User's Guide

CE

OMEGA

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PHH-925 and PHH-950
pH Meters

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It is the policy of OMEGA to comply with all worldwide safety and EMC/EMI regulations that apply. OMEGA is constantly pursuing certification of its products to the European New Approach Directives. OMEGA will add the CE mark to every appropriate device upon certification.

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

The following quickly steps you through meter operation. For detailed instructions on each step, refer to the page(s) indicated.

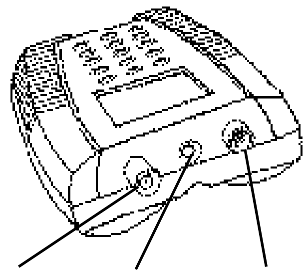
Step	Description	Page
1. Install Batteries	Install four AA alkaline batteries into the rear battery compartment.	1
2. Connect Electrode	Install electrode in the appropriate connector input on top of the meter.	5
3. Turn Meter On	Press **On/Off.**	3
4. Select Channel	Make sure that the channel selected, A (Twist-Lock input) or B (BNC input), matches the electrode connection. Press **channel** and select. Note: If no electrode is connected to channel A Twist-Lock input, only channel B is allowed.	3
5. Set Mode	For the channel A Twist-Lock input, the meter automatically recognizes the electrode connected, and selects the appropriate modes. For channel B BNC input, any allowed mode can be selected. Press **mode** and select.	3
6. Standardize	Immerse the electrode into a buffer or standard and stir. Press **std** (standardize) and follow the prompts. Repeat this step to enter buffers or standards.	9 (pH) 13 (ion) 15 (Conductivity)
5. Print	Press **Print** to send the measurement to the internal datalog and out to a printer/computer (if using the Docking Station).	19

Warning: Use of this product in a manner not specified by the manufacturer may impair any safety protection provided by the equipment.

This manual explains the operation of PHH-925 and PHH-950 meters for obtaining pH, mV, ion and conductivity (PHH-950) measurements. Before beginning, we recommend that you become familiar with the various features of your meter:

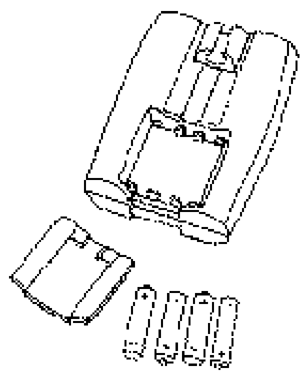
Electrode Connector Inputs

Twist-Lock: Used for attaching pH/ATC, FET pH/ATC, conductivity/ATC cells or ATC (temperature) electrodes with the waterproof Twist-Lock connector.
BNC: Used for attaching pH, ORP, or ISE electrodes with BNC connector.
Reference: Used for attaching a separate reference probe.



Batteries

The meter requires four AA alkaline batteries (unless used with the optional Power or Docking Station). To install batteries, slide the compartment cover open by pressing in and down where indicated. Position the batteries according to the directional markings and insert. Slide the cover closed.



Note: Nickel-cadmium rechargeable batteries can be used, but their operating life is half that of alkaline cells, and they cannot be recharged in the meter.

LCD Display

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

(A) **Temperature**: The meter 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.

(B) **Result:** Current measurement.

(C) **BAT:** Indicates that the meter has 10% of battery life remaining (approximately 4 hours), or **AC** indicates that the meter is connected to the Docking or Power Station.

(D) **Channel:** Indicates result is from **A** (Twist-Lock input) or **B** (BNC input).

(E) **Manual Temperature: M** indicates that measurement is using a manually entered temperature in place of the automatic temperature. (See page 13).

(F) **Date:** The meter displays the current date, either in mm/dd/yy or dd/mm/yy format.

(G) **Buffers/Standards**: Shows individual buffers or standards that have been entered.

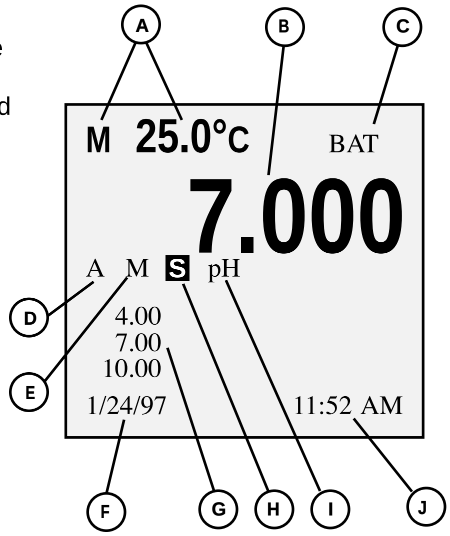
(H) **Stability symbols**: **S** indicates the reading is stable, **U** indicates an unstable reading.

(I) **Mode**: Indicates the meter is in pH, mV, ion, rel mV, conductivity, resistivity, salinity or TDS mode.

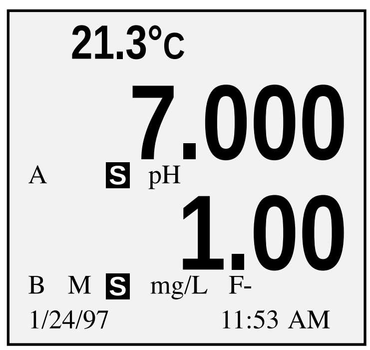
(J) **Time:** Displays the current time in either 12 hour AM/PM or 24 hour format.

