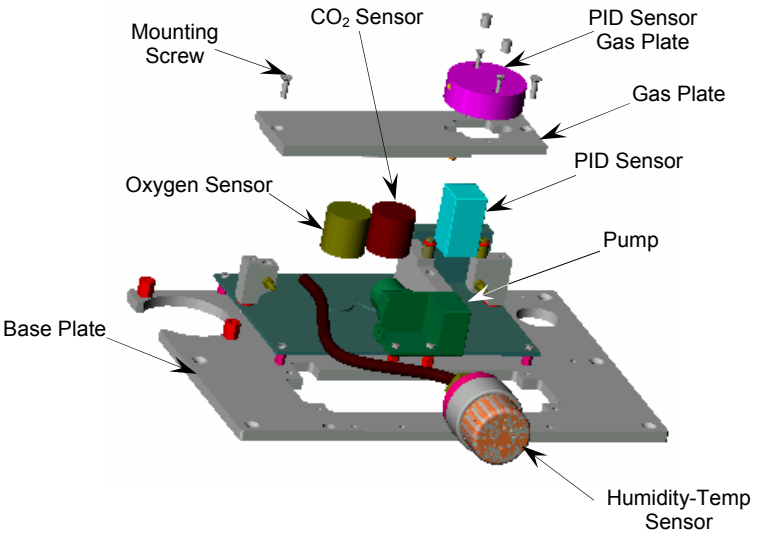


Figure 6-2 Detailed Sensor Assembly of IAQRAE

8. Turn IAQRAE on. The microprocessor will automatically recognize the sensors installed and configure the monitor accordingly.

Special Bias Voltage for Toxic Gas Sensors

The NO and NH_3 sensors require a special 300 mV bias voltage to operate. Only the toxic gas sensor socket provides such a special bias voltage. There is a pin jumper located on the edge of the analog PCB next to the bottom of the housing. When an NO or NH_3 sensor is plugged into the sensor socket, it is necessary to switch the jumper to enable the bias voltage. During the power on sequence, the microprocessor will check the sensor ID and the bias voltage. If the NO or NH_3 sensor is plugged into the wrong sensor socket or if the jumper is not switched on, an error message will appear. (Note: When the jumper is switched on, the bias is off.)

6.2 PID Sensor Maintenance

This section only applies to IAQRAE monitors that are equipped with a PID sensor. During the course of normal operation, a film of gas vapor may build up inside the PID sensor module and the UV lamp. The rate at which the film develops depends on the type and concentration of the vapors being sampled.

The PID lamp/sensor is self-contained and not designed to be cleaned manually. If the PID has poor sensitivity, the sensor should either be replaced or cleaned using the automatic self-cleaning function. Turn the unit on in manual operation mode, place it in a clean environment (<2 ppm VOC reading) and set the duty cycle to the lowest value (50%) to allow the maximum self-cleaning.

IAQRAE has a built-in sensing mechanism to monitor the status of the UV lamp. If the UV lamp is not on, the “Lamp” error message will appear. To resolve this problem, it may help to turn the monitor on and off a few times. It is possible the UV lamp is actually on when the “Lamp” error message appears. When the UV lamp ages, changes, or the configuration file inside the IAQRAE has been completely overwritten, the threshold level to determine lamp failure may be wrong and cause a false alarm. To eliminate such possibilities, apply some VOC source by putting a felt-tipped marker close to the inlet of the IAQRAE and see if the VOC raw count increases. If the UV lamp is on while the error message persists, then the lamp threshold must be reduced to below the actual lamp current reading. (See Section 7.1 Diagnostic Mode - Show PID Lamp Parameters)

6.3 Sampling Pump Replacement

The sampling pump is positive displacement piston pump. When approaching the end of the specified lifetime of the pump, it will consume a higher amount of energy and reduce its sample draw capability significantly. When this occurs, it is necessary to replace the pump.

