

VRAE

# Using the VRAE Personal Multigas Monitor

Firmware v 2.00D



PROTECTION THROUGH DETECTION

# Training Agenda:

- VRAE features
- Turning on the VRAE
- Recommended Daily Start-up Procedure
- User displays
- Alarm modes
- Programming displays
- Calibration



PROTECTION THROUGH DETECTION

## VRAE Features: Sensors

- Oxygen: 0-30%
- Combustibles (Dual Range):
  - 0-100% by Volume
  - 0-100% of LEL
- Toxic gas sensors: Select up to four from CO, H<sub>2</sub>S, SO<sub>2</sub>, NO, NO<sub>2</sub>, Cl<sub>2</sub>, ClO<sub>2</sub>, HCN, NH<sub>3</sub>, PH<sub>3</sub>
- LEL/O<sub>2</sub> + 3 Toxics or LEL + 4 Toxics
- ClO<sub>2</sub> requires retrofit Teflon tubing inside



PROTECTION THROUGH DETECTION

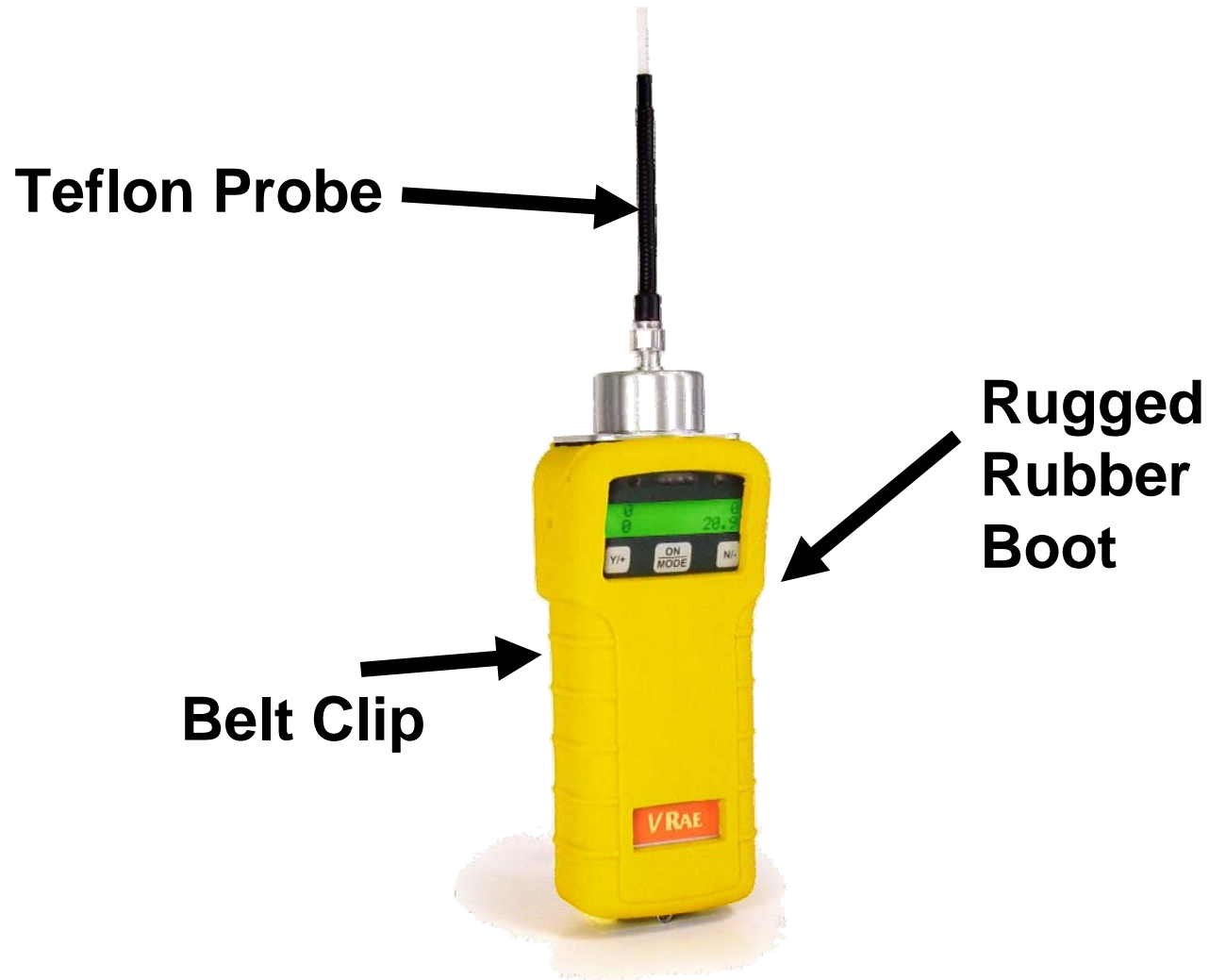
