Using the Q-RAE+ personal multigas monitor

Firmware v 1.10

Training Agenda:

- *Q-RAE+ features*
- *Turning on the Q-RAE+*
- *Recommended Daily Start-up Procedure*
- *User modes & displays*
- *Alarm modes*
- *Programming displays*
- *Calibration*

The "Q" in Q-RAE stands for quad, as in it can carry four sensors at a time:

- *Oxygen: 0-30%*
- *Combustibles: 0-100% of LEL*
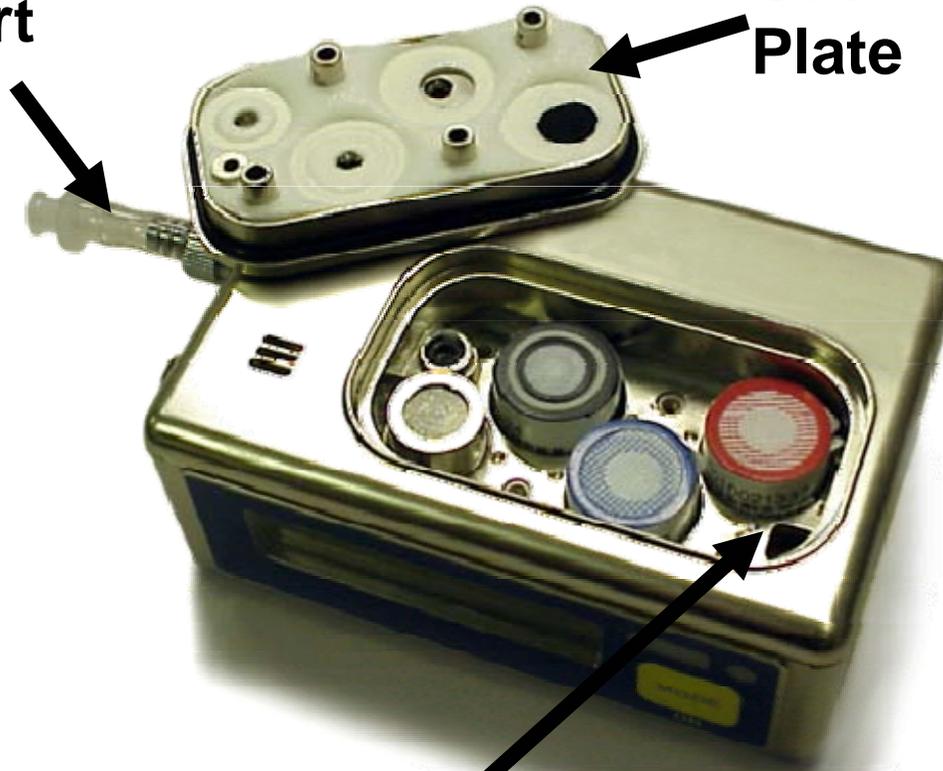- *Select two toxic sensors from: CO, H_2S, SO_2, NO, NO_2, Cl_2, HCN, NH_3, PH_3*

RAE SYSTEMS

PROTECTION THROUGH DETECTION

Q-RAE+ Features: Sensors

Sample Port

Gas Plate

Sensor Compartment

Separate sensor compartment allows quick sensor access and reduces the chance of damage to the computer boards through leaking sensors or user damage while replacing sensors.

RAE SYSTEMS

Q-RAE+ Features: Reliability

- **Extremely rugged for extensive field use**
- **Weather Proof Case**
- **Temperature range of -4°F to 113°F(-20°C to 45°C)**
- **RFI protection against radio interference**
- **UL Intrinsic safety for flammable gases, vapors &** DUSTS
  - *UL Vapor: Class I, Division 1, Groups A, B, C, D*
  - *UL Dust Class II, Division 1, Groups E, F, G*
  - *CSA*
  - *ATEX*

