ToxiRAE

POCKET PID

PGM-30

OPERATION AND MAINTENANCE MANUAL

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Rev. E

RAE SYSTEMS INC.
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RAE Systems Product Line

- Gas Detection Tubes & Pumps
- SampleRAE Electronic Tube Pumps
- D-RAE Combustible/O_2/H_2S/CO Monitors
- AreaRAE Wireless Multi-gas Monitors
- MultiRAE PLUS Multi-gas Monitors
- Q-RAE Confined Space Monitors
- VRAE Five Gas Surveyors
- MiniRAE 2000 Portable VOC Monitor
- ppbRAE Parts Per Billion Monitors
- UltraRAE Specific Compound Monitors
- ToxiRAE PLUS PID Monitors
- ToxiRAE PLUS Single Gas Monitors
- ToxiRAE PLUS Oxygen Monitors
- ToxiRAE PLUS Combustible Monitors
- ModuRAE Fixed System PID
- MiniRAE PLUS Classic Monitor

How can I be informed and updated?

Be sure to mail in your warranty card via email, post or fax to get on RAE's private database (information is never supplied to others).

You will be updated on new products, technical advisory notices, new accessories and much more. Thank you for your purchase!

IMPORTANT!

Note: RAE Systems' updated **firmware version V1.30 and above** for the ToxiRAE PID (PGM-30) requires the new lamp so when ordering replacement lamps please use **part #050-0040-000**. The ToxiRAE PID (PGM-30) with **firmware version V1.27 and below** requires the standard lamp, please use **part #050-0010-000** when ordering replacement lamps.

Thank you.

RAE Systems

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⚠ **WARNING** ⚠

-DO NOT PROCEED WITHOUT READING-

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.

CAUTION!!

TO REDUCE THE RISK OF ELECTRIC SHOCK, TURN OFF POWER BEFORE REMOVING THE SENSOR CAP AND SENSOR MODULE FOR SERVICE. NEVER OPERATE THE UNIT WHILE THE CAP IS REMOVED. REMOVE SENSOR CAP AND SENSOR MODULE ONLY IN AN AREA KNOWN TO BE NON-HAZARDOUS.

TO REDUCE THE RISK OF IGNITION OF HAZARDOUS ATMOSPHERES, RECHARGE BATTERY ONLY IN AREA KNOWN TO BE NON HAZARDOUS.

CAUTION:

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

ATTENTION:

Pour des raisons de sécurité, cet équipment 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.

WARNING:

Use only RAE Systems battery packs, part nos. 500-0021 or 500-0022. This instrument has not been tested in an explosive gas/air atmosphere having an oxygen concentration greater than 21%. Substitution of components may impair intrinsic safety. Recharge batteries only in non-hazardous locations.

AVERTISSEMENT:

Utiliser seulement l'ensemble de batterie RAE Systems, la reference 500-0021 au 500-0022. Cet instrument n'a pas été essayé dans une atmosphère de gaz/air explosive ayant une concentration d'oxygène plus élevée que 21%. La substitution de composants peut compromettre la sécurité intrinsique. Ne charger les batteries que dans emplacements désignés non dangereux.

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 used or put into service.

For maximum safety, the accuracy of the ToxiRAE should be checked by exposing the sensor(s) to known concentration calibration gas before each day's use.

AVERTISSEMENT:

La calibration de toute instruments de RAE Systems doivent être testé en exposant l'instrument a une concentration de gaz connue par une procédure dietalonnage avant de mettre en service l'instrument pour la première fois.

Pour une securite maximale, la sensibilité du ToxiRAE doit être verifier en exposant l'instrument a une concentration de gaz connue par une procédure dietalonnage avant chaque utilisation journalière.

Special Note
-1-

When the PGM-30 Pocket PID is taken out from the transport case and turned on for the first time, there may be some residual organic vapor trapped inside the ionization chamber. The initial reading may indicate a few ppm. Enter an area known to be free of any organic vapor and turn on the unit. After running for several minutes, the residual vapor in the sensor chamber will be cleared and the reading should return to zero.

-2-

The battery of the ToxiRAE unit will discharge slowly even if it is turned off. If the unit has not been charged for 5-7 days, the battery voltage will be low. Therefore, it is a good practice to always leave the unit in the charger so that it is fully charged and ready for immediate use. It is also recommended to fully charge the unit FOR AT LEAST 4 HOURS before first use (see Section 3.0 for more information).

1. GENERAL INFORMATION

ToxiRAE is a programmable pocket Photo-Ionization Detector (PID) designed to provide continuous exposure monitoring of toxic gases for workers in hazardous environments. It monitors two classes of toxic gases: (1) organic vapors with the supplied 10.6 eV gas discharge lamp, and (2) chlorinated compounds with the interchangeable 11.7 eV lamp available as an optional accessory. Features are:

- **Lightweight and Compact**
  -6.4 oz, pocket size

- **Dependable and Accurate**
  -12 hours monitoring with micro controller

- **User Friendly**
  -menu driven, intuitive end-use operation

- **Programmable Alarm Thresholds**
  -audio buzzer & flashing display alarm

ToxiRAE (PGM-30K) consists of: A Pocket PID unit, a single station charging unit, plus calibration accessories.

1.1 General Specifications

Table 1.1

Pocket PID Unit Specification	
Dimensions	6.0"L x 1.75"W x 1.0"H
Weight	6.4 oz with battery
Detector	Electrodeless 10.6 eV ultraviolet discharge lamp with Teflon stainless steel chamber
Battery	Rechargeable, 2.4V/900 mAh, Ni-CD battery pack or alkaline battery adapter
Operating Time	12 hours continuous operation
Attachment	Belt/Pocket clip
Display	8 digit LCD with LED backlight
Range	0 to 99.0 ppm with 0.1 ppm resolution 100 to 2000 ppm with 1 ppm resolution
Accuracy	+/- 2 ppm or +/- 10% of reading calibrated to 100 ppm isobutylene
Response Time	<10 seconds to reach 90% point when exposed to 100 ppm isobutylene (continue)

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Pocket PID Unit Specification

	(continued)
Keypads	1 operation key and 2 programming keys
Alarm Settings	Separate alarm limit settings for TWA, STEL, Low and High alarm
Alarm	90 dB buzzer and flashing red LED to indicate exceeded preset limits, low battery, or lamp failure
Calibration	Two point field calibration for zero gas and standard reference gas
Protection	Password protected calibration settings, alarm limits and data
Data Storage	4000 readings in non-volatile memory (programmable period)
Temperature	-10° to 40^oC (14° to 104^oF)
Humidity	0 to 95% relative humidity (non-condensing)

Table 1.2

Single-unit Charging Station Specification	
Dimension	2.5"L x 2"W x 3.5"H
Weight	4.1 oz.
Charging Capacity	1 slot to charge a ToxiRAE Pocket PID plus 1 auxiliary connector to charge a spare Ni-Cd battery pack
Power Source	110VAC or 6V DC
Charging Time	4 hours to full charge
Charge Status	Three-color LED to indicate charging (red), ready (green), discharge (amber) and not charging (off)
Safety Control	Two step constant voltage / constant current charging to prevent overcharging

2. OPERATION OF TOXIRAE

The ToxiRAE PID Unit is a pocket size organic vapor exposure monitor/sampler. It gives the real time measurements and activates alarm signals whenever the exposure exceeds preset limits. Prior to factory shipment the ToxiRAE is preset with default alarm limits and the sensor is pre-calibrated with 100 ppm isobutylene gas. However, the user should calibrate the instrument before the first use. After the unit is fully charged and calibrated, it is ready for immediate operation.

2.1 Physical Description

Figure 2.1 shows the main components of the ToxiRAE Pocket PID Unit which includes:

- 3 keys for user to interact with the unit: 1 operation key and 2 programming keys for normal operation or programming of the unit

- LCD display with back light to show real time and calculated measurements

- Buzzer and red LED for alarm signal whenever the exposures exceed preset limits

- Clip for attachment to the user's pocket, lapel or belt

- Battery contact for plugging directly to the charging station

- Gas entry port sensor cap

- Infrared communication port for PC interface (optional)
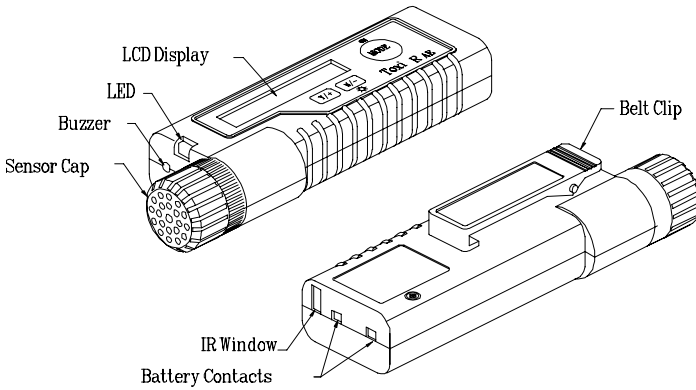
Figure 2.1   Major Parts of the ToxiRAE
              Pocket PID Unit

2.2 Keys and Display

Figure 2.2 shows the LCD display and the keypad on the front panel of the unit. The function of the 3 keys during normal operation are summarized below:
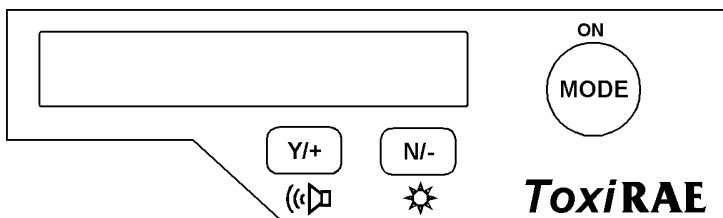
Figure 2.2   Key-pad and Display of the ToxiRAE
Pocket PID Unit

Table 2.1

Key	Function in Normal Operation
[MODE]	**-**Turn on/off the power* and choose different display mode
[N/-]	-Toggle on/off the back light
[Y/+]	-Alarm test and alarm acknowledge (turn off latched alarm

* Pressing and holding **[MODE]** key for 5 seconds turns off the power to the unit. Unit will beep once per second during power-down sequence. Press **[MODE]** key momentarily to choose different display modes (see Section 2.4 for details).

The Pocket PID includes an 8-digit dot matrix LCD display. The LCD show the following eight types of displays during normal operation:

- Real time gas concentration in ppm

- Time weighted average (TWA) value of the gas concentration in ppm

- Short term exposure level (STEL) of the gas concentration in ppm

- Peak gas concentration in ppm

- Battery voltage in volts

- Run time in hours and minutes

- "Log On/Off?" menu to enable/disable datalogging, (only in datalog version of PGM-30D)

- "PC Comm?" menu to send or receive data between PC and the ToxiRAE unit

2.3 Power On/Off

To turn on the ToxiRAE Pocket PID Unit, press **[MODE]** key. The audio buzzer will beep once and the display show "ON!.." and then "Ver n.nn" to indicate the software version number. The serial number of the unit is displayed next.   The unit will then go through a self-diagnostic routine to check the key components of the unit. A "Diagnose" message is displayed with red backlight turned on while the self-diagnostic routine is executing. The red LED will flash once and the buzzer will beep once to ensure that they are functional.

The unit next displays the four preset alarm limits, battery voltage and available data storage memory (in percentage). After about 20 seconds, the display shows the instantaneous reading of the gas concentration in ppm and is ready to monitor gas concentration.

To turn off the ToxiRAE Pocket PID Unit, press and hold the **[MODE]** key for 5 seconds. Unit will beep once per second during power-down sequence.   The message "Off!.." flashes on the LCD display and the display, goes blank indicating that the unit is turned off. When the unit is turned off, all the current real time data including TWA, STEL, Peak and run time are erased. However, the datalog data is preserved in non-volatile memory for data down load at a later time. The current date and time of day are also preserved, as long as the batteries have sufficient charge.

Datalog versus Non-Datalog unit

There are two versions of PGM-30 Pocket PID: Datalog unit and Non-Datalog unit. During power on sequence, if there is a letter "D" follows the version number indicates that the unit is configured as a Datalog unit. Without the letter "D," it is a Non-Datalog unit.

User can upgrade a Non-Datalog unit to a Datalog unit. Call factory for information on how to order the upgrade kit and follow the instructions described in Section 5.13 to enable or disable the datalog feature for the unit.

2.4 **Operations**

In the normal operations, the ToxiRAE Pocket PID Unit displays six different readings: Instantaneous gas concentration, TWA, STEL, Peak in ppm, battery voltage in volt and run time in hours and minutes. In addition, there are two more displays to enable or disable datalogging operation (only in datalog version of PGM-30D) and to communicate with a PC. Here is a brief explanation of each display:

1) The **instantaneous** reading is the actual gas concentration in parts per million (ppm). The reading is updated once per second and is shown as "nn.n ppm" in the LCD display.

2) The **TWA** reading is the accumulated reading of the gas concentration divided by 8 hours since the unit was turned on. The reading is updated once a minute and is shown as "TWA nn.n" in the LCD display.

2) The **STEL** reading is the last 15 minute average reading of the gas concentration. The reading is updated once per minute and is shown as "STEL nn.n" in the LCD display, for the first 15 minutes "STEL****" will be displayed.

4) The **Peak** reading is the maximum reading of the gas concentration since the unit was turned on. The reading is updated at one second intervals and is shown as "Peak nn.n" in the LCD display.

5) The **battery voltage** reading is the current battery voltage in volts. The reading is updated once per second and is shown as "Bat=2.4V" in the LCD display.
Note: a fully charged battery pack should show 2.8 volts or higher. When the battery voltage falls below 2.2 volts, a flashing "Bat" appears as a warning message. When the battery voltage falls below 2.0 volts, the unit will be turned off automatically.

6) The **run time** reading is the accumulated "On" time in hours and minutes since the unit was turned on. The reading is updated at one minute interval and is shown as "Run Time" and "nn:nn" on the LCD display.

7) The **Log On/Off?** menu prompts the user to turn on or off datalogging. To turn on datalogging, press the **[Y/+]** key while "Log On?" is displayed. Likewise, datalogging can be turned off by pressing the **[Y/+]** key while "Log Off?" is displayed. This display appears only on datalog units (PGM-30D).

8) The **PC comm?** menu (units with datalog option) display allows user to up load data from the ToxiRAE to a Personal Computer (PC) or down load configuration information from a PC to the ToxiRAE. Press the **[Y/+]** key to place the unit into communication standby mode, the LCD displays "Ready..." Place the unit into the charger and connect the charger to the serial port of a PC. The unit is ready to receive any command from PC.

Note: When the unit is in communication standby mode, it stops monitoring the gas concentration and stops datalogging. Datalogging must be manually restarted, if unit is in manual log mode.

Press the **[MODE]** or **[N/-]** key to exit the communication standby mode and move to the next display, which shows instantaneous readings.

