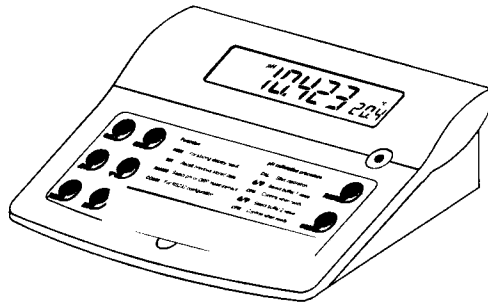


Instruction Manual

PHB-212

PHB-213

Microprocessor-based Bench pH/mV/°C Meters



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OMEGAnet® Online Service www.omega.com	Internet e-mail info@omega.com
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Servicing North America:

USA: One Omega Drive, Box 4047
Stamford CT 06907-0047
ISO 9001 Certified TEL: (203) 359-1660 FAX: (203) 359-7700
e-mail: info@omega.com

Canada: 976 Berger
Laval (Quebec) H7L 5A1
TEL: (514) 856-6928 FAX: (514) 856-6886
e-mail: info@omega.ca

For immediate technical or application assistance:

USA and Canada: Sales Service: 1-800-826-6342 / 1-800-TC-OMEGA®
Customer Service: 1-800-622-2378 / 1-800-622-BEST®
Engineering Service: 1-800-872-9436 / 1-800-USA-WHEN®
TELEX: 996404 EASYLINK: 62968934 CABLE: OMEGA

Mexico: En Español: (001) 203-359-7803 / FAX: (001) 203-359-7807
e-mail: espanol@omega.com / info@omega.com.mx

Servicing Europe:

Benelux: Postbus 8034, 1180 LA Amstelveen, The Netherlands
TEL: +31 (0)20 3472121 FAX: +31 (0)20 6434643
Toll Free in Benelux: 0800 0993344
e-mail: sales@omegoeng.nl

Czech Republic: Rudé armády 1868, 733 01 Karviná 8
TEL: +420 (0)59 6311899 FAX: +420 (0)59 6311114
Toll Free: 0800-1-66342 e-mail: info@omegashop.cz

France: 11, rue Jacques Cartier, 78280 Guyancourt, France
Tel: +33 (0)1 61 37 26 00 FAX: +33 (0)1 30 57 54 27
Toll Free in France: 0800 466 342 e-mail: sales@omega.fr

Germany/Austria: Daimlerstrasse 26, D-75392 Deckenpfronn, Germany
Tel: +49 (0)7056 9398-0 FAX: +49 (0)7056 9398-29
Toll Free in Germany: 0800 639 7678
e-mail: info@omega.de

United Kingdom: One Omega Drive, River Bend Technology Centre
ISO 9002 Certified Northbank, Irlam, Manchester
M44 5BD United Kingdom
Tel: +44 (0)161 777 6611
Toll Free in United Kingdom: 0800-488-488
FAX: +44 (0)161 777 6622 e-mail: sales@omega.co.uk

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The information contained in this document is believed to be correct, but OMEGA Engineering, Inc. accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

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

Dear Customer,

Thank you for choosing an Omega Engineering product. Please read this instruction manual carefully before using the instrument.

This manual will provide you with the necessary information for a correct use of the instrument, as well as a precise idea of its versatility in a wide range of applications.

These instruments are in compliance with **CE** directives EN 50081-1 and EN 50082-1.

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Recommendations for Users

Before using this product, make sure that it is entirely suitable for the environment in which it is used.

Operation of this instrument in residential areas could cause unacceptable interferences to radio and TV equipment, requiring the operator to take all necessary steps to correct interferences.

The glass bulb at the end of the pH electrode is sensitive to electrostatic discharges. Avoid touching this glass bulb at all times.

During operation, ESD wrist straps should be worn to avoid possible damage to the electrode by electrostatic discharges.

