HACH®

*sens*ion5™
Conductivity Meter
Manual

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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 *sension™5* Portable Conductivity Meter has been tested and is certified as indicated to the following instrumentation standards:

Product Safety:

Battery Eliminator 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 Docking Station and 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 61000-4-6:1994) 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 Docking Station and external 230 V, 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 Criterion Technology O.A.T.S. (NVLAP #0369), 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

CANADIAN INTERFERENCE-CAUSING EQUIPMENT REGULATION, IECS-003, Class A:
Supporting test records by Criterion Technology O.A.T.S., 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 Criterion Technology O.A.T.S., certified compliance by Hach Company.

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

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

CERTIFICATION, continued

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 the Docking Station and/or remove one of the batteries from the *sension5* Portable Conductivity meter to verify that the meter is or is not the source of interference.

2. Move the meter and its power supply away from the device receiving the interference.

3. Reposition the receiving antenna for the device receiving the interference.

4. Try combinations of the above.

SPECIFICATIONS

Specifications subject to change without notice.

Measurement Range:

Conductivity Range	0–19.99 μS; 20–199.9 μS/cm; 200–1999 μS/cm; 2–19.99 mS/cm; 20–199.9 mS/cm
TDS	0–50,000 mg/L as NaCl
Salinity	0–42 ppt (‰)
Temperature	-10 to 105 °C

Resolution:

Conductivity:

0.00–19.99 μS/cm	0.01 μS/cm
20.0–199.9 μS/cm	0.1 μS/cm
200–1999 μS/cm	1 μS/cm
2.00–19.99 mS/cm	0.01 mS/cm
20.0–199.9 mS/cm	0.1 mS/cm

TDS:

0.00–199.9 mg/L	0.1 mg/L
200–1999 mg/L	1 mg/L
2.00–19.99 g/L	0.01 g/L
20.0–50 g/L	0.1 g/L

Salinity	0.1 ppt
Temperature	±0.1 °C

Accuracy:

Conductivity	±0.5% of range
TDS	±0.5% of full scale
Salinity	±0.1 ppt (-2 to 35°C)
Temperature	±0.3 °C from 0–70 °C ±1.0 °C >70–110 °C

Conversion Factor for TDS: automatic or user adjustable

Temperature Compensation:
> **Manual** (user selected coefficient, % per °C) or
> **Automatic** (non-linear based on NaCl solutions)

Display: Custom LCD

SPECIFICATIONS, continued

Inputs: 5 pin DIN (with temperature); line power

Outputs: One-way RS232

Power requirements:
Meter-4 AA alkaline batteries or via Docking Station
Docking Station- 6-12 Vdc; use either Hach-supplied 115 or
230V, 50/60 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.

Environmental requirements: 5 to 45 °C and 5 to 85% relative
humidity, non-condensing

Meter dimensions: 21.2 x 8.7 x 4.2 cm (8.35 x 3.43 x 1.65 inches)

Enclosure: Water proof (meets IP67), chemical resistant, dust
proof; meter will float. Docking station is water resistant to IP40.

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 2.2.3 on page 25, Battery Installation**

HACH®

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 Materialsicherheitsdatenblätter 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.

SECTION 1 INTRODUCTION

The *sension™5* Conductivity Meter (*Figure 1*) features a custom digital LCD display that simultaneously displays temperature and measurement results. This meter meets IP67 waterproof specifications, and features an electrode holder, ergonomic design, datalogging, and RS232 communication for printing results to a computer or printer.

Figure 1   *sension5* **Conductivity Meter**
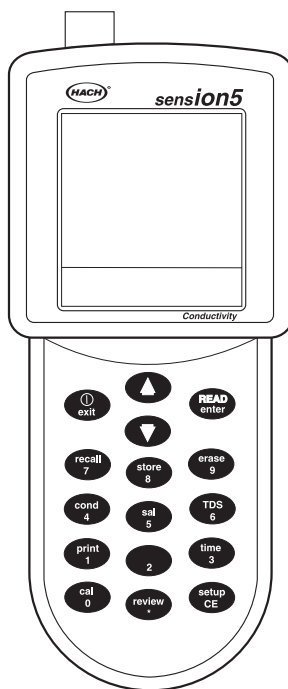
The meter can be used for a wide variety of applications in the field or the laboratory. Water quality, salinity, acids, bases, and other aqueous samples can be easily analyzed for conductivity with the available conductivity probes.

The meter microprocessor automates complicated and time-consuming calibration and measurement procedures for many applications. The direct calibration technique allows calibration by entering actual calibration standard values, eliminating repeated adjustments of cell constants. A probe, conductivity and TDS standards, and accessories are available.

The electrode holder in the back of the instrument allows the user to store the electrode and meter in one convenient package when not in use (see *Figure 2*).

Figure 2   Electrode Holder
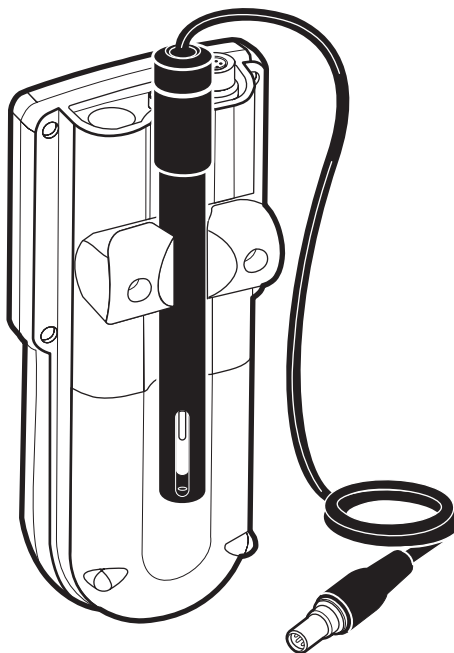
The meter is designed to be maintenance-free. If the meter gets dirty, wipe the surface with a damp cloth. Use a cotton-tipped applicator to clean or dry the connectors if they get wet.

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.

1.1.1 Standard Accessories

- Batteries - 4 alkaline AA (not rechargeable)

- Instrument Manual

- Conductivity probe (K = 0.5 ±10%)

- Conductivity standard (1000 µS/cm)

1.2 Keypad Description

Figure 3 illustrates the meter's keypad. The description and function of each key are given in *Table 1*.

