OMEGA

ENGINEERING, INC.

An OMEGA Group Company

MODEL PHH-65A

Field pH Meter

Operator's Manual

WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of 13 months from date of purchase. OMEGA 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 our customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. Our 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. However, 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 current, heat, moisture, vibration, or misuse. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

THERE ARE NO WARRANTIES EXCEPT AS STATED HEREIN. THERE ARE NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL OMEGA ENGINEERING, INC. BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL OR SPECIAL DAMAGES. THE BUYER'S SOLE REMEDY FOR ANY BREACH OF THIS AGREEMENT BY OMEGA ENGINEERING, INC. OR ANY BREACH OF ANY WARRANTY BY OMEGA ENGINEERING, INC. SHALL NOT EXCEED THE PURCHASE PRICE PAID BY THE PURCHASER TO OMEGA ENGINEERING, INC. FOR THE UNIT OR UNITS OR EQUIPMENT DIRECTLY AFFECTED BY SUCH BREACH.

Return Requests/Inquiries

Direct all warranty and repair requests/inquiries to OMEGA Customer Service Department, telephone number (203) 359-1660. Before returning any instrument, please contact the OMEGA Customer Service Department to obtain an authorized return (AR) number. The designated AR number should then be marked on the outside of the return package.

To avoid processing delays, also please be sure to include:

1. Returnee's name, address, and phone number.
2. Model and Serial numbers.
3. Repair instructions.

OMEGA ENGINEERING, INC.

One Omega Drive, Box 4047
Stamford, Connecticut 06907-0047
(203)359-1660 Telex: 996404 Cable: OMEGA
FAX: (203) 359-7700

Printed in U.S.A. M414/

PHH-65A

Field pH METER

Table of Contents

1.0 INTRODUCTION

The PHH-65A field portable pH meter is housed in a rugged plastic carrying case and allows pH and oxidation-reduction measurements to be taken directly at the sampling site. The pH meter has analog readout and features temperature compensation and an expanded mode. Also included is a zero millivolt input for diagnosis of meter function.

2.0 SPECIFICATIONS

Readout:	6 inch analog
Operating Modes:	pH, Expanded pH mV, Expanded mV
pH Measurements:	
Range(s):	0-14 pH (Normal) Any 1.4 pH F.S. (Exp.)
Sensitivity:	0.05 pH (Normal) 0.005 pH (Exp.)
Accuracy:	0.05 pH (Normal) 0.01 pH (Exp.)
Temp. Compensation:	Manual, 0-100°C
Millivolt/Redox Measurements Ranges:	± 700 mV (Normal) ± 70 mV (Exp.)
Accuracy:	1 mV
Input Impedance:	$>10^{10}$ Ohms
Connectors:	BNC Redox
Power:	DC/AC (rechargeable)
Size:	12¼" W x 4½" H x 8" D
Weight:	4.5 lbs. (2.04 Kg)

3.0 PRELIMINARY SET-UP

3.1 Remove and inspect carton for the following items:

- **a.** Field portable pH meter
- **b.** Support Rod
- **c.** Detachable electrode support
- **d.** pH 4.00, pH 7.00, and pH 10.00 buffer solutions and rack
- **e.** Batteries and battery charger
- **f.** Operation Manual

3.2 The instrument should be used in a location with adequate ventilation and freedom from vibration. The instrument should be located on a relatively flat, dry surface and close proximity to high voltage wires or transformers should be avoided.

