CE

User's Guide

OMEGA®
An OMEGA Technologies Company

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PHB-215 pH Meter
PHB-220 pH/Conductivity Meter
PHB-225 pH/Ion Meter
PHB-250 pH/Ion/Conductivity Meter

omega.com™

OMEGA®

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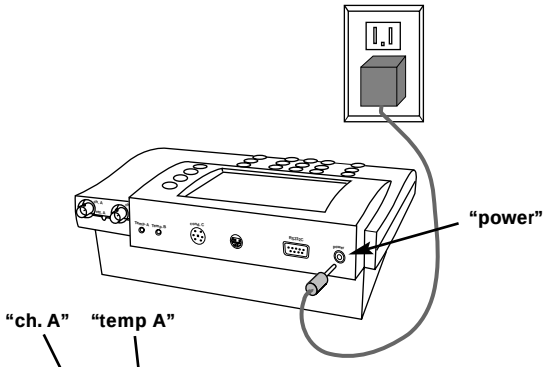
WARNING: These products are not designed for use in, and should not be used for, patient connected applications.

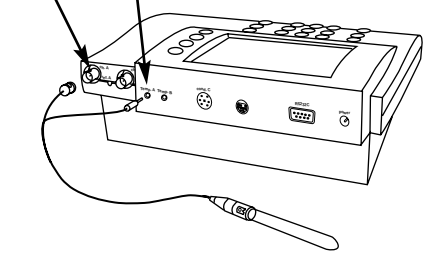
Table of Contents

Quick Start Guide for pH Measurement

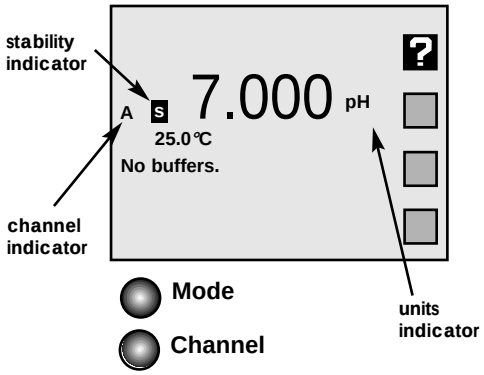
1. Connect power cable to meter connector on the rear panel marked “power” and to AC power source.



2. Connect the glass pH/ATC electrode to the channel A BNC connector marked “ch.A” and to the channel A temperature connector marked “temp A”.

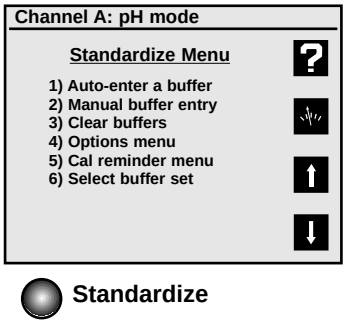


3. Verify the meter is in pH mode on channel A. Use the **Mode** key and **Channel** key to set the meter to the correct mode and channel if necessary. (See Function keys).

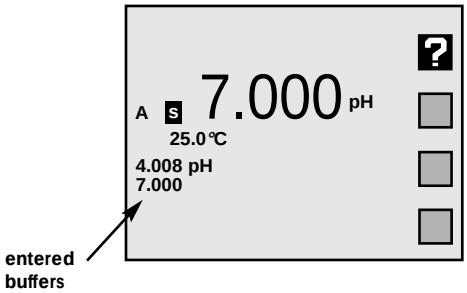


4. Standardize the electrode by immersing the electrode in a buffer, pressing **Standardize**, pressing **1) Auto-enter a buffer** and following the prompts. Repeat this step to enter each buffer. The meter will check the electrode and buffers, and give an error message if there is a problem.

   Press **Standardize** to enter or clear buffers, select buffers, set resolution, or set other parameters for the current mode and channel.



5. The display shows the current measurement, and indicates a stable reading with the **S** indicator. Press **Cal Data** to review and graph the electrode calibration data.

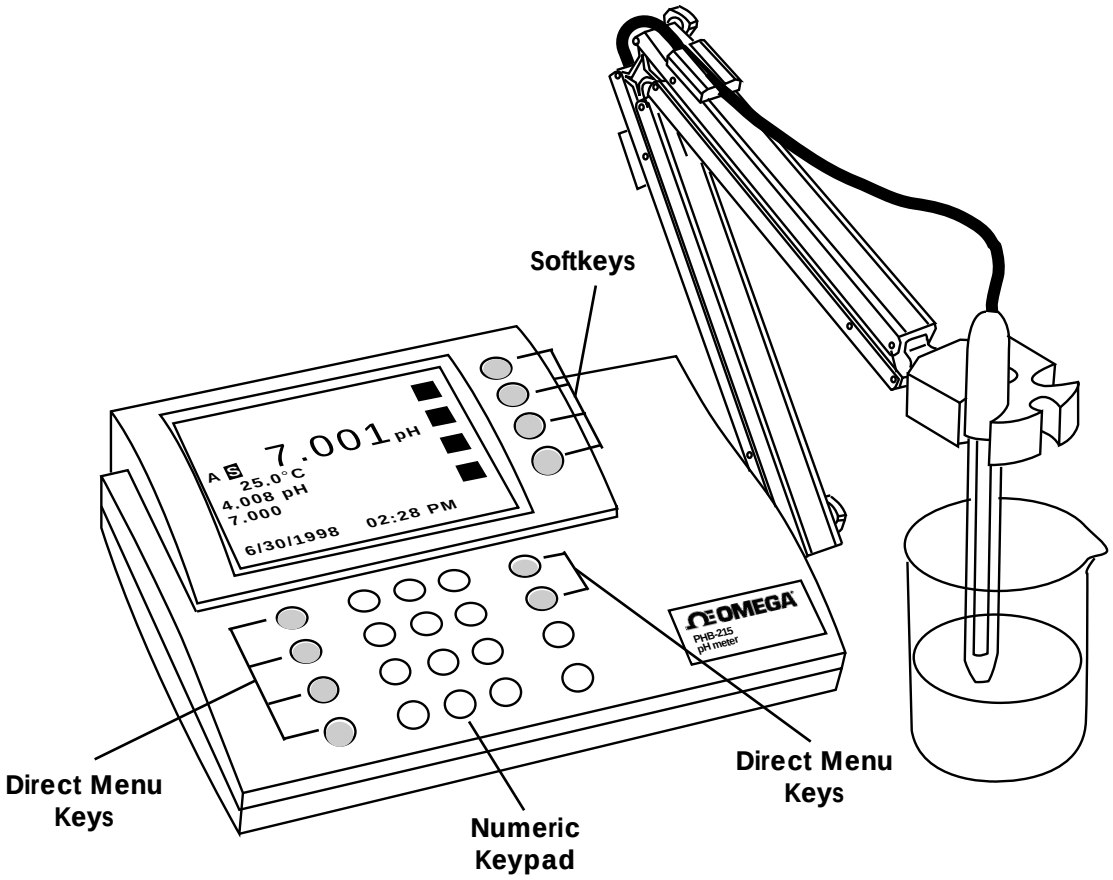


Introduction

This Omega meter is a powerful, versatile and accurate instrument. It features easy menu-based operation with easy to understand prompts and electrode/standard error checking.

These meters feature many advanced options, such as programmable stability criteria, programmable standardization reading delay times, multi-channel operation, fast reading update rates of twice per second for all channels, programmable alarms, programmable data logging of 500 data points and a superb RS-232 serial interface for controlling the meter and obtaining data.

Omega meters use flash programmable ROM for the operating code. The meter operating code can easily be upgraded as new features are made available.



Direct Menu Keys, Softkeys and Display

The meter uses six **Direct Menu** keys to access the menus and operations (such as selecting pH mode, standardizing, checking electrode calibration data, selecting the electrode channel).

There are four **Softkeys** that provide additional operations; these Softkeys change their function as needed and each Softkey has an icon to indicate its current function.

The display is a backlit quarter-VGA screen capable of displaying all four electrode channels (of a PHB-250) simultaneously. The backlight will turn off after a 45 minute period of non-use; pressing any key will automatically turn the backlight on again.

Introduction

Electrode Connectors and Inputs

BNC ("ch.A" or "ch.B") connectors: pH, Ion Selective Electrodes and ORP (redox) electrodes attach to the meter through a BNC ("round twist-on") connector to channel A or channel B (PHB-225 and PHB-250 only).

Temperature ("temp A" or "temp B") connectors: use to connect the 2.5mm mini-phone plug from the temperature sensor (built into the pH electrode with the Omega standard pH/ATC electrode) for Automatic Temperature Compensation (ATC).

