ANALYTICAL TECHNOLOGY, INC.

O & M Manual

Model PQ45P
Portable pH
Measurement System

Home Office

Analytical Technology, Inc.
6 Iron Bridge Drive
Collegeville, PA 19426
Phone: 800-959-0299
610-917-0991
Fax: 610-917-0992
Email: sales@analyticaltechnology.com

European Office

ATI (UK) Limited
Unit 1 & 2 Gatehead Business Park
Delph New Road, Delph
Saddleworth OL3 5DE
Phone: +44 (0)1457-873-318
Fax: + 44 (0)1457-874-468
Email: sales@atiuk.com

Table of Contents

Table of Figures

Part 1 - Introduction

1.1 General

The Model PQ45P Portable pH Monitor is designed for short-term measurement and data logging of pH in liquid. It may also be used for permanent monitoring in locations where solar power systems are available to provide continuous power.

Each system is a self-contained package that includes a battery-powered analyzer, sensor, flowcell assembly, and sample flow controls. Sample and drain connections are provided on the outside of the case, and connectors and tubing to adapt to water samples are supplied. Sample lines with pressures up to 75 PSI (5 Bar) may be connected without pressure reduction. For samples subject to higher pressures, a pressure-reducing valve should be used to control sample pressure to less than 75 PSI (5 Bar).

Both the fittings installed in the case and the fittings supplied for sample tubing connection externally are equipped with shut-off valves. When both fittings are plugged in, sample will flow. When either the inlet or outlet fittings are disconnected, sample flow will stop. Sample flow rate is controlled internally by a special orifice flow control device that provides a fixed 400 cc/min. flow at sample inlet pressures between 5 and 75 PSI (0.3-5.0 Bar). An in-line y-strainer is installed to trap particles larger than 65 micron.

Most system components are mounted on a hinged panel inside the case. The electronic unit is mounted on the front of the panel. If the optional data logger was ordered, this is also mounted on the front. Opening up the internal panel allows access to the sensor, flowcell, and flow control assembly. Maintenance items, connectors, and extra tubing are stored in the space behind the panel.

1.2 Standard System

Standard PQ45 systems include a battery-powered electronic unit, a pH sensor, flowcell, flow control components, sample and drain tubing, and various accessories. The standard batteries consist of two standard alkaline C-cell batteries located inside the electronic assembly.

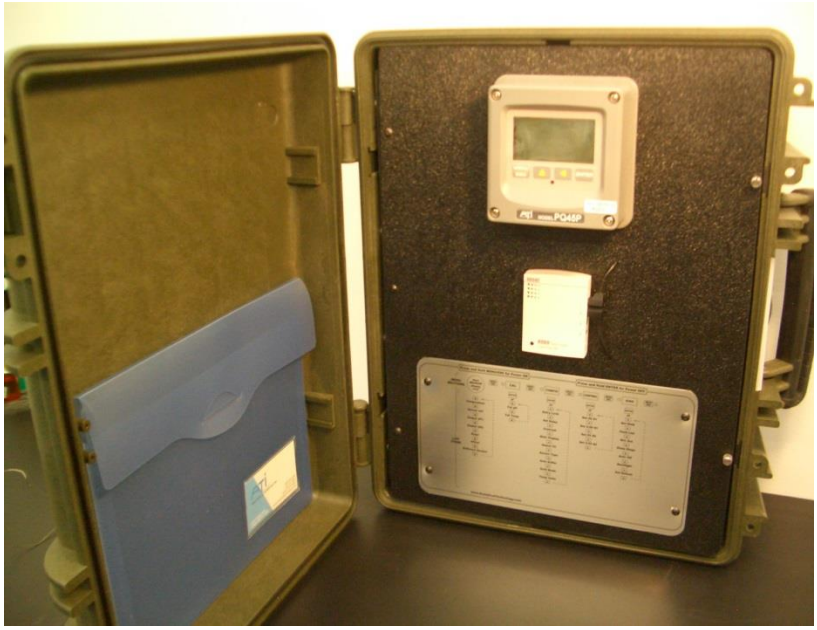


Figure 1 - PQ45 Portable Monitor System

1.3 Features

- Standard main module is designed to be a fully isolated, battery-powered instrument. An optional arrangement provides for external power from a 10-16 VDC supply.

- Output Hold, Output Simulate, Output Alarm, and Output Delay Functions. All forced changes in output condition include bumpless transfer to provide gradual return to on-line signal levels and to avoid system control shocks on both analog outputs.

- Two 10-bit, isolated, 0-2.5 VDC analog outputs may be configured to track pH and temperature, or pH and pH. Both analog outputs can be individually programmed to specific ranges. Optional plug-in datalogger (removable module) allows the user to gather up to 32,000 total data points on temperature and pH.

- Large, high contrast, custom Super-Twist display provides excellent readability even in low light conditions. 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.

- Sensor diagnostics monitor glass breakage, sensor leaks, and RTD condition. 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 two-point and sample calibration methods include auto-buffer recognition from 13 built-in buffer tables. To provide high accuracy, all calibration methods include stability monitors that check temperature and main parameter stability before accepting data.

- Selectable Pt1000 or Pt100 temperature inputs. Systems can also be hard-configured for three-wire elements. 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.

- High reliability, microprocessor-based system with non-volatile memory back-up that utilizes no batteries. Low mass, surface mount PCB construction containing no adjustment potentiometers. All factory calibrations stored in non-volatile EEPROM.

1.4 PQ45P System Specifications

Enclosure	NEMA 4X, polycarbonate, stainless steel hardware, weatherproof and corrosion resistant, HWD: 4.4" (112 mm) × 4.4" (112 mm) × 3.5" (89 mm)
Display	Large, high-contrast, Super-Twist (STN) LCD; 4-digit main display with sign, 0.75" (19.1 mm) seven-segment characters; 12-digit secondary display, 0.3" (7.6 mm) 5×7 dot matrix characters
Keypad	4-key membrane type with tactile feedback, polycarbonate with UV coating, integral EMI/static shield and conductively coated window
Ambient Temperature	Service, -20 to 60 °C (-4 to 140 ºF) Storage, -30 to 70 °C (-22 to 158 ºF)
Ambient Humidity	0 to 95%, indoor/outdoor use, non-condensing to rated ambient temperature range
Electrical Certification	Ordinary Location, cCSAus (CSA and UL standards - both approved by CSA), pollution degree 2, installation category 2
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	Selectable Pt1000 or Pt100 RTD with automatic compensation
Displayed Parameters	Main input, 0.00 to 14.00 pH Sensor temperature, -10.0 to 110.0 °C (14 to 230ºF) Output Values, 0 to 2.5 VDC, Vout #1/#2 Sensor slope/offset Model number and software version
Main Parameter Ranges	0.00 to 14.00 pH
Power	Generic 9 VDC alkaline battery, low battery indication at 6.75 V DC. Lithium 9 VDC battery recommended for max performance.

Outputs	Two 0-2.5 VDC isolated outputs are provided on for connection to data recorders, etc.
Battery Life	Approximately 100 hours with alkaline battery. Use of lithium cell increases life to approximately 300 hours.
Optional Datalogger	Removable data module holds 32,000 points from two user configured channels, time of logging is user configurable. Software supplied for data download and display.

1.5 PQ45P Performance Specifications

Accuracy	0.1% of span or better (± 0.01 pH)
Repeatability	0.1% of span or better (± 0.01 pH)
Sensitivity	0.05% of span (± 0.01 pH)
Stability	0.05% of span per 24 hours, non-cumulative (± 0.007 pH)
Warm-up Time	7 seconds to rated performance
Instrument Response Time	6 seconds to 90% of step input at lowest setting
Temperature Drift	Span or zero, 0.02% of span/°C
Max. Sensor-Instrument Distance	3,000 ft. (914 meters) w/ preamp, 30 ft. (9.1 meters) w/o preamp
Sensor Types	Model Q25P pH w/ preamp - 5 wire input, or the standard combination style pH electrode w/ TC - 2 wire input

Part 2 – System Components

2.1 General

The PQ45 Portable pH Monitoring System comes complete in a rugged molded case, and is designed to be operated by simply setting the case in the desired location, connecting sample and drain tubes, and turning on the power. Once the system has been readied for use, it can be turned on and off, and moved to various locations without requiring further service.