Function Keys

Single Channel Display



Dual Channel Display



mode: Selects the mode (pH, mV, ISE temperature, conductivity, resistivity, salinity, or TDS) to use for the currently selected channel (electrode input).

std: Initiates standardization process for the currently selected mode to enter pH buffers, ion standards or conductivity standards.

channel: Selects the channel(s) (electrode inputs) to display.

slope: Displays buffers or standards and calibration data in slope display. Press **data** to see the time and date for each calibration point.

print: Outputs the current result or calibration data to the Docking Station RS232 interface and the internal datalog.

setup: Calls the setup menu (see Setup).

Up/Down Arrows: Scrolls when viewing stored data and sets the display contrast.

data: Enters the datalogging menu (see Datalogging).

enter: Accepts numeric values, menu selections or pending operations.

on/off: Turns the meter on and off.

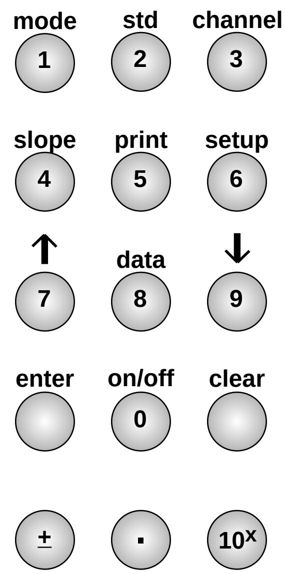
clear: Clears an incorrect number entry or cancels the current operation.

Numeric Keypad: Enters numbers for menu selection, standard entry and other operations.

± Enters a negative value.

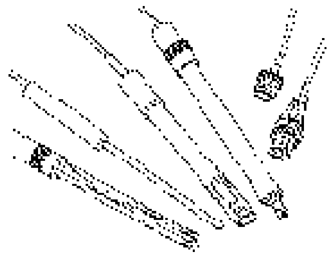
•: Enters a decimal point.

10^x: Enters the exponential part of a number.



Electrodes

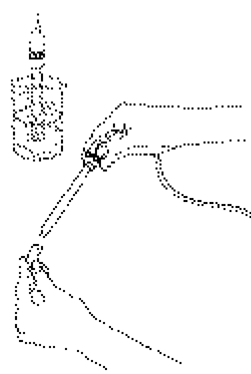
The meter allows you to use a variety of glass membrane (“glass”) pH/ATC electrodes, ion selective electrodes, the Field Effect Transistor (FET) Solid-State pH/ATC electrode (PHH-925 only), temperature (ATC) probes, Conductivity/ATC cells (AP50 only), combination electrodes using a BNC connector, or separate electrode pairs with BNC connector and reference pin. The glass pH, FET pH and conductivity cells with Twist-Lock connector are automatically detected and identified by the meter.



To measure	Use channel (connector)		
pH	**A** (Twist-Lock)	*or*	**B** (BNC)
ORP (mV)			**B** (BNC)
FET pH	**A** (Twist-Lock)		
ISE			**B** (BNC & Reference)
Conductivity	**A** (Twist-Lock)		
pH & ISE	**A** (Twist-Lock pH)	*and*	**B** (BNC ISE)
pH & Conductivity	**A** (Twist-Lock Cond.)	*and*	**B** (BNC pH)

Preparing pH and Ion Selective Electrodes

Remove the protective end cover or the soaker bottle 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 (4 Molar KCl solution) or in a buffer for pH electrodes. Store and condition ISE’s in the recommended solutions.

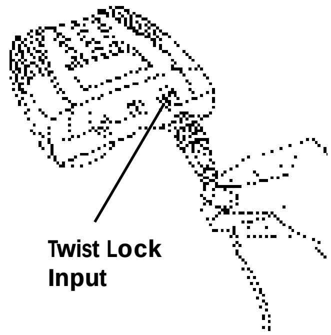


Preparing Conductivity Cells

Remove the protective end cover from the cell. Rinse the cell with deionized or demineralized water.

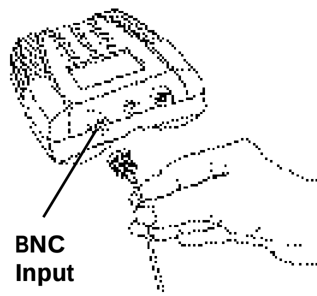
Connecting Electrodes

Note: If you install an electrode with a Twist-Lock connector, the meter automatically senses it and selects the appropriate mode and standardize menus for that type of electrode.



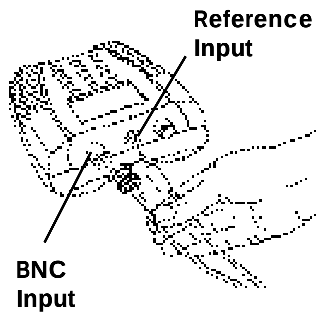
Glass pH/ATC, FET pH/ATC electrode, conductivity/ATC cell or ATC Probe (with Twist-Lock connector):

Connect the electrode to the Twist-Lock input located at the top of the meter. Line up the white arrow and line on the electrode's Twist-Lock connector and push until it locks in place. To disconnect, twist the connector ring in the arrow direction and pull apart.



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

Connect the electrode to the BNC input located at the top of the meter. Push in and rotate the electrode's BNC connector until it locks in place. To disconnect, twist the BNC connector in the opposite direction and pull.

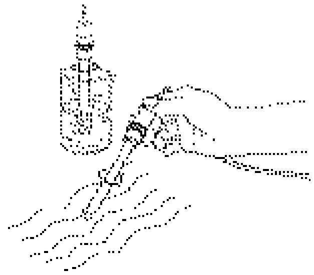


Electrode Pair Using a Reference Electrode (with Reference Pin Plug):

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.