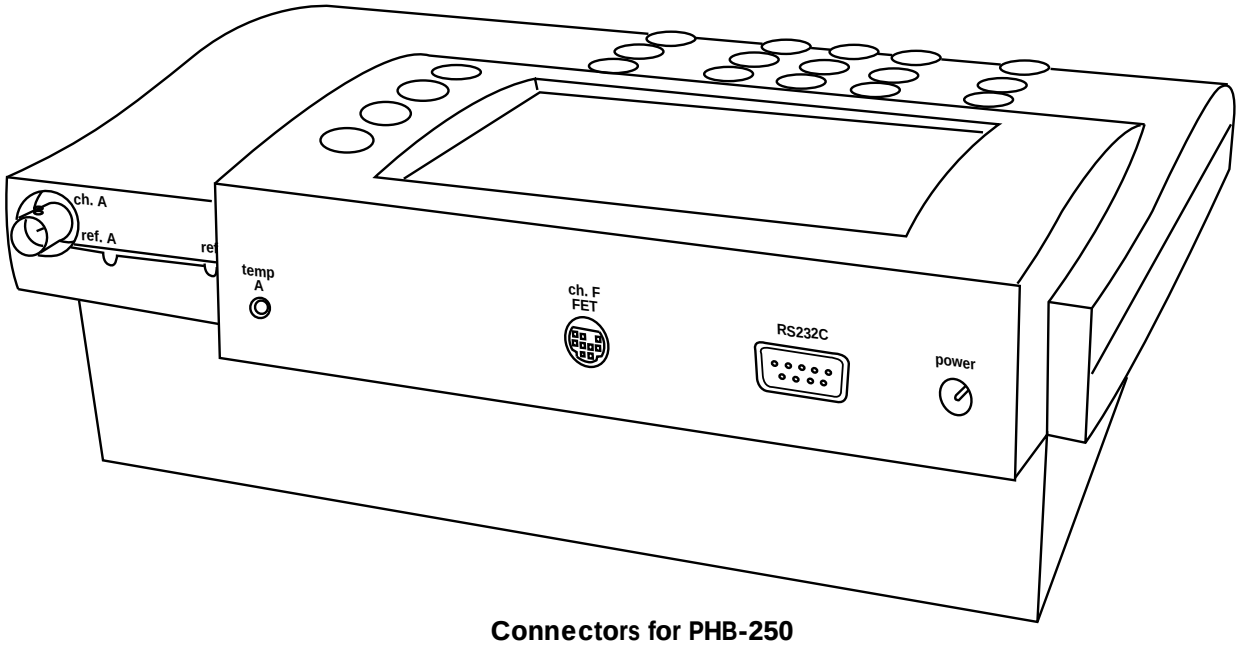
Reference ("ref.A" or "ref.B") connectors: use for attaching a reference electrode tip-pin plug when a separate reference electrode is used.

Conductivity DIN ("ch.C conductivity") connector: use to connect a 4-band conductivity/ATC cell. These 4-band cells offer improved linearity and stability over older 2-band conductivity cells. (PHB-220 and PHB-250 only).

FET DIN ("ch.F FET") connector: use to connect the Denver Solid-State Field Effect Transistor (FET) pH/ATC electrode. These non-glass pH electrodes offer certain advantages over conventional glass pH electrodes.

Serial port ("RS232") DB-9 connector: use to connect a serial printer or Personal Computer. This bi-directional interface outputs data and receives meter commands.

Power ("power") connector: use to connect a 5.5mm OD x 2.1 ID coaxial connector with 12VDC at 500mA (center pin negative).



Connectors for PHB-250

Display

Note: Not all of the following will display at the same time.

Ⓐ **Result:** current measurement.

Ⓑ **Units:** displays the units for the current measurement. Examples: pH, mV, mg/L F-, µS/cm or Ω-cm.

Ⓒ **Softkey icons:** show the current function assigned to each softkey.

Ⓓ **Calibration due reminder:** the **CAL!** icon means a calibration is now due.

Ⓔ **Date and time:** displayable in different formats.

Ⓕ **Datalogging:** the **Log** icon indicates datalogging is active.

Ⓖ **Buffers/Standards:** in single channel mode, all entered buffers or standards are displayed. A "!" symbol beside a buffer indicates that buffer is out of the entered calibration valid time (See Calibration reminder, page 9).

Ⓗ **Temperature:** displays the measured temperature when an electrode with ATC or separate temperature probe is attached. Shows "M" when a manually entered temperature is being used.

Ⓘ **Alarm:** "*" indicator means data is outside the set alarm limits.

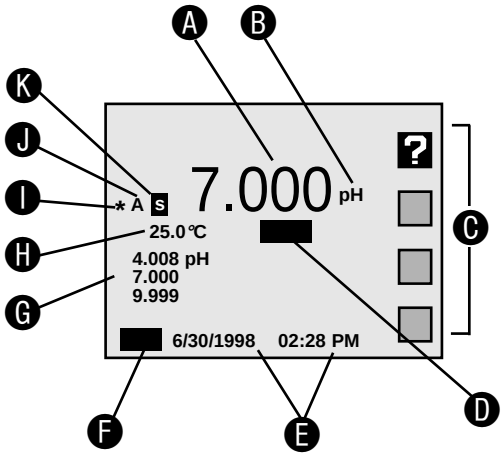
Ⓙ **Channel:** indicates which electrode channel (input) is being displayed. Channel A and Channel B (PHB-225 only) are BNC inputs. Channel F is the FET electrode input.

Ⓚ **Stability:** the **S** indicates the electrode is stable to the selected criteria.

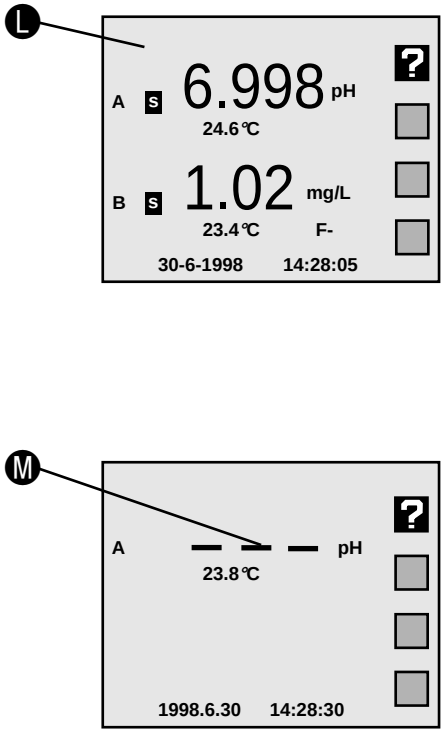
Ⓛ **Multiple Channel:** display can show two (PHB- 215), three (PHB-220 and PHB-225) or four (PHB-250) electrode measurements with temperature simultaneously.

Ⓜ **Out-of-range or non-valid reading:** dashes indicate a measurement is not available. This usually means the reading is out of range, or can mean in ion mode that no standards have been entered, or strict calibration has been set and the calibration expired.

Single channel display



Dual channel display



Function Keys

Ⓐ **Mode:** Selects the mode: pH, mV (PHB-215), Ion (PHB-225 and PHB-250), Conductivity - Resistivity-NaCl Salinity-Practical Salinity-TDS (PHB-220 and PHB-250) to use for the currently selected channel (electrode input).

Ⓑ **Standardize:** Enters buffers or standards for the currently selected channel and mode. Use to enter pH buffers, relative mV offset, ion standards or conductivity /resistivity standards.

Also used to change other settings which affect the measurement.

Ⓒ **Cal Data:** Displays and graphs buffers or standards with time and date stamp and electrode calibration data for the selected channel and mode.

Ⓓ **Channel:** Selects the channel(s) (electrode inputs) to display. The PHB-215 can display one or two channels simultaneously (Channels A and F). The PHB-225 can display one, two or three channels simultaneously (Channels A, B and F). The PHB-220 can display up to three channels (Channels A, C and F). The PHB-250 can display up to four channels (Channels A, B, C and F).

Ⓔ **Setup:** The Setup menu is used to set various general meter settings, such as date and time, display contrast, keypress beep and serial port.

Ⓕ **Data Log:** Displays the datalogging menu used to set datalogging and view the stored Data Log (see Datalogging).

Ⓖ **Clear:** Exits from the current menu and returns to the previous menu, cancels the current operation or clears a number entry.

Ⓗ **Enter/Print:** Accepts numeric values, menu selections or pending operations. In the main measure screen, acts as a Print key, sending all current measurements to a printer/ computer through the serial port and stores the measurements in the Data Log.

Ⓘ **Softkeys:** These four keys access different operations at different times. Most menus offer a "Help" softkey and the "Measure" softkey, which allows a direct return to the main measuring screen, exiting all menus immediately. The "Up Arrow" and "Down Arrow" softkeys offer one way to select a menu item. The "Left Arrow" key is a backspace, active during number entry.

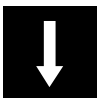
Ⓙ **Numeric Keys:** Pressing a number key selects a numbered item in a menu. The number keys also allow entering values for buffers, standards, and various meter settings.