Any variation introduced by the user to the supplied equipment may degrade the instrument's EMC performance.

To avoid electrical shock, do not use this instrument when voltages at the measurement surface exceed 24VAC or 60VDC.

To avoid damages or burns, do not perform any measurement in microwave ovens.

PRELIMINARY EXAMINATION

Remove the instrument from the packing material and examine it carefully to make sure that no damage has occurred during shipping. If there is any damage, notify your Dealer or the nearest Hanna Customer Service Center.

Each meter comes supplied complete with:

- PHE-210 glass-body combination pH Electrode with 1 m (3.3') cable
- PHAT-210 Temperature Probe
- Electrode Holder
- pH 4 & 7 Buffer Solutions (20mL each)
- Electrolyte Solution
- 12VDC Power Adapter
- Instruction Manual

Note: Save all packing material until you are sure that the instrument functions correctly. All defective item must be returned in the original packing with the supplied accessories.

GENERAL DESCRIPTION

The PHB-212 and PHB-213 are microprocessor-based bench meters for pH and temperature measurements.

The PHB-213 can also measure ion concentration (ISE) and ORP (Oxidation Reduction Potential) in the mV range.

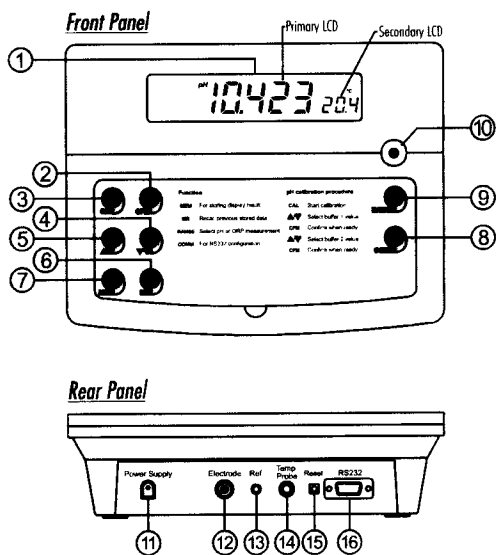
The pH measurements are compensated for temperature effect manually or automatically with the temperature probe.

The meter comes equipped with a large easy-to-read LCD which shows the pH (or mV) and temperature simultaneously together with graphic symbols.

The calibration process is guided step by step through clear indications on the LCD. A stability indicator make the calibration procedure error-free.

Through the RS 232C serial port you can transfer the data to a PC.

FUNCTIONAL DESCRIPTION PHB-212 AND PHB-213



- 1) Liquid Crystal Display (LCD)
- 2) CFM key, to confirm calibration values
- 3) CAL key, to enter or exit calibration mode
- 4) ▼°C key, to manually decrease temperature or select pH buffer
- 5) ▲°C key, to manually increase temperature or select pH buffer
- 6) MR key, to recall the stored value
- 7) MEM key, to store a value in memory
- 8) COMM key, to set baud rate
- 9) RANGE key, to select measurement range
- 10) ON/OFF switch
- 11) Power adapter socket
- 12) BNC electrode connector
- 13) Electrode reference socket
- 14) Temperature probe socket
- 15) RESET button
- 16) RS232C socket

SPECIFICATIONS

Range	pH mV °C	-2.00 to 16.00 / -2.000 to 16.000 ± 999.9 (ISE and ORP, pH 213 only) 0.0 to 100.0
Resolution	pH mV °C	0.01 / 0.001 0.1 (ISE and ORP, PHB-213 only) 0.1
Accuracy (@20°C/68°F)	pH mV °C	±0.002 & ±0.01 ±0.05% f.s. (ISE and ORP, PHB-213 only) ±0.5
Typical EMC Deviation	pH mV °C	±0.01 ±0.6 (PHB-213 only) ±0.5
pH Calibration		Automatic 1 or 2 points with 3 memorized buffers (4, 7, 10)
Temperature Compensation		From 0 to 100°C (32 to 212°F) manual or automatic with PHAT-210 probe (included)
Electrode		PHE-201 glass-body combination refillable pH electrode (included)
Temperature probe		PHAT-210 (included)
Input impedance		10 ¹² Ω
Computer Interface		Opto-isolated RS232C
Power supply		12 VDC adapter (included)
Environment		0 to 50°C (32 to 122°F) max. 95% RH non-condensing
Dimensions		240x182x74 mm (9.4x7.1x2.9")
Weight		1.1 kg (2.5 lb.); kit with holder: 3.0 kg (6.5 lb.)

