



*sensio*TM**n4** Laboratory
pH/ISE Meter
Instruction Manual

TRADEMARKS OF HACH COMPANY

AccuGrow [®]	H ₂ O University [™]	Pond In Pillow [™]
AccuVac [®]	H ₂ OU [™]	PourRite [®]
AccuVer [™]	Hach Logo [®]	PrepTab [™]
AccuVial [™]	Hach One [®]	ProNetic [™]
Add-A-Test [™]	Hach Oval [®]	Pump Colorimeter [™]
AgriTrak [™]	Hach.com [™]	QuanTab [®]
AluVer [®]	HachLink [™]	Rapid Liquid [™]
AmVer [™]	Hawkeye The Hach Guy [™]	RapidSilver [™]
APA 6000 [™]	HexaVer [®]	Ratio [™]
AquaChek [™]	HgEx [™]	RoVer [®]
AquaTrend [®]	HydraVer [®]	<i>sensio</i> n [™]
BariVer [®]	ICE-PIC [™]	Simply Accurate SM
BODTrak [™]	IncuTrol [®]	SINGLET [™]
BoroTrace [™]	Just Add Water [™]	SofChek [™]
BoroVer [®]	LeadTrak [®]	SoilSYS [™]
C. Moore Green [™]	M-ColiBlue24 [®]	SP 510 [™]
CA 610 [™]	ManVer [®]	SpecV [™]
CalVer [®]	MolyVer [®]	StablCal [®]
ChromaVer [®]	Mug-O-Meter [®]	StannaVer [®]
ColorQuik [®]	NetSketcher [™]	SteriChek [™]
CoolTrak [®]	NitraVer [®]	StillVer [®]
CuVer [®]	NitriVer [®]	SulfaVer [®]
CyaniVer [®]	NTrak [®]	Surface Scatter [®]
Digesdahl [®]	OASIS [™]	TanniVer [®]
DithiVer [®]	On Site Analysis. Results You Can Trust SM	TenSette [®]
Dr. F. Fluent [™]	OptiQuant [™]	Test 'N Tube [™]
Dr. H. Tueau [™]	OriFlow [™]	TestYES! SM
DR/Check [™]	OxyVer [™]	TitraStir [®]
EC 310 [™]	PathoScreen [™]	TitraVer [®]
FerroMo [®]	PbEx [®]	ToxTrak [™]
FerroVer [®]	PermaChem [®]	UniVer [®]
FerroZine [®]	PhosVer [®]	VIScreen [™]
FilterTrak [™] 660	Pocket Colorimeter [™]	Voluette [®]
Formula 2533 [™]	Pocket Pal [™]	WasteAway [™]
Formula 2589 [™]	Pocket Turbidimeter [™]	ZincoVer [®]
Gelex [®]		

TABLE OF CONTENTS

CERTIFICATION	5
SAFETY PRECAUTIONS	9
SPECIFICATIONS.....	11
OPERATION.....	13
SECTION 1 INTRODUCTION.....	15
1.1 Unpacking the Instrument.....	15
1.2 Standard Accessories.....	15
1.3 Keypad Description.....	16
1.4 Display Fields and Icons	18
1.5 Audible Signals	20
SECTION 2 INSTRUMENT SETUP	21
2.1 Instrument Description.....	21
2.2 Power Connections.....	21
2.3 pH/ISE and Temperature Probe Connections.....	21
2.3.1 pH/ISE Probe Connections	21
2.3.2 Temperature Probe Connection	22
2.4 Printer and Computer Connections	23
2.5 Turning the Meter On.....	23
2.6 Temperature Measurement.....	23
2.7 Millivolt Measurements	24
SECTION 3 INSTRUMENT OPERATION	25
3.1 Setup Menu	25
3.1.1 Choosing the Probe Connector	25
3.1.2 Turning Display Lock Off and On.....	26
3.1.3 Selecting Temperature Units.....	26
3.1.4 Selecting Measurement Resolution	27
3.1.5 Selecting Auto Buffer Recognition.....	27
3.1.6 Selecting Stability Criteria.....	27
3.1.7 Setting the Time.....	28
3.1.8 Setting the Month and Day	29
3.1.9 Setting the Year.....	30
3.1.10 Setting the Print Interval.....	30
3.2 Calibrating the Meter	31
3.2.1 Performing a Calibration Using pH 1.68, 4, 6.86, 7, 10, and 12.45 Buffers	31
3.2.2 Calibrating With Other Buffers	32

TABLE OF CONTENTS, continued

3.2.3 One-Point Calibration	33
3.3 ISE Calibration	34
3.4 Reviewing Calibrations.....	36
3.5 Measuring Sample pH	38
3.6 Measuring Samples Using ISEs.....	38
3.7 Measuring Samples Using Standard Additions	39
SECTION 4 STORING AND RECALLING DATA.....	41
4.1 Storing pH/ISE Measurements	41
4.2 Recalling Stored Data	42
4.3 Erasing Data.....	42
4.3.1 Erasing Single Data Points.....	42
4.3.2 Erasing All Data Points.....	43
SECTION 5 PRINTING/TRANSFERRING DATA.....	45
5.1 Connecting to Printers/Computers.....	45
5.1.1 Connecting with the RS232 Cable	45
5.1.2 Connecting to a Printer.....	45
5.1.3 Connecting to a Personal Computer.....	46
5.2 Sending Data to Printers/Computers.....	48
5.2.1 Printing Data at Intervals.....	48
5.2.2 Sending Currently Displayed Data.....	48
5.2.3 Sending Recalled Data Points	49
5.2.4 Sending All Stored Data and the Average pH Value	49
5.2.4.1 Printed Data Format.....	50
5.2.5 PC Control of the Meter through the RS232 Interface.....	50
SECTION 6 TROUBLESHOOTING.....	53
6.1 Introduction.....	53
6.2 Shorting Test.....	53
6.3 Error Codes And Errors	54
6.4 Meter Service Request Questionnaire.....	54
GENERAL INFORMATION.....	55
REPLACEMENT PARTS.....	57
HOW TO ORDER	59
REPAIR SERVICE	60
WARRANTY	61

CERTIFICATION

Hach Company certifies this instrument was tested thoroughly, inspected and found to meet its published specifications when it was shipped from the factory.

The *sensio*TM4 Laboratory pH/ISE Meter has been tested and is certified as indicated to the following instrumentation standards:

Product Safety:

External Power Supplies Only:

115 VAC Supply: UL listed and CSA certified or

230 VAC Supply: CE marked per 73/23/EEC, VDE listed

EMI Immunity:

Instrument tested with external 230V, 50 Hz power supply.

Per **89/336/EEC EMC: EN 61326:1998** (Electrical Equipment for measurement, control, and laboratory use— EMC requirements) Supporting test records by Hach Company, certified compliance by Hach Company.

Standards include:

IEC 1000-4-2: 1995 (EN 61000-4-2:1995) Electro-Static Discharge Immunity (Criteria B)

IEC 1000-4-3: 1995 (EN 61000-4-3:1996) Radiated RF Electro-Magnetic Fields (Criteria B)

IEC 1000-4-4: 1995 (EN 61000-4-4:1995) Electrical Fast Transients/Burst (Criteria B)

IEC 1000-4-5: 1995 (EN 61000-4-5:1995) Surge (Criteria B)

IEC 1000-4-6: 1996 (EN 61000-4-6:1996) Conducted Disturbance Induced by RF Fields (Criteria A)

IEC 1000-4-11: 1994 (EN 61000-4-11:1994) Voltage Dips, Interruptions and Variations (Criteria B)

ENV 50204:1996 Radiated Electro-Magnetic Field from Digital Telephones (Criteria B)

CERTIFICATION, continued

Emissions:

Instrument tested with external 230V, 50 Hz power supply.

Per **89/336/EEC EMC: EN 61326:1998** (Electrical Equipment for measurement, control, and laboratory use— EMC requirements). Class B emission limits. Supporting test records by Hewlett Packard Hardware Test Center, Ft. Collins, CO (A2LA #0905-01), certified compliance by Hach Company.

Standards include:

EN 61000-3-2 Harmonic Disturbances Caused by Electrical Equipment

EN 61000-3-3 Voltage Fluctuations (Flicker) Disturbances Caused by Electrical Equipment

Additional Standards include:

EN 55011 (CISPR 11) Emissions, Class B Limits

Additional Emissions Standard/s include:

CANADIAN INTERFERENCE-CAUSING EQUIPMENT REGULATION, IECS-003: Class A emission limits. Supporting test records by Hewlett Packard Hardware Test Center, Ft. Collins, CO (A2LA #0905-01), certified compliance by Hach Company.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

FCC PART 15, Class “A” Limits:

Supporting test records by Hewlett Packard Hardware Test Center, Ft. Collins, CO (A2LA #0905-01), certified compliance by Hach Company.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

CERTIFICATION, continued

(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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. The following techniques of reducing the interference problems are applied easily.

1. Disconnect the external power supply from *sensioN4* Laboratory pH meter to verify that the meter is not the source of interference.
2. Move the meter away from the device receiving the interference.
3. Reposition the receiving antenna for the device receiving the interference.
4. Try combinations of the above.

SAFETY PRECAUTIONS

Please read this entire manual before unpacking, setting up, or operating this instrument. Pay particular attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To ensure the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that which is specified in this manual.

Use of Hazard Information

If multiple hazards exist, this manual will use the signal word (Danger, Caution, Note) corresponding to the greatest hazard.

DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTE

Information that requires special emphasis.

Precautionary Labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.



This symbol, if noted on the instrument, references the instruction manual for operational and/or safety information.



