ANALYTICAL TECHNOLOGY, INC.

O & M Manual



Model Q45D/60
Portable Optical D.O. Measurement System

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Part 1 - Introduction

1.1 General

The Model Q45D is a versatile on-line monitoring system designed for the continuous measurement of dissolved oxygen in solution. The full scale operating range of the system 0-40 ppm, and the sensing system will operate on water streams with temperatures ranging from 0 to 50°C.

While the Q45D may be used with either optical oxygen or galvanic membrane sensors, this manual is specific for systems utilizing ATI's optical D.O. sensor.

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.

1.2 Features

- Standard Q45D/60 electronic transmitters are designed to be a fully isolated, battery operated instrument. The monitor can be quickly converted to either a loop power transmitter or line powered analyzer.

- High accuracy, high sensitivity system, measures from 0.1 ppm to 40.0 ppm through 2 internal automatic ranges.

- Large, high contrast, custom LCD display with LED back light 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, air 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 Q45D/60 System Specifications

(Common to all variations)

Displayed Parameters	Main input, 0.1 ppm to 40.0 ppm %Saturation, 0 to 999.9% Sensor temperature, -10.0 to 50.0°C (23 to 122ºF) Sensor signal, -40 to +2000 mVDC Loop current, 4.00 to 20.00 mA Sensor slope/offset Model number and software version
Main Parameter Ranges	Manual selection of one of the following display ranges, 0.00 to 40.00 ppm 0.00 to 40.00 mg/l 0.0 to 999.9% Saturation
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
Enclosure:	NEMA 4X, polycarbonate, stainless steel hardware, weatherproof and corrosion resistant, HWD: 4.4" (112 mm) x 4.4" (112 mm) x 3.5" (89 mm)
Mounting Options	Handheld w/Nylon Carrying Strap
Conduit Openings	Standard 3 – Pg9 openings with cordgrips Optional ½” conduit adapters available
Weight	1 lb. (0.45 kg)
Ambient Temperature	Analyzer Service, -20 to 60 °C (-4 to 140 ºF) Sensor Service, -5 to 55°C (23 to 131 °F) Storage, -30 to 70 °C (-22 to 158 ºF)
Ambient Humidity	0 to 95%, indoor/outdoor use, non-condensing to rated ambient temperature range
Altitude	Up to 2000 m (6562 ft)
Electrical Certification	Ordinary Location, cCSAus (Certified to both CSA and UL standards), 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	Pt1000 RTD with automatic compensation
Sensor	Optical oxygen sensor utilizing fluorescence quenching technology. Optical element life 3-5 years.
Sensor Materials	Noryl, PVC, and stainless steel
Sensor Cable	Submersible: 30 ft. (9.1 m)
Max. Sensor-to-Analyzer Distance	200 feet (61 m), with junction box
Power	Two generic AA alkaline batteries, low battery indication at 1.60 VDC.
Outputs	Two 0-2.5 VDC isolated outputs are provided on for connection to data recorders, etc.
Battery Life	Approximately 240 hours of operational use on a set of batteries (without backlight).

1.5 Q45D Performance Specifications

(Common to all variations)

Accuracy	0.2% of selected range or better
Repeatability	0.05% of selected range or better
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	120 seconds to 90% of step input at lowest damping

Part 2 – Instrument Handle/Mounting

2.1 General

The Q45D/60 Portable Dissolved Oxygen 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.

