Agilent 3200M Multi-Parameter Analyzer

User Guide
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Safety Notices

CAUTION
A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING
A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.
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This chapter describes how to install the 3200M Multi-Parameter Analyzer.
Tools and Components Needed for Installation

Agilent Technologies, Inc. provides necessary special tools needed for installation. The shipping box contains the following:

- Power adaptor (5185-8389)
- Short circuit plug (shipped installed on the meter) (G4383-40000)
- ATC temperature diagnostic tool (5185-8390)
- Conductivity diagnostic tool (5185-8391)
- DC401 Reference line
- DC501 Ground line
- USB Communications cable
- Electrode, for example:
  - P3211 pH Combination Electrode (5190-3988)
  - D6111 DO Probe (5190-3997)
  - C5111 Conductivity Probe (5190-3994)
Installing the 3200M Multi-Parameter Analyzer

Open the packing case of the 3200M Multi-Parameter Analyzer (Meter Kit). Remove the Multi-Parameter Analyzer, multifunction electrode holder, and other parts.

Installing the multifunction electrode holder

![Diagram of the multifunction electrode holder]

1. Electrode holder
2. Small nut
3. Flexible arm
4. Large nut
5. Small nut
6. Large nut
7. Setscrew
8. Electrode holder base

**Figure 1** Installing the electrode holder
1 Installation

Installing the electrodes

There are three kinds of electrode sockets on the back panel of the meter (Figure 2):

- **pH/pX** socket: To measure pH/pX, ion concentration
- **Cond** socket: To measure conductivity/TDS/salinity
- **DO/Temp** socket: To measure DO/saturation/temperature.

Install the proper electrodes and probes for your measuring needs. Connect a probe (or electrode) to its matching socket type. Place each probe in the holder and route the cable to the

![Back view of the analyzer](image)

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground</td>
<td>Reference electrode socket</td>
<td>pH Combination electrode / ISE electrode socket</td>
<td>DO Probe socket</td>
<td>Conductivity probe socket</td>
<td>USB port</td>
<td>Power (DC 9 V, 800 mA)</td>
</tr>
</tbody>
</table>

Figure 2 Back view of the analyzer
meter as shown in Figure 3.

- Use the DO/Temp socket for DO and ATC probes.
- Use the Cond. socket for conductivity probes.
- Use the pH/pX socket for pH/pX electrodes.

**CAUTION**

If you do not want to measure pH, pX, and ion concentration, insert the short circuit plug (shipped with the meter) into the pH/pX electrode socket to prevent damage to meter circuitry.

---

**Installing other cables**

1. Connect the supplied reference cable to the meter.
2. Connect the USB cable between the meter USB port and the computer.

**Figure 3** Installing the electrodes and probes
1 Installation

The meter ships with an optional ground line. During use, if another device (such as a constant temperature bath) causes electrical interference and an unstable reading, install the ground line. Connect one terminal of the ground line to the meter ground socket (grounds) and the other terminal to the interference source.

Installing the power adaptor

The universal power adapter (5185-8389) that is included with your benchtop meter is the only power adapter recommended for use with this unit.

The external electrical power adapter is rated at 100 to 240 VAC, 1 A, 50/60 Hz.

This power adaptor provides a plug converter which supports several kinds of plugs. Choose the appropriate power plug. Connect the output plug of the power adapter to the power input on the meter. A click will be heard when the plug is properly engaged.
Installing optional software

If purchased, install the optional G4390A Electrochemical Data Collecting Software now. The software provides communications between the meter and a computer. Connect the computer to the meter with a USB cable. See the G4390A software documentation for more information.

If not using the G4390A software, Agilent provides downloadable data printing software on the Agilent Customer Portal (see “Agilent Customer Portal” on page 21). To use this software, download it from the portal and install it. Then connect the meter to the PC using the USB cable. Refer to the data printing software documentation for more information.
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Introduction

Before operating your meter, be sure to read the installation and operation instructions.

System components

1. Display screen
2. Keypad
3. Conductivity probe
4. pH Combination electrode
5. DO probe

Figure 5  Major parts of the system

Figure 6  Front view of the analyzer
Figure 7  Back view of the analyzer

1  Ground
2  Reference electrode socket
3  pH Combination electrode/ISE electrode socket
4  DO Probe socket
5  Conductivity probe socket
6  USB port
7  Power (DC 9 V, 800 mA)
2 Operation

The Operating Panel

Operating panel is composed of display and keypad.

The display

The display shows the current state, measurements, and settings of the 3200M Multi-Parameter Analyzer. During turn on, the display shows company name, meter model, version number, and other information. After system self-check, the meter goes to the initial state (Figure 8). The left side of the screen shows current system time, and the right side shows the current measuring mode and parameter.

![Figure 8](image)

During measurement, the display shows your selected measurement parameters.

See also “The initial state (startup display)” on page 28 and “Parameter displays” on page 29.

The keypad

The meter has 15 operating keys. The keys are shown in Figure 9 and described in Table 1. Most keys have two values, a numeric entry and a function. Which one applies depends on the display; if it is waiting for a number, the numeric entry applies, otherwise, the function applies. To complete a numeric entry, press [Enter].
### Table 1  Key values

<table>
<thead>
<tr>
<th>Key symbol</th>
<th>Numeric entry</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/Output</td>
<td>1</td>
<td>Output presently displayed data</td>
</tr>
<tr>
<td>2/▲</td>
<td>2</td>
<td>Move up/select mode</td>
</tr>
<tr>
<td>3/Save</td>
<td>3</td>
<td>Store measurement result</td>
</tr>
<tr>
<td>4/◄</td>
<td>4</td>
<td>Move left</td>
</tr>
<tr>
<td>5/Setup</td>
<td>5</td>
<td>Set function or mode</td>
</tr>
<tr>
<td>6/▲</td>
<td>6</td>
<td>Move right</td>
</tr>
<tr>
<td>7/View</td>
<td>7</td>
<td>View stored or calibrated data</td>
</tr>
<tr>
<td>8/▼</td>
<td>8</td>
<td>Move down/select mode</td>
</tr>
<tr>
<td>9/Mode</td>
<td>9</td>
<td>Switch display window or parameter</td>
</tr>
<tr>
<td>0/Measure</td>
<td>0</td>
<td>Begin measurement from the initial state display</td>
</tr>
<tr>
<td>—/Delete</td>
<td>– (negative number)</td>
<td>Delete selected item</td>
</tr>
<tr>
<td>./Calibrate</td>
<td>. (decimal point)</td>
<td>Calibrate electrode</td>
</tr>
<tr>
<td>Enter</td>
<td></td>
<td>Enter</td>
</tr>
<tr>
<td>Cancel</td>
<td></td>
<td>Cancel</td>
</tr>
<tr>
<td>On/Off</td>
<td></td>
<td>Turn meter on or off</td>
</tr>
</tbody>
</table>
Safety Information

The most common safety issues when working with the meter include:

- Failing to use the original power adaptor may produce some safety problems.
- Guarantee the meter has a good ground connection.
- Prevent exposure to corrosive gases.
- Keep the connectors of the meter clean and dry. Avoid contact with acid, alkaline and salt solutions.
- The meter can be used continuously for a long time. After a measurement, soak all electrodes in distilled water.
- The improper use of the conductivity probe will lead to abnormal readings. When immersing the conductivity probe in a sample solution, position the conductivity probe in a location with good solution mobility.
- The Multi-Parameter Analyzer is an analytical instrument with high accuracy. To protect high resistance components from damage, install the short circuit plug (G4383-40000) onto the pH/pX electrode socket when the meter is not connected to a pH/pX electrode. (The short-circuit plug ships installed on the pH/pX socket on the meter.) Keep the short-circuit plug clean and dry. The plug can be damaged by humidity. A damaged short-circuit plug can damage the meter.
- After a measurement, store a DO probe in distilled water. **Do not** soak the DO probe in a sodium sulfite solution. If that solution permeates inside the probe, performance will be impacted.
Agilent Customer Portal

Agilent provides customized information for the products you own through a customer portal. This web service provides many customizable services as well as information related directly to Agilent products and orders. Log onto the portal at http://www.agilent.com/chem.
2 Operation

Term Definitions

**pH Slope:** The mV variation per unit of pH in mV/pH or percent theoretical slope.

**pH E₀:** Also known as Zero potential and is the mV value at pH 7.

**One-point pH calibration:** Calibration with one pH buffer.

**Multi-point pH calibration:** Calibration with two or more pH buffers.

**Cell constant:** For the conductivity probe, the ratio of distance to area of platinum sheet in cm⁻¹.

**TDS Factor:** The factor to convert conductivity to TDS.

**Temperature coefficient:** The percent change of conductivity with temperature in %/°C.

**Dissolved oxygen concentration:** The concentration of oxygen molecules dissolved in water under certain conditions in mg/L. DO is the abbreviation for dissolved oxygen.

**Dissolved oxygen saturation:** The ratio of actual DO concentration to saturated DO concentration in percent.

**Barometric pressure:** The barometric pressure in kPa.

**Salinity:** The salinity of water in g/L.

**Zero oxygen calibration:** DO probe calibration in oxygen-free solution (freshly prepared 5% sodium sulfite solution or as instructed by the DO probe manual.)

**Full scale calibration:** DO probe calibration with air-saturated water.
Features

The 3200M Multi-Parameter Analyzer is a state-of-the-art bench top analytical instrument. It simultaneously measures provides the ability to make measurements that otherwise require four different meters:

- Ion
- Conductivity
- Dissolved oxygen
- Temperature

Its Ion measuring functions measure potential, pH, pX and ion concentration. Its Conductivity measuring functions measure conductivity, resistivity, TDS, and salinity. The Dissolved Oxygen functions measure dissolved oxygen (DO) current, DO concentration, and DO saturation. The Temperature function measures the temperature of the sample solution.

With the appropriate probes installed, the meter can simultaneously measure several parameters, or it can be set to measure only one parameter (for example, only pH or only conductivity).

Ion measurement

- Supports measurement of pH/pX, ion concentration, potential, and temperature.
- Supports automatic pH buffer recognition to NIST, DIN, and GB standards.
- Supports multi-point calibration (up to five-point calibration).
• Can measure many common ions. Provides ion measurement modes for H⁺, Ag⁺, Na⁺, K⁺, NH₄⁺, Cl⁻, F⁻, NO₃⁻, BF₄⁻, CN, Cu²⁺, Pb²⁺ and Ca²⁺. Choose the appropriate ion selective electrodes (ISE) and reference electrodes to measure ion concentration. After measurement, the meter transforms the measurement results into concentration units. The user can also establish customer-defined ion measurement modes for other ions (when using the corresponding ISEs).

• Supports four ion concentration measuring methods: Direct Reading Mode, Standard Addition Mode, Sample Addition Mode and GRAN Method.

**Conductivity measurement**

• Supports measurement of conductivity, resistivity, TDS, salinity, and temperature.

• Automatic temperature compensation, automatic calibration, auto-range, and automatic frequency switch function over the whole measuring range.

• Supports calibration. User can calibrate cell constant or TDS factor.

**DO measurement**

• Supports measurement of DO concentration, saturation, and temperature.

• Supports calibration at zero oxygen and full scale.
Other features

• LCD display.

• Supports Good Laboratory Practices (GLP):
  • Requires setting an operator number.
  • Can record, display and output calibration data.
  • All saved data meets GLP standards. The meter can store 200 sets of pH, conductivity, TDS, salinity or DO data. The meter can save 100 sets of pX data and 100 sets of ion concentration data for each of six ion modes. Meanwhile the meter allows user to save data from 6 kinds of ion modes.
  • Can view, output and delete stored data.

• Supports three measuring modes: Continuous Mode, Timed Reading Mode and Auto-Lock Mode.

• Has power-off protection. When the meter is turned off or automatically shuts off, the stored measurement data, calibrated data, and settings remain.

• Provides LCD back lighting for use under dim lighting conditions.
2 Operation

Specifications

The major specifications of the 3200M Multi-Parameter Analyzer include measuring range, resolution, accuracy of electric unit, normal working conditions, size and weight.