## VRAE Features: Reliability

- Extremely rugged for extensive field use
- Weather-proof case
- Temperature range of -4°F to 113°F (-20°C to 45°C)
- 4-Way power: NiMH, Alkaline or run continuously on 110 VAC and 12 VDC
- Runs 10 hours continuously
- RFI protection against radio interference
- Intrinsically safe: Class I, Division I, Groups A, B, C, D
- LEL Over-Range Protection



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# VRAE Features: Rugged Boot

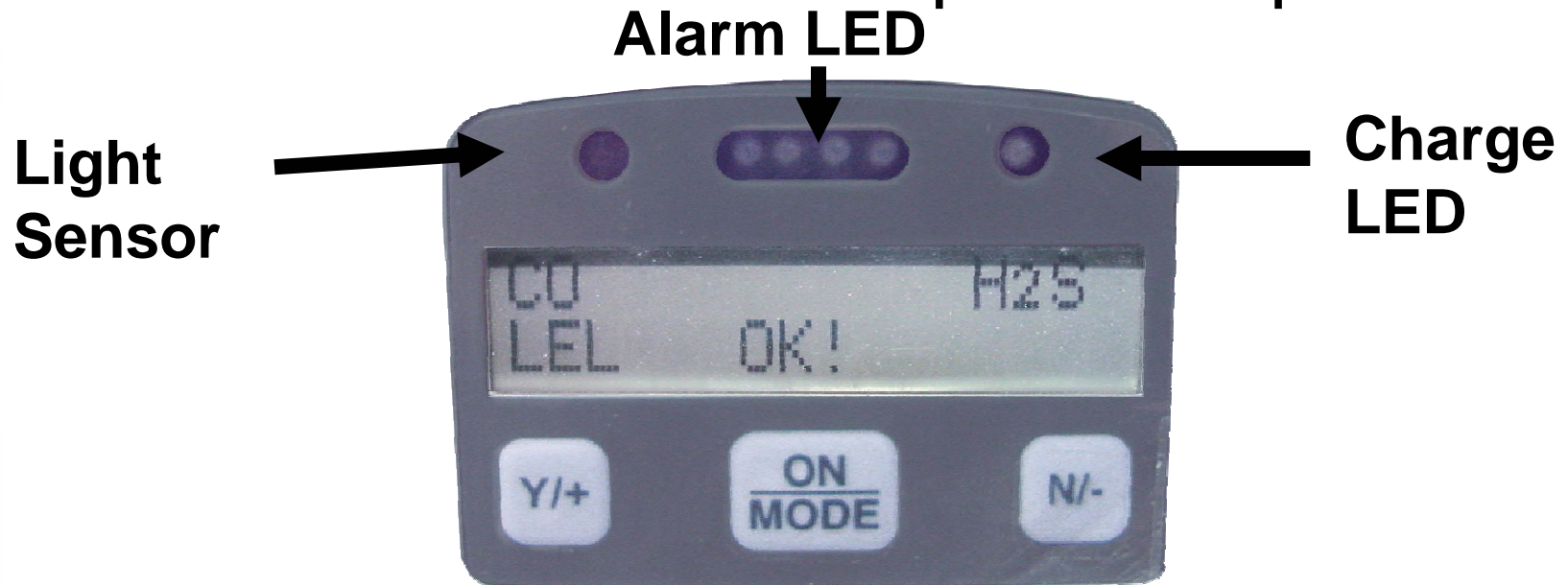


# VRAE Features: Rugged Case



PROTECTION THROUGH DETECTION

## VRAE Features: Simple Faceplate



- Three buttons on a sealed membrane faceplate:
  - Y/+ : clears & tests alarms
  - N/- : turns on manual backlight for 90 seconds
  - ON/MODE