To choose a display:
These eight displays are arranged in a "round robin" order:

instantaneous   => TWA => STEL => Peak => battery voltage=> Run time => Log On(Off)? => PC comm? => instantaneous

To choose a specific display, press the **[MODE]** key one or more times in normal operation mode until the desired display appears. For example, to display the STEL reading, press **[MODE]** key twice, and so on.

Display time out
In all displays (except the instantaneous reading) the display will automatically change to the instantaneous reading after a one-minute interval if no key is pressed.

2.5 Alarm Signals

The built-in microcomputer constantly updates and monitors gas concentration and compares it with the programmed alarm limits (TWA, STEL, and two instantaneous gas concentration alarm limit settings: Lo & Hi). Whenever the concentration exceeds any of the preset limits, the loud buzzer and red flashing LED are activated immediately to warn user of the alarm condition.

In addition, when the battery voltage is below a pre-set voltage level (2.2 V), UV lamp or the sensor module fails or datalog memory is full, the unit also activates the buzzer and red LED. When the low battery alarm occurs, there is approximately 20-30 minutes of operating time remaining. When the battery voltage falls below 2.0 V, the unit will turn off automatically.

Alarm Signal Disabled: It is extremely important to note that during the following conditions, the alarm signals are disabled:
1) When entering PC communication standby mode.
2) When entering calibration mode.

During these two modes of operation, real time monitoring of the gas concentration stops.   None of the gas concentrations will be calculated, including; Peak, STEL and TWA.

Alarm Signal Latching:

It is possible to setup the ToxiRAE from a PC so that when an alarm condition occurs, the alarm signals stay on even after the alarm condition is no longer present. This is called "latching alarm" mode. The alternative mode is to automatically reset the alarm signal when the alarm condition is absent. This is the default alarm mode (see Section 5.0 for details on how to set alarm mode).

Alarm Signal Summary:

The various alarm signals are summarized here:

Condition	Alarm Signal
Gas exceeds "Hi Alarm" limit	3 beeps/flashes per second
Gas exceeds "Lo Alarm" limit	2 beeps/flashes per second
Gas exceeds STEL	1 beep/flash per second
Gas exceeds TWA	1 beep/flash per second
Pump (fan) failure	3 beeps/flashes per second plus "Fan" message on LCD
Sensor (lamp) failure	3 beeps/flashes per second plus "Lmp" message on LCD
Low battery	1 beep/flash per minute plus "Bat" message on LCD
Memory full	1 beep/flash per minute plus "Mem" message on LCD

Alarm Signal Testing:

Under normal non-alarm condition, it is possible to test the ToxiRAE LED, buzzer and backlight by pressing the **[Y/+]** key momentarily. The buzzer will beep and the LED and backlight will flash once to indicate that these alarm signals are functioning correctly.

WARNING:
THE ALARM SIGNALS ARE DISABLED DURING PC COMMUNICATION OR CALIBRATION OPERATION. TO REDUCE THE RISK OF EXPOSURE TO HAZARDOUS ATMOSPHERES, PERFORM PC COMMUNICATION OR CALIBRATION ONLY IN AREA KNOWN TO BE NON HAZARDOUS.

2.6 Backlight

The LCD display is equipped with a red LED backlight to assist in reading the display under poor lighting conditions. Pressing and holding the **[N/-]** key for one second in normal operation can turn on this backlight. Pressing the **[N/-]** key a second time turns off the backlight.

Note: The LED backlight consumes a higher amount of energy from the battery and shortens the operating time of the unit. Therefore, the backlight will automatically turn off after 30 seconds.

2.7 Preset Alarm Limits and Calibration

The ToxiRAE Pocket PID Unit is factory calibrated with standard isobutylene gas, and is programmed with default alarm limits as listed below.   Refer to Section 4 for programming procedures if new calibration or alarm limits are required.

Table 2.2

Factory Calibration and Preset Alarm Limits	
Calibration standard gas	100 ppm isobutylene
TWA Alarm Limit	10 ppm
STEL Alarm Limit	25 ppm
Lo Alarm Limit	50 ppm
Hi Alarm Limit	100 ppm

2.8 Datalogging

ToxiRAE Pocket PID Unit calculates and stores the gas readings based on user specified data logging period and the type of measurement. Three types of gas measurements (minimum, average, and maximum concentration) can be stored, at each datalogging period. The datalogging period can be programmed from one second to 60 minutes in one-second increments. In addition, a time stamp, a user ID, a site number, serial number, last calibration and check date, and alarm limits are also stored. All data is retained in non-volatile memory so it can be down loaded at a later time to a PC, even if the unit was turned off.

There are several ways to initiate the datalogging operation. The user can choose to start datalogging automatically when the unit is turned on and off. Datalogging can be manually started and stopped by pressing a key. The user can further choose to start and stop datalogging based on a preset time schedule.

All datalogging options and modes can be programmed with a PC and down loaded to the unit.

Start/stop datalogging manually

If manual datalogging mode has been selected, from the normal operation menu, toggle through the menu using the **[MODE]** key until the **Log On/Off?** prompt is displayed. Pressing the **[Y/+]** key while "Log On?" is displayed, turns on datalogging and displays a "⌐" symbol in front of the "ppm" to inform user that the datalogging is on. Likewise, pressing the **[Y/+]** key while "Log Off?" is displayed, turns off datalogging and causes the "⌐" symbol to disappear.

Pressing the **[MODE]** or **[N/-]** key, while prompted with **"Log On/Off?",** will not cause any change in datalogging status. All other modes of datalogging will start and stop automatically without any user intervention.

Automatic Datalogging

Datalogging is automatically started at the end of each "datalogging period" when the unit is turned on.

Scheduled Start/Stop Datalogging

Data logging starts at a specific date and time, and logs data at the "datalogging period" rate. When the "stop date and time" is reached, the unit stops datalogging. This mode, as others, requires that the unit be turned on first before the datalogging can start.

Periodic Start/Stop Datalogging

Data logging starts daily at a specific time, and logs data at the "datalogging period" rate. When the "stop time" is reached, the unit stops datalogging. This mode, as others, requires that the unit be turned on first before the datalogging can start.

Datalogging indicator

If datalogging is on, a small "⌈" symbol is displayed before the letter "ppm" to indicate the datalogging status.

Datalogging pause

Under the following conditions, the datalogging will be paused automatically:

1) When entering programming mode, datalogging will stop.   Upon exiting the programming mode, the datalogging will resume.

2) When entering PC Communication standby mode, datalogging will stop.   Upon exiting the PC communication standby mode, datalogging will restarted **only if datalogging mode was set to automatic mode.**

3. OPERATION OF CHARGING STATION

The charging station includes:

- Auxiliary connector for charging a spare battery pack of the Pocket PID

- An AC to 6V DC wall mount adapter for 110 V AC power source

- Tri-colored LED for charging status indication of the charger:

      Red   -battery is being charged
      Green   -charging is completed
      Amber   -battery is being discharged
      No Light   -bad connection or defective battery

- Infrared transceiver and serial cable for connecting the ToxiRAE to the serial port of a PC

Figure 3.1   Single Unit Charging Station

Charging Station Operation Procedures

1. Connect the AC adapter (or the optional automotive charging adapter) to the charging station.

2. With the Pocket PID front cover facing the same direction as the front label of the charging station, as shown in Figure 3.1, place the Pocket PID into the slot.

3. To charge a spare battery pack, connect the battery directly to the charging station by plugging it into the small jack on the back of the station.

4. The LED should be red in color when charging. If the battery is fully charged, the LED will change from red to green. The red color indicates that the battery is being charged. The green color indicates that the battery is fully charged. A completely discharged Pocket PID or a spare battery will be charged to full capacity automatically within 4 hours.

Note: The charging station is designed to charge one ToxiRAE or one spare battery. Therefore, if a ToxiRAE and a spare battery are plugged into the charging station simultaneously, it will take twice as long to charge both batteries.

The battery of the ToxiRAE unit will be drained slowly even if the unit is turned off. If the unit has not been charged for 4-5 days, the battery voltage will be low. The charging circuit is designed to prevent over charging. Therefore, it is good practice to always leave the unit in the charger when it is not in use so that it is fully charged and ready for immediate use.

The factory-supplied battery is designed to last for 12 hours of normal operation for a new battery under the best condition. As the battery becomes older or is subject to adverse conditions, the battery capacity will be reduced significantly.

Charger Time Out

The battery charger has a built-in time out timer. After the battery has been charged for 4 hours, it will automatically switch to trickle charge mode and turn on the green LED to prevent over charging the battery. It will not switch back to charging mode unless the unit is lifted from the charger and set down again to reset the timer. Since the charger reverts to trickle mode, the ToxiRAE will not operate indefinitely if left turned on in the charger, but should operate 30-40% longer than when the battery is fully charged.

Discharging the battery:

Ni-CD batteries are known to have a memory effect, i.e. if the battery has not been fully discharged before it is charged again, it will lose some of its capacity. Therefore, it is necessary to completely discharge the battery from time to time in order to recover full capacity. The charging station provides a means to manually discharge the Ni-CD battery.

Inside the opening of the charger, near one corner of the bottom plate, there is a small hole. Insert a pencil or ball point pen to press a switch inside the hole. This sets the unit into discharge mode and turns on the amber colored LED. Place the ToxiRAE into the charger and the Ni-Cd battery will be completely discharged in about one hour. The charger will automatically switch from discharging mode to charging mode (LED changes from amber to red) when the battery is fully discharged.

Alkaline battery adapter

An alkaline battery adapter is supplied with each ToxiRAE kit. It accepts two AAA size alkaline batteries and can be used in place of the Ni-Cd battery pack to provide approximately 8-9 hours of operation. The adapter is intended for use in emergency situations when there is no time to charge the Ni-Cd battery

The charging station is designed to prevent damage to alkaline batteries and the charging circuit.

Note: The AAA Alkaline battery adapter is intrinsically safe!

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.

4. PROGRAMMING OF TOXIRAE

The ToxiRAE Unit is built with a microcomputer to provide programming flexibility for the user. Authorized users can re-calibrate the unit, change the alarm limits, change site number, user ID, datalogging period, real time clock, etc.

Programming is menu-driven to provide intuitive end-use operation. The display shows the menu options, and the keypad is used for menu selection and data entry.

Note: The real time monitoring of the gas concentration continues while in the programming mode. However, during the calibration procedure, the real time monitoring will pause until the calibration is completed. In addition, entering the programming mode will pause datalogging operation automatically. After exiting the programming mode, datalogging operation will resume.

4.1 Menu Options

The programming mode provides seven menu options as shown in Table 4.1. Each menu includes various sub-menus to perform additional programming functions. The first menu option allows entry into the programming mode by keying-in a four-digit password. Once inside the programming mode, menu options two through seven can be viewed by pressing the **[N/-]** repeatedly until the desired option is displayed. To enter a particular menu, press **[Y/+]** key, the sub-menu will be displayed. To exit the programming mode, press the **[MODE]** key at any of the seven menu options.

Table 4.1

	Menu Option	**Display**
1	Verify password	Code0000
2	Calibrate instrument	Calib?
3	Set alarm limits	Alarm?
4	Set datalogging options	Data?
5	Set real time clock	Clock?
6	Gas correction factor	Gas?
7	Setup instrument	Setup?

Note: Each of the six menu items has various numbers of sub-menus. Appendix A shows a more detailed menu tree structure.

User Mode

There are two user modes to allow a user to control the access to the programming menu. If the user mode is set to "display," then a user cannot enter programming menu at all. If the user mode is set to "program", then a user can enter programming mode. The user mode must be set using a PC (see Section 5.0 for details on setting up the user mode).

Security Level

There are three levels of security in the ToxiRAE programming mode to provide further protection against un-unauthorized changes to the instrument alarm settings and other settings. The **level 2** security allows a user to enter programming mode without any password checking. This is the default security setting. The **level 1** security requires a 4-digit password to enter programming. **Level 0** security allows a user to enter the programming mode without any password checking, as the level 2. However, it does not allow a user to save any changes to the alarm limits, real time clock, gas selection, correction factor, user ID or site numbers. A user can still perform calibration with level 0 security. The security level must be set using a PC (see Section 5.0 for details on setting up the security level).

4.2 Keys for Programming Mode

The three keys perform a different set of functions during
the programming mode as summarized below.

Table 4.2

Key	Function in Programming Mode
[MODE]	Exit menu when press momentarily or exit data entry mode when pressed and held for 1 second
[Y/+]	Increase numerical value for data entry or confirm (yes) for a question
[N/-]	Decrease numerical value for data entry or deny (no) for a question

4.3 Entering into Programming Mode

1. Turn on the ToxiRAE unit (refer to Section 2.3 for the power on sequence).

2. Press and hold down both **[MODE]** and **[N/-]** keys for three seconds to enter programming mode. Note: this is to prevent user entering programming mode by accident.

3. If the security level is 0 or 2, after holding down 2 keys for 3 seconds, the unit should enter the programming mode and the first menu item "Calib?" will be displayed. If the user mode is "display", the unit will show "Display.." and return to normal display of instantaneous readings.

4. If the security level is 1, after holding down the two keys for three seconds, the display will show "Code0000" with the left-most digit flashing. User should enter a password starting from this flashing digit.

Note 1: Prior to factory shipment the ToxiRAE unit was installed with "0000" as the default password.

Note 2: For added security, "0000" is always displayed instead the actual password at this step.

5. If the correct digit value is not "0", use **[Y/+]** key or **[N/-]** key to increase or decrease the digit value. Then press **[MODE]** key momentarily to confirm the digit value.
    - Display shows the actual digit entered and moves the flashing cursor to the next digit (to the right)

6. Repeat Step 4 until all four digits are entered. Press and hold **[MODE]** key for one second.

7. If the entered password is correct, the unit enters the programming mode. The first menu item "Calib?" will be displayed.

8. If the password is incorrect, the display shows "Code????" and returns to instantaneous reading display.

4.4 Calibration of ToxiRAE Unit

> **CALIBRATION WARNINGS:**
>
> **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 ToxiRAE should be checked by exposing the sensor(s) to known concentration calibration gas before each day's use.**

In programming mode, the user may re-calibrate the ToxiRAE Unit. This is a two-point calibration process using "zero gas" and the standard reference gas. First, a "zero gas" which contains no detectable organic gases or vapors is used to set the zero point. Then a standard reference gas, which contains a known concentration of a given gas, is used to set the second point of reference (also known as span gas). The two-point calibration procedure is detailed below. Table 4.2 shows the sub-menus for calibration operations.

Table 4.2

Sub-Menu Option	Display
1 Zero gas calibration	Zero?
2 Span gas calibration	Span?
3 Span gas check	Check?
4 Span gas value	Cal Gas?

4.4.1 Zero Gas Calibration

This procedure determines the zero point of the sensor calibration curve. To perform zero gas calibration, the calibration adapter, a gas bottle and a bottle of "zero" air. (optional) are required. The "zero" air is clean dry air without any organic vapor or impurities. If such an air bottle is not available, any clean ambient air without detectable contaminant can also be used. A charcoal filter should be used if one is not sure of the ambient air's purity.