Figure 3   *sensION5* **Meter Keypad**
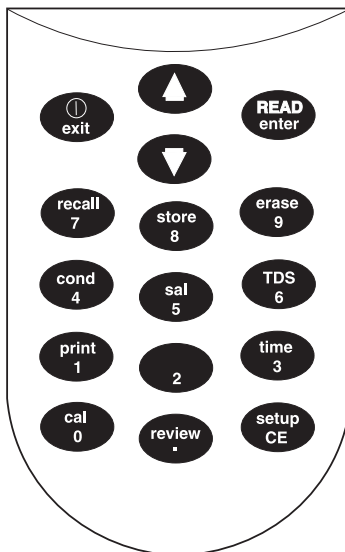

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Table 1 Keys and Description

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 illuminated. In Setup mode, backs up one step toward the Reading mode. Performs the following and returns to the most recent Reading mode: • Exits the Store, Erase, 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.
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.
Cond	Displays sample conductivity in Read or Recall mode.
Sal	Displays sample salinity in Read or Recall mode.
TDS	Displays estimated Total Dissolved Solids in Read or Recall mode.
Print Key	Sends current or recalled data to a printer or a computer via the RS232 port.
Time Key	In Reading mode, allows user to view the current time and date. In Recall Data and Calibration Review modes, 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.

1.3   Display Fields and Icons

The display has two screens. The upper screen displays measurements or standard values, the operation mode in use, sample temperature, error codes, and indicates if the meter reading is stable. The lower screen displays the active keys.

Figure 4 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 4   Display Elements
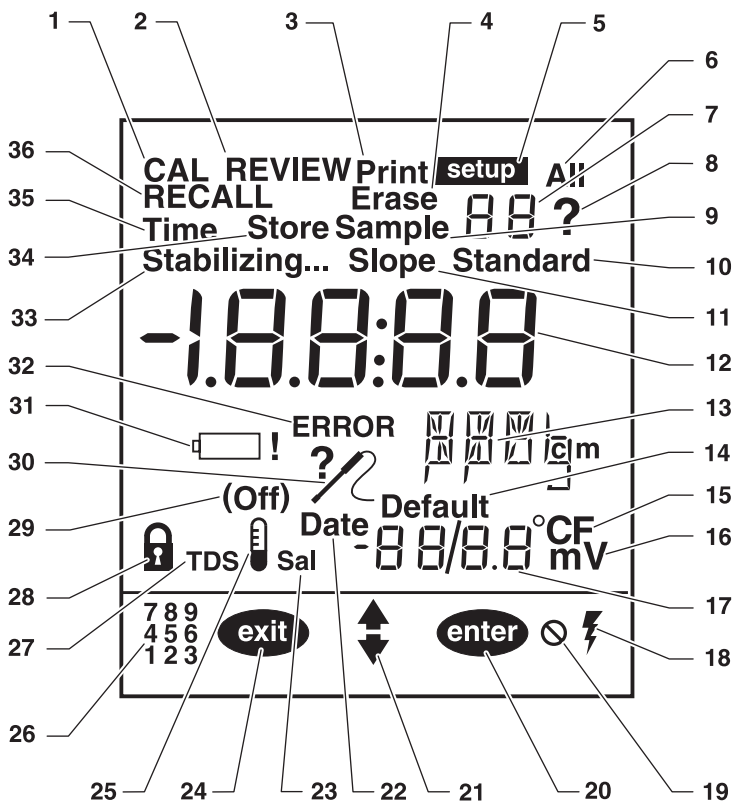
Table 2 Main Display Elements

Item No.	Description
1	Indicates meter is in Calibration mode. If the **?** is flashing, calibration is necessary.
2	Indicates meter is in Calibration Review mode.
3	Indicates data is being sent to a printer/computer.
4	Indicates recalled data that is currently displayed is being erased.
5	Indicates meter is in Setup mode.
6	Indicates all data points are being printed or erased.
7	Numerical field that displays Setup, Sample. and Standard numbers when those words are displayed to the left of the number. If **Standard** and **1** are displayed, the meter is measuring Standard 1.
8	Flashing **?** and **CAL** indicate calibration is necessary. Also a prompt to press the **ENTER** or **EXIT** key.
9	Indicates the meter is displaying recalled data.
10	Indicates the meter is measuring a standard (standard number is displayed to the right).
11	NA
12	Numerical field that displays the measured values of standards and samples.
13	Indicates measurement units.
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	NA
17	Numerical field that displays temperature value.
18	Indicates meter is using AC power (only displayed when in the docking station).
19	Indicates an inactive key has been pressed and that function is not allowed.
20	Indicates **ENTER** key is active.
21	Indicates arrow keys are active.
22	In Setup mode, it indicates the date is being set.
23	Indicates displayed value is salinity.
24	Indicates **EXIT** key is active.
25	Indicates temperature compensation is being used.
26	Indicates numeric part of the keys is active.
27	Display Lock icon. Displayed with item 27.
28	Indicates displayed value is TDS.
29	Indicates whether Display Lock or Temperature Compensation setting is **On** or **Off**.
30	Faulty probe connection or incorrect probe attached. Usually displayed with an error code.
31	Low battery icon. Change batteries as soon as possible.

Table 2 Main Display Elements (Continued)

Item No.	Description
32	Indicates a meter function problem.
33	Flashing word indicates signal from sample is not yet stable. When it quits flashing, the reading is stable and may be recorded.
34	Used with **?** icon. Asking if user wants to store the displayed sample data or the calibration that has been just completed.
35	Used with large display to indicate the time is being set.
36	Indicates meter is in recall mode and the data displayed is stored data.

1.4   Audible Signals

The meter will beep under certain conditions:

- a non-functional key press is made (one beep)

- when display lock is enabled and when measurement stability is reached during reading mode (three beeps)

- any time measurement stability is reached during calibration mode, regardless of the Display Lock setting

SECTION 2   INSTRUMENT SETUP

2.1 Instrument Description

This *sension™5* Portable Conductivity meter is designed for field or laboratory use and operates on four alkaline batteries or 115/230 Vac power. A Docking Station supplies line voltage to the meter in the laboratory. It will not recharge batteries.

The meter measures from 0 μS to 199.9 mS/cm, 0 to 50.0 g/L TDS, 0 to 42 g/L salinity, and the sample temperature. Displayed values are temperature corrected using the measured sample temperature. To display conductivity, TDS, and salinity values, press the **COND, SAL** and **TDS** keys.