2.2 Front Panel Components

The PQ45 contains an internal hinged panel. Release the two main case latches and you will see the electronic monitor on the front of the panel with a graphic of the software map located below. The graphic is meant to be a reference for navigating the software in the analyzer. If the optional data logger was ordered, this component will be located just below the monitor, and will have two connectors plugged into the side.

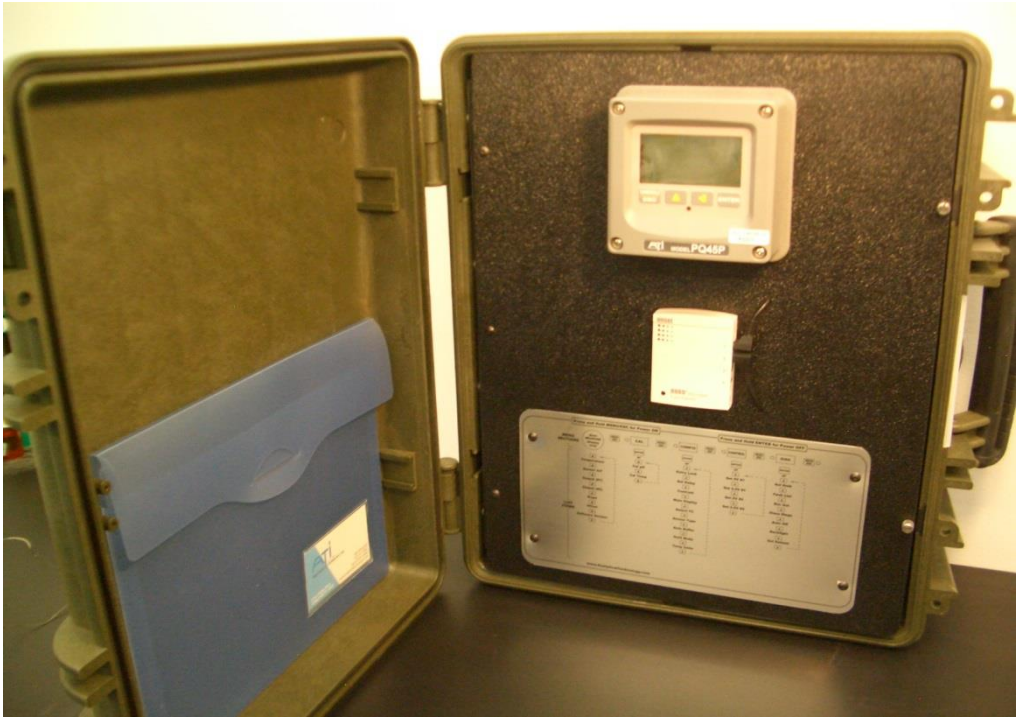


Figure 2 - Front View of Hinged Panel

2.3 Internal Flow System

The “Wet” section of the analyzer is located on the back of the internal hinged panel. The panel is held in place by two captive screws on the right side. Loosen these screws to get access to the sensors and sample flow components. Figure 3 identifies the items located on the back of the panel.

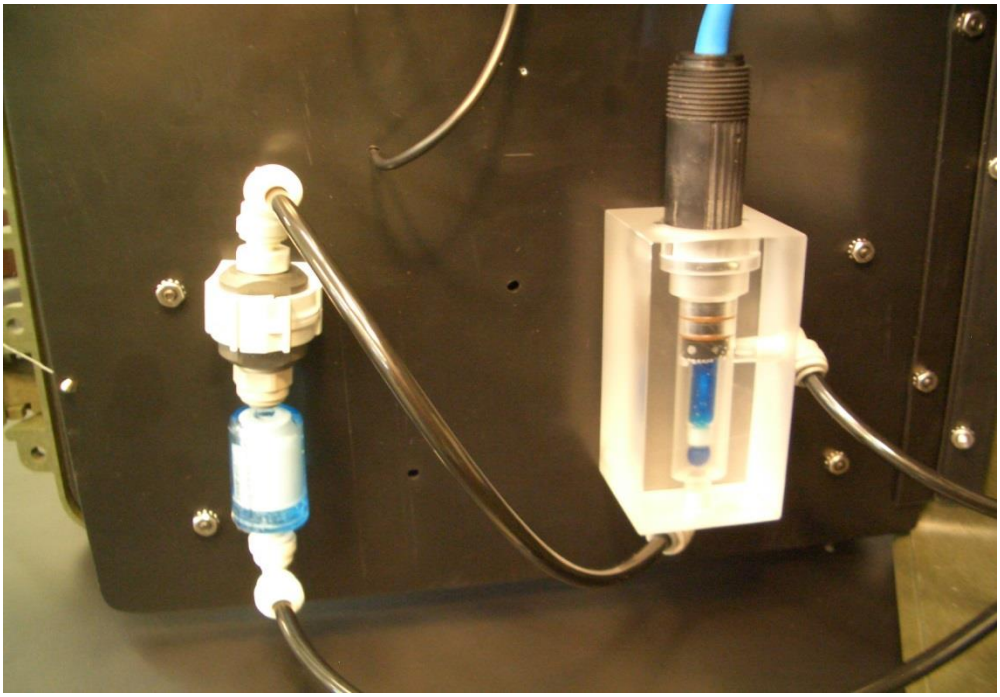


Figure 3 - Sensor and Flow Components

The flow system inside the case consists of quick-disconnect sample and drain fittings, polyurethane tubing, flow control assembly, and a flowcell with pH sensor. This system is completely assembled and is designed for connection to water sources with pressure between 5 and 75 PSI. Note that the drain tube MUST discharge to an unpressurized drain. You may not connect the drain to a pressurized line or the system will not function properly.

Most tubing connections are made using what are called “instant tube fittings”. These fitting are designed to allow tubing to be readily removed in case service is needed on a particular component. This is normally only needed to remove the flow control assembly to clean the y-strainer.

The instant tube fittings have a circular collar at the end of the fitting. This collar must be pushed toward the main body of the fitting while pulling the tubing in the opposite direction. When reinserting the tubing, simply press the tubing into the fitting and you will feel it slide into place.

2.4 Flow Control System

The sample flow to the sensors in this instrument is controlled by a special orifice control device that controls sample flow to approximately 400 cc/min. regardless of variations in inlet pressure. The flow control device is protected by a y-strainer. This strainer is designed to remove any large particles that might adversely affect the performance of the flow control.

The y-strainer should be inspected periodically and cleaned of accumulated solids. To do so, it is easiest to remove the entire flow control system by disconnecting the inlet and outlet tubes from the top and bottom of the assembly, and then removing it from the mounting clip. Once removed, use a crescent wrench to unscrew the screen holder. Remove the screen and rinse as needed to remove any accumulated solids.

2.5 Water Sample Connections

On the hinged side of the case are two quick-disconnect fittings marked INLET and OUTLET. This is where you will connect your water sample. These connectors contain valves that automatically close when the mating connector is removed. Mating connectors also contain valves so that sample lines can be disconnected without closing the main tap valve.

A 20-foot (6 m.) length of 0.25" O.D. x 0.17" I.D. polyurethane tubing is supplied for connection to water lines. In addition, tube fittings that mate with either 1/8" NPT or ¼" NPT sample lines are supplied for convenience.