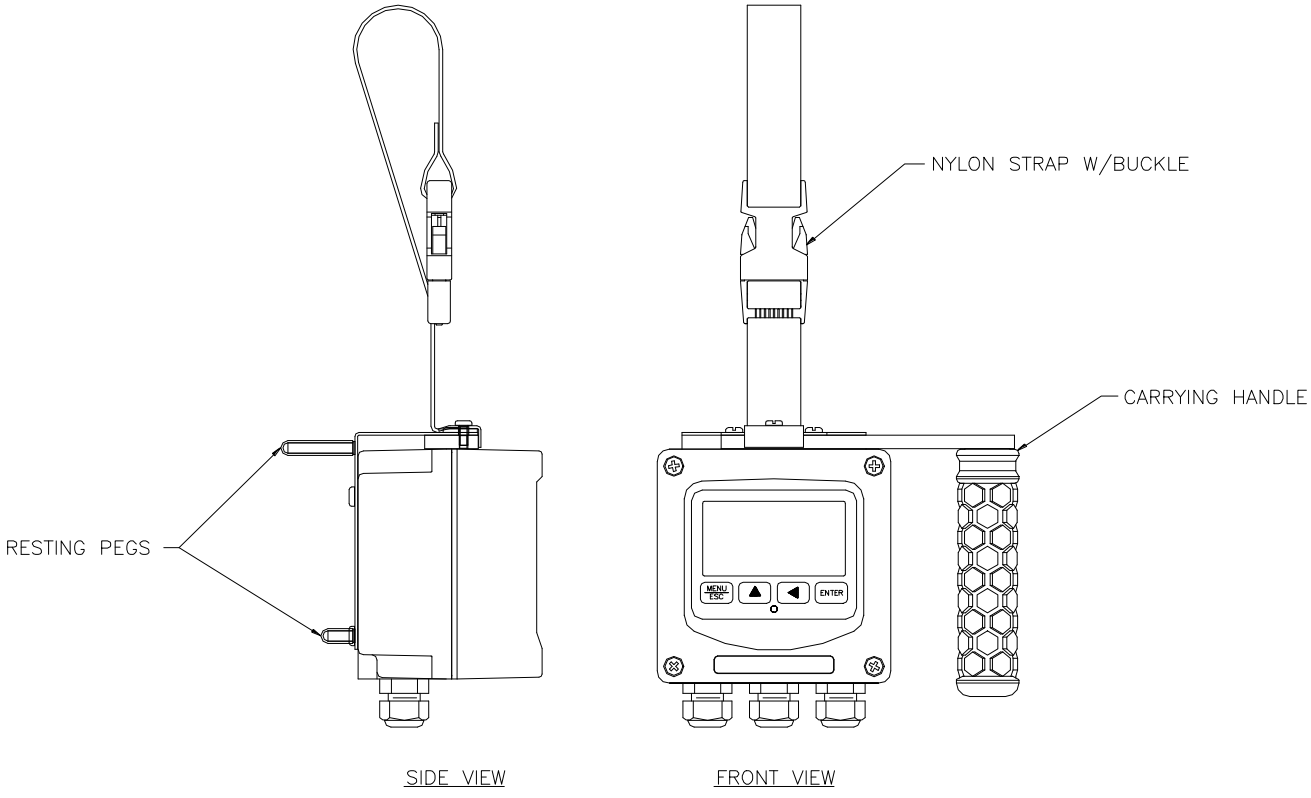


Figure 1 - Portable w/Handle Configuration

Part 3 –Electrical Connection

3.1 General

The sensor cable can be quickly connected to the Q45 terminal strip by matching the wire colors on the cable conductors. A junction box is also available to provide a quick-disconnect point for the sensor, or a break point for very long sensor cable runs. Route signal cable away from AC power lines, adjustable frequency drives, motors, or other noisy electrical signal lines. Do not run sensor or signal cables in conduit that contains AC power lines or motor leads.

3.2 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.

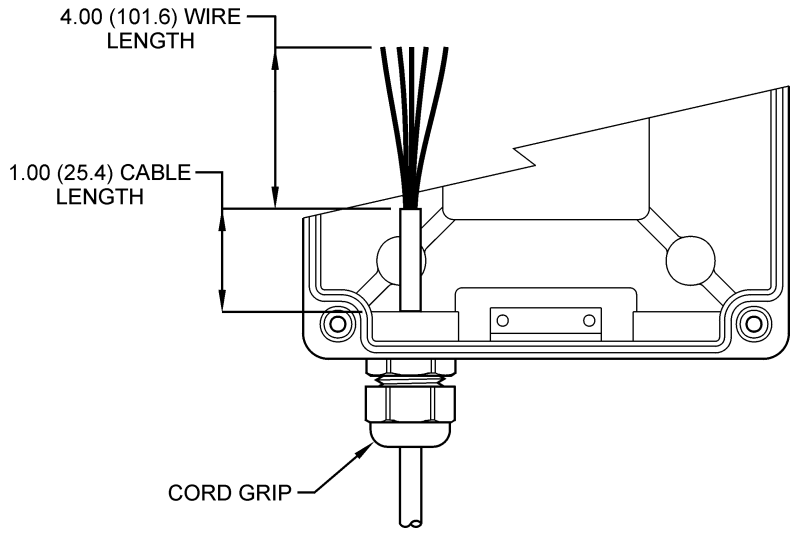


Figure 2 - Direct Sensor Connection

Once inside the enclosure, the individual colored sensor cable leads can be connected directly to the SENSOR connection terminals by matching the wire colors. On Q45D older systems, there may exist a YELLOW wire label on the sensor terminal strip rather than the wire color ORANGE or BROWN, which are used now. If your system has a YELLOW label, simply connect orange/brown from the sensor to that point.

3.3 Sensor Wiring

The sensor cable can be quickly connected to the Q45 terminal strip by matching the wire colors on the cable to the color designations on the label in the monitor. A junction box is also available to provide a break point for long sensor cable runs. Route signal cable away from AC power lines, adjustable frequency drives, motors, or other noisy electrical signal lines. Do not run sensor or signal cables in conduit that contains AC power lines or motor leads.

WIRING NOTE: The cable for the optical D.O. sensor contains a “black” wire that is actually a black shrink tube covering both a blue and a pink wire. These two wires connect to the same point designated by black in Figure 3. If the cable is cut to a shorter length, be sure that both wires are connected to the terminal marked black.

A yellow and a gray wire are contained in the cable and are covered to avoid shorting. If the cable length is changed, do not strip these two wires. If possible, leave sensor cable uncut to avoid problems.