Section 2.2 on page 21



Section 2.3 on page 21



Section 2.4 on page 23



Section 5.1 on page 45

SPECIFICATIONS

Specification subject to change without notice.

pH mode

Range	-2.00 to 19.99
Resolution	0.001/0.01/0.1 (selectable)
Slope range	45 to 65 mV/decade at 25 °C

ISE mode

Range	0.000 to 19900
Resolution	Auto-ranging

Millivolt mode

Range	-2000 to 2000 mV
Resolution	0.1 mV
Accuracy	±0.2 mV or ±0.05% of reading, whichever is greater

Temperature mode

Range	-10.0 to 110 °C (can also display °F)
Resolution	0.1 °C
Accuracy	±0.3 °C from 0–70 °C ±1.0 °C from 70–110 °C

Display: Custom LCD

Inputs: 2 BNC; two 5-pin Hach pH/temperature or Hach temperature probe; 2 pin-tip; (one combination input type for each of the two channels or two half-cells per channel).

Outputs: Two-way RS232

Power Requirements: 6–9 VDC provided by 120 V 50/60 Hz or 230 V, 50 Hz external power supply or a customer-provided supply with 50 mA output, 5.5-mm power plug with a 2.5 mm center post opening.

Installation Category: II (for external power supplies)

Input Impedance: $>10^{12}$ ohms

Instrument Drift: $<40 \mu\text{V}/^\circ\text{C}$

Input Bias Current: $<\pm 1$ picoamp at 25 °C; $<\pm 4$ picoamp over full range

SPECIFICATIONS, continued

Environmental Requirements: 0 to 50 °C at 85% non-condensing relative humidity. Enclosure is water resistant, chemical resistant, dust proof.

Dimensions: 25.4 x 15 x 8.37 (10.15 x 6 x 3.35 in.)



OPERATION

DANGER

Handling chemical samples, standards, and reagents can be dangerous. Review the necessary Material Safety Data Sheets and become familiar with all safety procedures before handling any chemicals.

DANGER

La manipulation des échantillons chimiques, étalons et réactifs peut être dangereuse. Lire les Fiches de Données de Sécurité des Produits (FDSP) et se familiariser avec toutes les procédures de sécurité avant de manipuler tous les produits chimiques.

PELIGRO

La manipulación de muestras químicas, estándares y reactivos puede ser peligrosa. Revise las fichas de seguridad de materiales y familiarícese con los procedimientos de seguridad antes de manipular productos químicos.

GEFAHR

Das Arbeiten mit chemischen Proben, Standards und Reagenzien ist mit Gefahren verbunden. Es wird dem Benutzer dieser Produkte empfohlen, sich vor der Arbeit mit sicheren Verfahrensweisen und dem richtigen Gebrauch der Chemikalien vertraut zu machen und alle entsprechenden Material Sicherheitsdatenblätter aufmerksam zu lesen.

PERIGO

A manipulação de amostras, padrões e reagentes químicos pode ser perigosa. Reveja a folha dos dados de segurança do material e familiarize-se com todos os procedimentos de segurança antes de manipular quaisquer produtos químicos.

Hach provides pH and ISE meters for applications from pH measurements to accurate Ion Selective Electrode work. This manual describes the operation and use of the Hach *sension*^{TM4} Portable pH/ISE/mV/Temperature Meter (see *Figure 1*).

This meter features a custom digital LCD display which simultaneously displays temperature and measurement results. This meter has all the features of a simple pH/ISE meter plus:

- two measurement channels
- a millivolt mode
- standard additions program
- automatic buffer recognition when in the pH mode
- pH averaging
- calibration review
- datalogging
- bi-directional RS232 communication for printing results to a computer or printer, or controlling the meter from a PC.

The meter is designed to be maintenance-free. If the meter gets dirty, wipe the surface with a damp cloth. Use a cotton-tipped applicator to clean or dry the connectors if they get wet.

1.1 Unpacking the Instrument

Remove the instrument and accessories from the shipping container and inspect each item for any damage that may have occurred during shipping. Verify that all items listed on the packing slip are included. If any items are missing or damaged, contact Hach Customer Service, Loveland, Colorado for instructions. Hach's toll free phone number for customers within the United States is 800-227-4224. For customers outside the United States, contact the Hach office or distributor serving you.

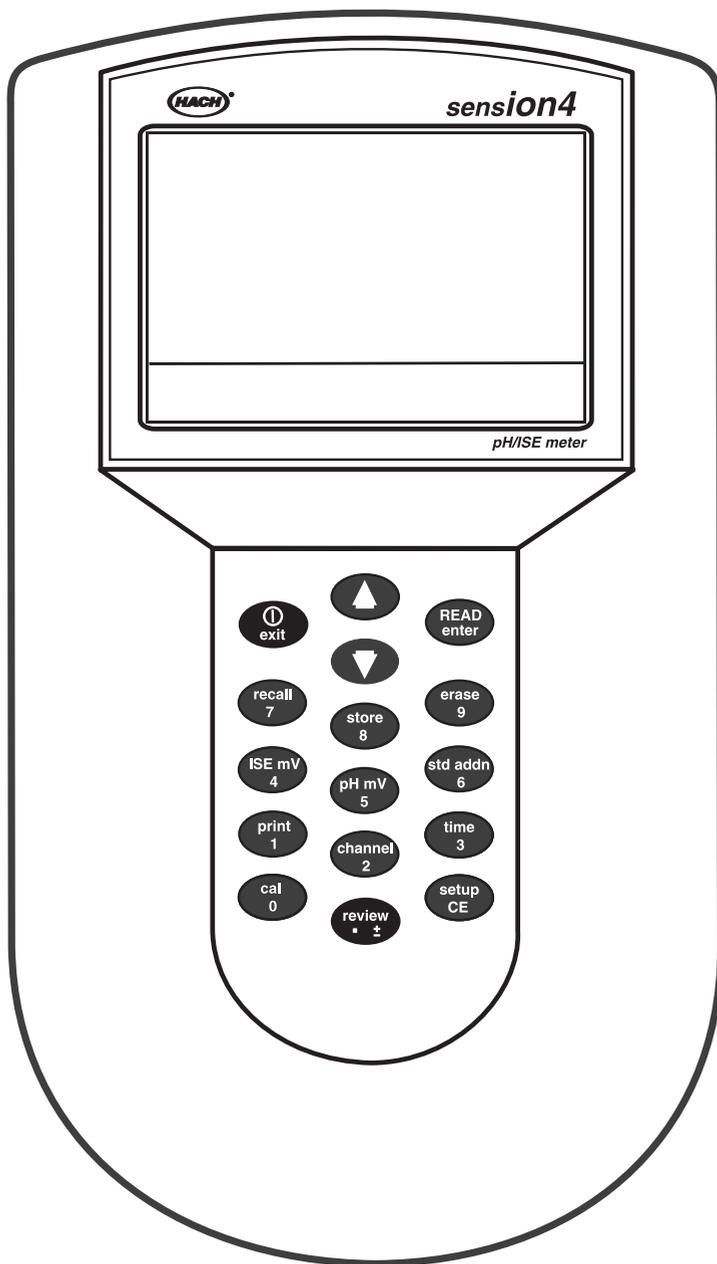
1.2 Standard Accessories

- AC to DC wall adapter
- Instrument Manual
- Include electrode and related accessories (covered in the electrode manual).

1.3 Keypad Description

Figure 1 illustrates the meter's keypad. The description and function of each key are given in Table 1.

Figure 1 Hach *sension4* Meter



SECTION 1, continued

Table 1 Keys and Description

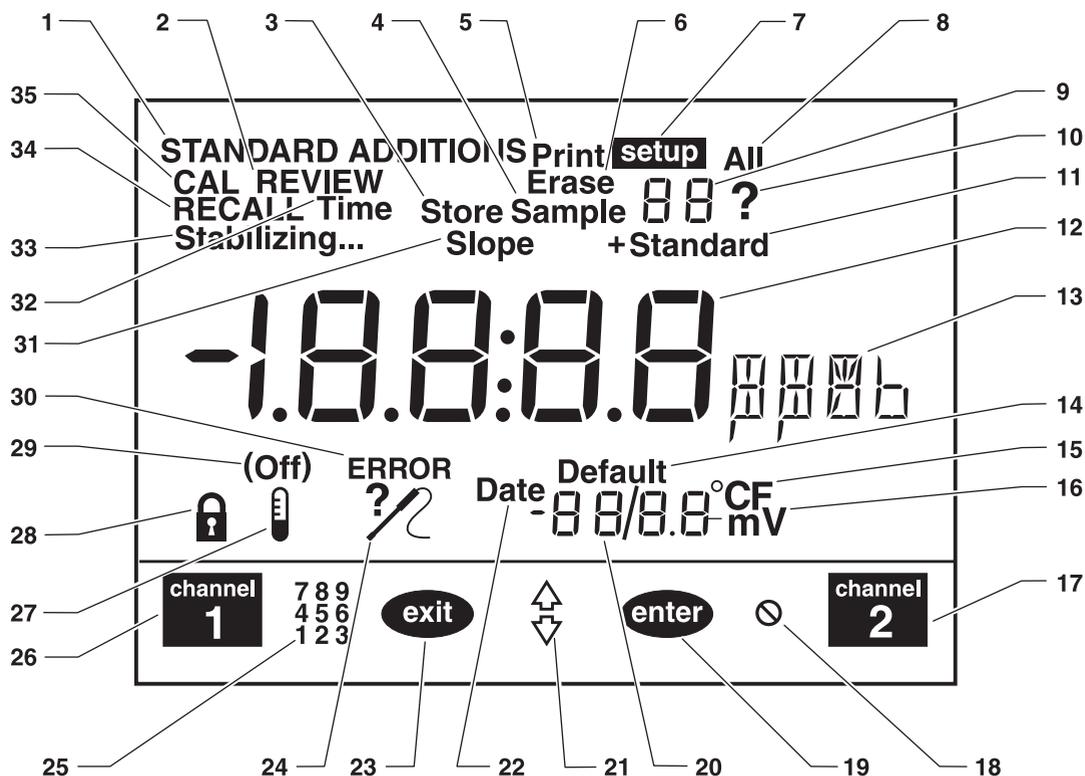
Key	Description
Exit/Power On-Off	Turns the instrument on; turns it off from a Reading mode. Acts as a NO or Cancel key when the question mark icon is flashing. In Setup mode, backs up one step toward the Reading mode. Performs the following and returns to the most recent Reading mode: <ul style="list-style-type: none">• Exits the Store or Recall mode• Aborts a calibration• Exits a calibration review
Arrow Keys	Scrolls between options in Setup mode. Scrolls through data points in Store and Recall modes. Scrolls between the option to print or erase one data point and all data points. Changes the default temperature when a temperature probe is not in use.
READ/ENTER Key	Accepts numerical input. Acts as a "YES" answer when the question mark is flashing. Allows user to edit a setup when the setup number is flashing. Accepts the current Setup option when that option is flashing. Initiates a new measurement when the meter has stabilized in the Display Lock Enabled mode.
Recall Key	Recalls stored sample data (from Reading mode only).
Store Key	Stores the current (displayed) measurement (from Reading mode only).
Erase Key	Erases recalled data points.
ISE/mV Key	Toggles between ISE concentration value and mV in Reading, Calibration, and Cal Review modes.
pH/mV Key	Toggles between pH value and mV value in Reading, Calibration, and Cal Review modes.
Std Addn	Moves meter into program to use for standard additions.
Print Key	Sends current or recalled data to a printer or a computer via the RS232 port.
Channel	Toggles between channel 1 and 2. Will not toggle in Calibration, Cal Review, and Recall modes.
Time Key	In Reading mode, allows user to view the current time and date. In Recall Data mode, it toggles between the time and date of the stored measurement.
Cal Key	Enters Calibration mode (from Reading mode only)
Review Key	Enters Calibration Review mode (from Reading mode only)
Setup/CE Key	Enters Setup mode (from Reading mode only) or clears a numeric entry when the keypad icon is displayed.