2.2 Power Connections

The Docking Station provides AC power to the meter and also acts as the connection for sending data to a printer or computer. The Docking Station will operate with the batteries inserted or removed. It will not recharge the batteries.

2.2.1 Using the Docking Station

The optional *sension* Docking Station (*Figure 5*) is the AC adapter for the meter when it is used in the laboratory. It also allows the meter to send data to a printer or computer.

1. Plug the AC/DC connector into the Docking Station.

2. Plug the external power supply into a wall outlet.

3. Place the meter in the Docking Station so the three metal connector pins on the bottom of the meter align with the three metal connectors protruding up from the Docking Station.

When the meter is using AC power, the AC power icon will be displayed in the lower right corner of the display. The indicator light on the docking station only lights when data is being transferred and does **not** indicate that power is on.

The Docking Station will not recharge rechargeable batteries. Use a separate alkaline battery charger.

Automatic shutoff is not functional while the meter is in the Docking Station.

Figure 5   **Docking Station**

2.2.2   Docking Station Connections

The Docking Stations has a power connector, a serial port, and a green indicator light on the back (see *Figure 6*). To connect the Docking Station to AC power, plug the pin connector from the wall power unit into the power jack. AC power is not required to send data to a printer or computer.

The standard 9-pin RS232 serial port connector on the Docking Station is used for sending data to a printer or computer. Adapters, such as a 9-pin to 25-pin connector, may be required. See *Section 6.1* on page *49* for more information.

SECTION 2, continued

The green light on the Docking Station is lit when a connection is made to a printer or computer. It flickers when data is being transferred to a printer or computer via the serial port. It does **not** indicate the power is on.

Figure 6   Docking Station Connections

AC/DC Power Connector

RS 232 Connector

Data Transfer Indicator
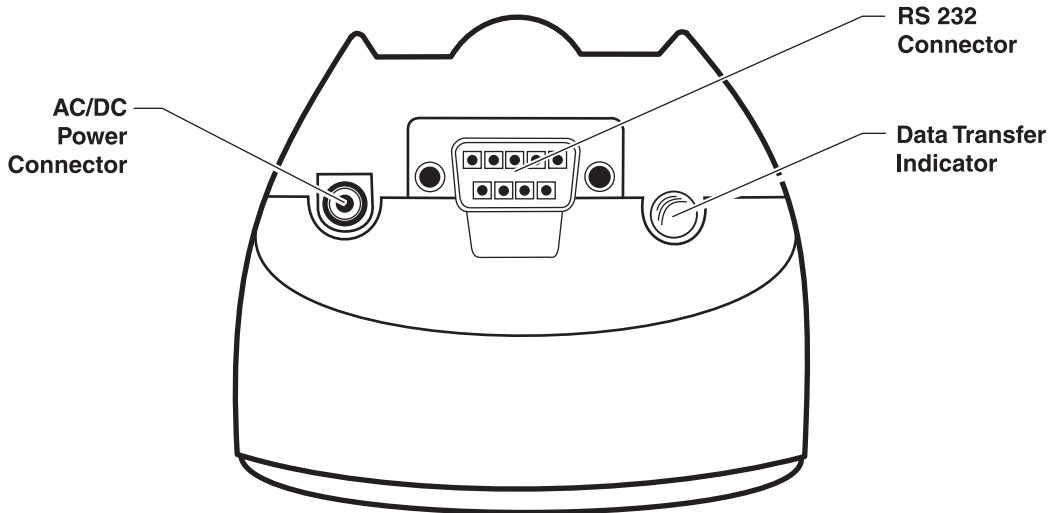
2.2.3 ⚠ Battery Installation

CAUTION
Use only alkaline batteries in this product. Other types of batteries can result in safety hazards.

PRUDENCE
Utiliser seulement des piles alcalines dans cet appareil. Les autres types de piles peuvent créer des risques pour la sécurité.

ATENCIÓN
Utilice solamente baterias alcalinas en este producto. El uso de otros tipos de baterias puede causar riesgos de seguridad.

VORSICHT
Verwenden Sie in diesem Produkt nur Alkali-Batterien. Die Verwendung anderer Batterien gefährdet die Betriebssicherheit.

ATENÇÃO
Use somente baterias alcalinas neste produto. Outros tipos de baterias podem resultar em risco a segurança.

The *sension5* meter requires four AA batteries for portable operation. **Use only alkaline batteries.** The battery compartment access panel is on the bottom of the instrument. To access the battery compartment, turn the instrument over and position the connectors away from you. Hold the instrument between your hands and use your thumbs to slide the panel towards you. See *Figure 7*.

When battery replacement is necessary, replace all four batteries. The position of the batteries in the instrument is important. Icons of the correct orientation are molded into the bottom of the compartment.

With the connectors pointing away from you, insert a battery in left-most position so the positive end faces you. Insert the other three batteries so the positive and negative ends alternate (i.e, +, -, +, -). Insertion is easiest if the battery is pushed against the spring connector first, then put into place.

Figure 7   Battery Installation
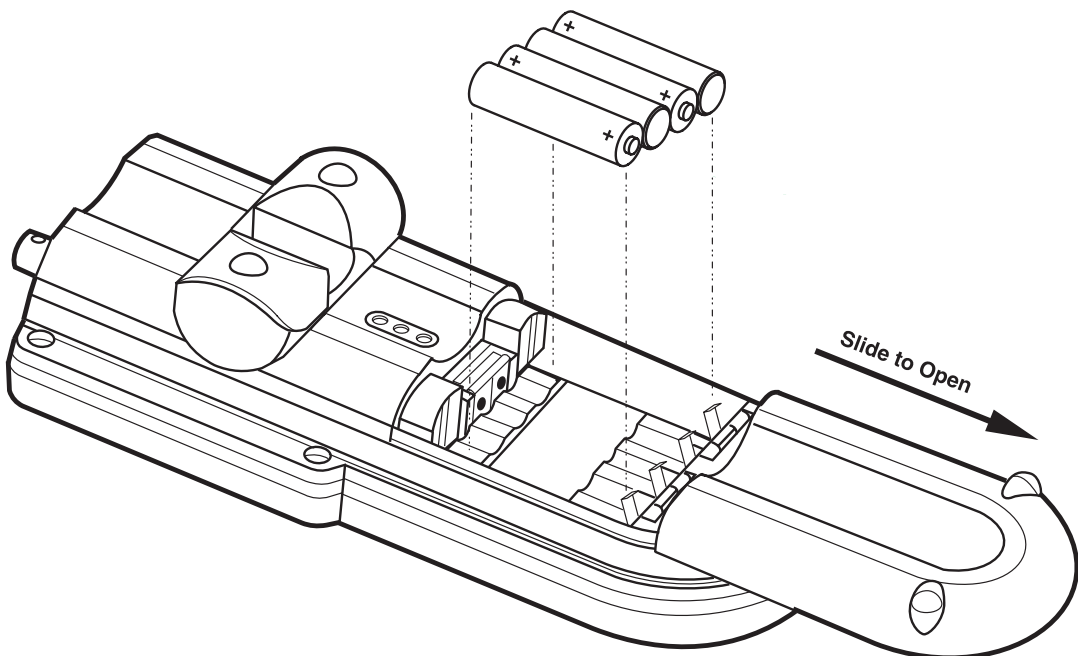
2.3 Conductivity Probe Connection