3.3 Make certain that the front knob is turned to OFF.

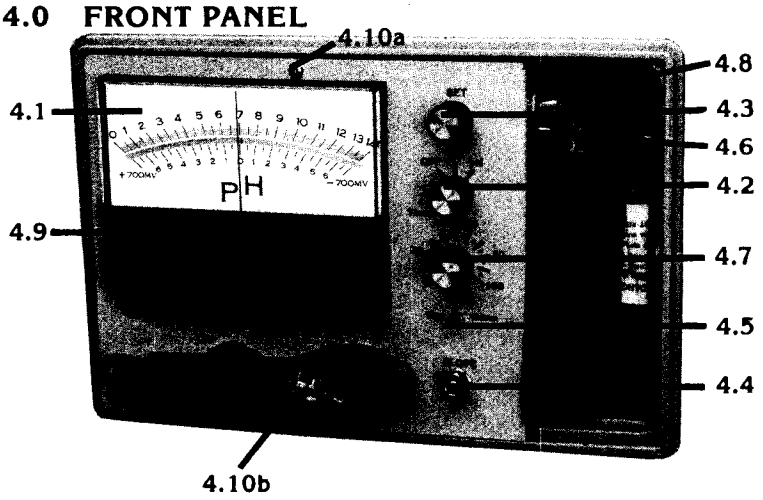
3.4 Plug the rechargeable unit into the appropriate outlet (the field pH meter is available in both 110 VAC and 220 VAC models). To assure a full battery charge, the unit should be allowed to charge at least overnight.

3.5 Attach the pH or ORP probe into the BNC connector. pH or ORP probes with U.S. standard connections will require an adaptor.

3.6 To decrease breakage, the electrode should then be placed in the electrode holder and attached to the support rod. The electrode holder can then be raised or lowered for sample measurement.

3.7 The instrument can now be calibrated and used. See section 5.0 for pH calibration procedures. Turn the front switch to ON for use.

4.0 FRONT PANEL



4.1 **Analog face**–6" mirror-backed analog display for pH and millivolt readings.

4.2 **OFF/MV/pH**
OFF: Power to instrument is off.
mV: Millivolt-meter will display millivolt input from oxidation-reduction (ORP) or pH electrode.
pH: Meter will display pH input from pH electrode.

4.3 **SET**–Calibration knob used for first point in two point calibration, usually pH 7.00 buffer. It can also be used for millivolt offset.

4.4 **SLOPE**–Calibration screw used for second point in two point calibration, usually pH 4.00 or pH 10.00 buffer.

4.5 **NORM–EXP**–Toggle switch that allows meter display in normal (NORM) mode 0-14 pH units, ± 700 mV or expanded (EXP) mode–only 1.4 pH units, ± 70 mV.

4.6 **ZERO**–Used for standard input of zero millivolts. When the button is depressed, the meter should read zero millivolts. The reading can be adjusted using the SET knob. Establishing zero millivolts is especially important when the instrument is used in the expanded mode.

4.7 **TEMP**–Temperature compensation knob–when this knob is set to the sample temperature, the pH readings are temperature compensated. **Note:** All temperature settings are in degrees centigrade.

4.8 **BNC Connector**–The connector for the BNC fitting of an ORP or pH electrode.

4.9 **Mechanical Zero**–Screw used to adjust meter needle to 0 starting position when meter is OFF.

4.10 **a&b: Panel Screws**–Removable screws that allow access to the rechargeable batteries.

5.0 STANDARD pH CALIBRATION

5.1 Three buffer capsules are available, pH 4.00, pH 7.00, and pH 10.00. Use the buffers for calibration that are closest to the pH range that you will be using. If your use will span the entire pH range, the instrument should be calibrated with two buffers and checked with a third.

5.2 Make pH buffers by dissolving one capsule per 100 ml of deionized or distilled water. After complete dissolution, the buffers should be properly stored in clearly labelled, tightly capped containers. Commercially prepared buffers can also be used.

5.3 Check meter needle position—Before the calibration procedure is performed, the meter needle position should be checked when the meter is turned OFF. If the meter needle does not read zero, then the mechanical zero screw should be used to adjust the needle to read zero.

5.4 Place pH electrode in pH 7.00 buffer. Sufficient buffer should be used to immerse the pH tip. Freshly poured buffers should be used for each calibration so avoid using excessive amounts. The temperature control knob should be adjusted to 25°C or room temperature.