1.4 Display Fields and Icons

The display has two screens. The upper screen displays measurements or standard values, operation mode, slope, sample/default temperature, pH or mV units, error codes, and indicates if the meter reading is stable. The lower screen displays keys that are active.

Figure 2 shows the icons and screens displayed by the meter and Table 2 describes each element. All icons on the display will be displayed if the power key is held down for several seconds.

Figure 2 *sensION4* Display



SECTION 1, continued

Table 2 Main Display Elements

Item No.	Description
1	Indicates meter is in Standard Addition mode.
2 (Cal Review)	Indicates meter is in Calibration Review mode.
3	Used with ? to ask if user wants to store calibration, standard value, or sample value
4	Indicates the meter is measuring/reviewing a sample (sample # is displayed to the right).
5	Indicates data is being sent to a printer/computer.
6	Indicates recalled data that is currently displayed is being erased.
7	Indicates meter is in Setup mode.
8	Indicates all data points are being printed or erased.
9	Numerical field that displays Setup, Sample, and Standard numbers when those words are displayed with the number. If Standard and 1 are displayed, the meter is measuring Standard 1.
10	Flashing ? and CAL indicate calibration is necessary. Also a prompt to press the ENTER or EXIT key.
11	Indicates the meter is measuring/reviewing a standard (standard # is displayed above).
12	Numerical field that displays the values of standards and samples, slope, pH or mV.
13	Indicates measurement units (pH, mV, mg/L, µg/L, ppm, ppb, M).
14	When Default is displayed, the meter is using the default temperature value to calculate the temperature correction for the pH value.
15	Temperature units (choice of °C or °F).
16	Indicates value displayed in small numerical field (item 20) is in millivolts.
17	Indicates channel 2 is in use.
18	Indicates an inactive key has been pressed and that function is not allowed.
19	Indicates ENTER key is active.
20	Numerical field that displays temperature value.
21	Indicates arrow keys are active.
22	Indicates the date is being set or displayed.
23	Indicates EXIT key is active.
24	Faulty probe connection or incorrect probe attached. Usually displayed with an error code.
25	Indicates numeric part of the keys is active.
26	Indicates channel 1 is in use.
27	NA
28	Display Lock icon. Indicates reading is locked after stability is achieved.
29	In setup mode, indicates whether Display Lock setting is On or Off.
30	Indicates a meter function problem.

SECTION 1, continued

Table 2 Main Display Elements (Continued)

Item No.	Description
31	Indicates the displayed number is the electrode slope.
32	Indicates Time is being set or displayed.
33	When on or flashing, Stabilizing... indicates signal from sample is not yet stable. When it disappears, the reading is stable.
34	Indicates meter is in recall mode and the data displayed is stored data.
35 (CAL)	Indicates meter is in Calibration mode. If the ? is flashing, calibration is necessary.

1.5 Audible Signals

The meter will beep under certain conditions:

- a non-functional key press is made (one beep)
- when display lock is enabled and measurement stability is reached during reading mode (three beeps)
- any time measurement stability is reached during calibration mode, regardless of the Display Lock setting
- to signal an error condition (two beeps)
- if the number entry and a press of the **ENTER** key causes two beeps, the meter will automatically return to the beginning of number entry.

2.1 Instrument Description

This *sensio*TM4 Laboratory pH/ISE/mV meter is designed for laboratory use and operates on 115/230 VAC power. Two channels are available for electrode connection.

The meter measures from -2.0 to 19.99 pH units and the sample temperature. Displayed pH values are temperature corrected using the measured sample temperature or a default temperature setting. To display mV and pH values, press the **pH/mV** key to toggle between the units.

In the ISE mode, the meter measures from 0 to 19900 with the highest resolution as ten thousandths (0.0001). To display mV and concentration values, press the **ISE/mV** key to toggle between the units.

2.2 Power Connections

A 115 or 230 AC to DC converter is required to power the meter. Plug the power jack of the adapter into the meter power connector (see *Figure 3*). Then plug the adapter into the wall.

2.3 pH/ISE and Temperature Probe Connections

2.3.1 pH/ISE Probe Connections

Electrodes may be simultaneously attached to the 5-pin and BNC connectors of the same channel as long as they are not in contact with the same solution. To select either of the connectors for measurement, go to **Setup 1** and choose one.

Five-pin Connectors

Attach pH electrodes with 5-pin connectors to the meter input by lining the pins up with the holes in the meter port (see *Figure 3*). Push towards the instrument.

BNC Connectors

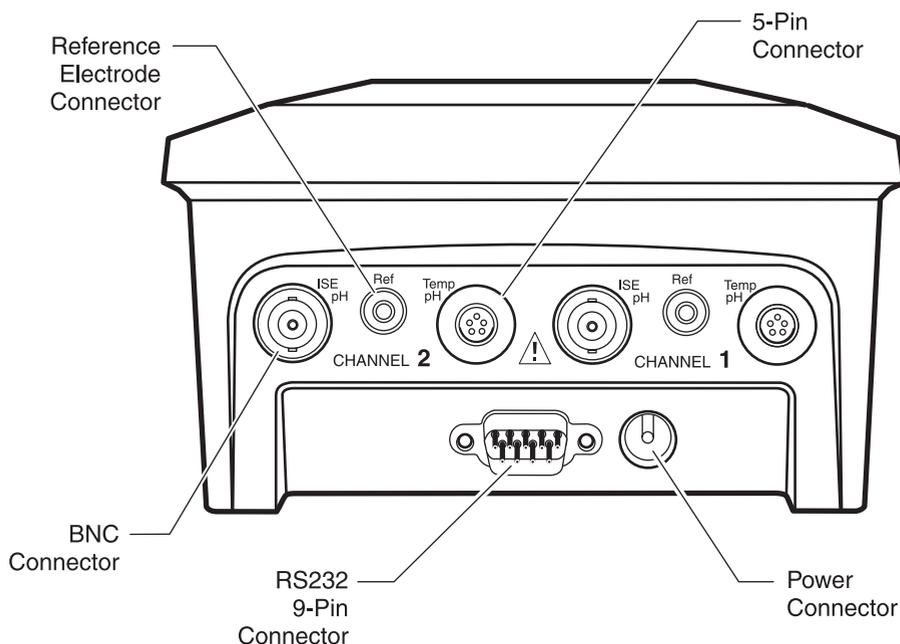
For pH or ISE probes with BNC connectors, slide the connector into the input. Push towards the instrument and turn the metal sleeve clockwise to lock into position. Do not use a pH probe with temperature sensor to measure temperature while using an ISE probe.

Pin-type Connectors

When using half-cells, connect reference electrodes with pin tip connectors by pushing the connector straight into the center reference input.

Note: If using a combination electrode with a BNC or 5-pin connector, the reference pin-tip jack is not used.

Figure 3 *sensION4* Power, RS232, and Probe Connections



2.3.2 Temperature Probe Connection

Hach pH electrodes with the 5-pin connector have the temperature sensing unit included in the electrode probe and require only the 5-pin connector. If using a pH electrode with BNC connector, connect the Hach Temperature Probe (Cat. No. 51980-00) to the 5-pin connector on the meter (see *Figure 3*). The user can also measure the temperature manually and enter the value as the default temperature on the meter (see *Section 2.6* on page 23). Do not use a pH probe with temperature sensor to measure temperature while using an ISE probe.

2.4 Printer and Computer Connections

The meter can send data to a computer or printer via the 9-pin serial port on the meter (see *Figure 3*). **The printer cable and computer cable are different.** The printer cable is a 9-pin to 25-pin cable and the computer cable is a 9-pin to 9-pin cable. Be sure to use the correct cable.

The meter can print to serial printers without an adapter. For parallel printers, a converter and cable adapter are required. The Citizen PN60 printer (Cat. No. 26687-00) requires a special Citizen adapter (supplied with the printer). Pressing the **PRINT** key will send the currently displayed data to the printer or the user can enable the autoprint function (see *3.1.10* on page 30). The data may be either a current measurement or recalled data.

To communicate with a computer, connect the 9-pin serial port on the meter to a 9-pin serial port of the computer using a 9-pin to 9-pin cable. Pressing the **PRINT** key will send the currently displayed data to the computer. The data may be either a current measurement or recalled data. To send commands from a computer, see the *Table 6* on page 51.