OPERATIONAL GUIDE

Power connection

Plug the 12VDC adapter into the power supply socket (#11 on page 4).

Note: PHB-212 and PHB-213 use an EEPROM to retain the pH, mV and temperature calibrations as well as the serial communication setting. The instrument will retain the data after a calibration or serial communication setting, even when it is unplugged.

Note: Make sure the main line is protected by a fuse.

Electrode and Probe connections

For combination pH or ORP electrodes (with internal reference) connect the electrode's BNC to the socket on the back of the meter (#12 in functional description).

For electrodes with a separate reference, connect the single cell electrode's BNC to the BNC socket (#12 in functional description) and the reference electrode plug to the reference socket (#13 in functional description).


For **temperature** measurements and automatic temperature compensation connect the temperature probe to the appropriate socket (#14 in functional description).

Note: to prevent damage to the electrode, remove the pH electrode from the solution before turning the meter off.

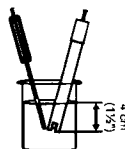
If the meter is OFF, detach the electrode from the meter before immersing the electrode in the storage solution.

pH MEASUREMENTS

Make sure that the instrument has been calibrated before taking pH measurements.

- Switch the instrument on by pressing the ON/OFF switch. The meter automatically defaults to the pH measurement mode. 

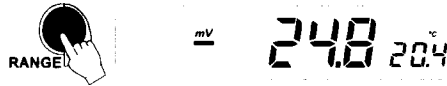
- Submerge the tip (4cm/1½") of the electrode and the temperature probe into the sample to be tested. Allow time for the electrode to stabilize.



- pH is displayed on the primary display and temperature on the secondary one.



- It is also possible to view the mV reading by pressing the "RANGE" key.



If measurements are taken successively in different samples, it is recommended to rinse the electrode thoroughly with deionized water or, if not available, tap water first and then with some of the next sample to condition the electrode before immersing it in the sample. The pH reading is affected by temperature. In order for the meter to measure the pH accurately, temperature must be taken into consideration. To use the **Automatic Temperature Compensation** feature, connect and submerge the PHAT-210 temperature probe into the sample as close to the electrode as possible and wait for a couple of minutes.

If the temperature of the sample is known or tests are always performed at the same temperature you can simply manually compensate for it. For this purpose the temperature probe must be disconnected.

The display will then show the default temperature of 25°C or the last recorded temperature reading with the "°C" symbol blinking.



Note the temperature of the sample using an accurate reference thermometer.

The temperature can now be adjusted with the ▲°C and ▼°C keys.



TAKING ORP MEASUREMENTS (PHB-213 only)

An optional ORP electrode must be used to perform ORP measurements (see accessories).

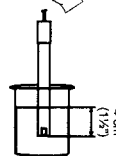
Oxidation-reduction potential (REDOX) measurements provide the quantification of the oxidizing or reducing power of the sample tested.

To correctly perform a redox measurement, the surface of the ORP electrode must be clean and smooth.

- Switch the meter on and press the "RANGE" key to enter the mV mode.



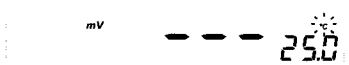
- Submerge the ORP electrode tip (4cm/1½") into the sample. Allow a few minutes for the reading to stabilize.



