Model Q45H/63
Portable Combined Chlorine Measurement System

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PRODUCT WARRANTY

Analytical Technology, Inc. (Manufacturer) warrants to the Customer that if any part(s) of the Manufacturer's equipment proves to be defective in materials or workmanship within the earlier of 18 months of the date of shipment or 12 months of the date of start-up, such defective parts will be repaired or replaced free of charge. Inspection and repairs to products thought to be defective within the warranty period will be completed at the Manufacturer's facilities in Collegeville, PA. Products on which warranty repairs are required shall be shipped freight prepaid to the Manufacturer. The product(s) will be returned freight prepaid and allowed if it is determined by the manufacturer that the part(s) failed due to defective materials or workmanship.

This warranty does not cover consumable items, batteries, or wear items subject to periodic replacement including lamps and fuses.

Gas sensors carry a 12 months from date of shipment warranty and are subject to inspection for evidence of misuse, abuse, alteration, improper storage, or extended exposure to excessive gas concentrations. Should inspection indicate that sensors have failed due to any of the above, the warranty shall not apply.

The Manufacturer assumes no liability for consequential damages of any kind, and the buyer by acceptance of this equipment will assume all liability for the consequences of its use or misuse by the Customer, his employees, or others. A defect within the meaning of this warranty is any part of any piece of a Manufacturer's product which shall, when such part is capable of being renewed, repaired, or replaced, operate to condemn such piece of equipment.

This warranty is in lieu of all other warranties (including without limiting the generality of the foregoing warranties of merchantability and fitness for a particular purpose), guarantees, obligations or liabilities expressed or implied by the Manufacturer or its representatives and by statute or rule of law.

This warranty is void if the Manufacturer's product(s) has been subject to misuse or abuse, or has not been operated or stored in accordance with instructions, or if the serial number has been removed.

Analytical Technology, Inc. makes no other warranty expressed or implied except as stated above.

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Part 1 - Introduction

1.1   General

The Model Q45H/63 is a versatile portable monitoring/recording system designed for the measurement of combined chlorine (chloramines) in solution. The full scale operating range of the system is user selectable for 0-200.0 ppb, 0-2.000 ppm, 0-20.00 PPM, or 0-200.0 ppm, and the sensing system will operate on water streams with temperatures from 0 to 55°C.

The system operates on two AA batteries, and will run continuously for approximately 240 hours.

Warning: If unit is to be stored for more that 6 months REMOVE the batteries from the holder to avoid potential damage from battery leakage.

The basic sensing element used in the combined chlorine monitor is a polarographic membrane sensor that measures chlorine directly. Water simply flows past the sensor and directly to drain, with the flow rate and pressure across the sensor controlled by a constant head flow cell assembly. The chlorine measurement does not alter the sample or add any chemicals to the sample stream, so the water flow can return to the system if desired.

1.2   Standard System

The standard model Q45H/63 system includes three main components, the Q45H analyzer, a constant head flow cell, and a combined chlorine sensor. A low-volume flowcell is also available for applications where sample flowrate and pressure can be carefully controlled.

For connection of the sensor to the electronics, a 25' cable is supplied. All required spare parts are also provided with the basic system, including spare membranes, electrolyte, o-rings, and any special hardware.

1.3   Features

- Standard main module is designed to be a fully isolated, battery powered instrument for monitoring/recording applications. Can be quickly converted to either a loop power transmitter or line powered analyzer (optional board required for analyzer.)

- High accuracy, high sensitivity system, measures from 0.1 ppb to 200.0 ppm through 4 internal automatic ranges. User ranges of 200.0 ppb, 2.000 ppm, 20.00 ppm, or 200.0 ppm.

- Two 10-bit, isolated, 0-2.5 Vdc analog outputs may be configured to track combined chlorine and temperature, or combined chlorine and combined chlorine. Both analog outputs can be individually programmed to specific ranges.

- Large, high contrast, custom Super-Twist display provides excellent readability. The secondary line of display utilizes 5x7 dot matrix characters for clear message display two of four measured parameters may be on the display simultaneously. An LED backlight can be turned on if necessary for use in very low light conditions.

- Diagnostic messages provide a clear description of any problem with no confusing error codes to look up. Messages are also included for diagnosing calibration problems.

- Quick and easy one-point calibration method and sensor zero-cal. To provide high accuracy, all calibration methods include stability monitors that check temperature and main parameter stability before accepting data.

- High accuracy three-wire Pt100 temperature input. Temperature element can be user calibrated.

- Security lock feature to prevent unauthorized tampering with transmitter settings. All settings can be viewed while locked, but they cannot be changed.

1.4   Q45H/63 System Specifications

(Common to all variations)

Displayed Parameters   Main input, 0.1 ppb (0.0001 ppm) to 200.0 ppm
                                  Sensor temperature, -10.0 to 55.0 °C (23 to 131 ºF)
                                  Sensor Current, 0.0–999.9 nA, 0.000 to 99.99 uA
                                  Loop current, 4.00 to 20.00 mA
                                  Sensor slope/offset
                                  Model number and software version
                                  PID Controller Status

Main Parameter Ranges   Manual selection of one of the following ranges,
                                  0.000 to 200.0 ppb
                                  0.0 to 2.000 ppm
                                  0.00 to 20.00 ppm
                                  0.00 to 200.0 ppm

Display   0.75" (19.1 mm) high 4-digit main display with sign
                                  12-digit secondary display, 0.3" (7.6 mm) 5x7 dot matrix.
                                  Integral LED back-light for visibility in the dark.

Keypad   4-key membrane type with tactile feedback, polycarbonate
                                  with UV coating

Weight   1.5 lb. (0.68 kg)

Ambient Temperature   Analyzer Service, -20 to 60 °C (-4 to 140 ºF)
                                  Sensor Service, -5 to 55°C (23 to 131 °F)
                                  Storage, -5 to 70 °C (-22 to 158 ºF)

Ambient Humidity   0 to 95%, non-condensing.

EMI/RFI Influence   Designed to EN 61326-1

Output Isolation   600 V galvanic isolation

Filter   Adjustable 0-9.9 minutes additional damping to 90% step
                                  input

Temperature Input   Pt100 RTD with automatic compensation

Sensor   2-electrode polarographic membraned sensor for direct
                                  measurement of chlorine,

Sensor Materials   Noryl and stainless steel

Sensor Cable   25 ft. (7.5 meter) cable with 6-pin plug.

Max. Sensor-to-Analyzer

Distance	100 feet (30.5 meters), with junction box
Optional pH Compensation Input	**Not available on portables**
Flow Cell	Constant head overflow, clear cast acrylic, 7-30 GPH, 15 GPH recommended, inlet is ¼" hose barb at 1/8" MNPT, outlet is ½" hose barb at 3/8" MNPT
Instrument Power	Two generic AA batteries, low battery indication at 1.60V DC.
Outputs	Two 0-2.5 Vdc isolated outputs are provided for connection to data recorders, etc.
Battery Life	Approximately 240 hours of operational use on a set of batteries (without backlight).

1.5   Q45H Performance Specifications

(Common to all variations)

Accuracy	0.5% of selected range or 0.02 PPM
Repeatability	0.3% of selected range or 0.01 PPM
Sensitivity	0.05% of selected range
Non-linearity	0.1% of selected range
Warm-up Time	3 seconds to rated performance (electronics only)
Supply Voltage Effects	± 0.05% span
Instrument Response Time	60 seconds to 90% of step input at lowest damping

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Part 2 – Analyzer Mounting

2.1 General

The Q45H/63 Portable Chlorine Monitoring System comes complete with a specially designed handle that allows the system to be comfortably carried, or quickly strapped to a railing. Although the system is designed to be a portable system, it can be permanently mounted for longer term field use. This is possible due to the very long battery life spans that can be achieved with the system.

2.2 Portable Handle

A removable handle is included with each unit that provides not only comfortable transportation of the system, but the integral locking strap allows the system to be quickly mounted to pipes or rails for longer term use in one area.
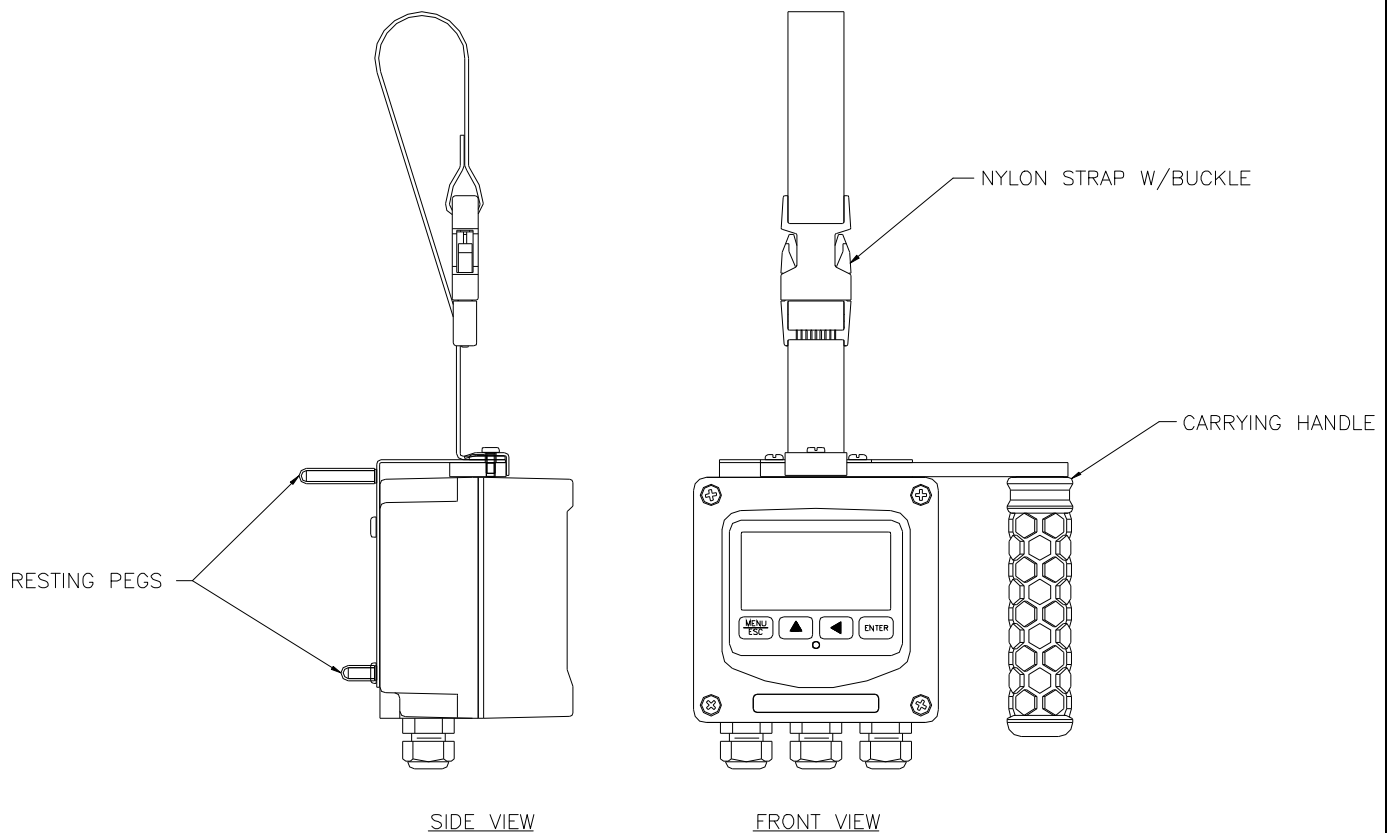

SIDE VIEW   FRONT VIEW

Figure 1 - Portable Handle Views

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Part 3 – Sensor/Flowcell Mounting

3.1 General

Select a location within the maximum sensor cable length for mounting of the sensor flow cell.