2.5 Turning the Meter On

After plugging the correct power adapter into the wall, turn the instrument on using the **I/O/EXIT** key (located on the upper left side of the keypad). Press the key once to power the instrument up. The display will show the software version number, then move to the Reading mode.

2.6 Temperature Measurement

The meter displays temperature in the range of -10.0 to +110 °C simultaneously with sample results. If a temperature probe is properly connected, actual temperature measurements are displayed in the temperature/mV field.

The meter requires a temperature to calculate temperature-corrected pH readings. The meter uses temperature data from one of three sources:

- The temperature sensor in the sample
- The factory default setting (20 °C)
- A user-entered default setting

SECTION 2, continued

If a temperature probe is connected properly, the meter will display the current sample temperature and will not allow the temperature to be manually set.

To manually set the temperature

When a temperature probe is not used to supply the temperature for pH temperature compensation, the default temperature (20 °C) will be used. In either case, **Default** will be displayed above the temperature.

To change the default temperature, first put the meter in Reading or Calibration mode. Press the arrow keys to increase or decrease the displayed default temperature value to the desired temperature. The value adjusts in 0.1 °C (0.1 to 0.2 °F) increments. To scroll rapidly, hold the arrow key down.

***Note:** Acceptable temperatures range from -10 to 110 °C.*

To change the units of temperature measurement, see Section 3.1.3 on page 26.

2.7 Millivolt Measurements

The meter can be used to measure absolute millivolts (mV). To display a current millivolt reading, press the **pH/mV** or **ISE/mV** key. The mV value is displayed with **mV** in the units field. Press the key again to return to pH or ISE measurement units.

Absolute millivolts are displayed with 0.1 mV resolution in the range of -2000.0 to +2000.0. The millivolt mode is useful when measuring oxidation-reduction potential, performing potentiometric titrations, or preparing calibration curves. Detailed instructions for any Hach electrode are given in the electrode instruction manual. Titration instructions are included in the Hach ORP Electrode Instruction Manual, or in standard analytical chemistry texts.

3.1 Setup Menu

The *sension*TM4 Laboratory pH/ISE meter has a setup menu for each channel which allows the analyst to choose options for connector choice, display lock, temperature units, display resolution, automatic buffer recognition, time, date and others (see *Table 3*). Each channel can have separate setup options except date and time.

To access the Setup menu, press the **SETUP** key. The arrow icons will be displayed, indicating that additional options are available within the menu. Press the up or down arrow key to scroll to the desired option, then press **ENTER**. To exit the setup menus, press **EXIT** until the meter returns to Reading mode.

When using the Setup menu, the screen will display a number in the upper right numerical field, indicating which option is being changed. *Table 3* describes these options.

Table 3 *sension*4 Setup Options

Setup Number	Setup Description
1	Use BNC or 5-pin connector
2	Display lock (On or Off)
3	Temperature units (°C or °F)
4	pH measurement resolution (0.0, 0.00, or 0.000)
5	Buffer auto recognition (6.86 or 7.00)
6	Stability criteria
7	Time of day (24-hour clock)
8	Date (mm/dd)
9	Year (4 digits)
10	Print interval settings

3.1.1 Choosing the Probe Connector

This setup ensures the potential from the appropriate electrode is detected by the meter. Do not use both a pH electrode and an ISE electrode from the same channel in the same solution. Both can be connected if they are in separate solutions, but only the electrode on the selected connector (BNC or 5-pin) will be active.

SECTION 3, continued

1. From the reading mode, press **SETUP**.
2. The **Setup** icon and the number **1** (flashing) will be displayed. Change the connector choice by pressing **ENTER**; this toggles the selection between **BNC** and **5 pin**.
3. When the desired option is selected, press **EXIT** to return to the reading mode.

3.1.2 Turning Display Lock Off and On

Setup 2 is the Display Lock option. This feature stops measurement reading fluctuation on the display once a stable reading is reached. The default setting is Off.

When this feature is not used, the measurement value may continue to fluctuate.

1. From the reading mode, press **SETUP**.
2. The **Setup** icon and the number **1** (flashing) will be displayed. Press the up arrow once so the Setup number is **2**.
3. Change the Display Lock status by pressing **ENTER**; this toggles the Display Lock between off and on. When the Display Lock is disabled, the Display Lock icon and **Off** are displayed. When this feature is enabled, the Display Lock icon is displayed when the stabilization criteria are met.
4. When the desired option is selected, press **EXIT** to return to the reading mode.

3.1.3 Selecting Temperature Units

1. From the reading mode, press **SETUP**.
2. The **Setup** icon and the number **1** (flashing) will be displayed. Press the up arrow twice so the Setup number is **3**.
3. Change the temperature unit by pressing **ENTER**; this key toggles the temperature units between °C and °F. The default is °C.
4. When the desired option is selected, press **EXIT** to return to the reading mode.

SECTION 3, continued

3.1.4 Selecting Measurement Resolution

The meter can display pH measurement values to tenths (0.0), hundredths (0.00) or thousandths (0.000). The default is hundredths. The choice of resolution affects the stability criteria.

1. From the reading mode, press **SETUP**.
2. The **Setup** icon and the number **1** (flashing) will be displayed. Press the up arrow until the Setup number is **4**.
3. Change the resolution by pressing **ENTER**; this toggles between the three resolution options.
4. When the desired option is selected, press **EXIT** to return to the reading mode.

3.1.5 Selecting Auto Buffer Recognition

The *sension4* Meter is designed to auto-recognize and calibrate on 1.68, 4.01, 6.86 or 7.00, 10.01, and 12.45 pH buffers.

The only selection option for pH buffer auto recognition is choosing 6.86 or 7.00. The default is pH 7.00. To change this option:

1. From the reading mode, press **SETUP**.
2. The **Setup** icon and the number **1** (flashing) will be displayed. Press the up arrow until the Setup number is **5**.
3. Change the buffer value by pressing **ENTER**; this toggles the between the choices 6.86 and 7.00.
4. When the desired option is selected, press **EXIT** to return to the reading mode.

3.1.6 Selecting Stability Criteria

The meter is designed to recognize a stable ISE reading based on the rate of drift in mV/min (criteria are automatically selected for pH measurement based on resolution). If the electrode voltage is drifting slower than the chosen mV stability criteria, the display will show a stabilized reading. If the electrode voltage is drifting faster than the chosen mV stability criteria, the display will continue to display **Stabilizing...** and measurement values will fluctuate.

SECTION 3, continued

The default stability drift rate is 0.500 mV/min. Lower stability criteria (i.e., 0.300 mV/min) will require longer stabilization times, but the measurement will be more precise. Higher stability criteria will require shorter stabilization times, but measurements may be less precise.

To change this option:

1. From the reading mode, press **SETUP**.
2. The **Setup** icon and the number **1** (flashing) will be displayed. Press the up arrow until the Setup number is **6**.
3. Change the stability criteria by pressing **ENTER**. The display will show **_ _ _ _**. The numbered keypad will become active.
4. Enter the desired mV value using the keypad. Press **ENTER** when entry is complete.
5. If a number entry error occurs, start over by pressing **SETUP/CE**.
6. When the desired value has been accepted, press **EXIT** to return to the Reading mode.

3.1.7 Setting the Time

1. From the reading mode, press **SETUP**.
2. The **Setup** icon and the number **1** (flashing) will be displayed. Press the up arrow until the Setup number is **7**.
3. Change the time by pressing **ENTER**. The main display will change to **_ _ : _ _**, with the left place holder flashing. The numerical keypad will become active.
4. Press the desired number key for the left most digit. The meter uses a 24-hour military clock (12 a.m. = 00:00; 1 p.m. = 13:00). All four digit places must have a number. If the left-most digit(s) is not necessary, use zero for the value (i.e., 08:15 for 8:15 a.m. or 00:30 for 12:30 a.m.).

SECTION 3, continued

5. Once a number key is pressed, the next digit place holder will flash. Continue to enter the desired numbers until all four places have a value. Press **ENTER**.
6. If a number entry error occurs, start over by pressing **SETUP/CE**.
7. When the desired value has been accepted, press **EXIT** to return to the Reading mode.

3.1.8 Setting the Month and Day

1. From the reading mode, press **SETUP**.
2. The **Setup** icon and the number **1** (flashing) will be displayed. Press the up arrow until the Setup number is **8**. The display will show **Date** and a date near the bottom of the display.
3. Change the date by pressing **ENTER**. The numeric display will change to **_/_/_**, with the left place holder flashing. The date format has two places for the month on the left side of the slash and two places for the day of the month on the right side of the slash.
4. The numerical keypad will become active. Press the desired number key for the left most digit. All four digit places must have a number. If the left-most digit is not necessary, use zero for the value (i.e., 02/06 is February 6).
5. Once a number key is pressed, the next digit place holder will flash. Continue to enter the desired numbers until all four places have a value. Press **ENTER**.
6. If an number entry error occurs, start over by pressing **SETUP/CE**.
7. When the desired value has been accepted, press **EXIT** to return to the Reading mode.

SECTION 3, continued

3.1.9 Setting the Year

1. From the reading mode, press **SETUP**.
2. The **Setup** icon and the number **1** (flashing) will be displayed. Press the up arrow until the Setup number is **9**. The display will show **Date** and a year in the main display.
3. Change the year by pressing **ENTER**. The main display will change to **_ _ _ _**, with the left place holder flashing. The numerical keypad will become active.
4. Press the desired number key for the left most digit. Once a number key is pressed, the next digit place holder will flash. Continue to enter the desired numbers until all four places have a value. Press **ENTER** to accept the value.
5. If a number entry error occurs, start over by pressing **SETUP/CE**.
6. When the desired value has been accepted, press **EXIT** to return to the Reading mode.

3.1.10 Setting the Print Interval

The default for this option is Off. To transfer data when this option is disabled, press the **PRINT** key. When this option is enabled, the meter will automatically send data at the selected interval to a computer or printer via the RS232 port.