2.6 Spare Parts

Behind the internal panel in the area of the flowcells and sensors is a molded foam area that holds spare parts that might be needed in the field. The following items are normally supplied.

Qty. 1 Data Logger Software (if purchased with system)
Qty. 2 Quick-disconnect fittings for sample & drain connection
Qty. 4 Water system adapter fittings – two each of 1/8" NPT & ¼" NPT
20 feet ¼" O.D. x 0.17" I.D. sample / drain tubing

Attached inside the front cover is a plastic pouch containing the O&M manual for the instrument.

To remove the pH sensor from the flowcell, turn the sensor until the twist-lock pins line up with the insertion slots and **CAREFULLY** pull the sensor upward. Be very careful removing the sensor as it is easily broken.

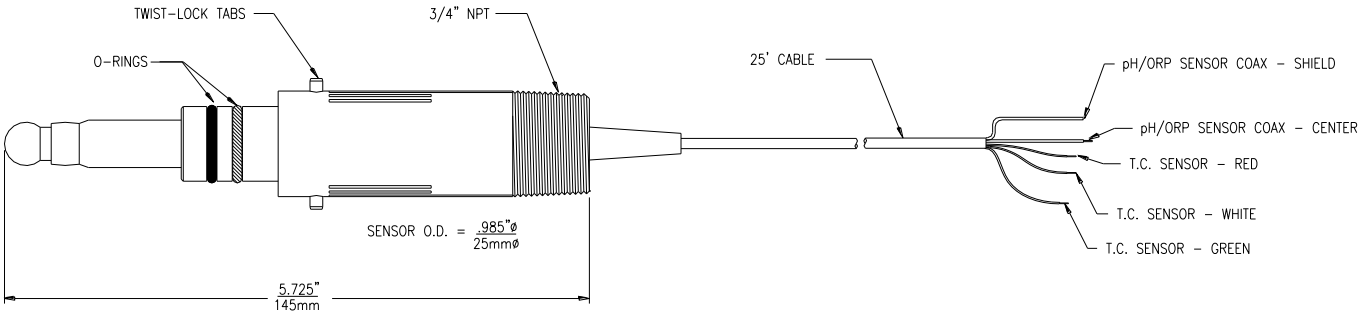


Figure 4 - Standard pH Sensor

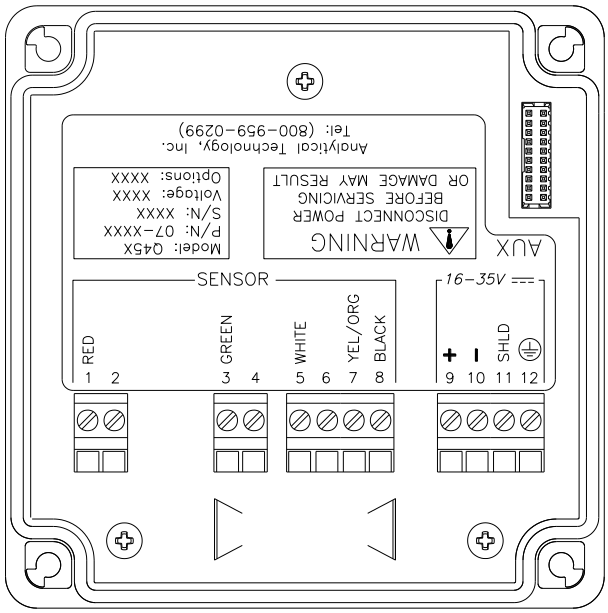
Part 3 – Electrical Assembly

3.1 General

PQ45 Portable Analyzers are factory wired and are ready to operate as received. If units were supplied with the optional data logger, voltage output cables that plug into the logger will be supplied. If no logger was purchased with the unit, these cables will not be installed. Units supplied with the external power and output connector will be provided with a mating cable assembly.

3.2 Sensor Connections

Figure 5 below provides information on the proper connection of sensor cables. This information is for reference only as the connections are made at the factory. Note that jumpers will be installed at the factory between terminals 3 and 5, and terminals 6 and 9



pH SENSOR WIRING

SENSOR WIRING	TRANSMITTER T/B'S
pH CENTER	RED (1)
pH SHIELD	GREEN (3)
RED	YEL/ORG (7)
WHT & BLU or GRN	BLACK (8)

JUMPER WIRE BETWEEN GRN & BLK
(FACTORY INSTALLED)

Figure 5 - Sensor Connections, PQ45P pH System

3.3 Battery / Power Circuit Board

PQ45P monitors are normally powered by internal C-cell alkaline batteries or by an external power connection. Figure 6 shows this board assembly with batteries installed. Figure 7 shows the same board with terminals installed for external power connection.

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

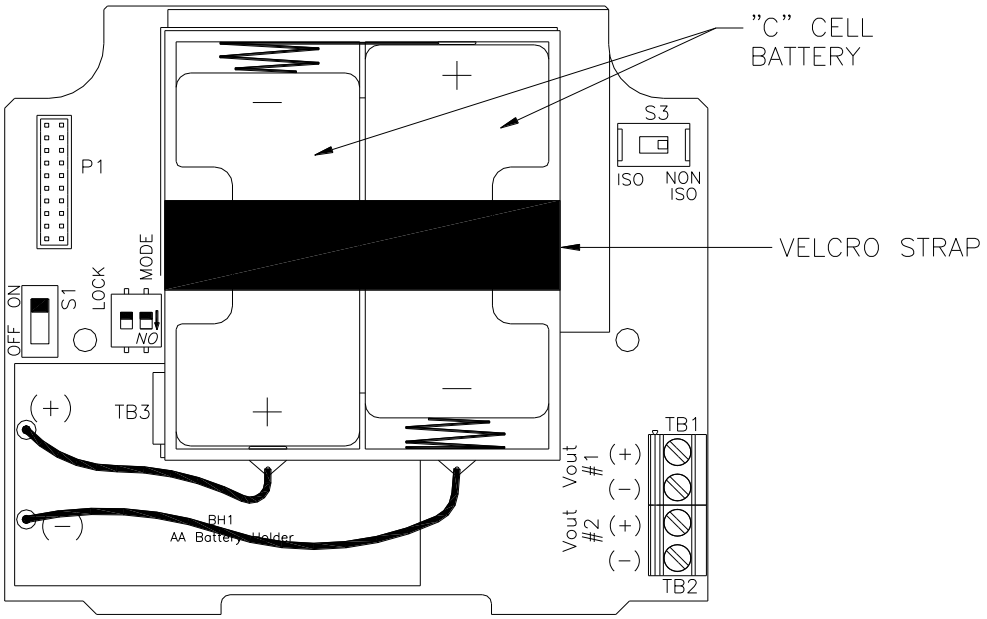


Figure 6 - Battery Circuit Board w/C-Cell Batteries

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 0.75 volts. However, the monitor can be operated using rechargeable nickel-metal hydride (NiMH) batteries as well. This type of battery should not be discharged below about 1 volt before recharging. When using alkaline batteries, the mode switch is in the OFF position (factory default). If rechargeable NiMH batteries are substituted, place the MODE switch in the ON position. Note that rechargeable NiMH batteries have only about 35% of the capacity of an alkaline C-cell, so

operation will be limited to about 10 days on a charge. 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.

3.4 External Power / Output Connections

PQ45H units ordered with the external connection option are designed for applications where power is to be supplied from an external source, and the two voltage outputs are to be wired to an external device. If that option has been supplied, an interface cable will be provided.

Figure 7 below identifies the terminal connections for external power and voltage outputs. These terminal are factory wired to a connector on the side of the case, and are connected to the outside using the supplied interface cable.

Figure 8 below identifies the color code for signals carried by this interface cable. External power is connected to the red and black wires. The other conductors carry the voltage outputs.

