User's Guide

ΩΕ **OMEGA**®

7.00 pH
25.0 °C

CAL: A+B

POWER   HOLD ESC   REC ENTER
A   B

☼

Function

▲   ▼

TIME   LOGGER SET

Sampling check

SD Card Data Logger
pH METER ORP

PHH-SD1

PHH-SD1
pH Meter
With Data Logging SD Card

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INTRODUCTION

Thank you for purchasing PHH-SD1 pH Meter with Datalogging SD Card. Please read this user's manual carefully and thoroughly before using the instrument.

The PHH-SD1 is a general-purpose handheld instrument suitable for measuring the pH and oxidation-reduction potential (ORP) of a solution. Using optional probes with a BNC connector, the meter can measure pH from 0 to 14 and ORP from -1999 mV to +1999 mV. The meter also accepts an optional automatic temperature compensation (ATC) probe that configures the pH electrode to measure solutions whose temperature is between 32 and 150°F (0 and 65°C). For measuring the pH of solutions at temperatures between 32 and 212°F (0 and 100°C), the temperature compensation can be set manually. pH electrodes must be calibrated for pH 4, pH 7 and pH 10 using buffer solutions.

Among the applications and environments suitable for the PHH-SD1 are water conditioning, wastewater monitoring, beverage production, aquaculture (fish farming), aquariums, pulp and paper processing, electroplating, and photography.

The PHH-SD1 has the performance and features needed to satisfy the most demanding aspects of the above applications. A front-panel pushbutton enables rapid switching between the two measurement modes. Measurement accuracies are ± (0.02 pH units + 2 digits) for pH readings and ± (0.5% of the reading + 2 digits) for ORP readings.

Because it is microprocessor-based, the PHH-SD1 can make full use of the portability, reliability and large storage capacities that SD memory cards offer. Measurements can be made automatically at any sampling rate between one second and nine hours. After time-stamping and storing the measurements on an SD card plugged into the instrument (a process called datalogging), the user can remove the card and plug it into to a laptop or desktop computer either directly or via a USB card reader. The data logs are stored on the card as files with the .xls extension, which can be opened by Microsoft's Excel application.

The PHH-SD1 has a backlit 2-1/2 inch diagonal display and is powered by six AA Alkaline batteries or an optional 9-VDC AC adapter.

KEY FEATURES

- Measures pH and ORP using optional electrodes
- Measured parameter can be changed by pressing front-panel button
- Optional ATC temperature probe automatically calibrates pH electrode to pH 4, pH and pH 10
- Displays maximum and minimum readings
- Performs real-time automatic datalogging at sampling time settable from 1 second to 9 hours
- Also supports manual logging and changing of card storage location
- Outputs Excel-compatible data logs
- Accepts SD memory cards of up to 16 GB capacity
- Big (2.5-inch diagonal) front-panel green backlit LCD is easy to read
- Auto power off function
- Powered by six AA batteries or optional 9V AC/DC adapter

OPERATING INSTRUCTIONS

What's in the case
The PHH-SD1 comes fully assembled with a 2 GB SD memory card and this user's manual.

Optional accessories available from OMEGA include pH electrodes, a probe that enables automatic temperature compensation (ATC) of pH electrodes, an ORP electrode, pH 4 and pH 7 buffer solutions, and a 9VDC adapter for a 110V power supply. See the Optional Accessories section of this manual for more details.