1. From the reading mode, press **SETUP**.
2. The **Setup** icon and the number **1** (flashing) will be displayed. Press the up arrow until the Setup number is **10**. The display will show the current setting.
3. To change the print interval, press **ENTER**.
4. Use the arrow keys to scroll through the options:
Off
30 sec
0:01 min (1 minute), 0:05 min., 0:20 min.
1:00 hr, 2:00 hr, 6:00 hr
5. Press **ENTER** to select the desired option. Press **EXIT** to leave the setup.

3.2 Calibrating the Meter

The *sensION4* Meter is designed to auto-recognize and calibrate on 1.68, 4.01, 6.86 or 7.00, 10.00, and 12.45 pH buffers. Calibrating with buffers that have pH values other than these requires a modified procedure. Each channel requires independent calibration.

Hach recommends a daily two-point calibration using buffers that bracket the sample pH. This will verify the electrode is working properly and allow the slope value to be stored.

3.2.1 Performing a Calibration Using pH 1.68, 4, 6.86, 7, 10, and 12.45 Buffers

1. Select the desired channel. If using a probe without a temperature sensor, see *Sections 2.3.2* on page 22 and 2.6 on page 23 for information about obtaining and using a default temperature.
2. Prepare pH buffers that bracket the sample pH according to the electrode instruction manual. the meter can be calibrated with two to five autorecognized buffers.

Note: Use a 6.86 or 7.0 pH buffer for the mid-range buffer. To view or change the setting for the mid-range buffer see Section 3.1.5.

Note: The pH values for the buffers are given for 25 °C. If the sample temperature is not 25 °C, the pH values displayed for the buffers will reflect the correct pH value for the sample temperature.

3. Press **I/O/EXIT** to turn the instrument on. Select the desired channel. If necessary, press the **pH/mV** key to get into the pH reading mode (**pH** will be displayed).
4. From the pH reading mode, press **CAL**. **CAL** and **?** will appear in the upper display area, along with **Standard** and **1**.
5. Place the pH electrode in one of the buffers.
6. Press **READ/ENTER**. The temperature and pH values will be updated until a stable reading is reached.

Note: If the meter is measuring in pH mode, it automatically moves to the next calibration step when stabilization is reached (indicated by three beeps). If measuring in mV mode, the three beeps will still sound when the stabilization occurs, but you must press **ENTER** to

SECTION 3, continued

accept the reading. This lets the operator control the acceptance point of the buffer.

7. When the reading has been accepted, the standard number will change to 2.
8. Remove the probe from the first buffer and rinse with deionized water. Place the probe in the second buffer.
9. Press **READ/ENTER**. The temperature and pH values will be updated until a stable reading is reached.
10. When the reading has been accepted, the standard number will change to 3.
11. Repeat *steps 8 and 9* for the third, fourth, or fifth buffer or press **EXIT**. The slope value and the **Store** and ? icons will appear. Verify the slope value is within the ranges specified in the electrode manual.
12. To save the calibration and return to the reading mode, press **ENTER**. To exit the calibration without saving it and return to the reading mode, press **EXIT**.

3.2.2 Calibrating With Other Buffers

1. Select the desired channel. If using a probe without a temperature sensor, see *Sections 2.3.2* on page 22 and *2.6* on page 23 for information about obtaining and using a default temperature.
2. Prepare two pH buffers that bracket the sample according to the electrode instruction manual.
3. Turn the instrument on. Select the desired channel. If necessary, press the **pH/mV** key to get into the pH reading mode (**pH** will be displayed).
4. From the reading mode, press **CAL**. Functional keys will appear in the lower left part of the display. **CAL** and ? will appear in the upper display area, along with **Standard** and **1**. The numeric keypad will become active.

SECTION 3, continued

5. Place the pH electrode in a buffer (starting with the lowest pH makes it easy to keep track).
6. Enter the pH value of the buffer using the number keys and press **ENTER**. A flashing underscore (__) indicates where the next number will be placed. It is not necessary that all four places have a number entered in them.
7. The temperature and pH value will be updated until a stable reading is reached.
8. When the reading has stabilized, the standard number will change to **2**. If measuring in the mV mode, press **ENTER** to continue.
9. Rinse the electrode and place it in the next buffer.
10. Enter the pH value of the buffer using the number keys as described above. Press **ENTER**.
11. When the reading has stabilized, the standard number will change to **3**. Repeat *steps 9–10* for other calibration buffers.
12. Press **EXIT**. The slope value and the **Store** and **?** icons will appear. Verify the slope value is within the ranges specified in the electrode manual.
13. To save the calibration and return to the reading mode, press **ENTER**. To exit the calibration without saving it and return to the reading mode, press **EXIT**.

3.2.3 One-Point Calibration

The one-point calibration is used to adjust the calibration offset and cannot be done unless a prior calibration using at least two points is being used for measurements.

1. From the reading mode, press **CAL**. **Cal**, **1**, **?**, and **Standard** will be displayed.
2. Place the electrode in a pH calibration buffer.
3. Press **READ/ENTER**. The temperature and pH values will be continuously updated until a stable reading is reached.

SECTION 3, continued

4. When the reading has stabilized, the standard number will change to 2.
5. Press **EXIT**. The adjusted offset value, the slope, and the **Store** and **?** icons will appear. Verify the offset value (isopotential point) is within the range specified in the electrode manual.
6. To save the adjusted calibration and return to the reading mode, press **ENTER**. To exit the calibration without saving it and return to the reading mode, press **EXIT**.

3.3 ISE Calibration

Calculation for ISE values does not require temperature compensation, so a temperature probe is not necessary for ISE testing. However, a temperature probe will still function properly and display the correct sample temperature. Use the 5-pin temperature probe available from Hach, Cat No. 51980-00.

1. Prepare standards according to the electrode instruction manual or the instructions for the standard. Use two to five standards for calibration. Pour 25 mL of each standard into a 50-mL beaker.
2. Turn the instrument on. Select the desired channel and the BNC connector (Setup 1). If necessary, press the **ISE/mV** key to get into the ISE reading mode (the last concentration units entered will be displayed).
3. Press **CAL**. Functional keys will appear in the lower left part of the display. **CAL**, **?**, and flashing units will appear.
4. To change the units, use the arrow keys to scroll to the desired choice (g/L, mg/L, $\mu\text{g/L}$, ppm, ppb, M). Press **ENTER**.
5. Add ionic strength adjustor to 25 mL of the least concentrated standard.
6. **Standard**, and **1** will appear in the upper display. If the meter has been calibrated, the last value for standard 1 will appear. The numeric keypad will become active.
7. Place the ISE electrode in the standard with the lowest value. While measuring, stir the solution slowly and steadily.

SECTION 3, continued

8. To enter or change the standard's concentration value, use the number keys, then press **ENTER**. A flashing underscore (__) indicates where the next number will be placed. It is not necessary that all four places have a number entered in them.

To retain the standard concentration value, just press **ENTER**.

Note: Once a new value is entered, the meter will assume the calibration values have changed and will no longer display values for other standards from the previous calibration.

9. The concentration value selected will be displayed until a stable reading is reached. mV values may be observed during calibration by pressing the **ISE/mV** key.

Note: If the meter is measuring in ISE mode, it automatically moves to the next calibration step when stabilization is reached (indicated by three beeps). If measuring in mV mode, the three beeps will still sound when the stabilization occurs, but you must press **ENTER** to accept the reading. This lets the operator control the acceptance point of the standard.

10. When the reading has stabilized, the standard number will change to **2**. The previous value for standard 2 will be displayed if a new value for Standard 1 has not been entered.
11. Add ISA to 25 mL of the standard with the next highest concentration.
12. Rinse the electrode and place it in the standard with the next highest concentration. While measuring, stir the solution slowly and steadily.
13. Enter or change the standard's concentration value using the number keys as described above. Press **ENTER**.
14. To retain the standard concentration value, just press **ENTER**.
15. When the reading has stabilized, the standard number will change to **3**. Repeat *steps 10–12* for each standard. The meter will accept up to seven ISE calibration points and five pH calibration points.
16. After the last standard is measured, press **EXIT**. The **Store** and **?** icons will appear.

SECTION 3, continued

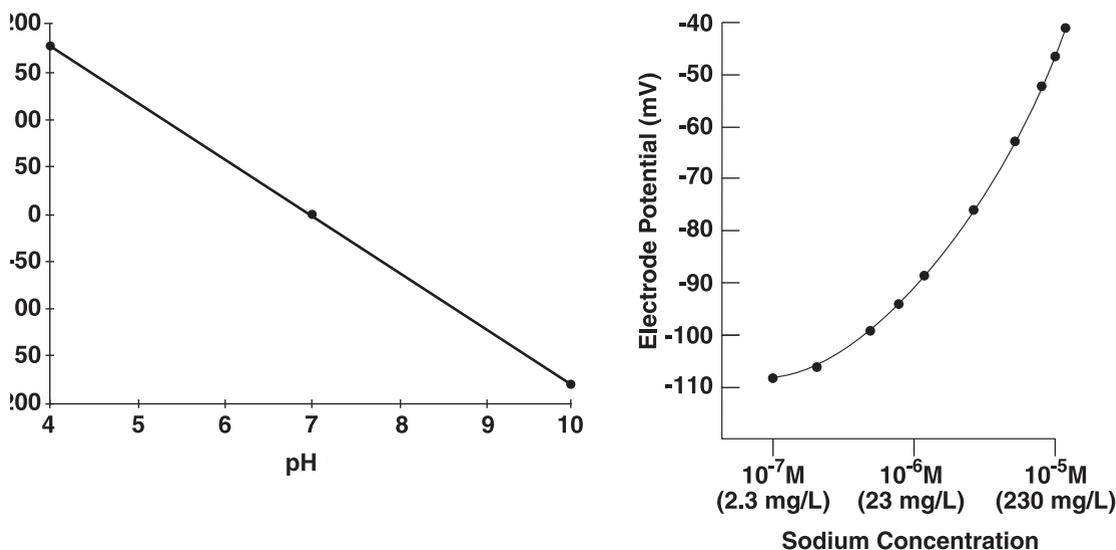
17. To save the calibration and return to the reading mode, press **ENTER**. To exit the calibration without saving it and return to the reading mode, press **EXIT**.
18. After the calibration is stored, the meter is immediately ready to begin measuring samples. See *Section 3.6* on page 38.