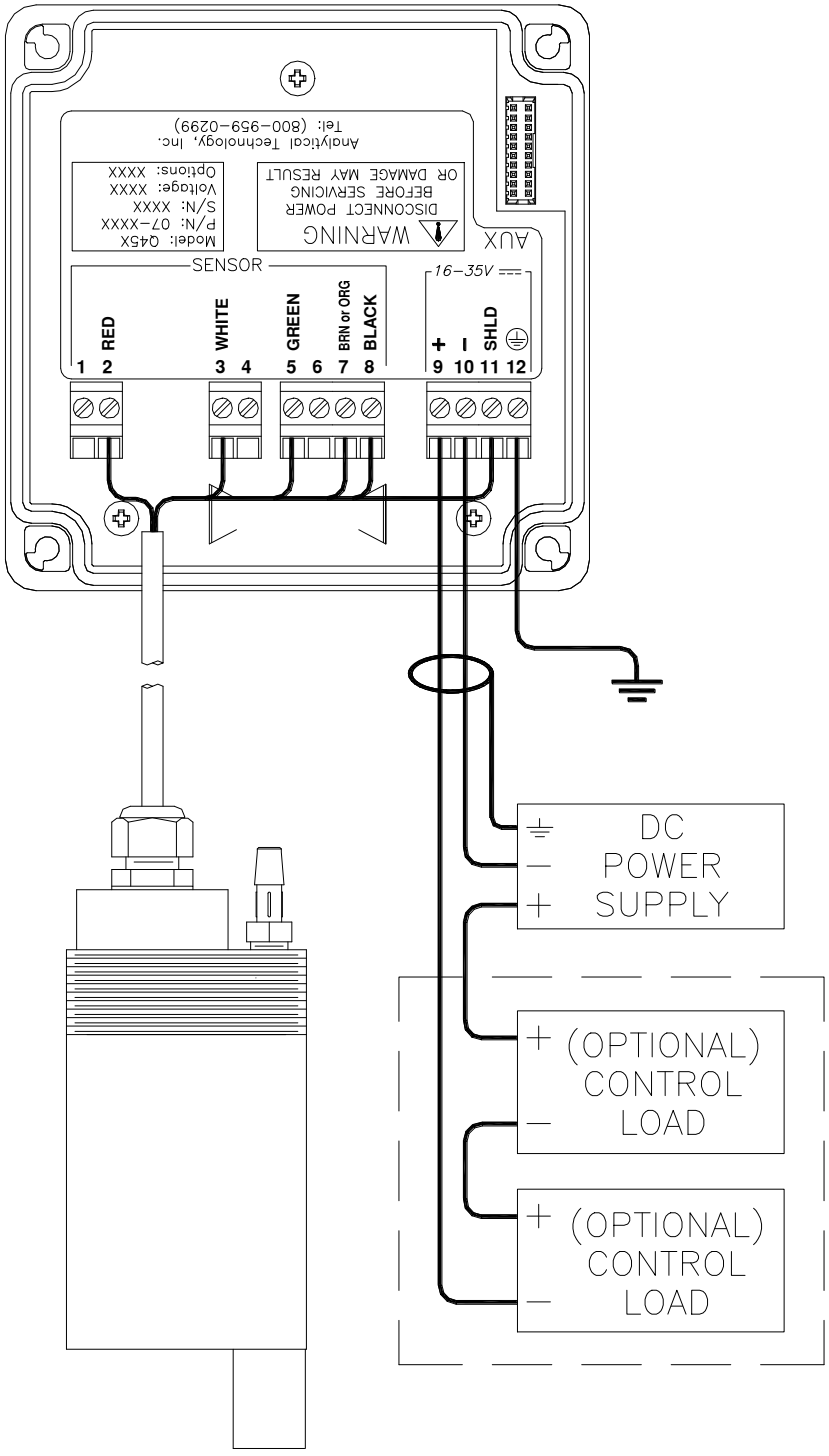


Figure 3 - Optical Sensor Wiring

Part 4 – Optical D.O. Sensor

4.1 General

Optical D.O. sensors are supplied complete and ready to use. All that's needed is to make the proper sensor connections as shown in the previous section.

A rubber boot protects the end of the sensor in transit. Leave the protective boot in place until the sensor is to be placed into operation. Removal of the protective boot prior to submergence may expose the sensing element to mechanical damage that is not covered by warranty.

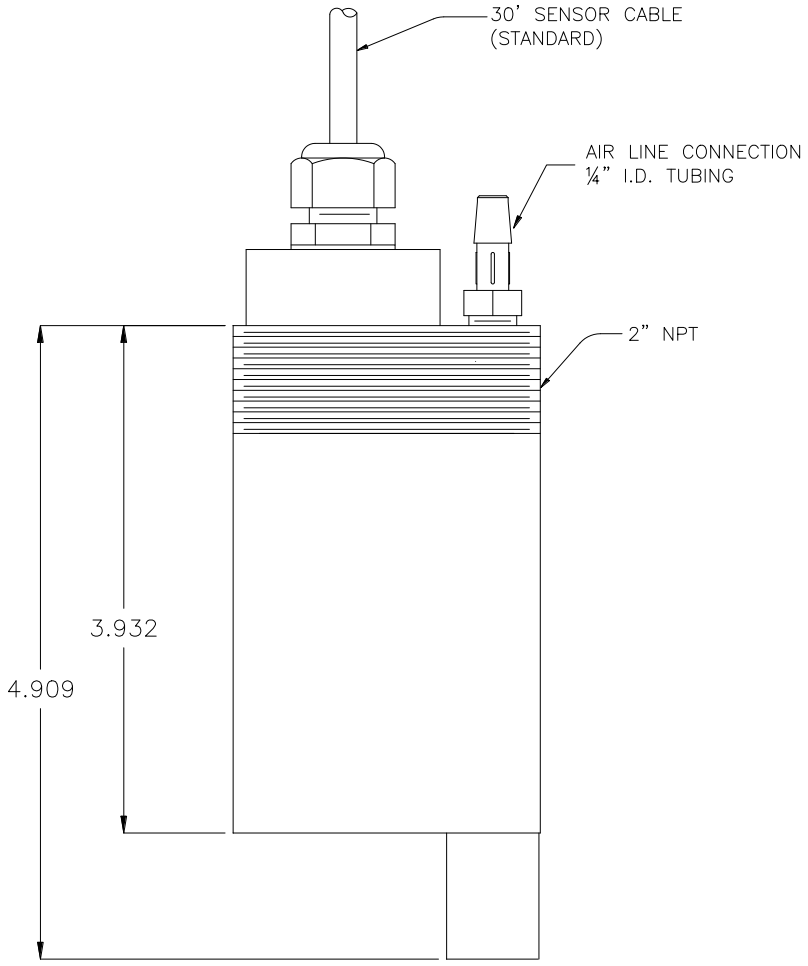


Figure 4 - Submersible D.O. Sensor Assembly

4.2 Optical Sensing

Optical D.O. measurement employs a technique called “fluorescence quenching” in order to measure molecular oxygen. The sensor will respond to oxygen either in the air or dissolved in water.