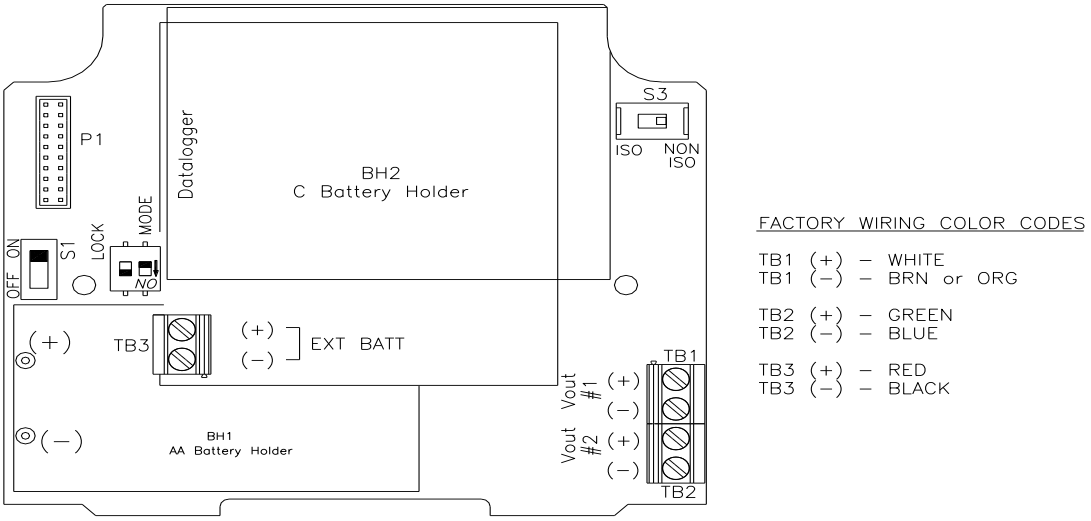


Figure 7 - Battery Circuit Board w/External Power Terminals

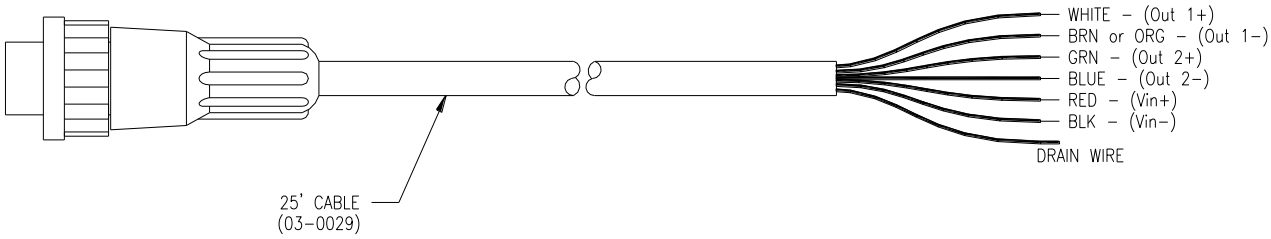


Figure 8 - External Connection Cable Color Code

Part 4 – Operation

4.1 User Interface

To turn the system ON, simply press the MENU key and the display will come on.

Once the instrument is turned on, it will run continuously until it is turned off manually or the batteries are consumed. **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.**

An automatic shut-off feature may be turned on if desired in software. Activating this function will cause the instrument to shut off after 60 minutes of operation. If you wish to operate in this way, turn the Auto-OFF feature to ON in the DIAG menu. This mode is useful when doing short-term measurements.

The normal continuous operating mode is intended for use with the data logger or when the instrument outputs are used for transmitting data. In this mode, the instrument will run continuously until the battery reaches the shutdown level. With the standard two C-cell alkaline batteries, the unit should operate for around 30 days continuously. Using NiMH batteries will decrease this period to about 10 days. Keep in mind that battery life in either case will be influenced by ambient temperature. Cold temperatures will reduce battery capacity.

There is a power (PWR) switch on the battery circuit board that disconnects the batteries. This is normally used only when 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.

There is a display flag "**B**" that will flash 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 about 5 minutes and then will shut down automatically.

Once the electronics are running, connect sample and drain lines from the water source to be monitored. Flow is controlled internally so all that needed is to connect sample and turn on the valve at the water source. Always connect the drain fitting first, followed by the sample inlet, to reduce pressure effects on the sensor.

4.2 Battery Power Circuit Board

The PQ45 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 PQ45 AUX port through a ribbon cable. The battery board contains the battery clips for the two C-cell 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. When storing for more than 30 days, remove the batteries.

4.3 Voltage Outputs

There are two analog voltage outputs on the battery board with a terminal strip located in the lower right corner. The outputs are 0-2.5 VDC and may be used to send isolated data the optional PQ45 data logger or to remotely located recorders, PLC's, etc. Output #1 is used only for pH, and Output #2 can be used for either temperature or pH. Output 2 can also be set for pH if 2 outputs for pH are needed.

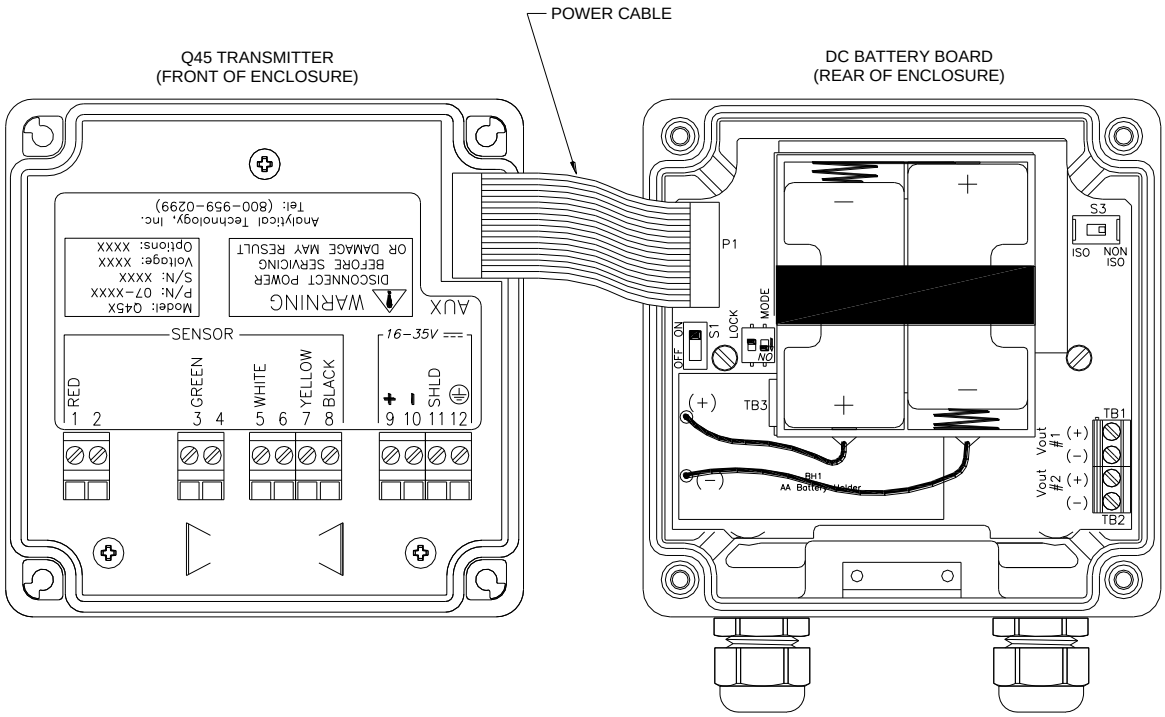


Figure 9 - Battery Board Connection

4.4 External Power

PQ45 monitors can be powered from external DC supplies. This type of power requires that units be purchased with the optional external connector and mating adapter cable. This cable is used to run external DC power (5-17 VDC) into the unit, and can also be configured to carry the analog output voltage signals to external devices.