RAE SYSTEMS

PROTECTION THROUGH DETECTION

Q-RAE+ Features: Rugged Case

Alarm Buzzer
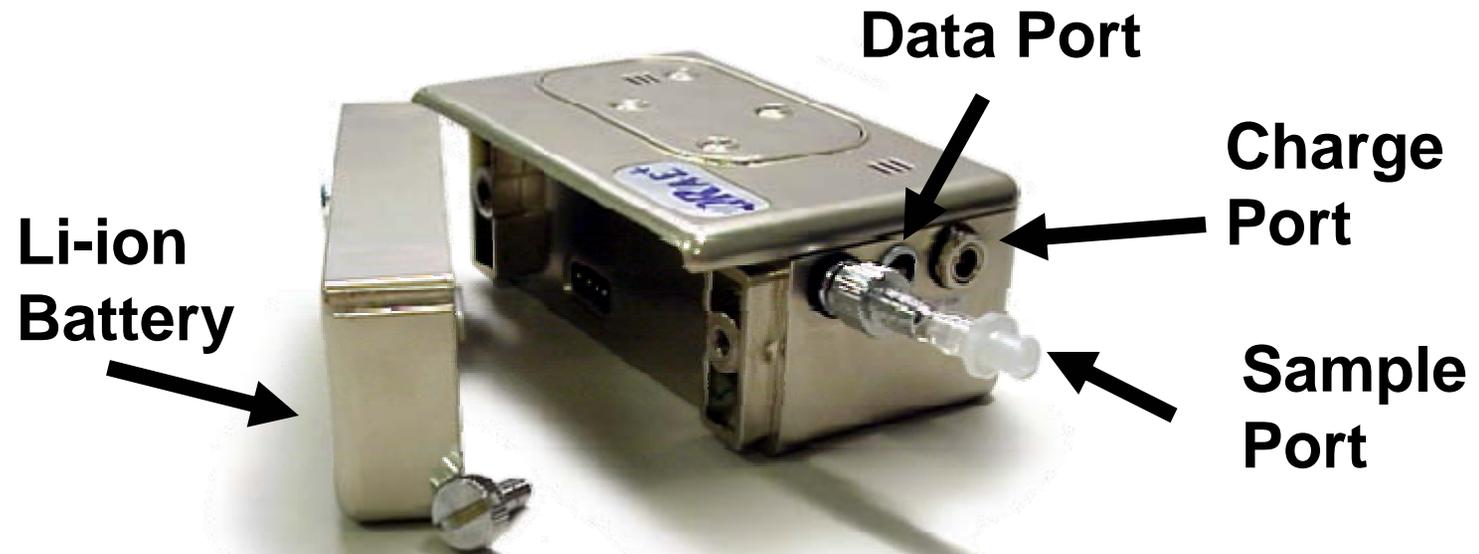
Gas Exit Port

Li-ion Battery

Display

MODE

ON

Q-RAE+ Features: Li-Ion Battery

Data Port

Charge Port

Li-ion Battery

Sample Port

Up to 20 hours on Lithium-Ion Batteries

- *4-Way power: Lithium-Ion, Alkaline or run continuously on 110 VAC and 12 VDC*
- *Battery is quick and easy to detach for quick field change to alkalines*
- *Unscrew battery using a coin*

RAE SYSTEMS

Q-RAE+ Features: Simple Faceplate

Light Sensor

Alarm LEDs

Front View

Side View

Just 3 buttons control all functions:

- *Y/+ (horn): clears & tests alarms*
- *N/- (light): turns on manual backlight for 5 seconds*
- *MODE (on)*

RAE SYSTEMS

PROTECTION THROUGH DETECTION

Q-RAE+ Features: Internal Pump

- *Optional internal pump makes remote sampling easy*
- *Sample draw over 100 feet!*
- *Liquid water trap for added protection*
- *Pump stall feature: when moisture is detected or when pump is blocked the pump will shut off, protecting the QRAE+ from potential damage*
- *~150cc/min at Low flow, ~250cc/min at High flow*

Q-RAE+ Features: External Prefilter

- ***Always use the prefilter***
- ***Replace when it looks very dirty***
- ***Replace when Q-RAE+ is in pump alarm with the filter on and you can clear the pump alarm with the filter off.***

You wouldn't leave your house without putting on your pants so don't use the Q-RAE+ without its external filter!