Connect the probe with 5-pin connectors to the meter input by lining the pins up with the holes in the meter port (see *Figure 8*). Push toward the instrument.

Figure 8   *sensiON5* **Probe Connection**

**5 Pin Shielded
Connector**
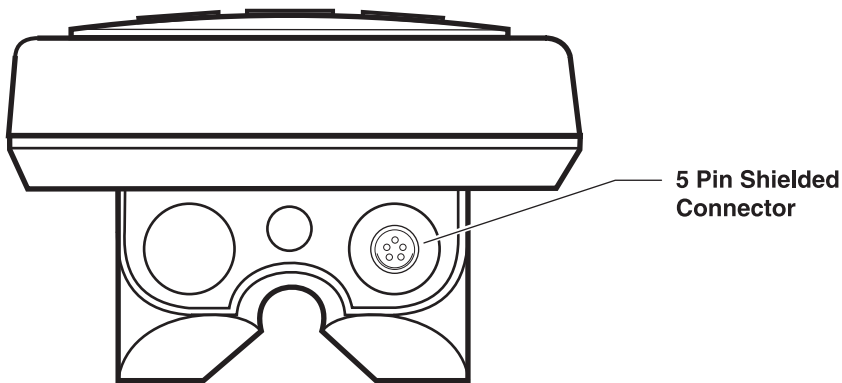
2.4 Printer and Computer Connections

The meter can send data to a computer or printer via the 9-pin serial port on the Docking Station. **The printer cable and computer cable are different.** The printer cable (Cat. No. 49503-00) is a 9-pin to 25-pin cable and the computer cable (Cat. No. 48129-00) 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. The data may be either a current measurement or recalled data.

To send data to a computer, connect the 9-pin serial port on the meter to a 9-pin serial port of the computer. Pressing the **PRINT** key will send the currently displayed data to the computer. The data may be either a current measurement or recalled data.

2.5   Turning the Meter On

After plugging the correct power adapter into the wall or installing batteries, 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, perform internal tests, then move to the Reading mode.

2.6   Automatic Shut-off Function

The meter is equipped with an automatic shut-off feature to prolong battery life. The meter will automatically shut off 15 minutes after the last key press unless the meter is in Calibration mode. If it is Calibration mode, automatic shutoff will occur four hours after the last key press.

Press the **I/O** key after automatic shut-off to restore power to the instrument.

SECTION 3   INSTRUMENT OPERATION

3.1   Setup Menu

The *sension™5* Portable Conductivity meter setup menu allows the analyst to choose options for display lock, temperature units, time, date, temperature correction factor, TDS calculation factor, and reference temperature.

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 the desired option, then press **ENTER**.

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 *sension5* Setup Options

Setup Number	Description
1	Display lock (On or Off)
2	Temperature units (°C or °F)
3	Temperature Correction (conductivity only) (On or Off)
4	Temperature Correction Factor
5	TDS Correction Factor
6	Reference Temperature Selection (20 or 25 °C)
7	Time of day (24 hour clock)
8	Date (mm/dd)
9	Year (four digits)

3.1.1   Turning Display Lock Off and On

Setup 1 is the Display Lock option. This feature stops measurement reading fluctuation on the display once a stable reading is reached. The default setting is On.

When this feature is not used, the measurement value may continue to fluctuate and **Stabilizing...** will be displayed.

1. From the reading mode, press **SETUP**.

2. The **Setup** icon and the number **1** (flashing) will be displayed. Change the Display Lock status by pressing **ENTER**; this toggles the setting between off and on. When the setting is

disabled, the Display Lock icon and **Off** are displayed. When this feature is enabled, the Display Lock icon is displayed without **Off**

3. When the desired option is selected, press **EXIT** to return to the reading mode or an arrow key to scroll to other setups.

3.1.2   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 once so the Setup number is **2**.

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 or an arrow key to scroll to other setups.

3.1.3   Turning Temperature Correction Off and On
Because the activity of ions in solutions varies with temperature, conductivity measurements are typically corrected for the sample temperature. To obtain conductivity measurements that are not temperature corrected (i.e., using the soil cup), turn this option off. For typical measurements, ignoring the effects of temperature can result in significant error. Salinity and TDS always require temperature compensation. The probe supplied with the meter measures temperature with a thermistor for automatic temperature compensation.

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 **3**.

3. Change the temperature correction status by pressing **ENTER**; this toggles the setting between off and on. When the setting is disabled, the thermometer icon and **Off** are displayed. When this feature is enabled, the thermometer icon is displayed without the **Off** icon.

Note: When the thermometer and Off icons appear in the Read mode, the instrument is not correcting the measured conductivity for temperature.

4. Press **EXIT** to return to the reading mode or an arrow key to scroll to other setups.

Note: Salinity and TDS measurements always use temperature-compensated conductivity readings even if this feature has been turned off.

3.1.4 Entering a Temperature Correction Value

This feature allows selection of a linear or non-linear temperature correction function. The non-linear coefficient has been determined from measurements using aqueous NaCl solutions. If the linear function is chosen, the measured conductivity values are automatically temperature-corrected based on the entered temperature coefficient and the selected reference temperature. The linear temperature correction value for the meter has a default value of 2% per 1 °C.

Conductivity of samples which contain other salts or ions may change at a different rate with temperature. This rate depends on the solution temperature, the ion concentration, and the reference temperature selected, and should be determined experimentally. Once determined, enter the temperature correction value using this setup option.

The Temperature Correction option must be on for the meter to use a temperature correction value (see *Section 3.1.3*).

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 temperature correction value by pressing **ENTER**.