**Measuring range**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>–2.000 pH to 20.000 pH</td>
</tr>
<tr>
<td>pX</td>
<td>0.000 pX to 14.000 pX</td>
</tr>
<tr>
<td>mV</td>
<td>–1999.9 mV to 1999.9 mV</td>
</tr>
<tr>
<td>Unit</td>
<td>pX, mol/L, ppm, percent (%), mg/L, µg/L</td>
</tr>
<tr>
<td>Conductivity</td>
<td>0.000 µS/cm to 2000 mS/cm</td>
</tr>
<tr>
<td>Resistivity</td>
<td>5.00 Ω•cm to 100.0 MΩ•cm</td>
</tr>
<tr>
<td>TDS</td>
<td>0.000 mg/L to 100.0 g/L</td>
</tr>
<tr>
<td>Salinity</td>
<td>0.00 to 8.00%</td>
</tr>
<tr>
<td>DO concentration</td>
<td>0.00 to 45.00 mg/L</td>
</tr>
<tr>
<td>DO saturation</td>
<td>0.0 to 300.0%</td>
</tr>
<tr>
<td>Temperature</td>
<td>–5.0 to 110.0 °C</td>
</tr>
</tbody>
</table>

**Resolution**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH/pX</td>
<td>0.001 pH/pX</td>
</tr>
<tr>
<td>mV</td>
<td>0.1 mV</td>
</tr>
<tr>
<td>Concentration</td>
<td>Four effective digits (scientific notation)</td>
</tr>
<tr>
<td>DO concentration</td>
<td>0.01 mg/L</td>
</tr>
<tr>
<td>DO saturation</td>
<td>0.1%</td>
</tr>
<tr>
<td>Temperature</td>
<td>0.1 °C</td>
</tr>
</tbody>
</table>
**Accuracy**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH/pX</td>
<td>±0.002 pH/pX</td>
</tr>
<tr>
<td>mV</td>
<td>±0.03% (full scale)</td>
</tr>
<tr>
<td>Concentration</td>
<td>±0.3%</td>
</tr>
<tr>
<td>Conductivity</td>
<td>±0.5% (full scale)</td>
</tr>
<tr>
<td>Resistivity</td>
<td>±0.5% (full scale)</td>
</tr>
<tr>
<td>TDS</td>
<td>±0.5% (full scale)</td>
</tr>
<tr>
<td>Salinity</td>
<td>±0.1%</td>
</tr>
<tr>
<td>DO</td>
<td>±0.10 mg/L</td>
</tr>
<tr>
<td>DO saturation</td>
<td>±2.0%</td>
</tr>
<tr>
<td>Temperature</td>
<td>±0.1 °C</td>
</tr>
</tbody>
</table>

**Normal operating conditions**

- Ambient temperature: 0 to 40 °C
- Relative humidity: ≤ 85%
- Power supply: Power adaptor 5185-8389
- Power input: 100 to 240 VAC, 1 A
- Power output: 9 VDC, 1 A
- No performance-affecting vibrations nearby
- No corrosive gases in ambient air
- No strong electromagnetic interference except the geomagnetic field
- Size (mm): 190 width × 190 depth × 105 height
- Weight (kg): approximately 1 kg
Setting Up the 3200M Multi-Parameter Analyzer

The 3200M Multi-Parameter Analyzer is composed of an electronic unit and an electrode system. The electrode system consists of the electrode holder (optional) and probes, which can include a pH electrode (ISE electrode), conductivity probe, DO probe, and ATC probe.

To start up the 3200M Multi-Parameter Analyzer

1. Before turning on the analyzer, connect it to the power supply.
2. Check that the meter has a good ground.
3. Check the electrodes connections.
4. Make sure that no corrosive gas is present.

The initial state (startup display)

The initial state of the meter is shown in Figure 10. The left side shows the current system time; the right side shows the current measuring mode and parameter.

![Figure 10](image)

The Initial State display
Parameter displays

During operation, the meter can display parameters included with ion measurement, conductivity measurement, and DO measurement. Each measurement type (ion, conductivity, or DO) will display in a separate window. See Figure 11. The number of measurement windows depends on the parameters selected during setup. No more than three parameters can be displayed from a measuring method. Note also that some parameters cannot be measured simultaneously (for example, pH and pX) and so cannot be displayed at the same time.

The largest window in Figure 11 displays three parameter values. The first is the major parameter; the other two are the auxiliary parameter and the current temperature. The other windows only display one parameter, which is the value of the chosen parameter. Table 2 lists the available parameters.

Figure 11  Example measurement display (pH in continuous mode)

<table>
<thead>
<tr>
<th>Parameters from measurement method</th>
</tr>
</thead>
</table>

Table 2  Display parameters available by measuring mode

<table>
<thead>
<tr>
<th>Measurement method</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ion</td>
<td>pH, pX, ion concentration, Potential (mV)</td>
</tr>
<tr>
<td>Conductivity</td>
<td>Conductivity, TDS, salinity</td>
</tr>
<tr>
<td>DO</td>
<td>DO, saturation, DO current (nA)</td>
</tr>
</tbody>
</table>
2 Operation

Figure 12 and Figure 13 show additional examples.

![Figure 12 Example measurement display with only conductivity selected (as the major parameter)](image)

**Figure 12** Example measurement display with only conductivity selected (as the major parameter)

![Figure 13 Example measurement display with TDS selected as the major parameter and conductivity shown as an auxiliary parameter](image)

**Figure 13** Example measurement display with TDS selected as the major parameter and conductivity shown as an auxiliary parameter

The display automatically changes when selecting new measurement parameters during setup.

During measurement, you can view, save, or print another parameter without changing the setup. See “Viewing Parameters and Data” on page 43 for details.
To set up the meter for use

From the initial state display, press [Setup]; the display is shown in Figure 14.

![Figure 14 The Setup display](image)

Use this screen to set the following:

**Mode&Para** sets the **Measuring Mode** and its parameter value.

**Ion Mode** selects the target ions for ion-related measurements, such as concentration.

**System** includes **Time & Date, Set Manual Temp, Set Operator No** (number) and **Set Condition**.

**Language** can switch between Chinese and English.

**Parameter** includes **Set Cell Const** (Constant), **Set Temp Coef** (Coefficient), **Set TDS Factor**, **Set Air Pressure** and **Set DO Salinity**.

To set up the meter:

1. Select the desired measurement parameter(s) and corresponding mode. See “To select measurement parameters and modes” on page 33.

2. Select the ion of interest. See “To set the ion mode” on page 37.
3 If needed, set system setpoints. See “To set up the system” on page 39.

4 If needed, set the language. See “To select the language” on page 42.

5 If needed, set any parameters, constants, and coefficients used by the meter. See:
   “To set or calibrate the cell constant” on page 75
   “Temperature coefficient” on page 83
   “To set or calibrate the TDS factor” on page 81
   “To set the DO salinity” on page 87
   “To set the ambient barometric pressure” on page 86

Press [Cancel] to return to the initial state display.
To select measurement parameters and modes

The meter can measure the major parameters listed in Table 3 using the modes shown for each.

### Table 3  Modes available for each measurable parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter modes</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>Continuous Mode, Timed Reading, Auto-Lock Mode</td>
</tr>
<tr>
<td>pX or conductivity</td>
<td>Continuous Mode, Timed Reading, Auto-Lock Mode</td>
</tr>
<tr>
<td>TDS</td>
<td>Continuous Mode, Timed Reading, Auto-Lock Mode</td>
</tr>
<tr>
<td>Salinity</td>
<td>Continuous Mode, Timed Reading, Auto-Lock Mode</td>
</tr>
<tr>
<td>DO</td>
<td>Continuous Mode, Timed Reading, Auto-Lock Mode</td>
</tr>
<tr>
<td>Saturation</td>
<td>Continuous Mode, Timed Reading, Auto-Lock Mode</td>
</tr>
<tr>
<td>Ion concentration</td>
<td>Direct Reading, STD Addition, Sample Addition, GRAN Method</td>
</tr>
</tbody>
</table>
To set the measuring mode:

1. From the initial state display, press [Setup] and then [Enter]. The display will be similar to Figure 15.

- The left column displays the available measurement parameters, which can include pH, pX or COND (ion conductivity), TDS, SALI (salinity), DO, SATU (saturation), and CONC (ion concentration).

- The right column displays the measuring modes for the selected (highlighted) parameter. For most parameters, these are: Continuous Mode, Timed Reading, and Auto-Lock Mode. For most ion concentration, these are: Direct Reading, STD Addition, Sample Addition, and GRAN Method. See below for details on these modes.

- A ✓ indicates that this mode has been selected in the current setup.

2. Use arrow keys to highlight the desired parameter.
3 Press [Setup] to select (turn on or turn off) the highlighted parameter.

4 Use the arrow keys to highlight the desired measurement mode for the selected parameter.

5 Press [Setup] to enable the mode.

6 Repeat steps 2 through 5 to select or clear all desired parameters and modes.

7 After setting all desired parameters and modes:
   Press [Enter] to save the new setup, exit from setup mode and return to the initial state, or
   Press [Cancel] to exit setup mode without saving changes and return to the initial state.

Continuous Mode

This is the most often used measuring mode. When measurement begins, the meter continuously displays the results of measurements and calculations. You can view a calibrated parameter, calibrate the electrode, and save or print the results during measurement. See “Viewing Parameters and Data” on page 43. To stop measurement, press [Cancel] and then [Enter].

Timed Reading

In this mode, the meter continuously measures the parameter for a specified period of time. When the set time period ends, the meter saves the measurement and begins the next one.

For example, if performing a reading of conductivity every 30 minutes, select this mode and set the time interval to 30. When measurement begins, the meter continuously displays the conductivity measurement. After 30 minutes, the meter saves the last result and starts the process again.

In this mode, you enter the desired time interval. The default value for the time interval is 10 minutes. The range is 1 to 99 minutes.

To stop measurement, press [Cancel] and then [Enter].
Auto-Lock Mode

Auto-Lock Mode requires that you set a condition as described in “To set a Condition” on page 41. When measurement begins, the meter continuously displays the results of measurements and calculations until the measurements meet the preset Auto-Lock condition, at which point the measurement ends.

During a measurement in this mode, you can view measuring parameters, calibrate the electrode, and so forth. See “Viewing Parameters and Data” on page 43. After measurement ends, you can save and output the results.

Press [Cancel] to exit this mode or press [Measure] to begin the next measurement.

Direct Reading

This is the most commonly used ion concentration measuring method. When measurement begins, the meter reads, calculates and displays the potential (mV) value. When the reading becomes stable, press [Enter] and the meter calculates the current concentration value. See “Direct Reading mode” on page 65 for details.

STD Addition (standard addition mode)

In this mode, the user adds standard solution to the sample. Measure the potential before and after the addition of standard solution. The meter then calculates sample concentration. See “To clear the blank concentration calibration” on page 68 for details.

Sample Addition (sample addition mode)

This method is similar to the standard addition method, except that the user adds sample solution to the standard solution. Measure potential variation before and after adding sample solution. See “Sample addition mode” on page 71 for details.
**GRAN Method**

The GRAN Method uses multiple additions of standard solution to the sample solution. The user adds a fixed amount of standard solution to the sample repeatedly. Measure the potential after each addition. See “GRAN method” on page 72 for details.

**To set the ion mode**

The meter provides 10 preset ion modes, used to measure different ion concentrations.

To set the ion mode:

1. If needed, install the appropriate probe for the desired ion.
2. Press [Setup].
3. Select **Set Ion Mode**.
4. Press [Enter] and the meter will display as shown in Figure 16.

   ![Set Ion Mode](image)

   **Figure 16** Set Ion Mode

5. Use the scroll keys to highlight the desired ion. The currently-selected ion name and molecular weight appear at the bottom of the screen.

   Always select the correct ion mode before measurement. An improper choice leads to inaccurate measurements. For example, to measure sodium ion concentration, select $\text{Na}^+$. 

6. Press [Enter] to select the highlighted ion, or press [Cancel] to close this screen and return to the initial state.
Regular ions

These ion modes are supplied with the meter: H⁺, Ag⁺, Na⁺, K⁺, NH₄⁺, Cl⁻, F⁻, NO₃⁻, BF₄⁻, CN⁻, Cu²⁺, Pb²⁺ and Ca²⁺. Since H⁺ is always allowed, it is not displayed in the ion mode.