A polymer element at the end of the sensor contains an embedded fluorescent dye. When the element is exposed to a pulse of light from an internal LED, the material in the polymer will fluoresce, or emit light at another wavelength. This light decreases (or is quenched) at a rate proportional to the amount of oxygen in the polymer. The monitor measures the rate at which this quenching occurs and calculates the oxygen concentration based on the measurement.

Optical oxygen sensors provide the ability to measure oxygen in stagnant water, and are not affected by certain kinds of non-biological coatings. However, optical sensors are affected by biologically active coatings and must be kept clean. In activated sludge applications, biological films can have a much lower D.O. concentration on the sensor side of the film than on the bulk solution side. The automatic air cleaning system integrated into the Q45D system will eliminate coating problems by cleaning the sensor on a regular programmed schedule.



Figure 5 - Optical Sensing Element

Part 5 – Configuration

5.1 General

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.

5.2 Battery / Power Circuit Board

Q45ODO 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.

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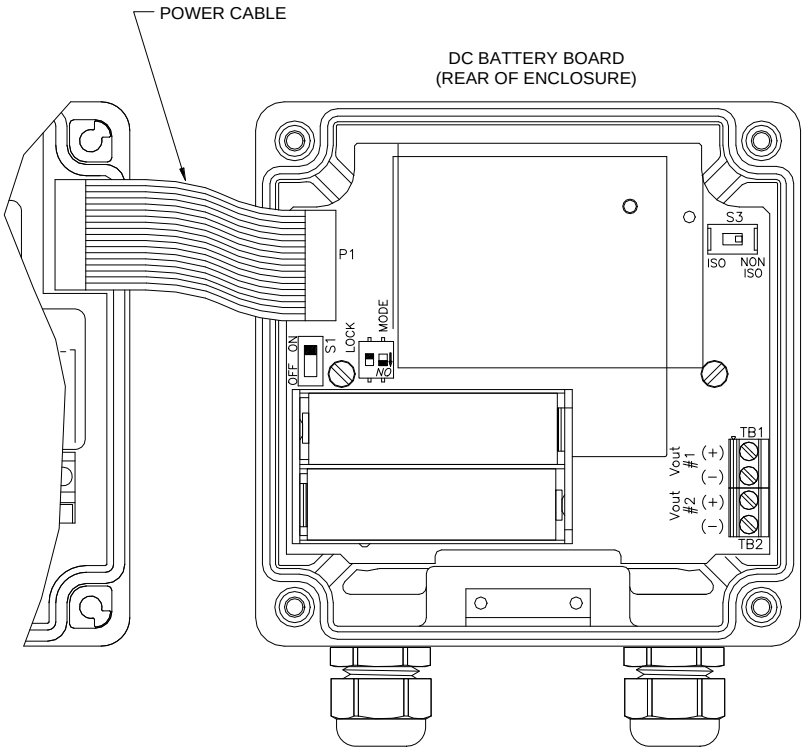


Figure 6 - Battery Board Connections

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 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.

5.3 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.

5.4 Voltage Outputs

There are two sets of analog voltage outputs on the datalogger terminal strip that may be used to send isolated data back to remotely located recorders, PLC's, etc. Output #1 is used only for dissolved oxygen information, and Output #2 can be used for an additional dissolved oxygen output channel, or it can be selected to output temperature information.

5.5 Software 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.).

When power is first applied, you may notice that the display does not come on immediately. This is normal. There is a 5 second start routine that runs before the display illuminates. In addition, you will notice an occasional “flicker” of the display, occurring about twice an hour. This is the result of a display processor refresh program that insures long-term display integrity, and will always occur during normal operation of the instrument.