Note: If the linear function is currently active, the temperature correction coefficient will appear in the display (i.e., 2.000%). If the non-linear function is active, then NaCl will appear in the display.

4. The **?** icon and the flashing **NaCl** will appear. If the linear function is active, go to *step 5*. If the linear function is not active, press the up arrow key.

5. The main display will show the current value. The numeric keypad will become active.

6. Enter the desired value using the keypad. Once a number key is pressed, the next digit place holder will flash. Continue to enter the desired numbers. Press **ENTER** to accept the value. If an number entry error occurs, start over by pressing **SETUP/CE**.

Note: If the compensation factor is set to 0.00%, the conductivity readings will not be corrected for temperature.

7. Press **EXIT** to return to the reading mode or an arrow key to scroll to other setups.

Table 4 shows some typical temperature coefficients (percent change of conductivity per °C).

Table 4 Percentage Change of Conductivity per Degree C

Solution	Percent/°C
Ultrapure Water	4.55
Salt (NaCl)	2.125
NaOH	1.72
Dilute Ammonia	1.8810
10% HCl	1.325
5% Sulfuric Acid	0.9698
Sugar Syrup	5.64

3.1.5   Entering a TDS Correction Factor

This setup lets the user choose a linear or non-linear conversion from conductivity to TDS. TDS measurements use conductivity readings that are temperature-compensated. When the linear conversion is chosen, the meter uses the reference temperature (see *Section 3.1.6*) and the temperature-correction option chosen in *Section 3.1.4* to determine temperature-corrected conductivity. The non-linear (NaCl) conversion uses the non-linear temperature correction function and a reference temperature of 25 °C to convert temperature-compensated conductivity readings to TDS readings.

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. If the linear TDS conversion is active, the conversion coefficient will appear in the display (e.g., **0.500**). If the non-linear TDS conversion is active, then **NaCl** will appear.

4. To change the conversion type, press **ENTER**. A **?** will appear next to the **5**.

5. Press an arrow key to toggle between linear and non-linear conversion. To choose a non-linear conversion, scroll until a flashing **NaCl** appears, then press **ENTER**.

Note: In Reading Mode, the TDS icon indicates the meter is using the default non-linear conversion.

6. To select a linear conversion, scroll until the conversion coefficient appears. Use the numeric keypad to set the value of the coefficient, then press **ENTER**. If an number entry error occurs, start over by pressing **SETUP/CE**.

7. Press **EXIT** to return to the reading mode or an arrow key to scroll to other setups.

3.1.6   Selecting a Reference Temperature

When measuring solutions that are not at the reference temperature, the meter automatically adjusts the reading to the conductivity value that would have been measured if the sample had been at the reference temperature. The reference temperature choices are 20 or 25 °C.

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 reference temperature unit by pressing **ENTER**; this key toggles the temperature units between 20 °C and 25 °C. The default is 25 °C.

4. When the desired option is selected, press **EXIT** to return to the reading mode or an arrow key to scroll to other setups.

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 numeric 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., 08:00 for 8 a.m or 00:30 for12:30 a.m.).

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**. If a number entry error occurs, start over by pressing **SETUP/CE**.

6. Press **EXIT** to return to the reading mode or an arrow key to scroll to other setups.

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**.

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 numeric 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**. If an number entry error occurs, start over by pressing **SETUP/CE**.

6. Press **EXIT** to return to the reading mode or an arrow key to scroll to other setups.

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**.

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. If an number entry error occurs, start over by pressing **SETUP/CE**.

5. Press **EXIT** to return to the reading mode or an arrow key to scroll to other setups.

3.2   Calibrating the Meter

The meter must be calibrated before use. There are two ways to calibrate the meter:

• Using NaCl standards with known electrolytic conductivity. The meter is factory-set for use with a NaCl standard having conductivity of 1000 μS/cm at 25 °C or a NaCl standard having conductivity of 18 mS/cm at 25 °C. In addition, conductivity of other standards may be entered via the keypad. The meter will use the non-linear temperature coefficient to correct the measurement during calibration.

If using standards that are not sodium chloride-based (i.e, the 53 mS/cm standard), calibrate as closely to 25 °C as possible for best accuracy.

- Entering/adjusting the cell constant of the conductivity probe.

Each method is described in the following sections.

3.2.1   Calibrating with a Known Standard

1. Place the probe in a conductivity standard which is in the expected range of the samples. On the meter, choose one of the four ranges that corresponds to the sample range. Agitate the probe to dislodge bubbles in the cell. Avoid resting the probe on the bottom or sides of the container.

2. Press **CAL**. Functional keys will appear in the lower left part of the display. **CAL**, **?**, and **1.000 1/cm** will appear in the upper display. If the meter has been calibrated, the last calibration value will appear. The numeric keypad will become active.

3. Press the arrow keys to scroll to the factory calibration options (1000 µS/cm or 18 mS/cm). To calibrate using one of these standards, press **ENTER**.

4. If using a standard with a different value, use the number keys to enter the standard conductivity at 25 °C, then press **ENTER**. The meter will automatically correct the calibration measurement to 25 °C using the NaCl-based, non-linear temperature coefficient.

   If the standard has a value at 25 °C in the µS/cm range, enter the value when 1000 µS/cm is displayed. If the standard has a value at 25 °C in the mS/cm range, enter the value when 18 mS/cm is displayed. It is not necessary that all four place have a number entered in them. If a number entry error occurs, start over by pressing **SETUP/CE.**

5. When the reading is stable, the calibration is automatically stored and the instrument returns to reading mode.

3.2.2   Calibrating by Adjusting the Cell Constant
The Conductivity probe may have slightly different cell constants depending on the nature, temperature, and range of the solution used for calibration.

1. Follow *Section 3.2.1* to calibrate the meter. Be sure the meter is in the conductivity measurement mode.

2. After the calibration is complete, press **REVIEW**. The cell constant for the probe will be displayed. Record this value.

3. Press the up arrow to display the standard concentration value. Record this value. Press **EXIT**.

4. As the conductivity of the sample measurements change, the cell constant can be updated without calibrating with a standard. First, press **CAL**.

5. Functional keys will appear in the lower left part of the display. **CAL** and **?** will appear in the upper display. The main display will show the last value used for calibration.