1. Turn off the IAQRAE, and remove the battery pack.
2. Refer to Figures 6-1 and 6-2. Remove the two hex screws holding the instrument housing together, then carefully unscrew four No. 2 screws that hold down the gas piping plate to the analog PCB and sensors. Remove the gas piping plate.
3. Carefully loosen the connector. Unscrew the two screws that hold the pump assembly to the gas plate. Unscrew the two screws that holding the pump to the PCB. Disconnect the Tygon tubing that connects the pump to the gas inlet port.
4. Replace with a new pump assembly. Connect the Tygon tubing to the gas inlet port. Reattach the pump and screw down the pump assembly to the analog PCB.
5. Replace the gas piping plate and tighten the four screws to hold down the sensors.
6. Reattach the hex screws holding the instrument housing together, and reinstall the battery pack.

7. Troubleshooting

To aid the user in diagnosing the monitor, a diagnostic mode can be used to display critical, low level parameters. Section 7.1 describes the operation of the Diagnostic Mode. Section 7.2 summarizes possible encountered problems and suggested solutions. If the user turns the IAQRAE monitor on in Diagnostic Mode and refers to the table in Section 7.2, the problem can usually be narrowed down and corrected without having to return the monitor for repair.

WARNING

The diagnostic mode allows the user to set several low level parameters that are very critical to the operation of the monitor. Extra care should be taken when setting these low level parameters. If the user is not familiar with these parameters and sets them incorrectly, it may cause the monitor to shut down or malfunction. The diagnostic mode should be used by qualified personnel only.

7.1 Diagnostic Mode

To place the monitor into the special diagnostic mode, first turn the monitor off. Next simultaneously push and hold [Y/+] and [MODE] for at least two seconds. After the required delay, release both keys and the monitor will go through the normal start-up display sequence and display a “Diagnostic mode” message. For fast start-up in diagnostic mode, press [Y/+] once when “Diagnostic Mode” is shown. At the end of the special mode start-up, the display will show 1 to 5 numbers with a message “Raw.” These numbers are raw sensor readings without calibration.

Other critical parameters of the monitor are available as shown in Table 7.1. They can be reached by pressing the [MODE] repeatedly until the desired parameters are displayed.

Table 7.1 Critical Parameters

Key Action	Display
	Raw Readings
[MODE]	PID Sensor Raw Counts
[MODE]	PID Lamp Parameters
[MODE]	CO_2 Raw Counts and Bias
[MODE]	Toxic Gas Sensor and Raw Counts
[MODE]	Adjust LCD Contrast
[MODE]	Adjust Pump Stall Threshold
[MODE]	Clock and Battery Voltage
[MODE]	Battery Duration Time
[MODE]	Communicate with PC?

Diagnostic displays and how to interpret the displayed values:

1. Raw Sensor Readings

The raw sensor readings provide a quick diagnose on the response and the sensitivity of each sensor. When zero gas (fresh clean air) is applied to the monitor, the raw sensor readings typically should be:

1000 to 2500 for the CO_2 sensor
200 to 700 for the toxic gas sensor
200 to 1000 for the PID sensor
100 to 1520 for the relative humidity sensor
800 to 2820 for the temperature sensor

If the raw reading is outside these ranges when zero gas is applied, the sensor or the electronics may be defective.

When a specific gas is applied to the monitor, the corresponding sensor should respond and the raw reading should increase or decrease. If the reading of the corresponding sensor does not change when the specific gas is applied, then the sensor may be defective.

365	**360**	**2373**
530	**RAW**	**1897**

2. PID Sensor Raw Counts

This diagnostic menu only applies to IAQRAE monitors equipped with a PID sensor. The PID signal and the PID reference signal both have three different gains, labeled x1, x10 and x100. Press [Y/+] or [N/-] to display the raw output of the three amplifiers:

PID	**REF**	**x1**
342	**344**	**255**

When zero gas is applied, both signals should be between 200 and 500. When a VOC gas is applied, both signals should increase; the amount of increase for the gain x1, should be about 1/10 of the increase for the gain of x10, and should be about 1/250 of the increase for the gain of x100. If the increase does not agree with expected value, then the gain switch of the amplifier may be defective.

3. PID Lamp Parameters

This function applies to monitors equipped with a PID sensor. Drv is the lamp drive and is not adjustable from the standard value of 200. Lamp is the lamp current draw. Fail is an adjustable failure threshold. Use [N/-] and [Y/+] to set the Fail about 10 counts lower than the lamp reading. The asterisk appears by the previously stored value:

Drv	Lamp	Fail
200	84	*80

4. CO_2 Raw Counts and Bias

The CO_2 sensor output is connected to two amplifiers. CO_2 is for the CO_2 signal and Ref is for the reference. The display shows the current bias setting. When zero gas is applied, CO_2 should read a lower value, while Ref should display almost no change. When a CO_2 gas is applied, CO_2 output should increase. The bias value is adjustable but should not be changed.