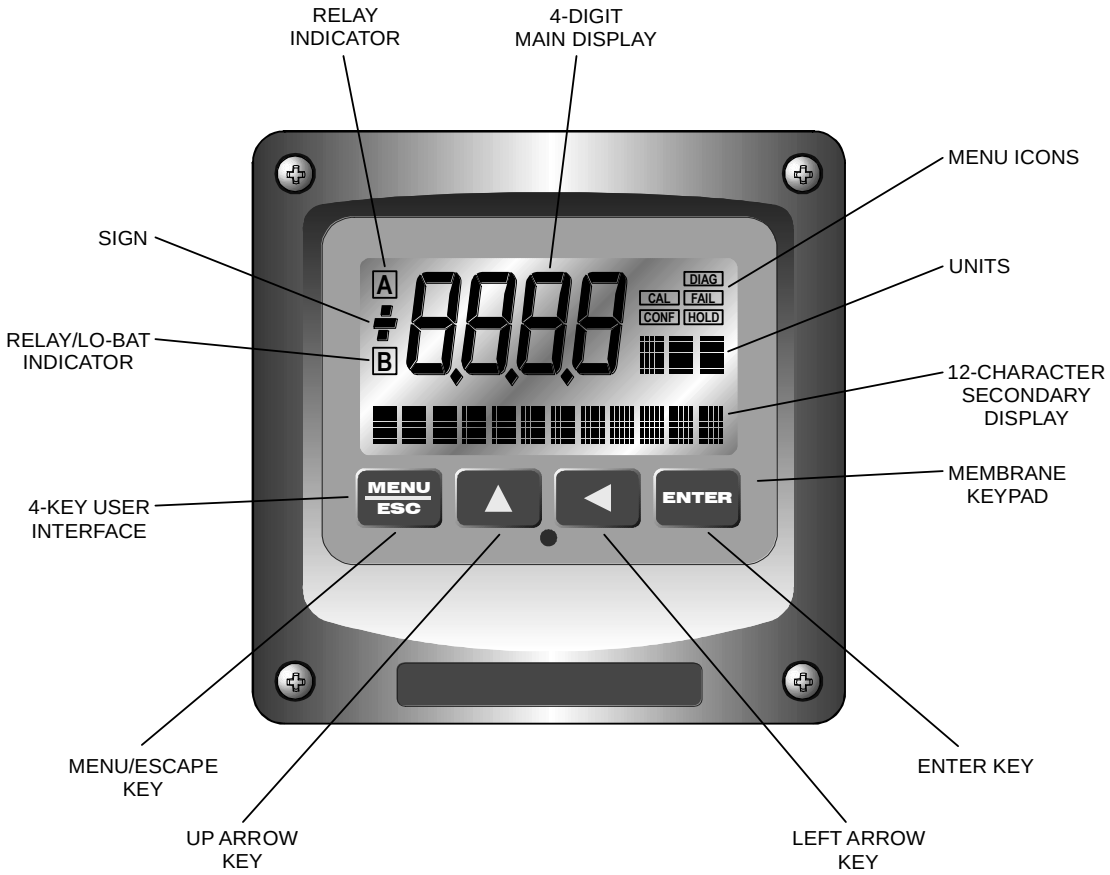


Figure 7 - User Interface

5.51 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.

5.52 Display

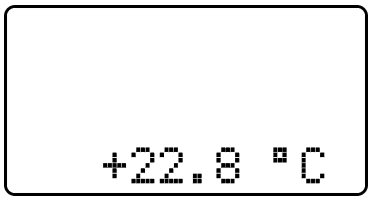
The large custom display provides clear information for general measurement use and user configuration. There are three main areas of the display: the main parameter display, the secondary message line, and the icon area.

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.



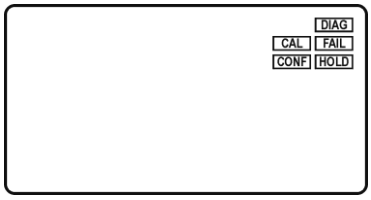
Lower Line

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 8.31 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 the battery power is low.



5.6 Software

The software of the Q45D 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.**

5.61 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 8 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 sequences, variables are changed as the result of some process. For example, the calibration of oxygen 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.

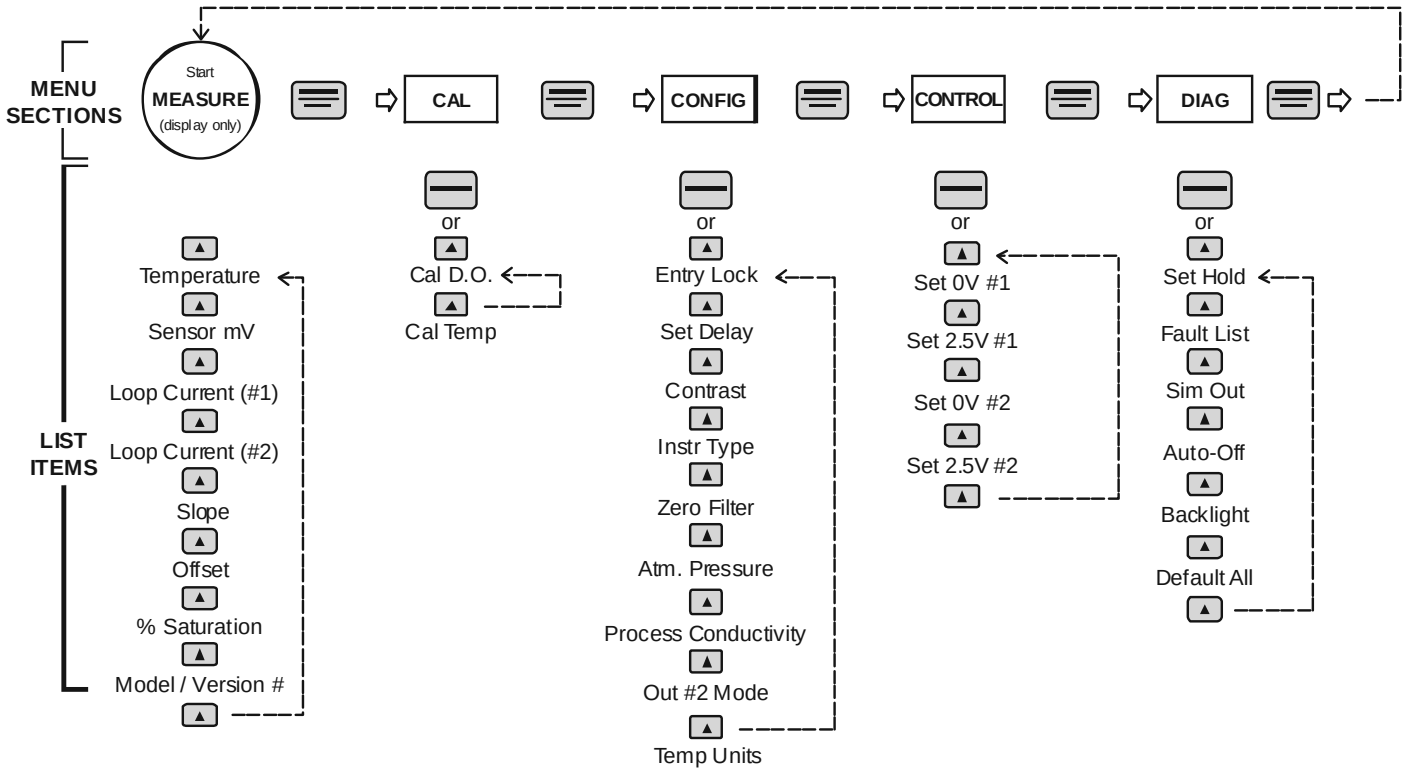


Figure 8 - Software Map

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.