6. Press the down arrow until the current cell constant is displayed (in 1/cm).

7. Use the numeric keypad to enter the cell constant from the previous calibration. If the range of the samples has changed, use a cell constant from a previous calibration in that range. If a number entry error occurs, start over by pressing **SETUP/CE.**

8. Press **ENTER**. When the calibration is complete, the meter will return to measurement mode.

3.3   Reviewing Calibrations

1. From the reading mode, press the **REVIEW** key.

2. The meter will display the current cell constant in 1/cm. Press the up arrow key once.

3. The display will show the value of the standard used for calibration. Press the up arrow once.

4. The display will show the time of the most recent calibration. Press the up arrow once.

5. The display will show the date of the most recent calibration.

6. To exit Cal Review mode, press **EXIT**. To review the standard information again, press the down arrow.

3.4   Measuring Total Dissolved Solids

Determining TDS with the *sension5* meter is easy; just press the **TDS** key on the keypad. The instrument will display the TDS value for the currently displayed conductivity measurement.

The standard method to determine TDS (Total Dissolved Solids) is to evaporate the sample to dryness at 180 °C, then weigh the residue. Another way to estimate TDS is by calculating what concentration of sodium chloride that would have the same conductivity as the sample at the same temperature. The *sension5* meter reports a sample's TDS value in mg/L of sodium chloride by comparing the sample conductivity and temperature to data stored in the meter's memory. Data were obtained from empirical procedures using sodium chloride solutions.

3.5   Measuring Salinity

Determining salinity with the *sension5* meter is easy; just press the **SAL** key on the keypad. The instrument will display the salinity value for the sample being measured.

Salinity, a measure of the mass of dissolved salts in a given mass of solution, is used to describe seawater, natural, and industrial waters. Salinity is a relative scale based on a KCl solution. A salinity value of 35 is equivalent to a KCl solution containing 32.4356 g KCl in 1 kg of solution at 15 °C. Salinity is measured in ‰ (ppt—parts per thousand). The meter calculates the salinity based on the Extended Practical Salinity Scale of 1978, as referenced in 17th edition of *Standard Methods,* 25200 B. The applicable range is 0 to 42‰ and –2 to 35 °C.

3.6   Measuring Conductivity

Determining conductivity with the *sension5* meter is easy; just press the **COND** key on the keypad. The instrument will display the conductivity value for the sample being measured.

For conductivity, place the probe into the sample and make sure the slot on the end of the probe is totally immersed. Agitate the sample with the probe for 5-10 seconds to remove bubbles that may be trapped in the slot.

Table 5 shows the conductivity ranges of common solutions.

Table 5 Conductivity Range of Common Aqueous Solutions

Sample Type	Conductivity Range
High Pressure Boiler Water	<0.1 µS/cm to 0.2 µS/cm
Demineralized Water	1 µS/cm to 80 µS/cm
Drinking Water	100 µS/cm to 1 mS/cm
Wastewater	85 µS/cm to 9 mS/cm
Surface Water	100 µS/cm to 10 mS/cm
Industrial Process Water	8 mS/cm to 130 mS/cm
Concentrated Acids and Dyes	85 mS/cm to >1000 mS/cm

3.6.1   Measuring Low Levels of Conductivity

When the non-temperature corrected conductivity is less than 1 µS/cm, the meter automatically uses the temperature correction coefficients for pure water for the reference temperature selected (derived from *ASTM method D* 1125-91, page 253, 1993).

For best accuracy, Hach recommends using the Low Ionic Strength Chamber to prevent gases in the atmosphere from changing the conductivity level.

1. Make sure the meter is using the non-linear NaCl temperature correction (see *Section 3.1.4* on page *31*).

2. Zero the dry probe by pressing **READ** and **CAL** at the same time. The probe must be dry to obtain a correct value.

3. Calibrate using the 180 µS/cm standard (see *Section 3.2.1* on page *36*).

4. Thoroughly rinse the electrode with the sample.

5. Start the sample flow into the LIS chamber. Insert the conductivity probe into the LIS chamber.

6. Wait for a stable conductivity value, then store or record the result.

Note: If the non temperature-corrected conductivity of the sample increases above 1 µS/cm, the meter will use the temperature correction coefficients for NaCl. This may cause a noticeable jump in the displayed conductivity reading.

3.7   Operational Notes

When measuring very low conductivity levels (< 2 μS), protect the sample from gasses such as ammonia or carbon dioxide. These gasses cause rapid changes in the conductivity when they dissolve into water. To avoid this problem, measure conductivity using the Low Ionic Strength Chamber.

Pretreat water that is likely to contain high amounts of hydroxides (boiler water) with Gallic Acid Solution. Untreated samples may result in falsely high values. To pretreat the sample:

1.   Add four drops of Phenolphthalein Indicator Solution to the sample.

2.   Stirring constantly, add Gallic Acid Solution until the pink/red color disappears. The solution will become colorless if a small amount of hydroxides are present, or it may turn brownish-yellow if large amounts of hydroxides are present. Adding too much Gallic Acid can increase the conductivity, so add the minimum amount to achieve the color change.

3.8   Common Conversion Factors

The *sension5* meter converts conductivity readings to TDS and salinity values at the touch of a key. *Table 6* lists more conversion factors that may be useful.

Table 6 Conversions

To Convert From	To	Use This Equation
mS/cm	μS/cm	mS/cm x 1000
μS/cm	mS/cm	μS/cm x 0.001
μS/cm	μmhos/cm	μS/cm x 1
mS/cm	mmhos/cm	mS/cm x 1
g/L TDS	mg/L TDS	g/L TDS x 1000
mg/LTDS	g/L TDS	mg/L TDS x 0.001
mg/L TDS	gpg TDS	mg/L TDS x 0.05842
g/L TDS	gpg TDS	g/L TDS x 58.42
μS/cm	ohms•cm	1,000,000 ÷ μS/cm
mS/cm	ohms•cm	cm 1,000 ÷ mS/cm

3.9 Theory of Operation

Conductivity is the ability of a material to conduct current. Positive and negative ions in a solution will move to the oppositely charged electrode when an electric charge is applied to the solution, thus conducting current. In addition to the current applied, ion movement is affected by the solvent properties (temperature, viscosity) and the physical properties of the ion (size, charge, concentration...). As temperature increases, ions move faster and conduct more current. As viscosity increases, the ions move slower and conduct less current.

For our purposes, conductivity is measured by placing a cell (probe) in an electrolytic solution. A cell consists of two electrodes of a specific size, spaced at a specific distance apart. The conductivity of a liquid is the ratio of current to voltage between the electrodes. The conductivity value changes if the electrodes are spaced closer or further from each other. To have useful analyses, the distance between the two electrodes must be considered in the conductivity calculation.