4.5 Data logger Module

For local data recording using the two voltage outputs, the optional data logger is mounted on the PQ45 front panel below the monitor display unit. Interface cables are factory wired to the logger with plugs that easily disconnect when removing the logger for downloads.

For the interface cables, the white lead from the plug connects to (+) and the outer braid connects to (-). The 0 – 2.5 VDC signals from the Q45 are designed to exactly match the input requirement for the data logger module. Once connected, Output #1 and #2 signals are sent directly into the data logger module. The logger is held in place with two screw clips. For downloading of data contained on the data logger module, the module can be quickly removed (and swapped if necessary.) The data-loaded module can be brought to a PC for easy recovery of data, without the requirement of having to bring a PC to the Q45 installation.

4.7 User Interface

The user interface for the PQ45 Series instrument consists of a custom display and a membrane keypad. All functions are accessed from this user interface (no internal jumpers, pots, etc.).

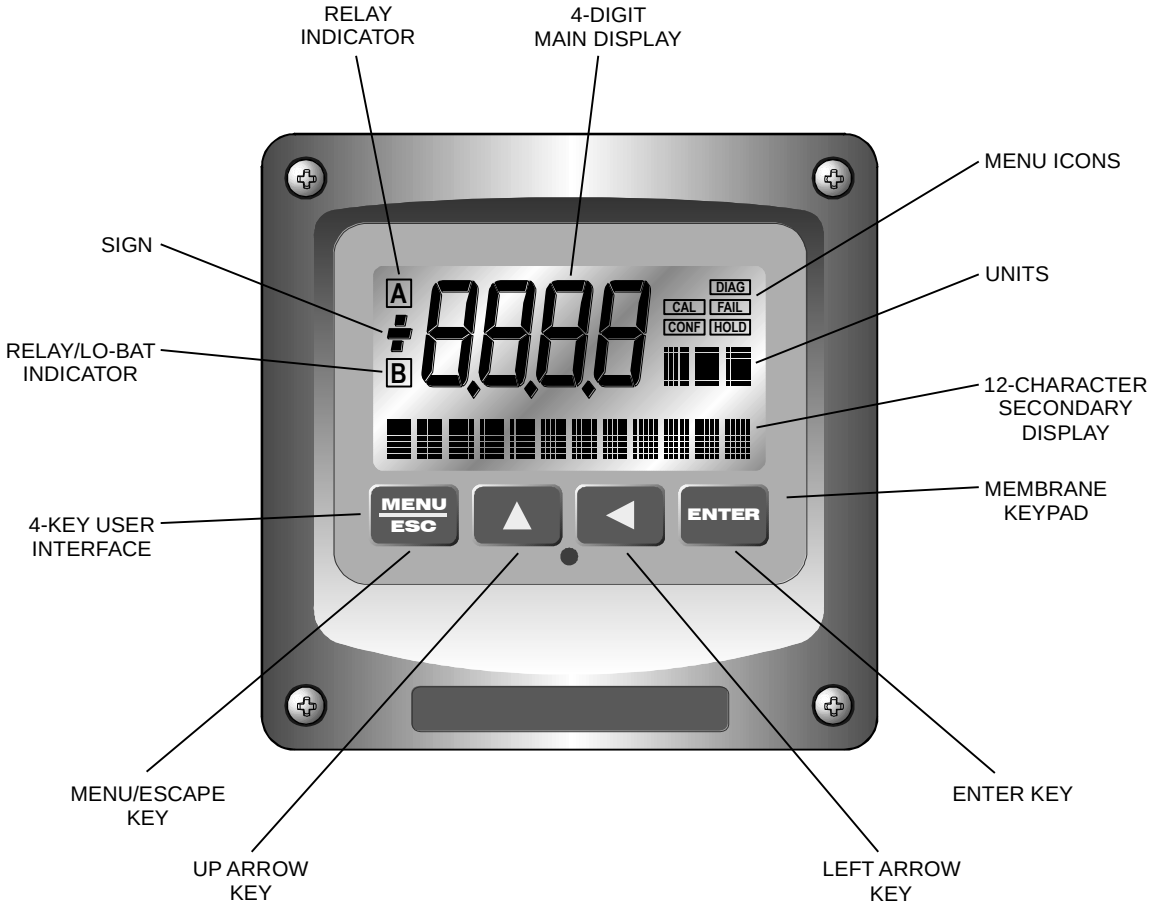


Figure 10 - User Interface

4.71 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. 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.

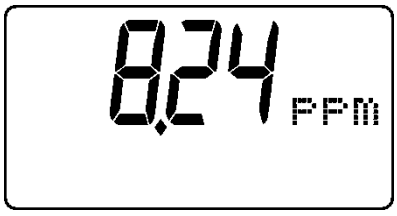
ENTER To select a menu section or list item for change and to store any change.

4.72 Display

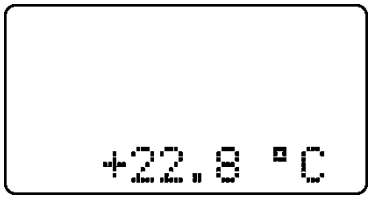
The large custom display provides clear information for general measurement use and user configuration. The display contains a back-light to allow good visibility under any conditions. In the default mode of operation, the back-light will come on when any key is pressed and will remain on for about 30 seconds after a key has been pressed. The back-light can be turned on or off in the DIAG menu.

There are three main areas of the display: the main parameter display, the secondary message line, and the icon area.

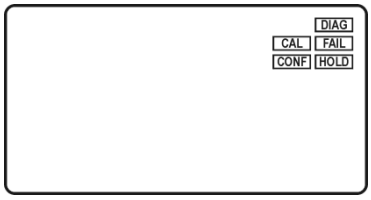
Main Parameter During normal operation, the main parameter display indicates the present process input with sign and units. This main display may be configured to display any of the main measurements that the system provides. During configuration, this area displays other useful set-up information to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



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 8.3 Display Messages.



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.



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.

Icon B The left screen area contains one “B” icon that indicates that the battery voltage is at a low level. (The “A” indicator is not used in battery-powered units).

4.8 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.**

4.81 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 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 dioxide 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.