5.62 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:

TRANSMITTER MEAS SCREENS:

25.7C 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 25C setting due to a failure with the temperature signal input.

320 mV Raw sensor signal. Useful for diagnosing problems.

100% 20.00 mA PID Status screen (if enabled.) Shows the present controller output level on left, and actual transmitter current on the right. The controller can be placed in manual while viewing this screen by pressing and holding the ENTER key for 5 seconds until a small flashing "m" appears on the screen. At that point the controller output can be adjusted up or down using the UP and LEFT arrow keys. To return to automatic operation, press and hold the ENTER key for 5 seconds and the "M" will disappear.

20.00 mA Transmitter output current.

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 signal at a zero ppm input. This value updates after a zero-calibration has been performed. Useful for resolving sensor problems.

% Saturation The most common display of D.O. in water is either PPM or mg/L units. However, the same PPM value at different water temperatures can represent quite different concentrations of oxygen in terms of the percent of saturation. This display simply indicates the % of oxygen saturation represented by the current PPM or mg/L display.

Q45D Vx.xx Transmitter software version number.

0.00 PPM D.O. Reading in PPM (or mg/L if selected under **Instr Type**)

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.

5.63 Calibration Menu [CAL]

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

Cal D.O. The oxygen 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 6 – 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 6 – Calibration for more details.

5.64 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 49 for the Q45D 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 oxygen 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.

Instr Type

This function allows the user to change the type of measurement to be displayed in the primary display area. The user may select **"1 PPM"¸ "2 mg/L,** or **"3 %Sat".** There is not a great deal of difference between type 1 and 2 settings as PPM and mg/L measurement units are pretty close to the same. However, programming for type 3 percent saturation changes the measured parameter to read a dissolved oxygen value that represents the percent of oxygen saturation at a given temperature. When this unit of measurement is selected, the main analog output and all alarm and control functions will relate to this measurement. While a PPM measurement is displayed on the lower line, it is no longer the primary variable being measured by the system. Press ENTER to initiate user entry mode, and the selected value will flash. Use the UP arrow key to modify the desired display value. Press ENTER to store the new value.

Zero Filter

The Q45D allows the user to program a value near zero below which the monitor will read zero. Because sensors rarely have a perfect zero stability, this zero filter eliminates occasional displays of numbers that are not meaningful. For instance, setting a zero filter at 0.03 PPM D.O. will cause any measured values of 0.01 or 0.02 PPM to be displayed as 0.00 PPM.

Atm Pres

The Q45D instrument utilizes the atmospheric pressure value as an input for the calculation of a theoretical ppm value during a saturation calibration. The input default units are inHg (inches Mercury) since these units are easy to obtain from most local weather services or from the general chart located on page 66 of this manual. This value is only entered during initial installation – it does not need to be modified at every calibration. Press ENTER to initiate user entry mode and the entire value will flash. Use the arrow keys to modify the value; range is 20.00 to 31.50 inHg.

The reference table on page 66 is provided to convert inHg from several other common air pressure units. Press ENTER to store the new value.

Proc Cond

The Q45D instrument also utilizes the process conductivity value as an input for the calculation of a theoretical ppm value during a saturation calibration. This value is only required to be entered during initial installation - it does not need to be modified at every calibration. Press ENTER to initiate user entry mode and the value will flash. Use the arrow keys to modify the value; range is 0.00 to 76.00 mS/cm. Press ENTER to store the new value.

Note: If the user will not be changing solution conductivity dramatically during the calibration process, leave a default setting of 00.50 mS/cm. For ultrapure water applications, set this value to 0.00. For sea water applications, set this value to 53.00.

Out2 Mode

This function sets analog output #2 to either track PPM or temperature. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify the desired value and 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.

5.65 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 40.00 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 dissolved oxygen. Output #2 will be in either units of ppm or C/F, depending on whether dissolved oxygen or temperature is set for Out#2 in the CONFIG menu.

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.)

5.66 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. 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 oxygen 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 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 The Back-light screen is used to set the operating conditions under which the backlight will turn on. The default is AUTO, which configures the light to come on whenever any key is pressed. The light will automatically shut off if no key is pressed for 30 seconds. Other selections are OFF (always off), AL for Alarm, where the light comes on in alarm condition and flashes under a Fail condition, and ON (always on). Do not select ON when using internal batteries for operation, as battery life will be greatly reduced.

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 6 – Calibration

6.1 General

The instrument must be calibrated periodically to maintain a high degree of measurement accuracy. A complete calibration will include zeroing and spanning the sensor. It is generally unnecessary to set the zero at every calibration, but it should be done during the initial installation.

The output of the optical dissolved oxygen sensor will degrade very slowly over the lifetime of the optical element, which is normally 3-5 years. To account for this degradation, the Q45D system should be re-calibrated about every 6 months. The frequency of calibration must be determined by the application. High temperature applications or applications involving other extreme operating conditions may require more frequent calibration than those operating at more ambient levels. It is important for the user to establish a periodic calibration schedule for a particular application. Before calibrating with a new sensor for the first time, or whenever a sensor has been left unpowered for 10 days or more, first connect the sensor to the transmitter and allow the system to operate for at least 2 hours to allow for sensor stabilization and hydration of the optical element. Once the sensor has been properly conditioned, the user must select the proper operating parameters, including atmospheric pressure and solution conductivity.

The system provides three methods of D.O. calibration: 1-Point (sample), % Saturation (air cal), and Zero. These three methods are significantly different.