Figure 1 shows all of the controls and indicators on the front, back, top, bottom and right side of the PHH-SD1. Familiarize yourself with the positions and functions of these controls, indicators and connectors before moving on to the setup procedure.
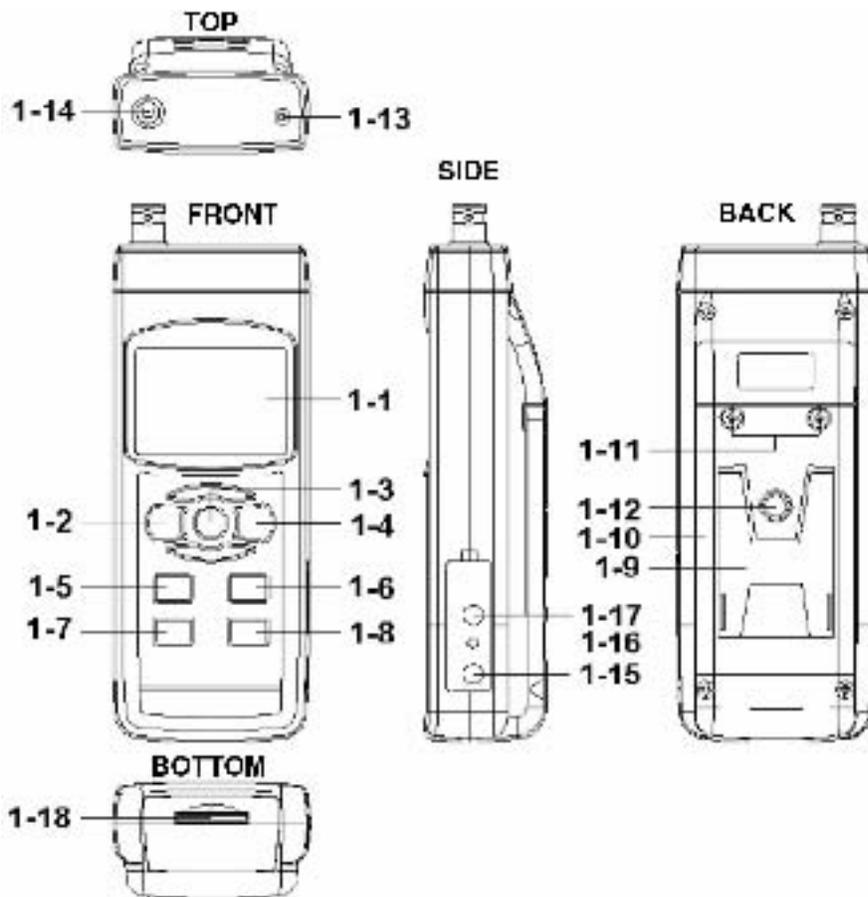
1. The PHH-SD1's controls and indicators and other physical features

1-1 Liquid-crystal display	1-10 Battery compartment cover
1-2 POWER button	1-11 Battery compartment cover screws
1-3 HOLD/ESC button	1-12 Tripod attachment nut
1-4 REC/ENTER button	1-13 Socket for ATC temperature probe
1-5 ▲ button	1-14 Socket for pH electrode
1-6 ▼ button	1-15 Socket for 9VDC AC adapter
1-7 TIME button	1-16 Reset button
1-8 LOGGER SET button	1-17 RS232 output jack
1-9 Kickstand	1-18 SD card socket

Setup

1. **Choose the power source.** Before using the PHH-SD1, be sure it is powered by fresh batteries or an optional 9VDC AC adapter plugged into the bottom jack on its right side (callout 1-15).

   To remove the battery compartment cover, remove the two screws holding it in place (callout 1-11). Then install six AA batteries in the correct orientation, using the polarity marks on the inside of the compartment as a guide. Replace the cover by replacing the two screws.

2. **Install an SD card.** To prepare for setup, also install the supplied 2 GB SD memory card or another card with a capacity from 1 GB to 16 GB in the socket on the bottom of the PHH-SD1 (callout 1-18). When installing the card, make sure its gold contacts are facing front and push the card into the socket until you hear a click. To remove the card, push it in until you hear a click and the card pops out.

Now power on the instrument by pressing the POWER button (callout 1-2) to generate a short beep. (To power off the PHH-SD1, press the POWER button and hold it until the instrument responds with a long beep.)

When the meter powers on, a series of transient startup screens will briefly appear. Once the display has stabilized, perform the following eight setup steps in the order presented.