Custom ions

You can create up to five custom ions (custom ion modes), named Cus00 to Cus04. A custom ion mode requires an ISE electrode capable of measuring the ion.

To create a new custom ion mode:

1. Press [Setup] (at the Set Ion Mode screen) to establish a new one. (The meter supplies the name for the mode.)
2. Press [Enter] to create the new Custom ion mode.
3. Press [Setup], then select Amend Ion Mode.
4. Set the ion valence and molecular weight for this custom ion.
5. Press [Enter] to confirm.

To delete a custom ion mode, navigate to the Set ion mode screen, then press [Setup]. Scroll to Delete Ion Mode then press [Enter].

CAUTION

When deleting certain custom ion modes, all corresponding stored data will be deleted at the same time.
To set up the system

System setup includes Time & Date, Set Manual Temp, Set Operator No, Set Condition, Calib Interval, Auto Power Off, and Set Default. From the initial state display, press [Setup], move the highlight to System Setup and select the desired item.

To set the date and time

1. From the initial display, press [Setup].
2. Use the arrow keys to highlight Time&Date.
3. Press [Setup] to open the menu shown in Figure 17.

The window displays the current time setup including year, month, day, hour, minute and second. To modify the time setup, use arrow keys to highlight the proper time cell, then press [Setup] and enter the correct time. When all changes have been made, press [Enter] to save the final setup. Press [Cancel] to exit from System Setup.
2 Operation

To set the temperature manually

If using an ATC probe (an ATC probe is connected to the meter), the meter uses the temperature data from the probe. Otherwise, the user must enter the temperature value of the sample solution.

1 Press [Setup] and select Set Manual Temp. See Figure 18.

![Set Manual Temp](image1)

**Figure 18** Manual temperature entry

2 Press [Setup] to select Manual Temp and then modify the temperature value.

To set the operator number (Operator No)

**Operator No** is a three-digit number in the range 000 to 200. Every set of recorded data contains the Operator No field. If you need to track the operator, assign a unique number for each operator.

![Set Operator No](image2)

**Figure 19** Set operator number
To set a Condition

In Auto-Lock mode (only), **Set Condition** is used to set the termination conditions for the measured parameters. The meter measures the parameter until the condition is met and is stable for the duration specified in **Auto-Lock Time**.

To set a measurement condition:

1. Press [Setup] and select **Set Condition**. See Figure 20.

![Figure 20 Set condition](image)

2. Use the arrow keys to select the desired condition, then enter the desired value.

3. Select **Auto-Lock Time** and enter the desired time, in seconds. Valid range is 1 to 200 seconds.

For example, Figure 20 shows that the condition for conductivity (**COND**) is 1%. When the conductivity measurement stabilizes within ±1%, and remains stable for the **Auto-Lock Time** of 5 seconds, measurement ends.
2 Operation

To set the calibration interval

**Calib Interval** is the time interval between recalibration prompts. The meter counts the time since the last calibration and if the time counted exceeds the preset calibration time interval, the meter displays a popup window to remind the user to recalibrate the electrode. **Calib Interval** is measured in hours. Input zero hours to disable. Figure 21 shows all prompts disabled.

![Calibration interval](image)

**Figure 21** Calibration interval

To set Auto Power Off

This meter can automatically turn off after a specified period of time (from 10–480 min). When the meter has run for the length of time that equals the **Auto Power Off** setpoint, the meter turns off.

To disable **Auto Power Off**, set the time period to 0. When the meter is controlled using the optional G4390A software, **Auto Power Off** is disabled.

To select the language

The meter can display either Chinese or English text. From the initial state, press **[Setup]**, choose **Language Select**, and then select either Chinese or English.
Viewing Parameters and Data

During measurement, the selected measurement parameters automatically display. You can also view other parameters, calibration data, stored data, and calibrated ion data.

To view saved data

View stored measurement data as follows:
1. From the initial state display or measurement display, press [View].

![Figure 22](image)

**Figure 22** Viewing stored data and last calibration data

2. Scroll to the desired type of data to view, for example View Saved pH, and press [Enter]. The display lists the stored data.
2 Operation

See Figure 23.

Number of saved entries
Viewing mode (type of data)
Saved data expands when selected
Other saved data entries

Figure 23  Viewing save pH

- The upper area displays the current viewing mode and actual stored amount.
- Each page can display up to 10 saved data entries.
- The display format varies with the type of data.
- The data includes **Save time** and **Operator No**.
- Use the arrow keys to view each saved datum.

3  Press **Output** to print data (requires a connection to a PC). Press **Delete** to delete the highlighted data. See Figure 24 on page 45 for example output.
MODEL 3200M
MULTI_PARAMETER METER
SOFT VERSION VER 1.00
PRINT TIME 10:25:42
2010/06/20
OPERATOR NO 000
************************
STORED NUM: 003
************************
NO:001
OPERATOR NO: 000
STORED TIME: 10:19:00
2010/06/20
SLOPE: 100.00%
E0: -0.0mV
POTENTIAL: 0.0mV
pH: 7.000pH
TEMP: 25.0c
TC.TYPE: MTC
************************
NO:002
OPERATOR NO: 000
STORED TIME: 10:19:00
2010/06/20
SLOPE: 100.00%
E0: -0.0mV
POTENTIAL: 0.0mV
pH: 7.000pH
TEMP: 25.0c
TC.TYPE: MTC
************************
NO:003
OPERATOR NO: 000
STORED TIME: 10:19:00
2010/06/20
SLOPE: 100.00%
E0: -0.0mV
POTENTIAL: 0.0mV
pH: 7.000pH
TEMP: 25.0c
TC.TYPE: MTC
************************
Figure 24 Output format
The meter saves data from each ion mode separately. To view data from another ion mode:

1. Press [Setup] (or [Mode] or [View]) to change to other ion modes.

2. The meter will prompt View Other Ion? Press [Enter] to continue. Figure 25 shows changing from viewing stored data of the Na⁺ ion to viewing stored data of the Ag⁺ ion.

![Figure 25](Changing viewed ion data)

**To view calibration data**

1. From the initial state display, press [View].

2. Select Last pH Calib or Last Calib and press [Enter]. The meter shows the selected calibration data. See Figure 26.

![Figure 26](Example of most recent pH calibration data)
3 Use the arrow keys to view details.

4 Press [Output] to print data (requires a connection to a PC). See Figure 27 for example output.

```
MODEL
  3200M
  MULTI_PARAMETER METER
SOFT VERSION
  VER 1.00
PRINT TIME
  10:11:27
  2010/06/20
OPERATOR NO
  000
*******************************************************************************
PH CALIB DATA
CALIB TIME: 08:12:00
  2008/06/01
OPERATOR NO: 000
*******************************************************************************
POINT 1
pH: 4.003pH
POTENTIAL: 177.3mV
TEMP: 25.0c
*******************************************************************************
POINT 2
pH: 6.864pH
POTENTIAL: 8.0mV
TEMP: 25.0c
*******************************************************************************
POINT 3
pH: 9.182pH
POTENTIAL: -129.1mV
TEMP: 25.0c
*******************************************************************************
CALIB RESULT
SLOPE 1: 100.00%
E0 1: -0.0mV
SLOPE 2: 100.00%
E0 2: -0.0mV
*******************************************************************************
Figure 27  Example calibration output
```

To print current parameter data, connect the meter to the PC with a USB cable and press [Output]. For detailed setup, see “To output data” on page 49.
To view other parameters during measurement

You can view other parameters during a measurement, even if you did not select them during setup. To view other parameter values during a measurement:

1. Press [Mode] and the display will highlight the measuring window (see Figure 28). Press [4/◄] or [6/►] repeatedly to switch parameters. When you stop pressing [4/◄] or [6/►] for more than a few seconds, the meter automatically returns to the normal measuring mode display.

2. Press [Output] to print or press [Save] to save displayed values.

Figure 28   Switching parameters
Data Storage

The meter can save 200 sets of pH, conductivity, TDS, salinity, or DO data, plus 100 sets of pX data and 100 sets of ion concentration data for each of six ion modes. When the meter cannot store additional data, the meter prompts to either:

- Overwrite the oldest data with the newest
- Delete some old data to make room for the new data.

To save viewed data

Saving data varies depending on the parameter mode.

- In continuous mode and auto-lock reading mode, press [Save] to save data when readings become stable.
- In timed reading mode, the meter will periodically save measurement data. In this mode, data can also be saved manually.

To delete stored data

The meter can delete saved data one by one or all at once. Data can only be deleted when viewed.

1  From the initial or measuring mode, press [View] to display data.
2  Scroll to the data to delete, then press [Delete] to select the specific operation.

To output data

There are two ways to output current measurements, calibration data, and saved data.

If using the optional G4390A the data collecting software with the meter, the software can collect the data, print it, and so forth.

If not using the optional G4390A software, install the optional data printing software. See “Installing optional software” on page 13.
Using the 3200M Multi-Parameter Analyzer

General operating procedure

To use the meter:

1 Install probes or electrodes as needed.
2 Turn on the meter.
3 If needed, set up the meter system parameters (date, time, operator number, and so forth). See “Setting Up the 3200M Multi-Parameter Analyzer” on page 28.
4 If needed, set the parameter(s) to measure and their corresponding modes. See “To select measurement parameters and modes” on page 33.
5 Verify the latest calibration data.
6 Recalibrate probes/electrodes if required.
7 Perform measurements.

During measurement, the LCD will display the current state. Users can also set various parameters by pressing appropriate keys.

NOTE

If the meter is set for the desired parameters and mode, and if you are sure that the meter has been recently calibrated and zeroed as needed, you can simply start taking measurements. After first startup, you do not need to set up the meter before each use.

For more information, see also:

“Ion Measurement” on page 52
“pX Measurement” on page 61
“Ion Concentration Measurement” on page 65
“Conductivity Measurement” on page 74
“DO Measurement” on page 86
“To Turn Off the 3200M Multi-Parameter Analyzer” on page 94
Instrument control

The 3200M Multi-Parameter Analyzer is usually controlled by the keypad. It can also be controlled through a computer using the optional G4390A software. For details on how to use the optional data collecting software, see the information provided with the software.
Ion Measurement

The meter provides 10 preset ion modes, used to measure different ion concentrations. Each mode requires an appropriate electrode.

If no other parameters are selected, the meter defaults to ion measurement.

To measure the concentration of an ion in a sample solution:

1. Prepare the ISE electrode needed to measure the desired ion. See “To prepare an ISE electrode” on page 61.
2. Install the electrode needed to measure the desired ion.
3. Select the desired ion as described in “To set the ion mode” on page 37.
4. Adjust the mV offset as described in “To adjust mV zero”.
5. Select the appropriate pH buffer group as described in “About pH buffer groups” on page 53.
6. Select the appropriate buffers for the sample as described in “To select a buffer in a group” on page 55.
7. Calibrate the electrode to the selected buffers as described in “To calibrate an ISE electrode” on page 62.
8. Press [Measure].

To adjust mV zero

Although the meter compensates for many factors which may affect measurement (such as temperature), it still cannot guarantee zero drift. For accurate measurement, perform Adjust mV Zero before measurement.

To check for drift in pH measurement:

1. Turn off the meter.
2. Install the short circuit plug (G4383-40000) into the pH/pX socket.
3. Turn on the meter and let stabilize for 30 seconds.
4. Press [Setup].
5 Select **Adjust mV Zero**, and press [Enter]. The meter will prompt **Adjust mV zero?**.

6 Press [Enter] to calibrate a new mV zero.

   If the potential (mV) value deviates far from zero, double check the short circuit plug connection. Ensure the meter is in zero mV state to avoid an incorrect adjustment.

   To abort the adjustment, press [Cancel]. The meter will end the operation and return to the measuring state.

### About pH buffer groups

The meter provides auto-recognition of several buffer groups prepared according to either the NIST standard, the DIN standard, or the GB standard. Each group contains several buffers. Using a buffer group simplifies ion calibration. Before measurement, select the buffer solutions most applicable to the sample solution, then calibrate the electrode to those buffers. The meter uses these calibrations to provide accurate results.