Q-RAE+ Features: Alarms

- *Audible:* **LOUDER 95dB buzzer (special resonance chamber increases the sound)**

- *Tactile:* **internal vibrator**

- *Visual:* **Display backlight turns on along with bright LEDs on faceplate**

- *External:* **Audible and vibration alarms via dataport**

RAE SYSTEMS

Q-RAE+ Start-Up: Turning On

- **Unplug Q-RAE+ from charger**
- **Hold "MODE" Key to turn on**
- **Alarm will beep once**
- **Watch the 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**

PROTECTION THROUGH DETECTION

> # Sensor 1: CO
> # Warranty expired

- *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.*

- *For maximum QRAE+ availability, RAE Systems recommends replacing sensors at the end of their warranty period.*

QRAE SYSTEMS

PROTECTION THROUGH DETECTION

Q-RAE+ Start-up: Check Sensor Zero

0		0
0	OK	20.9

- *After 90 sec. warm-up, the Q-RAE+ will display for all of the installed sensors*
- *If there is no alarm, and the sensor readings are in the range shown above, then the Q-RAE+ is ready for use.*
- *A "Fresh Air Calibration" may be required if the sensors do not read correctly.*

RAE
SYSTEMS

PROTECTION THROUGH DETECTION

Q-RAE+ Start-up: Check Pump

```
0                           0
0        Pump     20.9
```

- *Every time the Q-RAE+ 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*

RAE
SYSTEMS

PROTECTION THROUGH DETECTION

Q-RAE+:   Two Display Modes

- **Basic Operation Mode:** a reduced set of user and programming screens designed for most users.

- **Advanced Operation Mode:** provides more user screens and full access to all programming screens.

Comparison of Display Modes

Advanced (11)	Basic (7)
Sensor ID	Sensor ID
PEAK	PEAK
MIN	MIN
STEL	STEL
TWA	TWA
Battery	Battery
Time/Date/Temp	PC Comm
Start Datalog*	
LEL Gas	
Print Reading*	
PC Comm	

Q-RAE+: Main Display

$$\boxed{\begin{array}{ll} \text{0/CO} & \text{0/H}_2\text{S} \\ \text{0/LEL} & \text{20.9/OXY} \end{array}}$$

- Q-RAE+ will return to this screen in 60 seconds if left in any subsequent screen
- This screen alternates between the instantaneous reading and the sensor name approximately every 3 seconds
- Tap "MODE" key to proceed

RAE SYSTEMS

Peak Reading Display

34	11
6 PEAK	20.9

- Holds Highest reading since Q-RAE+ was turned on

- Pressing "Y" key will produce "Reset Peak?" prompt. Pressing again will clear Peaks.

- Tap "MODE" key to proceed to next screen

Minimum Reading Display

0	0
0	MIN 16.3

- Holds Lowest reading since Q-RAE+ was turned on

- Pressing "Y" key will produce "Reset Min?" prompt. Pressing again will clear Minimum readings.