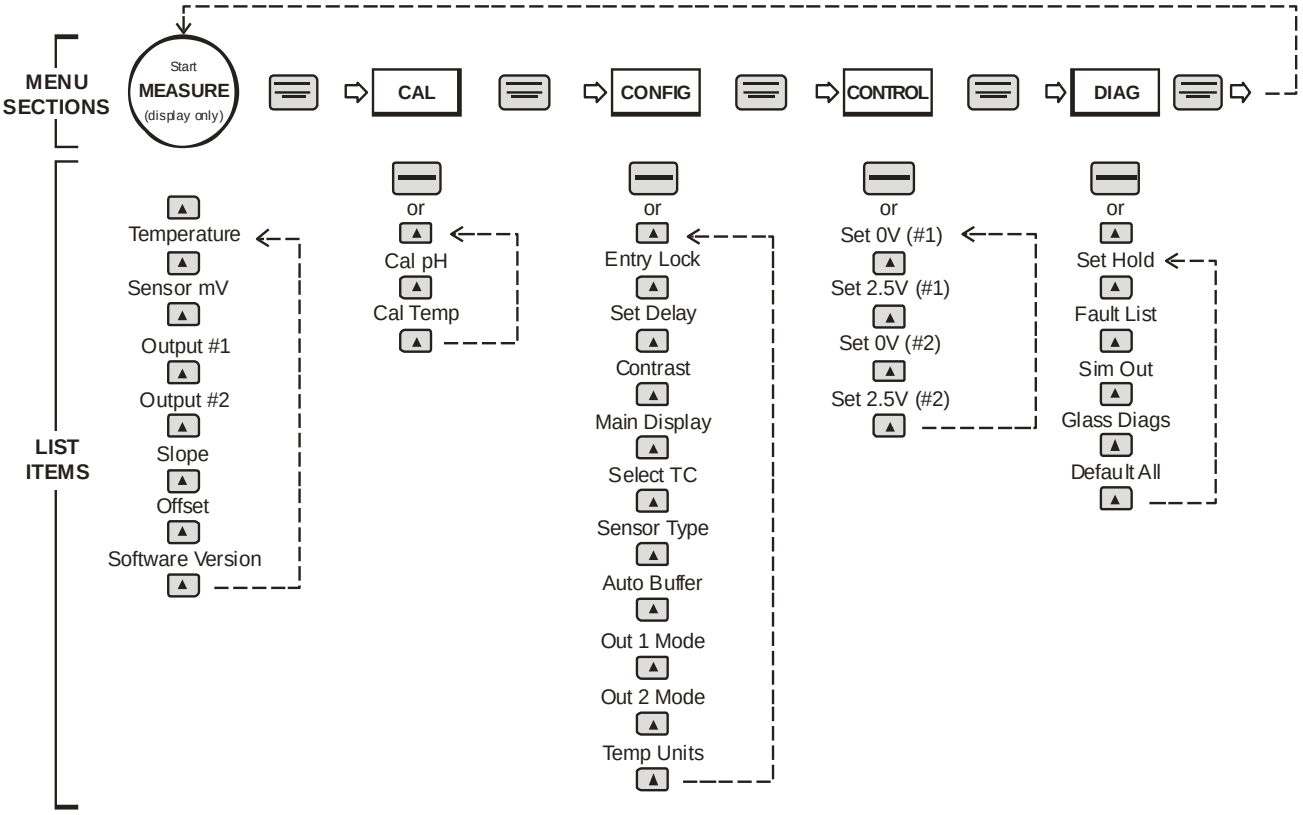


Figure 11 - Software Map

4.82 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:

TRANSMITTER MEAS SCREENS:

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.

+132 mV Raw sensor voltage. Useful for diagnosing problems.

2.5V Transmitter output voltage.

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 mV Sensor output current at a zero input. This value updates after a zero-calibration has been performed. Useful for resolving sensor problems.

Q45P v2.07 Transmitter software version number.

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.

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

4.83 Calibration Menu [CAL]

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

Cal pH This function will be displayed in the menu listing. This specific function selects whether a 1 or 2 point method is to be used for the pH sensor calibration. The selection value in this menu determines how many pH points the user intends to calibrate. For on-line calibrations where the sensor will not be removed and only adjusted, select a 1-point calibration. For calibration in two different buffer solutions and for all first-time calibrations, choose a 2-point calibration. See Part 5 – Calibration for more details.

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 5 – Calibration for more details.

4.84 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 pH 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.

Main Display This function allows the user to change the measurement in the primary display area. The user may select between pH, sensor temperature, or output mV. Using this function, the user may choose to put temperature in the main display area and pH 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.

Select TC

This function allows the user to select either a Pt1000 or Pt100 platinum RTD temperature element. The Pt1000 element is the standard element in all high performance Q25 sensors; it is the recommended temperature sensing element for all measurements. The Pt100 selection is for use with the standard combination-style sensor. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify the desired value. Press ENTER to store the new value.

Sensor Type

This function sets the sensor input type. This selection is critical for control of the internal diagnostics and compensation factors. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify the desired value. Selections are **1** for Q25P glass sensor, **2** for the standard combination electrode, **3** for Q25P antimony electrode, and **4** for pure water sensor using special compensation table. Press ENTER to store the new value.

Auto Buffer

This is a multiple variable function that allows the user to choose which pH buffer sets that will be utilized in the 2-point calibration mode. The PQ45P contains 3 sets of built-in buffer tables with compensation values ranging from 0 to 95 °C. During 2-point calibration, the instrument will automatically identify which buffer is being used and compensate for the value based on the built-in tables. This allows very quick, highly accurate calibrations by the user. The order in which the buffers are used during calibration is unimportant, since the system automatically chooses the correct buffer.

The default setting for this feature is **OFF**, which disables the auto-recognition function. Press ENTER to change this setting. The buffer table set options are: 1: [4/7/10], 2: [4/7/9.18], and 3: [4.65/6.79/9.23]. See Figure 4-4 for buffer tables. Once the buffer set is selected, press ENTER and the message **Accepted!** will be displayed on the lower line.

Out#2 Mode

This function sets analog output #2 for either temperature (default) 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 or 2-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.

Table 1

4.00 pH		7.00 pH		10.00 pH	
ºC	**pH**	**°C**	**pH**	**°C**	**pH**
0	**4.00**	0	**7.10**	0	**10.27**
10	**3.99**	10	**7.06**	10	**10.15**
20	**4.00**	20	**7.02**	20	**10.05**
30	**4.01**	30	**6.99**	30	**9.95**
40	**4.03**	40	**6.97**	40	**9.87**
50	**4.05**	50	**6.98**	50	**9.80**
60	**4.08**	60	**6.98**	60	**9.75**
70	**4.12**	70	**6.97**	70	**9.73**
80	**4.16**	80	**6.99**	80	**9.73**
90	**4.21**	90	**7.01**	90	**9.75**
95	**4.24**	95	**7.01**	95	**9.77**

Table 2

4.00 pH		7.00 pH		9.18 pH	
ºC	**pH**	**°C**	**pH**	**°C**	**pH**
0	**4.00**	0	**7.10**	0	**9.46**
10	**3.99**	10	**7.06**	10	**9.33**
20	**4.00**	20	**7.02**	20	**9.23**
30	**4.01**	30	**6.99**	30	**9.14**
40	**4.03**	40	**6.97**	40	**9.07**
50	**4.05**	50	**6.98**	50	**9.01**
60	**4.08**	60	**6.98**	60	**8.96**
70	**4.12**	70	**6.97**	70	**8.92**
80	**4.16**	80	**6.99**	80	**8.89**
90	**4.21**	90	**7.01**	90	**8.85**
95	**4.24**	95	**7.01**	95	**8.83**

Table 3

4.65 pH		6.79 pH		9.23 pH	
ºC	**pH**	**°C**	**pH**	**°C**	**pH**
0	**4.67**	0	**6.89**	0	**9.48**
10	**4.66**	10	**6.84**	10	**9.37**
20	**4.65**	20	**6.80**	20	**9.27**
30	**4.65**	30	**6.78**	30	**9.18**
40	**4.66**	40	**6.76**	40	**9.09**
50	**4.68**	50	**6.76**	50	**9.00**
60	**4.70**	60	**6.76**	60	**8.92**
70	**4.72**	70	**6.76**	70	**8.88**
80	**4.75**	80	**6.78**	80	**8.85**
90	**4.79**	90	**6.80**	90	**8.82**
95	**4.79**	95	**6.80**	95	**8.82**

Figure 12 - Automatic pH Buffer Tables

4.85 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 the range selected in the "Set Range" parameter under the CAL Menu 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.

NOTE: If the temperature units are changed between °C and °F (see Temp Units in this section), the default settings for this output will be stored (present data is not converted.)

4.86 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 pH level of the instrument to check the output settings. The user enters a pH 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 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.

Glass Diags

This function allows the user to shut off the glass breakage/leak diagnostics. It does not affect the state of the remaining system diagnostics. This capability is provided to eliminate nuisance trips in electrically noisy applications, such as some plating operations.