## VRAE Features: Internal Pump

- Makes remote sampling easy
- Sample draw over 200 feet horizontally and 90 feet vertically!
- Moisture and dust trap for added protection
- Pump stall feature: when moisture is detected or when pump is blocked the pump will shut off, protecting the VRAE from potential damage
- ~500 cc/min at High flow, ~ 25% less at Low flow. Default is high



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## VRAE vs QRAE Plus

- Stronger Pump (500 vs. 350 cc/min)
- Firmware & tubing for ClO<sub>2</sub> Sensor
- Better firmware for VOL Sensor
- Up to 4 Toxic Gas Sensors vs. 3
- Different form factor
- Higher price



PROTECTION THROUGH DETECTION

## VRAE Start-up: Turning On

- Unplug VRAE from charger
- Hold “MODE” Key to turn on
- Alarm will beep once
- Watch display screen for messages such as:
  - Sensors installed & their warranty expiration
  - Alarm limits
  - Last calibration date
  - User/Alarm/Datalog modes
- Warm-up will take approximately 90 seconds



# VRAE Start-up: Warnings

TOX1

TOX2

TOX3

LEL

**Incorrect Year  
Check Clock!!!**

OXY

- If this screen appears during the start-up just acknowledge it with the “Y” key and follow the procedure for setting the clock.
- The battery has gone dead and the VRAE has detected a mismatch between the date code on the sensors and its internal clock.



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# VRAE Start-up: Warnings



- This is a warning screen. As long as the sensor calibrates properly it is valid to continue using it. Acknowledge by pressing the “Y” key to continue warm-up.
- To ensure proper operation, RAE Systems recommends replacing sensors at the end of their warranty period.



## VRAE Start-up: Check Sensor Zero

TOX1		TOX2		TOX3
	0	0	0	
LEL	0		20.9	OXY

- After 90 sec. warm-up, the VRAE should display readings for all of the installed sensors
- If there is no alarm, and the sensor readings are within limits, then the VRAE is ready for use.

# VRAE Start-up: Check Sensor Zero

TOX1		TOX2		TOX3
	0	0	0	
LEL	0-3		20.6-21.2	OXY

- If any reading is outside these limits, wait a few minutes then check again.
  - If readings are in limits use the unit
  - If readings are still outside these limits perform “Fresh air calibration”

# VRAE Start-up: Pump Alarm

TOX1		TOX2		TOX3
	0	0.0	0	
LEL	0	Pump	20.9	OXY

- Every time the VRAE is used it is important to check pump flow
- Block the filter on the pump inlet
- Reset pump alarm by pressing the “Y” key
- If pump does not go into alarm, check for loose/cracked filter or service pump



## 3 Display Modes

- **Program Mode:** 12 screens and programmability for most advanced users
- **Display Mode:** 12 screens, no programmability
- **Text Mode:** 3 screens and has password to get into programming (default)



# Comparison of Display Modes

## **Program (12)**

Sensor ID  
PEAK  
MIN  
STEL  
TWA  
Battery  
Time/Date/Temp  
Start Datalog\*  
LEL Gas  
Pump Speed  
LEL/VOL  
PC Comm

## **Display (12)**

Sensor ID  
PEAK  
MIN  
STEL  
TWA  
Battery  
Time/Date/Temp  
Start Datalog\*  
LEL Gas  
Pump Speed  
LEL/VOL  
PC Comm