3.4 Reviewing Calibrations

pH calibrations result in a linear calibration curve, so only one slope value and its correlation coefficient (r^2) are displayed in Cal Review mode. ISE calibration result in a linear, piecewise calibration for each pair of standards (see *Figure 4*). Therefore, the meter will display a slope for each “calibration” between each pair of standards. The first slope displayed is for Standards 1 and 2. The second slope displayed is for standards 2 and 3, and so forth. Use the arrow keys to scroll to these values.

The mV values for the standards can be viewed by pressing the **ISE/mV** or **pH/mV** key. This toggles between concentration and mV values.

Figure 4 pH and ISE Calibration Curves



SECTION 3, continued

1. Select the desired channel. From the pH or ISE reading mode, press the **REVIEW** key. To review the pH calibration, be sure the meter is in pH mode. To review the ISE calibration, be sure the meter is in ISE reading mode. View mV values by pressing the **pH/mV** or **ISE/mV** key.
2. The meter will display the time the calibration was stored. Press the up arrow key once.
3. The display will show the standard number, standard concentration and temperature. Press the up arrow once.
4. The meter will continue to scroll through the standard information with each press of the up arrow key. When all the standards have been displayed, press the up arrow key again.
5. For pH calibrations, The meter will display the slope and offset of the calibration curve. Press the up arrow again to see the r^2 value for the curve. Skip to *step 8* if reviewing a pH calibration.

For ISE calibrations, the meter will display the slope value of the curve between standards 1 and 2. Press the up arrow once.

6. The meter will display the slope value for the curve between standards 2 and 3.
7. Each press of the up arrow will display the remaining slope values until all the slope values have been displayed.
8. To exit Cal Review mode, press **EXIT**. To review any standard or slope information again, press the down arrow.

3.5 Measuring Sample pH

See instructions in the electrode manual for more information and specific steps for using the electrode.

1. Place the electrode in the sample. Press **READ/ENTER**. **Stabilizing...** will be displayed, along with the sample temperature and the pH or mV reading. These values may fluctuate until the system is stable.
2. When the reading is stable, **Stabilizing...** will disappear. If the Display Lock is enabled, the display will “lock in” on the pH or mV and sample temperature. If the Display Lock is off, **Stabilizing...** will still disappear, but the display will show the current reading and temperature and the values may fluctuate.
3. Record or store the pH or mV value. See *SECTION 4* on page *41* to store or recall data.
4. Remove the electrode from the sample, rinse with deionized water and place the electrode in the next sample. Repeat *steps 1–3* for each sample.
5. When measurements are complete, press the **I/O/EXIT** key to turn the meter off. Rinse the electrode with deionized water and blot dry. Replace the protective cap on the electrode. For proper electrode storage, see the electrode manual for specific instructions.

3.6 Measuring Samples Using ISEs

This is a general guide for ISE measurements. Most measurements require reagent addition. See instructions in the electrode manual for more information and specific steps.

1. After calibration, rinse the electrode and blot dry. If necessary, add ISA to 25 mL of sample. Place the electrode(s) into the sample.
2. When the reading is stable **Stabilizing...** will disappear. If the Display Lock is enabled, the display will show the concentration or mV and sample temperature when a stable reading is reached. If Display Lock is off, **Stabilizing...** will disappear, but the current readings may fluctuate.

SECTION 3, continued

3. Record or store the concentration or mV value. See *SECTION 4* on page 41 to store or recall data.
4. Remove the electrode from the sample, rinse with deionized water, and blot dry. Place the electrode in the next prepared sample. Repeat *steps 1–3* for each sample.
5. When measurements are complete, press the **I/O/EXIT** key to turn the meter off. Rinse the electrode with deionized water and blot dry. Replace the protective cap on the electrode. For proper electrode storage, see the electrode manual for specific instructions.

3.7 Measuring Samples Using Standard Additions

This method should only be used within the linear range of the sensing electrode (see the electrode manual). In this mode, the user may also set the stabilization criteria for the channel used. The slope of the electrode being used must be known.

1. If necessary, add ISA to the sample. Rinse the electrode and blot dry. Place the electrode in the sample.
2. Select the desired channel. From the Reading mode, press **STD ADDN**.
3. The display will show **STANDARD ADDITIONS**, and the units will be flashing. Use the arrow keys to scroll to the desired units, then press **ENTER**.
4. The display will show the slope that was used for the last standard addition measurement. If desired, enter another value using the numerical keypad. To enter a negative slope, enter the number first, then press the **REVIEW/ ±** key. The – sign should appear in front of the slope. Press **ENTER**.
5. The display will show **Sample, mL**, a flashing **?**, and a value for the sample volume.
6. To change the sample volume, use the numerical keypad. When entry is complete or no change is needed, press **ENTER**.
7. The meter will measure the sample for a baseline voltage. **Stabilizing...** will appear until the mV reading is stable.

SECTION 3, continued

8. After stabilizing, the display will show **Standard**, a flashing **?**, **mL**, and a value for the standard volume.
9. To change the standard volume, use the numerical keypad. When entry is complete or no change is needed, press **ENTER**.
10. The display will show **Standard**, a flashing **?**, units, and a value for the standard concentration.
11. To change the standard concentration, use the numerical keypad. Immediately add the selected volume of the selected standard to the sample. Press **ENTER**. Do not press **ENTER** until the standard has been added to the sample.
12. The meter will return to Reading mode. The **+** icon in front of **Standard** indicates that standard has been added to the sample.
13. During measurement the meter will display a mV value. After stabilization, the meter will calculate and display the value of the original sample.
14. If desired, press **STORE** to store this data. When this data is recalled **STANDARD ADDITIONS** will appear in the display.

4.1 Storing pH/ISE Measurements

The *sensio*TM4 meter can store up to 99 measurement readings. Data must be stored to recall it later for review, downloading, or printing. Although the meter display will only show the temperature, data location, and pH/ISE value, the following information is stored (and can be downloaded or printed) for each sample:

- storage location
- software version
- date
- time
- channel
- mV reading
- sample temperature
- pH or ISE value
- instrument model and serial number

The new data is saved in the next available memory location, numbered from 1 to 99. If no memory locations higher than the current one are available, the meter will “wrap around” and choose the next available location. The user also has the option of choosing the storage location.

To store data:

1. Press **STORE**. The display will prompt **Store Sample #?** (# is the next available location). The question mark will be flashing.
2. Press **ENTER** to store the measurement reading in that location number. To store the data in another location, use the arrow keys to scroll to another location or enter a location using the number keys. Press **ENTER**.

Note: *If all memory locations are full, the meter will prompt to overwrite a data point by displaying **Erase Sample ##?** Press **ENTER** to replace the data in that location with the current data. Press **EXIT** to return to the previous screen without replacing the data.*

3. The meter will store the reading and return to Reading mode.

4.2 Recalling Stored Data

1. To recall stored data, press the **RECALL** key while in the Reading mode. The screen will display the most recently saved or recalled measurement data.
2. Use the arrow keys to scroll to the desired storage location. Press **RECALL** again to allow number entry of a storage location. The question mark will flash. Enter the number of the desired storage location. Press **ENTER** to accept the storage location or **EXIT** to escape.
3. To display the mV value of the reading, press the **pH/mV** or **ISE/mV** key.
4. To review the time of the calibration, press **TIME** once. To review the date of the calibration, press **TIME** twice. Press **EXIT** to return the reading value.
5. When recalling is complete, press **EXIT** to return to the Reading mode.

4.3 Erasing Data

4.3.1 Erasing Single Data Points

1. To erase data, it must be recalled first. Press the **RECALL** key while in the Reading mode. See *Section 4.2* for more information.
2. When the desired data point is displayed, press **ERASE**.
3. The meter will display **Erase Sample #** and a flashing **?**. Press **ENTER** to erase the data. The data will disappear.
4. The meter will recall the most recently stored or recalled. There are three options at this point:
 - Press **ERASE**, then **ENTER**, to erase the displayed data.
 - Press **EXIT** to exit Recall mode.
 - Press an arrow key to scroll to other data points.
5. Repeat *steps 2-3* for each data point that needs to be deleted.

SECTION 4, continued

4.3.2 Erasing All Data Points

1. To erase data, it must be recalled first. Press the **RECALL** key while in the Reading mode. See *Section 4.2* for more information.
2. When the data point is displayed, press **ERASE**.
3. Press the up arrow. The instrument will show **Erase** and **All** with the ? (flashing). At this point the options are:
 - Press **EXIT** to return to Recall mode without erasing.
 - Press the down arrow to return to the single point erase prompt.
 - Press **ENTER** to erase all data and return to Reading mode.
4. After all the data is erased, the meter will return to the Reading mode.

5.1 Connecting to Printers/Computers

5.1.1 Connecting with the RS232 Cable

The standard 9-pin RS232 connector on the meter connects with a 9-pin D-sub connector. A suitable cable is listed under *Optional Apparatus* page 57.

The RS232 interface output is an 8-bit data word plus one stop bit and no parity with a baud rate of 1200. It can communicate with a serial printer or a serial port on a computer.

5.1.2 Connecting to a Printer

Connecting a serial printer to the meter requires a 9-pin to 25-pin RS232 cable. See *Figure 5*. The cable provides a direct link between the instrument and the 25-pin connector used for the serial port on most serial printers. *Table 4* shows the proper pin connections for 25-pin printer cables. Using cables that do not match the pin information in the table may cause undesirable operation.

Parallel printers require a serial-to-parallel adapter. This allows use of printers that are normally used for IBM-compatible applications.

The Citizen PN60 printer requires a special cable to fit into the printer. This cable is shipped with the printer when ordered from Hach Company.