Softkeys


Help


Measure


Scroll up


Scroll down


Backspace


Graph

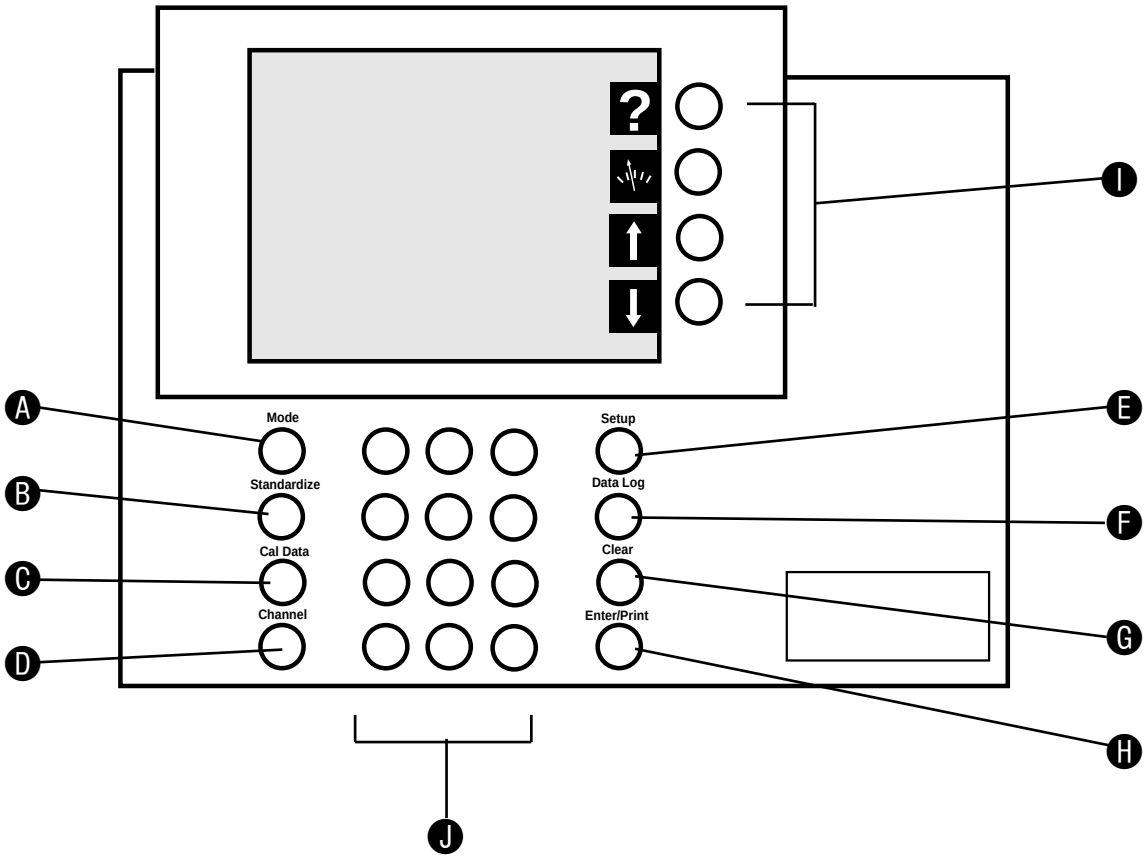

Exponent number entry


Incremental ion method


Measure lock


Measure unlock

Function Keys



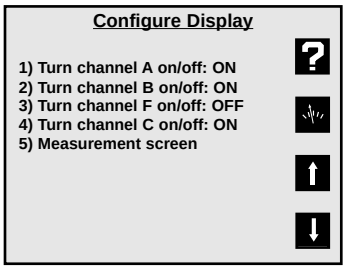
Channels

The Channel key is used to turn on or off each available channel. In single-channel operation, additional information for the selected channel is provided, including a display list of all entered buffers or standards. In multi-channel operation, the Mode, Standardize and Cal Data menus ask for the channel before accessing the menu.

The PHB-215 offers single or dual channel operation using channel A (pH and ORP electrodes) and channel F (Solid-state FET pH electrode). The PHB-225 offers up to three-channel simultaneous operation of channel A and channel B (pH, ORP and Ion Selective Electrodes) and channel F (Solid-state FET pH electrode).

The PHB-220 has Channel A (pH and ORP electrodes), Channel C (Conductivity cells) and Channel F (solid-state FET pH electrode). The PHB-250 provides up to four channel measurement with Channel A and Channel B (pH and ORP and Ion Selective electrodes), Channel C (Conductivity cells) and Channel F (solid-state FET pH electrode).

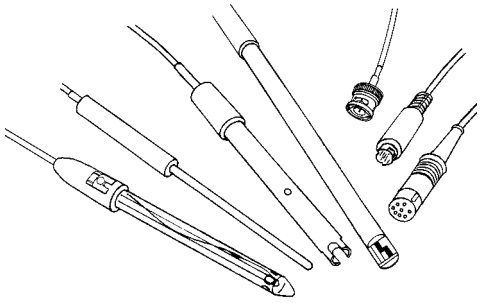
PHB-250 Select Channel screen



Channel

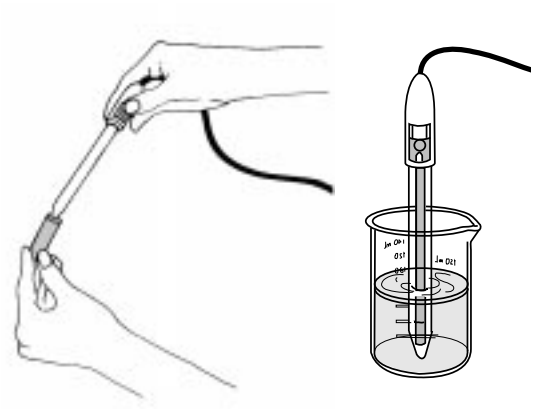
Electrodes

The meter allows you to use a variety of glass membrane ("glass") pH/ATC electrodes, ion selective electrodes, Conductivity/ATC cells, the Omega Field Effect Transistor (FET) Solid-State pH/ATC electrode, temperature (ATC) probes, combination electrodes using a BNC connector, or separate electrode pairs with BNC connector and reference pin.



To measure	Use channel (connector)		
pH	**A** (BNC)*	*or*	**B** (BNC)*
mV (ORP)	**A** (BNC)*	*or*	**B** (BNC)*
ion (ISE)	**A** (BNC)*	*or*	**B** (BNC)*
Conductivity	**C** (DIN)		
Resistivity	**C** (DIN)		
Salinity	**C** (DIN)		
TDS	**C** (DIN)		
pH (FET)	**F** (mini-DIN)		

*Separate reference electrodes can be used with "Ref A" or "Ref B" connectors



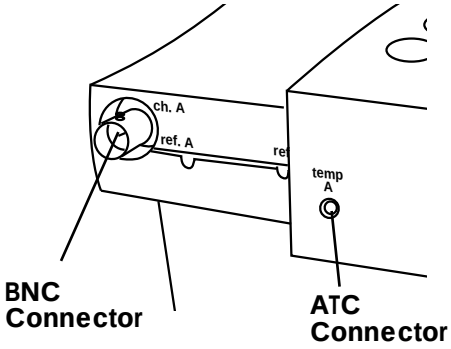
Preparing Electrodes and Conductivity Cells

Remove the wetting cap or storage cap from the electrode. Before first using your pH electrode or whenever the electrode is dry, soak it several hours in an electrode filling or storage solution (3 Molar KCl solution) or in a buffer for pH electrodes. Condition ISE's in the recommended solutions. Rinse Conductivity cells with deionized water before use.

Connecting Electrodes

pH, ORP or ISE electrodes (with BNC connector):

Connect the electrode to the BNC input, either channel A or channel B (PHB-225 and PHB-250 only), located at the rear of the meter. Push in and rotate the electrode's BNC connector until it locks in place. Connect the ATC connector to the temp. A or temp. B connector. To disconnect, twist the BNC connector in the opposite direction and pull.

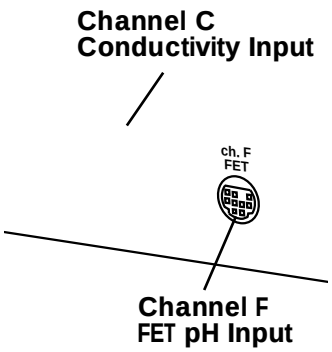


Electrode Pair Using a Reference Electrode (with Reference Pin Plug):

Connect the indicating electrode to the BNC input. Connect the reference electrode to the Reference input. Push the electrode's tip pin plug into the input to connect and pull out to disconnect.

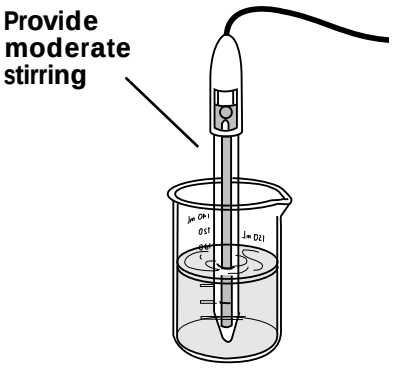
Conductivity Cells (with DIN connector):

Align and push in the DIN connector fully to the channel C input (PHB-220 and PHB-250 only). Pull carefully to disconnect.



Electrodes

Using and Storing Electrodes



pH Electrodes

- Provide moderate stirring for faster electrode response.
- Leave the fill hole open during all use.
- Rinse the electrode between each measurement with a portion of the next sample or buffer to be measured, or with deionized or distilled water.
- Keep glass electrodes wet when not being used by placing some electrode filling solution in the wetting cap and storing with the wetting cap on.
- Keeping glass electrodes "wet" will improve their performance. Store electrodes in electrode filling solution or storage solution (3M KCl).

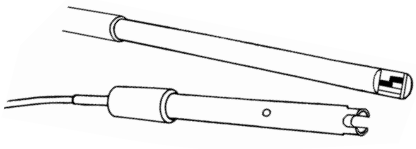
Store with wetting cap and Fill Solution (3M KCl)

Solid-State FET Electrode

- All models allow use of both standard glass pH/ATC and Solid-State FET (Field Effect Transistor) pH/ATC electrodes. The meter can store a calibration for both types of electrodes. Plug the FET electrode into the channel F mini-DIN input.
- Allow the FET about 1 minute to stabilize when first connected. The FET electrode can be stored dry or in electrode storage solution. Provide moderate stirring.

Ion Selective Electrodes

- Add proper amount of Ionic Strength Adjuster (ISA) to all standards and samples, usually 1 mL ISA to 50 mL standard or sample.
- Provide moderate stirring for faster electrode response.
- Rinse the electrode(s) between each measurement with a portion of the next sample or standard to be measured, or with deionized or distilled water.
- Follow the instruction sheets for the individual electrode. Store as recommended.



Store FET and Conductivity Cells dry

Conductivity Cells

- When changing samples or standards, immerse the cell into the new solution, then lift and allow solution to drain out. Repeat two more times.
- Gently tap cell to dislodge air bubbles.

Meter Setup

Meter Setup Menu

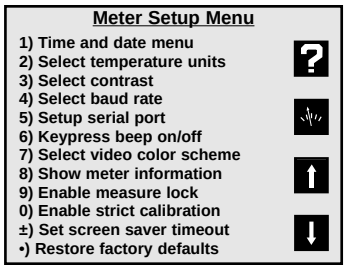
Press **Setup** to access the Meter Setup menu:

1. **Time and date menu:** use to set the time format (HH:MM AM/PM or HH:MM:SS), set the time, set the date format (MM/DD/YY, DD-MM-YY or YYYY.MM.DD), and set the date.
2. **Select temperature units:** use to select temperature measurement and display in degrees Celsius, degrees Fahrenheit or Kelvin.
3. **Select contrast:** use to select the display contrast, making the displayed characters lighter or darker. Select setting “5” for typical conditions.
4. **Select baud rate:** use to set the serial RS232 port baud rate. This must match the baud rate setting of the printer or computer being used with the meter.
5. **Setup serial port:** use to configure the serial port start bits and parity setting. This must match the settings of the printer or computer being used with the meter.
6. **Keypress beep on/off:** use to turn on or off a "beep" upon each keypress as an audible signal that a key has been pressed.
7. **Select video color scheme:** use to set the display to black characters on a white background or white characters on a black background.
8. **Show meter information:** use to show the meter model, software version and serial number.
9. **Enable measure lock:** use to enable the measure lock where a stable measurement is locked (frozen) for later review. Stability criteria should be set to SLOW for all channels and modes in use.
0. **Enable strict calibration:** use to set strict calibration where no measurements are displayed if the calibration reminder has expired.