Set Default

The Set Default function allows the user to return the instrument back to factory default data for all user settings or for just the calibration default. It is intended to be used as a last resort troubleshooting procedure. All user settings or the calibration settings are returned to the original factory values. Hidden factory calibration data remains unchanged. Press ENTER to initiate user entry mode and select either **CAL** or **ALL** with the UP arrow key. The default CAL routine will reset the zero offset to 0.0 nA and reset the slope to 100%. The default ALL routine will reset all program variables to factory default and should be used with care since it will change any user settings that were programmed in the field.

Part 5 – Calibration

5.1 Overview and Methods

Since the sensor slope (mV/pH output) will degrade over time, the instrument must be calibrated periodically to maintain a high degree of measurement accuracy. Frequency of calibration must be determined by the application. High temperature applications or applications involving extreme pH operating conditions may require more frequent calibration than those that operate at more neutral pH levels and ambient level temperatures. It is important for the user to establish a periodic cleaning and calibration schedule for sensor maintenance to maintain high system accuracy.

Before calibrating the instrument for the very first time after initial installation, it is important to select the proper operating parameters in the configuration menus for items like Sensor Type and Auto Buffers.

If Auto Buffers is not enabled, select buffers with values that are close to the normal operating pH of the process. For example, if the process is operating normally at 8 pH, buffer values of 9.18 pH and 7.00 pH are preferred over buffers of 4.00 pH and 7.00 pH. If possible, select one of the buffers to be near 7.00 pH.

NOTE: Buffers must be at least 2 pH units apart to ensure accurate calibration.

The system provides two methods of pH calibration: 2-point and 1-point. These two methods are significantly different. See Sections 5.13 and 5.14 for a brief description of their uses.

5.11 Sensor Slope

The sensor slope is a number (expressed as a percentage) which represents the current condition of the sensor electrodes. The slope display is updated after every calibration. When new, the sensor slope should be between 95% and 105%. A 100% slope represents an ideal sensor output of 59.16 mV/pH, from standardization (7.00 pH at 25°C). Over time, the glass electrodes in the sensor will age with use. This results in a reduction of the slope (mV/pH output) of the sensor. Thus a sensor slope of 85% is equivalent to an output of 50.29 mV/pH from standardization. The instrument will not allow calibrations on a sensor with a slope less than 80%. The slope information from the most recent calibration can be viewed at any time in the Measure Menu (see Section 4.62).

5.12 Sensor Offset

Sensor offset is a number that indicates sensor output (expressed in mV) in 7.00 pH buffer at 25 ºC. Ideally, the sensor will output 0 mV under these conditions. A sensor offset reading of +10 mV indicates that the sensor will output +10 mV when placed into a perfect 7.00 pH buffer at 25 ºC. In other words, sensor offset shifts the entire mV/pH curve up or down. Sensor offset is generally produced by a small voltage drop at the sensor reference junction. Large offsets are most typically the result of foulants on the reference junction, an aged reference junction, or a weak reference fill solution. The instrument does not allow calibrations on a sensor with an offset greater than +90 mV or less than –90 mV. Sensor offset information from the most recent calibration can be viewed at any time in the Measure Menu (See Section 4.62).

5.13 2-Point Calibration Explained

The 2-point calibration method involves the movement of the sensor through two known pH buffer values. Therefore, the sensor must be removed from the application to utilize this method. Two-point calibration adjusts both the slope and the offset of the sensor. It is the recommended method of calibration for highest accuracy. In addition, this calibration method utilizes an automatic buffer recognition and compensation method.

IMPORTANT: the 2-point calibration mode MUST be performed when a new sensor is first put into operation so that accurate calibration data is available for possible later 1-point calibrations.

5.14 1-Point Calibration Explained

The 1-point calibration method is generally known as the "grab sample" calibration method. In the 1-point calibration method, the sensor may be removed from the application and placed into one buffer. It may also be left in the measurement process and calibrated by reference. 1-point calibration adjusts only the sensor offset. Since the sensor slope degrades much slower than the sensor offset, this method may be used as a frequent calibration method between more involved 2-point calibrations. For example, a user may choose to perform on-line 1-point calibrations weekly and 2-point calibrations monthly.

5.2 Performing a 2-Point Calibration

The 2-point calibration method utilizes an automatic buffer recognition and compensation system. For this system to operate properly, the user must first configure the proper buffers in the Set Buffers screen (see Section 4.64). If the buffers are not present in this menu, the user can override the automatic values and enter arbitrary values. However, the highest accuracy is provided when the user selects and uses buffers from this pre-defined table list. With the pre-defined buffers, the temperature variations in the buffer are automatically compensated for during the calibration process. If the buffer data is manually entered, the calibration buffer sample must be very temperature stable to achieve the same degree of accuracy.

Procedure

1. Remove sensor from application. Rinse and clean if necessary.

2. Allow sensor to temperature equilibrate with the buffer as best as possible. With the sensor coming from an application solution that differs greatly in temperature from the buffer, the user may have to wait as much as 20 minutes for this to occur.

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

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

5. The display will prompt the user to place the sensor in the first buffer and press ENTER. If the sensor has been placed into this buffer already, once the temperature has stabilized, press ENTER to continue.
6. The present pH value will be displayed and the secondary line of the display will flash **Wait** for approximately 10-15 seconds. At this time the system is attempting to recognize the first buffer value from the two values entered into the Set Buffers selection.
7. The screen will display the buffer value to be used for calibration. If the user chooses to change this value, the arrow keys can be used to modify the value. Any value between 0.00 and 14.00 pH can be entered. After adjusting this value, or to accept the automatic value, press ENTER.
8. The system now begins acquiring data for the calibration value of this buffer point. As data is gathered, the units for pH and temperature may begin to flash. Flashing units indicates that this parameter is unstable. The 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.
9. Once the first calibration value has been established, the screen will prompt the user to move the sensor to the second buffer. At this point, rinse sensor with water and move the sensor into the second buffer solution. Allow temperature to stabilize, and then press ENTER.
10. The present pH value will be displayed and the secondary line of the display will flash **Wait** for approximately 10-15 seconds. At this time the system is attempting to recognize the second buffer value from the two values entered into the Set Buffers selection.
11. The screen will display the buffer value to be used for calibration. If the user chooses to change this value, the arrow keys can be used to modify the value. Any value between 0.00 and 14.00 pH can be entered. The second buffer must be at least 2 pH units away from the first. After adjusting this value, or to accept the automatic value, press ENTER.
12. The system now begins acquiring data for the calibration value of this buffer point. As data is gathered, the units for pH and/or temperature may again flash, indicating unstable parameters.
13. If accepted, the screen will display the message **PASS** with the new slope and offset readings, 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 sensor offset value in % from the last span calibration is displayed on the lower line of the Default Menus for information purposes.

5.3 Performing a 1-Point Calibration

The 1-point, or sample calibration method does not utilize the automatic buffer recognition and compensation system. This calibration method is intended to be primarily used as an on-line calibration method, in which the actual calibration point will not be a buffer value. However, the sensor can be removed and calibrated in a separate buffer. During calibration, the system will display the current pH reading and the user can manually enter a reference value from a lab grab-sample or a comparative reference instrument.

Procedure

1. Determine whether the calibration will be done on-line or with the sensor removed and placed into a buffer. If the sensor is removed from the application, rinse and clean if necessary.

2. If the sensor has been removed and placed into a buffer, allow sensor to temperature equilibrate with the buffer as much as possible. With the sensor coming from an application which differs greatly in temperature difference, the user may have to wait as much as 20 minutes. 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.

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

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

5. The system now begins acquiring data for the calibration value. As data is gathered, the units for pH 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.

6. The screen will display the last measured pH value [or the auto buffer value, if activated] 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.

7. If accepted, the screen will display the message **PASS** with the new offset reading, and 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.

5.4 Temperature Calibration

The temperature input is factory calibrated for the highest accuracy. Temperature calibration is not recommended; however, it is provided for applications in which very long cable lengths are needed. For example, at 50 feet, readings may be off ±0.2 °C.