3. **Format the SD card.** LOGGER SET button (callout 1-8) and hold it for at least five seconds, until "Sd-F" appears in the lower half of the display. Quickly (within three seconds) press the REC/ENTER button.

(If you press buttons too slowly in setup mode, the screen will revert to the normal display. To return to the setup sequence, press and hold the LOGGER SET button again. To move ahead to the next field in the sequence or to the next parameter, press the HOLD/ESC button.)

   Pressing the REC/ENTER button causes the word "no" or "yES" to appear over the term "Sd-F". Press the ▼ button to make a selection. Choose "yES" whenever a new SD card is being used, or when a used card is being repurposed (from use with another SD card instrument or a camera, for example) and all data on it is to be erased. Choose "no" to preserve any data on a card previously used with this instrument.

   If you choose "yES", after you press the REC/ENTER button the instrument will prompt you to confirm that decision by displaying the term "Ent" below "yES" and sounding three beeps. To confirm that you want to begin the erasure/formatting procedure, press the REC/ENTER button. "Ent" will then flash several times and the instrument will sound another three beeps to confirm that the SD card has been erased and formatted.

4. **Set the date and time.** Once the SD card has been formatted (or not), the meter will automatically move to the next step in the startup sequence: setting the current date and time. When the word "dAtE" appears in the center of the display, along with the flashing value "00.00.00" at the lower left, above "yy.mm.dd", set the current year by pressing the ▼ or ▲ button repeatedly until the correct value appears above "yy". Press the REC/ENTER button to store the setting. The next screen that appears will have the value above "mm" flashing. Use the ▼ or ▲ button to navigate to the current month and press the REC/ENTER button to store the setting. When the next screen flashes the value

above "dd", again use the ▼ or ▲ button to navigate to the current day and press the REC/ENTER button to store the setting.

Once you have set the date, the display will prompt you to set the hour, minute and second of the current time. Again use the ▼ or ▲ buttons to navigate to the correct values, and the REC/ENTER button to store the settings.

5. **Set the datalogging sampling time.** Once the date and time have been set and stored, the display will show a value below the letters "SP-t". Press the ▼ or ▲ button to decrease or increase the flashing hour value until the desired number appears below "SP-t". Press the REC/ENTER button to store that setting. The minutes value will then flash. Press the ▼ or ▲ button to decrease or increase the value and then press the REC/ENTER button to store that setting. Finally, press the ▼ or ▲ button to decrease or increase the flashing seconds value and then press the REC/ENTER button to store that setting.

6. **Enable or disable auto power off.** Once the sampling time has been set and stored, the display will show the word "yES' over the term "PoFF". Press the ▼ button until the desired automatic power off management scheme ("yES" for enable; "no" for disable) is displayed. Press the REC/ENTER button to store the selection. If enabled, the power off function shuts off the PHH-SD1 after a period of inactivity of ten minutes.

7. **Enable or disable the beeper.** Once the auto power off function has been enabled or disabled, the display will show the word "yES" over the word "bEEP". Press the ▼ button until the desired setting ("yES" or "no") is displayed, and then press the REC/ENTER button to store the selection.

8. **Choose a decimal point or comma** to represent the decimal division between integers and fractions (for example, American-style 20.88 vs. European-style 20,88). Once the beeper has been enabled or disabled, the display will show the word "bASIC" above the phrase "dEC". Press the ▼ button to make "bASIC" (American style) or "Euro" appear in the upper display, as desired. Press the REC/ENTER button to store the selection.

9. **Select the temperature unit.** Once the format of decimal point divisions has been set and stored, the lower portion of the display will show the term "t-CF". Press either the ▼ or ▲ button to change the letter displayed at the right of the display to "C" (for Celsius units) or "F" (for Fahrenheit units), as desired. Then press the REC/ENTER button to store the selection.

10. **Set the compensation temperature for pH electrode measurements** when operating without an ATC temperature probe. The default value is 77°F (25°C). The value is adjustable between 32 and 212 ^{o}F (0 and 100 ^{o}C).