## **Text (3)**

Battery  
PC Comm  
Sensor ID w/OK

\* Will not show  
if no datalogging  
option or auto  
datalogging



# Instantaneous Reading (Main Display)

TOX1		TOX2		TOX3
	0	0	0	
LEL	0	OK!	20.9	OXY

- In text mode, “OK!” is displayed if there is no alarm

# Instantaneous Reading (Main Display)

TOX1		TOX2		TOX3
	CO	SO <sub>2</sub>	H <sub>2</sub> S	
LEL	LEL		OXY	OXY

- CO: Carbon Monoxide sensor
- SO<sub>2</sub>: Sulfur Dioxide sensor
- H<sub>2</sub>S: Hydrogen Sulfide sensor
- LEL: Combustible gas sensor
- OXY: Oxygen sensor
- Tap "MODE" key to proceed

# Peak Reading Display

*This screen is deleted in Text Mode*

TOX1	TOX2	TOX3
34	584	11
LEL	PEAK	OXY
6	20.9	

- Holds Highest reading since VRAE was turned on or Peak cleared
- Tap “MODE” key to proceed to next screen



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# Minimum Reading Display

*This screen is deleted in Text Mode*

TOX1	TOX2	TOX3	
0	0.0	0	
LEL	MIN	OXY	13.5

- Holds Lowest reading since VRAE was turned on or Min cleared
- Tap “MODE” key to proceed to next screen



PROTECTION THROUGH DETECTION

# STEL Display

*This screen is deleted in Text Mode*

TOX1		TOX2		TOX3
	0	0.0	0	
LEL	STEL			OXY

- Short Term Exposure Limit (average for the past 15 minutes)
- Displays “\*\*\*\*” until VRAE has been on for 15 minutes
- STEL only is calculated for toxics
- STEL alarm beeps once a second
- Tap “MODE” key to proceed



PROTECTION THROUGH DETECTION

# TWA Display

*This screen is deleted in Text Mode*

TOX1		TOX2		TOX3
	0	0.0	0	
LEL	TWA			OXY

- Time Weighted Average is the accumulated dose in ppm-hours since the VRAE was turned on, divided by 8 hours
- TWA only is calculated for toxics
- TWA alarm beeps once per second
- Tap "MODE" key to proceed to next screen



PROTECTION THROUGH DETECTION

# Battery Voltage Display

*This screen is deleted in Text Mode*

TOX1

TOX2

TOX3

LEL

**Battery = 5.1V**  
**Shut off at 4.1V**

OXY

- VRAE shuts down when battery voltage drops below 4.2 volts
- Normal full charge is over 4.8 volts
- Tap “MODE” key to proceed to next screen



PROTECTION THROUGH DETECTION

# Date/Time/Run Time/Temp. Display

*This screen is deleted in Text Mode*

TOX1	TOX2	TOX3
Feb 15, 01	12:00	
LEL	ON=01:22	OXY
	75°F	

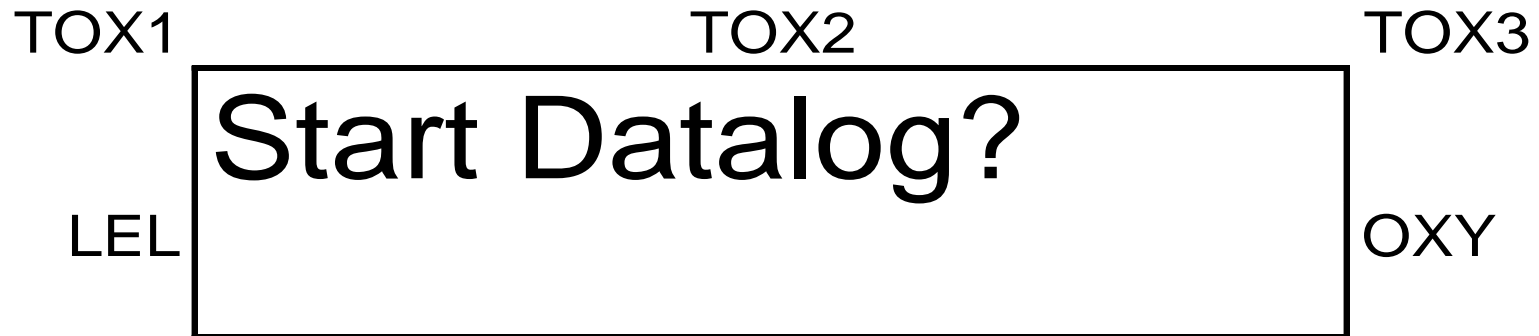
- Date, Time of day
- Accumulated time in hours and minutes since the VRAE was turned on
- Temperature in Centigrade or Fahrenheit (operating range -20 to +45°C, -4 to +113°F)
- Tap “MODE” key to proceed