CO_2	REF	Bias
4136	4139	*255

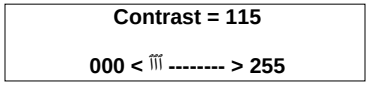
5. Toxic Gas Sensor and Raw Counts

The raw output of the toxic gas sensor is displayed. Some sensor types use the ToxA channel, while others use the ToxB channel indicated by an asterisk on the left is operative. Use the [N/-] or [Y/+] to toggle between x1 and x10 gains. When zero gas is applied, both signals should be between 200 and 500. When a toxic gas is applied, both signals should increase; the increase of x1 gain should be about 1/10 of the increase of the x10 gain. If the increase does not increase in this ratio, the gain switch may be defective.

ToxA	ToxB	x1
366	*364	48

6. Adjust LCD Contrast

This display allows the user to adjust the LCD contrast. Press [Y/+] to increase contrast and [N/-] to decrease the contrast. The bar graph shows the current LCD contrast setting. If the display appears to have dark lines, press [Y/+] several times and a clearer display should appear:



7. Adjust Pump Stall Threshold

This display can be used to calibrate the pump stall threshold. If the gas inlet is blocked but the pump does not shut down, or the pump shuts down too easily with a slight blockage to the gas inlet, then the pump stall threshold value may be set too high or too low. Use the following steps to adjust the pump stall threshold.

a. The maximum and average pump current is displayed on the first row: "Pump = xxx/zzz." The current pump stall value is displayed on the second row: "Stall = yyy +/-." The typical maximum pump current without any blockage should be between 20 – 35 when the speed is set to be "low" and the water trap filter is installed. The typical stall value should be higher than the "un-blocked" pump current by at least 5-8 counts.

b. The user can block the gas inlet for about ten seconds and watch the pump current reading. The stall threshold should set to be the average of the idle reading and the block reading. That is: Stall = (Idle + Block) / 2. The readings to be used in the calculation are maximum pump current readings at the "xxx" location of the unit.

c. Use [Y/+] or [N/-] to increase or decrease the stall value until it is the average of the idle reading and the block reading. Press [MODE] to exit this display. If the threshold value is changed, a message "Save new stall threshold?" will appear. Press [Y/+] to confirm the change, [N/-] or [MODE] to abandon the changes.

d. The pump stall threshold should be re-adjusted if the pump speed is switched to “low” or “high,” or water trap filter changed, or the firmware configuration has been totally refreshed.

8. Clock and Battery Voltage

This display shows the real time clock and battery voltage in raw count.

9. Battery Duration Time

This display shows the run time of the last time the unit powered itself off due to a low battery. It is useful for battery life testing.

10. Communicate with PC?

This display give the option of communicate with the PC for upload or download activity.

7.2 Possible Problems & Solutions

Problem	Possible Reason	Possible Solution
No power after charging battery	Drained battery Defective battery Microprocessor hang-up	Charge battery Replace battery Disconnect then reconnect battery to reset computer
No LED or LCD backlight	Defective LED or LCD backlight	Call authorized service center
Lost password	Forgot password	Call authorized service center
Buzzer inoperative	Defective buzzer	Call authorized service center
Reading abnormally high	Wrong calibration data Dirty PID sensor Dirty water trap filter Excessive moisture and/or water condensation	Calibrate with gas again Reduce pump duty cycle Replace water trap filter Blow dry sensor modules
“Lamp” message during operation	Wrong threshold Dirty PID sensor Weak or defective PID lamp	Adjust lamp threshold Replace PID sensor

(Continued)