Once the display temperature unit has been set and stored, the lower portion of the display will show the term "t-SEt". Press either the ▼ or ▲ button until the value above "t-SEt" matches the desired compensation temperature, in ^{o}C or ^{o}F. Press the REC/ENTER button to store the setting.

The display will then either return to the first of the eight steps in the setup sequence—choosing whether or not to format the SD memory card—or show the term "ESC". If "ESC" appears, press either the HOLD/ESC button or the LOGGER SET button to exit the setup procedure and enter normal operating mode.

Calibrating the pH electrode
The optional pH electrode you are using must be calibrated before making pH measurements with it for the first time. The electrode also should be calibrated whenever you wish to maximize the accuracy of measurements. Calibration is necessary because not every pH electrode is an "ideal" electrode that generates 0 mV at pH 7 and 177.4 mV at pH 4.

1. **To calibrate the pH electrode**, perform the following procedure while referring to Figure 2.
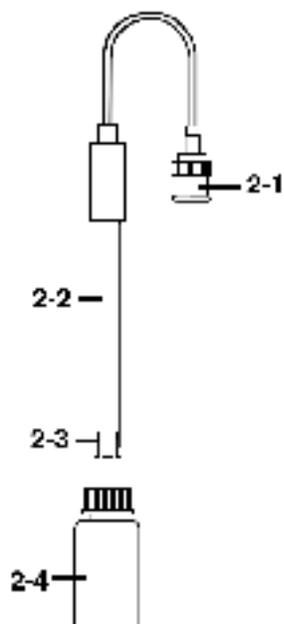

2. Calibrating a pH electrode using the buffer solution

2-1 Electrode plug
2-2 Electrode handle
2-3 Electrode head
2-4 pH buffer solution

1. **Insert the plug of the pH electrode** into the BNC socket at the top of the meter (callout 1-14 of Fig. 1).
2. **Power on the meter** by pressing the POWER button.
3. Using the procedure detailed earlier, **manually adjust the compensation temperature** so it matches the temperature of the buffer solution. Alternatively, use an ATC temperature probe to make the adjustment automatically.
4. Holding it by its handle, **immerse the pH electrode** in the bottle of buffer solution. (If you are using the ATC temperature probe, immerse its head in the bottle as well.)
5. **Gently shake the electrode** (and the probe, if used). The display will show the pH value.
6. **Use two fingers to press the REC/ENTER and HOLD/ESC buttons** at the same time.

When this screen

PH
CAL
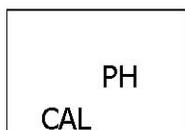
appears, release the buttons.

7. **Press the ▼ or ▲ button** until this screen
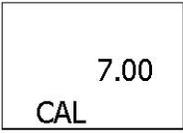
    ```
    7.00
    CAL
    ```
    appears. Press the REC/ENTER button to calibrate the electrode for pH 7.

8. **Press the ▼ or ▲ button again** until this screen
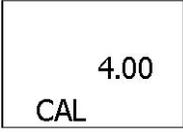
    ```
    4.00
    CAL
    ```
    appears. Press the REC/ENTER button to calibrate the electrode for pH 4.

9. **Press the ▼ or ▲ button again** until this screen
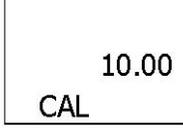
    ```
    10.00
    CAL
    ```
    appears. Press the REC/ENTER button to calibrate the electrode for pH 10.

10. The pH electrode has now been calibrated once. To maximize measurement accuracy, General recommends rinsing the head of the electrode (and the head of the ATC temperature probe, if used) in distilled water and then repeating the above steps at least twice more.

11. **To recalibrate the electrode in the future**, you must clear the existing settings. To do

    ```
    CLr
    CAL
    ```
    so, press the ▼ or ▲ button until this screen appears. Then press the REC/ENTER button to clear the saved settings before repeating the steps above to calibrate the electrode for pH 7, pH 4 and pH 10.
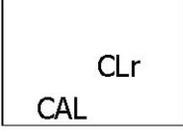
Normal operation

The PHH-SD1 can measure either the pH or the oxidation-reduction potential (ORP) of a solution.