The calibration adapter links up the sensor cap on the ToxiRAE Unit to the gas bottle (see Figure 4.1).
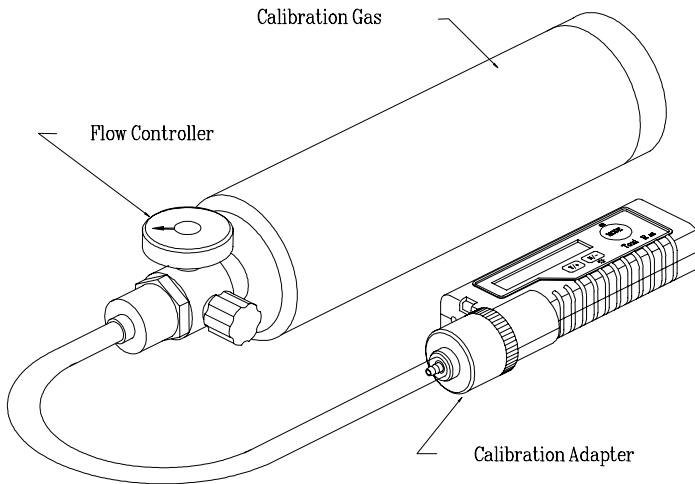
Figure 4.1   Installation of Gas Calibration

1. "Calibration" is the first menu item in Table 4.1. Display shows "Calib?"- Press **[Y/+]** to perform calibration. The first sub-menu shows: "Zero?"

2. If "zero" air is available, snap in the calibration adapter over the sensor cap of the ToxiRAE Unit and connect the other end of the tube to the zero gas bottle, as shown in Fig. 4.1. If the "zero" air is not available, simply leave the unit in an area free of any detectable vapor (do not use calibration adapter in the latter case).

3. Press **[Y/+]** key to zero the unit. The display shows "zero..." After about 2 seconds, the display should shows reading of "0.0 OK?"

4. If the reading shows a small non-zero value, press **[N/-]** key to zero it again. Repeat this process until the reading is stabilized at 0.0 or 0.1 ppm. Press **[Y/+]** key to exit zero gas calibration and move on to next calibration sub-menu item. This completes the zero gas calibration sequence.

5. Press the **[MODE]** key to exit the calibration sub-menu and move directly to next menu item "Set Alarm Limits" shown in Table 4.1.

4.4.2 Standard Reference Gas (Span Gas) Calibration

This procedure determines the second point of the sensor calibration curve. A bottle of standard reference gas (span gas) is needed to perform this procedure. 100 ppm isobutylene is typically used as the span gas. Snap in the calibration adapter over the sensor cap of the ToxiRAE Unit, and connect the tube to the gas bottle as shown in Figure 4.1

1. Continue from Step 4 of the previous section, the display should show "Span?" Press **[Y/+]** key. The display shows "Gas On?"

2. Turn on the valve of the gas bottle to start the flow of span gas. Then press **[Y/+]** key.
   - Display shows "Wait..." for about 30 seconds while the instrument performs calibration. Afterward, the display shows "100.0 OK?"

   Note: The reading should be very close to the value of the given calibration gas. If the reading is lower or higher than the standard gas value and is still rising slowly, it means that the calibration gas has not yet settled. Wait a few seconds and then press **[N/-]** key again to calibrate the instrument. The new reading should be closer to the standard gas value. Repeat this process a few more times, if necessary, until the reading is stable and within 1 or 2 ppm of the standard gas value. This completes the standard gas calibration procedure.

3. Press **[Y/+]** key to exit the standard gas calibration procedure and move to the next sub-menu item.

4. Turn off the flow of gas. Disconnect the calibration adapter from the ToxiRAE Unit. Ensure that the sensor cap is still firmly secured onto the PID unit.

5. Press the **[MODE]** key to exit the calibration sub-menu and move directly to next menu item "Set Alarm Limits" shown in Table 4.1.

   Note: When span calibration is performed, a time stamp and the actual calibration value is stored in the non-volatile memory. This information will be included in the datalogging report.

4.4.3 Standard Reference Gas (Span Gas) Check

The purpose of this function is to check the instrument drift since last calibration. A bottle of standard reference gas is needed to perform this procedure. Use the same gas as used in calibration. Snap in the calibration adapter over the sensor cap of the ToxiRAE Unit, and connect the tube to the gas bottle as shown in Figure 4.1

1. Continue from Step 3 of the previous section, the display should show "Check?" Press **[Y/+]** key. The display shows "Gas On?"

2. Turn on the valve of the gas bottle to start the flow of span gas. Then press **[Y/+]** key.
   - Display shows "Wait..." for about 5 seconds. Afterward, the display should show "100.0 OK?"

   Note: The reading should be close to the value of the given calibration gas. If the reading is lower than the standard gas value and is still rising slowly, it means that the span gas has not yet settled. Wait a few seconds and press **[N/-]** key again to re-check the instrument. The new reading should be closer to the standard gas value. Repeat this process a few more times, if necessary, until the reading is stable. This completes the standard gas check procedure.

3. Press **[Y/+]** key when correct, to exit the span gas check procedure and move to next sub-menu item.

4. Turn off the flow of gas. Disconnect the calibration adapter from the ToxiRAE Unit. Ensure that the sensor cap is still firmly secured onto the PID unit.

5. Press the **[MODE]** key to exit the calibration sub-menu and move directly to next menu item "Set Alarm Limits" shown in Table 4.1.

   Note: When span check is performed, a time stamp and the actual check value are stored in the non-volatile memory. This information will also be included in the datalogging report.

4.4.4 Enter Standard Calibration Gas Value

This function allows the user to change the value of the standard calibration gas.

1. "Enter Calibration gas value" is the next sub-menu item in Table 4.2.
    - Display shows "Cal Gas?"

2. Press **[Y/+]** key.

    - Display shows "Cal Gas=" and "+- 100.0" which means that the previous calibration gas value is 100 ppm. If the concentration of the new calibration gas to be used is different from the previously stored value, enter the new concentration value in Step 3. Otherwise, press and hold the **[MODE]** key for 1 second to accept the previously stored calibration gas value and exit the calibration sub-menu.

3. Starting from the left-most digit of the standard calibration gas value, use **[Y/+]** or **[N/-]** key to change the digit value and press **[MODE]** key momentarily to advance to next digit, the flashing digit will move to next digit to the right. Repeat this process until all 4 digits are entered. Press and hold the **[MODE]** for 1 second to enter the new calibration gas value.

4. The display shows "Save?" To confirm the new value, press the **[Y/+]** key to accept the change and exit the calibration sub-menu. Press the **[N/-]** key or the **[MODE]** key to discard the change and exit the calibration sub-menu.

4.5 Set Alarm Limits

In the programming mode, the users may change various alarm limits for the ToxiRAE Unit.

Table 4.3 shows the sub-menus for setting alarm limits (default limits shown).

Table 4.3

Sub-Menu Option	Display	
1 Set TWA alarm limit	TWA	+- 0010.0
2 Set STEL alarm limit	STEL	+- 0025.0
3 Set Lo Alarm limit	Lo Alarm	+- 0050.0
4 Set Hi Alarm limit	Hi Alarm	+- 0100.0

4.5.1 Set TWA Alarm Limit

1. The first sub-menu item in Table 4.3 is to set the TWA alarm limit.
   -Display shows "TWA" and "+ - 0010.0" with the left-most digit flashing, where "0010.0" is the previously stored TWA alarm limit.

2. To modify this limit, starting from the left-most digit, use the **[Y/+]** or **[N/-]** key to change the digit value and press **[MODE]** key momentarily to advance to next digit. The flashing digit will move on to next digit to its right. Repeat this process until all 4 digits of the new TWA alarm limit are entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode. If there is any change to the existing value, the display shows "Save?" Press the **[Y/+]** key to accept the new value and move to next sub-menu. Press the **[N/-]** key to discard the changes.

3. To preserve the previously stored TWA alarm limit, press and hold the **[MODE]** key for 1 second, the unit will exit data entry mode and move to the next sub-menu option.

4.5.2 Set STEL Alarm Limit

1. The second sub-menu item in Table 4.3 is to set the STEL alarm limit.
   -Display shows "STEL" and "+- 0025.0" with the left-most digit flashing, where "0025.0" is the previously stored STEL alarm limit.

2. To modify this limit, starting from the left-most digit, use the **[Y/+]** or **[N/-]** key to change the digit value and press **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until all 4 digits of the new STEL alarm limit are entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode. If there is any change to the existing value, the display shows "Save?" Press the **[Y/+]** key to accept the new value and move to next sub-menu. Press the **[N/-]** key to discard the changes.

3. To preserve the previously stored STEL alarm limit, press and hold the **[MODE]** key for 1 second, the unit will exit data entry mode and move to the next sub-menu option.

4.5.3 Set Low Alarm Limit

1. The third sub-menu item in Table 4.3 is to set the Lo Alarm limit.
   - Display shows "Lo Alarm" and "+- 0050.0" with the left-most digit flashing, where "0050.0" is the previously stored Lo Alarm limit.

2. To modify this limit, starting from the left-most digit, use **[Y/+]** or **[N/-]** key to change the digit value and press **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until all 4 digits of the new Lo Alarm limit are entered. Press and hold **[MODE]** key for 1 second to exit data entry mode. If there is any change to the existing value, the display shows "Save?" Press **[Y/+]** key to accept the new value and move to next sub-menu. Press **[N/-]** key to discard the changes.

3. To preserve the previously stored Lo Alarm limit, press and hold **[MODE]** key for 1 second, the unit will exit data entry mode and move to the next sub-menu option.

4.5.4 Set High Alarm Limit

1. The fourth sub-menu item in Table 4.3 is to set the Hi Alarm limit.
    - Display shows "Hi Alarm" and "0100.0" with the left-most digit flashing, where "0100.0" is the previously stored Hi Alarm limit.

2. To modify this limit, starting from the left-most digit, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until all 4 digits of the new Hi Alarm limit are entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode. If there is any change to the existing value, the display shows "Save?" Press the **[Y/+]** key to accept the new value and exit the alarm setting sub-menu. Press the **[N/-]** key to discard the changes.

3. To preserve the previously stored Hi Alarm limit, press and hold the **[MODE]** key for 1 second, the unit will exit data entry mode and move to the next menu item in Table 4.1.

4.6 Set Datalog Options

ToxiRAE unit calculates and stores the gas readings at a specified interval or period. More datalogging options can be programmed in the PC and downloaded to the unit (see Section 5.0 for details on how to program various datalogging options). Table 4.4 shows the two sub-menus for datalogging.

Table 4.4

Sub-Menu Option	Display
1 Clear data memory	Clear?
2 Set datalogging period	Period?

4.6.1 Clear Data Memory

This function will erase all data stored in the non-volatile data memory.

1. "Clear data memory" is the first sub-menu item in Table 4.4. Display shows "Clear?" message.

2. Press the **[Y/+]** key to clear the data memory.
   - Display shows "Sure?" to re-confirm the clearing of memory.

3. Press the **[Y/+]** key again will erase all the data memory.

4. Press the **[N/-]** or **[MODE]** key to exit without clearing the data memory and move to next sub-menu item.

4.6.2 Set Datalogging Period

The datalogging period can be programmed from one to 3,600 seconds (1 hour) with one-second increment.

1. "Set datalogging period" is the second sub-menu item in Table 4.4. Display shows "Period?" message.

2. Press the **[Y/+]** key to set the period. - Display shows "+- 0060" with the left-most digit flashing, where "0060" is the previously stored data logging period in unit of seconds.

3. To modify this period, starting from the left-most digit, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move to the next digit to the right. Repeat this process until all 4 digits of the new period are entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode. If there is any change to the existing value, the display shows "Save?" Press the **[Y/+]** key to accept the new value and exit the datalog sub-menu. Press the **[N/-]** key to discard the changes and move to the next menu option.

4. To preserve the previously stored period, press and hold the **[MODE]** key for 1 second. The unit will exit data entry mode and move to the next menu item in Table 4.1.

4.7 Set Real Time Clock

In the programming mode, users may change the year, month, date, hour and minute of the real time clock inside the ToxiRAE Unit. Table 4.5 shows the sub-menus for setting real time clock.

Table 4.5

Sub-Menu Option		Display
1 Set year	Year =	+- 95
2 Set month	Month =	+- 02
3 Set date	Day =	+- 05
4 Set hour	Hour =	+- 14
5 Set minute	Minute =	+- 30

4.7.1 Set Year

1. The first sub-menu item in Table 4.5 is to set year.
. - Display shows "Year =" and "+- 95" with the left-most digit flashing, where "95" is the current year value of the real time clock.

2. To modify this value, starting from the left-most digit, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until both digits of the new year value are entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode. If there is any change to the existing value, the display shows "Save?" Press the **[Y/+]** key to accept the new value and move to next sub-menu. Press the **[N/-]** key to discard the changes and move to the next menu option.

3. To preserve the current year value in the clock, press and hold the **[MODE]** key for one second, the unit will exit data entry mode and move to the next sub-menu option.

4.7.2 Set Month

1. The second sub-menu item in Table 4.5 is to set month. Display shows "Month =" and "+- 02" with the left-most digit flashing, where "02" is the current month value of the real time clock.

2. To modify this value, starting from the left-most digit, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until both digits of the new month value are entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode. If there is any change to the existing value, the display shows "Save?" Press the **[Y/+]** key to accept the new value and move to next sub-menu. Press the **[N/-]** key to discard the changes and move to the next menu option.

3. To preserve the current month value in the clock, press and hold the **[MODE]** key for one second, the unit will exit data entry mode and move to the next sub-menu option.

4.7.3 Set Day

1. The third sub-menu item in Table 4.5 is to set date.
.   - Display shows "Day =" and "+- 05" with the left-most digit flashing, where "05" is the current date value of the real time clock.

2. To modify this value, starting from the left-most digit, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until both digits of the new date value are entered.   Press and hold the **[MODE]** key for 1 second to exit data entry mode. If there is any change to the existing value, the display shows "Save?" Press the **[Y/+]** key to accept the new value and move to next sub-menu. Press the **[N/-]** key to discard the changes and move to the next menu option.

3.   To preserve the current date value in the clock, press and hold the **[MODE]** key for one second, the unit will exit data entry mode and move to the next sub-menu option.

4.7.4 Set Hour

1. The fourth sub-menu item in Table 4.5 is to set hour. Display shows "Hour =" and "+- 14" with the left-most digit flashing, where "14" is the current hour value of the real time clock stored in 24 hour clock style.

2. To modify this value, starting from the left-most digit, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until both digits of the new hour value are entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode. If there is any change to the existing value, the display shows "Save?" Press the **[Y/+]** key to accept the new value and move to next sub-menu. Press the **[N/-]** key to discard the changes and move to the next menu option.