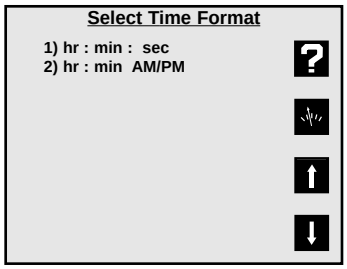
“±” **Set screen saver timeout:** use to set a time for the backlight to turn off and the screensaver to activate.

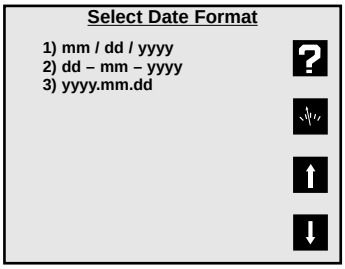
"•" **Restore factory defaults:** use to reset all settings to factory defaults. On occasion it may be useful to completely reset the meter, for example, if other users have changed a setting.

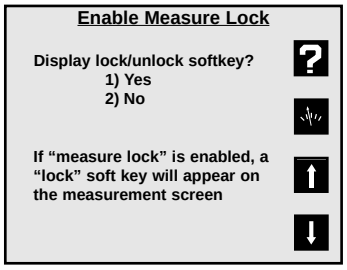
Warning!
A reset also clears all electrode standardizations.

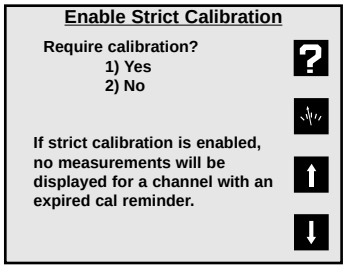


Setup





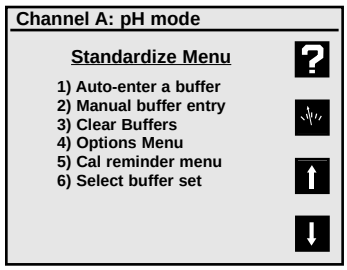




pH Mode

pH Mode Standardize Menu

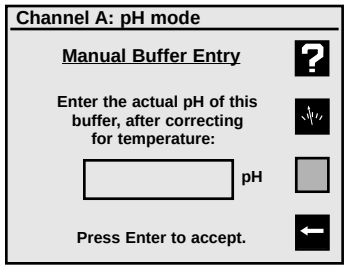
Press **Mode** and select **1) pH**.
Press **Standardize** and the pH Mode Standardize Menu appears:



Standardize

1. **Auto-enter a buffer:** use to add a new buffer which is auto recognized by the meter, or update an existing buffer. Follow the prompts.

2. **Manual buffer entry:** use to enter a buffer value by manually entering the pH of the buffer.

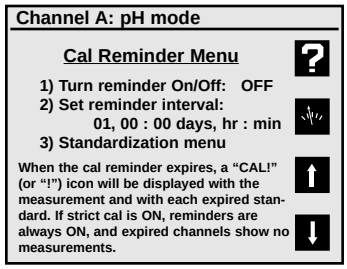


3. **Clear buffers:** use to clear all buffers entered for the current channel (pH mode). If <u>all</u> entered buffers are being re-entered, it is usually not necessary to clear buffers before re-entering them.

4. **Options Menu:** A menu of additional specific pH mode settings. (See page 10).

5. **Cal reminder menu:** use to set a timer reminding you to recalibrate. A **CAL!** icon will appear on the main screen and an exclamation mark will appear beside the buffers for which time has expired.

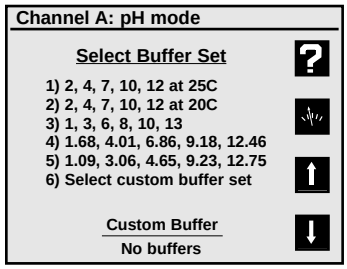
   The calibration reminder is a reminder of when electrode calibration (with buffers) should be redone. It is based on elapsed time from the oldest entered buffer.



If strict calibration is set (see Meter Setup Menu), when a calibration has expired the **CAL!** icon appears, and "**- - -** " is displayed in place of the measurement. No measurements can be obtained until a calibration is performed.

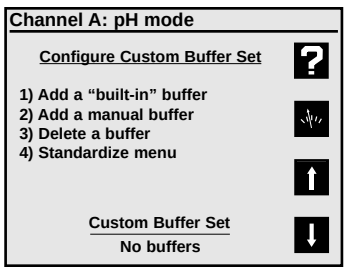
Note: When strict calibration is set, the calibration reminders for all channels are turned ON, and can't be turned off from the Cal Reminder Menu.

6. **Select buffer set:** There are five auto-recognition buffer sets and the option to configure and use a custom buffer set of your own.



Select custom buffer set

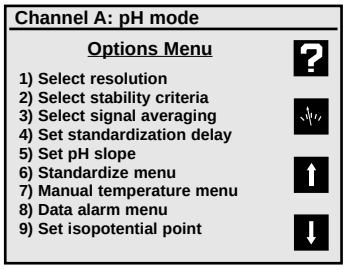
Use Custom Buffer Set to make a set of buffers containing the specific buffers in use (up to five buffers). Select Custom Buffer Set, configure the custom buffer set, then buffers from this set will be automatically recognized and entered.



Custom buffers can have any numeric pH value, or can be selected from the built-in temperature corrected buffers. Using the built-in buffers allow temperature correction of the pH values of the buffers, offering more accuracy.

pH Mode

pH Mode Options Menu



1. **Select resolution:** use to set pH readings to 0.1, 0.01, or 0.001 pH units.
2. **Select stability criteria:** use to set stability criteria to slow, medium or fast to match the electrode's speed of response and the variability of the signal allowed for a "stable" (**S**) measurement.
3. **Select signal averaging:** use to set filtering of the electrode signal to very slow (10 readings), slow (8), medium (6), fast (4) or very fast (2). Slower settings give more stable readings, although may require longer times to reach stability.
4. **Set standardization delay:** use to set a reading delay time for the meter to wait before accepting an electrode signal during standardization. Programming a standardization reading delay helps slow responding electrodes reach equilibrium before the electrode signal is accepted.
5. **Set pH slope:** use to set a known electrode slope used by the meter with a zero- or single-point standardization. The normal default slope is 59.16 mV/pH. The meter allows between 80 and 120 % efficiency to be entered.
6. **Standardize menu:** Returns to the pH mode Standardization Menu.
7. **Manual temperature menu:** use to set a temperature to be used in the absence of an ATC probe or when manually overriding the ATC.
8. **Data alarm menu:** use to set pH limits. If the limits are exceeded an alarm indication ("*") is displayed and recorded with any data points placed in the Data Log.
9. **Set isopotential point:** use to set an isopotential point for use in high accuracy electrode measurements (See Isopotential, page 20).

Notes:

1. Auto-recognized buffers are found in the Auto-recognized built-in buffer sets. These buffers are auto-recognized by the meter, and are also automatically temperature corrected for the variation of buffer pH with temperature.

2. When manually entering buffers, the exact pH of the buffer at the current temperature must be entered. All buffers change pH with temperature. For best accuracy, either use the built-in buffers or make sure manually entered buffers are at the expected temperature (so that their pH as entered is correct).

3. Auto-recognition Buffer Sets:
   1) 2, 4, 7, 10, 12 (nominal value adjusted at 25°C)
   2) 2, 4, 7, 10, 12 (nominal value adjusted at 20°C)
   3) 1, 3, 6, 8, 10, 13
   4) 1.68, 4.01, 6.86, 9.18, 12.46 (NIST buffers)
   5) 1.09, 3.06, 4.65, 9.23, 12.75 (DIN buffers)
   6) Select custom buffer set

4. Temperature Correction of Electrodes and Buffers

The meter automatically compensates for the temperature dependence of the electrode's response when measuring pH. The meter also compensates for buffer change in pH value with temperature. Temperature compensation is based on temperature either from an ATC probe or a manually entered temperature.

Actual Buffer pH vs. Temperature
pH 4.00(4.01)/7.00/10.00 buffer (nominal 25°C)

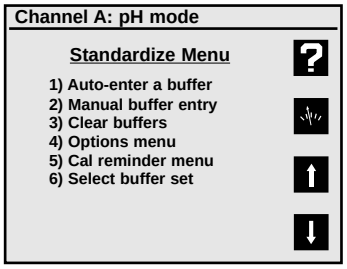
Temperature (°C)	Buffer 4	Buffer 7	Buffer 10
30	4.016	6.991	9.947
25	4.008	7.003	10.000
20	4.003	7.020	10.057
15	4.000	7.042	10.119
10	3.998	7.069	10.187

Using a Solid-state FET (Field Effect Transistor) pH/ATC Electrode

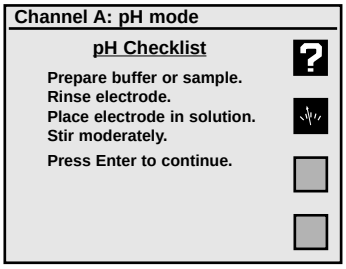
By turning channel F (FET) on, an Omega FET pH/ATC electrode can be directly used. pH and mV modes are available with the FET electrode. FET devices can have large offset potentials that vary with each transistor chip, so Manual buffer entry must be used to enter the first buffer. After one buffer has been entered using "Manual buffer entry", following buffers can usually be entered with "Auto-enter a buffer".