Reading abnormally low	Incorrect calibration Low sensitivity to the specific gas Low gas flow to sensor(s)	Calibrate monitor Replace sensor Check sensor raw response in diagnostic mode Check gas flow path for leaks; replace pump or pump diaphragm
Read a small background value when there is no detectable gas	Sensor zero drifted The unit was out of battery power connection The sensor had just been plugged in	Do fresh air calibration Wait for reading to be stabilized
Reading jumps around randomly	Incorrect gas calibration Low sensitivity to calibration gas	Calibrate the sensor Reduce duty cycle to clean PID Check sensor raw response in diagnostic mode
Cannot turn monitor off Corrupted characters on LCD	Microprocessor hang-up	Disconnect and reconnect battery to reset computer Call authorized service center
Calibration error message	Low standard gas input Defective sensor	Check cylinder expiration date Check cylinder pressure Check gas flow path for leaks Check pump flow User higher gas concentration Replace sensor

(Continued)

“Bat” message in operation	Uncharged battery	Recharge battery
“Voltage too high” message in charge mode	Battery fuse blown Incorrect fuse AC adapter is not plugged in all the way	Check battery and adapter Plug adapter in correctly
Full scale PID measurement in humid environment	Dirty or wet sensor	Run dry gas through sensor Reduce pump duty cycle to clean sensor Replace water trap filter
VOC measurement saturates at certain level	Dirty PID sensor module Weak PID lamp	Reduce pump duty cycle to clean sensor Replace PID Sensor Replace filter
Excessive pump noise No inlet air vacuum	Leaky inlet path Defective pump	Check inlet connection Replace pump Replace or clean pump diaphragm

Navigation Guide

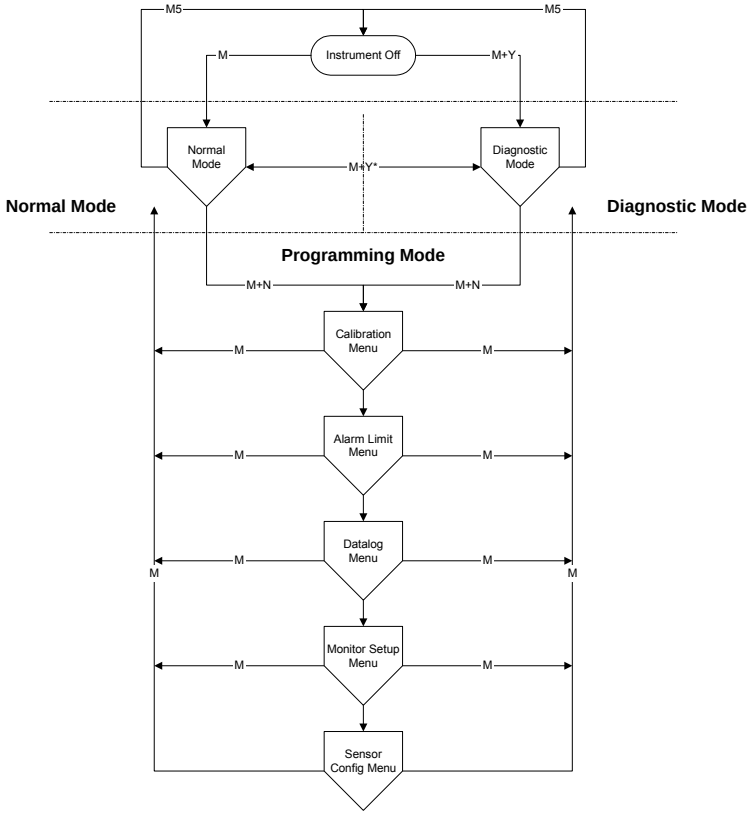
M: Press [MODE]