- The meter displays the mV reading on the primary display.



- If readings are out of range, "---" will appear on the LCD.



TAKING TEMPERATURE MEASUREMENTS

Taking a temperature measurement is very easy. Connect the PHAT-210 temperature probe and turn the instrument on. Dip the temperature probe in the sample and allow the reading on the secondary display to stabilize.



HOLD FUNCTION

Press and hold MEM. The last reading will be frozen on the display until MEM is released. During this operation, the MEM indicator is also shown on the LCD.



Press MR and the previously memorized reading will be displayed with the MEM indicator on the LCD.



RESET

The RESET button (#15 in functional description) should only be used when the instrument displays erroneous messages due to strong electrical interference or when the instrument's power supply was disconnected before the meter was switched off.

After pressing RESET always recalibrate the unit before proceeding.

pH CALIBRATION

Calibrate the instrument often, especially if high accuracy is required.

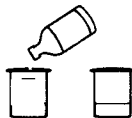
The instrument should be recalibrated :

- a) Whenever the pH electrode is replaced.
- b) At least once a week.
- c) After testing aggressive chemicals.
- d) After pressing RESET.
- e) If higher accuracy is required.

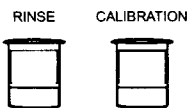
PREPARATION

Pour small quantities of the buffer solutions into clean beakers. If possible use plastic beakers to minimize any EMC interferences.

For accurate calibration and to minimize cross contamination, use two



beakers for each buffer solution. One for rinsing the electrode and the second for calibration.



If you are measuring in the acid range, use pH 4 as second buffer; if you are measuring in the alkaline range, use pH 10 second buffer.

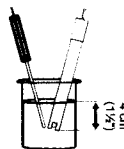
PROCEDURE

Calibration has a choice of 3 memorized buffers: pH 4, 7 and 10.

It is always recommended to perform a two-point calibration. The pH meters however also provide for one-point calibration, as described below.

One-point calibration

- Immerse the pH electrode and the temperature probe approximately 4 cm (1½") into a buffer solution of your choice (pH 4, 7, or 10) and stir gently. The temperature probe should be close to the pH electrode.
- Press CAL. The "CAL" and "BUF 1" indicators and the "7" buffer will be displayed.



- If necessary, press "▲°C" or "▼°C" to select a different buffer value.



- The "NOT READY" indication will blink on LCD until the reading has stabilized.



- When the reading is stable, "READY" and "CFM" will blink. Press CFM to confirm the calibration.



- If the reading is close to the selected buffer, the meter stores the reading. The calibrated value is then displayed on the primary LCD and the secondary LCD will display the second expected buffer value.



- If the value measured by the meter is not close to the selected buffer, "WRONG" and "WRONG" will blink alternately. In this case check if the correct buffer has been used or refresh the electrode by following the maintenance procedure below. If necessary change the buffer or the electrode.



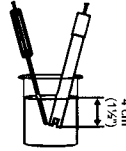
- Press CAL to quit calibration. The meter will return to normal operation and memorize the one-point calibration data.



Two-point calibration

Any two of the 3 memorized buffers can be used for this purpose. However, it is recommended that pH 7 is chosen as the first point and pH 4 (acidic) or pH 10 (alkaline) as the second point.

- Proceed as described in "One-point calibration" above but do not quit calibration by pressing CAL at the end.
- After the first calibration point is confirmed, immerse the pH electrode and the temperature probe approximately 4 cm (1½") in the second buffer solution and stir gently. The temperature probe should be close to the pH electrode.



- If necessary, press "▲°C" or "▼°C" to select a different buffer value.



Note: The meter will automatically skip the buffer used for the first point.

- The "NOT READY" indication will blink on LCD until the reading has stabilized.
- When the reading is stable, "READY" and "CFM" will blink. Press CFM to confirm the calibration.