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 (see section 4.66) feature prior to calibration to lock out any output fluctuations.

Procedure

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 message **Adjust temp value then 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.

5. 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.

6. 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 6 – Data Logger (Option)

6.1 General

The data logger module is an entirely separate device from the Q45 and is supported by a complete software suite for the PC. The required download cable and software are available as an option (only one download cable and one piece of software is required to download an unlimited number of modules.) The software also sets the recording interval, time stamps, and scaling for the module. The module is removed from the analyzer when setting up or configuring the settings. The logger module itself is a self-contained, battery powered device.

6.2 Removing the Data Logger

The data logger is held in place on the front panel with two screws. The logger clips onto the screws and slides down about ¼". To remove the logger, push it up slightly. You will feel it slide on the retaining screws. After sliding it up, pull it toward you to disengage the screws. Reverse the process to remount the logger.

6.3 Starting Logger

The data logging function is activated using a computer connected through a USB port. The software package is called HOBOware Pro for Windows (a MAC version is also available). The software and an instruction manual for the software are provided when ordered. The software and the USB to Logger cable are provided in the foam insert behind the hinged panel of the PQ45H.

Prior to operating the logger, the software must be installed on your computer. Insert the software CD into your CD drive and follow the instructions on your computer screen for installation. For convenience, you may wish to install a shortcut icon on your desktop for starting up the HoboWare Pro software.

The manufacturer of the data logger and software provides a convenient on-line video instruction for using HoboWare Pro software. From your internet command line, type in http://www.onsetcomp.com/files/flash/software/HOBOware_Demo_Launch.swf. The demo lasts for about 3 minutes and will give you good primer on setting up your logger.

The cable supplied with the software provides a USB connector on one end and a special connector that plugs into the data logger on the other end. If you are using an older computer equipped only with an RS-232 port, special RS-232 to USB cables are available commercially that will allow you to adapt to the logger.

Your data logger will have an initial setup already programmed into it from the factory. This setup is done in order to check the unit prior to shipment. You will need to change the channel scaling to fit your specific requirements. The factory default for the logging interval is 1 minute, which again can be easily changed to suit specific application requirements.

Consult the software manual supplied with the system for details on programming the logger, activating the logging cycle, downloading the logged data, and other aspects of data handling. The HOBOware Pro software allows you to convert the data contained in the file to either Excel, Lotus 123, or comma delimited text files for manipulation using other programs.

6.4 Logger Battery Replacement

The data logger contains a disposable battery that will normally last over 6 months in continuous operation. The battery condition can be seen on the setup screen in the HOBOware Pro software. To change the battery, remove the 2 screws from the back of the logger and open the plastic case. Slide the battery out of the holder and replace it with a new battery. The battery type is Sony CR-2032 or equivalent and is widely available in electronics stores, camera stores, and some drug stores and supermarkets. They can also be purchased from ATI if required.

Part 7 – System Maintenance

7.1 General

The PQ45P pH Monitoring 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.

7.2 Analyzer Battery Replacement

No maintenance of the analyzer is required. All that's required is to replace the C-Cell batteries when they become discharged. The batteries are located inside the electronic unit. Loosen the 4 screws in the corners of the electronics and allow the front section to hinge down. A Velcro strap holds the batteries in place. Carefully pull out the strap and then remove and replace the batteries. Pay attention to battery polarity to insure proper operation. Use only high quality batteries in this instrument. Use of poor quality batteries often results in battery acid leakage that will damage the electronics. **If the system will not be used for a period of more than 30 days, remove the batteries from the instrument to avoid possible damage.**

7.3 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 8 – Troubleshooting

8.1 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.

8.2 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.

3. Check cell drive circuit. With a digital voltmeter (DVM), measure the voltage between terminals 1 and 3 on the back of the monitor to verify that the millivolt value is actually -200 mV.

4. Check TC drive circuit. Place a wire-short between the GREEN and RED terminals. With a digital voltmeter (DVM), measure the voltage between the BLACK and GREEN 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 GREEN terminals. The temperature reading should display approximately 0°C and the ozone reading should display approximately 0 ppm.

8.3 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.
Slope HIGH	Sensor slope calibration is less than 80%	Get fresh cal solutions, allow temperature and pH readings to fully stabilize, check for correct buffer values.
Slope LOW!	Sensor slope from calibration is less than 80%	Clean sensor, get fresh cal solutions, allow temperature and pH readings to fully stabilize, check for correct buffer values.
Offset High	Sensor offset from calibration is less than -90 mV or greater than + 90 mV.	Clean or replace saltbridge, replace reference cell solution, clean sensor, get fresh cal solutions, allow temperature and pH readings to fully stabilize, check for correct buffer values.
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.
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.
pH too High	The pH reading is > 14.00 pH.	The pH reading is over operating limits.
pH too Low	The pH reading is < 0.00 pH	The pH reading is under operating limits.
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.
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.
TC-F25 lock!	The TC selection is in F25 mode, locked at 25º C	Calibration and TC adjustment cannot be performed while TC is in F25 mode. To allow access to TC calibrations, change TC mode from F25 to SENS (sensor).
Meas Break	Leakage detected on measuring electrode of sensor.	Measuring electrode glass may be cracked or broken. Electrical noise may falsely trip this diagnostic. Turn off glass diagnostic feature and see if sensor operates correctly. If it does not, sensor must be replaced.
Ref Break	Leakage detected on reference electrode of sensor.	Reference glass may be cracked or broken. Electrical noise may falsely trip this diagnostic. Turn off glass diagnostic feature and see if sensor operates correctly. If it does not, sensor must be replaced.

Figure 13 - PQ45 Display Messages

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 14 - 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.

Spare Parts

Part No.	Description
03-0349	PQ45 Front Electronic Assembly
01-0240	Battery circuit board with dual 0-2.5 VDC output
63-0013	pH Sensor, twist-lock
45-0254	pH Flowcell
55-0048	Fixed flow regulator, 0.4 LPM
47-0093	Y-Strainer, delrin, 74 micron
42-0289	O-ring for 63-0013 Sensor
44-0287	Panel mount inlet/outlet fitting
44-0288	Inlet/Outlet plug in connector

Lock/Unlock Code: 1456

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

WATER QUALITY MONITORS

Dissolved Oxygen
Free Chlorine
Combined Chlorine
Total Chlorine
Residual Chlorine Dioxide
Potassium Permanganate
Dissolved Ozone
pH/ORP
Conductivity
Hydrogen Peroxide
Peracetic Acid
Dissolved Sulfide
Residual Sulfite
Fluoride
Dissolved Ammonia
Turbidity
Suspended Solids
Sludge Blanket Level
MetriNet Distribution Monitor

GAS DETECTION PRODUCTS

NH_3	Ammonia
CO	Carbon Monoxide
H_2	Hydrogen
NO	Nitric Oxide
O_2	Oxygen
CO	Cl2 Phosgene
Br_2	Bromine
Cl_2	Chlorine
ClO_2	Chlorine Dioxide
F_2	Fluorine
I_2	Iodine
H_X	Acid Gases
C_2H_4O	Ethylene Oxide
C_2H_6O	Alcohol
O_3	Ozone
CH_4	Methane (Combustible Gas)
H_2O_2	Hydrogen Peroxide
HCl	Hydrogen Chloride
HCN	Hydrogen Cyanide
HF	Hydrogen Fluoride
H_2S	Hydrogen Sulfide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
SO_2	Sulfur Dioxide
H_2Se	Hydrogen Selenide
B_2H_6	Diborane
GeH_4	Germane
AsH_3	Arsine
PH_3	Phosphine
SiH_4	Silane
HCHO	Formaldehyde
$C_2H_4O_3$	Peracetic Acid
DMA	Dimethylamine