M+Y: Press [MODE] and [Y/+] together

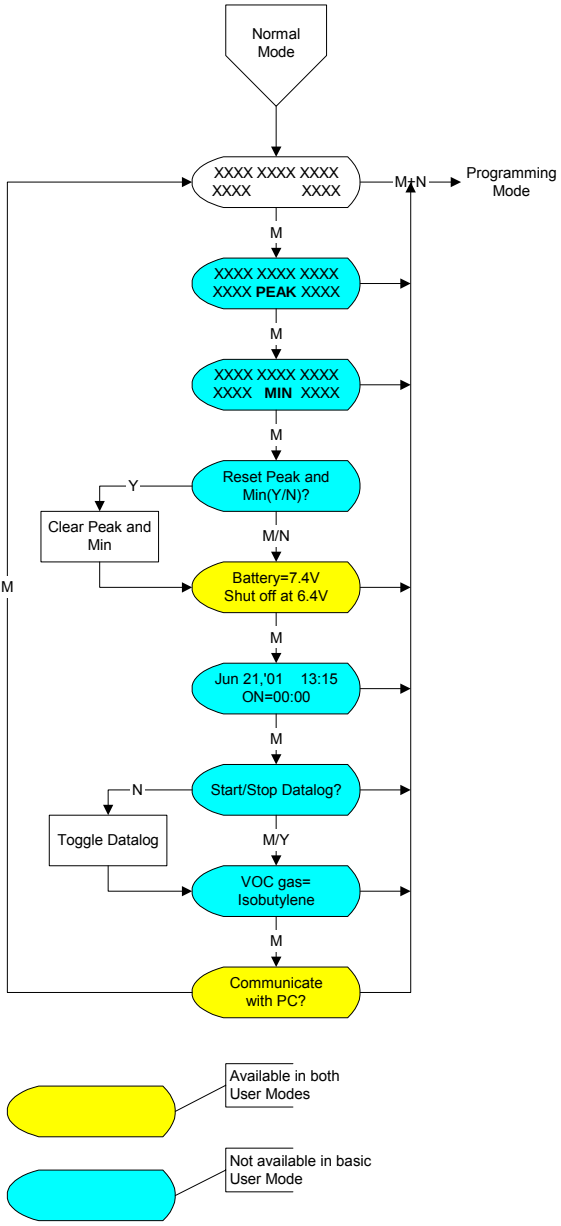
M+N: Press [MODE] and [N/-] together

M5: Press [MODE] for more than 3 seconds, then countdown for 5 seconds

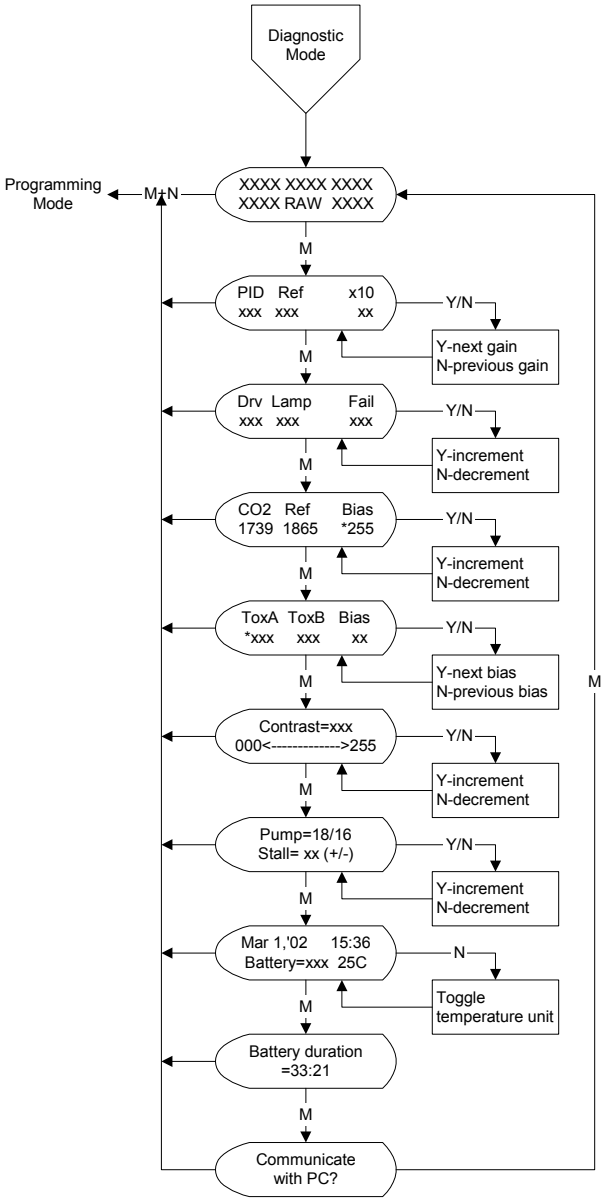
* If the unit is turned on in Diagnostic Mode, the user may switch between Diagnostic Mode and Normal Mode, by pressing [MODE] and [Y/+] together.