3.2 Constant-Head Flowcell

Combined chlorine sensors are best used in a constant-head overflow chamber because variations in sample flow rate and pressure can cause unstable readings. When monitoring low concentrations (below 0.5 PPM), this method should always be used.

Mechanical installation of the flow cell requires that it be mounted to a wall or other convenient flat surface. Alternatively, the mounting holes on the plate will accommodate a 2″ U-bolt for mounting the plate to a 2″ pipe. Figure 2 - Constant Head Flowcell

shows the dimensions and mounting hole locations for the flow cell. Be sure to allow enough clearance on the left side of the flow cell for insertion and removal of the sensor. About 12 inches clearance is recommended.
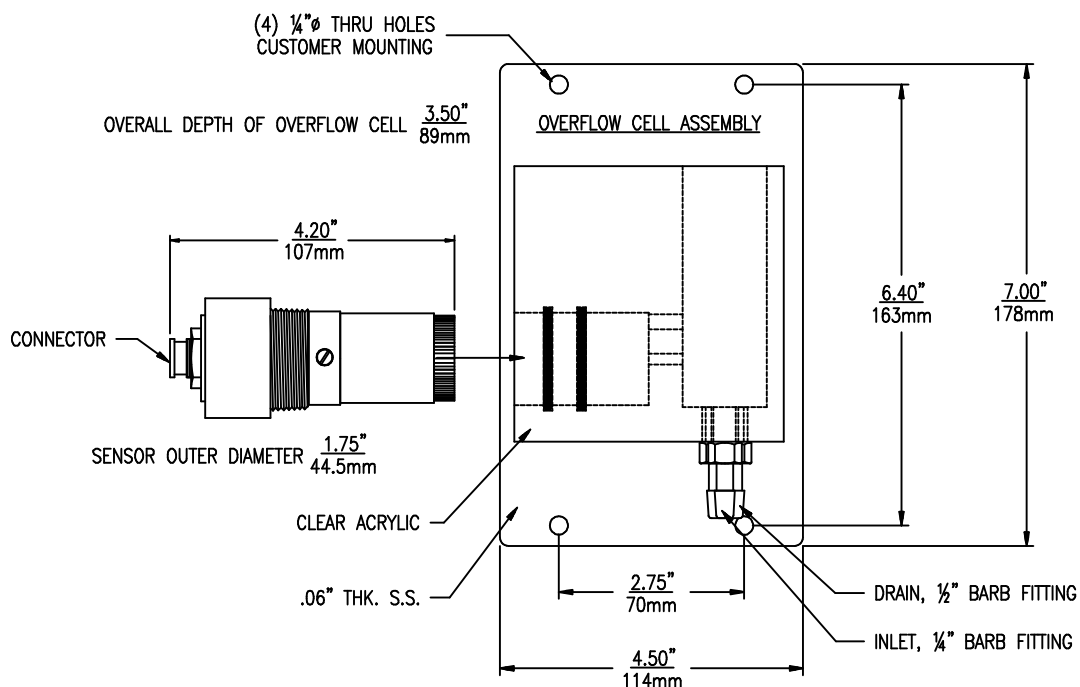

Figure 2 - Constant Head Flowcell

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Once mounted, inlet and drain connections must be made.   The flow cell contains a 1/8" MNPT inlet connection and a 3/8" MNPT drain connection. Hose barbs for the inlet and drain connections are supplied with the flow cell for use with flexible tubing. The inlet hose barb is used with ¼" I.D. tubing and the drain hose barb is used with ½" I.D. tubing.

3.3 Sealed Flowcell

Applications where the sample inlet flow is well controlled can use a simpler sealed flowcell.   Using this flowcell requires that sample flow be controlled externally to about 400 cc/min. using pressure regulators and needle valves. Variable flow rate or variable pressure will cause unstable readings in this flowcell. ATI offers a special flow control element that can be used ahead of this flowcell on the incoming sample line. The flow control is part no. (55-0048). It will control the inlet flowrate at 400 cc/min. with inlet pressure variations from 5-150 PSIG.   A 50 micron y-strainer ahead of the flow control element is recommended.
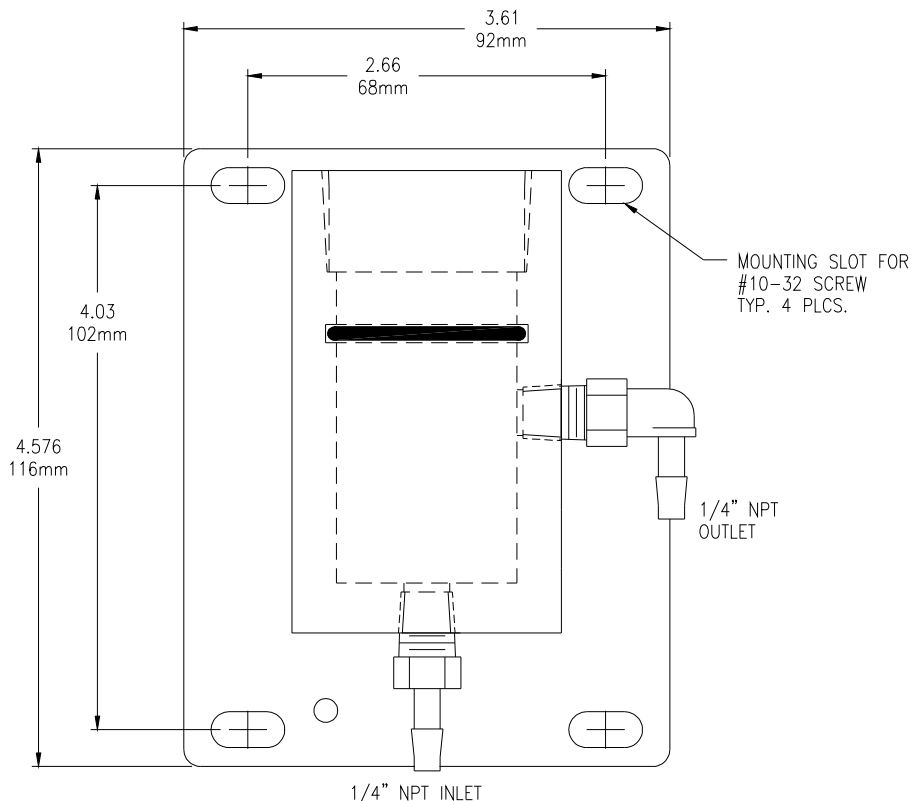

Figure 3 - Sealed Flowcell

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3.4   Submersion Mounting

Some applications are much easier done using the submersible sensor. This method can sometimes be used where flow is reasonably constant, and hydraulic head does not vary appreciably. Chlorine sensors can never be used in completely stagnant conditions. A flow velocity of at least 0.3 feet per second is normally required for measurement. Any applications for a submersible chlorine sensor should first be discussed with ATI. A trial of such installations may be necessary.

Submersible sensors are mounted to a 1" pipe using a standard 1" PVC thread by thread pipe coupling. The mounting pipe can be secured to standard 1½" pipe rail using a mounting bracket kit available from ATI (part number 00-0628) as shown in Figure 4 - Submersible Sensor Mounting

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SENSOR CABLE

2" HANDRAIL

SWIVEL MOUNTING BRACKET WITH HARDWARE, SUPPLIED BY ATI

1" T x T PVC COUPLING SUPPLIED BY ATI

1" ALUMINUM CONDUIT, THREADED ONE END OR 1" SCHED 80 PVC PIPE LENGTH AS REQUIRED (SUPPLIED BY CUSTOMER)