3. To preserve the current hour value in the clock, press and hold the **[MODE]** key for one second, the unit will exit data entry mode and move to the next sub-menu option.

4.7.5 Set Minute

1. The fifth sub-menu item in Table 4.5 is to set minute. Display shows "Minute =" and "+- 30" with the left-most digit flashing, where "30" is the current minute value of the real time clock.

2. To modify this value, starting from the left-most digit, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until both digits of the new minute value are entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode. If there is any change to the existing value, the display shows "Save?" Press the **[Y/+]** key to accept the new value and exit the clock sub-menu. Press the **[N/-]** key to discard the changes and move to the next menu option.

3. To preserve the current minute value in the clock, press and hold the **[MODE]** key for one second, the unit will exit data entry mode and move to the next menu item in Table 4.1.

4.8 Gas Correction Factor

The correction factor for a specific gas is defined as:

$$\text{Correction Factor} = \frac{\text{Sensitivity to a calibration gas}}{\text{Sensitivity to a specific gas}}$$

The correction factors are often used to obtain a calculated concentration of a given gas while using a different gas during calibration.

ToxiRAE Unit can store four sets of correction factors for different gases (including the calibration gas). From a PC, the user can choose 4 gases from a list of over 40 gases and down load them into the ToxiRAE (see Section 5.0 for details on how to select and down load correction factors). Table 4.6 shows the two sub-menus for selecting or modifying correction factors in the ToxiRAE.

Table 4.6

Sub-Menu Option	Display
1 Select gas	Gas = Hexane?
2 Modify correction factor	Factor = +- 002.40

4.8.1 Select Gas

This function allows users to choose one of the four gases pre-stored in the unit and load its correction factor to be used during gas measurements.

1. "Select gas" is the first sub-menu item in Table 4.6. Display shows "Gas = Hexane?" message where Hexane is the previously selected gas.

2. Press the **[Y/+]** key to accept the current gas selection.
   - Display shows "Hexane.. loaded" and move to next sub-menu item. ---
   Or press the **[N/-]** key to see next available gas.
   -Display shows "Gas = Benzene?" message where Benzene is the next available gas pre-stored in the unit.

3. Press the **[N/-]** repeatedly until the desired gas name is displayed or press the **[MODE]** key to exit without changing the gas selection and move to next menu in Table 4.1.

4.8.2 Modify Correction Factor

User can modify the correction factor to increase or decrease the gain of the gas reading. This allows users to use a custom factor for a specific gas or mixture of gases.

1. "Modify correction factor" is the second menu item in Table 4.6. Display shows "Factor = +- 002.40" with the left-most digit flashing, where "002.40" is the correction factor of the selected gas in the previous section.

2. To modify this factor, starting from the left-most digit, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until all 4 digits of the new factor are entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode. If there is any change to the existing value, the display shows "Save?" Press the **[Y/+]** key to accept the new value and exit the gas selection sub-menu. Press the **[N/-]** key to discard the changes.

3. To preserve the previously stored correction factor, press and hold the **[MODE]** key for 1 second, the unit will exit data entry mode and move to the next menu item in Table 4.1.

4.9 Setup Instrument

In the programming mode, users may change the user ID or site number so that datalogging will include appropriate user and site information. Table 4.7 shows the two sub-menus for setting up the instrument.

Table 4.7

Sub-Menu Option	Display
1 Set user ID	User 7777
2 Set site number	Site 1001

4.9.1 Set User ID

A four-digit user ID number is stored with each set of datalogging information. This ID number can be used to identify different users of the instrument.

1. The first sub-menu item in Table 4.7 is to set user ID. Display shows "User7777" with the left-most digit flashing, where "7777" is the current user ID number.

2. To modify this value, starting from the left-most digit, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until all four digits of the new ID value are entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode. If there is any change to the existing value, the display shows "Save?" Press the **[Y/+]** key to accept the new value and move to next sub-menu. Press the **[N/-]** key to discard the changes.

3. To preserve the current user ID value in the unit, press and hold the **[MODE]** key for one second, the unit will exit data entry mode and move to the next sub-menu option.

4.9.2 Set Site Number

A four-digit site number is stored with each set of datalogging information. This site number can be used to identify different job or site locations during the operation of the instrument.

1. The second sub-menu item in Table 4.7 is to set site number. Display shows "Site1001" with the left-most digit flashing, where "1001" is the current site number.

2. To modify this value, starting from the left-most digit, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until all four digits of the new site value are entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode. If there is any change to the existing value, the display shows "Save?" Press the **[Y/+]** key to accept the new value and exit the setup sub-menu. Press the **[N/-]** key to discard the changes.

3. To preserve the current site number value in the unit, press and hold the **[MODE]** key for one second, the unit will exit data entry mode and move to the next menu item in Table 4.1.

4.10 Exit Programming Mode

1. To exit programming mode from menu level (see Table 4.1), press the **[MODE]** key once.
   - Display shows an instantaneous reading of normal operation mode.

2. To exit programming mode from sub-menu level (see Table 4.2 - 4.7), press the **[MODE]** key twice.

2. To return to programming mode, press and hold down both the **[MODE]** and **[N/-]** keys for 3 seconds as described in Section 4.3.

5. COMPUTER INTERFACE FOR ToxiRAE

Each datalogging ToxiRAE is shipped with a software package, called ProRAE-Suite, and a serial computer interface cable.

This software package runs on any IBM compatible Personal Computer (PC) under Windows 95®, Windows 98®, Windows NT® 4.0 and later environments. It allows the user to configure the ToxiRAE through a user-friendly interface and send the configuration information from the PC to the ToxiRAE monitor. Collected data can also be extracted from the ToxiRAE to the PC in order to perform data analysis, report generation or record keeping. Installation and operation of this software package is described in the following sections.

5.1 Install ProRAE-Suite Software

ProRAE-Suite software package is available on several 3.5" setup diskettes. To install the ProRAE-Suite software, insert the first setup diskette into the "A" or "B" floppy disk drive. Click the **Start** button on the taskbar to display the start menu, then click the **Run** from the start menu to display the **Run** dialog box. If the setup diskette is in disk drive A, type A:\Setup.exe in the **Open** field, as shown in Figure 5.1.
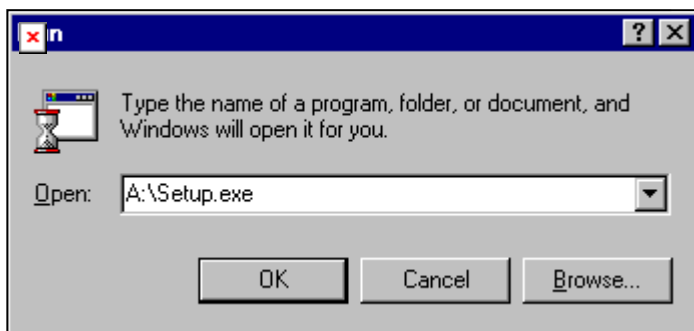

Figure 5.1   Run Dialog Box

Press the **Enter** key on the keyboard or click the **OK** button on the **Run** datalog box to start the setup process. If the user chooses the default settings in every step of the process, the ProRAE-Suite software will be installed under the default directory**: C:\Program Files\RAE Systems Inc\ProRAE-Suite**. After the software is installed successfully, a new menu item **ProRAE-Suite** is added to the **Programs** menu. To start the ProRAE-Suite software, click the **Start** button on the taskbar to display the **Start** menu, click the **Programs** menu item to display the **Programs** submenu, then click the **ProRAE-Suite**

menu item to display the **ProRAE-Suite** submenu. There are two submenu items under the **ProRAE-Suite** submenu: **ProRAE-Suite** and **Readme**, as shown in Figure 5.2. Click the **ProRAE-Suite** submenu item to start the ProRAE-Suite software.
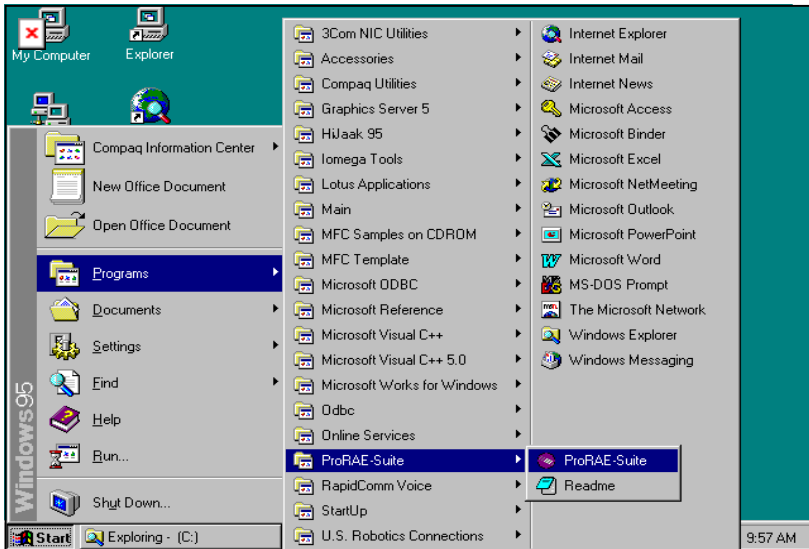

Figure 5.2   Start Menu

5.2 Connect ToxiRAE to PC

The basic kit of the ToxiRAE is supplied with a serial interface cable. Connect the DB-9 connector side of the cable to the serial port of the PC, and connect another side of the cable to the ToxiRAE monitor.

Turn on the power to the ToxiRAE monitor. Press the **[MODE]** key several times until the LCD shows "Communicate with PC?" Press the **[Y/+]** key and the display shows "Pause Monitor, OK?" Press **[Y/+]** key to confirm and the display shows "Comm..." to indicate that the ToxiRAE monitor is ready and waiting for communication with PC. During the communication session, the PC will directly control the ToxiRAE monitor through the serial link. There is no need for users to press any key on the ToxiRAE monitor during the communication session.

If no data transfer has occurred within two minutes, the ToxiRAE monitor will return to instantaneous reading display.

Note: Do not connect to the parallel port of the PC by mistake. The parallel port is usually a 25 pin **female D connector** on the back of the PC, the serial port is usually a 25 or 9 pin **male D connector**. If the serial port on the PC is a 25-pin connector, the user needs to use a 25 pin to 9-pin adapter in order to accept the serial cable.

5.3 Start ProRAE-Suite Software

To start the ProRAE-Suite software, click the **Start** button on the taskbar to display the **Start** menu, click **Programs -> ProRAE-Suite -> ProRAE-Suite** submenu item to start the ProRAE-Suite software. Figure 5.3 shows the main window of the ProRAE-Suite software.
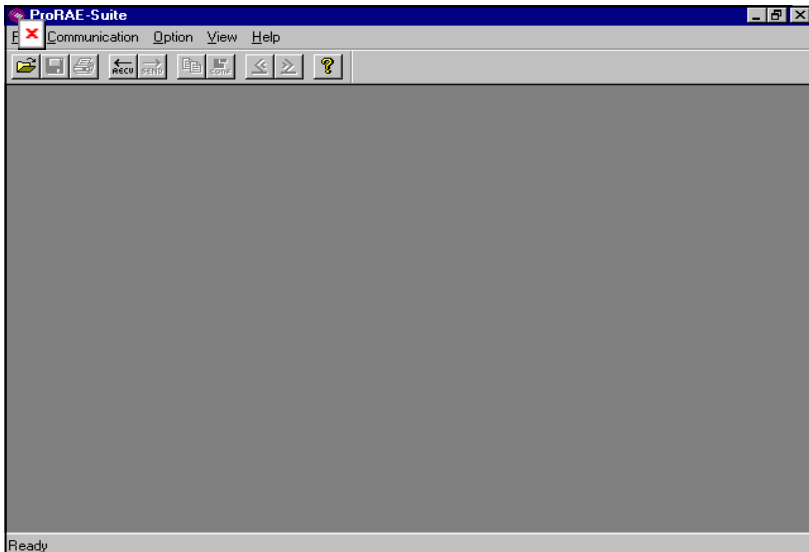

Figure 5.3   ProRAE-Suite Main Window

The functions of ProRAE-Suite software can be divided into three categories:

1) Configuration data category. This category includes editing the configuration data file, sending the configuration data to the ToxiRAE monitor and receiving the configuration data from the ToxiRAE monitor, etc.

2) Logged data category. This category includes receiving the logged data from the ToxiRAE monitor,

displaying the logged data in different format, exporting the logged data to a tab delimited text file so that it can be read by the Microsoft Excel software, etc.

There is a tool bar beneath the menu bar. The frequently used functions are represented in this tool bar in the form of a small icon. For example, the **Receive data** function in the **Communication** sub-menu is represented as a small arrow with the letters "RECV." When the mouse cursor (a small arrow) is positioned near each icon in the tool bar, a short text will also appear at the bottom of the Window to describe the function of this icon.

This tool bar allows users to invoke a function conveniently by clicking on the icon without going through the sub-menus.

5.4 Setup Communication Port

It is necessary to setup the communication port on the ProRAE-Suite software so that the ToxiRAE monitor can communicate with the PC correctly. Figure 5.4 shows the **Setup Port** dialog box. Choose the appropriate port according to the PC's serial port setup.
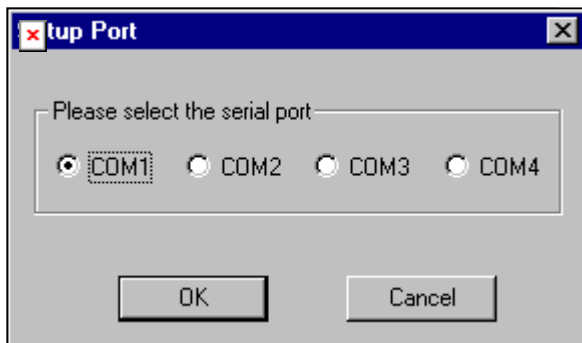
Figure 5.4   Setup Port Dialog

Note: In most PC's, there are two serial ports. Make sure that the serial port selected in the **Setup Port** dialog box matches the actual serial port connected to the ToxiRAE monitor.   The default serial port for ProRAE-Suite is COM1.   If the incorrect serial port is selected, an error message of "error occur during serial port initialization" will appear when a user tries to communicate between the PC and the ToxiRAE monitor.

5.5 Processing the Configuration Data

The ProRAE-Suite software allows user to edit the configuration data, send the configuration data to the ToxiRAE monitor, and receive the configuration data from the ToxiRAE monitor. The following sub-sections describe the detail of each operation.