**Table 4** Buffer groups

<table>
<thead>
<tr>
<th>Buffer pH</th>
<th>NIST group</th>
<th>DIN group</th>
<th>GB group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.677</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.680</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>3.557</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.559</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>3.775</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.003</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>4.008</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>6.864</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>6.865</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>7.000</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>7.409</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>7.416</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>
For each Buffer Group setup, you may select up to five buffers. Since the pH range of a buffer may overlap with the pH range of another buffer in the same buffer group, the meter prevents selecting two or more buffers with overlapping pH ranges.

Table 4  Buffer groups (continued)

<table>
<thead>
<tr>
<th>Buffer pH</th>
<th>NIST group</th>
<th>DIN group</th>
<th>GB group</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.182</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.184</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.014</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.454</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.460</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.469</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
To select a pH buffer group

1 View the last pH calibrated data. See “To view calibration data” on page 46.

2 Press [Setup] to enter Group Setup as shown in Figure 29.

![Figure 29](image.png)

Figure 29  Group setup

Figure 29 indicates that the current Buffer Group Setup meets the DIN standard (DIN is checked). The upper area displays the 3 buffer groups and the bottom area displays the buffers included in the selected buffer group.

3 Use arrow keys to highlight the desired buffer group.

4 Press [Setup] to select the highlighted buffer group. (Only one group can be active at a time.)

To select a buffer in a group

After selecting the desired buffer group, select the individual buffers that best correspond to the sample.

To prevent selecting buffers with overlapping pH ranges, select only buffers necessary for measurement and clear selection of other buffers.

1 Verify the current buffer group.

2 Use arrow keys to highlight the target buffer group and press [Setup]. The meter shows the buffers available in the group. See Figure 30.
2 Operation

Icons with \( \sqrt{\text{✓}} \) indicate that a selected buffer.
Icons without \( \sqrt{\text{✓}} \) indicate an available buffer.
The bottom part of the display shows the pH value and the pH range of the highlighted buffer.

3 Use the arrow keys to select (highlight) a buffer.
4 Press [Setup] to select or deselect this buffer.

For example, to select the 4.008 pH buffer, use arrow keys to highlight the 4.008 pH icon. Press [Setup] to select the icon.

Calibrate the meter to all selected buffers.

To prepare the pH electrode

A new electrode should be stored wet in the storage solution and should be in working condition when received from the factory.

1 Visually check for any mechanical damage. If the storage bottle is dry, soak the electrode in reference filling solution for at least 2 hours before use.
2 Take the storage bottle off and keep it for future use.
3 If there is electrolyte solidified on the measuring tip, rinse it off with distilled or deionized water.
4 Unplug the filling hole.
5 Siphon away the reference solution and add new reference solution. The level of the reference solution must be at least 20 mm higher than the level of sample. The liquid junction must be immersed completely in solution.

6 To guarantee mobility of the reference solution, keep the filling hole open during measurement.

7 Hold the electrode measuring tip downwards and swing it several times to remove air bubbles near the sensitive glass bulb.

8 Connect the electrode to the meter. Put the electrode in the first buffer solution with the measuring tip downwards.

**To calibrate the pH electrode**

Before each measurement, we recommend recalibrating the electrode to the series of buffers chosen for the sample. After calibration, any previous calibration data is overwritten. See also “To set the calibration interval” on page 42.

The meter can perform calibration manually (**Manual config**) or using its auto-recognition feature (**Auto-config**).

- In **Auto-config**, the meter will automatically compare the current pH measurement against the selected buffers and assign the calibration to the correct one. If the meter cannot recognize a buffer, it will return a **Calibration error**.

- In **Manual config**, the meter prompts you for the correct buffer pH at the selected temperature.

1 Prepare 1 to 5 buffers. They can be purchased or can be prepared by you. Place them in a constant temperature environment to equilibrate.
2 View the current calibration. For example, see Figure 31. The upper area shows the current pH (in this example the slope is set to 100.00%), potential and temperature value. The bottom area shows the current calibration result.

![Figure 31 Calibrating the pH electrode](image1)

3 Confirm the Buffer Group setup. See “To select a pH buffer group” on page 55 and “To select a buffer in a group” on page 55.
   - If you try to calibrate to a buffer that is not selected, it can cause a calibration error or a bad calibration.

4 Press [Setup] and scroll to **Set Config Type** to select the recognition method.

![Figure 32 Calibration setup](image2)

5 Select **Auto-config** or **Manual config**.
   - For regular buffers, use the Auto-Recognition method. Select **Auto-config**.
   - If using a custom pH buffer, select **Manual config**.
- If using both regular buffers and custom buffers, use both recognition methods. You can calibrate to some buffers, change the buffer selections, then calibrate to another buffer. See “Calibrating custom buffers and buffers with overlapping pH values”.

6 Clean the pH electrode, reference electrode and ATC probe. Place them in the calibration buffer.

7 When the reading becomes stable, press [Enter]. The meter will display Storing...... and save the calibration data.

8 After a few seconds, the meter will display a Continue? prompt window. To calibrate other buffers, select the next buffer to continue. Repeat steps 6 and 7.

At any time during calibration, press [Cancel] to end calibration.

The meter supports up to five calibration points. When the fifth buffer is calibrated, the meter will prompt to end calibration.

**Calibrating custom buffers and buffers with overlapping pH values**

For buffers such as 6.864 pH and 7.000 pH which have overlapping pH ranges, try the following:

- When you calibrate the 6.864 pH buffer, set the buffer group to contain only 6.864 pH, then calibrate it. Reset the buffer group to contain only 7.000 pH, then calibrate it.
- Use Manual config and manually input the pH of each selected buffer at the selected temperature.

**To measure pH**

1 From the initial state display, press [Setup].

2 Select the pH parameter and a measuring mode.

3 Press [Measure] to enter that measuring mode as shown in Figure 33. The upper area of the screen shows the current
measuring mode and system time. The central area of the screen shows present pH, potential, and temperature.

![Continuous Mode](image)

Figure 33   Example pH measurement in Continuous Mode

4 When measurement begins, adjust mV zero. See “To adjust mV zero” on page 52.

5 If the electrode has not been recently calibrated, calibrate it. See “To calibrate the pH electrode” on page 57.

6 Start measurement. Press [Measure].

During measurement, you can recalibrate the electrode, set parameters and select the pH display resolution.

After measurement, press [Save] to save data, [Output] to output data, or [Cancel] to end measurement.

See also “To select measurement parameters and modes” on page 33.

**To measure mV**

In any measuring mode, the meter always displays the current pH and mV values.

**To measure temperature**

In any measuring mode, the meter will display the current temperature value.
pX Measurement

To set the ion mode

Select the correct ion mode before measurement. For example, to measure sodium ion concentration, select Na⁺ in Set Ion Mode. Other ion measurements are similar. See “To set the ion mode” on page 37.

To adjust mV zero

Similar to pH measurement, adjust mV zero before measurement. For details, see “To measure pH” on page 59.

To prepare an ISE electrode

1 Different ISE electrodes need different preparation. Ensure the unused electrode was stored in accordance with the requirements of “Electrode and probe storage” on page 107. If not, soak the electrode in storage solution for at least 2 hours.

2 Take the electrode tip out of its protective sleeve or storage bottle. Preserve them for future use.

3 If there is electrolyte solidified on the outside of the electrode tip, rinse it off with distilled water.

4 Hold the electrode tip downwards and swing it several times to remove any air bubbles from the electrode.

5 If the electrode is refillable, open the filling hole and add filling solution. Fill to at least 20 mm higher than the sample solution level.

6 To guarantee filling solution mobility during measurement, leave the filling hole open.
To calibrate an ISE electrode

1 Prepare the electrode for use as described in “To prepare an ISE electrode” on page 61.

2 Install the electrode.

3 Set $p_X$ as the measurement parameter and set Continuous Mode. See “To select measurement parameters and modes” on page 33.

4 Press [Measure] to start $p_X$ measurement.

5 Press [Calibrate], then scroll to and select Calib $p_X$ EC.

6 Press [Enter] to begin the electrode slope calibration. The meter enters calibration mode as shown in Figure 34.

The upper area shows the current $p_X$ (the slope is set at 100.00 %), potential and temperature value. The bottom area shows the current calibration result.

7 Prepare one to five standard solutions. They can be common purchased standard solutions or can be special standard solutions prepared by the user.

8 Equilibrate the solutions at the required temperature.

9 Clean the appropriate ISE electrode or reference electrode and ATC probe, and place them in the standard solutions to be calibrated.

10 Press [Setup] and select Set STD Value. Manually input the STD $p_X$ value of the selected standard solution at the selected temperature.

Figure 34  $p_X$ calibration mode
11 When the reading becomes stable, press [Enter] and the meter will display Storing ... and save the calibration data.

![Figure 35 Storing calibration](image)

12 After a few seconds, the meter displays a Continue? prompt. To calibrate another standard solution, select your new standard solution and press [Enter] to repeat the procedure. Continue until all standard solutions are calibrated. At any time during calibration, press [Cancel] to end the process.

**To measure pX**

With a recently-calibrated ISE installed, you can begin measurements.

1 From the initial state display, ensure the measured parameter is pX. If not, select pX measurement as described in “To select measurement parameters and modes” on page 33.

2 Check the current ion mode. See “To set the ion mode” on page 61.

3 Adjust mV zero as described in “To measure pH” on page 59.
4 Press **Measure**. See the example in Figure 36.

![Figure 36 pX measurement](image)

During measurement, you may recalibrate the electrode and set parameters.

After measurement, you can press **Save** to save measurement data, **Output** to print data, or **Cancel** to end measurement.

If the ISE electrode is not calibrated, prepare and calibrate the ISE before use.
Ion Concentration Measurement

There are four concentration measurement modes:

- Direct Reading of Concentration Mode (Direct Reading)
- Standard Addition Mode (STD Addition)
- Sample Addition Mode (Sample Addition)
- GRAN Method (GRAN Mode)

Direct Reading mode

The Direct Reading mode uses the following Nernst formula to calculate the concentration:

\[ E_x = E_0 + S \cdot \log (C_x + C_b) \]

In which:
- \( E_x \) = Equilibrium potential of sample
- \( E_0 \) = Zero potential, potential for ion activity = 1
- \( S \) = Electrode slope
- \( C_x \) = Concentration value of sample
- \( C_b \) = Blank concentration value

Obtain slope and zero potential through slope calibration. Calibrate the blank concentration also. Then measure concentration of the sample directly.

To measure concentration in Direct Reading mode

1. Select CONC as the parameter and select Direct Reading as the mode.

2. Select the ion mode that matches the ISE (ion selective electrode) type. For instance, to measure Ag\(^+\) concentration, select Ag\(^+\) mode. For details, see “To set the ion mode” on page 61.

3. Set ion concentration as the current parameter and select Direct Reading mode (see “To select measurement parameters and modes” on page 33.)
4 Press [Enter] to return to the initial state.

5 Press [Measure] to perform Direct Reading as shown in Figure 37.

| Mode&Para | Direct Reading
|-----------|----------------
| Meas CONC | Ion: Na⁺        
| Last Calib|                
| 15 45     | 2011/07/14     

The upper right area shows current system time, potential, temperature, and pX value. The bottom area shows current measuring result and blank concentration value.

During measurement, you can view calibrated data, calibrate the electrode, adjust mV zero, calibrate blank concentration, and reset blank concentration.

6 If necessary, perform a blank concentration correction. See “To calibrate a blank concentration” on page 67.

7 Rinse the ISE thoroughly and put it in sample solution. The meter displays current measurement data.

8 When the reading becomes stable, press [Enter] and the meter calculates measurement result as shown in Figure 38 on page 67.

- Press [Save] to save current measuring result.
- Press [Measure] to perform another ion concentration measurement.
- Press [Cancel] to exit direct reading mode and return to the initial state.
- Press [Setup] to select the proper concentration unit.
To calibrate a blank concentration

Both direct reading mode of concentration and standard addition mode have blank calibration. Performing a blank calibration is the same in either mode.

1. Create a blank solution with a similar chemical composition to the sample solution (except for the concentration of the ion measured).