In theory, a conductivity measuring cell consists of two 1-cm square electrode surfaces spaced 1 cm apart. The cell constant (K) is determined by the cell length (L) and cross-sectional area (A) $(K = L \div A)$. The theoretical cell just described has a cell constant of $K = 1.0$ 1/cm. Cells with larger/smaller electrodes or electrodes spaced at a different distance are characterized by a different cell constant.

Often, the physical characteristics of a cell are designed differently due to sample volume or space. Cells with cell constants of 1.0 cm^{-1} or greater normally have small, widely spaced electrodes. Cells with constants of $K = 0.1$ or less normally have large, closely spaced electrodes.

Electrolytic conductivity is not the same as specific conductivity. Electrolytic conductivity is a property of the solution being measured; specific conductivity includes the property of the measuring cell, partially defined by its physical design. By defining the physical parameters of the cell, a standard measure is created. This standard measure (specific conductivity) is reciprocal of the resistance (1/ohm), measured between the opposing faces of 1 cm cube of liquid at a specific temperature.

The S.I. unit for conductivity is Siemens (S) (1 Siemen = 1 mho). Other units are: 1/ohm = 1 mho = 1000 mS = 1,000,000 μS.

Since the cell's physical configuration significantly affects the conductivity measurement, it must be multiplied by the conductance to obtain the actual conductivity reading. For example, if the conductance reading is 350 μS using a cell with K = 0.1 1/cm, the conductivity value is 350 x 0.1 = 35.0 μS/cm.

Simply stated, the cell constant is defined as the ratio of the distance between the electrodes (d) to the electrode area (A). However, this neglects the existence of a fringe-field effect, which affects the electrode area by the amount AR. Therefore:

K = d/(A + AR)

Normally it is not possible to measure the fringe-field effect and the amount of AR to calculate the cell constant. For most uses, the actual cell constant (K) of a specific cell is determined by comparing the measurement of a standard solution of known specific conductivity (e.g., 0.01 M KCl) to the measured conductance.

The conductivity of a solution at a specific electrolyte concentration will change if the temperature changes. For accuracy, measured values should be adjusted for the solution temperature. The temperature-compensated conductivity of a solution is the conductivity that the solution exhibits at the reference temperature. This temperature is either 25 °C or 20 °C. A measurement made at reference temperature does not need compensation.

The *sension5* meter automatically compensates for temperature during conductivity measurements, using the sample temperature. Temperature compensation is different for different types of samples. Some examples are shown in *Table 4* on page *32*. The closer the sample is to the reference temperature, the smaller the error will be if the meter temperature coefficient is not correct.

SECTION 4   STORING AND RECALLING DATA

4.1   Storing Measurements

The *sension™5* 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 conductivity (or TDS/salinity) value, the following information is stored and can be downloaded (or printed) for each sample:

- storage location
- sample temperature
- software version
- model and serial number
- date
- conductivity, TDS, or salinity value
- time

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 storage location). The question mark will be flashing.

2. Press **ENTER** to store the measurement reading in that location. 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 one of the data points 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 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. 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 next stored sample data. There are three options at this point:

   • Press **ERASE** 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.

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 a data point is displayed, press **ERASE**.

3. Press the up arrow. The meter will display **Erase All** and a 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 the Reading mode.

4. After all the data is erased, the meter will return to the Reading mode.

SECTION 5   MAINTENANCE

5.1 Cleaning the Probe

During normal use, rinse the probe thoroughly with deionized water between measurements. This will minimize the buildup of interfering substances on the probe element.

If the sample contains oils, grease, or fats, the probe may become coated. If this occurs, clean the probe with a strong detergent solution or dip it in a 1:1 hydrochloric acid solution. Rinse thoroughly with deionized water.

For long term storage, rinse the probe with deionized water and store dry.

5.2 Meter Maintenance

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

SECTION 6   PRINTING/TRANSFERRING DATA

6.1   Connecting to Printers/Computers

6.1.1   Connecting with the RS232 Cable

The standard 9-pin RS232 connector on the Docking station connects with a 9-pin D-sub connector. A suitable cable is listed under *Optional Apparatus* in the *Replacement Parts* list.

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.

6.1.2   Connecting to a Printer

Connecting a serial printer to the Docking Station requires a 9-pin to 25-pin RS232 cable. The cable provides a direct link between the instrument and the 25-pin connector used for the serial port on most serial printers. *Table 7* 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. The meter does not need AC power to transfer data to a printer.

Parallel printers require a serial-to-parallel adapter. This allows the 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 7 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

Connect the RS232 cable to the Docking Station by lining up the holes in the cable connector with the pins of the serial port. Gently and firmly push the cable into the Docking Station. Then secure the connection by screwing in the screws on either side of the cable connector (see *Figure 9*). 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 9   RS232 Cable Connector
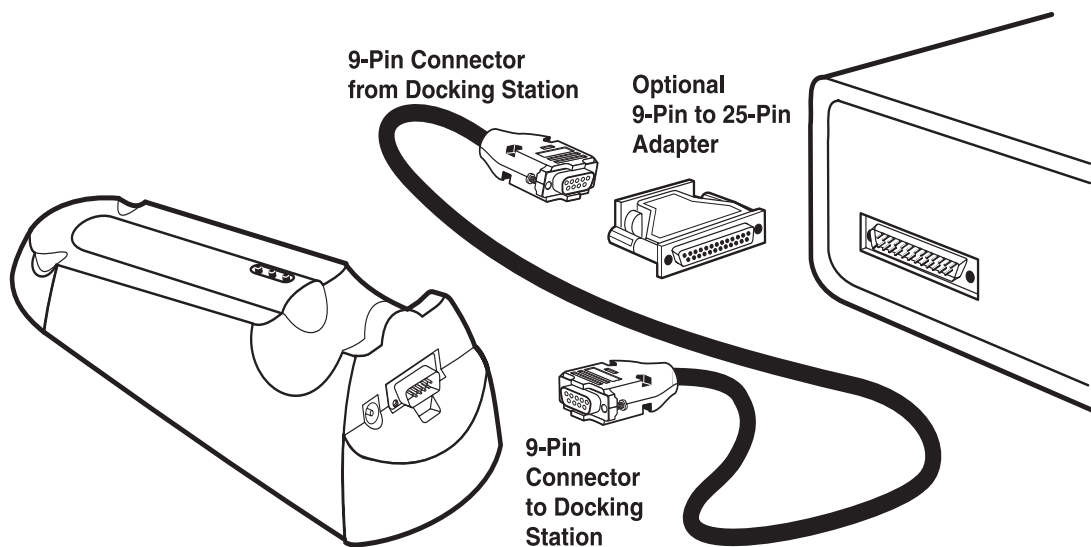
6.1.3   Connecting to a Personal Computer

Connect the Docking Station to a personal computer (PC) with the computer interface cable (Cat. No. 48129-00) listed under *REPLACEMENT PARTS* on page *59*. 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).