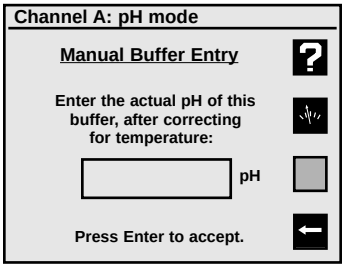
Standardizing and Measuring pH

1. Immerse the electrode in a buffer and stir moderately. The meter displays the current pH measurement.
2. Allow the electrode sufficient time to reach equilibrium.
3. Press **Standardize**, then press either **1) Auto-enter a buffer** or **2) Manual buffer entry.**
4. Follow the prompts on the display.
5. The meter waits for a stable signal, automatically recognizes the buffer (if using "Auto-enter"), checks the electrode and buffer and enters the buffer. The entered buffer appears in the display.
6. Alternatively, if the signal is not stable, you can press **Enter** when the reading stabilizes according to your tolerance criteria. The meter then enters the buffer.
7. Repeat steps 1 through 4 to enter a second, third, fourth or fifth buffer. With more than one buffer the meter performs a diagnostic check on the electrode. The electrode is considered good if the slope is between 90 to 105%. If a sixth buffer is entered, the buffer farthest away is replaced by the new buffer.



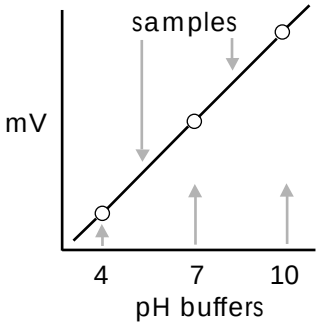
Standardize





Hints to achieve better accuracy:

- During standardization, allow time for the electrode to stabilize before entering the buffer into the meter.
- Standardize using at least two buffers, bracketing the expected pH of your samples.
- Standardize at least daily for the most accurate readings.
- Open the Fill Hole on the electrode.
- Stir all buffers and samples.
- Rinse the electrode with DI water between samples and buffers.
- Always use fresh buffers.



Clearing Buffers

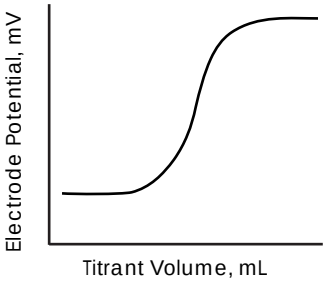
Press **Standardize**, then press **3) Clear buffers** to clear buffers. If all previously entered buffers will be re-entered, it is not necessary to clear buffers since the meter will replace the previous values. If re-entering only some buffers, all the old buffers should be cleared.

mV Mode

Millivolt measurements are used to measure ORP (oxidation-reduction potential) or redox potential, to check performance of pH or Ion Selective Electrodes, and for redox titrations.

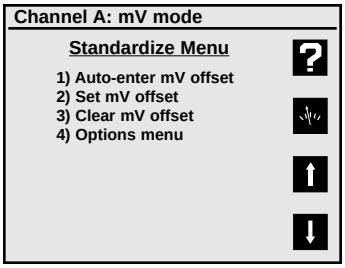
The meter will measure millivolts (mV) by pressing **Mode** and selecting **2) mV**. Relative mV can be measured by entering a mV offset or using the current mV value as the mV offset.

Redox Titration



mV Standardization Menu

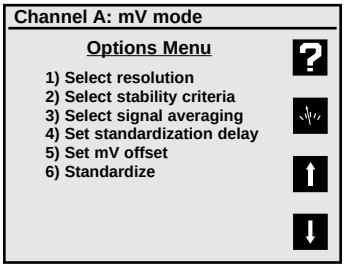
In mV mode, press **Standardize** and the mV mode Standardization Menu appears:



Standardize

1. **Auto-enter mV offset:** use to set the relative mV offset equal to the current mV reading. The current mV becomes 0.0 relative mV.
2. **Set mV offset:** use to manually enter a mV offset.
3. **Clear mV offset:** use to clear any offset that has been entered, returning the meter to absolute mV mode.
4. **Options menu:** a menu of additional settings specific to the mV mode. See below.

mV Mode Options Menu



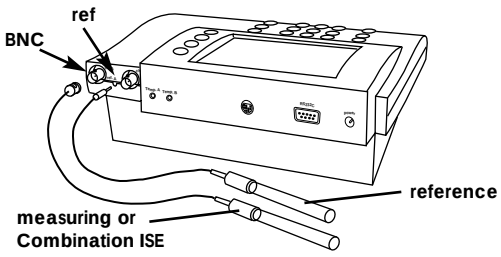
1. **Select resolution:** use to set mV readings to 1 or 0.1 millivolt resolution.
2. **Select stability criteria:** use to select stability criteria for slow, medium or fast response which use a tight, average or loose requirement to indicate a "stable" (S) reading.
3. **Select signal averaging:** use to set the meter to average readings that are very slow (10 readings), slow (8), medium (6), fast (4) or very fast (2).
4. **Set standardization delay:** use to set a length of time for the meter to wait before entering a relative mV standardization.
5. **Set mV offset:** use to manually enter a mV offset (same as in the mV Standardize menu).
6. **Standardization menu:** returns to the mV Standardization Menu.

Clearing Relative mV Mode

Press **Standardize**, then press **3) Clear mV offset** to clear offset and return the meter to absolute mV mode.

Quick Start Guide for Ion Measurements

1. Connect the Ion Selective Electrode (ISE) and Reference Electrode, if required, to the meter."Combination" ISE's have a reference electrode built-in, and do not require a separate reference electrode or connection.

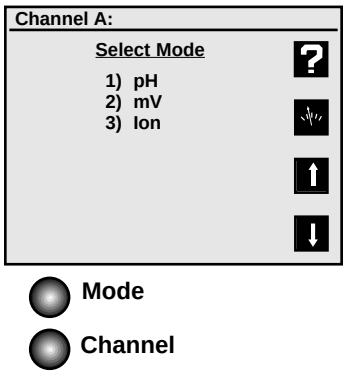


2. Prepare two or more ion standards at concentrations bracketing typical sample solutions. Add the appropriate Ionic Strength Adjuster solution to each standard.

Example: 1 mg/L **10 mg/L** **Ionic Strength Adjuster**

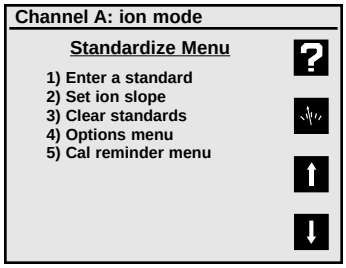
3. Set the meter to display the correct channel (the channel with the ISE attached, either A or B) using **Channel**. Set the meter to Ion mode: press **Mode**, then **3) Ion.**

   Note: The meter will display "— — —" (no valid data) until an ion standard has been entered.

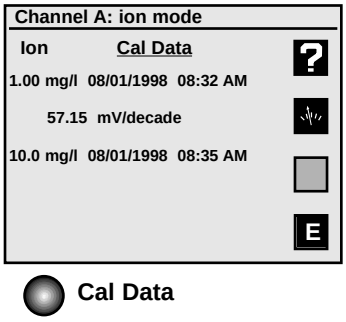


4. Place the electrode(s) in the standard, provide stirring (a magnetic stirrer is recommended), and allow sufficient time (1 to 5 minutes depending on the ISE) for the electrode to reach a stable signal.

5. Press **Standardize**, **1) Enter a standard** and follow the prompts. Repeat these steps to enter up to seven ion standards. See the Standardizing and Measuring Ion section for more information.

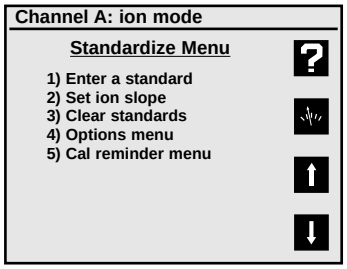


6. Check the ISE response by pressing **Cal Data** to see the standards and the ISE slope between calibration points (standards). The meter will allow an ion electrode slope between 5.92 mV/decade (10% slope) and 70.99 mV/decade (120% slope).



Ion Mode

Ion Mode Standardization Menu

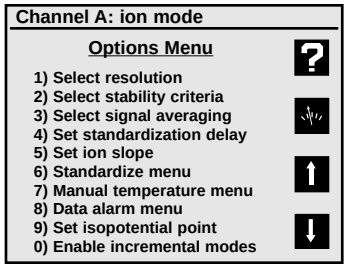


Select channel A or B. Press **Mode** and then press **3) Ion** for ion mode. Press **Standardize** and the Ion Mode Standardize Menu appears.

1. **Enter a standard:** use to add a new standard or update (re-enter) an existing standard. Follow the prompts. With the first standard you select the ion name and units.
2. **Set ion slope:** use to manually enter a slope for the selected ion electrode. Used with a one-point ion calibration. Useful if the ISE has a known, stable slope, so that measurements can be made after entering a single ion standard.

   Note: when two or more standards are entered, the meter uses the actual determined slope(s).
3. **Clear standards**: use to clear standards for the electrode standardization selected.
4. **Cal reminder menu:** use to set a timer reminding you to recalibrate. A **CAL!** icon will appear on the main screen and an exclamation mark will appear beside the standards which need to be re-entered.
5. **Options Menu:** use to set various additional parameters to the ion mode. See below.

Ion Mode Options Menu



1. **Resolution:** use to set the readings to 1, 2, or 3 significant digits.
2. **Select stability criteria:** use to set the stability criteria to slow, medium or fast to match the electrode's speed and stability of response, providing tight, medium and loose requirements for a stable (**S**) indication.
3. **Select signal averaging:** use to set filtering of the electrode signal to very slow (10 readings), slow (8), medium (6), fast (4) or very fast (2). Slower settings give more stable readings, although may require longer times to reach stability.
4. **Set standardization delay:** use to set a reading delay time for the meter to wait before accepting an electrode signal during standardization. Programming a standardization reading delay helps slow responding electrodes reach equilibrium before the electrode signal is accepted. Delays of one minute for fast ISE's and five to ten minutes for slow ISE's are appropriate.
5. **Set ion slope:** use to enter a known ion electrode slope for a one point standardization.
6. **Standardize menu:** returns to the ion standardize menu.
7. **Manual temperature menu:** use to set a manual temperature for use in the absence of an ATC probe or when manually overriding the ATC.
8. **Data alarm menu:** use to enter ion limits to be entered. If the limits are exceeded an alarm indication ("*") is displayed.
9. **Set isopotential point:** use to enter an isopotential point. See page 20.
0. **Enable incremental:** use to turn on the known addition/subtraction type ion methods. See page 17.