Using and Storing Electrodes

pH Electrodes



Provide moderate stirring for faster electrode response.

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 moistening the cotton in their end covers with electrode filling solution and storing them with end covers on, or by placing in their storage vials.

Keeping glass electrodes "wet" will improve their performance. In the lab, store electrodes in electrode filling solution or storage solution (4M KCl). For electrodes used in field applications, occasionally leave them in solutions for several hours.

Solid-State FET Electrode

The model PHH-925 allows 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 Twist-lock input. Allow the FET about 2 minutes to warm up and stabilize when first connected. The FET electrode can be stored dry or in electrode storage solution. If the FET electrode remains connected to the meter (and batteries are in the meter), further warm up is not necessary.

Ion Selective Electrodes

Add proper amount of Ionic Strength Adjuster (ISA) to all standards and samples.

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.

In the lab, follow the instruction sheets for the individual electrode. Store as recommended.

Conductivity Cells

Rinse the cell between each measurement with a portion of the next sample or standard to be measured.

Immerse the cell fully into the standard or sample to be measured, lift the cell to allow the solution inside the cell to drain, and immerse the cell again. Repeat three times.

Stir briefly and tap the cell against the container bottom to dislodge air bubbles.

Clean any deposits from the cell body by rinsing with deionized water and store dry.

Setup Menu

Press **setup** to access the menu options.

1. **Check battery** - Indicates the battery power remaining.
2. **Set sleep mode** - Enter the time in minutes before the meter automatically turns itself off ("sleeps") if no keystrokes have been pressed. Enter a value of 0 to keep the meter on continuously. The maximum time allowed is 999 minutes.
3. **Set sample ID#** - Select a starting value for the sample ID number. Sample measurements will then be identified by sequential sample ID numbers. Each time the **print** key is pressed the sample number will be incremented.
4. **Set time and date** - Enter time and format, and date and format.
5. **Signal averaging** - Set the meter to very slow (10 readings), slow (8), medium (6), fast (4) and very fast (2). The meter places each new reading into a moving window, from which it calculates the average (displayed) and standard deviation (for stability determination).
6. **Manual temperature** - Enter a temperature to be used in the absence of an ATC probe or with manual temperature override.
7. **Set contrast** - Adjust the display contrast.
8. **Printer baud rate** - Select the baud rate for the RS232 input/output.

Pressing a number key causes that menu selection to be chosen or that operation to be executed.

Setup Menu
1 - Check battery
2 - Set sleep mode
3 - Set sample ID#
4 - Set time and date
5 - Signal averaging
6 - Manual temperature
7 - Set contrast
8 - Printer baud rate

pH Standardization Menu

Press **mode** and select **1 – pH**. Press **std** and the standardize pH menu appears:

Standardize pH Channel A
1 - Enter a buffer 2 - Clear buffers 3 - Select buffer set 4 - Enter slope 5 - Temperature source 6 - Set isopoint 7 - Resolution

1. **Enter a buffer** - Allows you to add a new buffer or update an existing buffer. Follow the prompts.
2. **Clear buffers** - Clears all buffers currently stored.
3. **Select buffer set** - There are five auto recognition buffer sets, one custom set and manual entry available. For some buffer sets the meter will ask for the nominal reference temperature for the buffers set (the temperature at which the buffers are at their nominal values; e.g., 7.000 at 25°C).

   Auto-recognition buffer sets - The five buffer sets are automatically recognized and temperature corrected for the variation of buffer pH with temperature.

   Custom buffers - Allows you to enter up to five custom buffers (each at least two pH units apart), with no temperature compensation.

   Manual entry - Allows you to enter any buffer value.
4. **Enter slope** - Allows you to enter a known slope to be used by the meter with a single-point standardization. The normal default slope is 59.16 mV/pH. The meter allows between 80 and 120 % efficiency to be entered.
5. **Temperature source** - Allows the meter to be set to use the ATC if present (Auto) or use a manual temperature override (Manual).
6. **Set isopoint** - Allows you to enter in an isopotential point (See Appendix F).
7. **Resolution** - Allows pH readings to be set to 0.1, 0.01, or 0.001 pH units.

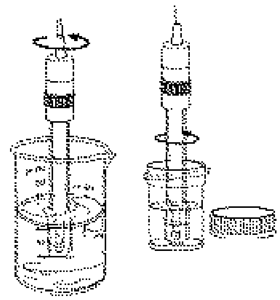
Auto-recognition Buffer Sets

- 2, 4, 7, 10, 12
- NIST 1.68,4.01,6.86, 9.18,12.46
- 1, 3, 6, 8, 10, 13
- DIN 1.09, 3.06, 4.64, 6.79, 9.23, 12.75
- 1, 4, 7, 10, 13

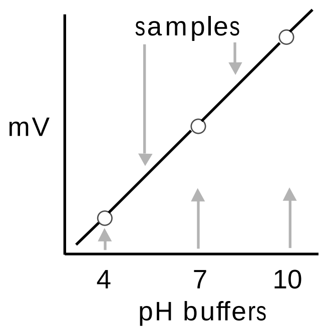
- Custom buffers

Note: *During automatic calibration, the meter allows pH electrodes with 90 to 105% efficiency to be used.*

Standardizing and Measuring pH



1. Immerse the electrode in a buffer and stir moderately. The meter displays the current pH measurement.
2. Press **std,** then press **1–Enter a buffer.**
3. Follow the prompts on the display.
4. The meter automatically recognizes the buffer, waits for a stable signal, and enters the buffer. The entered buffer appears in the display.
5. 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.