5.5.1 Editing the Configuration Data

From the main menu of the ProRAE-Suite software, select the **Open** menu item from the **File** dropdown menu, or click the **Open** toolbar button, a dialog box appears. Select the "Files of type:" to Config Files [*.cfg], as shown in Figure 5.5.
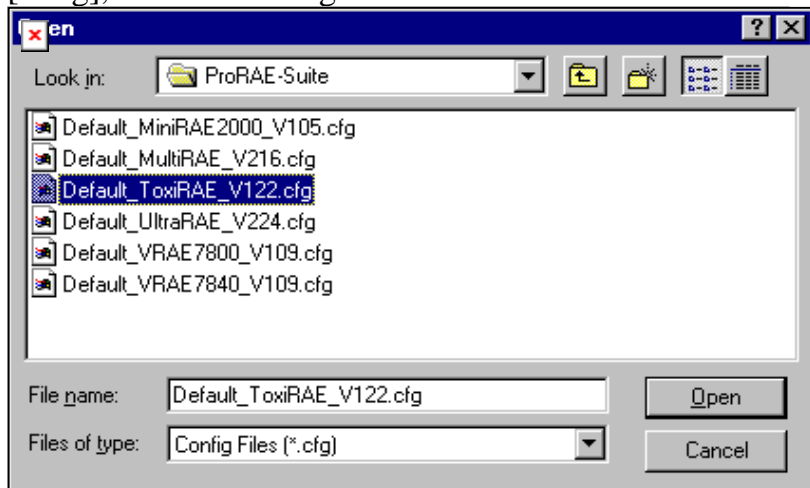

Figure 5.5   Open Dialog Box

There should be one or more configuration files in the file list. Each configuration file has a file extension of ".CFG". There is one generic ToxiRAE configuration file supplied with ProRAE-Suite software: **Default_ToxiRAE_V###.CFG**, where **###** is the version number of the default configuration file. For example, Default_ToxiRAE_V122.cfg means this file is for **ToxiRAE** monitor and its version is V1.22. Choose a configuration file by highlighting the file name and press the **Enter** key or click the **Open** button on the dialog box.

Once the configuration file is open, the configuration data is displayed in the newly opened client window, as shown in Figure 5.6.
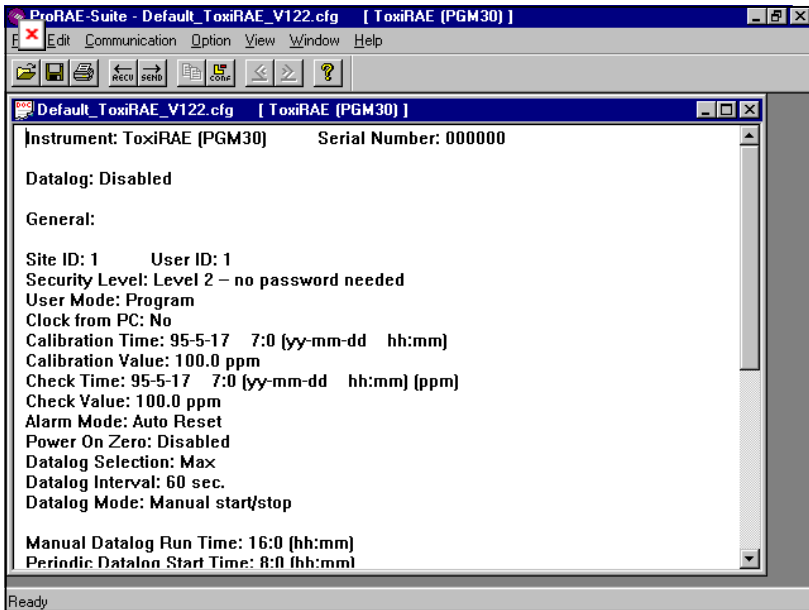

Figure 5.6   Displayed Configuration Data

To edit the opened configuration data file, click the **Edit - > Configuration** menu item or the **Configuration** toolbar button to open the **Edit Configuration File** dialog box, as shown in Figure 5.7.

After finished the editing of the configuration settings, click the **OK** button to close the **Edit Configuration File** dialog box. The new values of the configuration settings will be reflected in the client window.
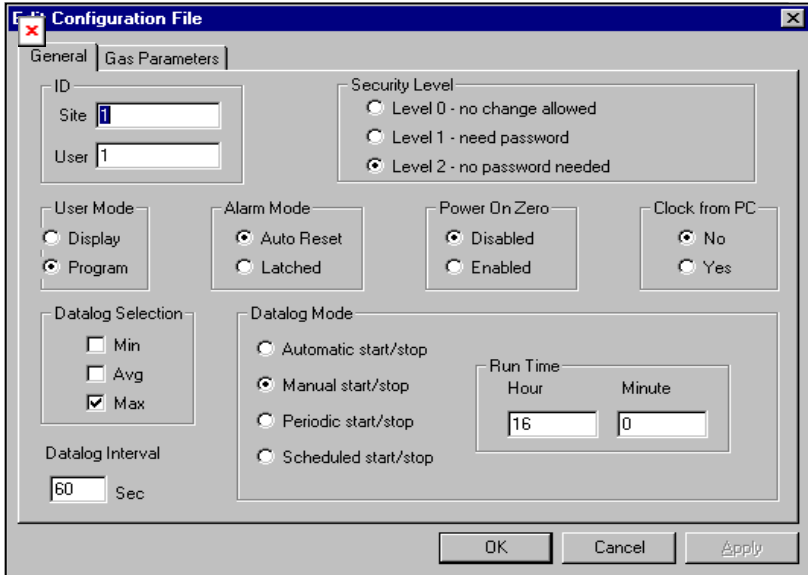
Figure 5.7   Edit Configuration File Dialog Box

The **General** tab page, which is shown in Figure 5.7, allows user to change the general settings of the configuration data. The following is the description of each field in the **General** tab page of the **Edit Configuration File** dialog:

ID:
This section sets the identification that is used throughout the datalog process. Both editing fields, **Site** and **User,** can hold up to eight alphanumeric letters.

Security Level:
There are three levels of security. Use security level to provide protection against unauthorized changes to the monitor settings in the programming mode.

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Level 0 allows the user to enter the programming menu without password checking, but does not allow changes to alarm limits, real time clock, correction factor, or user and site information, etc. The user can still perform calibrations.

If **Level 1** is selected, a four-digit password is required to enter the programming menu.

If **Level 2** is selected, the programming menu may be entered without restriction. Any changes made in the programming menu can be saved.

Password:
Entry to the programming menu requires the four-digit password be punched in if Level 1 is selected as the security level.

User mode:
In the **Display** mode, the user can view several readings in the normal operation, but cannot enter the programming menu. In the **Program** mode, the user can enter the programming mode to calibrate the monitor or change various setups in the monitor.

Alarm mode:
This option allows the alarm to be either **latched** or **auto-reset**. Selecting the **auto-reset** option allows the monitor to turn off alarms when the alarm situation no longer exists. The **latched** option allows the alarm to stay on as long as the alarm situation is no longer exist and a key is pressed to acknowledge the alarm situation.

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Power On Zero:
This option allows the monitor to perform a fresh air calibration automatically when the monitor is turned on. Care must be taken, when using this mode, to ensure that the monitor is in a fresh air environment when turned.

Clock from PC:
This option allows the PC clock to be downloaded to the ToxiRAE monitor so that the user does not need to manually set the clock in the ToxiRAE monitor.

Datalog Selection:
User can choose one or more values for datalogging purpose. User can choose to datalog the minimum, average, and maximum values, or any combinations of the three values.

Datalog Interval:
The datalog interval is the rate at which datalog samples are recorded while the datalog is running. The unit of datalog interval is second. The datalog interval determines how often a new sample is calculated and stored to the datalog.

Datalog Mode:
This may be set to either of four choices:
-- With **Automatic start/stop**, the datalogging begins when the monitor is turned on and ends when it is turned off.
-- With **Manual start/stop**, the datalog can begin by a series of key presses in the menu of normal operation. The maximum run time determines an automatic end to the datalog or it can be stopped manually.
-- If **Periodic start/stop** (or daily) mode is chosen, the user must specify the start and stop hour and minute. The

interval between start and stop is the period of time the monitor will datalog (at "data logging period" rate).

-- With **Scheduled start/stop,** all the entry boxes for year, month, day, hour and minute for both start and stop time must be entered to specify when the datalog is to occur.

Run Time:

If **manual start/stop** mode for datalogging is chosen, the user needs to specify a maximum run time. After the monitor has been on for the specified run time, datalogging will be turned off automatically.

Start Time and Stop Time:

If **scheduled start/stop** mode is chosen for datalogging, all entry boxes must be completed for start and stop year, month, day, hour and minute. The monitor must already be turned on. Then once the start date/time is reached, the monitor will start datalogging. When the stop date/time is reached, the datalogging will stop automatically. With **periodic start/stop** mode, the hours and minutes are used for the datalog period to be run each day.

Figure 5.8 shows the **Gas Parameters** tab page that allows the user to change the gas parameters of the configuration data. The following is the description of each field in the **Gas Parameters** tab page **of the Edit Configuration File** dialog:
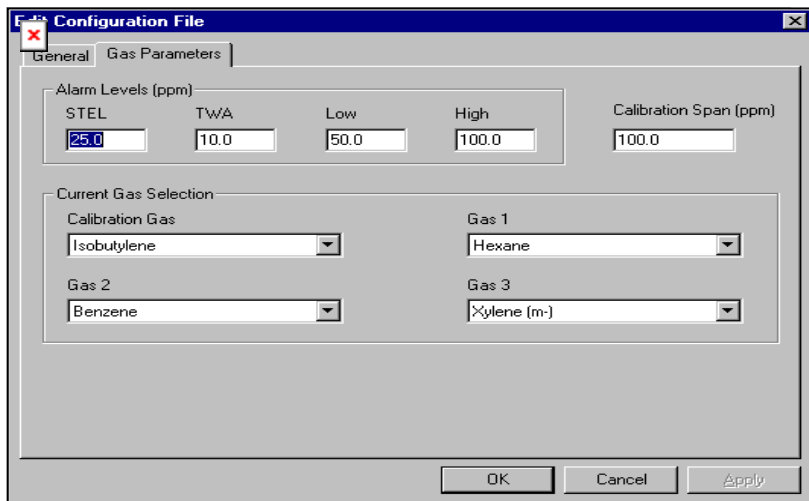
Figure 5.8   Gas Parameters Settings Tab Page

Alarm Levels (ppm):
This is the place where the user can specify the STEL alarm level (ppm), TWA alarm level (ppm), low alarm level (ppm) and high alarm level (%) for the sensor.

Calibration Span (ppm):
The user can specify the calibration gas span for the sensor here.

Current Gas Selection:
This is the place where the user can choose a set of gases for correction factors of the sensor. Each list box contains a list of gases. Scroll the list using the up or down arrow until the desired gas name is shown. Press **Enter** key to select the gas.

OK/Cancel:

When the configuration changes are completed, click on the **OK** button to save the configuration and return to the client window, or click on the **Cancel** button to abort the configuration changes.

5.5.2 Send Configuration to the ToxiRAE

After the ProRAE-Suite software opens the configuration data file, the user can send the configuration settings to the ToxiRAE monitor. To send the configuration settings to the instrument, click **Communication->Send Config** menu item or click the **Send** toolbar icon (right arrow with "Send" letters), a message box will appear to remind the user to connect the instrument to the PC through the serial port. After making sure that the instrument is connected to the PC, click the **OK** button to start the data transfer.

After the configuration information is sent successfully, a message box will appear to indicate that the configuration sending process is completed. Click the **OK** button to close the message box.

If the communication is not successful, an error message indicating that there is no response from the instrument will appear. Check the cable to make sure that the connectors on both ends of the cable are securely seated in the sockets, then try to send the configuration again. If the error message still appears after repeated attempts, call an authorized service center for help.

5.5.3 Receiving Configuration Data

To receive the configuration data from the ToxiRAE monitor, click the **Communication->Receive Config** menu item. A message box will appear to remind the user to connect the instrument to the PC through the serial port. After making sure that the instrument is connected to the PC, click the **OK** button to start the data transfer. After the data transfer is finished, a new client window is opened with the newly received configuration data displayed. In order to save the configuration information for future use, user can click **File->Save** or **File->Save As** menu item to save the newly received configuration data to a file. Once the configuration file is saved on disk, it can be opened at a later time for further modification or can be sent to the ToxiRAE monitor.

5.5.4 Configuring All Settings

A user can use this function to update the entire configuration settings (except the instrument ID, serial number and the datalog option) in the ToxiRAE monitor. To configure all the settings in the instrument, click the **Option->Config All** menu item, and a message box will appear to remind the user to connect the instrument to the PC through the serial port. After making sure that the instrument is connected to the PC, click the **OK** button. Another message box will appear to warn the user that this operation will erase all the current configuration settings in the monitor. If the user does not want this to happen, click the **Cancel** button, otherwise click the **OK** button to start the data transfer.

After the information is sent successfully, a message box will appear to indicate that the sending configuration process is completed. Click the **OK** button to close the message box.

*Note***:** The **Config All** option is mainly used to restore the ToxiRAE monitor's default operational settings, such as calibration data, lamp & pump drive, and diagnostic parameters, etc.   If the user feels that the internal calibration data of the instrument are set incorrectly and cannot be recovered, then the user can open the default configuration file and use this option to restore the instrument to a known state.

5.6 Processing the Logged Data

The ProRAE-Suite software allows the user to retrieve the logged data from the ToxiRAE monitor and display the data in many different formats. The user can also export the displayed text to a tab delimited text file so that Microsoft Excel can read it directly.

5.6.1 Receiving Data

To receive the logged data from the ToxiRAE monitor, click the **Communication->Receive Data** menu item or click the **Receive Data** toolbar button (left arrow with "Recv" letters). A message box will appear to remind user to connect the instrument to the PC through the serial port. After making sure the instrument is connected to the PC, click the **OK** button to start the data transfer. After the data transfer is finished, a new client window is opened with the newly received logged data displayed. In order to save the logged data for future use, user can click **File->Save** or **File->Save As** menu item to save the newly received logged data to a file.