Table 8 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. The meter does not need AC power to transfer data to a computer.

Table 8 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 Docking Station by lining up the holes in the cable connector with the pins of the serial port. Gently and firmly push the cable into the Docking Station. Then secure the connection by screwing in the screws on either side of the cable connector (see *Figure 9*). 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 *sension* 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., 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:

- 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

- 3½ 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 and DOS 3.3 or later

6.2   Sending Data to Printers/Computers

6.2.1   Sending Currently Displayed Data

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

2. The word **PRINT** will be briefly displayed, then the meter will return to Reading mode.

3. The print out for data that is printed without being stored will not have a storage location number.

6.2.2   Sending Recalled Data Points

1. To transfer recalled data, it must be recalled first. Press the **RECALL** key while in the Reading mode. See *Section 4.2* on page *44* for more information.

2. When the desired sample data is displayed, press **PRINT**.

3. **Print Sample #** and a flashing **?** will be displayed. Press **ENTER**.

4. The word **PRINT** will be briefly displayed, then the meter will return to Recall mode.

6.2.3   Sending All Stored Data

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 *44* 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 Recall mode without printing.

• Press the down arrow to return to the prompt for printing single data points.

• Press **ENTER** to print all data (data that is displayed 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.

6.2.3.1   Printed Data Format

Printed data will have the following format:

	TDS, Salinity or Conductivity Reading*	Units	Sample Temperature	Alternate Units	Reference Temperature/ Temperature compensation	Date	Time	Serial Number	Software Version
1	400	uS/cm	13.5 °C	0.450/cm	Tref:25 Tc:0.0%	10/03/99	08:30	SI512344577	FX.X
2	557	mg/L	13.5 °C	TDS:NaCl		10/04/99	09:11	SI512344577	FX.X
3	0.6	‰	13.5 °C	881 uS/cm		10/10/99	12:44	SI512344577	FX.X
4	1284	uS/cm	25.0 °C	0.450/cm	Tref:20 Tc:2.00%	10/12/99	23:10	SI512344577	FX.X
5	642	mg/L	25.0 °C	TDS:0.500	Tref:20 Tc:2.00%	10/13/99	13:45	SI512344577	FX.X
6	1412	uS/cm	25.0 °C	0.450/cm	Tref:25 Tc:NaCl	10/13/99	14:23	SI512344577	FX.X

* Value depends on the mode used to measure the sample. For example, the TDS value will appear in this column if the meter was in TDS mode during the stored measurement.

Tref:= reference temperature in °C; Tc:= temperature compensation in effect;
TDS:= TDS calculation scheme in effect; 0.450/cm is the cell constant;
881 μS/cm is the non-temperature corrected conductivity for stored salinity

SECTION 7   TROUBLESHOOTING

7.1 Introduction

Correcting problem conditions with the *sension*™ 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.

7.2 Error Codes

Error codes indicate a functional problem with the meter and/or the electrode. Error code numbers will appear in the temperature field along with other icons. *Table 9* describes the possible error codes and some possible solutions to eliminate the cause.

Table 9 Error Codes

Error Code	Error Name & Display Icons	Description
E1	Storage failure.	Call Hach Service.
E2	Cell constant out of range.	Meter does not recognize a calibration buffer/standard. Prepare fresh buffers/standards and repeat calibration.
E3	Probe error.	The value read will not work in the calibration algorithm. Repeat calibration with new standards. Check electrode.
E6	Conductivity is out of range.	Sample conductivity is too high.
E7	Temperature is out of range. **ERROR** will be displayed.	Sample temperature is too low for salinity measurement (less than −2 °C).
E8	Temperature is out of range. **ERROR** will be displayed.	Sample temperature is too high for salinity measurement (greater than 35 °C).
E9	Corrupt data.	Recalled data had a bad checksum. Call Hach Service.

7.3   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.

HACH ®

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

REAGENTS

Description	Unit	Cat. No.
Gallic Acid Solution	50 mL SCDB	14423-26
Phenolphthalein Indicator Solution	15 mL SCDB	162-36
Potassium Chloride, ACS	454 g	764-01
Sodium Chloride Standard Solution, 1000 mg/L (1990 ±20 µS/cm, 995 ±5 TDS)	100 mL	2105-42
Sodium Chloride Standard Solution, 85.47 mg/L (180 ±10 µS/cm, 90 ±5 TDS)	100 mL	23075-42
Sodium Chloride Standard Solution, 491 mg/L (1000 ±10 µS/cm, 500 ±5 TDS)	100 mL	14400-42
Sodium Chloride Standard Solution, 10246 mg/L (18000 ±50 µS/cm, 9000 ±25 TDS)	100 mL	23074-42
Sodium Chloride Standard Solution, 53000 µS/cm, 35 ppt salinity	500 mL	27143-49

APPARATUS

Description	Unit	Cat. No.
Beaker, poly, 50 mL	each	1080-41
Batteries, AA, Alkaline	4/pkg	19380-04
Bottle, wash, 125 mL	each	620-14
Computer Interface Cable, 9-pin to 9-pin	each	48129-00
Docking Station, 115 V, North American plug	each	51875-01
Docking Station, 230 V, European plug	each	51875-02
Low Ionic Strength Chamber	each	51899-00
Probe, Conductivity, cell constant = 54 wire, 1 m cable	each	51975-00
Probe, Conductivity, cell constant = 54 wire, 3 m cable	each	51975-03
Printer, Citizen PN60I, 115 V, North American plug	each	26687-00
Printer, Power Cord, European style for Citizen PN60I printer	each	46836-00
PRinter Interface Cable, 9-pin to 25-pin	each	49503-00
Software, HachLink™, 3½ in. Disk	each	49665-00

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 LIMITED 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 for three years from the shipping date. The Docking Stations is warranted for one year from the shipping date.

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