SENSOR, TYPICAL 2 - 3 FT. SUBMERGENCE
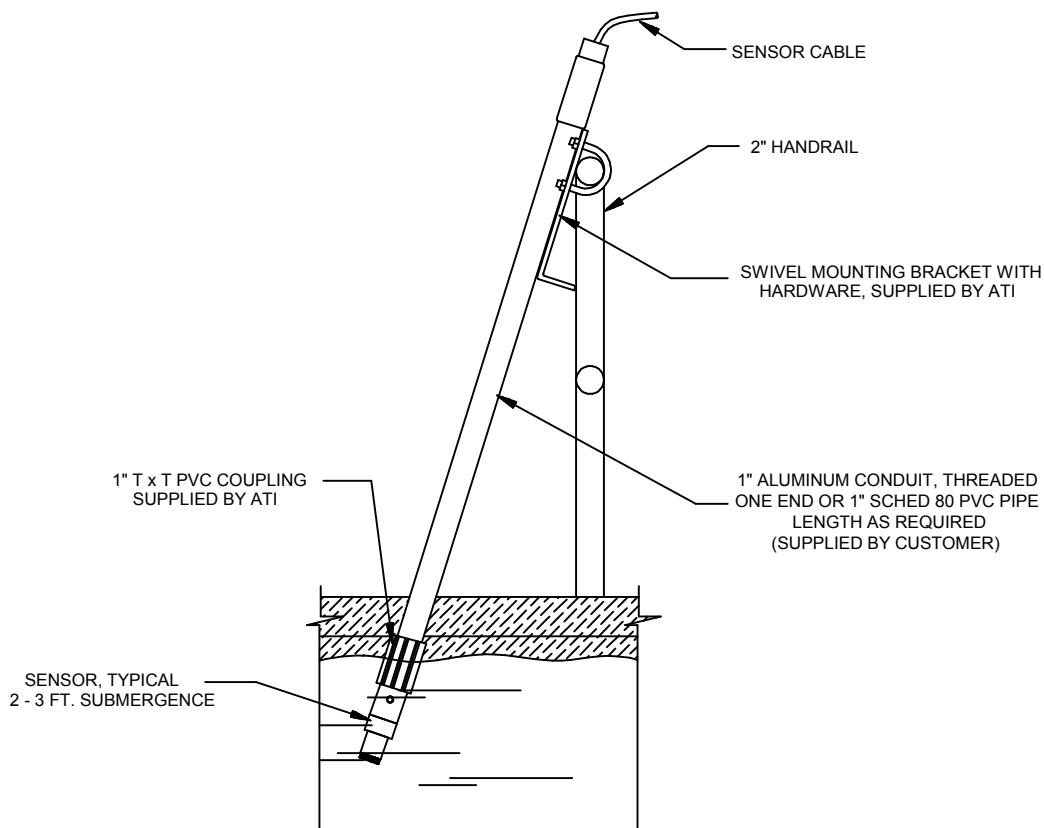
Figure 4 - Submersible Sensor Mounting

Part 4 – Electrical Installation

4.1 General

The sensor cable can be quickly connected to the Q45 terminal strip by matching the wire colors on the cable conductors.

4.2 Direct Sensor Connection

The sensor cable should be routed into the enclosure through the right hand cord grip on the bottom of the enclosure. Make sure the cord-grips are snugly tightened after electrical connections have been made to prevent moisture incursion. When stripping cables, leave adequate length for connections in the transmitter enclosure, as shown below.
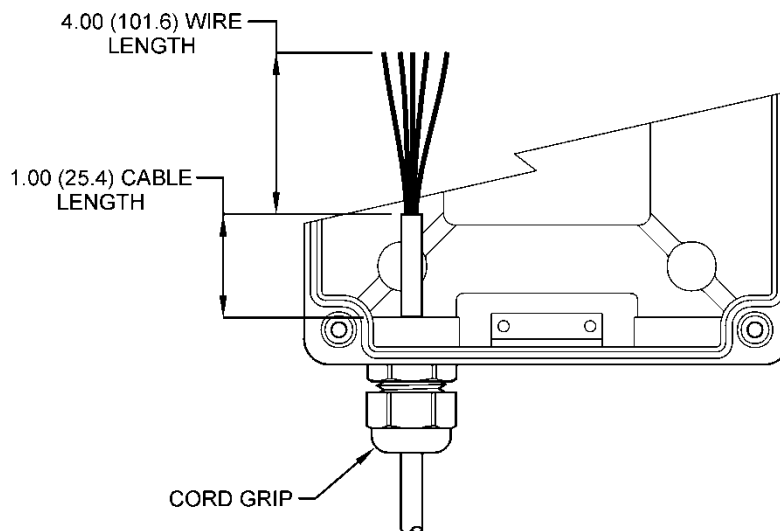
Figure 5 - Sensor Cable Preparation
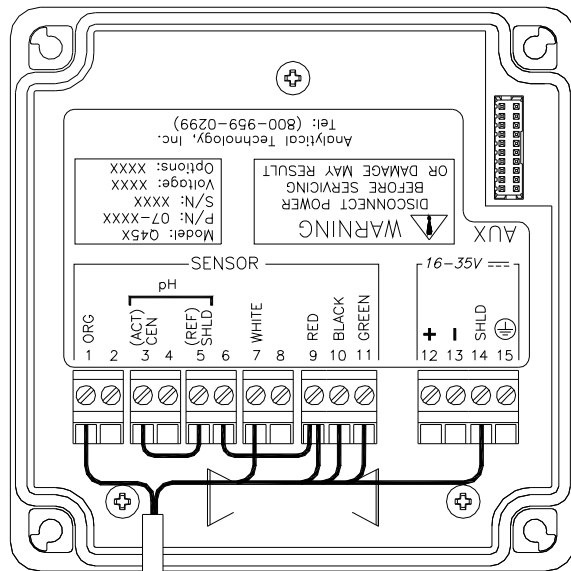
Note: The **BLUE** wire is **NOT** used when connecting a Flow Style Probe to the transmitter

PROBE
FLOW STYLE
(00-0066)
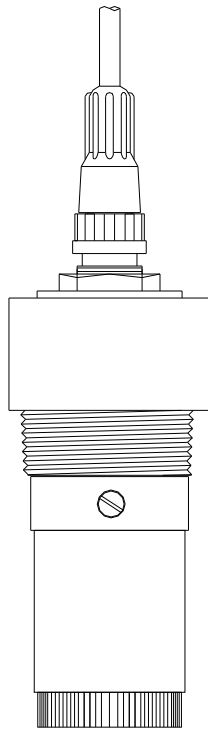
Figure 6 - Sensor Connections

Part 5 – Sensor Assembly

5.1   Chlorine Sensor Preparation

The chlorine sensor supplied with the Q45H is shipped dry. It will not operate until it is prepared by adding electrolyte and a membrane. Preparation of the sensor for operation must be done carefully. The procedure should be done by a qualified technician, and it should only be done when the system is ready for operation. Until then, it is best to leave the sensor in the condition in which it is received.
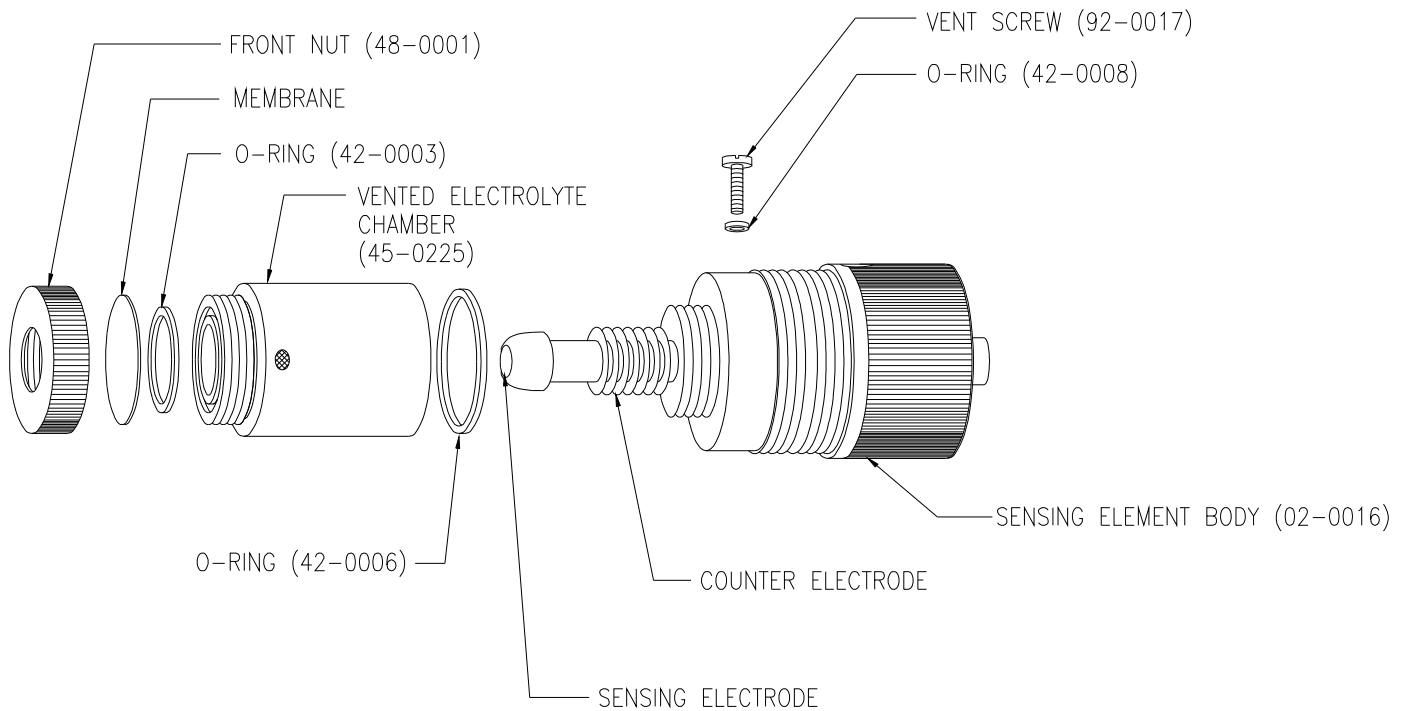
Figure 7 - CI2 Sensor Assembly

Submersible chlorine sensors are made up of two separate parts, a submersion holder that also contains the temperature compensating element and a sensing module. The sensing module screws into the holder, with an o-ring providing a water tight connection.
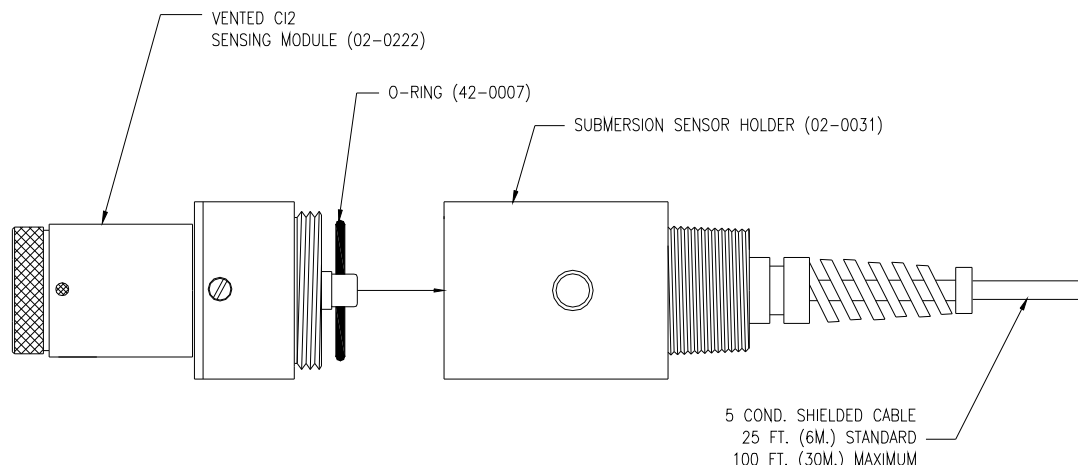
Figure 8 - Submersible Cl2 Sensor Assy

Follow the procedure below to prepare the chlorine sensor for operation:

1. Unscrew the electrolyte chamber from the assembled sensor and also remove the vent screw from the side of the sensor body.