PROTECTION THROUGH DETECTION

# Datalog Mode Display

*This screen is deleted in Text Mode*



- Manual: logs if “Y/+” key is pushed now
- Automatic: this screen is deleted and it logs data when as soon as the VRAE turns on
- Scheduled: logs data at a preset date & time
- Periodic: start and stop datalogging daily based on preset time

# Datalog Mode Display

*This screen is deleted in Text Mode*

TOX1		TOX2		TOX3
	0	0.0		0
LEL	0	L		OXY
				20.9

- A small “L” displayed in the left center of the screen indicates datalogging is active
- Will datalog 16,000 points (53 hrs of data)
- $T_{max} = (\#Points/\#Sensors) * Sample\ Period = (16,000/5) * 60 = 192k\ secs = 53\ hours$
- Entering programming pauses datalogging

# LEL Units Display

*This screen is deleted in Text Mode*

TOX1

TOX2

TOX3

LEL

LEL gas =  
Methane

OXY

- Target Gas for LEL displayed here (VRAE is currently measuring LEL in units of methane)
- Correction Factor can only be changed in programming mode
- Tap “MODE” key to proceed to next screen



PROTECTION THROUGH DETECTION

# Pump Speed Display

*This screen is deleted in Text Mode*

TOX1

TOX2

TOX3

LEL

Pump Speed =  
Low?

OXY

- Low speed flow rate: 300-400 cc/min
- High speed flow rate: 400-500 cc/min
- Tap "MODE" key to proceed to next screen



PROTECTION THROUGH DETECTION



# Communicate with PC Display

TOX1

TOX2

TOX3

LEL

**Communicate  
with PC?**

OXY

- If “Y/+” key is pushed then VRAE will display “Monitor will Pause. OK?”
- If “Y/+” key is pushed again the VRAE will display “Ready...” until it receives a signal from the computer or the “MODE” key is pressed.
- Tap “MODE” key to proceed



PROTECTION THROUGH DETECTION

## Communicate with PC Display



- ***When the VRAE is in this communication standby mode it stops monitoring gas concentrations and stops datalogging.***
- Datalogging must be manually restarted when exiting unless automatic datalogging is in use.

# VRAE Alarm Signals

- The VRAE will provide audible and visual alarms to alert users to unsafe states
- It is extremely important to note that during the following conditions the alarm signals are disabled:
  - *When entering the “Communicate with PC?” standby mode.*
  - *When entering the “Calibrate Monitor” menu*
  - *When viewing data in the “View or Change Datalog?” menu*



## VRAE Alarms: High

TOX1		TOX2		TOX3
	0	High	0	
LEL	0		20.9	OXY

- “High” display along with 3 beeps/second audible/visible alarm and flashing display backlight indicates that TOX2 sensor (SO<sub>2</sub>) has exceeded high alarm set point (10 ppm default set point for SO<sub>2</sub>).
- Press “Y/+” key to clear if latching alarm

## VRAE Alarms: Low

TOX1		TOX2		TOX3
	0	0	0	
LEL	0		Low	OXY

- “Low” display along with 2 beeps/second audible/visual alarm and flashing display backlight indicates that Oxygen sensor has gone into low alarm (less than 19.5% Oxygen default)
- Press “Y/+” key to clear if latching alarm

## VRAE Alarms: STEL

TOX1		TOX2		TOX3
	0	STEL	0	
LEL	0		20.9	OXY

- “STEL” display along with a 1 beep/second audible/visual alarm indicates that SO2 sensor has exceeded STEL alarm set point (5 ppm default)
- ***This alarm will only clear after 15 minutes in clean air or if the VRAE is turned off!***