6. Repeat steps 1 through 3 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.

Hints: To achieve better accuracy:

- Standardize using at least two buffers, bracketing the expected pH of your samples.
- Standardize at least daily for the most accurate readings.
- Rinse the electrode with DI water between samples and buffers.
- Blot the electrode dry (DO NOT rub or wipe) between samples and buffers.
- Stir all buffers and samples.
- During standardization, allow time for

the electrode to stabilize before entering the buffer into the meter.
- Always use fresh buffers.

Clearing Buffers

Press **std,** then press **2–Clear buffers** to clear buffers. If all previously entered buffers will be re-entered, it is not necessary to clear buffers. If re-entering only some buffers, all the old buffers should be cleared.

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

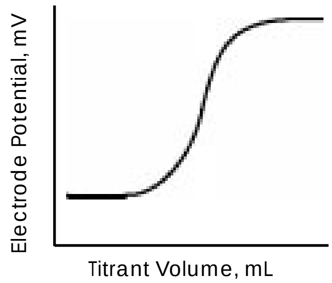
Actual Buffer pH vs. Temperature
pH 4.00(4.01)/7.00/10.00 buffer (nominal 25°C)

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

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 selecting mV mode using the **mode** key. Relative mV can be measured by entering a mV offset or using a mV value as the relative mV reference point.

Redox Titration



Relative mV Standardization Menu

In mV mode, press **std** and the standardize mV menu appears:

1. **Auto-zero relative mV** - Sets the relative mV offset equal to the negative of the current mV reading. The current mV becomes 0.0 relative mV.
2. **Enter manual mV offset** - Allows you to enter in any mV offset.
3. **Clear relative mV mode** - This clears any offset that has been entered, returning the meter to absolute mV mode.
4. **Resolution** - Allows mV readings to be set to 1 or 0.1 millivolt.

Standardize mV
Channel A

1 - Auto-zero relative mV
2 - Enter manual mV offset
3 - Clear relative mV mode
4 - Resolution

Clearing Relative mV Mode

Press **std**, then press **3 – Clear relative mV mode** to clear offset and return the meter to absolute mV mode.

The PHH-925 and PHH-950 can be used with Ion Selective Electrodes (ISE's) to directly read ion concentrations. ISE's are connected to the channel B (BNC) input. If a separate reference electrode is required, connect it to the reference input jack.

Ion Standardization Menu

Select channel B using the **channel** key. Press **mode** and then press **3–ISE** for ion concentration mode. Press **std** and the standardize menu appears.

1. **Enter a standard** - Allows you 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. **Clear standard**s - Clears standards for the standardization set in current use.
3. **New ion cal** - Allows for another set of calibration standards to be entered/stored for a different ISE. The meter stores up to five ion calibrations.
4. **Recall ion cal** - Allows the recall of an ion calibration set.
5. **Enter slope** - Allows entry of a known slope to be used with a single-point standardization. The normal default slope is 59.16 mV/decade for monovalent ions and 29.58 mV/decade for divalent ions at 25°C.
6. **Temperature source** - Allows the meter to use the ATC (if present) or a manually entered temperature override*****.
7. **Set Isopoint** - Allows you to enter an isopotential point (See Appendix F).
8. **Enter blank** - Allows you to enter a blank.
9. **Resolution** - Allows the readings to be set to 1, 2 or 3 digits.

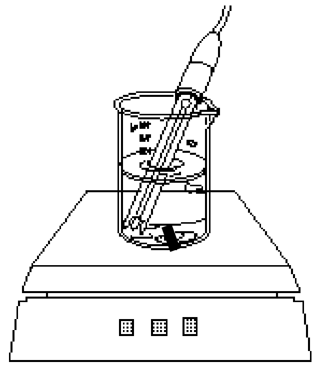
Standardize ISE
Channel B

1 - Enter a standard
2 - Clear standards
3 - New ion cal
4 - Recall ion cal
5 - Enter slope
6 - Temperature source
7 - Set isopoint
8 - Enter blank
9 - Resolution

***Temperature Source**

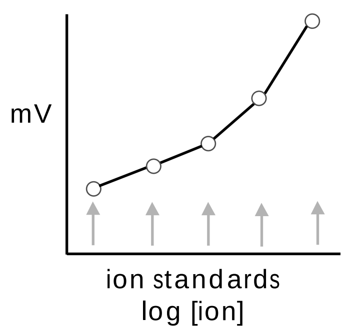
Set to Auto to use the ATC probe (if present). Set to manual when samples being measured on one channel are at a different temperature from samples with the ATC probe. Use manual when temperature correction is not desired or the isopotential is not known (ISE's).

1. Add the appropriate Ionic Strength Adjuster (ISA) solution to the standard.
2. Immerse the electrode(s) in the solution and stir continuously.
3. Press **std** and select **1–Enter a standard** to add a standard.
4. Follow the prompts.
5. The meter waits for a stable signal and enters the standard. The entered standard 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 standard.
7. Repeat steps 1 through 6 to enter a second, third, fourth or fifth standard. 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.



Clearing Standards

Press **std,** then press **2–Clear standards** to clear the current set being used. This will not clear other stored ion calibrations.
The meter will automatically recognize when a conductivity cell is attached to the meter.

Select Mode
Channel A

1 - Conductivity
2 - Practical Salinity
3 - NaCl Salinity
4 - Resistivity
5 - Total Dissolved Solids
6 - Temperature

Select channel A using the **channel** key. Pressing **mode** allows the meter to be set to the proper units.