2. Remove the front nut from the bottom of the chamber and discard the protective membrane. O-rings are contained in grooves on both the bottom and top of the chamber. Be sure that these o-rings remain in place.

3. From the package of membranes supplied with the sensor, place a new membrane into the front nut. **The membrane is white in color and is separated from other membranes by a light blue paper spacer.**

   CRITICAL NOTE: The (05-0023) membrane used on the combined chlorine sensor **MUST** be installed with the proper side facing the sample. **Examine the membrane carefully to identify the "shiny" side**. The membrane has a dull side and a shiny side. **The shiny side must face out**, or be in contact with the measured sample. Reversing the membrane will cause no damage, but the measurement will be very unstable

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Screw the front nut on to the chamber until you feel the o-ring compress. Hand tight compression is all that is needed. Do not use tools to tighten. The membrane should be flat across the bottom of the chamber without wrinkles.

4. Fill the chamber with electrolyte until the level reaches the bottom of the internal threads.

5. Slowly screw the chamber onto the sensor body. A small amount of electrolyte will run out of the hole from which the vent screw was removed. Place a paper towel around the sensor to absorb the electrolyte overflow. The electrolyte is harmless and will not irritate skin. Tighten the chamber until the o-ring at the top of the chamber is compressed. Once again, do not use tools to tighten.

6. Shake excess electrolyte from the vent hole on the side of the sensor and replace the vent screw.

The sensor is now ready for operation. The membrane should be stretched tightly across the tip of the sensor.

CAUTION: When handling the assembled sensor, do not set the sensor on its tip or damage to the membrane will result. Severe impacts on the tip of the sensor from dropping or other misuse may cause permanent damage to the sensor.

Part 6 – Operation

6.1 User Interface

To turn the system ON, simply press and hold the MENU key for approximately 5 seconds and the display will come on. **To turn the unit off, press and hold the ENTER key until the display shuts off (about 3 seconds). Note that the unit must be in the MEASURE menu in order for the 3-second key press to operate.** The instrument will turn off automatically after 30 minutes if no keys are pressed – optimizing battery life. This mode of operation is ideal for portable operation where intermediate readings are being taken. Assuming the instrument is used perhaps an hour per day, this would result in a battery lifespan of about 240 hours. For continuous operation with no automatic shut-off, turn the Auto-OFF feature to OFF in the DIAG menu. This mode is intended for use when the instrument outputs are used for transmitting data. In this mode, the instrument will run continuously until the battery reaches the shut-down level (1.6V). It should be noted that rechargeable AA batteries reduce operational times dramatically, as they typically contain much less energy than standard batteries.

The PWR switch disconnects the AA batteries and is only used to disconnect the battery if the system is not to be used for a long period of time (> 3 months of storage). Otherwise, leave this switch in the ON position. The red dip switch is only for factory use.

The "**B**" will flash on the display next to the main measurement indication when the instrument requires battery replacement. If the battery is not replaced, eventually the unit may not turn on in the normal operating mode. Once the low battery condition is indicated, the instrument will only stay powered for 10 minutes.

6.2 Battery / Power Circuit Board

Q45H monitors are powered by internal AA alkaline batteries Figure 5 shows this board assembly with batteries installed.

The battery circuit board contains 3 switch assemblies as shown in the drawings.

POWER CABLE

DC BATTERY BOARD
(REAR OF ENCLOSURE)
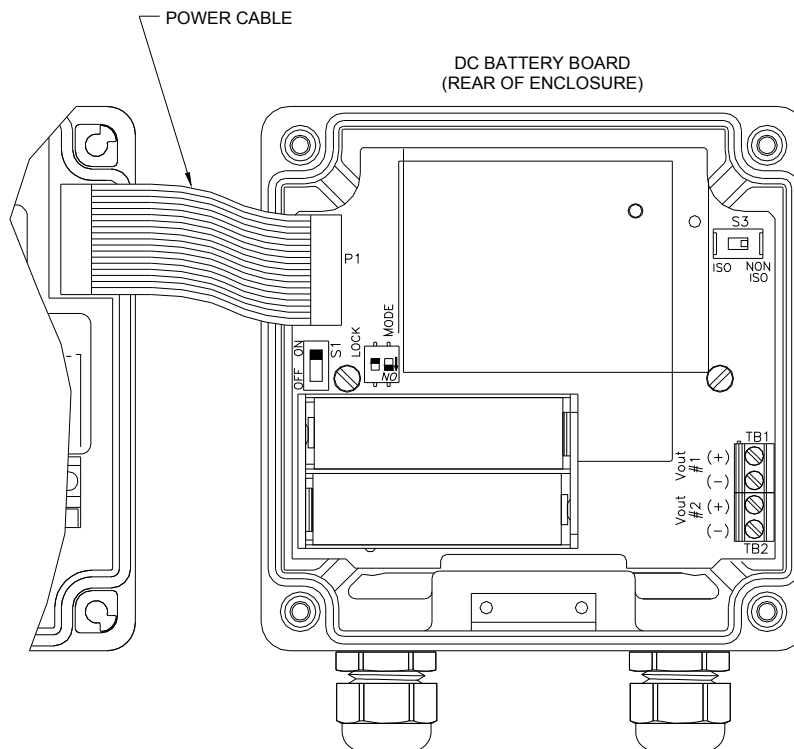
Figure 9 - Battery Board Connections

The first **(S1)** is an On/Off slide switch. This switch must be in the ON position for operation. Turn it to OFF if you do not intend to operate the monitor in the next week or two.

The second switch assembly **(S2)** contains two switches, the one on the left marked LOCK and the one on the right marked MODE. The function of these two slide switches are as follow:

LOCK   This switch is used to define how the monitor will turn on and off. This switch is normally in the OFF position. With the lock switch off, the monitor will be turned on manually using the MENU key on the front of the monitor. With the lock switch in the ON position, the monitor will always be on when there is enough power to run the monitor. The ON position is normally used when operating from an external power supply intended for continuous operation.

MODE   This switch is used to set the voltage at which monitor will shut off when powered by internal batteries. Alkaline batteries can normally be run down to about 0.8 volts. When using alkaline batteries, the mode switch is in the OFF position (factory default). If rechargeable NiMH batteries are substituted, place the MODE

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switch in the ON position. Note that rechargeable NiMH batteries have only about 35% of the capacity of an alkalines. However, NiMH batteries can be recharged hundreds of times.

The third switch assembly is a single slide switch **(S3)** which defines whether the 0-2.5 VDC signals from the monitor are isolated or non-isolated. Output isolation is not required when outputs are connected to the internal data logger. However, if the outputs are connected to external devices through the external connection cable, putting this switch in the ISO position will protect against possible ground loops. The isolation circuit will slightly increase the power requirement for the monitor, resulting in a bit less battery life.

6.3   Battery Power Circuit Board

The Q45 portable instrument is primarily operated by software settings. However, there are also a few hardware details on the battery circuit board to note.

The battery board is a circuit board that sits in the rear of the Q45 enclosure, and connects to the Q45 AUX port through a ribbon cable. The battery board contains the battery clip for the two AA batteries and the output terminal strip for the two 0-2.5 VDC outputs. Along the left side below the ribbon cable is an ON/OFF slide switch. This switch can be used to turn the instrument completely OFF when not intending to use the unit for an extended period.

6.4   Voltage Outputs

There are two sets of analog voltage outputs on the battery board that may be used to send isolated data back to remotely located recorders, PLC's, etc. Output #1 is used only for residual chlorine, and Output #2 can be used for temperature.

6.5   User Interface

The user interface for the Q45 Series instrument consists of a custom display and a membrane keypad. All functions are accessed from this user interface (no internal jumpers, pots, etc.).
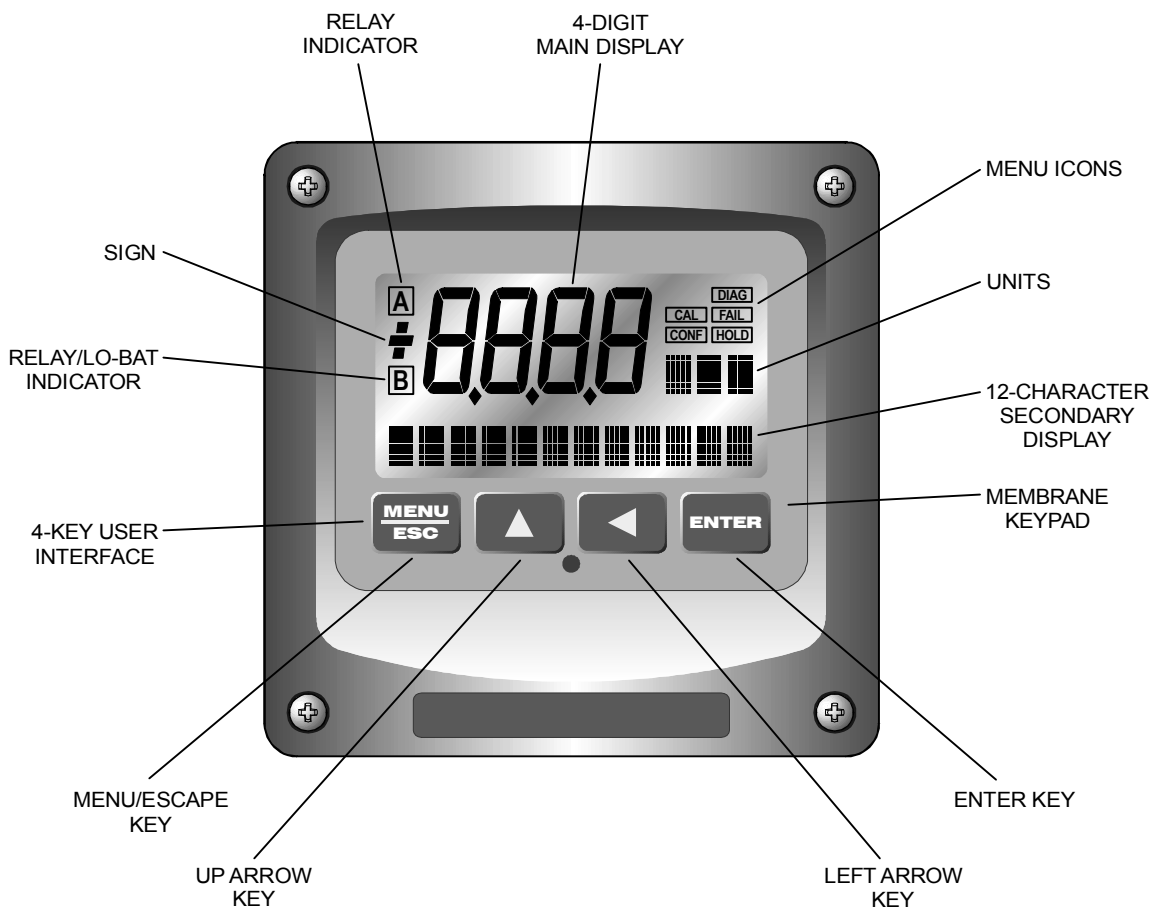
Figure 10 - User Interface