2. From Direct Reading or STD Addition mode, press [Setup].

3. Scroll to CONC Unit and select the correct units.

4. Scroll to Blank CONC and press [Setup].

5. Put the ISE and ATC probe in the blank solution.

6. When the reading becomes stable, press [Enter] and the meter calculates and saves the blank concentration value.

7. Press [Cancel] to return to direct reading mode of concentration.
To clear the blank concentration calibration

To clear the last blank concentration value:

1. From Direct Reading or STD Addition mode, press [Setup].
2. Select Clear Blank CONC.

Standard Addition Mode (STD Addition)

Standard Addition Mode is also called “known addition mode”. First, measure the potential of the sample solution after the reading becomes stable. Then add standard solution of known concentration to the sample. Measure the potential again after the reading becomes stable. Calculate the sample concentration through the change in potential using the formula:

\[
C_x = \frac{\rho \times C_s}{(1 + \rho) \times 10^{(E_2 - E_1)/S} - 1} + \frac{\rho \times C_b}{(1 + \rho) \times 10^{(E_{b2} - E_{b1})/S} - 1}
\]

In which:

- \(C_x\) = Concentration value of sample to be measured
- \(C_s\) = Concentration value of STD solution (add solution)
- \(S\) = Slope of electrode
- \(C_b\) = Blank STD concentration value
- \(E_1\) = Potential value of the system before adding solution
- \(E_2\) = Potential value of the system after adding solution
- \(\rho\) = Ratio of added volume of the standard solution (\(V_s\)) to volume of the sample to be measured (\(V_x\))
- \(E_{b1}\) = Potential value of the system before adding solution when calibrating blank
- \(E_{b2}\) = Potential value of the system after adding solution when calibrating blank
To measure concentration in STD Addition mode

1. Select **CONC** as the parameter and select **STD Addition** as the mode.

2. From the initial state display, select the ion mode. See “To set the ion mode” on page 37.

3. Press [Measure]. The meter enters standard addition mode as shown in Figure 40.

4. Input the required information:
   - a. Use the arrow keys to select each parameter.
   - b. Press [Setup] to modify the parameter or to calibrate the blank concentration (if **Blank CONC** is selected).

   **Adding Volume**: Addition volume. The standard solution volume to be added.

   **Vol before Add**: The sample volume before adding any standard.

   **STD CONC Value**: Standard solution concentration

   **STD CONC Unit**: Standard solution concentration unit

   **Blank CONC**: Blank concentration value. See “To calibrate a blank concentration” on page 67.

5. After setup, rinse the ISE electrode thoroughly and put it in the sample solution.
6 Press [Enter] to perform the standard addition measurement. The meter displays current potential, temperature and pX value. See Figure 41.

![STD Addition](image)

**Figure 41** Before adding

7 When the reading becomes stable, press [Enter] to save this potential. The meter displays STD Addition.

8 Add the correct volume of standard solution and mix.

9 When the reading becomes stable, press [Enter]. The meter prompts to end the process and shows the calculated sample concentration (Figure 42).

![STD Addition](image)

**Figure 42** Final screen

After measurement, save or output the results as desired.
Sample addition mode

This mode is similar to the standard addition mode, except that the solution is added to the standard. The meter calculates the concentration from the formula:

\[
C_x = C_s \times \left[ (1 + \rho) \times 10^{\frac{(E_2 - E_1)}{S}} - \rho \right]
\]

In which:
- \(C_x\) = Concentration value of sample to be measured (add solution)
- \(C_s\) = Concentration value of STD solution
- \(\rho\) = Volume of STD solution (Vs)/volume of sample to be measured (Vx)
- \(E_1\) = Potential value of the system before adding measured sample
- \(E_2\) = Potential value of the system after adding measured sample
- \(S\) = Slope of electrode

To measure concentration in Sample Addition mode

1. Select CONC as the parameter and select Sample Addition as the mode.
2. From the initial state display, select the ion mode. See “To set the ion mode” on page 37.
3. Press [Measure]. The meter enters sample addition mode as shown in Figure 43.

![Sample Addition](image)

Figure 43 Sample Addition
2 Operation

4 Input the required information:
   a Use the arrow keys to select each parameter.
   b Press [Setup] to modify the parameter or to the calibrate blank concentration (if Blank CONC is selected).

5 After setup, rinse the ISE electrode thoroughly and put it in the sample solution.

6 Press [Enter] to perform the sample addition measurement. The meter displays current potential, temperature and pX value.

7 When the reading becomes stable, press [Enter] to save this potential. The meter displays Sample Addition.

8 Add the correct volume of sample solution and mix.

9 When the reading becomes stable, press [Enter]. The meter prompts to end the process and shows the calculated sample concentration.

GRAN method

The meter supports the GRAN method for measuring samples with low concentration. The result, \( C_x \), is calculated by solving this equation:

\[
(V_s + V_x) \times 10^{E/S} = 10^{E_0/S}(C_x V_x) + 10^{E_0/S}(C_s V_s)
\]

Operation is similar to standard addition mode.

1 Select CONC as the parameter and select GRAN Mode as the mode.

2 From the initial state display, select the ion mode. See “To set the ion mode” on page 37.

3 Press [Measure]. The meter enters GRAN mode.

4 Input the concentration \( C_s \) and volume \( V_s \) of the STD solution and the volume \( V_x \) of the sample.
5 Measure the electrode potential value of the sample after the standard solution is added.

6 Repeat the measurement 3 to 8 times. The meter will calculate the concentration of the sample.
Conductivity Measurement

There are five major steps to measure conductivity:

- Meter setup (“To set up the meter for use” on page 31)
- Prepare the conductivity probe (“Prepare probes” on page 74)
- Set or calibrate the cell constant (“To set or calibrate the cell constant” on page 75)
- Set the temperature coefficient (“Temperature coefficient” on page 83)
- Measure conductivity (“To measure conductivity” on page 80)

Prepare probes

1. When using a probe for the first time, or when using a probe that has been in storage for a long time, submerse the measuring tip in absolute ethanol for 1 minute.
2. Repeat step 1 two more times using new absolute ethanol each time.
3. Rinse thoroughly with DI water.
4. Soak in DI water for 1 hour.
5. Connect the probe to the meter.
6. Run a measurement test. After finishing a test, clean the measuring tip using the proper method for the test solution that was used.

**CAUTION**

Avoid damaging platinum black coating on the C5111 Conductivity probe during cleaning.

7. Calibrate the cell constant. See “To set or calibrate the cell constant” on page 75. Each probe’s cell constant is printed on the probe’s label. However, transportation, prolonged
storage, and extended use may change the cell constant to some degree.

8 Before use, ensure there is no precipitate formed on the platinum sensing elements from exposure to the sample solution. Ensure there is no corrosion on the platinum sensing elements or chemical reaction in solution catalyzed by platinum.

9 If there is unusual performance during measurement or you suspect an error in measurement, see Chapter 3, “Troubleshooting and Maintenance” to diagnose the problem.

To set or calibrate the cell constant

The cell constant for each probe was calibrated and printed on the probe label before shipping. However, transportation, storage, and continued use may change the cell constant to some degree. Recalibrate the conductivity probe before measurement.

One-point calibration

1 In order to calibrate, you need to make a standard solution. Read the printed cell constant from the probe’s label. Use the general order of magnitude of the cell constant to read Table 5 and find the needed KCl concentration of the standard solution.

<table>
<thead>
<tr>
<th>Table 5</th>
<th>Concentration of standard solution based on cell constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell constant (cm⁻¹)</td>
<td>0.01</td>
</tr>
<tr>
<td>KCl concentration (mol/L)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

2 Use the concentration found in step 1 to read Table 6. Find the weight of KCl to add to a liter of DI water to make the standard solution. For example, to make a concentration of 0.1 mol/L, you would mix 7.4365 g of KCl with 1 L of DI water.
Table 6  Composition of standard solution

<table>
<thead>
<tr>
<th>Concentration (mol/L)</th>
<th>Concentration of KCl in g/L (20 °C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>74.2650</td>
</tr>
<tr>
<td>0.1</td>
<td>7.4365</td>
</tr>
<tr>
<td>0.01</td>
<td>0.7440</td>
</tr>
<tr>
<td>0.001</td>
<td>Dilute 0.01 mol/L solution from 100 mL to 1 L</td>
</tr>
</tbody>
</table>

3 If the meter is connected to a conductivity probe but not an ATC probe, the meter will use the manual temperature (see “To set the temperature manually” on page 40) value as current temperature. If the manual temperature is set at 25.0 °C, conductivity is displayed without temperature compensation.

4 Rinse the conductivity probe with distilled or DI water.

5 Soak the conductivity probe in the standard solution. The temperature of the standard solution should be approximately 25 °C.

6 Press [Calibrate].

7 Select Calib Cell Const.

8 The Calibration screen appears. (see Figure 44).

Figure 44  The Calibration screen
9 Press [Setup] to enter a standard solution value (STD Value). Type the standard value listed in Table 7 for the corresponding solution concentration and temperature.

![Image of screen with STD Value: μS/cm]

**Figure 45** The standard solution value

<table>
<thead>
<tr>
<th>Table 7</th>
<th>STD Value (μS/cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15.0 °C</td>
</tr>
<tr>
<td>1 mol/L</td>
<td></td>
</tr>
<tr>
<td></td>
<td>92120</td>
</tr>
<tr>
<td>0.1 mol/L</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10455</td>
</tr>
<tr>
<td>0.01 mol/L</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1141.1</td>
</tr>
<tr>
<td>0.001 mol/L</td>
<td></td>
</tr>
<tr>
<td></td>
<td>118.5</td>
</tr>
</tbody>
</table>

10 When reading stabilizes, press [Enter]. The meter will calculate and set the new cell constant.

11 The calibration is done. Press [Cancel] to return to the initial screen.
Two-point calibration

When measuring a solution of high conductivity (>10 mS/cm), perform a two-point calibration.

1. Prepare two standard solutions. Standard solutions with high conductivity should have similar chemical composition to sample solution.

2. Calibrate the cell constant as described in “One-point calibration” on page 75.

3. Press [Enter] to end the first calibration.

**NOTE**
Do not press [Cancel]. Do not exit the calibration yet.

4. Put the conductivity probe into the second standard solution.

5. When reading stabilizes, press [Enter]. The meter will automatically calculate and set the two-point calibration.

6. The calibration is done. Press [Cancel] to return to the initial screen.

Manually enter a cell constant

1. While performing a measurement, press [Setup].

2. Select Cell Const and press [Enter].

3. The meter displays a popup window. Enter the cell constant given on the probe label.

**NOTE**
Manually entering a cell constant will overwrite a previous cell constant calibration.
Choose the correct probe

Before measuring, choose the proper conductivity probe. Refer to Table 8 on page 79 when choosing a conductivity probe. There are two kinds conductivity probes with cell constant K=1.0:

- **Platinum black** – Has platinum black coating on platinum sheet.
- **Bright** – Does not have platinum black coating on platinum sheet.

If conductivity is $\geq$3000 $\mu$S/cm, some measurement error may be inevitable. To measure high conductivity, use a conductivity probe with a high cell constant.

When conductivity is $\geq$200.00 mS/cm, use a conductivity probe with cell constant = 5 or 10.

When conductivity is $\geq$500.00 mS/cm, use a conductivity probe with cell constant = 10.

### Table 8  Conductivity range and corresponding cell constant

<table>
<thead>
<tr>
<th>Conductivity range</th>
<th>Resistivity range (Ω-cm)</th>
<th>Recommended cell constant (cm⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000–19.99 $\mu$S/cm</td>
<td>20.00 M–50.0 K</td>
<td>0.01</td>
</tr>
<tr>
<td>0.20–200 $\mu$S/cm</td>
<td>5.00 M–5.00 K</td>
<td>0.1</td>
</tr>
<tr>
<td>2.000–20 mS/cm</td>
<td>500 K–50 K</td>
<td>1.0</td>
</tr>
<tr>
<td>20.00–200 mS/cm</td>
<td>50 K–5 K</td>
<td>10</td>
</tr>
</tbody>
</table>
To measure conductivity

If the meter has been recently calibrated and zeroed, you can start taking measurements without recalibrating.