Conductivity modes and units are:

Conductivity - µS/cm or mS/cm.
Resistivity - Ω•cm , kΩ•cm or MΩ•cm
Practical Salinity - salt concentration in parts per thousand (ppt) based upon sea water.
NaCl Salinity - sodium chloride equivalent concentration in ppt.
Total Dissolved Solids (TDS) - an empirical scale relating conductivity to total dissolved solids in ppt.

Conductivity Standardization Menu

Press **std** and the standardize conductivity menu appears:

Standardize
Conductivity
Channel A

1 - Enter a standard
2 - Clear standards
3 - Temperature Source
4 - Enter known cell constant
5 - Enter temperature coefficient
6 - Resolution
7 - Autoranging

1. **Enter standard** - Allows you to add a new standard or re-enter an existing standard. Up to five points may be entered. Follow the prompts.
2. **Clear standards** - Clears all standards currently stored.
3. **Temperature source** - Allows the meter to use the ATC (if present), or use a manually entered temperature override.
4. **Enter known cell constant** - Allows you to enter the nominal or known actual cell constant.
5. **Enter temperature coefficient** -

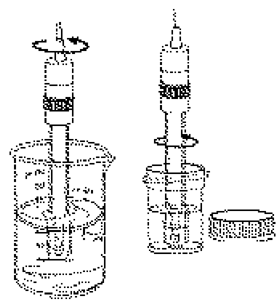
Allows you to select the reference temperature and the temperature coefficient (used with conductivity). The default setting is 1.90%/°C correction to 25°C.

6. **Resolution** - Allows the readings to be set to 1, 2, 3 or 4 digits.
7. **Autoranging (Conductivity/ Resistivity modes)**- Select unit autoranging (µS to mS, Ω to kΩ to MΩ) or fixed units (µS, KΩ).

or

7. **Solids factor (TDS mode)** - enters the solids factor used for TDS. The default is 0.5.

Standardizing and Measuring Conductivity, Salinity, Resistivity or TDS

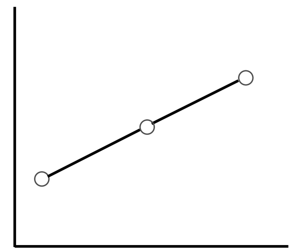


1. Immerse the cell in a standard and stir moderately. The meter displays the current measurement.
2. Press **std**, then press **1 – enter standard** to add or re-enter a standard. Follow the prompts.
3. The meter waits for a stable signal, and enters the standard. The entered standard appears in the display.
4. Alternatively, if the signal is not stable, you can press **enter** when the reading stabilizes according to your tolerance criteria to enter the standard.
5. Repeat steps 1 through 3 to enter a second, third, fourth or fifth standard. Standards must be at least two-fold apart in value. On each standard, the meter performs a diagnostic check on the cell. The cell is considered bad if the cell constant is outside 50% and 200% of the nominal

value.

Helpful Hints:

- Always immerse, then drain, the conductivity cell several times when transferring to a new standard or sample.
- Tap the cell gently to remove air bubbles.
- Always use fresh standards.
- Standards are entered in conductivity as µS/cm, in resistivity as KΩ•cm, and in salinity and TDS as either µS/cm or KΩ•cm.
- To achieve better accuracy, standardize using at least two standards, bracketing the expected range of your samples.
- Verify that the proper cell constant is being used for the sample's conductivity (1 or 10 cm^{-1}).



Conductivity
Concentration

Clearing Standards

1. Press **std**, then press **2 – Clear standards**.

Temperature Compensation

The meter automatically compensates for conductivity temperature dependence when a temperature coefficient is used. The range of values for the temperature coefficient is from 0 to 4%/°C. To disable temperature compensation, enter a value of zero. Resistivity is not temperature compensated, practical salinity is referenced to 15°C, and NaCl equivalent salinity is referenced to 25°C. For conductivity measurements, select a reference temperature and enter a temperature coefficient.

Determining Temperature Coefficients

The temperature coefficient of a particular sample can be determined and entered to allow temperature correction. A typical temperature coefficient for a simple salt solution is 1.9%/°C.

To determine temperature coefficient:

- Set reference temperature to 25°C and temperature coefficient to 0.00%/°C.
- Record the conductivity value and temperature of the solution (temperature must be different than the reference temperature).
- Heat or cool solution to the reference temperature.
- Record the conductivity of the solutions at the reference temperature.
- Solve the following equation for the temperature coefficient TC.

Datalogging

$$TC = \left[\frac{\text{Conductivity at } T}{\text{Conductivity at } T_{ref}} - 1\right]\left[\frac{100}{T - T_{ref}}\right]$$

Typical Temperature Corrections for 15°C to 25°C

NaCl	Concentration (M)	TC (%/°C)
	0.5	1.90
	0.1	1.96
	0.01	2.01
	0.001	2.02
KCl		
	1	1.75
	0.1	1.85
	0.01	1.90
	0.001	1.96

The meter will store up to 250 data points. Press **print** to store the current result with units, temperature, time, date, channel, sample number and stability to the internal datalog. Print also outputs an ASCII text string with the information to the optional Docking Station RS-232 interface.

Press **data** and the Datalogging menu will appear.

1. **Start interval** - Allows you to enter the time interval for automatic datalogging.
2. **Stop interval** - Stops time-based datalogging.
3. **View datalog** - Shows the stored data, one screen at a time. Press the data key to move side to side to show time and date for each sample. Use the arrow keys to scroll up and down through the samples.
4. **Clear datalog** - Clears all the data points out of memory.
5. **Print datalog** - Allows you to print all data points.