6.11 D.O. Span Cal (1-spl)

The 1-Point (sample or comparison) method is intended to be primarily used as an on-line calibration; however, the sensor can be removed, cleaned and then calibrated in a bucket of clean water if necessary. During calibration, the system will display the current ppm reading and the user can manually enter a reference value from a lab sample or comparative reference instrument. In the Q45D system, the 1-Point calibration adjusts the slope of the sensor output response.

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

2. If the sensor has been removed and placed into a bucket of water, allow sensor to temperature equilibrate with the solution as much as possible. With the sensor coming from an application which differs greatly in temperature, 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 DO** will then be displayed.

4. Press the ENTER key. The screen will display a flashing **1-spl** for 1-point, a **2-%sat** for Saturation calibration, or a **3-zer** for zero calibration. Using the UP arrow key, set for a 1-spl calibration and press ENTER.

5. 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.

6. If the data remains unstable for 10 minutes, the calibration will fail and the message **Cal Unstable** will be displayed.

7. 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.

8. If accepted, the screen will display the message **PASS** with the new slope 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.

6.12 Dissolved Oxygen Air Span Cal (% sat)

This is the recommended method for air temperatures greater than about 10C; however, it requires that the sensor be removed from the process and cleaned. Once cleaned, the sensor is held in air and allowed time to adjust to the air temperature. As the sensor temperature equilibrates, the transmitter automatically calculates the new 100% saturation point utilizing the temperature readings and the barometric pressure user data located on page 64. This method therefore requires no user input during calibration. **Note: It is very important to allow enough time for the sensor to completely temperature equilibrate with the surrounding air. This time is at least 10 minutes.**

This method requires that the sensor be removed from the process, cleaned, and Covered, shielding the sensor from direct sunlight. The sensor membrane must be dry for this procedure, and not submerged in liquid. This method requires no user input during calibration; however, if this is the first time the system is being installed and calibrated, make sure to enter the proper atmospheric pressure data and process conductivity data prior to calibration.

1. Remove the sensor from the process. Clean and rinse if necessary with water, paying particular attention to cleaning the membrane.

2. Cover the sensor, if necessary, to shield it from the direct rays of the sun. Remember, the membrane must not be submerged - it must be in the air letting the sensor hang, membrane downward, while powered.

3. Allow the system to operate undisturbed for at least 20 minutes. 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. Scroll to the CAL menu section using the MENU key and press ENTER or the UP arrow key. **Cal D.O.** will then be displayed.

5. Press the ENTER key. The screen will display a flashing **1-spl** for 1-point, a **2-%sat** for Saturation air calibration, or a **3-zer** for zero calibration. Using the UP arrow key, set for a **2-sat** span calibration and press ENTER.
6. The display will prompt the user to hold the sensor in air and press ENTER. If the sensor has already been removed from the process and reached temperature equilibrium, press the ENTER key.

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.

8. The calibration data point acquisition will stop only when the data remains stable for a pre-determined amount of time (approximately 15-20 seconds.) 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. If accepted, the screen will display the message **PASS** with the new sensor slope 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.

10. The range of acceptable values for sensor slope is 20% to 500%. It may be necessary to replace the sensor.

Should the slope value remain out of range and result in calibration failures, review the Maintenance Section of this manual, then contact the Service Dept. at ATI for further assistance.

6.13 Dissolved Oxygen Zero Cal

Dissolved oxygen sensors have extremely low offset outputs at zero. For this reason, it is normally sufficient to simply leave the zero at the factory default of 0 mV unless longer cable lengths are added to the sensor. As an alternative if non-standard cable lengths are added, a zero can be set by sensor from the performing the steps below.

For total cable length of:	Off-set Zero
30 m (98 ft)	0.96 mV
50 m (164 ft)	1.39 mV
60 m (200 ft)	1.90 mV

These steps below assume that the sensor has been connected to the monitor with the monitor powered for 2 hours. During this period, the sensor should be wet.

1. Remove the sensor from the application if necessary. Clean and rinse if required.

2. Place about an inch of zero solution in a small beaker or other convenient container and immerse the tip of the sensor. Allow the sensor to sit undisturbed for at least 15 minutes. Suspend sensor, DO NOT LET SENSOR SIT ON TIP.

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

4. Press the ENTER key. The screen will display a flashing **1-spl** for 1-point, a **2-%sat** for Saturation air calibration, or a **3-zer** for zero calibration. Using the UP arrow key, set for a 3**-Zer** zero calibration and press ENTER.

5. The system now begins acquiring data for the sensor zero calibration value. As data is gathered, the units for sensor millivolts (mV) 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.

6. If the data remains unstable for 10 minutes, the calibration will fail and the message **Cal Unstable** will be displayed.

7. 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 -40 mV to +40 mV. Review the Service section of this manual, and then contact the service dept. at ATI for further assistance.

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

6.2 Temperature Calibration

The temperature calibration sequence is essentially a 1-point offset calibration that allows adjustments of approximately ±5 °C. If sensor cable lengths beyond the standard cable length are being used the resistance of this added cable will affect the temperature accuracy and will have to be off-set to compensate for this added resistance.

Cable length	Temperature off-set
30 m (98 ft)	-1.09º C
50 m (164 ft)	-1.82º C
61 m (200 ft)	-1.90º 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 7 – System Maintenance

7.1 General

The Q45D/60 Dissolved Oxygen 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 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.

7.3 Sensor Maintenance

Very little sensor maintenance is required for an optical D.O. system. The primary requirement is simply to keep the sensing area clean. The photo in section 4 of this manual shows the sensitive area. Inspect the sensor every few weeks visually just to verify that this area is clean. Wipe with a soft cloth if necessary.

The life of the optical element is likely to be greater than 2 years but less than 5 years. When the optical sensing element is expended, a new one can easily be installed.