1. Calibrate the meter. See “To set or calibrate the cell constant” on page 75.

2. From the initial state display, press [Setup] and select a measuring mode. See “To select measurement parameters and modes” on page 33.

3. Press [Measure] to start taking a measurement according to the selected mode. See Figure 46. The upper area of the screen shows the current measuring mode and system time. The central area of the screen shows conductivity, resistivity and temperature.

![Figure 46 Measuring conductivity](image)

4. During a measurement, you can recalibrate the cell constant and setup parameters.

**NOTE**

When measuring conductivity and TDS with an ATC probe connected to the meter, the measurement will be temperature-compensated into the corresponding value at 25.0 °C according to the set temperature coefficient.

When measuring salinity with an ATC probe connected to the meter, the measurement will be temperature-compensated into the corresponding value at 18.0 °C according to the set temperature coefficient.

If no ATC probe is connected, the measurement is given without temperature compensation.

---

**To measure resistivity**

In the conductivity measuring mode, the meter displays both conductivity and resistivity. You can measure resistivity directly in the conductivity measuring mode.

**To measure temperature**

In any measuring mode, the meter displays the current temperature of the solution.

**To set or calibrate the TDS factor**

**Manually enter the TDS factor**

1 While measuring, press [Setup] and select **Set TDS Factor**. Press [Enter].

2 The meter displays a popup window. Enter the TDS factor according to your actual need.
Calibrate the TDS factor

1 Calibrate the meter with a conductivity standard solution. Select a proper standard solution according to the nature and measuring range of the sample. (The relationship between conductivity and the TDS standard solution can be seen in Table 9).

Table 9 Relationship between conductivity and TDS standard solution

<table>
<thead>
<tr>
<th>Conductivity (µS/cm)</th>
<th>TDS standard value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>KCl (mg/L)</td>
</tr>
<tr>
<td>23</td>
<td>11.6</td>
</tr>
<tr>
<td>84</td>
<td>40.38</td>
</tr>
<tr>
<td>447</td>
<td>225.6</td>
</tr>
<tr>
<td>1413</td>
<td>744.7</td>
</tr>
<tr>
<td>1500</td>
<td>757.1</td>
</tr>
<tr>
<td>2070</td>
<td>1045</td>
</tr>
<tr>
<td>2764</td>
<td>1382</td>
</tr>
<tr>
<td>8974</td>
<td>5101</td>
</tr>
<tr>
<td>12880</td>
<td>7447</td>
</tr>
<tr>
<td>15000</td>
<td>8759</td>
</tr>
<tr>
<td>80000</td>
<td>52168</td>
</tr>
</tbody>
</table>

NOTE
The value listed in the form is the one at 25 °C.
442 indicates 40% Na₂SO₄, 40% NaHCO₃, 20% NaCl.

2 While measuring, press [Setup] and select cell constant.
3 Set the cell constant to the value written on the conductivity probe label, or recalibrate the conductivity probe to obtain a new cell constant.
4 Press [Mode] and select **TDS Measuring mode**.

5 Press [Calibrate] and select **TDS Factor**. Press [Enter] to enter Calibration mode as shown in Figure 47.

![Calibration mode](image)

**Figure 47** Calibration mode

6 Rinse the conductivity probe with distilled water or DI water.

7 The temperature of the calibration solution should be 25.0 ± 0.1 °C. Soak the conductivity probe in the standard solution.

8 Press [Setup] and select **STD Value** and then press [Enter].

9 Enter an STD value given in Table 8 on page 79.

10 When the readings become stable, press [Enter].

11 The meter automatically calculates and sets a new TDS factor.

12 Calibration is finished. Press [Cancel] to exit.

### Temperature coefficient

Temperature affects the accuracy of conductivity measurement. When you set the temperature coefficient, the meter automatically compensates for the temperature while measuring.

1 While measuring, press [Setup] and select **Temp Coef**. Press [Enter].

2 The meter displays a popup window. Input the new temperature coefficient.
2 Operation

To view current temperature coefficient:

1 From the initial screen, press [View].

2 Select View COND Para and press [Enter]. The meter displays the View COND Para screen. See Figure 48.

The user can view current calibration data including cell constant and temperature coefficient. Usually the user doesn’t need to setup the temperature coefficient. The default temperature coefficient is 2.00%/°C.

![Figure 48 The View COND Para screen](image)

To measure TDS

**Measure TDS from the initial state**

1 Select a proper conductivity probe before measuring TDS. The selection principle is the same as the selection of a conductivity probe.

2 Set corresponding cell constant. See “To set or calibrate the cell constant” on page 75.

3 Set the temperature coefficient. See “Temperature coefficient” on page 83.

4 Set the TDS factor. See “To set or calibrate the TDS factor” on page 81.

5 To skip steps 2 through 4, recalibrate conductivity probe.

6 Once the TDS parameters have been set, you can measure TDS directly from the initial state.
Measure TDS using the TDS Measuring Mode

1  Set the TDS parameter with **Setup Measuring Mode**. See “To select measurement parameters and modes” on page 33.

2  For a description of display, measuring procedure, and operation in TDS measurement, see “To measure conductivity” on page 80.


To measure salinity

Measure salinity from the initial screen

1  Select a proper conductivity probe before measuring Salinity. See “Choose the correct probe” on page 79.

2  Set the corresponding cell constant. See “To set or calibrate the cell constant” on page 75.

3  Set the salinity parameters. See “To select measurement parameters and modes” on page 33. Now you can measure salinity directly from the initial screen.

Measure salinity using the Salinity Measuring Mode

1  Set the salinity parameter with **Setup Measuring Mode**. See “To select measurement parameters and modes” on page 33.

2  For a description of display, measuring procedure, and operation in TDS measurement, see “To measure conductivity” on page 80.

DO Measurement

The 3200M can measure DO and saturation. To measure DO or saturation:

1. If needed, set the barometric pressure. (Normally not needed unless ambient pressure is not approximately 101.3 kPa.) See “To set the ambient barometric pressure” on page 86.

2. If needed, set the salinity. See “To set the DO salinity” on page 87.

3. Prepare the DO probe. See “Preparing the DO probe” on page 88.

4. If needed, calibrate the probe. (In general, a new DO probe does not require calibration. See “About DO probe calibration” on page 89.)
   a. Calibrate at zero oxygen. See “To perform Zero Oxygen calibration” on page 89.
   b. Calibrate at full scale. See “Full scale calibration” on page 90.

5. Measure DO and saturation. See “To measure DO” on page 92 and “To measure saturation” on page 93.

To set the ambient barometric pressure

In general, you do not need to set barometric (atmospheric) pressure. The default value is 101.3 kPa. Only set the barometric pressure if using the meter in an environment where the air pressure deviates significantly from 101.3 kPa.

1. From the initial state display, press [Setup].
2. Scroll to Parameter and select Set Air Pressure. Press [Enter].
3 Use the keypad to enter the correct pressure value, in kPa, and press [Enter]. See Figure 49.

![Figure 49 Setting air pressure](image)

**To set the DO salinity**

**NOTE** In general, you do not need to set salinity. The default salinity value is 0.0 g/L.

1 From the initial state display, press [Setup].
2 Scroll to Parameter and select Set DO Salinity. Press [Enter].
3 Use the keypad to enter the correct salinity value, in g/L, and press [Enter]. See Figure 50.

![Figure 50 Setting salinity](image)
Preparation of the DO probe

1. Unscrew the membrane cap, rinse thoroughly with distilled or deionized water, and then swing the membrane cap a few times to throw away any residual water drops.

2. Rinse the silver and platinum parts of the stem with distilled or deionized water thoroughly and then dry with a soft lab tissue.

3. Fill the membrane cap with DO filling solution (5190-0547) to about 3/4 full.

4. Screw the membrane cap in slowly until finger tight. Ensure the membrane touches the platinum tip and there are no gas bubbles between the membrane and the platinum tip.

5. Polarize the DO probe for 60 minutes by connecting it to a powered 3200M Multi-Parameter Analyzer. The DO probe is always polarizing when connected with meter, so there is no need to repeat polarizing unless the DO probe has undergone maintenance or has been disconnected from the meter for over 1 hour.

   If the DO probe is removed from meter for less than 1 hour, polarize it for only 25 minutes before use.

6. Refresh the sample solution near the membrane. Some oxygen will be consumed during polarization, so the oxygen concentration will become low near the membrane. Swing the electrode horizontally at 20 to 80 cm/second, or use a stirrer to guarantee the flow rate of the sample solution near the membrane.

7. Check the membrane for damage.
   - There should not be any damage to the membrane.
   - Avoid touching the membrane with any solid or hard materials.
   - Ensure the membrane touches the platinum tip and there is no gas bubble between the membrane and the platinum tip.
   - If there is any damage to the membrane, replace the membrane cap.
During use, periodically change the DO filling solution. The time between refills depends on application conditions. Agilent recommends refilling the DO filling solution every 2 weeks to 2 months.

**About DO probe calibration**

Normally, a new DO probe does not require calibration. To obtain accurate measurements, a used DO probe must be calibrated before use. See “To perform Zero Oxygen calibration” on page 89 and “Full scale calibration” on page 90.

**To perform Zero Oxygen calibration**

Calibrate the Zero Oxygen point as follows:

1. Rinse the DO probe with distilled water and put it in zero oxygen solution (5% sodium sulfite solution or as described in the DO probe instruction manual).

2. In the measuring mode or initial state display, press [Calibrate].

3. Select Zero Oxygen calibration and press [Enter] to begin the calibration as shown in Figure 51.

4. When the reading become stable, press [Enter] twice. The meter will automatically record the zero oxygen value.
During calibration, you can press [Setup] to set calibration parameters such as barometric pressure and salinity, if desired. Press [Cancel] to end calibration.

**Full scale calibration**

Perform full scale calibration in either air or in water saturated with air.

1. Remove the DO probe from the solution and rinse it thoroughly with distilled water.

   **CAUTION**
   
   Be careful not to damage the membrane surface.

2. Dry the membrane surface with a soft tissue.

3. If calibrating with air, place the probe in a location where the air is free to move (not stagnant or confined).
   
   If calibrating in water, place the probe in air-saturated water.

4. Swirl the probe at a speed of 20 to 80 cm/s or stir the water to produce a similar linear speed across the membrane. Keep the water flow speed constant during calibration. Ensure that no air bubbles form on the membrane.

5. From the DO measurement mode or from the initial state display, press [Calibrate].
6 Select **Calib Full Scale** and press [Enter] to begin full scale calibration as shown in Figure 52.

![Calibration Screen](image)

**Figure 52**  
Full Scale calibration

7 When the reading becomes stable, press [Enter] and the meter will record the full scale response.

During calibration, press [Setup] to set calibration parameters such as barometric pressure and salinity, if desired. Press [Cancel] to exit calibration.

**NOTE**

The meter will display a prompt window to ask if the user wants another calibration. For example, after **Zero Oxygen** calibration the meter will ask if the user wants **Full Scale** calibration and *vice versa*. During calibration, press [Mode] to switch between **Zero Oxygen** calibration and **Full Scale** calibration.
To measure DO

Before using the DO probe for the first time, rinse it with distilled water and put it in a sample solution. Turn the meter on and perform a measurement.

If the DO probe has not been used for a long time, calibrate it before use. For details, see “About DO probe calibration” on page 89.

1 Select the DO parameter and the desired measuring mode. See “To select measurement parameters and modes” on page 33.

2 Press [Measure] and the meter will begin measurement as shown in Figure 53 (Continuous Mode shown).

<table>
<thead>
<tr>
<th>Continuous Mode</th>
<th>09:42</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.00mg/L</td>
</tr>
<tr>
<td></td>
<td>0nA   25.0°C</td>
</tr>
<tr>
<td>Last Calib</td>
<td></td>
</tr>
<tr>
<td>Zero: OnA Full:1000nA</td>
<td></td>
</tr>
</tbody>
</table>

Figure 53 Measuring mode

The upper area of the screen shows the current measuring mode, system time, DO data, corresponding DO current value and temperature. The bottom area displays Last Calib (the last calibration data).

During measurement, you can calibrate the probe. After measurement, you can save and output measuring data. Press [Cancel] to finish measurement.