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6.51 Keys

All user configurations occur through the use of four membrane keys. These keys are used as follows:

MENU/ESC   To scroll through the menu section headers or to escape from anywhere in software. The escape sequence allows the user to back out of any changes in a logical manner. Using the escape key aborts all changes to the current screen and backs the user out one level in the software tree. The manual will refer to this key as either MENU or ESC, depending upon its particular function. In the battery-powered version of the Q45, this is also the ON button.

UP (arrow)   To scroll through individual list or display items and to change number values.

LEFT (arrow)   To move the cursor from right to left during changes to a number value.

ENTER   To select a menu section or list item for change and to store any change.

6.52 Display

The large custom display provides clear information for general measurement use and user configuration. There are three main areas of the display: the main parameter display, the secondary message line, and the icon area.

Main Parameter   During normal operation, the main parameter display indicates the present process input with sign and units. This main display may be configured to display any of the main measurements that the system provides. During configuration, this area displays other useful set-up information to the user.

$$8.24 \text{ PPM}$$

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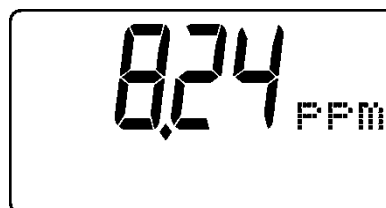
Lower Line   During normal operation, the lower line of the display indicates user-selected secondary measurements that the system is making. This also includes calibration data from the last calibration sequence and the transmitter model number and software version. During configuration, the lower line displays menu items and set-up prompts to the user. Finally, the lower line will display error messages when necessary. For a description of all display messages, refer to Section 10.4.

+22.8 °C
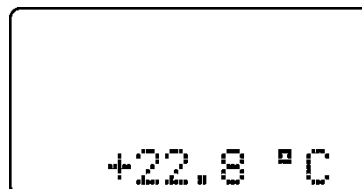
Icon Area   The icon area contains display icons that assist the user in set-up and indicate important states of system functions. The CAL, CONFIG, and DIAG icons are used to tell the user what branch of the software tree the user is in while scrolling through the menu items. This improves software map navigation dramatically. Upon entry into a menu, the title is displayed (such as CAL), and then the title disappears to make way for the actual menu item. However, the icon stays on.

DIAG
CAL FAIL
CONF HOLD
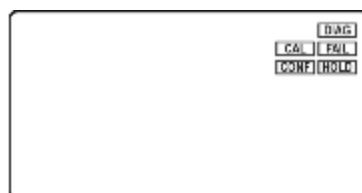
HOLD   The HOLD icon indicates that the current output of the transmitter has been put into output hold. In this case, the output is locked to the last input value measured when the HOLD function was entered. HOLD values are retained even if the unit power is cycled.

FAIL   The FAIL icon indicates that the system diagnostic function has detected a problem that requires immediate attention. This icon is automatically cleared once the problem has been resolved.

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Icon B   The left screen area contains one "B" icon that indicates that the battery voltage is at a low level.

```
┌─────────────────────┐
│ Ⓐ A                 │
│                     │
│ Ⓑ B                 │
│                     │
└─────────────────────┘
```

6.6   Software

The software of the Q45H is organized in an easy to follow menu-based system. All user settings are organized under five menu sections: Measure, Calibration [**CAL**], Configuration [**CONFIG**], Control **[CONTROL]** and Diagnostics [**DIAG**].

Note: **The default Measure Menu is display-only and has no menu icon.**

6.61   Software Navigation

Within the CAL, CONFIG, CONTROL, and DIAG menu sections is a list of selectable items. Once a menu section (such as CONFIG) has been selected with the MENU key, the user can access the item list in this section by pressing either the ENTER key or the UP arrow key. The list items can then be scrolled through using the UP arrow key. Once the last item is reached, the list wraps around and the first list item is shown again. The items in the menu sections are organized such that more frequently used functions are first, while more permanent function settings are later in the list. See

Figure 11 - Software Map

 for a visual description of the software.

Each list item allows a change to a stored system variable. List items are designed in one of two forms: simple single variable, or multiple variable sequences. In the single variable format, the user can quickly modify one parameter - for example, changing temperature display units from °F to °C. In the multiple variable sequence, variables are changed as the result of some process. For example, the calibration of chlorine generally requires more than one piece of information to be entered. The majority of the menu items in the software consist of the single variable format type.

Any data that may be changed will be flashing. This flashing indicates user entry mode and is initiated by pressing the ENTER key.   The UP arrow key will increase a flashing digit from 0 to 9. The LEFT arrow key moves the flashing digit from right to left. Once the change has been completed, pressing ENTER again stores the variable and stops the flashing. Pressing ESC aborts the change and also exits user entry mode.

The starting (default) screen is always the Measure Menu. The UP arrow key is used to select the desired display. From anywhere in this section the user can press the MENU key to select one of the four Menu Sections.

The UP arrow icon next to all list items on the display is a reminder to scroll through the list using the UP arrow key.

To select a list item for modification, first select the proper menu with the MENU key. Scroll to the list item with the UP arrow key and then press the ENTER key. This tells the system that the user wishes to perform a change on that item. For single item type screens, once the user presses the ENTER key, part or all of the variable will begin to flash, indicating that the user may modify that variable using the arrow keys. However, if the instrument is locked, the transmitter will display the message **Locked!** and will not enter user entry mode. The instrument must be unlocked by entering the proper code value to allow authorized changes to user entered values. Once the variable has been reset, pressing the ENTER key again causes the change to be stored and the flashing to stop. The message **Accepted!** will be displayed if the change is within pre-defined variable limits. If the user decides not to modify the value after it has already been partially changed, pressing the ESC key aborts the modification and returns the entry to its original stored value.

In a menu item which is a multiple variable sequence type, once the ENTER key is pressed there may be several prompts and sequences that are run to complete the modification. The ESC key can always be used to abort the sequence without changing any stored variables.
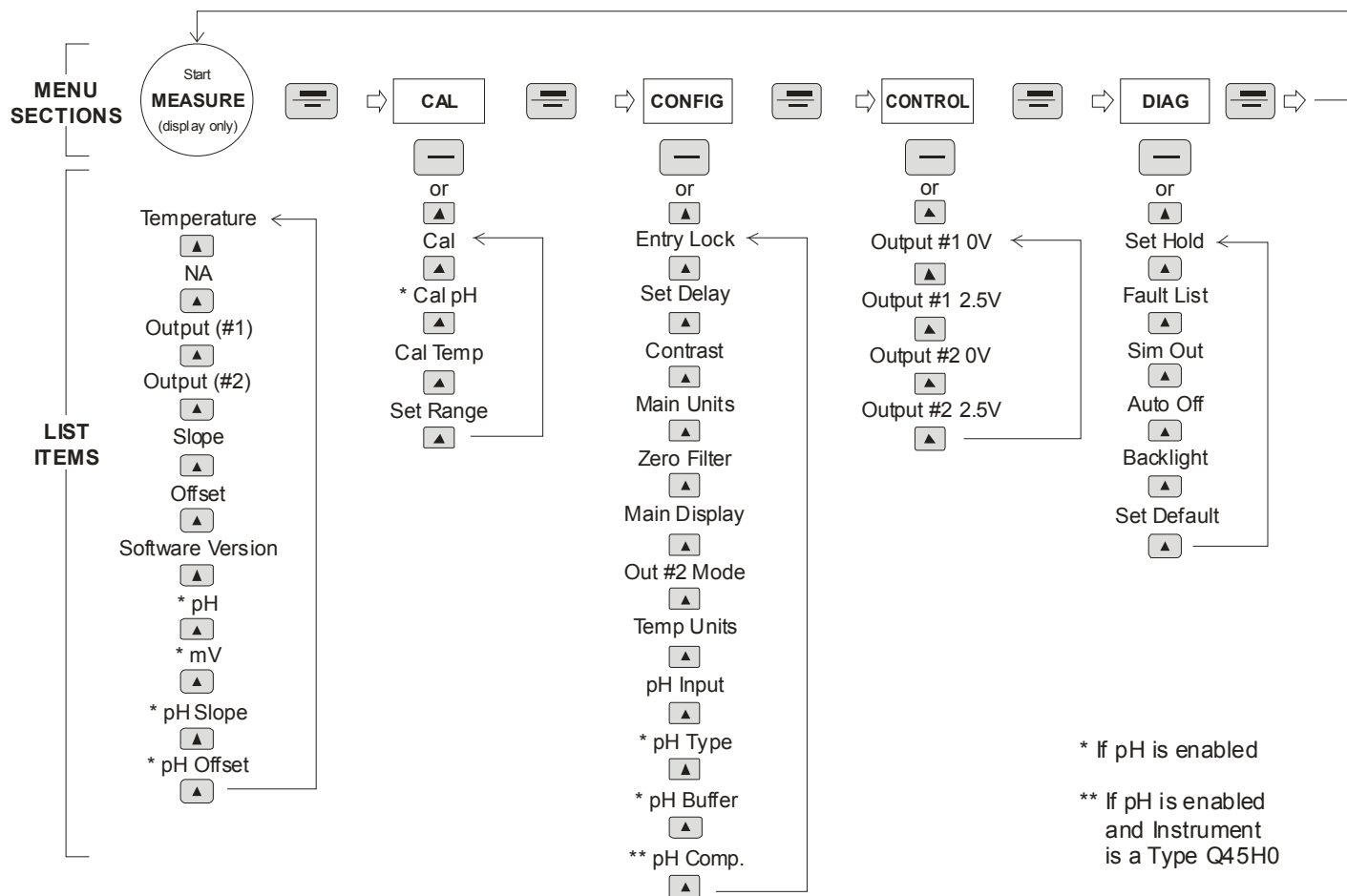
Figure 11 - Software Map

6.62   Measure Menu [MEASURE]

The default menu for the system is the display-only menu MEASURE. This menu is a display-only measurement menu, and has no changeable list items. When left alone, the instrument will automatically return to this menu after approximately 30 minutes. While in the default menu, the UP arrow allows the user to scroll through the secondary variables on the lower line of the display. A brief description of the fields in the basic transmitter version is as follows:

<u>**TRANSMITTER MEAS SCREENS:**</u>

25.7°C   Temperature display. Can be displayed in °C or °F, depending on user selection. A small "m" on the left side of the screen indicates the transmitter has automatically jumped to a manual 25°C setting due to a failure with the temperature signal input.