5.5 Make sure the front panel switch is set on pH and the expanded model is set to NORM.

5.6 Use the SET knob to adjust the analog needle to read a pH of 7.00.

5.7 Rinse the electrode with distilled water and carefully blot dry, using lint-free paper. **Caution:** Do not wipe the electrode. Wiping can cause static electrical charges which can result in faulty readings.

5.8 Immerse the electrode in a second standard buffer, either pH 4.00 or pH 10.00. Allow time for equilibration.

5.9 Use the SLOPE screw to adjust the readout to read exactly 4.00 or 10.00 depending on the second buffer used.

5.10 Rinse the electrode and blot dry.

The meter is now ready for use in the pH mode.

Note: The calibration of a pH meter is not permanent. It should be done on a regular basis and any time the pH reading response becomes slow or erratic.

6.0 EXPANDED MODE CALIBRATION

For sensitive pH or millivolt measurements, the instrument should be used in the expanded (EXP) mode. For pH measurements in the expanded mode, go to 6.2. For millivolt measurements in the expanded mode, go to 6.1.

6.1 Expanded Millivolt Calibration

It is important to understand that in the expanded mode, the full scale will span a range of 140 millivolts. Before deciding to use the expanded mode, the user must first establish that the total millivolt range required will not exceed this value.

a. Turn selection switch to mV (millivolt).
b. Place probe in a solution of known potential.
c. Use SET knob to adjust meter needle to read zero millivolts.
d. Switch toggle switch from NORM to EXP (Expanded).
e. Use SET knob to reset meter needle to the appropriate position for the millivolt range required.
f. The meter is now calibrated in the expanded millivolt mode and will reflect a change of 140 millivolts full scale.

g. Before switching the meter back to the NORM (normal) mode, make certain to reset the meter needle to zero millivolts. This prevents pegging the needle.

Example

For example, an oxidation-reduction potential (ORP) titration is to be performed, the starting solution has an initial ORP of +200 mV and a final end point of +320 mV. The probe is placed in the starting solution for the expanded mode calibration. Once in the expanded mode, the meter needle is set to −600 millivolts.

Therefore, in the expanded mode, the scale would read as follows:

−700 mV is now equal to 190 mV
−600 mV is now equal to 200 mV
−400 mV is now equal to 220 mV
0 mV is now equal to 260 mV
+400 mV is now equal to 300 mV
+600 mV is now equal to 320 mV
+700 mV is now equal to 330 mV

6.2 Expanded pH Calibration

It is important to understand that in the expanded mode, the full scale will span a range of 1.4 pH units. Before deciding to use the expanded mode, the user must first establish that the total pH range required will not exceed this value.

a. Turn selection switch to pH.
b. Calibrate the meter in the standard pH mode. (Section 6.0).
c. Place probe in a standard buffer or a solution of known pH.
d. Use the SET knob to adjust the meter needle to read pH 7.00.
e. Switch toggle switch from NORM to EXP (expanded).
f. Use SET knob to reset meter needle to the appropriate position for pH range required.

g. The meter is now calibrated in the expanded pH mode and will reflect a change of 1.4 pH units full scale.

h. Before switching the meter back to the NORM (normal) mode, make certain to reset the meter needle to 7.0. This prevents pegging the needle.

Example

For example, a solution has a starting pH of 3.25 and needs to be adjusted to an exact pH of 4.30 ± .01.

A pH 4.00 buffer solution is a good reference point. The probe is placed in pH 4.00 buffer. Once in the expanded mode, the meter needle is set at pH 10.00. Therefore in the expanded mode, the pH scale would read as follows:

pH 0.0 is now equal to 3.00
pH 1.0 is now equal to 3.10
pH 3.0 is now equal to 3.30
pH 7.0 is now equal to 3.70
pH 10.0 is now equal to 4.00
pH 13.0 is now equal to 4.30
pH 14.0 is now equal to 4.40

7.0 ELECTRODE CARE

Many electrode problems can be eliminated with reasonable care. Proper storage and use decreases down time and provides maximum benefits.