The optional Power Station provides a laboratory bench stand and external

Datalogging
(43 points)

1 - Start interval
2 - Stop interval
3 - View datalog
4 - Print datalog
5 - Clear datalog

Minimum Datalogging Time Interval

With meter continually on:
1 second at 9600 baud
2 seconds at 2400 baud
With meter in sleep mode:
10 seconds

View Datalog
(243 points)

5.432 pH		A S
#12345	M 25.4C	
9.99E-9 mg/L	F-	B S
#345	100.0C	
180.5 mV		B S
#3	34.5C	
9.500 ion Cl-		A S
#12345	100.2C	
100.2 μS/cm		A U
#12400	55.2C	

↑↓ screen ←→ data

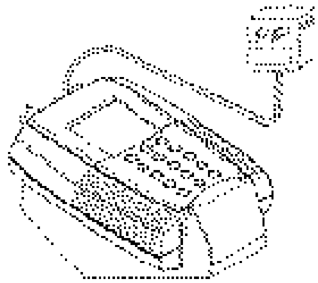
Data ←→ *toggles between these screens*

View Datalog
(243 points)

5.432 pH		A S
5:43PM	12/30/95	
9.99E-9 mg/L	F-	B S
5:43PM	12/30/95	
180.5 mV		B S
5:43PM	12/30/95	
9.500 ion Cl-		A S
5:43PM	12/30/95	
100.2 μS/cm		A U
5:43PM	12/30/95	

↑↓ screen ←→ data

AC power. The optional Docking Station provides external AC power and RS-232 interface to a printer or computer/terminal.



Installing Meter in the Station

1. Connect the power supply to the Power or Docking Station and to an AC outlet.
2. Place the meter in the station.
3. The meter displays **AC** to indicate external AC power is being used. The Auto-Off feature is suspended while the meter is in the station.

Using with a Printer or Computer/Terminal

1. Connect your serial cable from the Docking Station to the serial port on your printer or computer/terminal. See the next page for wiring requirements.
2. Set printer as follows:
   - baud rate must match the meter
   - 8 data bits
   - no parity
   - 1 stop bit
3. Pressing **print** causes the current reading to be printed.

Note: During standardization, the meter automatically prints standardization data, including the value, temperature, slope and the time and date.

```
Add standard:     7.ØØ3 pH    B    25.ØC   2/17/97  11:47 AM
Add standard:     4.ØØ9 pH    B    25.ØC   2/17/97  11:47 AM
Add standard:   1Ø.ØØØ pH    B    25.ØC   2/17/97  11:47 AM
          4.ØØ9 mS/cm      2/17/97  11:47 AM    25.ØC   99.8
          7.ØØ3 mS/cm      2/17/97  11:47 AM    25.ØC   99.7
        1Ø.ØØØ mS/cm      2/17/97  11:47 AM    25.ØC
Sample:   1S   1Ø.ØØ1 pH      B   25.Ø M  2/17/97  11:48 AM


Add standard:  1.ØØ ppm    Cl-  B   25.ØC  2/17/97  11:48 AM
Add standard:  1ØØØ ppm   Cl-  B   25.ØC  2/17/97  11:49 AM
Add standard:  1ØØ ppm     Cl-  B   25.ØC  2/17/97  11:49 AM
Add standard:  1Ø.Ø ppm    Cl-  B   25.ØC  2/17/97  11:49 AM
Sample:   2 S   1Ø.Ø ppm    Cl-  B   25.ØCM  2/17/97 11:50 AM


Clear standards:  cond A
Add standard:   1ØØ uS/cm    A    25.ØC   2/17/97  11:52 AM
Sample:   3 S   1ØØ uS/cm    A   25.ØC M  2/17/97 11:52 AM


Sample:  4 S  1Ø.Ø  kOhm CM   A   25.ØC M  2/17/97 11:52 AM
Sample:  5 U  1.ØØ  kOhm CM   A   25.ØC M  2/17/97 11:52 AM
```

The following serial interface commands are available:

Command	Function
KM	**Mode**
KS	**Standardize**
KC	**Channel**
KL	**Slope**
KP	**Print**
KT	**Setup**
KA	**Up Arrow**
KD	**Data**
KB	**Down Arrow**
KN	**Enter**
KO	**Off**
KX	**Clear**
KF	**±**
KG	**Decimal Point**
KE	10^x
K(digit)	**Enter numeric digit**

The complete pin connections for the digital I/O connector to the docking station are below.

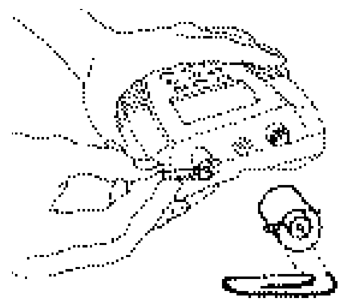
Note: Some printers and computer serial ports will require only pins 1-3 connection. Those requiring more extensive handshaking may require the other pin connections.

Testing the Electrode and Meter

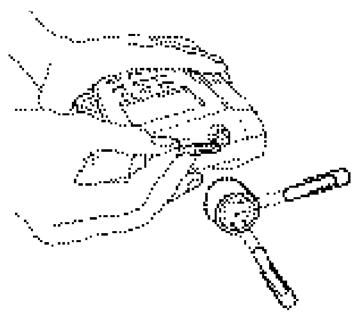
Docking Station	Pin Function	At Computer
1	common	1
2	serial data in	2
3	serial data out	3
4	no connection	4
5	no connection	5
6	no connection	6
7	common	7
8	common	8
9	no connection	9

To test the pH electrode, place it in a fresh pH 7 buffer. Select the correct channel for the electrode. Press **mode** and select **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



To test the meter for correct operation with a **BNC electrode**, short the BNC input connector using a bent paper clip as shown. Press **mode** and select mV mode. If the meter reads 0 ± 0.1 mV*, it is measuring correctly.