5.6.2   View Logged Data in Text Mode

Once the user opens a data file or receives the logged data from the instrument, a data window appears, as shown in Figure 5.9.
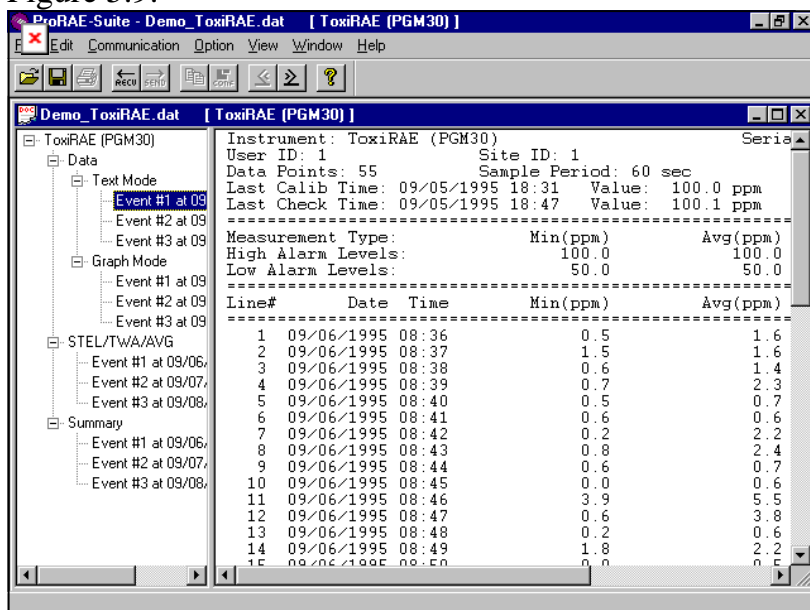

Figure 5.9   Displayed Logged Data

The data window is a two-pane client window. The left pane is a tree view that lists all the display format of each event, and the right pane displays the information according to the display format and the event the user selected on the left pane. To select any display format of any event, the user can simply click the format item on the left pane. To view the next event or the previous event, the user can click the **Next Event** (double right arrow) or the **Previous Event** (double left arrow) toolbar buttons. The user can also drag the splitter bar between

the left pane and the right pane to the left or to the right to enlarge a pane as desired.

To view the data points of a specific event, the user can click the item representing that event under the item **Text Mode**. For example, click the item **Event #1** on the left pane, and the right pane displays the data points of event #1, as shown in Figure 5.9.

5.6.3 View STEL/TWA/AVG Value

To view the STEL, TWA or AVG value of any event, click the event number item under the tree item **STEL/TWA/AVG** in the left pane.   The right pane displays the STEL, TWA and AVG value of each data point of that event, as shown in Figure 5.10.
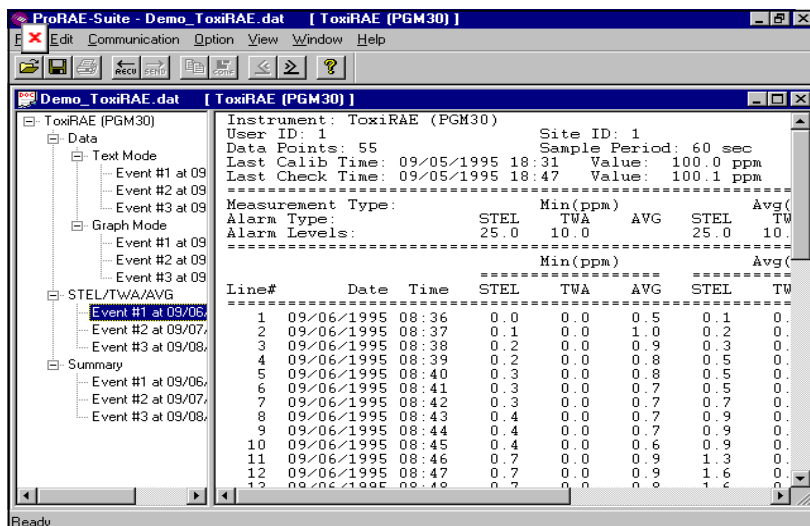

Figure 5.10   STEL/TWA/AVG of the Logged Data

5.6.4 View Summary Information

To view the summary information of any event, such as peak value and minimum value, click the event number item under the tree item **Summary** in the left pane. The right pane displays the summary information of that event, as shown in Figure 5.11.
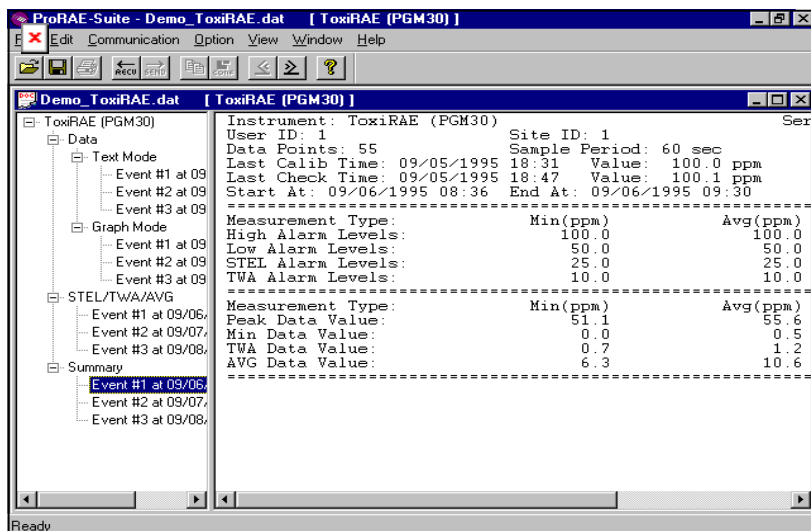

Figure 5.11   Summary Information of the Logged Data

5.6.5   View Logged Data in Graph Mode

To view the logged data of a specific event in graph mode, click the event item under the tree item **Graph Mode** in the left pane, and the right pane displays the graph of that event, as shown in Figure 5.12.
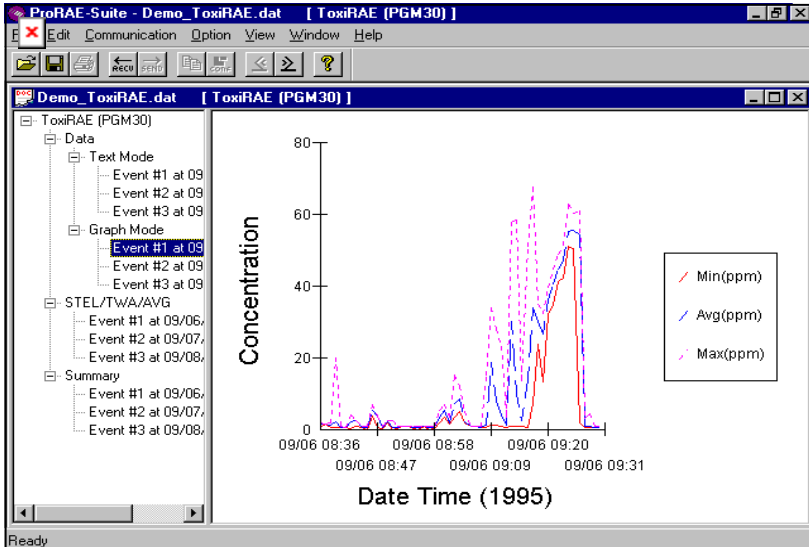
Figure 5.12   Graph of the Logged Data

Select graph type:

The user can choose the type of data in the **Graph Type** tab page of the **Graph Settings** dialog box. To display the **Graph Settings** dialog box, click any place in the right pane so that pane has the focus, then click **Option->Graph Settings** menu item to display the **Graph Settings** dialog box. Figure 5.13 shows the **Graph Type** tab page of the **Graph Settings** dialog box.
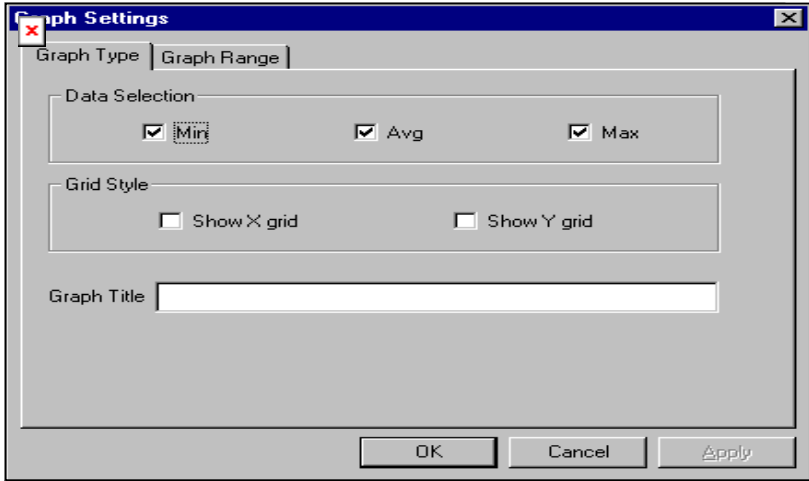
Figure 5.13   Graph Type Tab Page

Select graph range:

User can choose the value range on the x-axis and y-axis in the **Graph Range** tab page of the **Graph Settings** dialog box. To display the **Graph Settings** dialog box, click any place in the right pane so that pane has the focus, then click **Option->Graph Settings** menu item to display the **Graph Settings** dialog box. To bring the **Graph Range** tab page, user can simply click the page header of the **Graph Range** tab page. Figure 5.14 shows the **Graph Range** tab page of the **Graph Settings** dialog box. This is the place where user can choose the graph range on the x-axis and y-axis.
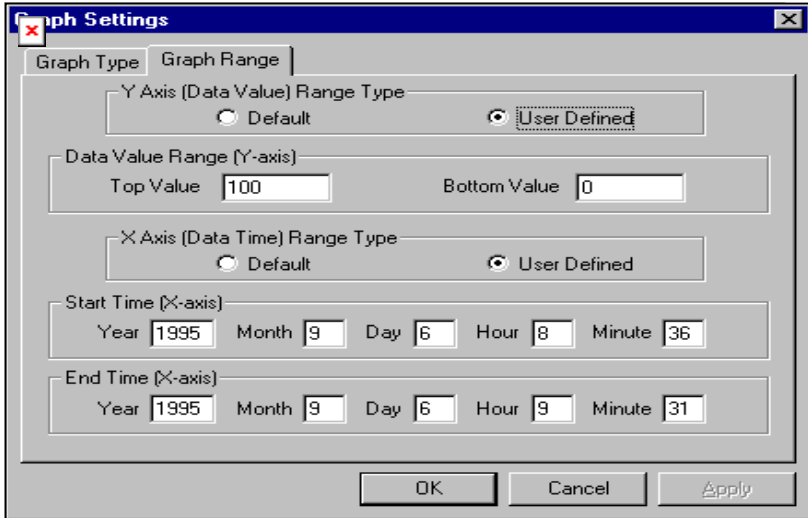
Figure 5.14   Graph Range Tab Page

To choose the range of Y-axis, first click the **User Defined** radio button in the **Y-Axis (Data Value) Range type** group box, then user can specify the top value and the bottom value in the **Data Value Range (Y-axis)** group box.

If the user selects the **Default** radio button in **the Y-Axis (Data Value) Range type** group box, the ProRAE-Suite software will scale the range of Y-axis by itself to cover the maximum data value on the y-axis.

To choose the range of X-axis, first click the **User Defined** radio button in the **X-Axis (Data Time) Range type** group box, then specify the start time fields in the **Start Time (X-axis)** group box and the end time fields in the **End Time (X-axis)** group box.

If the **Default** radio button is selected in **the X-Axis (Data Time) Range** group box, the ProRAE-Suite will scale the range of X-axis by itself to cover the every data point on x-axis.

5.6.6 Export the Displayed Data to a Text File

The ProRAE-Suite software allows the user to export the displayed text to a tab delimited text file so that Microsoft Excel® can read it directly. To export the text displayed in the right pane to a tab delimited text file, click **Option -> Export Text** menu item, a **Save As** dialog box is displayed. Specify the file name in the **File name** field, then click the **Save** button.

5.6.7 Exporting Graph to a File

The ProRAE-Suite software allows the user to export the displayed graph to a windows bitmap (.bmp) file or a windows metafile (.wmf) file. To export the displayed graph in the right pane to a windows bitmap or metafile file, first click any place in the right pane to make sure that the graph pane has the focus, then click **Option -> Export Graph** menu item to display a **Save As** dialog box. Select the export graph file type (.bmp or .wmf) in the **Save as type** field, then specify the export file name in the **File name** field. Click **Save** button to close the **Save As** dialog box. The newly created graph file contains the graph displayed in the right pane.

5.6.8 Print the Logged Data

After viewing the data results, the user may print the data to a printer in order to obtain a hard copy of the text or graphic data report. First, click any place in the right pane to set the focus on that pane, then select the **File -> Print** menu item, or click the **Print** toolbar button (a printer) to print the graphic or text data.

A printer setup dialog box will appear before the printing starts so that the paper size, orientation, printer type, etc. can be configured correctly.

5.6.9 Upgrade the Datalog Option

To upgrade the datalog option of the ToxiRAE monitor, open the ProRAE-Suite software. Do not open any configuration file or data file so the ProRAE-Suite software has no client window open, as shown in Figure 5.15.
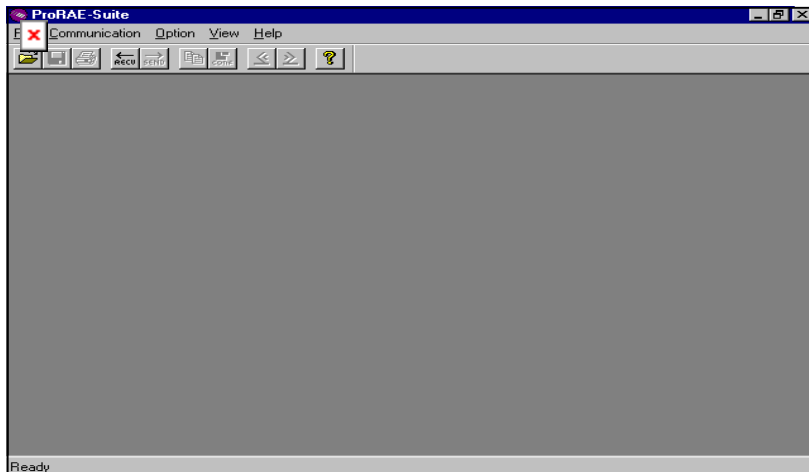
Figure 5.15   Main Window of ProRAE-Suite

Click **Option -> Enable Datalog** menu item, and a message box will appear to remind the user to connect the instrument to the PC through the serial port. After making sure that the ToxiRAE monitor is connected to the PC, click the **OK** button to start. After the ProRAE-Suite software made successful contact to the instrument connected to the PC, a dialog box is displayed, as shown on Figure 5.16.
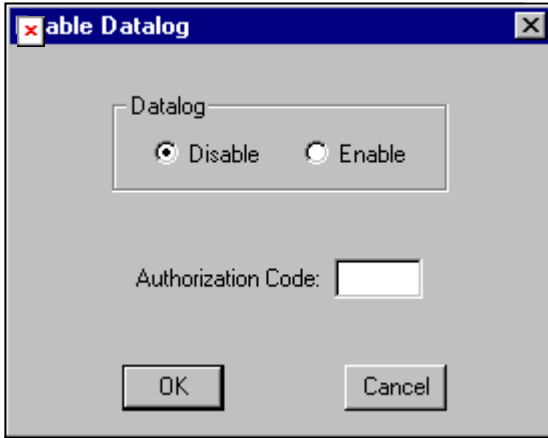
Figure 5.16   Enable Datalog Dialog Box

Figure 5.16 shows that the instrument's datalog feature are currently disabled. If the user wants to enable the datalog option, click **Enable** radio button, and type the three-digit authorization code in the **Authorization Code** field, then click the **OK** button to close the dialog box. After the datalog option is changed, a message box will appear on the screen to let the user know that the datalog option is successfully changed.