## VRAE Alarms: TWA

TOX1	0	TWA	0	TOX3
LEL	0		20.9	OXY

- “TWA” display along with a 1 beep/second audible/visual alarm indicates that SO2 sensor has exceeded the TWA alarm set point (2 ppm default)
- ***This alarm will only clear after moving to clean air and then turning off the VRAE***

## Alarms: LEL OFF

TOX1	0	TOX2	0	TOX3	0
LEL	OFF		20.9	OXY	

- “OFF” display along with a 3 beeps/second audible/visual alarm indicates that LEL sensor has been exposed to too much gas and has shut off to protect the sensor.
- Move the meter to clean air and press the “Y” key to reset.

## Alarms: NEG

TOX1		TOX2		TOX3
	0	NEG	0	
LEL	0		20.9	OXY

- “NEG” display along with a 1 beep/second audible/visual alarm indicates that SO<sub>2</sub> sensor has drifted negative (below zero) because the sensor was zeroed in an area containing SO<sub>2</sub>.
- ***Perform “Fresh Air Calibration” in an area clear of all toxics.***

## VRAE Alarms: Pump

TOX1		TOX2		TOX3
	0	0.0	0	
LEL	0	Pump	20.9	OXY

- “Pump” display along with 3 beep audible alarm indicates that pump has stopped due to line clog
- Pump alarm is a latching alarm
- Clear line/filter and press “Y/+” key to clear alarm and restart pump

## VRAE Alarms: Low Battery

TOX1		TOX2		TOX3
	0	0.0	0	
LEL	0	Bat	20.9	OXY

- A flashing “Bat” display along with a 1 beep alarm every 10 seconds indicates that the battery voltage has dropped below 4.35 V and it will shut down in 20-30 minutes
- Quickly complete confined space entry and charge VRAE or install alkaline battery

## VRAE Alarms: Memory Full

TOX1		TOX2		TOX3
	0	0.0	0	
LEL	0	MEM	20.9	OXY

- A flashing “MEM” display along with a 1 beep/second audible/tactile/visual alarm indicates that the datalog memory is full.
- Clear datalog in “View or Change Datalog?”

# Getting Into Programming

- *Hold “MODE” and “N/-” keys for 5 sec. to get in Programming Mode*
- If VRAE asks a question “?”
  - Answer “Y” or “N”
- To Accept or Escape
  - Use “MODE” Key
  - repeatedly pushing the “MODE” key will always eventually return user to main display



# Programming Menus

- Calibrate Monitor?
- Change Alarm Limits?
- View or Change Datalog?
- Change Monitor Setup?
- Change Sensor Configuration?
- *Choose (Y) to accept or (N) to move on*