To test the meter for correct operation with a **pH Twist-lock electrode**, short the Twist-lock input connector using two paper clips as shown. Each paper clip must touch two adjacent pins inside the connector. Press **mode** and select mV mode. If the meter reads 0 ± 0.1 mV*, it is measuring correctly.

* **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 ±4 mV at full scale (worst case). The long term drift will not exceed 0.1 mV per month.

Error Messages

pH value out of range

The electrode efficiency is outside the acceptable limits for the pH electrode: 90 to 105%.

The electrode has drifted too far from the last calibration.

- pH electrode is not in a solution.
- Insufficient or incorrect filling solution in reference electrode.
- Cracked or broken glass bulb membrane.
- Improper electrode conditioning.
- Bad buffers.
- Blocked or clogged reference electrode liquid junction.
- Poor technique not rinsing electrodes between buffers.
- Loose connector or cable.
- Incorrect manual buffer value entry.
- Defective meter.

mV value out of range

- Electrode is not in a solution.
- Defective electrode.
- mV input exceeds the design range of the meter.
- Defective meter.

Ion value out of range

The electrode slope is outside the acceptable limits for an ion selective electrode.

- Ion electrode is not in a solution.
- Bad standards.
- Entry of incorrect concentration.
- Poor technique, not rinsing electrodes between standards.
- Not stirring the standards.
- Improper electrode conditioning.
- Defective ISE or reference electrode
- Insufficient or incorrect filling solution

in reference electrode.
- Loose connector or cable.
- Defective meter.

The ion standard (mV signal) is too close to another standard.

- The standards are made too close together (should be 10 fold apart).
- Bad standards.
- There is no ISA adjuster in the standards.
- Defective ISE or reference electrode.
- Insufficient or incorrect filling solution in reference electrode.

Conductivity out of range.

Resistivity out of range.

Salinity or TDS out of range.

- Sample too high in conductivity for meter range with cell constant used.
- Defective probe.
- Defective meter.

Temperature out of range.

- Defective ATC probe.
- Temperature manually entered outside of -5 to 105°C.
- Defective meter.

The meter has lost calibration coefficients.

- Battery backed memory has been corrupted. (The memory does not use the AA batteries for backup. There is a separate lithium battery inside the meter. It is ***not*** user serviceable).
- Factory service is required to re-calibrate the meter for accurate mV, temperature, or conductivity measurements. pH, ion or conductivity measurements are still accurate after standardization with buffers or standards.

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:

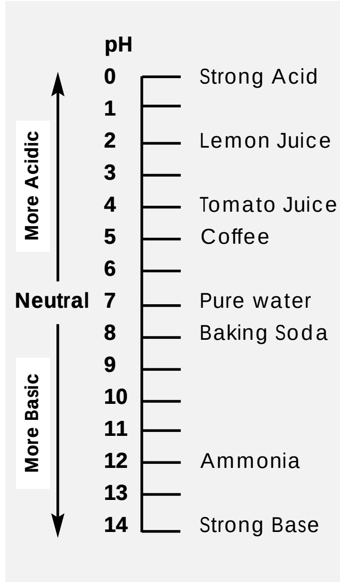
$$pH = -\log [H^+]$$

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 above 7 are alkaline, and pH values below 7 are acidic solutions.

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

The PHH-925 meter can also use a Field Effect Transistor (FET) 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.
The measurement of ions plays an important role in water quality, industry,



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

$$E = E_o + (2.303\ RT/F) \log a$$

Where:

- E = measured electrode potential
- E_o = standard potential of the system (constant)
- R = gas constant
- F = Faraday's constant
- T = absolute temperature
- a = activity of the ion interest in the solution

Conductivity Theory

Conductivity refers to the ability of a solution to conduct electricity. The amount of electrolytes present determine the ease with which a solution can carry a current.

Conductivity is used as a measure of the purity of water. Pure water contains few dissolved ions and has a low conductivity and a high resistivity. Ultrapure reagent grade waters are measured in resistivity. Practical salinity is a measure of salt concentration in sea water, NaCl Salinity is the amount of NaCl dissolved which would give the same conductivity as the sample, and Total Dissolved Solids (TDS) is an empirical relationship between conductivity and dissolved solids in typical samples.

Isopotential Point

$$\text{Conductivity} = \frac{1}{\text{Resistivity}}$$

$$r_T = c_0 + c_1 \cdot T + c_2 \cdot T^2 + c_3 \cdot T^3 + c_4 \cdot T^4$$

$$\text{Practical Salinity} = \sum_i a_i \cdot \left(\frac{C}{42914.0 \cdot r_T}\right)^{\frac{i}{2}} + \frac{T - 15}{1 + k \cdot (T - 15)} \cdot \sum_i b_i \cdot \left(\frac{C}{42914.0 \cdot r_T}\right)^{\frac{i}{2}}$$

$$\text{NaCl Salinity} = \frac{a_1 \cdot C + a_2 \cdot C^2 + a_3 \cdot C^3 + a_4 \cdot C^4 + a_5 \cdot C^5}{1 + 0.0191 \cdot (T - 25)}$$