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 External Sources of Problems

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

1. Verify the loads on any 4-20 mA outputs do not exceed the limits in the Instrument Specifications (500 Ohms each for analyzer.) During troubleshooting, it is many times helpful to disconnect all these outputs and place wire-shorts across the terminals in the instrument to isolate the system and evaluate any problems which may be coming down the analog output connections.

2. 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.

3. If rigid conduit has been run directly to the Q45 enclosure, check for signs that moisture has followed conduit into the enclosure.

4. Check for ground loops. Although the sensor is electrically isolated from the process water, high frequency sources of electrical noise may still cause erratic behavior in extreme conditions. If readings are very erratic after wiring has been checked, check for a possible AC ground loop by temporarily placing the sensor into a bucket of water. The reading should be initially stable and then fall very slowly in a smooth fashion

as the powered sensor depletes oxygen in the static sample directly at the sensor face.

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

6. Check sensor for fouling. Look closely for signs of grease or oil which may be present.

8.3 Analyzer Tests

1. If analyzer does not appear to power up (no display), remove and replace 9V battery

2. If analyzer does power up with a display, use the “Simulate” feature to check operation of the analog outputs with a DVM.)

3. Check sensor power circuits. With a DVM, verify between -4.5 and -5.5 VDC from sensor connection terminals WHITE (+) to BLACK (-). Then verify between +4.5 and +5.5VDC from GREEN (+) to BLACK (-).

4. Check TC drive circuit. Place a wire-short between the RED and BLACK sensor terminals. With a DVM, measure the voltage between the BLACK (-) and BROWN (+) sensor terminals to verify that the TC drive circuit is producing about -4.6 to -5.5 VDC open-circuit. Remove DVM completely and connect a 1000 Ohm resistor across the BLACK to BROWN terminals. The temperature reading on the front LCD should display approximately 0°C and the dissolved oxygen reading should display approximately 0 ppm.

8.31 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.
D.O. High	The oxygen reading is greater than the maximum of the User-selected range.	The oxygen 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 9 - Q45D Display Messages

MESSAGE	DESCRIPTION		POSSIBLE CORRECTION
D.O. Cal Fail	Failure of oxygen 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 20% or greater than 500%. Perform sensor tests as described in section 10.4. 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 10.4. 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.

Figure 9 – Q45D Display Messages (Cont'd)

8.4 Sensor Tests

1. Check the condition of the optical sensing element. Mechanical damage to the black covering over the optical element is an indication that sensor problems are likely.

2. Prior to disconnecting the sensor, measure the sensor output voltage at the analyzer terminal strip with a DVM while the sensor is hanging in air. If the sensor has been connected to a powered analyzer for at least 2 hours, the nominal output of the sensor will be about +400mVDC when measured in air at 25C (100% saturation) from BLACK (-) to RED (+) on the analyzer terminal strips. This value is affected by temperature, pressure, and age of the sensor so it's possible to see a typical value that ranges from perhaps +200mVDC to about +800 mVDC under a wide range of conditions in air.

3. Disconnect the five sensor wires from the oxygen monitor. Those wires are color coded red, white, blue, green, brown, and black. Note: the brown wire may be replaced by an orange wire in some cables. Connect the DVM between the brown 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.

Temperature °C	Resistance Ω
0	1000
5	1019
10	1039
15	1058
20	1078
25	1097
30	1117
35	1136
40	1155
45	1175
50	1194

Figure 10 - Pt100 RTD Table

If you suspect that water has gotten into a cable connection 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.

Barometric Pressure Conversion		
Inches of Mercury(inHg)	**Millimeters of Mercury (mmHg)**	**Feet Above Sea Level**
22.00	558.8	+8790
22.50	571.5	+8053
23.00	584.2	+7347
23.50	596.9	+6671
24.00	609.6	+6023
24.50	622.3	+5402
25.00	635.0	+4806
25.50	647.7	+4233
26.00	660.4	+3682
26.50	673.1	+3156
27.00	685.5	+2653
27.50	698.5	+2150
28.00	711.2	+1675
28.50	723.9	+1217
29.00	736.6	+776
29.50	749.3	+349
30.00	762.0	-64
30.50	774.7	-463
31.00	784.4	-759

Figure 11 - Barometric Pressure Conversion Table

Oxygen Solubility vs. Temperature					
Temperature		PPM	Temperature		PPM
°F	°C		°F	°C	
32	0.0	14.6	74	23.3	8.5
34	1.1	14.1	76	24.4	8.3
36	2.2	13.7	78	25.6	8.2
38	3.3	13.3	80	26.7	8.0
40	4.4	12.9	82	27.8	7.8
42	5.6	12.6	84	28.9	7.7
44	6.7	12.2	86	30.0	7.5
46	7.8	11.9	88	31.1	7.4
48	8.9	11.6	90	32.2	7.3
50	10.0	11.3	92	33.3	7.1
52	11.1	11.0	94	34.4	7.0
54	12.2	10.7	96	35.6	6.9
56	13.3	10.4	98	36.7	6.8
58	14.2	10.2	100	37.8	6.6
60	15.6	9.9	102	38.9	6.5
62	16.7	9.7	104	40.0	6.4
64	17.8	9.5	106	41.1	6.3
66	18.9	9.3	108	42.2	6.2
68	20.0	9.1	110	43.3	6.1
70	21.1	8.9	112	44.4	6.0
72	22.2	8.7	114	45.6	5.9

Figure 12 - Oxygen Solubility Table

Spare Parts

Part No.	**Description**
07-0012	Q45D D.O. monitor electronics assembly, 3VDC
63-0100	Submersible O.D.O. Sensor with 30’ cable

Lock/Unlock Code: 1454

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