Standardizing and Measuring Ion

Standardizing and Measuring Ion

1. Set the meter to ion mode (use **Mode**) and turn ON the channel (use **Channel**) with the Ion Selective Electrode (either Channel A or B).

   The meter displays "— — —", indicating no valid measurement, until at least one ion standard has been entered.

2. Prepare a standard, and add the appropriate Ionic Strength Adjuster (ISA) solution to the standard.

3. Immerse the electrode(s) in the solution and stir continuously.

4. Press **Standardize**, select the correct channel if prompted to do so, and select **1) Enter a standard** to add a standard. If this is the first standard to be entered, select the ion name and units.

   Follow the prompts. Be sure to allow enough time for the electrode to reach a stable signal.

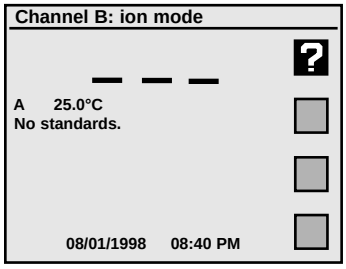
   Note: The default standardization delay for ion mode is 30 seconds. This can be set by the user. See Ion Mode Options Menu, page 15.

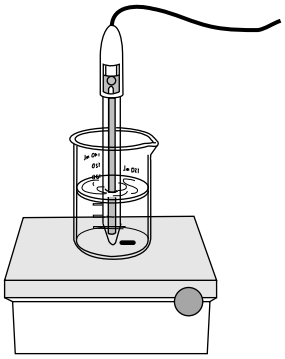
5. The meter waits for a stable signal and enters the standard. The entered standard appears in the display (in single channel mode). Alternatively, if the signal is not stable, you can press **Enter** when the reading stabilizes according to your tolerance criteria. The meter then enters the standard.

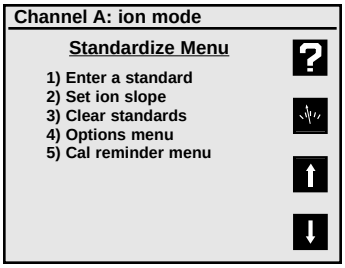
6. Repeat steps 2 through 5 to enter additional standards. Up to seven standards can be entered. With more than one standard, the meter performs a diagnostic check on the electrode.

Helpful Hints:

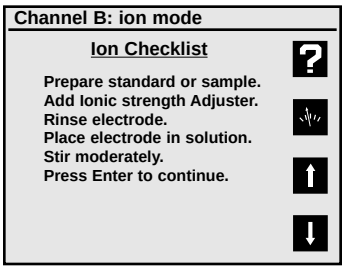
- Provide stirring.
- Allow the electrode time to reach a stable reading before entering the standard into the meter.
- To achieve better accuracy, standardize using at least two standards, bracketing the expected range of your samples.
- Standardize from low to high concentrations.
- Always use fresh standards.
- Use standards and samples near the same temperature.
- Remember to add Ionic Strength Adjuster to each standard and sample.

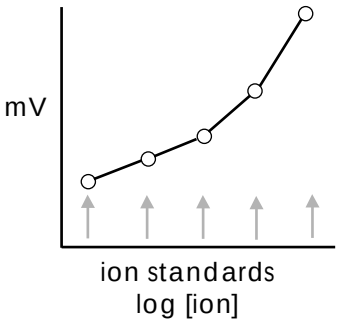






Standardize



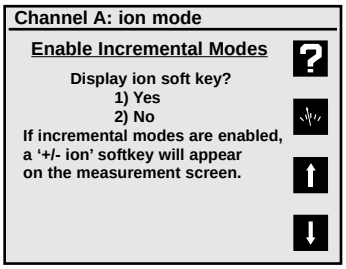


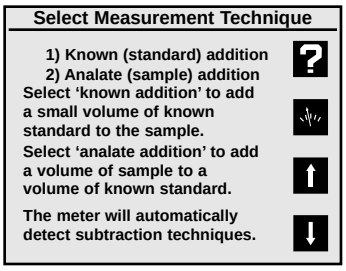
Measuring Ion using Known Addition type (Incremental Ion) Methods

The meter provides known ("standard") addition/subtraction and analate ("sample") addition/subtraction incremental methods for measuring ion concentrations. These advanced ion measurement techniques are useful in overcoming certain problems in ion analysis.

In known addition/subtraction a volume of sample is obtained, Ionic Strength Adjuster is added, and the ion electrode potential is obtained. Then a small volume of standard is added to the sample, and a second electrode potential is obtained. From the change in electrode potential, the ion concentration in the sample can be calculated. Interference from complexation and other ions can often be overcome by the known (standard) addition method.

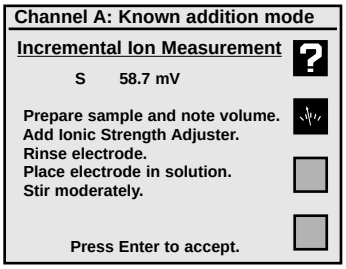
In analate addition/subtraction the ion electrode is placed in a volume of standard and the potential obtained. Then a small volume of sample is added and a second electrode potential is obtained. This method helps overcome problems from widely differing sample ionic strengths or temperatures.





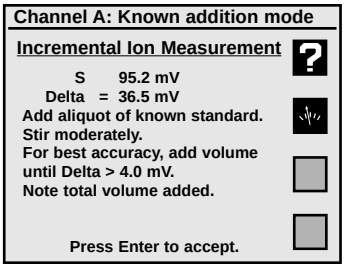
Enable Incremental Ion Modes

Press **Standardize,** select the channel (if necessary)**, 4) Options menu, 0) Enable incremental modes,** then **1) Yes.**
This will "turn on" a special softkey in the main measure screen which is a direct access softkey to start a known addition type measurement.



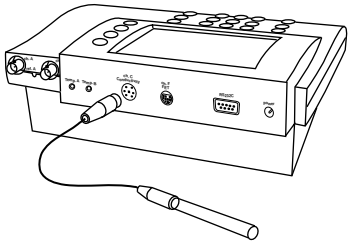
Using a known addition type incremental ion measurement

Press the incremental method softkey, select **1) Known (standard) addition** or **2) Analate (sample) addition.** Follow the prompts to place the electrode in the first solution and obtain a reading, add an aliquot (a known volume) of standard or sample, obtain a second electrode reading, and enter the sample volume and standard volume and concentration. The meter then displays the calculated ion concentration in the original sample. Press **Enter** to leave the result screen and return to the measure screen to use direct reading ion measurements or start another known addition type measurement.



Quick Start Guide for Conductivity/Resistivity/Salinity/TDS Measurements

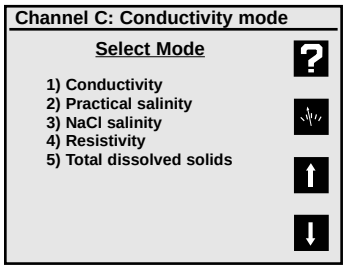
1. Connect the conductivity/ATC cell to the meter.



Conductivity/ATC cell

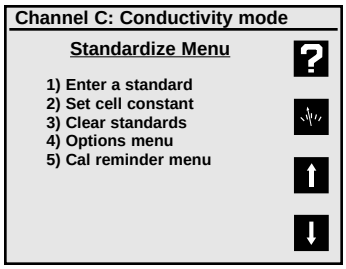
2. Prepare one or more conductivity/resistivity standard solutions at values near typical sample solutions.

3. Set the meter to display channel C using **Channel.** Set the meter to the correct mode (Conductivity, Resistivity, NaCl salinity, Practical salinity or Total dissolved solids) using **Mode.**

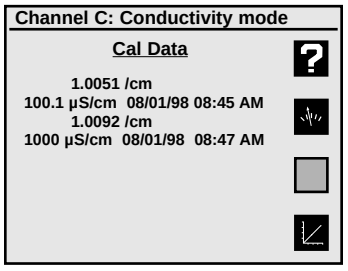


4. Place the conductivity cell in the standard, immerse the cell past the fill vent hole, then lift and allow the solution to drain out. Immerse and drain at least three times to fully flush the inner chamber of the cell. Gently tap the cell to dislodge any air bubbles.

5. Press **Standardize**, then **1) Enter a standard** and follow the prompts to enter the value of the standard. Repeat these steps to enter up to five conductivity/resistivity standards. Each standard is displayed in the main measuring screen when in single channel display.

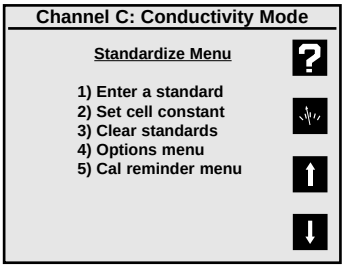


6. Check the cell performance by pressing **Cal Data** to display the standards and the cell constants between standards.



Conductivity/Resistivity/Salinity/TDS Menus

Conductivity/Resistivity/Salinity/TDS Standardize Menu

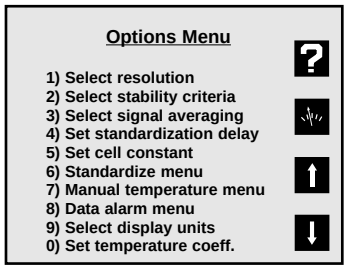


Turn ON Channel C using the **Channel** key. Press **Standardize** and the Standardize Menu is displayed.