- If the reading is close to the selected buffer, the meter stores the reading and returns to normal operational mode.
- If the value measured by the meter is not close to the selected buffer, "WRONG" and "WRONG BUF" will blink alternately. In this case check if the correct buffer has been used, or regenerate the electrode by following the cleaning procedure below. If necessary change the buffer or the electrode.



Note: Press RANGE to display the temperature reading on the LCD during calibration.



TEMPERATURE CALIBRATION (for technical personnel only)

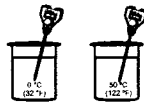
All the meters are factory calibrated for temperature.

The temperature probes are interchangeable and no temperature calibration is needed when they are replaced.

If, for any reason, the temperature measurements are inaccurate, temperature recalibration may be carried out.

For an accurate recalibration, contact Omega Customer Service.

- Prepare a vessel containing ice and water and another one containing hot water (at a temperature of around 50°C). Place insulation material around the vessels to minimize temperature changes.
- Use a calibrated thermometer with a resolution of 0.1°C as a reference thermometer.
- With the instrument off, press and hold CAL and then the ON switch. The "CAL" indicator will come on and the secondary LCD will show 0.0°C.



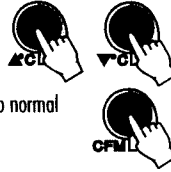
- Immerse the temperature probe in the vessel with the ice and water as near to the thermometer as possible. Allow a couple of minutes for the probe to stabilize.
- Use the "▲°C" or "▼°C" key to set the reading on the secondary LCD to that of ice and water.
- Press CFM to confirm. The secondary LCD will show 50.0°C.



- Immerse the temperature probe in the second vessel as near to the thermometer as possible. Allow a couple of minutes for the probe to stabilize.



- Use the "▲°C" or "▼°C" key to set the reading on the secondary LCD to that of the hot water
- Press CFM to confirm. The meter returns to normal operational mode.



mV CALIBRATION PHB-213 (for technical personnel only)

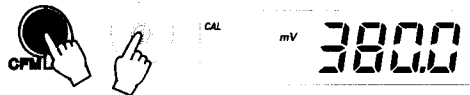
All the meters are factory calibrated for mV.

The ORP electrodes are interchangeable and no mV calibration is needed when they are replaced.

If, for any reason, the mV measurements are inaccurate, mV recalibration may be carried out.

For an accurate recalibration, contact Omega Customer Service.

- Attach to the electrode BNC connector a mV simulator with a range of at least ± 500.0 mV and an accuracy of ± 0.1 mV.
- With the instrument off, press and hold CFM and then the ON switch. The "CAL" indicator will come on and the primary LCD will show 380.0 mV.
- Set 380.0 mV on the simulator.
- Wait for 3 sec. and press CFM. The LCD will display -380.0 mV



asking for this value to be set.

- Set -380.0 mV on the simulator.
- Wait for 3 sec. and press CFM. The LCD will display 500.0 mV.
- Set 500.0 mV on the simulator.
- Wait for 3 sec. and press CFM. The LCD will display -500.0 mV.
- Set -500.0 mV on the simulator.
- Wait for 3 sec. and press CFM.
- The secondary LCD will display 0.0°C. It is now possible to proceed with the temperature calibration, if necessary, as described above, or return to normal operation by pressing CAL.



INTERFACE WITH PC

Data transmission from the instrument to the PC is now much easier with the new **PHB-200-SW** Windows[®] compatible application software (optional). **PHB-200-SW** also offers an on-line help feature.

Simply run your desired spread sheet and open the file downloaded by **PHB-200-SW**. Data can be further elaborated with graphics, statistical analysis, etc. using the most diffused spread sheet programs (e.g. Excel[®], Lotus 1-2-3[®]).

To install **PHB-200-SW** you need a 3.5" drive and a few minutes to follow the instructions printed on the disk label.