1. **To select the type of measurement**, press the ▼ button (which has the word "Function" stenciled above it) until the display shows either the term "pH" or "mV" (the unit of ORP measurements).

Following are the default states for the PHH-SD1:
- pH measurement
- Temperature unit of $^{\circ}$C
- Manual temperature compensation
- Auto power off
- Sampling time of 2 seconds

To change any of these parameters, use the specific procedure for it detailed in the Setup section.

2. **To measure the pH of a solution**, press the ▼ button until the display shows the term "pH". Make sure the pH electrode is seated firmly in the BNC socket (callout 1-14 of Fig. 1) on the top of the meter. If the ATC temperature probe is being used, make sure it is seated firmly in its socket (callout 1-13 of Fig. 1) on the top of the meter as well. If the ATC probe is not being used, perform the last step of procedure to manually match the compensation temperature to the temperature of the solution being tested.

Holding the pH electrode by its handle, immerse it in the solution under test. (If you are using the ATC temperature probe, immerse its head in the solution as well.) Gently shake the electrode (and probe, if used) to help any air bubbles escape and to ensure an accurate reading.

The display will simultaneously show the solution's pH in the center and either the manually selected compensation temperature or the actual temperature of the solution (as measured by the ATC probe) below it. By default, the temperature reading will be in ^{o}C, unless ^{o}F has been selected.

3. **To measure the ORP of a solution**, press the ▼ button until the display shows the term "mV". Plug an optional ORP electrode with a BNC connector into the same socket on the top of the meter (callout 1-14 of Fig. 1) that accepts the plug of a pH electrode.

   Holding the ORP electrode by its handle, immerse it in the solution under test. Gently shake the head of the electrode to help any air bubbles escape and to ensure an accurate reading. The display will show the ORP of the solution, in mV.

Whenever the PHH-SD1 is in measurement mode, you can turn off the backlight (which is on by default) by briefly pressing (but not holding) the POWER/ESC button. To reactivate the backlight, briefly press the button again.

Whenever the instrument is in measurement mode, you also can check the current date and time by briefly pressing the TIME button. Doing so causes both values to appear briefly at the lower left of the display.

Holding and storing measurements
4. **To hold a measured value** of pH or ORP, press the HOLD/ESC button during the measurement. Doing so will cause the word "HOLD" to appear at the top of the display. Pressing the HOLD/ESC button again releases the hold.

5. **To record and recall readings**, press the REC/ENTER button while making measurements. This will make the term "REC" appear at the top of the display. Pressing the REC/ENTER button again, briefly, will make the term "MAX" appear to the right of "REC" and switch the display to the maximum value stored in memory during the last recording session. Pressing the REC/ENTER button again, briefly, will make the term "MIN" appear to the right of "REC" and switch the display to the minimum value stored during the last session.

6. **To exit recording mode,** press and hold the REC/ENTER button for at least three seconds, until the term "REC" disappears from the top line of the display. The display will then revert to showing the current reading.

Automatic vs. manual datalogging
The PHH-SD1 can automatically log data at a user-selected sampling period from 1 second to 9 hours. To view the sampling time for which the instrument was set up, press the LOGGER SET button (which has the words "Sampling check" stenciled below it) once. To change the sampling time, perform Step 5 of the setup procedure.

7. **To start automatic datalogging**, press the REC/ENTER button once. The top line of the display will show the term "REC". Pressing the LOGGER SET button at this point will

make REC flash and add the flashing term "LOGGER" at the top right of the display. This indicates that the instrument is currently storing measured values and their time stamps in memory.

8. **To pause automatic datalogging**, press the LOGGER SET button once; this action makes the flashing term LOGGER disappear from the top right of the display and changes the term "REC" from flashing to constant. Pressing the LOGGER SET button again resumes automatic datalogging.

9. **To end automatic datalogging**, press the REC/ENTER button and hold it for at least two seconds. This action causes the "REC" message to disappear.