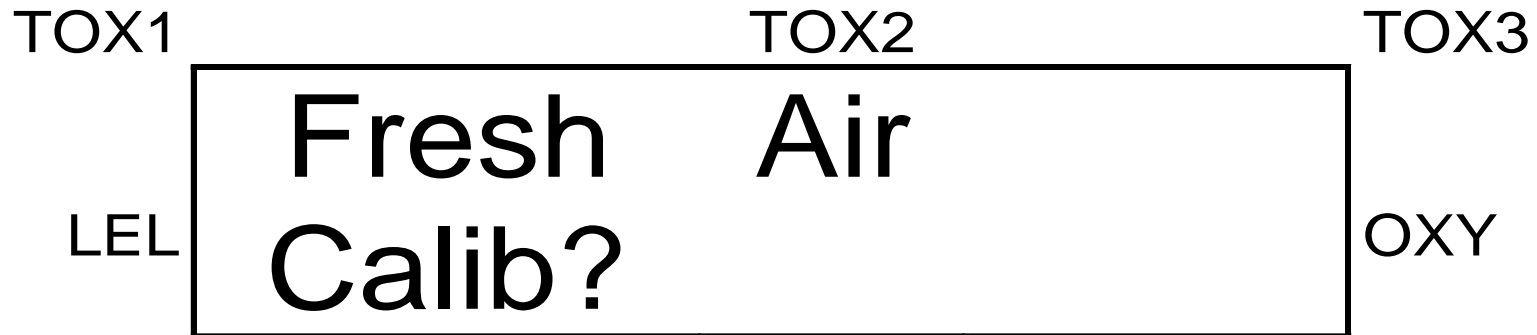
PROTECTION THROUGH DETECTION

# Calibrate Monitor

- Fresh Air Calibration?
  - *Make sure air is clean!*
- VOL% Zero Calibration?
- Multiple Sensor Calibration?
- Single Sensor Calibration?
- Modify Span Gas Value?
- Change LEL/VOL Span Gas?
  - *Choose (Y) to accept or (N) to move on, MODE to escape*



# Fresh Air Calibration



- At “Fresh Air Calibration” press “Y/+” key
- Zero’s all sensors including LEL but not VOL and sets O2 to 20.9%.
- Press “Y/+” key to continue

# VOL% Zero Calibration

TOX1	TOX2	TOX3
	Zero cal done	
LEL	Reading =	0
		OXY

- At “VOL% Zero Calibration” press “Y/+” key (Only shown in VOL or Auto LEL/VOL Mode)
- Apply VOL zero gas (often pure N2)
- Zero’s only VOL sensor, does not affect O2
- Successful zero cal appears as screen above
- Press “Y/+” key to continue

# Multiple Sensor Calibration

TOX1		TOX2		TOX3
	CO	- - -	H <sub>2</sub> S	
LEL	LEL	OK?	- - -	OXY

- At “Multiple Sensor Calibration” press “Y/+” key
- For CO/H<sub>2</sub>S/LEL mixed gas calibration the next screen should appear as above

# Multiple Sensor Calibration

TOX1

TOX2

TOX3

LEL

**Apply Mixed Gas**

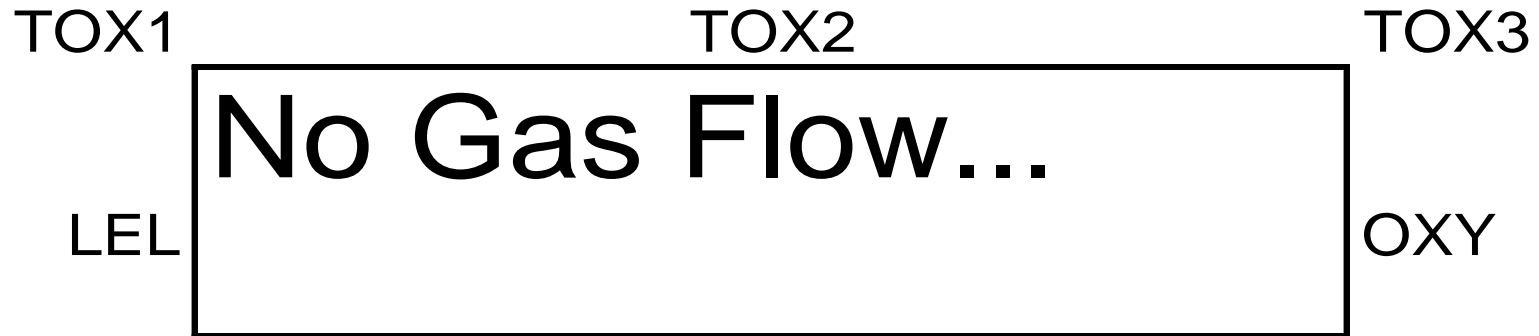
OXY

- Press “Y/+” key to display this screen
- Attach calibration gas regulator to mixed gas cylinder and attach calibration hose to VRAE
- Turn on calibration gas
- Follow instructions on screen



PROTECTION THROUGH DETECTION

# Multiple Sensor Calibration



- If you get this screen check for gas flow, the VRAE will not perform span calibrations unless it senses calibration gas

# Multiple Sensor Calibration

TOX1

TOX2

TOX3

LEL

**Apply gas or hit  
any key to start**

OXY

- Try again after you have verified that the gas is correct and it is flowing properly
- Follow instructions on screen
- Disconnect regulator from gas cylinder when complete calibration