To connect your meter to the PC use the optional **PHB-200-C** cable connector. Make sure that your meter is switched off and plug the connectors, one into the meter RS232C socket and the other into the serial port of your PC.

Note: Cables other than **PHB-200-C** may use a different configuration, in which case, communication between the meter and the PC may not be possible.

If you are not using **PHB-200-SW** application software, please find below some additional information to help you link-up to your PC.

Setting the Baud Rate and the Command Prefix

The baud rate of the meter and of the external device must be the same. To set the baud rate of the meter press **COMM**, the primary LCD shows the current **baud rate**.



The following baud rates can be selected with the "▲°C" or "▼°C" key: 150, 300, 600, 1200 (factory setting) and 2400.



Press **CFM** to confirm the setting. The primary LCD will show the current **command prefix** (factory setting is 16).



Note: The Command Prefix must not be changed when using **PHB-200-SW** Software.

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Select, if necessary, a different command prefix (between 0 and 47) by pressing the "▲°C" or "▼°C" key.



Press CFM to confirm the setting.



Sending Commands from PC

With any terminal program it is possible to remotely control your meter. Use PHB-200-C cable to connect the meter to a PC, start the terminal program and set the communication options as follows: 8, N, 1, no flow control.

Command Types

To send a command to the pH meter the scheme is:

<DLE> <command> <CR>

This line makes the computer send a Data Link Escape character, the command expressed as a 3-character sequence and a CR character.

Note: All the terminal programs that support the ANSI escape sequence, represent the DLE character by the string '^P' and the CR character by the string '^M'.

Commands not requiring an answer from the pH meter:

PHR sets the range to pH
MVR sets the range to mV (pH 213 only)
CAL is equivalent to pressing the CAL key
CFM is equivalent to pressing the CFM key
UPC is equivalent to pressing the ▲°C key
DWC is equivalent to pressing the ▼°C key
MEM is equivalent to pressing the MEM key
MRR is equivalent to pressing the MR key
COM is equivalent to pressing the COMM key
OFF sets the meter in standby mode

Commands requiring an answer:

pH? Causes the meter to send the pH reading ("Err 1" is sent if out of range). If the range is set to mV, "Err 6" is sent.
mV? Causes the meter to send the mV reading ("Err 2" is sent if out of range). If the range is set to pH, "Err 6" is sent.
TM? Causes the meter to send the temperature reading ("Err 3" is sent if out of range).

These commands may be sent with either capital or small letters. Invalid commands will be ignored. The characters sent by the meter are always capital letters. When the meter receives an unknown or a corrupted command, it will send a character CAN (ASCII Code 24).

pH VALUES AT VARIOUS TEMPERATURES

Temperature has an effect on pH. The calibration buffer solutions are affected by temperature changes to a lesser degree than normal solutions. During calibration the meter will automatically calibrate to the pH value corresponding to the measured or set temperature.

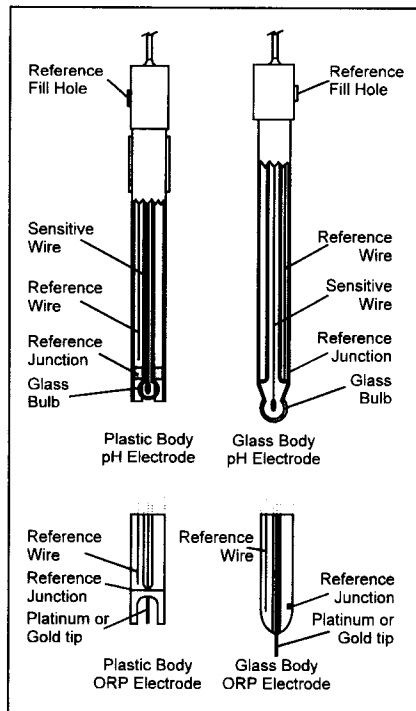
TEMP		pHVALUES		
°C	°F	4	7	10
0	32	4.01	7.13	10.32
5	41	4.00	7.10	10.24
10	50	4.00	7.07	10.18
15	59	4.00	7.04	10.12
20	68	4.00	7.03	10.06
25	77	4.01	7.01	10.01
30	86	4.02	7.00	9.96
35	95	4.03	6.99	9.92
40	104	4.04	6.98	9.88
45	113	4.05	6.98	9.85
50	122	4.06	6.98	9.82
55	131	4.07	6.98	9.79
60	140	4.09	6.98	9.77
65	149	4.11	6.99	9.76
70	158	4.12	6.99	9.75