10. **To log data manually**, set the sampling time to zero using Step 5 of the setup procedure. Then press the REC/ENTER button once. The display will show the term "REC" on the top line, a value in the middle, and below it the letter "P" on the left and a number from 1 to 99 on the same line to the right. The number indicates the position on the SD card that will be used to store manually logged data.

Now press the LOGGER SET button. This will cause the beeper to sound the term "LOGGER" to briefly appear at the upper right of the display. As in automatic datalogging mode, in this mode the instrument is storing measurements and their time stamps on the SD card.

In manual datalogging mode, however, measurements are being stored continuously (with a sampling time of zero), and their locations on the card can be changed.

11. **To change the storage location of manually logged data**, press the ▼ button once; this causes the "P" to disappear from the left side of the display and the value on its line to begin flashing. Once the flashing begins, you can use the ▼ and ▲ buttons to change the flashing value to any number between 1 and 99. Once you have chosen the storage location, press the REC/ENTER button to save the setting. This causes the value to stop flashing and the "P" to return.

12. **To end manual datalogging**, press the REC/ENTER button and hold it for at least three seconds. This action causes the "REC" message to disappear from the top line of the display.

Transferring data from the SD card to a computer
After automatic or manual datalogging of measurements, remove the SD card from the meter and plug it into your computer either directly (if it has an SD card slot) or through an SD card reader.

Because the files containing time-stamped data logs have the file extension .xls, they open in Microsoft's Excel application. Figures 3, 4 and 5 show three kinds of Excel presentations: a data-only screen, a graphics-only screen, and a mixed data/graphics screen.

	A	B	C	D	E	F	G
1	Position	Date	Time	Ch1_Value	Ch1_Unit	Ch2_Value	Ch2_unit
2	1	2009/8/12	13:16:36	73.1	uS	24.7	Degree_C
3	2	2009/8/12	13:16:38	73.2	uS	24.7	Degree_C
4	3	2009/8/12	13:16:40	73.2	uS	24.7	Degree_C
5	4	2009/8/12	13:16:42	73.2	uS	24.7	Degree_C
6	5	2009/8/12	13:16:44	73.4	uS	24.7	Degree_C
7	6	2009/8/12	13:16:46	73.5	uS	24.7	Degree_C
8	7	2009/8/12	13:16:48	73.4	uS	24.7	Degree_C
9	8	2009/8/12	13:16:50	73.4	uS	24.7	Degree_C
10	9	2009/8/12	13:16:52	73.5	uS	24.7	Degree_C
11	10	2009/8/12	13:16:54	73.3	uS	24.7	Degree_C
12	11	2009/8/12	13:16:56	73.2	uS	24.7	Degree_C
13	12	2009/8/12	13:16:58	73.2	uS	24.7	Degree_C