Storage

7.1 Gel and refillable electrodes should be stored in an acidic solution with a low salt content. Commercial soaking solutions are available or you can make your own by mixing a 1M KCl solution adjusted to pH 4.0.

7.2 Electrode storage in a field unit is more difficult due to the horizontal storage. To assure proper hydration of the pH bulb, the electrode should always be stored wet in the solution described above. The easiest way to accomplish this is to store the electrode using the plastic cap or soaking bottle that accompanies the new electrode when shipped.

Use

7.3 Electrodes should always be used in a vertical position.

7.4 Electrodes should be rinsed between samples with distilled or deionized water. **NEVER** wipe an electrode—to remove excess water, just blot the end of the electrode with a lint free paper. Wiping an electrode can cause spurious readings due to static charges.

7.5 The level of filling solution in refillable electrodes should be kept at least ⅔ full. The filling hole should be open during use.

7.6 pH electrodes are fragile. A proper electrode holder should be used to provide support and aid in raising and lowering the probe into solutions.

8.0 THEORY OF pH MEASUREMENT

8.1 Color Methods

Over the years, researchers have discovered dyes and chemicals that will change color at prescribed pH values. Litmus paper is a good example of a commonly used indicator. In an alkaline solution, the paper turns blue and in acid solution, the paper will turn pink. But there are two major drawbacks with the use of indicators. First is the difficulty of detection in highly colored or turbid solutions and second is chemical interferences with the indicator, invalidating the test. With the invention of the pH probe and meter, scientists were able to eliminate these drawbacks as well as increase the precision of pH measurements.

8.2 Instrument Methods

There are three components of pH measurement. The measuring electrode, the reference electrode, and the pH meter.

Instrumental pH measurement can be performed relatively fast and with a high degree of precision.

a. **Measuring Electrode**–The key to the pH measuring system is the glass bulb at the end of the measuring electrode. This glass bulb is manufactured from a special glass which is very sensitive and highly selective to hydrogen ions. The pH measurement is then a function of a voltage charge across the bulb which is directly related to the hydrogen ion concentration.

b. **Reference Electrode**–A second electrode, the reference electrode, is then required to complete the electrical circuit between the measuring electrode, through the meter, into the sample being measured. The reference electrode completes this circuit by very, very slow seepage of KCl ($K^+ + Cl^-$), into the sample through a porous junction. Clogging of this junction can cause erratic and incorrect pH readings.

c. **Combination Electrode**–Combination electrodes are electrodes which contain both a measuring and a reference electrode in one probe.

d. **pH Meter**–The input signals from the electrodes are displayed on the pH meter. A direct reading of the voltage input is displayed when the meter is set on the millivolt scale. For the more common pH usage, the meter converts the voltage input from the electrodes to a unit of pH which is displayed when the meter is set on the pH scale.

9.0 TROUBLESHOOTING

9.1 Symptom

Meter exhibits no response.

Action

a. Check battery power.

Plug the attached recharger into the appropriate power outlet (110 VAC or 220 VAC depending on model ordered) for at least 24 hours to insure full battery charge. Recheck function. If there is still no response, then replace batteries.

b. Change batteries

1. Turn meter OFF.
2. Unplug battery charger.
3. Remove the panel screws.
4. Carefully remove front panel and turn over.
5. The batteries are located underneath the right side of the front panel.
6. Replace the four AA rechargeable batteries one at a time to insure proper alignment.
7. Plug the recharger into the appropriate outlet and recharge for 24 hours.
8. Recheck function. If there is still no response, continue.

c. Check millivolt function of the pH meter.