TDS = Conductivity x Solids Factor

Where C = Conductivity

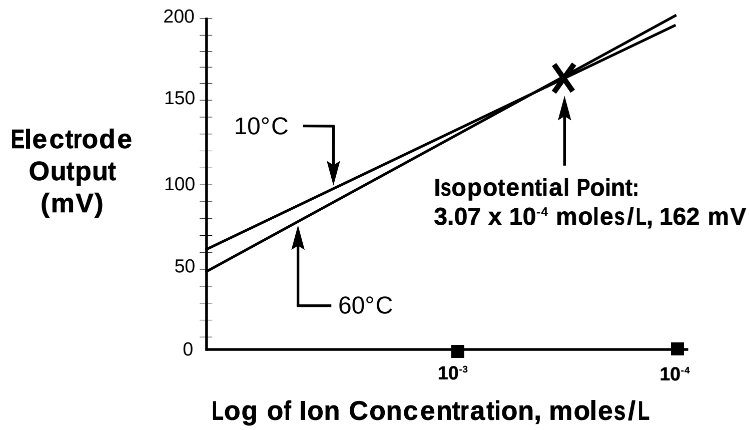
T = Temperature °C

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.

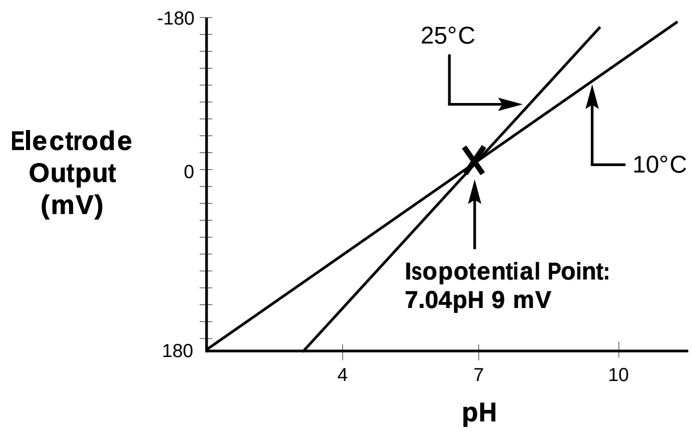
- Prepare a set of buffers or ion standards spanning the linear range of the electrode. Place the buffers or standards in a temperature bath at known temperature.
- Place the meter into mV mode.
- Measure and record mV readings of each pH or concentration, and repeat at several temperatures.
- Using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

Where the lines intersect is the Isopotential point.

Ion Electrode Isopotential Point



pH Electrode Isopotential Point



pH

Range:	-2.000 to 20.000
Resolution:	0.1/0.01/0.001
Accuracy:	±0.002

mV

Range:	±1,200
Resolution:	1/0.1
Accuracy:	±0.1mV over ±400mV: ±0.2mV over ±1200mV
Zero temperature coefficient:	0.01 mV/°C max.
Scale temperature coefficient:	85ppm/°C max.

Ion

Range:	1.00E-9 to 9.99E9
Resolution:	1, 2, or 3 significant figures
Accuracy:	0.17n%; where n equals electrons exchanged in the electrode reaction

Conductivity

Conductivity	0.01 – 300,000 µS/cm*
Practical Salinity:	0 to 42 ppt*
NaCl equivalents:	0 to 70 ppt*
Resistivity:	33 to 100 megohms*
TDS:	0.005 – 300,000 ppt*
Resolution:	1, 2, 3 or 4 significant figures
Accuracy:	±0.5% of reading ±0.01 µS/cm
Temperature coefficient:	0.001 µS/cm/°C

with cell constant 1.0 cm^{-1}

Range 5:	30,000 to 3,000 µS/cm
Range 4:	3,000 to 300 µS/cm
Range 3:	300 to 30 µS/cm
Range 2:	30 to 3 µS/cm
Range 1:	3 to 0.3 µS/cm

Temperature

Range	-5° – 105°C
Resolution	0.1°C
Accuracy	±0.3°C

* dependent on cell constant

Maintenance

Other than battery replacement, this product contains no user serviceable parts. All replacement parts other than batteries should be obtained from Omega Engineering Inc.

Cleaning

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

NOTICE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

CAUTION

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

WARRANTY/DISCLAIMER

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

the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's ustomer Service Department will issue an Authorized Return (AR) number immediately upon hone or written request. Upon examination by OMEGA, if the unit is found to be defective it will e repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting om any action of the purchaser, including but not limited to mishandling, improper interfacing, peration 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 f being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; mproper specification; misapplication; misuse or other operating conditions outside of OMEGA's ontrol. Components which wear are not warranted, including but not limited to ontact points, fuses, and triacs.

MEGA is pleased to offer suggestions on the use of its various products. However, MEGA neither assumes responsibility for any omissions or errors nor assumes liability for ny damages that result from the use of its products in accordance with information pro-ided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR MPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WAR-ANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY ISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are xclusive and the total liability of OMEGA with respect to this order, whether based on con-ract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed he purchase price of the component upon which liability is based. In no event shall OMEGA e liable for consequential, incidental or special damages.

ONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; r (2) in medical applications or used on humans. Should any Product(s) be used in or with any uclear installation or activity, medical application, used on humans, or misused in any way, MEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, nd additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability r damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS / INQUIRIES

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

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

OR WARRANTY RETURNS, please have he following information available BEFORE ontacting OMEGA:

. P.O. number under which the product was PURCHASED,
. Model and serial number of the product under warranty, and
. 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.

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

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- Calibrators & Ice Point References
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- Infrared Pyrometers

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- Load Cells & Pressure Gauges
- Displacement Transducers
- Instrumentation & Accessories

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- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

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- Data Acquisition & Engineering Software
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- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
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- Heating Cable
- Cartridge & Strip Heaters
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- Flexible Heaters
- Laboratory Heaters

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- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments

M2831/0298