32.0 nA   Raw sensor current. Useful for diagnosing problems.

#1 1.05 Vdc   Instrument output signal #1.

#2 0.66 Vdc   Instrument output signal #2.

Slope = 100%   Sensor output response vs. ideal calibration. This value updates after each calibration. As the sensor ages, the slope reading will decay indicating sensor aging. Useful for resolving sensor problems.

Offset = 0.0 nA   Sensor output current at a zero ppm input. This value updates after a zero-calibration has been performed. Useful for resolving sensor problems.

Q45H0 v1.09   Transmitter software version number.

7.56 pH   **Not used on portables**

Slope = 100%   **Not used on portables**

Offset = X.X mV   **Not used on portables**

Note: A display test (all segments ON) can be actuated by pressing and holding the ENTER key while viewing the model/version number on the lower line of the display.

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The MEASURE screens are intended to be used as a very quick means of looking up critical values during operation or troubleshooting.

6.63 Calibration Menu [CAL]

The calibration menu contains items for frequent calibration of user parameters. There are four items in this list: Cal Chlor, Cal Temp, Set Range, and Cal Zero.

Cal Cl$_2$ The chlorine calibration function allows the user to adjust the transmitter span reading to match a reference solution, or to set the sensor zero point. See Part 7 - Calibration for more details.

Cal pH   **Not available on portables**

Cal Temp   The temperature calibration function allows the user to adjust the offset of the temperature response by a small factor of ±5°C. The temperature input is factory calibrated to very high accuracy. However, long cable lengths and junction boxes may degrade the accuracy of the temperature measurement in some extreme situations. Therefore, this feature is provided as an adjustment. See Part 7 - Calibration for more details.

Set Range   This function allows the user to set the display range of the transmitter to a specific application. Once set, all output functions use this display range to establish configuration settings. Press ENTER to initiate user entry mode, and the value will flash. Use the arrow keys to modify value; available ranges include 200.0 ppb, 2.000 ppm, 20.00 ppm, and 200.0 ppm. Press ENTER to store the new value. The display range does not affect the internal auto ranging scaler that, therefore, sensitivity is to specification in any user selected range.

6.64   Configuration Menu [CONFIG]

The Configuration Menu contains all of the general user settings:

Entry Lock   This function allows the user to lock out unauthorized tampering with instrument settings. All settings may be viewed while the instrument is locked, but they cannot be modified. The Entry Lock feature is a toggle-type setting; that is, entering the correct code will lock the transmitter and entering the correct code again will unlock it. The code is preset at a fixed value. Press ENTER to initiate user entry mode and the first digit will flash. Use arrow keys to modify value. **See end of manual for the Q45H lock/unlock code.** Press ENTER to toggle lock setting once code is correct. Incorrect codes do not change state of lock condition.

Set Delay   The delay function sets the amount of damping on the instrument. This function allows the user to apply a first order time delay function to the chlorine measurements being made. Both the display and the output value are affected by the degree of damping. Functions such as calibration are not affected by this parameter. The calibration routines contain their own filtering and stability monitoring functions to minimize the calibration timing. Press ENTER to initiate user entry mode, and the value will flash. Use the arrow keys to modify value; range is 0.1 to 9.9 minutes. Press ENTER to store the new value.

Contrast   This function sets the contrast level for the display. The custom display is designed with a wide temperature range, Super-Twist Nematic (STN) fluid.

The STN display provides the highest possible contrast and widest viewing angle under all conditions. Contrast control of this type of display is generally not necessary, so contrast control is provided as a means for possible adjustment due to aging at extreme ranges. In addition, the display has an automatic temperature compensation network. Press ENTER to initiate user entry mode, and the value will flash. Use arrow keys to modify the value; range is 0 to 8 (0 being lightest). Press ENTER to update and store the new value.

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Main Units   This function allows the user to select either PPM or mg/l for the chlorine measurement.

Zero Filter   This function forces the reading to zero when reading is below the entered value. For example, If the entered value were 0.0020 the display at 0.0019 would then indicate 0.0000. This feature is useful in blanking out zero noise.

Main Display   This function allows the user to change the measurement in the primary display area. The user may select between chlorine, sensor temperature, or output current. Using this function, the user may choose to put temperature in the main display area and chlorine on the secondary, lower line of the display. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify the desired display value. Press ENTER to store the new value.

*Iout#2 Mode   This function sets analog output #2 for temperature (default), chlorine, or pH. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify the desired value; selections include 1-C/F for temperature, 2-ppm for chlorine, or 3-pH for pH. Press ENTER to store the new value.

Temp Units   This function sets the display units for temperature measurement. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify the desired display value. The choices are **°F** and **°C**. Press ENTER to store the new value.

pH Input   **Not available on portables**

pH Type   **Not available on portables**

pH Buffer   **Not available on portables**

6.65   Control Menu [CONTROL]

The Control Menu contains all of the output control user settings:

Set 0V   #1
Set 2.5V #1
Set 0V   #2
Set 2.5V #2   These functions set the output range for each of the two
instrument outputs. The value stored for the 0V point may
be higher or lower than the value stored for the 2.5V point.

The entry values are limited to values within 20.00 ppm and
must be separated by at least 1% of this range Use the
LEFT arrow key to select the first digit to be modified. Then
use the UP and LEFT arrow keys to select the desired
numerical value. Press ENTER to store the new value.

Output #1 will always be in units of ppm, as it is fixed to track
residual chlorine. Output #2 will be in either units of ppm or
C/F, depending on whether residual chlorine, or temperature
is set for Out#2 in the CONFIG menu.

6.66 Diagnostics Menu [DIAG]

The diagnostics menu contains all of the user settings that are specific to the
system diagnostic functions, as well as functions that aid in troubleshooting
application problems.

Set Hold   The Set Hold function locks the current loop output values
on the present process value, and halts operation of the PID
controller. This function can be used prior to calibration, or
when removing the sensor from the process, to hold the
output in a known state.   Once HOLD is released, the
outputs return to their normal state of following the process
input. The transfer out of HOLD is bumpless on the both
analog outputs - that is, the transfer occurs in a smooth
manner rather than as an abrupt change. An icon on the
display indicates the HOLD state, and the HOLD state is
retained even if power is cycled. Press ENTER to initiate
user entry mode, and entire value will flash. Use the UP
arrow key to modify the desired value, selections are **ON** for
engaging the HOLD function, and **OFF** to disengage the
function. Press ENTER to store the new value.

Note: When the Relay Option Board is installed, the Set Hold function holds BOTH current levels, as well as ALL relay settings.

The Set Hold function can also hold at an output value specified by the user. To customize the hold value, first turn the HOLD function on. Press the ESC key to go to the DIAG Menu and scroll to Sim Output using the UP arrow key. Press ENTER. Follow the instructions under Sim Output (see following page).

Fault List
The Fault List screen is a read-only screen that allows the user to display the cause of the highest priority failure. The screen indicates the number of faults present in the system and a message detailing the highest priority fault present. Note that some faults can result in multiple displayed failures due to the high number of internal tests occurring. As faults are corrected, they are immediately cleared.

Faults are not stored; therefore, they are immediately removed if power is cycled. If the problem causing the faults still exists, however, faults will be displayed again after power is re-applied and a period of time elapses during which the diagnostic system re-detects them.   The exception to this rule is the calibration failure. When a calibration fails, no corrupt data is stored. Therefore, the system continues to function normally on the data that was present before the calibration was attempted.

After 30 minutes or if power to the transmitter is cycled, the failure for calibration will be cleared until calibration is attempted again. If the problem still exists, the calibration failure will re-occur. Press ENTER to initiate view of the highest priority failure. The display will automatically return to normal after a few seconds.

Sim Out
The Sim Out function allows the user to simulate the chlorine level of the instrument in the user selected display range. The user enters a ppm value directly onto the screen, and the output responds as if it were actually receiving the signal from the sensor. This allows the user to check the function of attached monitoring equipment during set-up or troubleshooting. Escaping this screen returns the unit to normal operation. Press ENTER to initiate the user entry

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mode, and the right-most digit of the value will flash. Use arrow keys to modify desired value.

The starting display value will be the last read value of the input. The output will be under control of the SIM screen until the ESC key is pressed.

Note: If the HOLD function is engaged before the Sim Output function is engaged, the simulated output will remain the same even when the ESC key is pressed. Disengage the HOLD function to return to normal output.

Auto-Off   Enables the automatic shut-off feature for the instrument. If ON, the instrument will automatically shut-off in 30 minutes after no keys are pressed to save power. If OFF, the meter will stay powered continuously until either the internal power switch on the battery board is turned OFF, or the battery voltage drops to the cut-off point (approximately 8-10 days on a standard 9 VDC alkaline battery.) Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify the desired display value. The choices are **OFF** and **ON**. Press ENTER to store the new value

Backlight   This function has three options. **ON** – On all the time, **OFF** – Off all the time, **AL** – Alarm (Default). This function flashes the backlight on and off whenever the Fail icon is displayed

Default All   The Default All function allows the user to return the instrument back to factory default data for all user settings. It is intended to be used as a last resort troubleshooting procedure. All user settings are returned to the original factory values. Hidden factory calibration data remains unchanged. Press ENTER to initiate user entry mode and the value **NO** will flash. Use the UP arrow key to modify value to **YES** and press ENTER to reload defaults.