PROTECTION THROUGH DETECTION

# Single Sensor Calibration

TOX1		TOX2		TOX3
	CO	SO <sub>2</sub>	H <sub>2</sub> S	
LEL	LEL	pick	OXY	OXY

- Toxic sensors can be calibrated individually if necessary
- At “Single Sensor Calibration” press “Y/+” key
- Use “MODE” to select sensor

# Single Sensor Calibration

- Attach calibration gas regulator to calibration gas cylinder
- Attach calibration hose to VRAE and make sure it is tight
- Turn on cal gas (Pre-soak slow sensors)
- With cursor on the appropriate sensor press “Y/+” key
- Follow instructions on screen
- Repeat if necessary for other gases
- Disconnect regulator



# Single Sensor Pre-Soak

- Standard Cal time is 60 sec except for ClO<sub>2</sub>, which is 150 sec
- Some slow sensors require pre-equilibration

Sensor	Response Time $t_{90}$ (seconds)	Total Cal Time (seconds)	Pre-exposure Time for 1-min Cal Time
HCN	200	230	170
ClO <sub>2</sub> , NH <sub>3</sub>	150	150	90
Cl <sub>2</sub> , PH <sub>3</sub>	60	120	60
CO, H <sub>2</sub> S, SO <sub>2</sub> , NO, NO <sub>2</sub> , O <sub>2</sub> , LEL, VOL	≤40	60	0

# Calibration

- **Modify Span Value**
  - Allows you to change the calibration gas values to use other cal gases
  - Do not change if you are using the RAE Systems cal gas supplied with your meter
- **Change LEL/VOL Span Gas?**
  - Allows you to change the calibration gas, which by default is methane
  - Do not change if you are using the RAE Systems cal gas supplied



## Change Alarm Limits?

- Change High alarm limit?
  - 3 Beeps per second (“High”)
- Change Low alarm limit?
  - 2 Beeps per second (“Low”)
- Change STEL alarm limit?
  - 1 Beep per second (“STEL”)
- Change TWA alarm limit?
  - 1 Beep per second (“TWA”)

*Choose (Y) to accept or (N) to move on,  
MODE to escape*



## View or Change Datalog?

- Reset Peak and Minimum?
- Clear All Data?
- Change Datalog Period?
- Select Data Type?
- View Datalog?
- Enable/Disable Datalog?

*Choose (Y) to accept or (N) to move on,  
MODE to escape*



# Change Monitor Setup?

- Change Site ID?
- Change User ID?
- Change Alarm Mode?
- Change User Mode?
  - “Program”
  - “Display”
  - “Text”



## Change Monitor Setup?

- Change Real Time Clock?
- Change Backlight Mode?
- Change Password?
- Change Pump Speed?
- Change Averaging Method?
- Set Temperature Unit? (°C or °F)

*Choose (Y) to accept or (N) to move on  
MODE to escape*



## Change Sensor Configuration?

- Change LEL/VOL Sensor Type?
- Enable/Disable Sensor?
- Change Dilution Ratio?
- Change LEL/VOL Gas Selection

*Choose (Y) to accept or (N) to move on,  
MODE to escape*

## VRAE: Power Off

- Hold Mode Key for full 5 seconds
- Audible alarm will beep and display will read “Power-down in ...5 seconds”
- Plug 12 VDC charger into VRAE charge port when not in use



# VRAE: Smart Charging

TOX1

TOX2

TOX3

LEL

**Start Battery  
Deep discharge?**

OXY

- NiMH does not need deep discharge
- Full charge can take up to 10 hours
- With the smart charging circuitry, removing the charger is not necessary.



PROTECTION THROUGH DETECTION

# VRAE: Trickle Charging

TOX1

TOX2

TOX3

LEL

**Charging.....**

**Battery=5.9V**

OXY

- Turning off and on power to charger will reset charge to high and may burn-out battery if done repeatedly

Questions?



PROTECTION THROUGH DETECTION