During use, periodically change the DO filling solution. The time between refills depends on application conditions. Agilent recommends refilling the DO filling solution every 2 weeks to 2 months.
To measure saturation

Saturation measurement is similar to DO measurement (see “To measure DO” on page 92). However, select the saturation parameter and the desired measuring mode. See “To select measurement parameters and modes” on page 33.
To Turn Off the 3200M Multi-Parameter Analyzer

After using the meter, make sure you have pressed [Save] to save your data. Then press [On/Off] to turn off the meter. When not in use, all electrodes should be soaked in distilled water. If the meter is out of use for a long time, pay attention to the following:

- Disconnect the power adaptor from the power line to avoid damage to the power adaptor and the meter.
- The sockets of the meter must be kept clean and dry. Keep acidic, alkaline, and salt solutions away from the socket.
- The pH/pX input terminal of the meter (the probe connector) must be kept clean and dry. If the electrode has been exposed to high humidity or water, wipe the cable interface of the probe with dry gauze or a soft tissue.
- Rinse the conductivity probe with deionized water and store it in the protective bottle.
- If the DO probe is not used, store it in distilled water. Do not soak it in sodium sulfite solution. If the sodium sulfite solution leaks into the DO probe chamber, DO probe performance will deteriorate.
- When not in use, insert the short circuit plug in the pH/pX socket to prevent damage of the open circuit.
3 Troubleshooting and Maintenance

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Troubleshooting and Maintenance

Troubleshooting the 3200M Multi-Parameter Analyzer

- If the meter is connected with the power supply and the display is not bright, check the power adaptor.
- The sockets of the meter must be kept clean and dry. Keep acid, alkaline, and salt solutions away from the socket.
- Improper operation of the conductivity probe will lead to abnormal readings. During measurement, soak the probe tip completely in solution. The location of the conductivity probe in the solution should have good mobility.

See Table 10 for a list of failure modes and solutions.

### Table 10  Failure modes, possible causes, and solutions

<table>
<thead>
<tr>
<th>Number</th>
<th>Failure mode</th>
<th>Failure cause</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No display after meter starts up</td>
<td>1 Incorrect installation of power adaptor.</td>
<td>1 Connect it again according to the instructions.</td>
</tr>
<tr>
<td></td>
<td>LCD display is not lighting.</td>
<td>2 The power supply does not meet with the requirements.</td>
<td>2 Use an approved power supply.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 Power adaptor is damaged.</td>
<td>3 Replace the power adaptor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 The power socket has a poor contact.</td>
<td>4 Check all connections for good contact.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 LCD is damaged (After start up for a few minutes, user can hear buzzing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>sound after pressing [On\Off] but there is no display on LCD.)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>No buzzing when pressing key.</td>
<td>1 You may have pressed invalid keys under current setup.</td>
<td>Press a valid key for the current screen.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 The buzzer has been damaged.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>No response when pressing key.</td>
<td>1 You may have pressed invalid keys under current setup.</td>
<td>Press a valid key for the current screen.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 The key has been damaged.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Meter does not display 25 °C when no ATC electrode is connected with meter.</td>
<td>When the meter is not connected with an ATC electrode, the meter will</td>
<td>Manually input temperature.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>automatically switch to manual temperature setting.</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>Failure mode</td>
<td>Failure cause</td>
<td>Solutions</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 5      | The reading is not stable after a long time. | 1 The electrode has been damaged or aged.                                   | 1 Replace the electrode.  
                                                                      | 2 There is strong electrical signal interference source nearby (electrical leaking, strong electromagnetic field, and so forth). | 2 Remove the electrical signal interference source. Lift or move the beaker away from the source of interference. Shield the meter and beaker from the electromagnetic field. Use a wire to connect the meter with a ground line. For the wire, one terminal is connected with the meter and the other terminal is connected with interference source. |
|        | 3 Sample not compatible or has bubbles. |                                                                              | 3 Refer to the instruction for the conductivity electrode. Remove gas bubbles.                |
| 6      | Severe drift during conductivity measurement. | Probe tip contaminated.                                                      | Clean the conductivity probe.                                                                 |

Table 10  Failure modes, possible causes, and solutions (continued)
General Troubleshooting Procedure

During use, there are many factors that may impact measurement results, including the electrode, the standard solutions used to calibrate the electrode, the sample solution, ambient temperature during measurement, the stirring rate, and the reagents used to adjust ionic strength, as well as incorrect operation and parameter set-up. When the measured results are significantly different from what is expected, first determine whether the meter itself or factors other than the meter caused the error. Follow the suggestions described below to diagnose the problem. Since there are multiple measuring methods, you will need to diagnose the meter based on your application conditions. For best results, follow the troubleshooting order shown below.

Check temperature measurement

Because the meter always takes temperature measurements and uses them for its internal calculations, always verify temperature measurement accuracy first.

Connect the meter to the ATC temperature diagnostic tool (5185-8390) shipped with the meter. Turn on the meter to enter into measurement state. With the ATC temperature diagnostic tool connected, the meter should display a temperature reading between 49.0 to 51.0 °C. If yes, the meter is correctly measuring temperature. If the meter displays a temperature reading significantly different from 50 °C, there is a problem with the meter. Contact Agilent service.

Troubleshoot ion measurement

Check the potential (mV) value

Disconnect the ISE electrode. Connect the meter to the short circuit plug (G4383-40000) shipped with the meter. Turn on the meter. Enter the pH measurement state. At this moment, the meter should display a potential (mV) reading between –0.5 to 0.5 mV (also called mV Zero). If yes, this indicates that the
meter is functioning properly. If the potential (mV) reading significantly deviates from zero, then use the Adjust mV Zero function to adjust mV Zero. (“To adjust mV zero” on page 52) After adjustment, the potential (mV) reading should be near to zero. If the potential value (mV) reading cannot be adjusted near to zero by the mV Zero adjustment, this indicates a problem with the meter. Contact Agilent service.

**Check the pH value**

Disconnect the ATC probe. Set the meter for manual temperature input. Input the temperature to 25 °C. When the potential (mV) is zero, the meter should display a pH reading between 6.99 to 7.01 pH. If yes, this indicates the electrode calibration data of the meter is acceptable. If not, there may be a problem with the electrode calibration data. Check the slope of electrode. Press [View], select **Last pH Calib**, and press [Enter]. Now, view the calibration data and slope from last calibration. If the calibration data is severely out of the measurement requirement (the meter displays error message—refer to “Error warning messages” on page 105), this indicates a problem in the last electrode calibration which may lead to a large measurement error. Recalibrate the electrode. Pay attention to the selection of the Buffer Group during calibration.

**NOTE**

In the measurement state, the meter may display an error message simultaneously with measurement data.

**Check the pX value**

If user observes a large deviation in pX measurement, the deviation in pX measurement may be related to the stirring rate and reagents used to adjust ionic strength. This procedure can only diagnose the meter. To diagnose other factors, refer to professional application notes.
To diagnose the meter, first check the temperature measurement (see “Check temperature measurement” on page 98). Next check the potential measurement (see “Check the potential (mV) value” on page 98), and then the pH value measurement (see “Check the pH value” on page 99).

For factors other than the meter, compare standard versus sample solutions to determine the cause of the problem. Put the electrode in different standard solutions and sample solutions. Check the corresponding potential (mV) value, pH or pX value. Based on the comparison, judge whether the deviation results from the electrode, the solution, or something else.

**Check the conductivity measurement**

1. Disconnect the conductivity probe, connect the meter to the conductive diagnostic tool (5185-8391) shipped with the meter.

2. Turn on the meter. At the initial state display, view the cell constant. If the cell constant is near to 1.000, then go to next step. If not, set the cell constant to 1.000. (See “To set or calibrate the cell constant” on page 75.)

Enter the conductivity measurement state. Set manual temperature mode and set the manual temperature to 25 °C. Enter the measurement state. At this moment, the meter should display a resistance value among 9.00 to 11.00 kΩ and a conductivity value between 90.0 to 110.0 µS/cm. If yes, this indicates that the hardware of the meter is functioning well. If the display deviates significantly from these values, this indicates that there is a problem with the meter. Contact Agilent service

For factors other than the meter, compare standard versus sample solutions to determine the cause of the problem. Put the conductivity probe in solutions with a concentration near to the standard solution or sample solution. Check the conductivity values measured. Based on the comparison, judge whether the deviation results from the probe, the solution, or something else.
When measuring conductivity in a solution with high conductivity or in ultra pure water, choose a proper conductivity probe. If not, the accuracy of the measurement could be reduced.

**Check the DO measurement**

Connect the meter to the ATC temperature diagnostic tool (5185-8390) shipped with the meter. Turn on the meter. Enter the measurement state. At this moment, the meter should display a current between 680 to 720 nA. When the ATC temperature diagnostic tool (5185-8390) is disconnected, the meter should display a current between 0 to 5 nA. If yes, the DO measurement of this meter is functioning well. If the display deviates significantly from these values, there is a problem with the meter. Contact Agilent service.

Generally, after the meter is connected to a real DO probe for a period of time, the current for the DO probe in air should be at a stable value ranging from 300 to 1000 nA (refer to DO probe manual for details). If not, there is some problem with the DO probe.

During DO measurement, stirring rate is an important factor affecting measurement.

**Restore default settings**

To check the meter thoroughly, restore factory defaults. See “To restore factory defaults” on page 102. Then test whether the meter still has the problem.
To restore factory defaults

Select **Set Default** from the initial state display to restore all settings and calibrations to the factory defaults. **Table 11** lists the factory defaults.

**Table 11**  Factory default changes and settings

<table>
<thead>
<tr>
<th>Ion measurement defaults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clears mV Zero adjustments. Re-zero before use.</td>
</tr>
<tr>
<td>Clears all Buffer Group calibrations. The default electrode slope is set to 100% and the $E_0$ is set to 0.0 mV. Select the desired buffer group before taking measurements.</td>
</tr>
<tr>
<td>Modifies the calibration data of the other ion measurement methods in the system to the default data.</td>
</tr>
<tr>
<td>For ion concentration measurement in the calibration state, mol/L is set up as the concentration unit.</td>
</tr>
<tr>
<td>For ion concentration measurement in the measurement state, mol/L is set up as the concentration unit.</td>
</tr>
<tr>
<td>The current Ion Measuring Method is set up as Na$^+$.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conductivity measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resets cell constant calibration data. Selects one standard solution.</td>
</tr>
<tr>
<td>Standard Value: 1408 uS/cm</td>
</tr>
<tr>
<td>Measured Value: 1408 uS/cm</td>
</tr>
<tr>
<td>Calibration temperature: 25.0 °C</td>
</tr>
<tr>
<td>Default cell constant: 1.000</td>
</tr>
<tr>
<td>Resets TDS calibration data. Selects one standard solution.</td>
</tr>
<tr>
<td>Standard Value: 704 mg/L</td>
</tr>
<tr>
<td>Measured Value: 704 mg/L</td>
</tr>
<tr>
<td>Calibrated temperature: 25.0 °C</td>
</tr>
<tr>
<td>Default TDS: 0.500</td>
</tr>
<tr>
<td>Modify temperature coefficient to the default 2.00%/ °C</td>
</tr>
</tbody>
</table>
Table 11  Factory default changes and settings (continued)

**DO measurement**

Resets DO calibration data.
- Zero oxygen: 0 nA
- Full scale: 1000 nA
- Calibrated temperature: 25.0 °C
- Calibrated barometric pressure: 101.3 kPa
- Calibrated salinity: 0.0 g/L

**Others**

Set manual temperature: 25 °C

Set measuring method: **Continuous Mode**

Set measurement parameter: pH, conductivity, DO

Set interval of **Timed Reading Mode**: 10 minutes.

Disable all calibration message intervals (**Calib Interval**).