Table 4 Standard 9-pin to 25-pin Printer Cable

9-pin D Connector Socket		Serial Printer 25-pin D Connector, plug	
Pin	Signal Name	Pin	Signal Name
2	RXD	no connection	
3	TXD	3	RXD
4	DTR	no connection	
5	GND	7	GND
6	DSR	20	DTR
7	RTS	no connection	
8	CTS	20	DTR

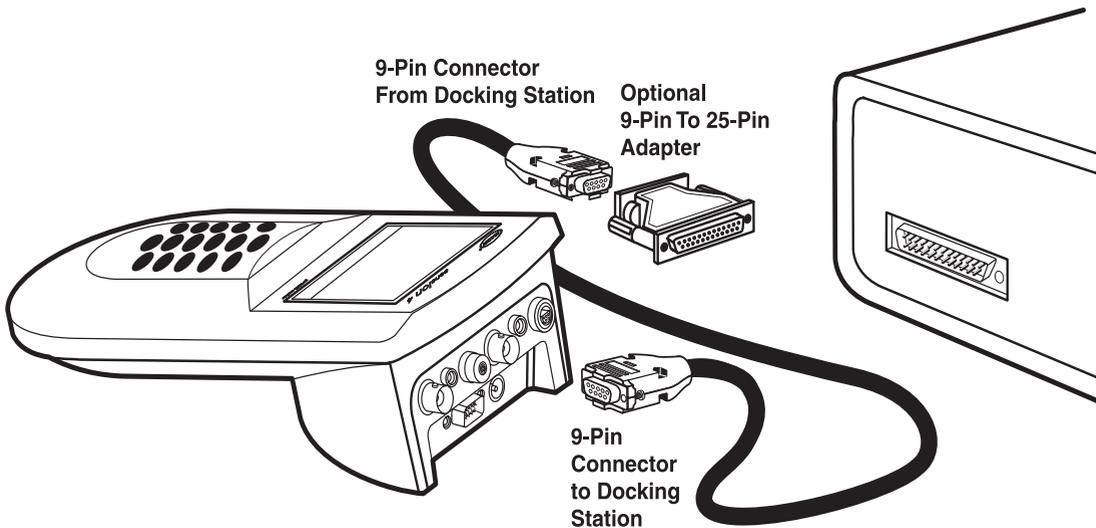
SECTION 5, continued

Connect the RS232 cable to the meter by lining up the holes in the cable connector with the pins of the meter serial port. Gently and firmly push the cable into the meter. Then secure the connection by screwing in the screws on either side of the cable port. Connect the cable to the printer in the same manner. Once the communication link is established, press **PRINT** to send data to the computer.

Note: For optimum performance and ESD protection, use a five-conductor shielded cable. Use a metal shell for the printer or computer terminal connector, and connect the shield of the cable to the metal shell and the sleeve (signal ground) of the RS232 plug.

Follow the printer manufacturer's instructions to configure the printer for compatibility with the meter.

Figure 5 RS232 Cable Connector



5.1.3 Connecting to a Personal Computer

Connect the meter to a personal computer (PC) with the computer interface cable (Cat. No. 48129-00) listed under *Optional Accessories* page 57. The cable provides a direct link between the meter and the 9-pin D connector used for the serial port on most personal computers. If your computer has a 25-pin D connector, use a 9-pin to 25-pin adapter (available at most computer supply stores).

SECTION 5, continued

Table 5 shows the proper pin connections for 9-pin computer cables. Using cables that do not match the pin information in the table may cause undesirable operation.

Table 5 Standard 9-pin to 9-pin Computer Cable

9-pin D Connector Socket		Computer 9-pin D Connector, plug	
Pin	Signal Name	Pin	Signal Name
2	RXD	3	TXD
3	TXD	2	RXD
4	DTR	no connection	---
5	GND	5	GND
6	DSR	no connection	---
7	RTS	8	CTS
8	CTS	7	RTS

Connect the RS232 cable to the meter by lining up the holes in the cable connector with the pins of the meter serial port. Gently and firmly push the cable into the meter. Then secure the connection by screwing in the screws on either side of the cable port (see *Figure 5*). Connect the cable to the computer in the same manner.

To transfer data, the communication parameters (baud rate, data bits and parity) of the meter and the computer must match. Once the communication link is established, press **PRINT** to send data to the computer.

Use a communications software, such as HachLink™ (Cat. No. 49665-00) to collect data from the instrument. HachLink is a Windows-based application that allows a personal computer to capture data from several Hach instruments, including the *sens^{ion}* electrochemical meters. The captured data can be stored in a text file as a spread-sheet compatible format or a free-format text. Data captured in the spreadsheet format is easily transferred into most spreadsheet programs (i.e., MS® Excel, Microsoft® Works, Lotus 123) for graphing and reporting.

To install and run HachLink™ Data Capture, the computer and software must meet the following minimum requirements:

SECTION 5, continued

- IBM PC/AT or compatible with a 386SX processor (16 MHz or better)
- 4 megabytes of RAM
- Hard disk drive with 2 megabytes or more of free space
- 3-1/2 inch, 1.44 megabyte floppy disk drive
- VGA graphics with 640 x 480 or higher resolution, 16 or more colors
- Mouse or other pointing device
- A 9-pin serial port (or 25-pin serial port with 9-pin adapter)
- Windows 3.1 or later
- DOS 3.3 or later

5.2 Sending Data to Printers/Computers

5.2.1 Printing Data at Intervals

The last option in the Setup menu lets the user choose a print interval. When this option is enabled, the meter will automatically send data to a printer or computer at the selected time interval. See Section 3.1.10 on page 30 for more information on enabling this option

5.2.2 Sending Currently Displayed Data

To print or transfer a current reading:

1. Wait until the display is stable. Press **PRINT**.

Note: Data can be printed before the reading is stable. An asterisk will be printed with the measurement data to indicate the stability criteria were not met.

2. The word **PRINT** will be briefly displayed, then the meter will return to Reading mode.
3. The printout for data that is printed without being stored will not have a storage location number.

SECTION 5, continued

5.2.3 Sending Recalled Data Points

1. To transfer data, it must be recalled first. Press the **RECALL** key while in the Reading mode. See *Section 4.2* on page 42 for more information.
2. When the desired sample data is displayed, press **PRINT**.
3. The word **PRINT** will be briefly displayed, then the meter will return to Reading mode.

5.2.4 Sending All Stored Data and the Average pH Value

1. To transfer all data, it must be recalled first. Press the **RECALL** key while in the Reading mode. See *Section 4.2* on page 42 for more information.
2. When a data point is displayed, press **PRINT**. The display will show **Print Sample # ?**.
3. Press the up arrow. The instrument will show **Print, Sample** and **All** with the flashing **?**. At this point the options are:
 - Press **EXIT** to return to Reading mode without printing.
 - Press the down arrow to return to the prompt for printing single data points.
 - Press **ENTER** to print all data and the average pH of the stored data (data that is printed but not stored will not be included). The word **PRINT** will be displayed until all the data has been printed. Then the meter will return to the most recently stored sample data. Press **EXIT** to return to Reading mode or an arrow key to scroll to another data point.

SECTION 5, continued

5.2.4.1 Printed Data Format

Printed data will have the following format:

Storage Location	Channel Number	Reading	Temperature	mV Reading	Date	Time	Meter Model	Serial Number	Software Version	
# 1	<1>	7.53 pH	22.7 C	-30.0 mV	10/03/99	08:30	senslon4	12344577	PX.X	
# 2	<1>	6.13 pH	13.6 C	50.0 mV	10/04/99	09:11	senslon4	12344577	PX.X	
# 3	<2>	7.01 pH	20.1 C	-0.0 mV	10/10/99	12:44	senslon4	12344577	PX.X	
*Average: 6.54				pH						

* This line will not be included unless **Print All** is chosen. This calculation is included for some reporting regulations, but is not just an average of the pH readings. The calculation for the pH average is:

$$\text{pH}_{\text{AVG}} = -\log_{10} \left(\frac{\sum_{i=1}^n (10^{-\text{pH}_i})}{n} \right)$$

5.2.5 PC Control of the Meter through the RS232 Interface

The meter can be controlled remotely using a PC. The communication protocols are 1200 baud rate, 8-bit word, 1-stop bit, no parity. A summary of the commands is shown in *Table 6*.

SECTION 5, continued

Table 6 sensION4 RS232 Commands

Key	Command (upper or lower case)	Returns
Instrument ID	IID	sens ion 4 xxxx (serialized part of serial number)
Exit Key	EXT	OK
Up Arrow	UPA	OK
Down Arrow	DOW	OK
Enter	ENT	OK
Recall	REC	OK
Store	STO	OK
Erase	ERA	OK
ISE/mV	ISE	OK
pH/mV	PHM	OK
Std Addn	STD	OK
Print	PRI	OK
Channel	CHA	OK
Time/Date	TIM	OK
Cal	CAL	OK
Review	REV	OK
Setup	SET	OK
Calibrate Offset (current channel and connector)	CRD	OK

6.1 Introduction

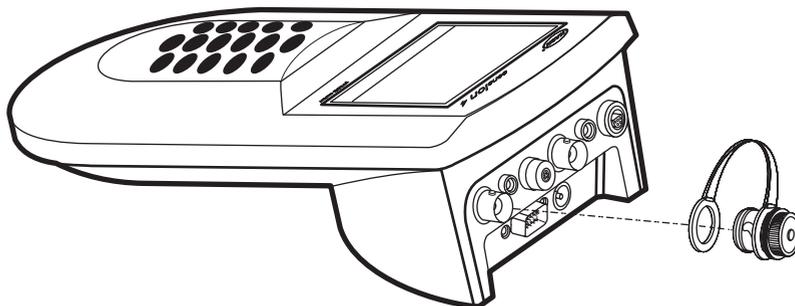
Correcting problem conditions with the *sens^{ion}* electrochemical meters is limited to responding to the error message displayed. Other problems must be handled by a Hach technician at a service center. Refer to Repair Service. **Do not** attempt to service the meter as there are no field-serviceable parts. Opening the meter case will void the warranty.