- Tap "MODE" key to proceed to next screen

RAE SYSTEMS

PROTECTION THROUGH DETECTION

STEL Display

```
0                    0
          STEL
```
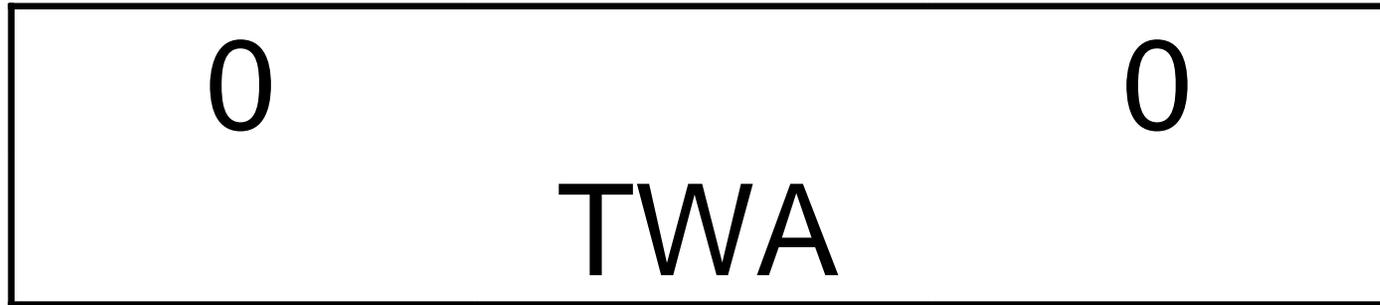
- Short Term Exposure Limit (average for the past 15 minutes)
- Displays "****" until Q-RAE+ has been on for 15 minutes
- STEL only is calculated for toxic sensors
- STEL alarm beeps once a second
- Tap "MODE" key to proceed

RAE SYSTEMS

TWA Display

0	0
	TWA

- Time Weighted Average is the accumulated reading of gas concentration divided by 8 hours since the Q-RAE+ was turned on.

- TWA only is calculated for toxic sensors

- TWA alarm beeps once per second

- Tap "MODE" key to proceed to next screen

RAE SYSTEMS

Battery Voltage Display

> # Battery = 3.8V
> # Shut off at 3.1V

- Q-RAE+ shuts down when battery voltage drops below 3.1 volts
- Normal Full Charge is about 4.2 volts
- Tap "MODE" key to proceed to next screen

Date/Time/Run Time/Temp. Display

This screen is deleted in Basic Mode

07/01/98	12:00
ON=01:22	25°C/^{o}F

- Date
- Time of day
- Accumulated time in hours and minutes since the Q-RAE+ was turned on
- Temperature in Centigrade or Fahrenheit (user selectable)
- Tap "MODE" key to proceed

RAE SYSTEMS

PROTECTION THROUGH DETECTION

Datalog Mode Display
This screen is deleted in Basic Mode

> # Start Datalog?

- *Manual: logs if "Y/+" key is pushed*
- *Automatic: logs data when as soon as the Q-RAE+ is turned on*
- *User can choose one of 4 datalog modes (Manual, Automatic, Periodic & Scheduled in ProRAE Suite)*
- *Screen deleted on non-dataloggers*

RAE SYSTEMS

Datalog Mode Display

0	0
0 L	20.9

- *A small "L" is displayed in the left center of the main Q-RAE+ screen indicates datalogging*
- *Will datalog 16,000 points*
- *66 hours at 1 minute interval for all 4 sensors*
- *User can choose one of 4 datalog modes (Manual, Automatic, Periodic & Scheduled in ProRAE Suite)*

RAE SYSTEMS

PROTECTION THROUGH DETECTION

LEL Units Display
This screen is deleted in Basic Mode

> # LEL gas=
> # Methane

- Measurement scale for LEL displayed here Measurement scale can be changed in programming mode
- Tap "MODE" key to proceed to next screen

Print Reading Display

This screen is deleted in Basic Mode

Print Reading?

- If the optional external printer is attached pressing the "Y/+" key will print out the current reading.
- If the optional printer is not installed it will display "wait" for 20 seconds and then return to the "Print Reading?" screen.
- This screen appears only if the option is enabled in ProRAE Suite

Communicate with PC Display

Communicate with PC?

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

RAE SYSTEMS

PROTECTION THROUGH DETECTION

Communicate with PC Display

Ready...

- *When the Q-RAE+ 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.

RAE SYSTEMS

PROTECTION THROUGH DETECTION

Q-RAE+ Alarm Signals

- The QRAE+ will provide audible, tactile 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 "Change Datalog?" menu*

Q-RAE+ Alarms: High

High	0
0	20.9

- "High" display along with a 3 beat/second audible/tactile/visual alarm indicates that CO sensor has exceeded high alarm set point (greater than 200 ppm CO default).