1. **Enter a standard:** use to enter or re-enter a conductivity standard. Follow the prompts.
2. **Set cell constant:** use to manually enter a known conductivity cell constant for use with no standards. If the cell constant is known and stable, then this allows standardizing the cell without using standard solutions. If a standard is entered, the actual cell constant is calculated and used.
3. **Clear standards:** use to clear all existing standards. This is useful if new standards are to be entered.
4. **Options menu:** accesses additional settings used with each conductivity-type mode. See below.
5. **Cal reminder menu:** use to set a timer reminding you when to recalibrate. A **CAL!** icon appears on the main screen and an exclamation mark appears beside those standards which need to be re-entered.
6. **[TDS mode only] Calculate solids factor:** use this to allow the meter to calculate a solids factor. *
7. **[TDS mode only] Set solids factor:** use to manually enter a known solids factor * for a particular sample type.

* The "solids factor" is used to correlate the conductivity measurement with the weight based TDS measurement for a sample type.

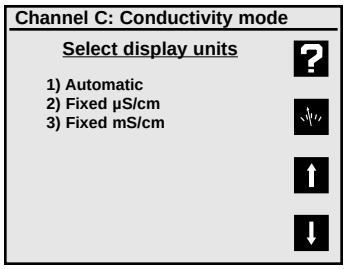
Conductivity Mode Options Menu

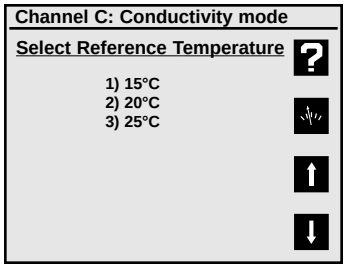


1. **Select resolution:** use to set readings to 1 through 4 significant digits resolution.
2. **Select stability criteria:** sets stability criteria used to determine when the meter indicates Stable **S**.
3. **Select signal averaging:** use to set filtering of the cell signal to very slow (average 10 readings), slow (8), medium (6), fast (4) or very fast (2 readings). Slower settings give more stable readings, and are recommended with conductivity measurements.
4. **Set standardization delay:** use to set a reading delay time used by the meter when entering conductivity standards. Programming a reading delay helps by ensuring sufficient time for the cell signal to become stable before being entered into the meter.
5. **Set cell constant:** use to manually enter a known conductivity cell constant. (Same as in Standardize Menu).
6. **Standardize Menu:** use to return to the Standardize Menu.

Conductivity/Resistivity/Salinity/TDS Modes

7. **Manual temperature menu:** Use to set a manual temperature for use in the absence of an ATC probe or when manually overriding the ATC.
8. **Data alarm menu:** use to set ion limits to be entered. If the limits are exceeded an alarm indication ("*") is displayed.
9. **Select display units:** the meter automatically switches between uS/cm and mS/cm in conductivity, or between ohm-cm, Kiloohm-cm and Megohm-cm in resistivity. If it is better to display a fixed unit, the "Fixed" settings allow that.
0. **Set temperature coefficient:** use to set the reference temperature to correct all conductivity and TDS measurements to, and set the temperature coefficient for the temperature correction. Salinity measurements by definition are corrected to 20°C. Resistivity measurements are not temperature corrected.



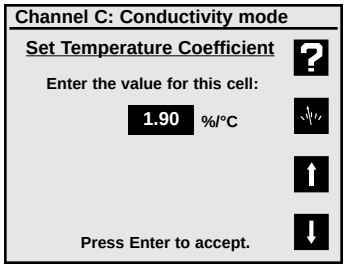


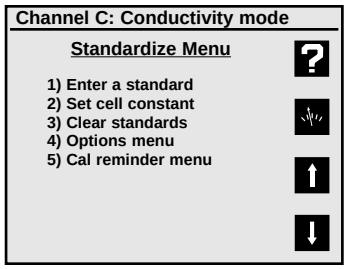
Standardizing and Measuring Conductivity/Resistivity/Salinity/TDS

1. Set the meter to display channel C (use **Channel**). Set the meter to the correct mode (Conductivity, Resistivity, NaCl salinity, Practical salinity or Total dissolved solids) using **Mode.**

2. Place the conductivity cell in the standard, immerse the cell past the fill vent hole, then lift and allow the solution to drain out. Immerse and drain at least three times to fully flush the inner chamber of the cell. Gently tap the cell to dislodge any air bubbles.

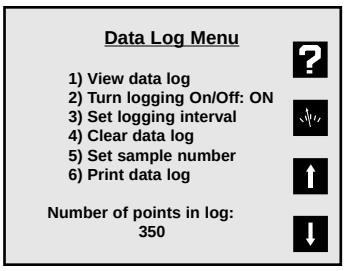
3. Press **Standardize,** select the channel if necessary, then **1) Enter a standard** and follow the prompts to enter the value of the standard. Repeat these steps to enter up to five conductivity/resistivity standards. Each standard is displayed in the main measuring screen when in single channel display. Use multiple standards that cover the range of values expected in samples. Generally, standards should be a factor of ten apart in conductivity.





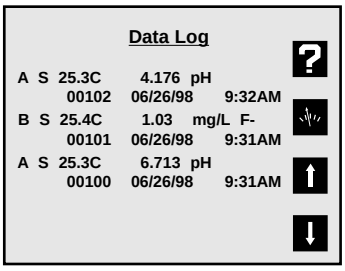
Data logging

The meter will store up to 500 data points in an internal data log. Press **Print** when in the main measure screen to store the current result with units, temperature, time, date, channel, sample number and stability in the data log. **Print** also outputs this data through the RS232 serial port. All channels displayed are printed and data logged.



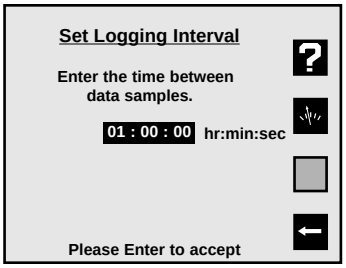
Data Log Menu

Press **Data Log** and the Data logging menu will appear.



1. **View data log:** Shows the stored data, one screen at a time. Press the arrow soft keys to page up and down through the stored data. Press **Clear** or **Enter** to return to the menu.

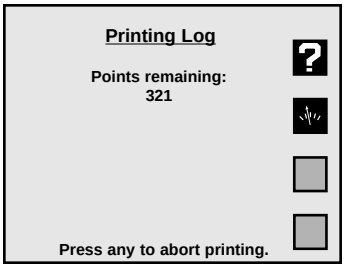
2. **Data logging on/off:** Turns the data logging on or off for all displayed channels.



3. **Set logging frequency:** Allows you to enter the time interval for automatic data logging.

4. **Clear data log:** Clears all stored data points from memory.

5. **Set sample number:** Allows a number to be assigned to the first sample. This number will increment for each consecutive sample logged.



6. **Print data log:** Use to send all data points in the Data Log to the RS232 serial port.

Warning

The Data log is kept in instrument RAM (Random Access Memory), which is powered by the external power supply. Removing power from the meter will lose the stored data in the Data log.

Note:

Meter settings and electrode standardization data are kept in separate non-volatile memory. Unplugging the meter has no effect on these stored items.

Troubleshooting

Testing the Electrode and Meter

To test the meter for correct operation with a pH, ORP or Ion Selective electrode, short the BNC input connector (either Channel A or B) using the BNC Shorting Cap that was supplied with the meter on the BNC connector(s). Select the correct channel using **Channel**. Select mV mode by pressing **Mode** and selecting **2) mV**. Verify meter is in absolute mV mode (display shows "mV", not "rel mV"). If the meter reads 0 ± 0.1 mV*, and is stable, the meter is measuring correctly.

To test the pH electrode, place it in a fresh pH 7 buffer. Select the correct channel for the electrode using **Channel**. Press **Mode** and select **2) mV**. Verify that the meter is in absolute mV mode (display shows "mV", not "rel mV") and note the mV reading. Repeat for either a pH 4 or pH 10 buffer. If the electrode potential is within the limits shown, it is measuring correctly.

pH 7	0 ± 30 mV
pH 4	159 to 186 mV higher than pH 7 reading
pH 10	159 to 186 mV lower than pH 7 reading

*** Note:** Meter accuracy is ±0.1 mV at calibration temperature, not including long term drift and a temperature error. The zero and slope temperature coefficients of the meter over the range of 15 to 40°C specify 85ppm/°C, or ±4 mV at full scale (worst case). The long term drift will not exceed 0.1 mV per month.

Meter Specifications

PHB-215, PHB-220, PHB-225 and PHB-250

Modes	pH	mV	Temperature
Range	-2.000 to 20.000	±1800.0	-5.0 to 105.0˚C
Resolution	0.001/ 0.01 / 0. 1	0.1 / 1	0.1
Accuracy	±0.002	±0.1	± 0.3
Temperature Compensation	Automatic & manual: -5 to 105˚C		
Slope Control	Automatic, 90 to 105% Manual, 80 to 120%		
Environmental Conditions	15 to 40°C, humidity from 0 to 90% (noncondensing)		
Power Requirements	115V 50/60Hz (Additional voltages available)		
Ordering Information			
Meter with kit includes:	Meter, power supply, high performance glass-body pH/ATC “3-in-1” electrode, electrode arm and operation manual.		
Meter only kit includes:	Meter, power supply, electrode arm and operation manual.		