6.2 Shorting Test

This test detects the meter offset

1. Turn the meter on. Connect the shorting cap to the BNC connector (see *Figure 6*). Make sure the channel with the shorting cap is selected. Select BNC from **Setup 1** choices.
2. Change the output to display in mV (press the **ISE/mV** or **pH/mV** key to toggle between mV and concentration). After the meter has stabilized, simultaneously press **CAL** and **ENTER**. The display should show **0.0 mV**. If it does not, contact Hach Service. Repeat for the other channel.

Figure 6 Attaching Shorting Caps to the BNC Connector



SECTION 6, continued

6.3 Error Codes And Errors

Errors and error codes indicate a functional problem with the meter and/or the electrode. Error codes numbers will appear in the temperature field along with other icons. *Table 7* describes the possible error codes, errors, and some possible solutions to eliminate the cause.

Table 7 Error Codes

Error Code	Error Name & Display Icons	Description
E2	Cal slope error. ERROR and SLOPE will be displayed.	Calibration slope is too high or low. Ensure correct pH buffers are used. Be sure a pH probe is connected to the meter. Disconnect any probe connected to the BNC connector.
E3	Cal Std Error. ERROR, CAL and Standard will be displayed.	The value read will not work in the calibration algorithm. Repeat calibration with new buffers or standards.
E9	Corrupt data	Recalled data had a bad checksum. Call Hach Service.

6.4 Meter Service Request Questionnaire

1. What is the complete lot code of the meter and electrode?
2. On what date was the meter purchased?
3. How long has the meter been in use?
4. What types of samples are being tested?
5. What is the temperature of the samples being tested?
6. How often is the meter being used?
7. How is the meter being stored between uses?
8. If the meter has been in use for a while, what maintenance has been performed?
9. Describe the suspected problem or failure of the meter.
10. Please have your meter, electrode, buffers/standards, and this completed questionnaire near the phone before calling technical support.



GENERAL INFORMATION

At Hach Company, customer service is an important part of every product we make.

With that in mind, we have compiled the following information for your convenience.

REPLACEMENT PARTS

REPLACEMENT REAGENTS

Description	Quantity Required		Cat. No.
	Per Test	Unit	
Buffer Powder Pillows:			
pH 4.01, color-coded red.....	1.....	50/pkg.....	22269-66
pH 7.00, color-coded yellow.....	1.....	50/pkg.....	22270-66
pH 6.86 (NIST).....	1.....	15/pkg.....	14098-95
pH 10.00, color-coded blue.....	1.....	50/pkg.....	22271-66
Buffer Solutions:			
pH 4.00, color-coded red, NIST.....	25 mL....	500 mL.....	22834-49
pH 7.00, color-coded yellow, NIST.....	25 mL....	500 mL.....	22835-49
pH 10.00, color-coded blue, NIST.....	25 mL....	500 mL.....	22836-49
pH Electrode Storage Powder Pillows.....	1.....	20/pkg.....	26573-64
pH Electrode Storage Solution.....	50 mL....	475 mL.....	50301-49

Standards and reagents for ISE testing are listed in the specific electrode manuals

REPLACEMENT APPARATUS

Beaker, poly, 50 mL.....	1.....	each.....	1080-41
<i>sensio</i> TM 4 Benchtop pH/ISE Meter, 115 V.....	1.....	each.....	51775-10
<i>sensio</i> TM 4 Benchtop pH/ISE Meter, 230 V.....	1.....	each.....	51775-11
Shorting Cap, BNC.....	1.....	each.....	51895-00
Temperature Probe, 5-pin.....	1.....	each.....	51980-00

OPTIONAL APPARATUS

Ammonia Combination Electrode, BNC.....		each.....	50250-00
Calcium Half-cell.....		each.....	50240-00
Chloride Combination Electrode, BNC.....		each.....	50225-00
Computer Interface Cable, 9-pin to 9-pin D-sub.....		each.....	48129-00
Cyanide/Iodide Electrode.....		each.....	50260-00
Demineralizer Bottle, 177 mL.....		each.....	14299-00
Electrode Stand.....		each.....	45300-00
Electrode Stand with Electromagnetic Stirrer, 115 Vac.....		each.....	45300-01
Electrode Stand with Electromagnetic Stirrer, 230 Vac.....		each.....	45300-02
Fluoride Combination Electrode.....		each.....	50265-00
Fluoride Half-cell.....		each.....	44500-71
HachLink TM Data Capture software.....		each.....	49665-00
Low Ionic strength Chamber.....		each.....	51899-00
Nitrate Combination Electrode, Platinum Series, BNC.....		each.....	51920-00
ORP Combination Electrode, BNC.....		each.....	50230-00

REPLACEMENT PARTS, continued

OPTIONAL APPARATUS (continued)

Description	Unit	Cat. No.
Platinum Series pH Flat Combination Electrode, 5-pin connector.....	each	51915-00
Platinum Series pH Combination Electrode, w/temp., 5-pin connector ..	each	51910-00
pH Gel-filled Electrode, w/temp., 5-pin connector	each	51935-00
Potassium Half-cell.....	each	50245-00
Printer Interface Cable, 9-pin to 25-pin	each	49503-00
Printer, Citizen PN60I, 115 V, North American Style Plug.....	each	26687-00
Power Cord, for Citizen PN60I, Continental European Style Plug	each	46836-00
Reference Electrode, double junction	each	50225-00
Reference Electrode, single junction	each	50220-00
<i>sensio</i> TM 1 Portable pH Meter.....	each	51700-00
<i>sensio</i> TM 2 Portable pH/ISE Meter.....	each	51725-00
<i>sensio</i> TM 3 Benchtop pH Meter, 115 V, No. American style plug	each	51750-00
<i>sensio</i> TM 3 Benchtop pH Meter, 230 V, European style plug	each	51750-01
Sodium Combination Electrode, Platinum Series, BNC	each	51925-00
Stir Bar, 7/16 X 3/16.....	each	45315-00
Temperature Probe, 5-pin	each	51980-00
Thermometer, mercury, -20 to 110 °C	each	20959-11

HOW TO ORDER

By Telephone:

6:30 a.m. to 5:00 p.m. MST
Monday through Friday
(800) 227-HACH
(800-227-4224)

By FAX:

(970) 669-2932

By Mail:

Hach Company
P.O. Box 389
Loveland, Colorado 80539-0389
U.S.A.

Ordering information by E-mail:

orders@hach.com

Information Required

- Hach account number (if available)
- Your name and phone number
- Purchase order number
- Brief description or model number
- Billing address
- Shipping address
- Catalog number
- Quantity

Technical and Customer Service (U.S.A. only)

Hach Technical and Customer Service Department personnel are eager to answer questions about our products and their use. Specialists in analytical methods, they are happy to put their talents to work for you. Call **1-800-227-4224** or E-mail **techhelp@hach.com**.

International Customers

Hach maintains a worldwide network of dealers and distributors. To locate the representative nearest you, send E-mail to **intl@hach.com** or call (970) 669-3050.

In Canada:

Hach Sales & Service Canada Ltd.; Manitoba, Canada
Telephone: (204) 632-5598; FAX: (204) 694-5134

REPAIR SERVICE

Authorization must be obtained from Hach Company before sending any items for repair. Please contact the Hach Service Center serving your location.

In the United States:

Hach Company
100 Dayton Ave.
Ames, Iowa 50010
(800) 227-4224 (U.S.A. only)
Telephone: (515) 232-2533
FAX: (515) 232-1276

In Canada:

Hach Sales & Service Canada Ltd.
1313 Border Street, Unit 34
Winnipeg, Manitoba
R3H 0X4
(800) 665-7635 (Canada only)
Telephone: (204) 632-5598
FAX: (204) 694-5134
E-mail: canada@hach.com

Other locations:

Hach Company World Headquarters,
P.O. Box 389
Loveland, Colorado 80539-0389 U.S.A.
Telephone: (970) 669-3050
FAX: (970) 669-2932

WARRANTY

Hach warrants most products against defective materials or workmanship for at least one year from the date of shipment; longer warranties may apply to some items.

HACH WARRANTS TO THE ORIGINAL BUYER THAT HACH PRODUCTS WILL CONFORM TO ANY EXPRESS WRITTEN WARRANTY GIVEN BY HACH TO THE BUYER. EXCEPT AS EXPRESSLY SET FORTH IN THE PRECEDING SENTENCE, HACH MAKES NO WARRANTY OF ANY KIND WHATSOEVER WITH RESPECT TO ANY PRODUCTS. HACH EXPRESSLY DISCLAIMS ANY WARRANTIES IMPLIED BY LAW, INCLUDING BUT NOT BINDING TO ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

LIMITATION OF REMEDIES: Hach shall, at its option, replace or repair nonconforming products or refund all amounts paid by the buyer. **THIS IS THE EXCLUSIVE REMEDY FOR ANY BREACH OF WARRANTY.**

LIMITATION OF DAMAGES: IN NO EVENT SHALL HACH BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND FOR BREACH OF ANY WARRANTY, NEGLIGENCE, ON THE BASIS OF STRICT LIABILITY, OR OTHERWISE.

This warranty applies only to Hach products purchased and delivered in the United States.

Catalog descriptions, pictures and specifications, although accurate to the best of our knowledge, are not a guarantee or warranty.

For a complete description of Hach Company's warranty policy, request a copy of our Terms and Conditions of Sale for U.S. Sales from our Customer Service Department.

Hach warrants the meter against defective materials or workmanship three years from the date of shipment. The Docking Station is warranted for one year after the date of shipment.



HACH COMPANY
WORLD HEADQUARTERS
P.O. Box 389
Loveland, Colorado 80539-0389
Telephone: (970) 669-3050
FAX: (970) 669-2932

FOR TECHNICAL ASSISTANCE, PRICE INFORMATION AND ORDERING:

In the U.S.A. - **Call toll-free 800-227-4224**

Outside the U.S.A. - **Contact the HACH office or distributor serving you.**

On the Worldwide Web - **www.hach.com**; E-mail - **techhelp@hach.com**