6. THEORY OF OPERATION

ToxiRAE unit uses a newly developed electrodeless discharge UV lamp as the high-energy photon source for the PID instrument. A special high-efficiency lamp driver is developed to turn on the UV lamp (see Figure 6.1).
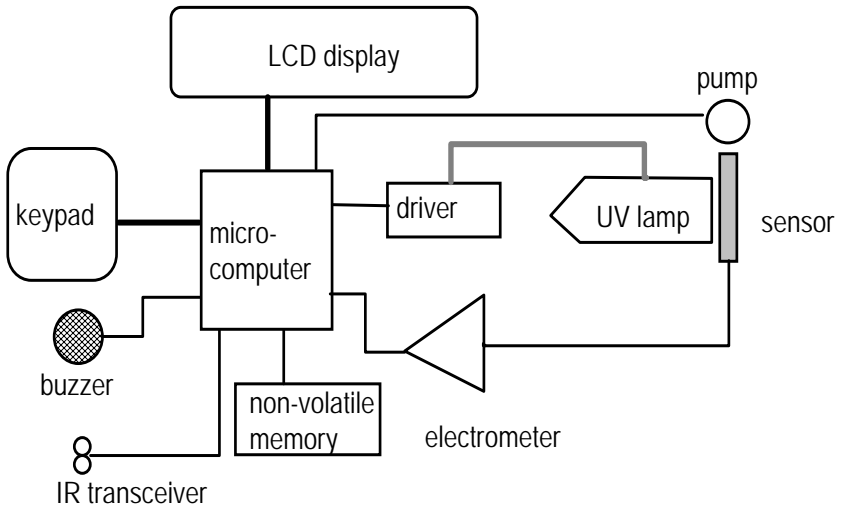
Figure 6.1   Block Diagram of ToxiRAE Unit

The ionization chamber for this ToxiRAE unit is constructed as a small cavity in front of the UV lamp. The electrode is made of wired mesh so that the high energy UV light can shine through the mesh and excite the gas molecules when they pass in front of the UV window. The ions collected on the electrode are measured by an electrometer. A centrifugal pump is installed inside the sensor module to draw an air sample into the sensor chamber for faster instrument response.

A single chip microcomputer is used to control the operation of the lamp, alarm buzzer, LED, power supply and the electrometer. It measures the electrometer readings and calculates the gas concentrations based on calibration to a known standard gas. The data is stored in non-volatile memory so that it can be sent to a PC for record keeping. A pair of infrared transceivers provides a wireless interface between the unit and the serial port of a PC. An 8-digit LCD display is used to show the readings. The user interacts with the unit through three keys on the front panel.

A rechargeable Ni-CD or alkaline battery pack powers the unit.

7. MAINTENANCE

As shown in Figure 7.1, the major maintenance items of a ToxiRAE PLUS are:

- Battery Pack
- Sensor Module
- Lamp
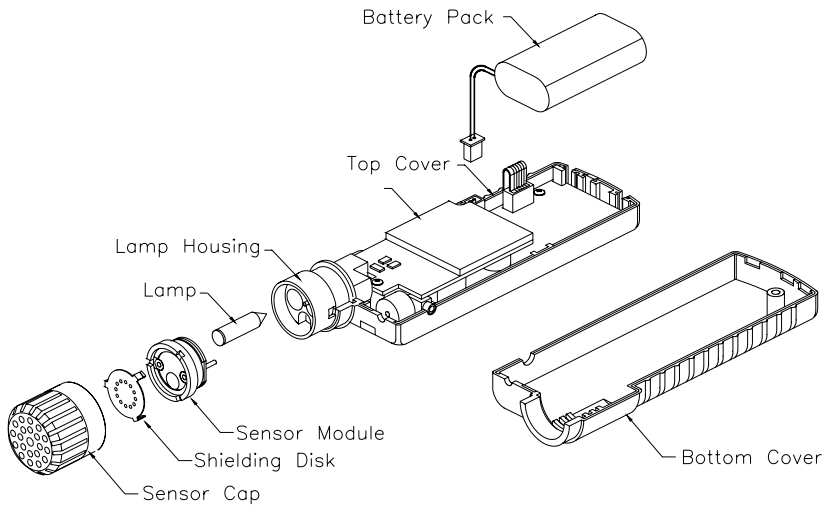
Figure 7.1   Main Components of ToxiRAE

7.1 Battery Charging and Replacement

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 ToxiRAE unit upon returning from fieldwork. A fully charged battery powers a ToxiRAE unit for 12 hours continuous operation. The charging time is less than 4 hours for a fully discharged battery. The charging station is controlled by two-step constant voltage/constant current charging to prevent over-charging.

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.

Recharging Pocket PID Unit

1. Turn off power of the Pocket PID unit.

2. Place the Pocket PID unit into the slot of the charging station to recharge (see Section 3.0).

3. Make sure that the indicator LED turns red to indicate that the unit has made good contact and is being charged. After the LED turns green, the unit is fully charged. If there is no LED light, turn the ToxiRAE in the charger so it faces the opposite direction. If there is still no LED light, it indicates a bad contact or defective battery pack.

Replacing and Recharging Battery Pack

1. Turn off power of the Pocket PID unit.

2. Refer to Figure 7.1, unscrew the sensor cap, remove one screw and open the Pocket PID unit covers.

3. Unplug the battery from the battery jack on the PC board of the Pocket PID unit.

4. Connect the battery to the rear jack on the back of the charging station for charging (see Section 3.0).

5. Replace the charged battery (or a spare battery) in the Pocket PID unit.

6. Ensure the battery plug is securely connected to the Pocket PID unit.

7. Close the Pocket PID unit covers and tighten screws.

Replacing Alkaline Battery Adapter

1. Insert two fresh AAA size alkaline batteries into the adapter. Make sure that the polarity of the battery is observed.

2. Follow the same procedure as described above to replace the battery adapter.

7.2 Sensor Module Cleaning

During the course of normal operation, a film of gas vapor may build up inside the sensor module and the filter. The rate at which the film develops depends on the type and concentration of the vapors being sampled. As a guide, it is recommended to clean the sensor module and filter regularly upon returning from fieldwork.

A metallic filter is installed in front of the sensor module to prevent dust and moisture entering the sensor module. It also serves as a static shield for the sensor. This filter needs to be cleaned when it is dirty.

The sensor module is made of several components and is attached to the lamp-housing unit as shown in Figure 7.1.

Sensor Module/Filter Cleaning Procedure
1. Turn off power of the Pocket PID Unit.

2. Refer to Figure 7.1, unscrew the sensor cap. Remove the sensor module and filter by grabbing the edge of the sensor module and gently pulling out the entire assembly.

3. Refer to Figure 7.1, carefully remove the filter from the sensor module.

4. Dip the entire sensor module into GC (Gas Chromatography) grade methanol. It is highly recommended that an ultrasound bath to be used to clean the sensor module for at least 3 minutes.

5. Clean the sensor cap and all the surface of the filter thoroughly with methanol using a cotton swab.

6. If the filter is dirty, clean the filter with methanol.

7. Refer to Figure 7.1, re-assemble the cleaned sensor module and the filter.

8. Make sure that the sensor module and filter is fully dried before it is put back into the instrument.

9. Refer to Figure 7.1, insert the sensor module and filter into the lamp housing. Make sure that the two pins on the sensor module is aligned with the two jacks on the lamp housing and the pogo pin of the lamp housing goes through the hole on the sensor module. Re-install the sensor cap to the Pocket PID Unit.

7.3 Lamp Cleaning and Replacement

If the lamp does not turn on or there is excessive film build -up on the lamp window, the unit will display a message of "Lmp" to indicate cleaning or replacing of the lamp is required. Periodic cleaning of the lamp window will also remove film deposits and restore lamp sensitivity. **Care must be exercised when cleaning the window surface so that it is not damaged.**

1. Turn off power of Pocket PID Unit.

2. Refer to Figure 7.1, unscrew the sensor cap. Remove the sensor module and filter.

3. Gently pull out the lamp, avoiding contact with the flat window surface.

4. Clean or replace a new lamp, avoiding contact with the flat window surface. Clean the filter if necessary.

5. Reinstall the sensor module and filter. Replace the sensor cap.

NOTE: When ordering replacement lamps for ToxiRAE (PGM-30) with **firmware V1.30** and above, please use **part #050-0040-000**. When ordering replacement lamps for ToxiRAE (PGM-30) with **firmware V1.27** and below, please use **part #050-0010-000**.

Lamp Window Cleaning Procedure:

Clean the lamp window surface by wiping it with anhydrous methanol using a cotton swab. Rub in a circular motion at moderate pressure. After cleaning, hold the lamp up to the light at an angle to detect any remaining film. Repeat the process until the lamp window is clean.

Never touch the window surface with fingers or anything that may leave a film.

(CAUTION: WATER WILL DEGRADE WINDOW SURFACES, ESPECIALLY THE 11.7 EV LAMP WINDOW)

8. TROUBLESHOOTING

To aid the user in diagnosing the instrument, the unit has a special mode that can display critical, low level parameters.

Along with a troubleshooting table, the user can usually narrow the problem down to one or two areas and correct the problem without having to return the unit for repair.

8.1 Special Diagnostic Mode

To place the unit into the special diagnostic mode, first turn the unit off. Next push and hold the **[Y/+]** key, while still holding the **[Y/+]** key, also push and hold the **[MODE]** key for at least two seconds. After the required delay, release both keys, the unit will now go through the normal start-up display sequence. At the end of the special mode start-up, the display will look something like "12x1". Note that no "ppm" is displayed. The first four digits are integer counts from the sensor, "x1" is the count multiplier. At higher gas concentrations this multiplier may change to "x10".

Table 8.1

Key Action	Results
	10 x1
[MODE]	Lamp 154
[MODE]	Pump 10
[MODE]	No Lamp?
[MODE]	Bat 2.4V
[MODE]	Run Time ... 00:01
[MODE]	Log On? (if log option)
[MODE]	PC comm?
[MODE]	10 x1

The Lamp and Pump displays indicate the present power consumption of the respective devices. The "No Lamp?" display can be used to calibrate the lamp failure threshold. If the lamp appears to be good but in normal operation a lamp error message is displayed, the lamp failure level may be set too high. This level can be adjusted using the following steps:
1. Turn the unit off.
2. Remove the lamp.
3. Turn on the unit in the special diagnostic mode.
4. Push the **[MODE]** key until "No Lamp?" is display.
5. Push the **[Y/+]** key in response to the question. This will optimally set the lamp error threshold.
6. Turn the unit off and replace the lamp.

In most cases lamp failure threshold adjust is not required, in which case the user should push **[MODE]** or **[N/-]**. If the **[Y/+]** key is pushed by accident (while lamp is installed), the lamp error message will appear during normal operation. The above steps must be followed to correct this problem.

8.2 Troubleshooting Table

Table 8.2

Problem	Possible Reasons & Solutions	
Cannot turn on power after charging the battery	**Reasons:**	Discharged battery. Defective battery. Microcomputer hang-up.
	Solutions:	Charge or replace battery. Disconnect then connect battery to reset computer.
No LED or LCD back light	**Reasons:**	Defective LED or LCD back light.
	Solutions:	Call authorized service center.
Lost password	**Solutions:**	Use default configuration to reset password.
Buzzer inoperative	**Reasons:**	Bad buzzer.
	Solutions:	Call authorized service center.

Problem	Possible Reasons & Solutions
Reading abnormally high	**Reasons:** Dirty sensor module. Dirty filter. Excessive moisture and water condensation. **Solutions:** Clean sensor module. Replace filter. Blow dry the sensor module.
"Lmp"/"Fan" message during operation	**Reasons:** Dirty sensor. Weak or defective lamp. Defective pump (Fan). **Solutions:** Clean sensor. Clean or replace lamp. Replace lamp housing with pump. **Note:** ToxiRAE (PGM-30) with **firmware V1.30 and above** requires replacement lamp (**part #050-0040-000**). ToxiRAE (PGM-30) with **firmware V1.27 and below** requires replacement lamp (**part #050-0010-000**).
Reading abnormally low	**Reasons:** Lamp dirty or not working. Incorrect calibration. Low sensitivity to the specific vapor. **Solutions:** Replace lamp & filter. Calibrate the unit.

Problem	Possible Reasons & Solutions	
Read a small background value	**Reasons:**	There is actually a small background gas level. Instrument zero drift.
	Solutions:	Do zero gas calibration (see Section 4.4.1).
Reading jumping around randomly	**Reasons:**	Incorrect gas calibration. Low sensitivity to cal gas.
	Solutions:	Calibrate the unit. Use different cal gas.
Cannot turn off unit or corrupted characters in LCD display	**Reasons:**	Microprocessor hang-up.
	Solutions:	Disconnect and re-connect battery to reset computer. Call authorized service center.
Calibration error message	**Reasons:**	No standard gas input. Low sensitivity to cal gas.
	Solutions:	Make sure standard gas flows into unit. Change cal gas.

| Problem	Possible Reasons & Solutions	
"Bat" message in operation	**Reasons:**	Discharged battery.
	Solutions:	Recharge battery.
Full scale measurement in humid environment	**Reasons:**	Dirty or wet sensor.
	Solutions:	Clean and dry sensor. Replace filter.
Measurement max out at certain level	**Reasons:**	Dirty lamp / sensor module. Weak lamp.
	Solutions:	Clean lamp / sensor module. Replace new lamp. Replace filter.
Excessive pump noise or fan blade does not turn	**Reasons:**	Defective fan blade. Incorrect seating of fan. Defective motor.
	Solutions:	Replace new lamp housing with pump.