1. Turn selection knob to mV (millivolt). Place electrode in fresh pH 7.0 buffer. Meter should read ± 15 mV.
2. Place electrode in fresh pH 4.0 buffer. Meter should read + 177 mV.
3. Place electrode in fresh pH 10.0 buffer. Meter should read – 177 mV.

Conclusion

— If pH meter responds correctly in mV mode, this pinpoints the fault to the pH board. The pH meter needs to be serviced.

— If the pH meter does not respond, you may have a faulty pH meter or faulty electrode. Proceed to next step.

d. Check pH circuitry of the pH meter.

1. Turn selection knob to pH.
2. Push zero button.
3. This should result in a stable needle reading which can be deflected more than 3 pH units using the SET knob.

Conclusion

— If the pH meter responds correctly when shorted, the meter is in good working order and the problem is probably a faulty electrode. Go to the next step.

— If the pH meter does not respond correctly when shorted, the meter is faulty and requires repair.

e. Check for faulty electrode.

1. If a faulty electrode is suspected, replace with a new or other working electrode and recheck pH function.
2. If another electrode is unavailable, a new electrode should be ordered.

9.2 Symptom

Unable to standardize meter.

Action

a. Check temperature knob to verify correct setting.

b. Open a new bottle or make a fresh batch of standard buffer and recheck standardization.

c. Check electrode for physical defects.

1. Visually check electrode for cracks or other abnormalities. A cracked or damaged electrode should be replaced.
2. Visually check electrode for low filling solution or excess KCl crystals. Filling solution should be at least ⅔ full, bulb and filling hole should be free of excess KCl crystals.

Conclusion

If no defects are seen, go to next step.

d. Clean the electrode to eliminate a clogged reference junction.

1. Immerse the tip of the electrode into concentrated NH_4OH for 10-15 minutes. **Caution:** NH_4OH is very caustic and should be used in a hood.
2. Rinse the electrode.
3. Soak in pH 4.0 buffer for 10-15 minutes.
4. Recheck calibration.

Conclusion

If cleaning does not result in improved performance, the meter could be at fault. Go to Section 9.1-c.

9.3 Symptom

pH readings are unstable, slow, erratic, or drift.

a. Check the sample.

1. A changing sample temperature — Allow sufficient time for a sample temperature to stabilize. **Note:** Vigorous stirring on an uninsulated stirring motor can lead to small but significant sample temperature changes.
2. A non-uniform sample— pH "zones," which result in erratic or drifting readings can be eliminated by gentle stirring using an insulated stirring motor.

3. A very low or very high ionic strength sample —
   These readings can take a long time to stabilize.
4. A sample that is incompatible with the pH electrode —
   When measuring pH of special solutions such as HF, strong oxidizing solutions, or solutions that contain elements that can poison an electrode be certain that you are using the correct electrode.

b. Check electrode for physical defects. (See Section 9.2-c).

c. Clean the electrode. (See Section 9.2-d).

d. Check the pH meter. (See Section 9.1-c).

10.0 PARTS LIST

The following parts can be ordered individually to aid in maintenance and repair. For price, please call OMEGA Engineering Customer Service Department at (203) 359-1660.

AC/DC (110/220)

	100K BALL BEARING POT	634-0104-10
	2K COMP POT	634-0202-00
	pH METER MOVEMENT	650-1040-00
	TOGGLE SWITCH	742-7121-10
	PUSH BUTTON SWITCH	740-8121-10
	BATTERY HOLDER	567-2182-00
	BNC CONNECTION	738-3110-00
	ELECTRODE CLIP	559-1006-00
*	CIRCUIT BOARD	600-0400-30
	RECHARGEABLE BATTERIES	706-0500-00
	PORTABLE BOX	526-2585-00
	BOTTLE RACK	538-0046-03
	PROBE HOLDER ASSEMBLY	610-0106-00
	ROD	532-0011-00
**	110V CHARGER	702-8113-10
**	220V CHARGER	702-0504-20

* No circuit board components are available separately

** Make certain to order the correct charger for your meter.