Set **Operator No**: 000

Set **Auto-Lock Condition** in **Auto-Lock Mode** to:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH/pX</td>
<td>0.01 pH</td>
</tr>
<tr>
<td>Conductivity</td>
<td>1.0%</td>
</tr>
<tr>
<td>Salinity</td>
<td>1.0%</td>
</tr>
<tr>
<td>DO</td>
<td>1.0%</td>
</tr>
<tr>
<td>Saturation</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

Set **Auto-Lock Time** in **Auto-Lock Mode**: 5 s

Set pH resolution: 0.001 pH

Set the time of **Auto Power Off**: 0 (disabled)
Meter Self-Diagnosis and Messages

The meter supports self-diagnosis, which can find some common errors caused by the meter, probe, solution or operation. It will deal with these errors differently according to their severity. There are two levels of severity: **Severe system errors** hinder further use of the meter or make the meter unable to finish necessary tasks. In this case, replacement or maintenance of the meter is required.

**Minor errors**, which are prompts or warnings, are caused by various reasons and can be corrected in several ways. However, you must pay attention to these errors to ensure measurement integrity and reliability. If you ignore these error messages, operation can continue.

### Severe errors

When severe errors occur, the meter will shut down and display a prompt window. In this case, you cannot do any further operation except turn off the meter. The meter will display an error message as shown in **Figure 54**.

![IMPORTANT MESSAGE](#)

**Figure 54**  Severe error message
Error warning messages

User should pay attention to messages or warnings resulting from improper probe, solution and operation. Read these error messages carefully. Maintain and operate the meter and conductivity probes according to instruction manuals to minimize the occurrence of such errors.

Figure 55 shows a warning that the temperature is out of range.

![Figure 55 Temperature warning](image)

is the icon for an error warning. The icon includes the error code. See Table 12.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Solution</th>
<th>Memo</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Conductivity measuring module error</td>
<td>Contact Agilent for service.</td>
<td>Serious error</td>
</tr>
<tr>
<td>01</td>
<td>DO measuring module error</td>
<td>Contact Agilent for service.</td>
<td>Serious error</td>
</tr>
<tr>
<td>02</td>
<td>Temperature measuring module error</td>
<td>Contact Agilent for service.</td>
<td>Serious error</td>
</tr>
<tr>
<td>03</td>
<td>Data storage error</td>
<td>Contact Agilent for service.</td>
<td>Serious error</td>
</tr>
<tr>
<td>20</td>
<td>Potential is out of range</td>
<td>Replace electrode.</td>
<td>–1999.9 to 1999.9 mV</td>
</tr>
<tr>
<td>21</td>
<td>pH/pX is out of range</td>
<td>Replace electrode.</td>
<td>–3.000 to 21.000 pH</td>
</tr>
<tr>
<td>22</td>
<td>Conductivity is out of range</td>
<td>Replace probe and solution.</td>
<td>0 to 2000 mS/cm</td>
</tr>
<tr>
<td>23</td>
<td>Resistivity is out of range</td>
<td>Replace probe and solution.</td>
<td>0 to 100 MΩ•cm</td>
</tr>
</tbody>
</table>
### Table 12  Error warning codes (continued)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Solution</th>
<th>Memo</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>Temperature is out of range</td>
<td>Replace electrode and reduce solution temperature.</td>
<td>–6.0 to 120.0 °C</td>
</tr>
<tr>
<td>25</td>
<td>DO electric current is out of range</td>
<td>Replace electrode.</td>
<td>0 to 4000 nA</td>
</tr>
<tr>
<td>26</td>
<td>pH electrode slope is out of range</td>
<td>Replace electrode and recalibrate it.</td>
<td>80 to 120%</td>
</tr>
<tr>
<td>27</td>
<td>Failed to recognize pH buffers</td>
<td>Replace electrode, setup proper buffer group and replace buffers.</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Temperature of pH buffer is out of range</td>
<td>Cool or heat buffer.</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Calibrate the same buffer repeatedly</td>
<td>Replace the buffer.</td>
<td>Due to incorrect operation</td>
</tr>
<tr>
<td>30</td>
<td>Number of pH buffers exceeds maximum</td>
<td>Remove one or more buffers from the group.</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>pH buffers conflict with each other</td>
<td>Remove one or more buffers with neighboring pH values.</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>The data storage is full.</td>
<td>Cover the previous data and store new data.</td>
<td>Do not delete all data</td>
</tr>
<tr>
<td>33</td>
<td>The internal clock has a low battery.</td>
<td>Set the time manually.</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Number of customer-defined ions exceeds maximum</td>
<td>Delete one or more unnecessary customer-defined ions.</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>The maximum ion mode number stored</td>
<td>Delete all storage data of certain ion mode.</td>
<td></td>
</tr>
</tbody>
</table>
Maintenance

Electrode and probe cleaning

General electrode cleaning includes inorganic cleaning, organic cleaning, grease cleaning, protein precipitation cleaning and glass sensitive membrane regeneration. The type of cleaning needed depends on the contaminants and the electrode. After one or more cleaning procedures, rinse the outside of the electrode with distilled water. Siphon the filling solution away and add fresh solution. Repeat 2 or 3 times. Store the pH electrode in the storage solution.

Electrode and probe storage

pH measuring electrode

When the electrode is not in use, store it in reference filling solution. For refillable electrodes, close the filling hole. When the electrode is not used for a long time, put the electrode back in the box and store it at a dry place at ambient temperature.

DO probe

During the intervals between tests, immerse the measuring tip in distilled water while the electrode is connected to the meter.

For long term storage, disconnect the electrode from the meter. Unscrew the membrane cap. Empty the membrane cap. Rinse the membrane cap with distilled or deionized water. Swing it a few times to throw away water drops. Dry the silver and platinum parts of the stem. Screw the membrane cap back in place. Do not add any DO filling solution. Store the probe in a dry place at ambient temperature.
### Consumables and Replacement Parts

Table 13 lists the consumables and replacement parts for the 3200M Multi-Parameter Analyzer.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Model and name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G4388A</td>
<td>Stirrer</td>
<td>Electrode holder and magnetic stirrer should be combined to stir solution with stable and precise speed with a large adjustable range.</td>
</tr>
<tr>
<td>G4389A</td>
<td>Electrode holder</td>
<td>It is used to support different probes and electrodes.</td>
</tr>
<tr>
<td>G4390A</td>
<td>Software package</td>
<td>3200M Multi-Parameter Analyzer can communicate with computer after this software package is installed (including software and communication cable).</td>
</tr>
<tr>
<td>5185-8389</td>
<td>AC Adaptor</td>
<td>100 to 240 VAC, 1 A, 50/60 Hz</td>
</tr>
<tr>
<td>G4383-40000</td>
<td>Short circuit plug</td>
<td>Used for Zero Potential calibration and diagnostics.</td>
</tr>
<tr>
<td>G4388-27000</td>
<td>Stirring bar</td>
<td>It is used with stirrer.</td>
</tr>
<tr>
<td>5190-3988</td>
<td>P3211 pH Combination electrode</td>
<td>Combination electrode, glass body and refillable.</td>
</tr>
<tr>
<td>5190-3989</td>
<td>P3212 pH Combination electrode</td>
<td>Combination electrode, plastic body and sealed.</td>
</tr>
<tr>
<td>5190-3990</td>
<td>P3311 pH Triode combination electrode</td>
<td>Triode combination electrode, glass body and refillable.</td>
</tr>
<tr>
<td>5190-3991</td>
<td>P3111 pH Electrode</td>
<td>Glass body and single electrode.</td>
</tr>
<tr>
<td>5190-3992</td>
<td>P3213 pH Combination electrode</td>
<td>Combination electrode, plastic body, flat and refillable.</td>
</tr>
<tr>
<td>5190-3993</td>
<td>P3214 pH Combination electrode</td>
<td>Combination electrode, glass body, spear-tip and sealed.</td>
</tr>
<tr>
<td>5190-4003</td>
<td>R8111 Reference electrode</td>
<td>Glass body, ceramic cored, Ag/AgCl and single-junction.</td>
</tr>
<tr>
<td>5190-3999</td>
<td>ORP8211 ORP Electrode</td>
<td>Combination electrode, glass body and refillable.</td>
</tr>
<tr>
<td>5190-3998</td>
<td>T7111 ATC probe</td>
<td>Stainless steel body</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measuring range: 0 to 100 °C.</td>
</tr>
<tr>
<td>5190-3997</td>
<td>D6111 DO probe</td>
<td>Plastic body with built-in ATC probe</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measuring range: 0 to 20 mg/L, 0 to 45 °C</td>
</tr>
<tr>
<td>5190-3994</td>
<td>C5111 Conductivity probe</td>
<td>Glass, K=1, platinum black</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measuring range: 2 to 20000 µS/cm</td>
</tr>
</tbody>
</table>
Table 13 Consumables and replacement parts (continued)

<table>
<thead>
<tr>
<th>Part number</th>
<th>Model and name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5190-3995</td>
<td>C5112 Conductivity probe</td>
<td>Glass, K=1, bright, Measuring Range: 2 to 3000 µS/cm</td>
</tr>
<tr>
<td>5190-3996</td>
<td>C5113 Conductivity probe</td>
<td>Glass, K=0.1, bright, Measuring Range: 0.05 to 200 µS/cm</td>
</tr>
<tr>
<td>5190-4002</td>
<td>I9111 Fluoride combination ISE</td>
<td>Combination electrode, plastic body and refillable</td>
</tr>
<tr>
<td>5190-4004</td>
<td>I9121 Ammonia combination ISE</td>
<td>Combination electrode, plastic body and refillable</td>
</tr>
<tr>
<td>5190-4005</td>
<td>I9131 Sodium combination ISE</td>
<td>Combination electrode, glass body and refillable</td>
</tr>
<tr>
<td>5185-8390</td>
<td>ATC temperature diagnostic tool</td>
<td>Temperature diagnostics</td>
</tr>
<tr>
<td>5185-8391</td>
<td>Conductivity diagnostic tool</td>
<td>Conductivity diagnostics</td>
</tr>
<tr>
<td>5190-0545</td>
<td>Reference filling solution (pH)</td>
<td>Bottle (3 x 3 mL each)</td>
</tr>
<tr>
<td>5190-0546</td>
<td>Reference filling solution (Na)</td>
<td>Bottle (3 x 3 mL each)</td>
</tr>
<tr>
<td>5190-0543</td>
<td>Ammonia electrode membrane kit</td>
<td>5 pcs</td>
</tr>
<tr>
<td>5190-0544</td>
<td>Filling solution for ammonia electrode</td>
<td>Bottle (3 x 3 mL each)</td>
</tr>
<tr>
<td>5190-0547</td>
<td>DO Filling solution</td>
<td>Bottle (3 x 3 mL each)</td>
</tr>
<tr>
<td>5190-0548</td>
<td>DO Membrane kit (3 pcs)</td>
<td>3 pcs/kit</td>
</tr>
<tr>
<td>5190-0533</td>
<td>pH Buffers</td>
<td>Bottle, 3 x 250 mL, 4.01, 7.00, and 10.01 pH</td>
</tr>
<tr>
<td>5190-0534</td>
<td>pH Buffers</td>
<td>Bottle, 3 x 250 mL, 4.00, 6.86, and 9.18 pH</td>
</tr>
<tr>
<td>5190-0541</td>
<td>pH 1.68 Buffer</td>
<td>Bottle, 3 x 250 mL</td>
</tr>
<tr>
<td>5190-0538</td>
<td>pH 4.00 Buffer</td>
<td>Bottle, 3 x 250 mL</td>
</tr>
<tr>
<td>5190-0535</td>
<td>pH 4.01 Buffer</td>
<td>Bottle, 3 x 250 mL</td>
</tr>
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<td>5190-0539</td>
<td>pH 6.86 Buffer</td>
<td>Bottle, 3 x 250 mL</td>
</tr>
<tr>
<td>5190-0537</td>
<td>pH 7.00 Buffer</td>
<td>Bottle, 3 x 250 mL</td>
</tr>
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<td>5190-0540</td>
<td>pH 9.18 Buffer</td>
<td>Bottle, 3 x 250 mL</td>
</tr>
<tr>
<td>5190-0536</td>
<td>pH 10.01 Buffer</td>
<td>Bottle, 3 x 250 mL</td>
</tr>
<tr>
<td>5190-0542</td>
<td>pH 12.46 Buffer</td>
<td>Bottle, 3 x 250 mL</td>
</tr>
</tbody>
</table>

3 Troubleshooting and Maintenance