Part 7 – Calibration

7.1   Chlorine Calibration

Once power is applied, the sensor must be given time to stabilize. This is best done by following the zeroing procedure below. Establishing a stable zero is critical to the proper operation of the monitor. A complete calibration will include zeroing and spanning the sensor. It is generally unnecessary to set the zero at every calibration, however, it should be done during the initial installation.

7.11   Chlorine Zero Cal

Chlorine sensors have extremely low offset currents at zero. For this reason, it is normally sufficient to simply leave the zero at the factory default of 0.0 nA. As an alternative, an electronic zero can be set by disconnecting the sensor from the cable and performing steps 1-5 below.

The steps below assume that the sensor has been prepared in accordance with section 5.1, Chlorine Sensor Assembly, earlier in this manual. Note that the 8 hour waiting time in step 2 below is not required if the monitor has been running for 24 hours prior to zeroing. If the unit has been running with the sensor connected, the sensor will normally return to a stable zero within 15 minutes.

1. Connect the sensor to the electronics by plugging the cable plug into the receptacle on the top of the sensor.

2. Place about an inch of water in a small beaker or other convenient container and immerse the tip of the sensor. The water used need not be distilled, but it must not contain residual chlorine. For submersible sensors, submerge the entire sensor in a bucket of unchlorinated water. Allow the sensor to sit undisturbed for at least 8 hours.

3. Scroll to the CAL menu section using the MENU key and press ENTER or the UP arrow key. **Cal Chlor** will then be displayed.

4. Press the ENTER key. The screen will display a flashing **1-Ref** for span calibration or a **2-Zer** for zero calibration. Using the UP arrow key, set for a **2-Zer** zero calibration and press ENTER.

   The system now begins acquiring data for the sensor zero calibration value. As data is gathered, the units for sensor current in nanoamps (nA) and temperature may flash. Flashing units indicate that this parameter is unstable. The calibration data point acquisition will stop only when the data

remains stable for a pre-determined amount of time. This can be overridden by pressing ENTER. If the data remains unstable for 10 minutes, the calibration will fail and the message **Cal Unstable** will be displayed.

5. If accepted, the screen will display the message **PASS** with the new sensor zero reading (offset), then it will return to the main measurement display. If the calibration fails, a message indicating the cause of the failure will be displayed and the FAIL icon will be turned on. The range of acceptable value for sensor offset is -25 nA to +25 nA. Should a FAIL occur, carefully inspect the sensor for a tear in the membrane. It will probably be necessary to rebuild the sensor as described in section 5.1, Chlorine Sensor Assembly. Should the offset value remain high and result in calibration failures, review the Service section of this manual, and then contact the service dept. at ATI for further assistance.

The sensor zero offset value in nA from the last zero calibration is displayed on the lower line of the Default Menus for information purposes.

7.12   Chlorine Span Cal

Span calibration of the system must be done against a laboratory measurement on the same sample that the sensor is measuring. A sample should be collected from the inlet line feeding the flow cell and quickly analyzed for combined chlorine. When calibrating, it is best to have a reasonably high concentration of combined chlorine in the system. The higher the value, the smaller will be the calibration errors caused by errors in the laboratory analytical procedure. It is generally preferable to calibrate at values above 0.5 PPM to reduce calibration errors. The chlorine monitor should be calibrated while operating on a chlorinated sample stream in the flow cell assembly.

Start flow cell and calibrate system as follows:

1. Place the previously zeroed sensor into the sensor chamber of the flow cell assembly. The sensor is inserted into the side of the flow cell and is sealed in place with a double o-ring. The o-rings are lubricated at the factory to allow the sensor to slide smoothly into place. If insertion becomes difficult, use a small amount of silicon grease to lubricate the o-rings. If the low-volume flow cell is used, screw the sensor into the flow cell until the membrane cap bottoms out on the acrylic flow cell. Do not over-tighten

2. Turn on the inlet water flow to the flow cell and adjust the inlet flow rate so that water is overflowing from the inlet chamber. The best performance will be obtained when some water is always overflowing. This maintains constant flow and pressure on the sensor at all times.

3. Allow the system to operate undisturbed for 30-60 minutes. Assuming the water contains chlorine, the display will be reading positive sensor current values. If the system is stable, the value on the display will increase to some PPM value and remain at that level. At that point, calibration can continue.

4. If the sensor is on-line, the user may want to set the output HOLD feature prior to calibration to lock out any output fluctuations.

5. Scroll to the CAL menu section using the MENU key and press ENTER or the UP arrow key. **Cal Cl$_2$** will then be displayed.

6. Press the ENTER key. The screen will display a flashing **1-Ref** for span calibration or a **2-Zer** for zero calibration. Using the UP arrow key, set for a **1-Ref** span calibration and press ENTER.

7. The system now begins acquiring data for the calibration value. As data is gathered, the units for ppm and temperature may flash. Flashing units indicate that this parameter is unstable. The calibration data point acquisition will stop only when the data remains stable for a pre-determined amount of time. This can be overridden by pressing ENTER. If the data remains unstable for 10 minutes, the calibration will fail and the message **Cal Unstable** will be displayed.

8. The screen will display the last measured ppm value and a message will be displayed prompting the user for the lab value. The user must then modify the screen value with the arrow keys and press ENTER. The system then performs the proper checks.

9. If accepted, the screen will display the message **PASS** with the new sensor slope reading, then it will return to the main measurement display. If the calibration fails, a message indicating the cause of the failure will be displayed and the FAIL icon will be turned on. The range of acceptable values for sensor slope is 20% to 500%. It may be necessary to rebuild the sensor as described in section 5.1, Chlorine Sensor Assembly. Should the slope value remain out of range and result in calibration failures, review the Service Section of this manual, then contact the service dept. at ATI for further assistance.

The sensor offset value in % from the last span calibration is displayed on the lower line of the Default Menus for information purposes.

7.2   Temperature Calibration

The temperature calibration sequence is essentially a 1-point offset calibration that allows adjustments of approximately ±5 °C.

The sensor temperature may be calibrated on line, or the sensor can be removed from the process and placed into a known solution temperature reference. In any case, it is critical that the sensor be allowed to reach temperature equilibrium with the solution in order to provide the highest accuracy. When moving the sensor between widely different temperature conditions, it may be necessary to allow the sensor to stabilize as much as one hour before the calibration sequence is initiated. If the sensor is on-line, the user may want to set the output HOLD feature prior to calibration to lock out any output fluctuations.

1. Scroll to the CAL menu section using the MENU key and press ENTER or the UP arrow key.

2. Press the UP arrow key until **Cal Temp** is displayed.

3. Press the ENTER key. The message **Place sensor in solution then press ENTER** will be displayed. Move the sensor into the calibration reference (if it hasn't been moved already) and wait for temperature equilibrium to be achieved. Press ENTER to begin the calibration sequence.

4. The calibration data gathering process will begin. The message **Wait** will flash as data is accumulated and analyzed. The **°C** or **°F** symbol may flash periodically if the reading is too unstable.

5. The message **Adjust value - press ENTER** will be displayed, and the right-most digit will begin to flash, indicating that the value can be modified. Using the UP and LEFT arrow keys, modify the value to the known ref solution temperature.   Adjustments up to ± 5°C from the factory calibrated temperature are allowed. Press ENTER.

Once completed, the display will indicate **PASS** or **FAIL**. If the unit fails, the temperature adjustment may be out of range, the sensor may not have achieved complete temperature equilibrium, or there may be a problem with the temperature element. In the event of calibration failure, it is recommended to attempt the calibration again immediately.

Part 8 – System Maintenance

8.1   General

The Q45H/63 Combined Chlorine System will generally provide unattended operation over long periods of time. With proper care, the system should continue to provide measurements indefinitely. For reliable operation, maintenance on the system must be done on a regular schedule. Keep in mind that preventive maintenance on a regular schedule is much less troublesome than emergency maintenance that always seems to come at the wrong time.

8.2   Analyzer Maintenance

No unusual maintenance of the analyzer is required if installed according to the guidelines of this operating manual. If the enclosure door is frequently opened and closed, it would be wise to periodically inspect the enclosure sealing gasket for breaks or tears.

8.3   Sensor Maintenance

Sensor maintenance is required for accurate measurements. The primary requirement is simply to keep the sensor membrane clean. The membrane is a micro-porous polymer that is resistant to anything that will be encountered in water streams. However, deposits can form on the surface or in the pores of the membrane, and these deposits will reduce the sensitivity. Certain constituents in water, mainly iron and manganese, will for precipitates when the water is chlorinated. These precipitates can sometimes form a coating on the membrane.

Because membranes are micro-porous, they can be relatively difficult to clean effectively. Immersing the tip of the sensor in 1N nitric acid solution will sometimes remove deposits that cause low sensitivity, but this is not always the case. The recommended practice is to simply replace the membrane when it becomes fouled. To change a membrane, follow the Sensor Assembly procedure in section 5.1 of this manual. Do not reuse the electrolyte from the sensor when changing a membrane. Always refill with fresh electrolyte. The electrolyte is stable and does not have a limited shelf life.

Refer again to the explanation of the sensor slope number after an accepted span calibration on the lower MEASURE screen. In normal operation, the slope of the sensor output will decrease over time as the membrane becomes fouled. This reduction indicates that the sensor is loosing sensitivity to chlorine. It is good practice to replace the membrane if the slope number falls to 30-40%. The value will not go below 20%.

Even if no buildup is apparent on the membrane, it should be changed on a regular schedule.   The recommended membrane change interval is every 3 months.   For high purity water applications, this can probably be extended if desired, but a more frequent changing interval is a small price to pay for avoiding membrane failure at the wrong time.

While the sensor is disassembled for membrane changing, examine the condition of the o-rings on both ends of the electrolyte chamber. If the o-rings show any signs of damage, replace them with new ones from the spare parts kit. It is good practice to change these o-rings once a year, regardless of their condition.

8.31   Sensor Acid Cleaning

Over an extended operating period, chlorine sensors can slowly accumulate deposits on the surface of the platinum electrode. Typically, this type of buildup occurs over years of operation, but can sometimes occur more quickly in high levels of manganese, iron, or other metals are dissolved in the water.   The platinum electrode can be "acid cleaned" using nitric acid solutions.