For instance, if the buffer temperature is 25°C, the display will show pH 4 or 7 or 10. If the buffer temperature is 20°C, it will show pH 4.00/7.03/10.06 or at 50°C, the display will show pH 4.06/6.98/9.82.

ELECTRODE CONDITIONING & MAINTENANCE

Note: To prevent damage to the electrode, remove the pH electrode from the solution before turning the meter off.

If the meter is OFF, detach the electrode from the meter before immersing the electrode in the storage solution.



PREPARATION

Remove the protective cap.

DO NOT BE ALARMED IF SALT DEPOSITS ARE PRESENT. This is normal with electrodes and they will disappear when rinsed with water.

During transport tiny bubbles of air may form inside the glass bulb affecting proper functioning of the electrode. These bubbles can be removed by "shaking down" the electrode as you would do with a glass thermometer.

If the bulb and/or junction is dry, soak the electrode in storage solution for at least one hour.

For refillable electrodes:

If the filling solution (electrolyte) is more than 2½ cm (1") below the fill hole, add 3.5M KCl Electrolyte Solution for double junction or 3.5M KCl + AgCl Electrolyte Solution for single junction electrodes.

For a faster response, unscrew the fill hole screw during measurements.

MEASUREMENT

Rinse the electrode tip with distilled water. Immerse the tip (bottom 4 cm /1½") in the sample and stir gently for a few seconds.

For a faster response and to avoid cross contamination of the samples, rinse the electrode tip with a few drops of the solution to be tested, before taking measurements.

STORAGE

To minimize clogging and assure a quick response time, the glass bulb and the junction should be kept moist and not allowed to dry out.

Replace the solution in the protective cap with a few drops of storage solution or, in its absence, filling solution.

Note: NEVER STORE THE ELECTRODE IN DISTILLED OR DEIONIZED WATER.

PERIODIC MAINTENANCE

Inspect the electrode and the cable. The cable used for connection to the meter must be intact and there must be no points of broken insulation on the cable or cracks on the electrode stem or bulb. Connectors must be perfectly clean and dry. If any scratches or cracks are present, replace the electrode. Rinse off any salt deposits with water.

For refillable electrodes:

Refill the reference chamber with fresh electrolyte. Allow the electrode to stand upright for 1 hour.

Follow the Storage Procedure above.

CLEANING PROCEDURE

General Soak in general cleaning solution for approximately ½ hour.

IMPORTANT: After performing any of the cleaning procedures rinse the electrode thoroughly with distilled water, refill the reference chamber with fresh electrolyte (not necessary for gel-filled electrodes) and soak the electrode in storage solution for at least 1 hour before taking measurements.

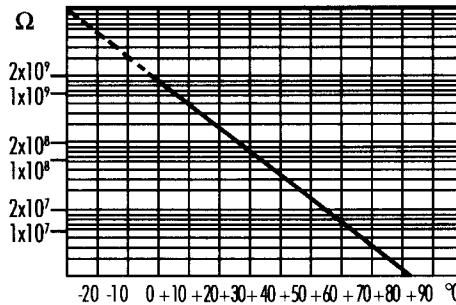
TROUBLESHOOTING

Evaluate your electrode performance based on the following.