APPENDIX A. QUICK REFERENCE OF DISPLAY MODE
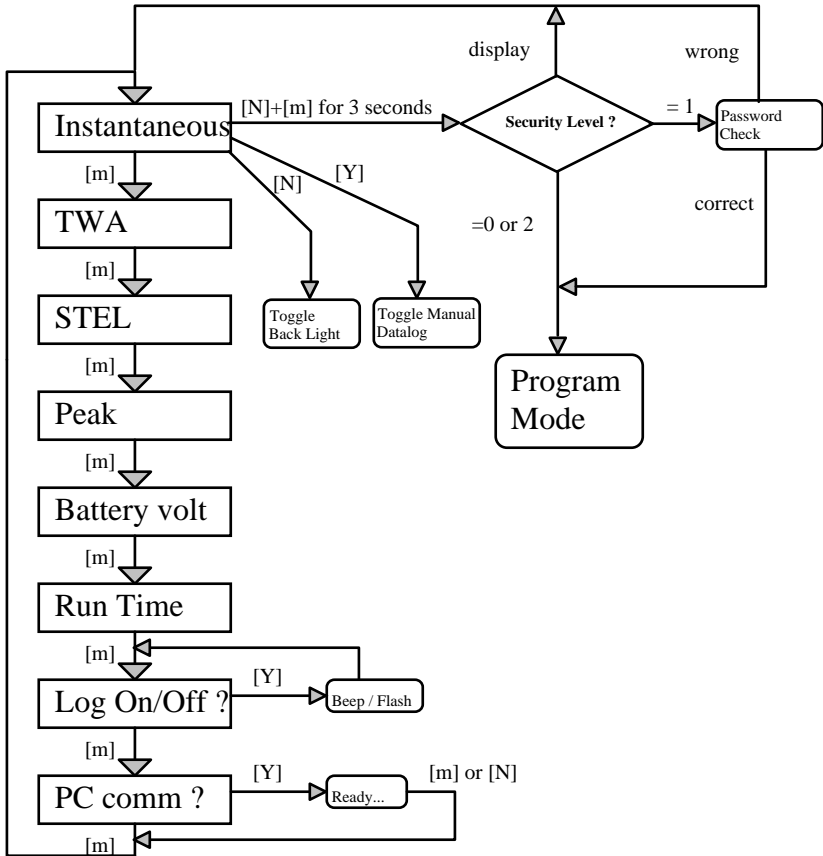
ToxiRAE POCKET PID
DISPLAY MODE

Key	Display	Meaning
MODE	ON!...	power on and version #
	V 1.20D	firmware version, datalog option
	SNxxxxxx	unit's serial number
	Diagnose	diagnostic in progress
	Alarms ...	current 4 alarm limits
	Bat =2.8 V	battery voltage
	Mem xx%	available data memory
	0.0 ppm	real time reading (ppm)
MODE	TWA 0.0	TWA reading (ppm)
MODE	STEL 0.0	STEL reading (ppm)
MODE	Peak 0.0	Peak reading (ppm)
MODE	Bat = 2.5 V	battery voltage (volt)
MODE	Run Time = 0:30,	Run time (hour: minute)
MODE	Log On/Off?	Enable or disable datalogging
Y/+		start/stop datalog in manual mode
MODE	PC Comm?	PC interface?
	Ready ...	standby for PC interface
N/-		on / off back light
MODE & N/- (3 sec)	Code0000 request password	
	Calib?	enter program mode
	Code????	in-correct password
	Display.	display mode only
Y/+	xx.x ppm	acknowledge latched alarm
MODE (5 sec)	OFF!.. turn off power	

General Message		
	Lmp	lamp failure
	Fan	pump or fan failure
	Mem	datalog memory full
	Bat	low battery voltage

APPENDIX B. QUICK REFERENCE OF PROGRAM MODE
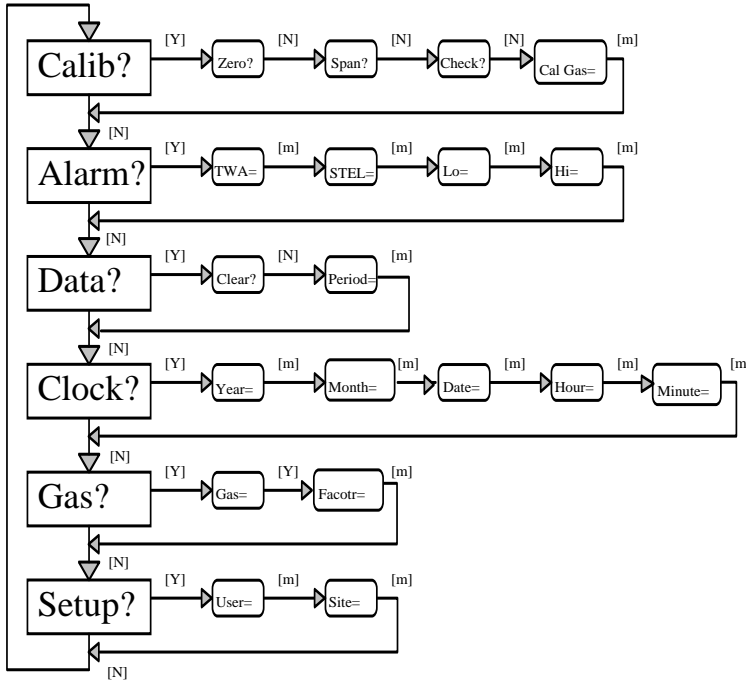
ToxiRAE POCKET PID
PROGRAM MODE

Key	Display	Meaning
MODE & N/-		Calib? calibrate instrument?
N/-	Alarm?	set alarm limits?
N/-	Data?	set datalog options?
N/-	Clock?	set real time clock?
N/-	Gas?	select gas correction factor?
N/-	Setup?	setup instrument information?
Y/+	Zero?	zero gas calibration?
N/+	Span?	span gas calibration?
N/+	Check?	span gas check?
Y/+	Gas On?	is span gas on?
	100.0 OK?	accept the value?
N/+	Cal Gas?	edit calibration gas value?
Y/+	Cal Gas=+-100.0	enter cal gas value
Y/+	TWA=+-01.0	enter TWA limit
MODE	STEL=+-02.0	enter STEL limit
MODE	Lo Alarm +-10.0	enter Lo Alarm limit
MODE	Hi Alarm +-10.0	enter Hi Alarm limit
Y/+	Clear?	clear data memory?
Y/+	Sure?	sure to clear data memory?
N/+	Period?	change datalogging period?
Y/+	Period=+-0060	enter datalogging period
Y/+	Year=+-01	enter year
MODE	Month=+-02	enter month
MODE	Day=+-10	enter date
MODE	Hour=+-14	enter hour
MODE	Minute=+-30	enter minute
Y/+	Gas=Hexane?	select this gas?
Y/+	Factor=+-02.40	enter correction factor
Y/+	User0020	enter user ID
MODE	Site0012	enter site number

APPENDIX C. RESPONSE INFORMATION

Calibration factors for a number of commonly used organic vapor for 10.6 eV lamp is included in Table C.1

Correction Factors for the 10.6 eV lamp:

Table C.1

Compound	Correction Factor
Acetaldehyde	5.5
Acetone	1.1
Allyl alcohol	2.4
Benzene	0.53
Butadiene	1.0
Butyl acetate	2.6
Carbon disulfide	1.2
Cyclohexane	1.4
Cyclohexanone	1.0
Cyclohexene	0.90
Diethyl amine	0.97
Diethyl sulfide	0.51
Ethyl acetate	4.6
Ethyl alcohol	12
Ethyl benzene	0.52
Ethyl ether	1.1
Ethylene	9.9
Heptane (n-)	2.6
Hexane	4.2
Hydrogen sulfide	4.1

Correction Factors for the 10.6 eV lamp continued:

Isopropyl alcohol	6.0
Methyl ethyl ketone	0.86
Methyl isobutyl ketone	1.2
Methyl methacrylate	1.4
Octane (n-)	1.8
Perchloroethylene	0.58
Pinene (a-)	0.31
Pinene (b-)	0.37
Propylene	1.7
Styrene	0.42
Tetrahydrofuran	1.8
Toluene	0.50
Trichloroethylene	0.52
Vinyl chloride	2.14
Xylene (m-)	0.43
Xylene (o-)	0.59
Xylene (p-)	0.45

The calibration factors in Table C.1 are measured relative to 100 ppm Isobutylene gas at 50% relative humidity and 25°C. These factors may change at higher concentration level or different temperature and humidity conditions.

APPENDIX D. RAE SYSTEMS TECHNICAL NOTES

π TN-102 Facts About PID Measurement

π TN-103 External Datalogger Interface to MiniRAE PID

π TN-104 Partial List of Ionization Potentials

π TN-105 MiniRAE PID Battery Characteristics

π TN-106 Correction Factors, Ionization Potentials, and Calibration Characteristics (updated quarterly)

π TN-108 MiniRAE PLUS PGM-76 and 76IS ProRAE 76 Software Upgrade for PGM-75

π TN-109 MiniRAE Professional PID Zero Drift

π TN-112 MiniRAE PLUS Datalogger Data Conversion to Microsoft Excel version 5.0

π TN-113 Calibration Procedures for ModuRAE PDM-10A

π TN-114 ToxiRAE Sensor Specifications

π TN-115 ToxiRAE Toxic Gas Monitor (PGM-35) at a Glance

π TN-116 ToxiRAE Oxygen Monitor (PGM-36) at a Glance

π TN-117 ToxiRAE Combustible Gas Monitor (PGM-37) at a Glance

π TN-118 Use of RAE PIDs for Soil Headspace Measurements

π TN-119 Calculation of STEL, TWA, Min., Max., and Average Values for ToxiRAE PID.

π   TN-120 Measuring Correction Factors for Volatile Compounds with MiniRAE 7 and ToxiRAE PIDs

π   TN-121 CO Sensor Cross-Sensitivity and Removal with Charcoal Filter

π   TN-122 MiniRAE Compliance with EPA Method 21

π   TN-123 Diagnostic Modes for RAE Instruments

π   TN 124 PID Lamp Characteristics

π   TN 125 Creating Custom Correction Factors and Gas Names for the ToxiRAE PID

π   TN-126 Interchangeability of Sensors in PGM-35 and PGM-50

π   TN-127 Benzene-Specific Measurements in Petroleum Hydrocarbons using the UltraRAE

π   TN-128 ToxiRAE PID Communications Problems

π   TN-129 Gas Detection Tube and Hand Pump Interchangeability

π   TN-130 Setting Alarm Limits for Mixtures

π   TN-131 Verifying and Fixing Gas Alarm Limits

π   TN-132 Upgrading RAE Instruments Firmware

π   TN-133 Methylene Chloride-Specific Measurements using the UltraRAE

π   TN-134 UltraRAE Bar Code Reader Patterns an Adjustments

π   TN-135 UltraRAE Firmware and Tube Data Upgrade Procedures

π   TN-136 UltraRAE Operations Tips

π   TN-137 Exiting Diagnostic Mode for ToxiRAE LEL

π   TN-138 RAE System Year 2000 Compliance

π   TN-139 UltraRAE Communication with NT

π   TN-140 Tubing Volume

π   TN-141 MultiRAE Remote Control

π   TN-142 MiniRAE 2000 Compound Library

π   TN-143 Tube Accuracy Comparison

π   TN-144 LEL Sensor Poisoning

π   TN-145 Ni-Cd Maintenance

π   TN-146 UV Lamps

π   TN-147 UltraRAE Butadiene

π   TN-148 Phosphine PID Lamp Care

π   TN-149 PGM-30 UV Lamps

See Appendix F on how to obtain
Technical Notes.

APPENDIX E. RAE SYSTEMS APPLICATION NOTES

- π AP-200 PIDs and Aircraft Wing-tank Entry
- π AP-201 Measuring Ammonia (NH_3) with PIDs
- π AP-202 ABCs of Gases in Industry
- π AP-203 PID as a Hazmat Response Tool
- π AP-204 Pulp & Paper: Measuring Turpentine & ClO_2
- π AP-205 Measuring Heat Transfer Fluids with a PID
- π AP-206 Guide to Atmospheric Testing in a Confined Space
- π AP-207 PIDs as an Arson Investigation Tool
- π AP-208 HAZMAT User List
- π AP-209 UltraRAE User List
- π AP-210 North American RAE Instrument User List
- π AP-211 PIDs for Continuous Monitoring of VOCs
- π AP-212 PIDs for Indoor Air Quality
- π AP-213 ModuRAE PID Configuration and Applications
- π AP-214 Environmental Applications for PIDs
- π AP-215 Gas Detection in Marine Industry
- π AP-216 Weapons of Mass Destruction
- π AP-217 Confined Spaces in the Construction Industry
- π AP-218 Lengthening the Interval Between Calibration Checks
- π AP-219 Using PIDs for 10% of LEL Decisions
- π AP-220 Using PIDs in Clan Lab Investigations
- π AP-221 PIDs for Exposure Risk in Unknown Environments
- π AP-222 CO & Natural Gas Detection for Fire Department Engine Companies
- π AP-223 ppbRAE User List

See Appendix F on how to obtain Application Notes.

APPENDIX F. LITERATURE REQUEST

Photocopy this page and fax to:

Attn: Literature Department
1.408.952.8480 FAX

Please send me the following information:

Name: _____

Company: _____

Mailing Address: _____

City, State, Zip: _____

Country:
Telephone: _____

Fax: _____

Technical Notes:
(just list TN #) _____

Application Notes:
(just list AP #) _____

Comments: _____

_____

_____

Thank you,
RAE Systems Sales & Marketing Department

APPENDIX G. REQUEST FOR RETURN AUTHORIZATION FORM

Need to send your monitor in for repair, calibration, service or upgrading?

Photocopy this page and fax to:
1.408.952.8480
You will receive, via fax, an **RMA Number**
and instructions on how to ship.

We must obtain the following information in full:

Name: _____

Company: _____

Shipping
Address: _____
City, State, Zip: _____

Telephone: _____

Fax: _____
Serial number: _____
Model: _____
Reason for
return: _____

_____

_____

Note: When returning an instrument for repair, please send only the monitor that needs to be worked on without any additional accessories. Only send accessories with the instrument when they are also in need of repair. This will help us get your equipment back to you in an efficient manner.

Thank you,
RAE Systems Service Department

LIMITED PRODUCT WARRANTY

RAE Systems (RAE) warrants the RAE products to the original owner purchased directly from RAE or an authorized RAE Reseller to be free of defects in workmanship for a period of one year from the date of original shipment to owner exclusive of consumable including batteries, filters and calibration gases. Pumps and 10.6 eV electrodeless discharge lamps are warranted for one year, 9.8 eV lamps for six months and 11.7 eV lamps for one month. RAE's obligation under this warranty is limited to replacing or repairing, at RAE's option, any defective part if returned to a RAE authorized factory repair center, with shipping charges prepaid by the buyer, and which, upon inspection by RAE, shall prove to have been defective in normal use and service.

To validate this warranty the original Warranty Registration Card supplied with the product must be completed and returned to RAE within 30 days of purchase. To maintain warranty, Purchaser must perform maintenance and calibration as prescribed in the Operation and Maintenance manual. In the event of defect, Purchaser will notify RAE designated factory repair center in advance and if trouble diagnosis procedures are unable to determine and remedy the condition, a Return Material Authorization (RMA) will be issued to assure proper repair and logistics tracking.

Warranty does not extend to any equipment malfunction or damage which results from alteration, accident, theft, misuse, abuse, abnormal use, improper or unauthorized repairs or improper maintenance. RAE neither assumes nor authorizes any other firm or person to assume on RAE's behalf any liability in any way connected with the sale of RAE products.

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For technical support, please call
1.888.723.4800   M-F   6:00 AM - 6:00 PM   PST

RAE Systems Inc.

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San Jose, CA 95134-1708

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FAX: 408.952.8480

Toll Free Numbers

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Technical Service: 888.RAE.4800 (723.4800)

Tube Sales: 888.RAE.TUBE (723.8823)

E-mail:

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Technical Service: tech@raesystems.com

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