- Press "Y/+" key to clear if latching alarm

Q-RAE+ Alarms: Low

```
┌─────────────────────────────────┐
│  0                            0  │
│  0                          Low  │
└─────────────────────────────────┘
```

- "Low" display along with a 2 beat/second audible/tactile/visual alarm indicates that Oxygen sensor has gone into low alarm (less than 19.5% Oxygen default)

- Press "Y/+" key to clear if latching alarm

Q-RAE+ Alarms: STEL

STEL	0
0	20.9

- "STEL" display along with a 1 beat/second audible/tactile/visual alarm indicates that CO sensor has exceeded STEL alarm set point (100 ppm CO default).

- *This alarm will only clear after 15 minutes in clean air or Q-RAE+ is turned off!*

RAE
SYSTEMS

PROTECTION THROUGH DETECTION

Q-RAE+ Alarms: TWA

TWA	0
0	20.9

- "TWA" display along with a 1 beat/second audible/tactile/visual alarm indicates that CO sensor has exceeded TWA alarm set point (35 ppm CO default).

- *This alarm will only clear after moving to clean air and then turning off the Q-RAE+*

Q-RAE+ Alarms: LEL OFF

0	0
OFF	20.9

- "OFF" display along with a 3 beat/second audible/tactile/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.

Q-RAE+ Alarms: LEL OFF

0	0
OFF	20.9

- If the Q-RAE+ is used in high concentrations of flammable gas consider either the "VOL" or "AUTO" setting in "Change LEL/VOL Sensor Type?" in the "Change Sensor Configuration" menu.

Q RAE
SYSTEMS

Q-RAE+ Alarms: NEG

NEG	0
0	20.9

- "NEG" display along with a 1 beat/second audible/tactile/visual alarm indicates that CO sensor has drifted negative (below zero) because the sensor was zeroed in an area containing CO.

- *Perform "Fresh Air Calibration" in an area clear of all CO.*

0	0
0	Pump 20.9

- "Pump" display along with a 3 beat/second audible/tactile/visual alarm indicates that pump has stopped due to line clog
- Pump alarm is a latching alarm
- Clear line/filter and press "Y/+" key to reset alarm and restart pump

RAE
SYSTEMS

PROTECTION THROUGH DETECTION

Q-RAE+ Alarms: Low Battery

0	0
0 Bat	20.9

- A flashing "Bat" display along with a 10 beat/seconds audible/tactile/visual alarm indicates every minute indicates that the battery voltage has dropped below 3.1V and it will shut down in 20-30 minutes

- Quickly complete confined space entry and charge the Q-RAE+

RAE SYSTEMS

Q-RAE+ Alarms: Memory Full

```
0                    0
0       MEM    20.9
```

- A flashing "MEM" display along with a 1 beat/second audible/tactile/visual alarm indicates that the datalog memory is full.

- Clear datalog in "Change Datalog?"

- If you get this alarm you might want to consider changing Select memory full type?" to "Wrap around."

Getting Into Programming

- *Hold "MODE" and "N/-" keys for 5 sec. to get in Programming Mode*

- If Q-RAE+ 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

RAE SYSTEMS

PROTECTION THROUGH DETECTION

Setting Security Levels

- ProRAE Suite allows users to configure security levels. Coupled with the **Basic** and **Advanced** modes, user can limit operator access to the higher functions of the Q-RAE+ to meet the specific needs of their application.