Models 225 and 250

Mode	Ion
Range	1.00E-9 to 9.99E9
Resolution	1, 2, or 3 significant figures
Accuracy	± 0.17%n (n = ion charge)
Slope Control	Automatic or manual, 5.9 mV/decade (10% slope) to 71 mV/decade (120%)

PHB-220 and PHB-250

Mode	Conductivity	Resistivity	Practical Salinity	NaCl Salinity	TDS
Range	0.01 – 300,000 µS/cm•	30 - 20MΩ•cm*	0.01 - 42 ppt*	0.01 - 70ppt*	0.005 - 150,000*
Resolution	1, 2, 3, or 4 significant figures				
Accuracy	± 0.5% ±0.01µS/cm				
Cell Constant	Automatic or manual, 0.01 - 100 /cm				
Temperature Coeff	Off or On (0 - 4% /°C)				
Number of Standards	5				

*depending on cell constant (from 0.1 to 10 /cm)

pH Theory

The measurement of pH plays an important role in water quality, industry and research. pH is a measure of acidity or alkalinity of a solution, and is usually written:

$$pH = -\log [H^+]$$

Where $[H^+]$ is the concentration of hydrogen ions.

pH levels generally range from 0 to 14, with a pH value of 7 being the neutral point. pH values greater than 7 are alkaline, and pH values less than 7 indicate acidic solutions.

Conventional pH meters use a combination glass pH electrode, which includes a reference electrode. The reference electrode provides a stable reference point and completes the electrical circuit. The pH meter reads the voltage of the two electrodes, converts it to pH units, and displays the result.

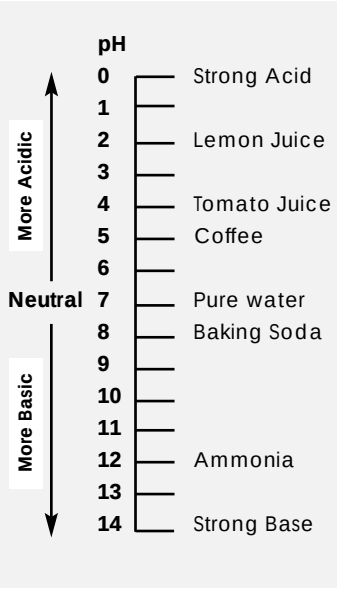
These meters can also use a Field Effect Transistor (FET) pH/ATC electrode for measuring pH. The FET uses an ion-sensing solid state membrane attached to a transistor to measure the hydrogen ion concentration of a solution. These non-glass pH electrodes offer durability, dry storage and no glass construction.

The electrode signal varies with the pH, according to the Nernst Equation:

$$E = E^\circ + S \bullet \log [H^+]$$

Where:

E = measured electrode potential
E° = standard potential of the system (constant)
S = slope



pH scale showing the relative acidity or basicity of some common substances

Ion Selective Electrode Theory

The measurement of ions plays an important role in water quality, industry, research and environmental monitoring. Ion-selective Electrodes (ISE's) respond, more or less exclusively, to a specific type of ion in solution. The particular ion to which an ISE responds depends on the chemical makeup of its sensing membrane. ISE's operate according to a form of the Nernst equation:

$$E = E_o + S \bullet \log [ion]$$

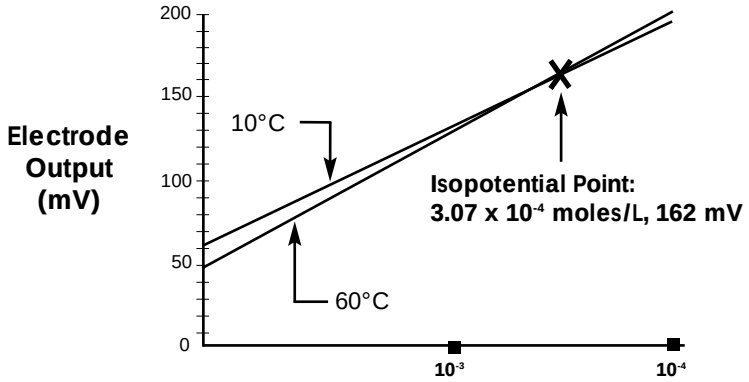
Determining the Isopotential Point

The Isopotential point is the potential of an electrode system which does not change with temperature. Typical pH electrodes have isopotential points near zero mV (which is the default setting for the meter). For high accuracy pH measurements, or for ion measurements where the sample temperature may widely vary, the isopotential of the pH or ion electrode may be experimentally determined and entered into the meter.

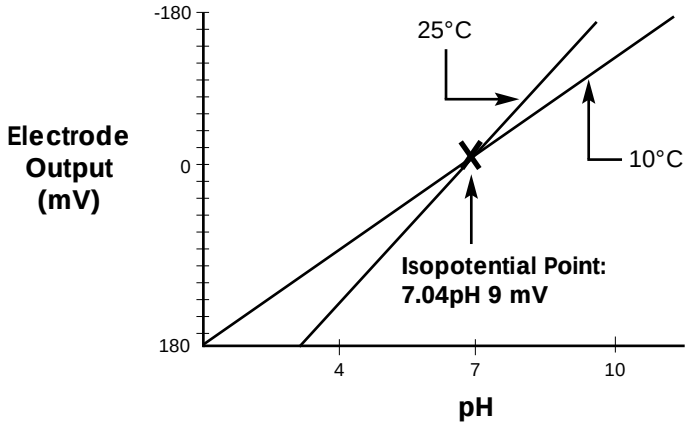
- Prepare a set of buffers or ion standards spanning the linear range of the electrode. Place the buffers or standards in a temperature bath at known temperature.
- Place the meter into mV mode.
- Measure and record mV readings of each pH or concentration, and repeat at several temperatures.
- Plot the log of concentration or pH value versus mV reading.
- Connect the points for each temperature.

Where the lines intersect is the Isopotential point.

Ion Electrode Isopotential Point



pH Electrode Isopotential Point



RS-232 Serial Interface Meter Command Set

Omega meters have a bi-directional RS-232 serial port, which can be used to send commands to the meter and output data from the meter. Special characters (Ω, µ, é) are coded using ASCII (not ANSI); use an ASCII font like "Terminal". Also use a terminal emulation like TTY or ANSI, not VT100.
Serial commands follow either "keystroke" mode or high level command mode consisting of "SET", "GET" and "DO" instructions.
(Note: "GET" and "DO" are optional).

Keystroke instructions

KEYS	M	Mode
	Z	Standardize
	C	Cal Data
	H	Channel
	S	Setup
	L	Data Log
	R	Clear
	N	Enter/Print
	[0 to 9]	Equivalent to pressing a numeric key
	-	+/- key
	.	Decimal key
	E	Used within a number to enter values in exponential form
	!	Press softkey #1 (at top, usually Help)
	@	Press softkey #2 (usually return to measuring screen)
	#	Press softkey #3 (usually up arrow)
	$	Press softkey #4 (at bottom, usually down arrow)

Notes: Key commands are acknowledged by the meter with a reply Keys = COMMAND_RECEIVED. Multiple keys can be concatenated together into a single command, for example, Keys Z413@ (Standardize, options, resolution, set to 3, main), or Keys Z4721.2-N@ (Set manual temperature to -1.2).

High level instructions

Use commands SET, GET, DO.
Follow command by a keyword like MODE, STDZPH, STDZCONDO, CALDATA, STDZCLEAR, CHANNEL, DATETIME, TIMESTAMP, DISPLAY, READ, INFO
Typical Syntax: [command] [keyword] [channel] [variable(s)]

Error conditions are replied to with an Error response; for example:
"Error: Need channel", "Error: Need mode", "Error: Unspecified"
Accepted commands have a response; indicated below for each command.

Mode operations
set mode "channel character" "mode id"

Examples:
SET MODE A PH
SET MODE B MV
SET MODE B ION
SET MODE C CONDUCTIVITY

Returns confirmation; for example "SET MODE A PH" returns "A mode = PH".
Valid modes are (depending on the meter model) PH, MV, CONDUCTIVITY, RESISTIVITY, PRAC_SALINITY, NACL_SALINITY, DISSOLVED_SOLIDS.

[get] mode "channel character" "mode id"
Examples: [GET] MODE A

Returns mode information on selected channel;
"A Mode = MV".

Channel operations
set channel "channel character" "on|off"
Examples: SET CHANNEL A ON
SET CHANNEL C OFF
Returns confirmation; for example "A Channel = ON".
[get] channel "channel character"
Example: [GET] CHANNEL B
Returns channel information; "A Channel = OFF".

(DO) READ "channel character" (Take reading w/temperature without sending to data log).

Standardization operations
[DO] STDZPH "channel character"
[DO] STDZCLEAR "channel character"
[DO] STDZCONDO "conductivity standard value"
[DO] CALDATA "channel character"

[DO] STDZPH A [Auto-enter a buffer]
Returns "Stdz pH = COMMAND_RECEIVED", followed by the Calibration Data printout.

[DO] STDZCLEAR A [Clear all buffers/standards.]
Returns "Stdz Clear = COMMAND_RECEIVED".

[DO] STDZCONDO 1000 [Enter a standard of 1000 uS/cm.]
Returns "C Stdz Condo = COMMAND_RECEIVED", followed by the Calibration Data printout.

[DO] CALDATA A
Returns "A Cal Data = COMMAND RECEIVED" followed by the Calibration Data printout.

General meter setup operations

SET DATETIME MM/DD/YYYY HH:MM:SS	[Leading 0's required, 24 hour time]
[GET] DATETIME	Returns: "MM/DD/YYYY HH:MM:SS"
[GET] INFO	Returns Model, Version, Serial#.
(DO) DISPLAY display_text_string (at 0,0)	[x = pixel from left, 0 - 319]
(DO) DISPXY x y display_text_string	[y = pixel from top, 0 - 239]

Example: DO DISPXY 15 0 Device ready, press any key.

SET TIMESTAMP #	(Set date/time using 'unix' seconds).
(GET) TIMESTAMP	

Maintenance

This product contains no user serviceable parts. All replacement parts should be obtained from the manufacturer or an authorized distributor.

Cleaning

The exterior surfaces of this product may be cleaned with a damp cloth or with mild detergent.

CAUTION

Changes or modifications not expressly approved by the manufacturer will void the user's warranty for this equipment.

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of 37 months from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal three (3) years product warranty to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

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RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR WARRANTY RETURNS, please have the following information available BEFORE contacting OMEGA:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR NON-WARRANTY REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. P.O. number to cover the COST of the repair,
2. Model and serial number of product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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