3. Typical Excel data-only screen
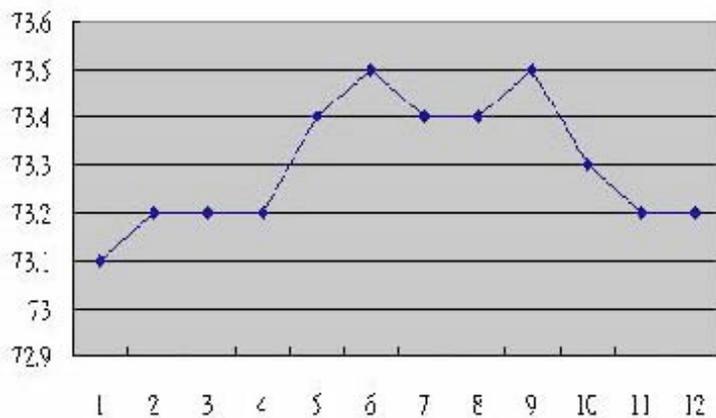
4. Typical Excel graphics-only screen
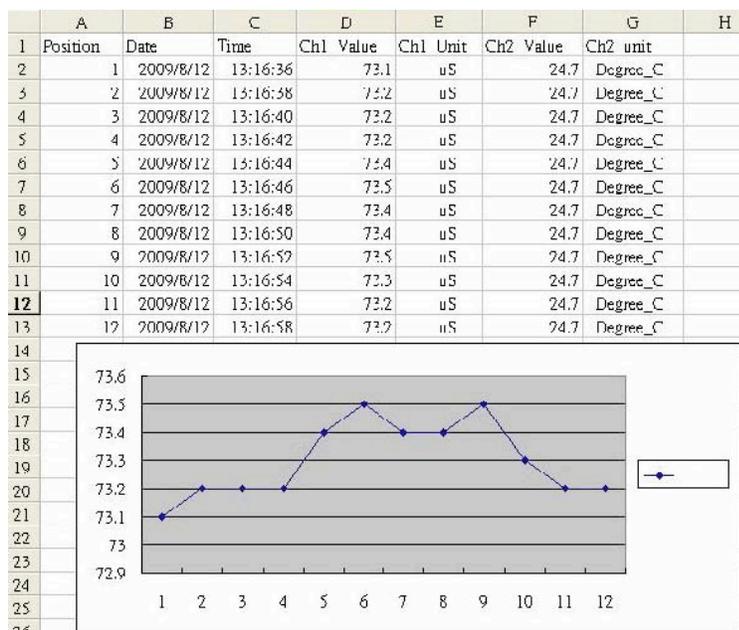
5. Typical Excel mixed data/graphics screen

SPECIFICATIONS

Embedded microcontroller	Custom one-chip LSI device
Display type	Liquid-crystal with green backlight
Display size	2.05 x 1.5 inches (52 x 38 mm)
Parameters measured	pH, ORP
Measurement range	0 to 14 for pH; -1999 mV to +1999 mV for ORP
Measurement accuracy	± (0.02 pH units + 2 digits) for pH; ± (0.5% of reading + 2 digits) for ORP
Measurement resolution	0.01 unit for pH; 1 mV for ORP
Temperature compensation	Automatic between 32 and 150°F (0 and 65°C) when using optional ATC temperature probe; manually settable between 32 and 212°F (0 and 100°C) without ATC probe
Storable/recallable readings	Maximum, minimum
Datalogging sampling time	Settable between 1 second and 8 hours, 59 minutes, 59 seconds (in automatic datalogging mode)
SD card capacity	1 GB to 16 GB
Settable parameters	Date, time, auto power off, beep sound, sampling time, decimal point or comma decimal division, temperature unit, compensation temperature
Operating temperature	32 to 122°F (0 to 50°C)
Operating relative humidity	0 to 85%
Power supply	Six Alkaline AA batteries or optional 9-VDC AC adapter
Power consumption	14 mADC (normal operation, with backlight off and SD card not saving data); 37 mADC with backlight on and card saving data; 49 mADC with backlight on and card saving data
Dimensions	6.97 x 2.68 x 1.77 inches (177 x 68 x 45 mm)
Weight	1.08 lb (489 g)

MAINTENANCE & TROUBLESHOOTING TIPS

Keep the pH and ORP electrodes and ATC temperature probe clean and protected from the elements when not in use. When the pH electrode is not being used, General recommends keeping its head inserted in the bottle of pH buffer solution.

When the icon ⌐⨉¬ appears in the left corner of the display, it's time to replace the six AA batteries that power the instrument (although measurements will remain valid for several hours after the low-battery indicator first appears). Replacing the batteries requires removing the two screws that hold the battery compartment cover in place, as explained earlier. After inserting fresh batteries in the correct orientation, tighten the screws to secure the cover.

If the meter "freezes" (like a computer) and buttons become unresponsive, try resetting the instrument by pushing the RESET button on its right side (callout 1-15 of Fig. 1) with the end of a paper clip.

Remove the batteries when storing the meter for an extended period of time.
Do not drop or disassemble the meter or immerse it in water.

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 in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

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

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

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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