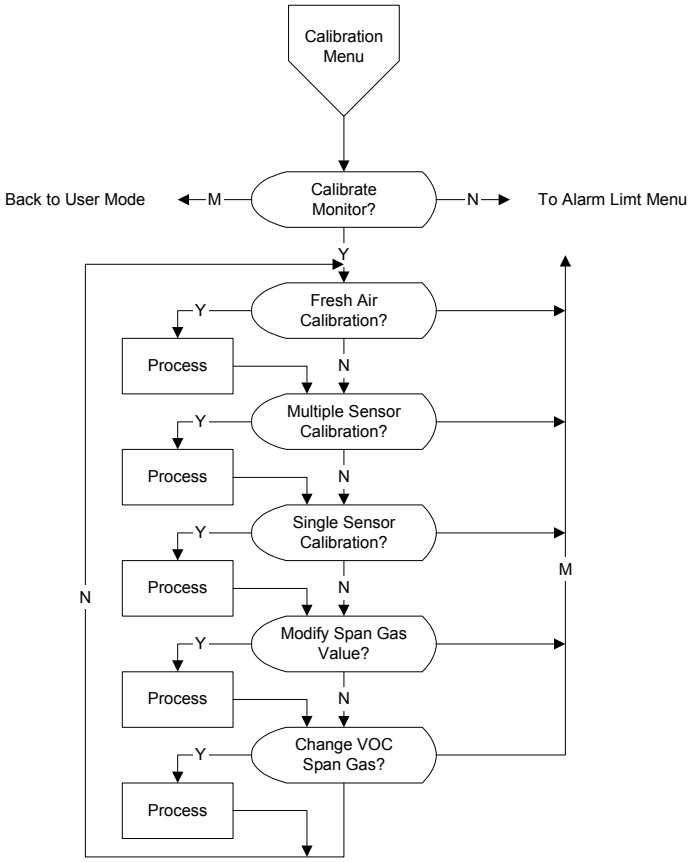
Normal Mode: Display Menu



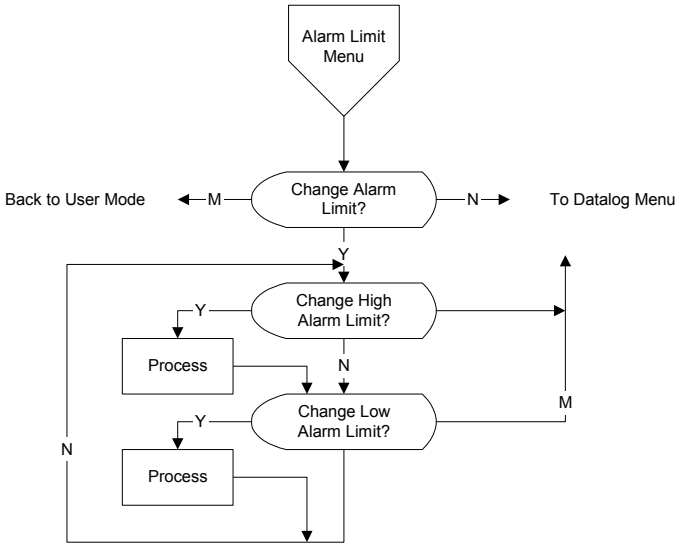
Diagnostic Mode: Display Menu



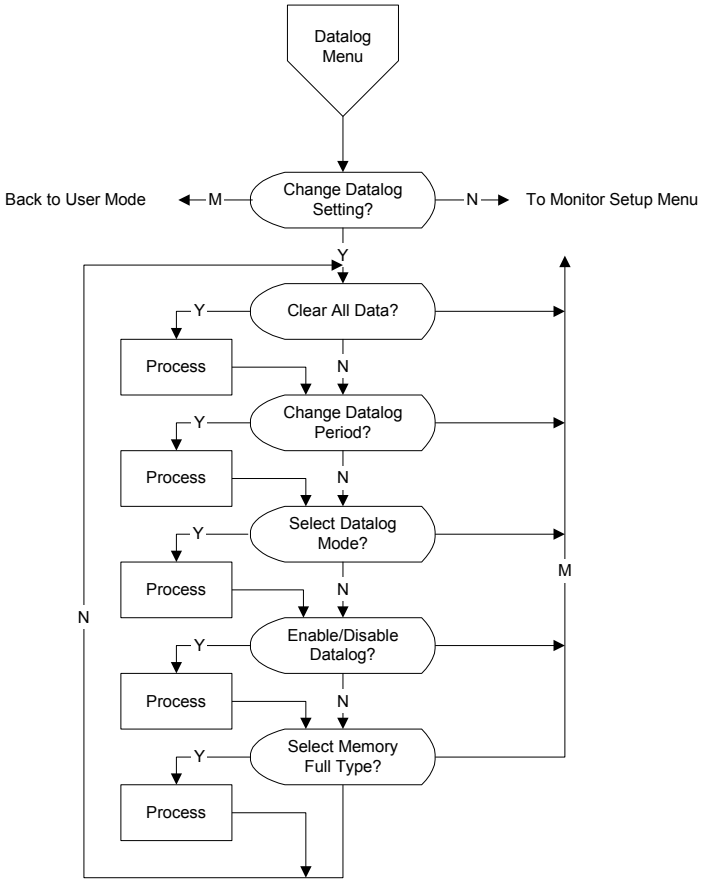
Programming Mode: Calibration Menu



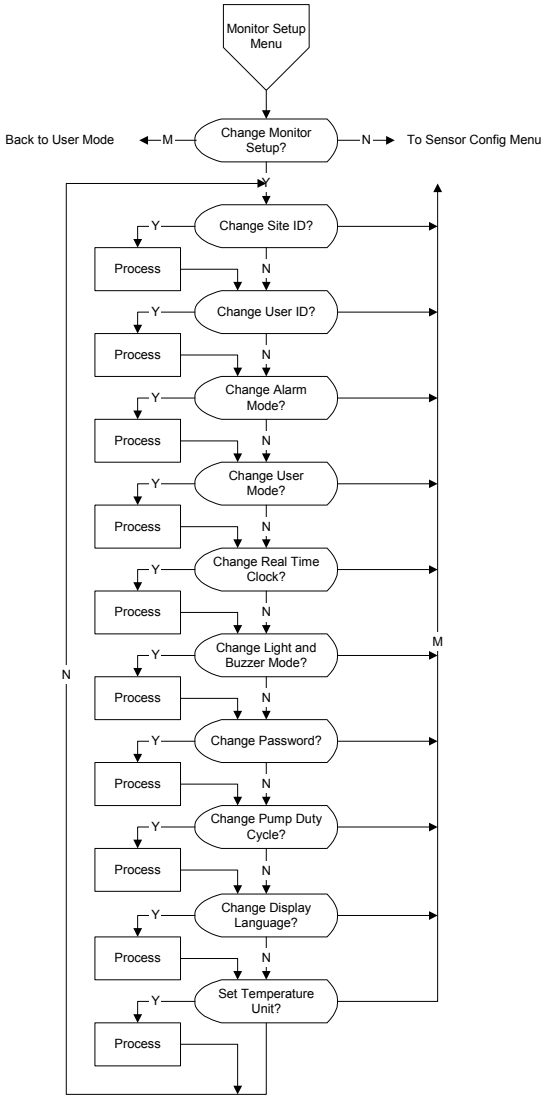
Programming Mode: Alarm Limit Menu



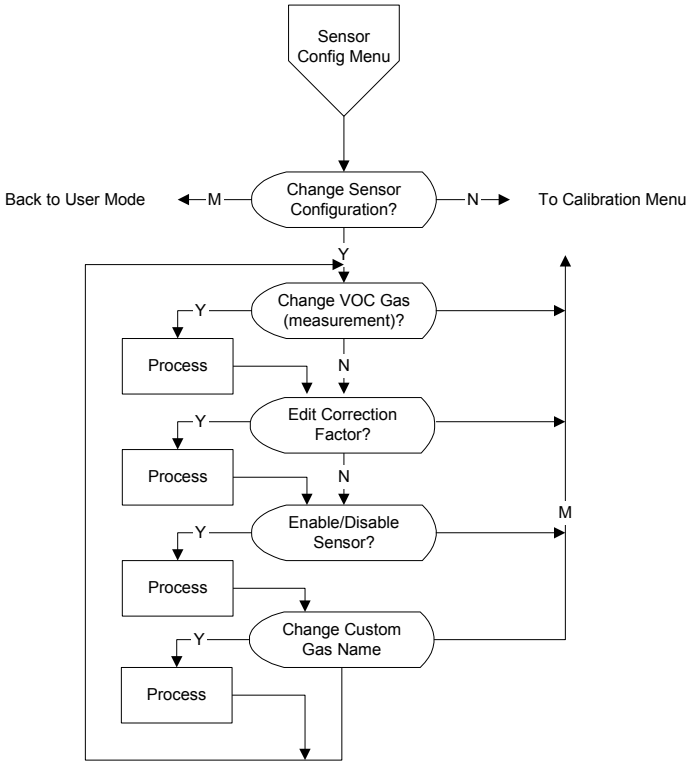
Programming Mode: Datalog Menu



Programming Mode: Monitor Setup Menu



Programming Mode: Sensor Configuration Menu



PID Correction Factors

Correction factors for a number of commonly used compounds for the 10.6 eV PID sensors has been provided. A comprehensive list of correction factors is available at the RAE website www.raesystems.com, under Technical Note 106.

VOC correction factors are measured relative to isobutylene gas. All gases are measured at less than 5% relative humidity and 25°C. These factors may change at higher concentration levels, different temperatures and/or humidity conditions. The IAQRAE uses