WARNING

THIS ACID CLEANING PROCEDURE INVOLVES THE USE OF HIGHLY CORROSIVE ACID SOLUTIONS. IT SHOULD ONLY BE COMPLETED BY TRAINED PERSONNEL USING PROTECTIVE EYEWEAR AND GLOVES. IF THERE IS ANY DOUBT ABOUT YOUR ABILITY TO SAFELY ACCOMPLISH THIS PROCEDURE, RETURN THE SENSOR TO ATI FOR FACTORY CLEANING!

To acid clean the electrode assembly, remove the electrolyte chamber from the sensor so that the so that both electrodes are exposed.   Then follow the procedure below.

1. Place a small amount of 50% nitric acid solution in a beaker.   Put in just enough so that the platinum tip of the sensor can be submerged without any contact with the silver coil.

2. Allow the sensor to soak in this acid solution for 2 minutes.   Remove the sensor body and rinse the platinum tip thoroughly with distilled water. Discard the nitric acid safely and according to all environmental regulations.

3. Fill the beaker with distilled water to the level sufficient to submerge both the tip and the silver coil. Do not allow the connector at the back of the sensor to be submerged. Allow the electrodes to soak in distilled water for 30 minutes.

4. Put a new membrane and fresh electrolyte in the electrolyte chamber and reassemble the sensor. Connect to the chlorine monitor electronics and allow the sensor to stabilize for at least 24 hours. The sensor can be placed in the flow cell with chlorinated water running through it during stabilization. However, the readings will not be useful for 24 hours.

8.4   **Flow Cell Maintenance**

The maintenance on the flow cell is simple cleaning. The flow cell is clear to make examination of the condition of the sensor easier without interfering with operations.   The flow cell may be cleaned by wiping or by washing with detergents or dilute acids. Do not try to clean with solvents as the acrylic may craze or crack.

Change the o-ring in the flow cell yearly or if any damage is observed. If insertion of the sensor into the flow cell becomes difficult, use silicon grease to lubricate the o-rings that hold the sensor in place. Use only enough grease to provide surface lubrication. Excess grease could foul the sensor membrane.

Part 9 – Troubleshooting

9.1 General

The information included in this section is intended to be used in an attempt to quickly resolve an operational problem with the system. During any troubleshooting process, it will save the most time if the operator can first determine if the problem is related to the analyzer, sensor, or some external source. Therefore, this section is organized from the approach of excluding any likely external sources, isolating the analyzer, and finally isolating the sensor. If these procedures still do not resolve the operational problems, any results the operator may have noted here will be very helpful when discussing the problem with the factory technical support group.

9.2 External Sources of Problems

To begin this process, review the connections of the system to all external connections.

1. Do not run sensor cables or analog output wiring in the same conduits as power wiring. If low voltage signal cables must come near power wiring, cross them at 90° to minimize coupling.

2. Carefully examine any junction box connections for loose wiring or bad wire stripping. If possible, connect the sensor directly to the analyzer for testing.

3. Check sensor membrane for fouling. Look closely for signs of grease or oil which may be present. Replace membrane and electrolyte, allow to stabilize, and re-check. The procedure in Chlorine Sensor Assembly, in section 5.1, must be followed when replacing the membrane.

9.3   Analyzer Tests

1. Disconnect power and completely disconnect all output wiring coming from the analyzer. Remove sensor wiring, relay wiring, and analog output wiring. Re-apply power to the analyzer.

2. Using the Simulate feature, check operation of outputs with a DMM.

2. Check cell drive circuit. With a digital voltmeter (DVM), measure the voltage between terminals ORANGE and WHITE on the inside of the monitor to verify that the millivolt value is actually -400 mV.

4. Check TC drive circuit. Place a wire-short between the GREEN and BLACK terminals. With a digital voltmeter (DVM), measure the voltage between the BLACK and RED terminals on the back of the monitor to verify that the TC drive circuit is producing about 4.8-5.1 Vdc open circuit. Remove DVM completely and connect a 100 Ohm resistor from the BLACK to RED terminals. The temperature reading should display approximately 0°C and the chlorine reading should display approximately 0 ppm.

9.4   Display Messages

The Q45 Series instruments provide a number of diagnostic messages which indicate problems during normal operation and calibration. These messages appear as prompts on the secondary line of the display or as items on the Fault List.

MESSAGE	DESCRIPTION	POSSIBLE CORRECTION
Max is 200	Entry failed, maximum user value allowed is 200.	Reduce value to ≤ 200
Min is 200	Entry failed, minimum value allowed is 200.	Increase value to ≥ 200
Cal Unstable	Calibration problem, data too unstable to calibrate. Icons will not stop flashing if data is too unstable. User can bypass by pressing ENTER.	Clean sensor, get fresh cal solutions, allow temperature and conductivity readings to fully stabilize, do not handle sensor or cable during calibration.
Out of Range	Input value is outside selected range of the specific list item being configured.	Check manual for limits of the function to be configured.
Locked!	Transmitter security setting is locked.	Enter security code to allow modifications to settings.
Unlocked!	Transmitter security has just been unlocked.	Displayed just after security code has been entered.
Sensor High	The raw signal from the sensor is too high and out of instrument range.	Check wiring connections to sensor.
Sensor Low	The raw signal from the sensor is too low.	Check wiring connections to sensor.
Chlor High	The chlorine reading is greater than the maximum of the User-selected range.	The chlorine reading is over operating limits. Set measuring range to the next highest level.
Temp High	The temperature reading is > 55ºC.	The temperature reading is over operating limits. Check wiring and expected temp level. Perform RTD test as described in sensor manual. Recalibrate sensor temperature element if necessary.
Temp Low	The temperature reading is < -10 ºC	Same as "Temp High" above.
TC Error	TC may be open or shorted.	Check sensor wiring and perform RTD test as described in sensor manual. Check j-box connections.

Figure 12 - Q45H Display Messages

MESSAGE	DESCRIPTION	POSSIBLE CORRECTION
Chlor Cal Fail	Failure of chlorine calibration. FAIL icon will not extinguish until successful calibration has been performed, or 30 minutes passes with no keys being pressed.	Clean sensor redo zero and span calibration. If still failure, sensor slope may be less than 25% or greater than 250%. Perform sensor tests as described in section 9.5. Replace sensor if still failure.
TC Cal Fail	Failure of temperature calibration. FAIL icon will not extinguish until successful calibration has been performed, or 30 minutes passes with no keys being pressed.	Clean sensor, check cal solution temperature and repeat sensor temp calibration. TC calibration function only allows adjustments of +/- 6 ºC. If still failure, perform sensor tests as described in section 9.5. Replace sensor if still failure. .
EPROM Fail	Internal nonvolatile memory failure	System failure, consult factory.
Chcksum Fail	Internal software storage error.	System failure, consult factory.
Display Fail	Internal display driver fail.	System failure, consult factory.
Range Cal Fail	Failure of factory temperature calibration.	Consult factory.

9.5   Sensor Tests

1. Check the membrane condition. A membrane that is not stretched smoothly across the tip of the sensor will cause unstable measurements. If necessary, change membrane and electrolyte.

2. Residual chlorine sensors can be tested with a digital voltmeter (DVM) to determine if a major sensor problem exists. Follow the steps below to verify sensor integrity:

    A. Disconnect the five sensor wires from the back of the chlorine monitor. Those wires are color coded white, brown, red, black, and green. Note that the brown wire may be replaced with an orange wire in some cables.

    B. Remove the electrolyte chamber from the sensor and dry the electrodes with a paper towel.

    C. Connect a DVM between the white and brown (or orange) wires. Reading resistance, you should find an open circuit value of infinite resistance. There must be no measurable resistance at all between these wires. Any resistance at all indicates either water in the cable connector or the breakdown in an electrode seal.

    D. Connect a DVM between the red and white wires. The red wire is part of the RTD circuit and the white wire is part of the measuring cell. There should be no connection. Reading resistance, you should find an open circuit value of infinite resistance. Any resistance at all indicates either water in the cable connector or the breakdown in an electrode seal.

    E. Connect the DVM between the red and black wires. These are the RTD leads, and you should find a resistance value that depends on the temperature. The table below lists the resistance values for various temperatures. Reading resistance between the red and green wires should give exactly the same values as between red and black.

Temperature °C	Resistance Ω
0	100.0
5	101.9
10	103.9
15	105.8
20	107.8
25	109.7
30	111.7
35	113.6
40	115.5
45	117.5
50	119.4

Figure 13 - Pt100 RTD Table

If you suspect that water has gotten into a cable connection on a flow type sensor or into the plug connection of a submersible sensor, disconnect the cable and allow the parts of the sensor to sit in a warm place for 24 hours. If water in the connector is the problem, it should dry out sufficiently to allow normal sensor operation. However, steps 4 and 5 above will have to be repeated after drying to see if the problem is gone.

3. Acid clean the sensor electrodes in accordance with the procedure on the previous page.

Spare Parts

Part No.	Description
07-0025	Portable monitor electronics assembly
00-1510	Chloramine Sensor – Flow Type, vented
02-0016	Sensing element body, (for #00-1510)
00-1506	Chlorine sensor, submersion type with 25' cable, vented
02-0222	Submersion sensing module, (for #00-1506)
02-0017	Submersion element body, (for #02-0222)
03-0029	Sensor interconnect cable with connector, 25 ft.
03-0315	Vented Chamber Assembly (For use with 00-1506 or 00-1510)
48-0001	Membrane holder, type 316 stainless steel
45-0010	Membrane holder, noryl
05-0007*	Membranes, pkg. of 10 (for older systems)
05-0023*	Combined Chlorine Membranes backed – pkg 10
05-0004*	Spare Parts Kit, screw & o-ring
09-0010*	Combined residual chlorine electrolyte, 4 oz (120 cc)
00-0043	Constant-Head Flowcell assembly with mounting plate
42-0014	Flowcell o-ring (each)
48-0108	2-Hole cord grip adapter
44-0260	Pg9 cord grip (each)
44-0263	½" NPT 2-hole cord grip (each)
55-0048	0.4 LPM Fixed Flow Regulator
63-0021	1" NPT Flow Adapter

Note: Instrument is supplied with sufficient spare parts for 6-12 months of operation. For 2 year spare parts inventory, 3 each of the items marked with an asterisk are required.

Lock/Unlock Code: 1456