- **Noise** (Readings fluctuate up and down) could be due to:
 - **Clogged/Dirty Junction:** Refer to the Cleaning Procedure above.
 - **Loss of shielding** due to low electrolyte level (in refillable electrodes only): refill with fresh electrolyte solution.
- **Dry Membrane/Junction:** Soak in storage solution for at least 1 hour.
- **Drifting:** Soak the electrode tip in warm (approx. 50-60°C) electrolyte solution for one hour and rinse the tip with distilled water. Refill with fresh filling solution.
- **Low Slope:** Refer to the cleaning procedure above.
- **No Slope:** Check the electrode for cracks in glass stem or bulb and replace the electrode.
- **Slow Response/Excessive Drift:** Soak the tip in solution for 30 minutes, rinse thoroughly in distilled water and then follow the Cleaning Procedure above.

TEMPERATURE CORRELATION FOR pH SENSITIVE GLASS

The resistance of glass electrodes partially depends on the temperature. The lower the temperature, the higher the resistance. It takes longer time for the reading to stabilize if the resistance is higher. In addition, the response time will suffer to a greater degree at temperatures below 10°C.



Since the resistance of the pH electrode is in the range of 200 Mohm, the current across the membrane is in the pico Ampere range. Large currents can disturb the calibration of the electrode for many hours. For these reasons **high humidity environments, short circuits and static discharges** are detrimental to a stable pH reading.

The pH electrode's life also depends on the temperature. If constantly used at high temperatures, the electrode life is drastically reduced.

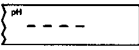

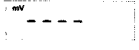
Typical Electrode Life	
Ambient Temperature	1- 3 years
90 °C	Less than 4 months
120°C	Less than 1 month

High concentrations of sodium ions interfere with readings in alkaline solutions; the pH at which the interference starts to be significant depends upon the composition of the glass. This interference is the alkaline error and causes the pH to be underestimated. Glass formulations have the indicated characteristics.

Alkaline Error

Sodium Ion Correction for the Glass at 20-25°C		
Concentration	pH	Error
0.1 Mol L ⁻¹ Na ⁺	13.00	0.10
	13.50	0.14
	14.00	0.20
1.0 Mol L ⁻¹ Na ⁺	12.50	0.10
	13.00	0.18
	13.50	0.29
	14.00	0.40

TROUBLESHOOTING GUIDE

Symptoms	Problem	Solution
The meter is slow in responding or gives faulty readings	The electrode is not working or the reference junction is clogged	Leave the electrode in a storage solution after cleaning the junction. If problem persists, replace the electrode
The meter does not accept the 2 nd buffer solution for calibration	Out of order pH electrode	Follow the cleaning procedure. If this doesn't work replace the electrode
The reading drifts	Defective pH electrode	Replace the electrode
Display shows: 	Out of range pH scale	a) Recalibrate b) Make sure the pH sample is in the specified range c) Check the electrolyte level and the general state of the pH electrode
Display shows: 	Out of range temperature scale	Make sure the temperature is in the 0 to 100°C range and the temperature probe is plugged in
Display shows: 	Out of range mV scale	Electrode not connected
Display shows: "WRONG 1" and "WRONG 2"	Erroneous buffer solution used for offset calibration Defective electrode	Make sure the buffer setting is correct and the solution is fresh. Replace the buffer if necessary Replace the electrode
Display shows: "WRONG 2" and "WRONG 1"	Erroneous buffer solution used for slope calibration Defective electrode	Make sure the buffer setting is correct and the solution is fresh. Replace the buffer if necessary Replace the electrode
The meter does not work with the temperature probe	Out of order temperature probe	Replace the probe
The meter fails to calibrate or gives faulty readings	Out of order pH electrode	Replace the electrode

WARRANTY

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of 13 months from date of purchase. OMEGA'S WARRANTY adds an additional one (1) month grace period to the normal one (1) year product warranty to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, 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 having been 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 traces.

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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. Purchase Order 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. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the 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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