the preset table below in the non-volatile memory to calculate and display the correct gas reading. Make sure the name of the measurement gas and calibration gas are entered correctly. (See Section 4.6.2 Edit Correction Factors) If the correction factor of the gas is <1.0, the sensitivity to the gas is higher than that of isobutylene.

Compound	CF at	Compound	CF at
Acetaldehyde	6	Cyclohexanone	0.9
Acetic acid	22	Dichloroethane, 1,2-	NR*
Acetone	1.1	Dichloroethene, t-1,2-	0.45
Acrylic acid	12	Dichloromethane	NR*
Acrylonitrile	NR*	Diesel Fuel	0.7
Allyl alcohol	2.4	Diethylamine	1
Ammonia	9.7	Dimethylhydrazine, 1,1-	0.8
Benzene	0.53	Epichlorohydrin	8.5
Butadiene	0.85	Ethanol	12
Butane, n-	67	Ethene	10
Butyl acetate, n-	2.6	Ethyl acetate	4.6
Butyl acrylate, n-	1.6	Ethyl acrylate	2.4
Carbon disulfide	1.2	Ethyl benzene	0.52
Cyclohexane	1.4	Ethyl ether	1.1

*NR = No Response

Compound	CF at	Compound	CF at
Ethyl hexyl acrylate, 2-	1.1	Methyl ethyl ketone	0.9