- *Appendix A-1 of the QRAE+ manual provides an excellent summary of how to configure operating modes and security levels for optimum performance.*

QRAE
SYSTEMS

PROTECTION THROUGH DETECTION

Setting Security Levels

- ## Level 0:

  - *Basic Mode: prevents operator access to all programming functions*

  - *Advanced Mode: limits operators access to the Basic programming functions*

- ## Level 1: operator access is password controlled but all mode programming functions available

Setting Security Levels

- Level 2: operator has complete access to all programming functions available in the operating mode

Basic Programming Menus

- Calibrate Monitor?
  - *Fresh Air Calibration?*
  - *Multiple Sensor Calibration?*
  - *Single Sensor Calibration?*
- Change Monitor Setup?
  - *Change User Mode?*
  - *Set Clock?*

- *Choose (Y) to accept or (N) to move on*
- *ref. Appendix A-1 & A-2 in Q-RAE+ Manual*

RAE SYSTEMS

PROTECTION THROUGH DETECTION

Advanced Programming Menus

- Calibrate Monitor?

- Change Alarm Limits?

- Change Datalog?

- Change Monitor Setup?

- Change Sensor Configuration?

- *Choose (Y) to accept or (N) to move on*

- *ref. Appendix A-2 in Q-RAE+ Manual*

Calibrate Monitor?

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

Multiple Sensor Calibration

CO	H$_2$S
LEL OK?	---

- At "Multiple Sensor Calibration" press "Y/+" key
- For CO/H2S/LEL mixed gas calibration the next screen should appear as above

Multiple Sensor Calibration

- Attach calibration gas regulator to mixed gas cylinder
- Turn on calibration gas
- Attach calibration adapter to Q-RAE+
- press "Y/+" key and the Q-RAE+ calibration procedure will start
- Follow instructions on screen
- Disconnect regulator when completed

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/VOC Span Gas?**
  - Allows you to change the calibration gas from methane (LEL) & isobutylene (VOC)
  - Do not change if you are using the RAE Systems cal gas supplied

OXY Calibration Type?

- **2 Point Calibration:** provides for calibration at 20.9% (Fresh Air) and 0% oxygen

- **3 Point Calibration:** provides for calibration at 20.9%, mid-range (like 16-19.5% Oxygen) and 0% oxygen. Many mixed gas cylinders have 16-19.5% oxygen for greater oxygen sensor accuracy at the critical 19.5% alarm point.

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

Change Datalog?

- Clear All Data?
- Change Datalog Period?
- Select Data Type?
- Enable/Disable Datalog?
- Select Memory Full Type?

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

Select Memory Full Type?

- **Wrap around (default):** after the memory becomes full the newest data is written over the oldest data (First in First Out or FIFO). *This is an excellent feature to provide "background" datalogging that is only used in case of an incident.*

- **Stop:** datalogging will stop when the memory is full and the "MEM" alarm will sound.

Change Monitor Setup?

- Change Site ID?
- Change User ID?
- Change Alarm Mode?
- Change User Mode? *(Advanced or Basic)*
- Change Real Time Clock?

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

Change Monitor Setup?

- Change Back Light Mode?
- Change Password?
- Change Pump Speed?
- Change Averaging Method?
- Change Display Language? (English, Spanish)
- Set Temperature Unit? (oC or oF)
- Enable/Disable Vibrator?

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

RAE SYSTEMS

Change Sensor Configuration?

- Change LEL/VOL Sensor Type? (LEL, %VOL, Auto for CH4 only)
- Enable/Disable Sensor?
- Change LEL Gas Selection?

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

Q-RAE+:   Power Off

- Hold Mode Key for full 5 seconds
- Audible alarm will beep and display will read "Power-down in ...5,4,3,2,1 seconds"
- Leave QRAE+ on charger when not in use

QRAE
SYSTEMS

Q-RAE+: Charging

Charging...

- Plug 12 VDC charger into charge port
- Q-RAE+ will take 6-8 hours to fully charge
- *The Lithium-Ion battery in the Q-RAE+ does not require deep discharge!*

Q-RAE+: Charging

- You can leave Q-RAE+ on charger when not in use
- The Q-RAE+ will automatically detect the alkaline battery adapter and prevent charging if it is attached instead of the Li-Ion

RAE SYSTEMS

PROTECTION THROUGH DETECTION

Using ProRAE Suite

Configuration from Computer

Datalogging

PROTECTION THROUGH DETECTION

Questions?