Ethyl sulfide	0.5	Methyl isobutyl ketone	0.8
Gasoline vapors	0.9	Methyl methacrylate	1.5
Gasoline, whole	1.0	Methyl t-butyl ether	0.9
Heptane, n-	2.8	Nitric oxide	5.2
Hexamethyldisilazane	0.2	Octane, n-	1.8
Hexane, n-	4.3	Pentane	8.4
Hydrazine	2.6	Perchloroethene	0.57
Hydrogen	NR*	Pinene, α-	0.31
Hydrogen sulfide	3.3	Pinene, β-	0.37
Isobutane	100	Propane	NR*
Isobutene	1.00	Propene	1.4
Isobutyl acrylate	1.5	Styrene	0.40
Isopropanol	6.0	Tetrahydrofuran	1.7
Jet fuel JP-4	1.0	Toluene	0.50
Jet fuel JP-5	0.6	Trichloroethane, 1,1,1-	NR*
Jet fuel JP-8	0.6	Trichloroethene	0.54
Methane	NR*	Vinyl chloride	2.0
Methanol	NR*	Xylene, m-	0.43
Methyl acrylate	3.7	Xylene, o-	0.59
		Xylene, p-	0.45

*NR = No Response

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Important Note: Before returning the unit for service or repair, please obtain a Return Material Authorization (RMA) Number for proper tracking of your equipment. Packages without RMA Numbers will be refused at the factory.