Orion 210A+, 230A+,
250A+, 290A+

Orion Aplus

Portable pH and ISE Meters

INSTRUCTION MANUAL

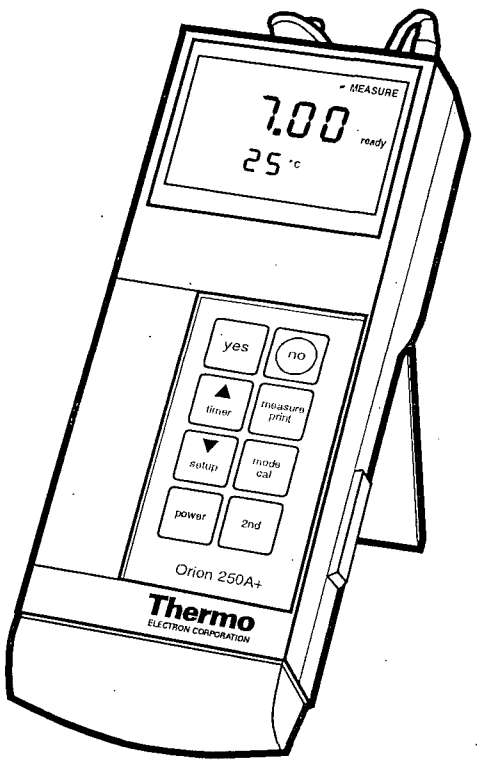

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Table Of Contents

Chapter I

Introduction

Orion's Portable Meters are compact, battery operated and microprocessor controlled for all measurement needs. All meters feature a custom digital LCD display, which simultaneously displays temperature along with measurement results. Ideal for field, plant, or laboratory use, each meter is lightweight and designed to fit comfortably in the hand.
A flip stand allows easy use in the lab.

The Orion 210Aplus is a basic pH meter that features 2 point autocalibration.

The Orion 230Aplus is a pH meter that features autocalibration and automatic temperature compensation, millivolt, relative millivolt and (E_H) ORP mode.

The Orion 250Aplus has all the features of the 230Aplus plus 3 point auto calibration and RS232-C output for use with the Orion 900A printer or other serial peripherals.

The Orion 290Aplus adds concentration measurements and an internal datalogging function to make a truly versatile meter for pH or ISE analysis.

This manual contains instructions for all four meters. See the calibration and measurement section for details on your particular meter. The general information section contains descriptions of hardware which pertain to all meters. The Temperature Compensation and Troubleshooting sections contain information applicable to all meters.

Chapter II

General Information

Orion's Portable Meters have a large custom LCD display and keypad with tactile and audible feedback. Designed for one-handed operation each features an electrode clip to attach electrode directly to meter and molded grip area. (Electrode clips included in Portable Meter Starter Kit, Orion No. OPBLSK)

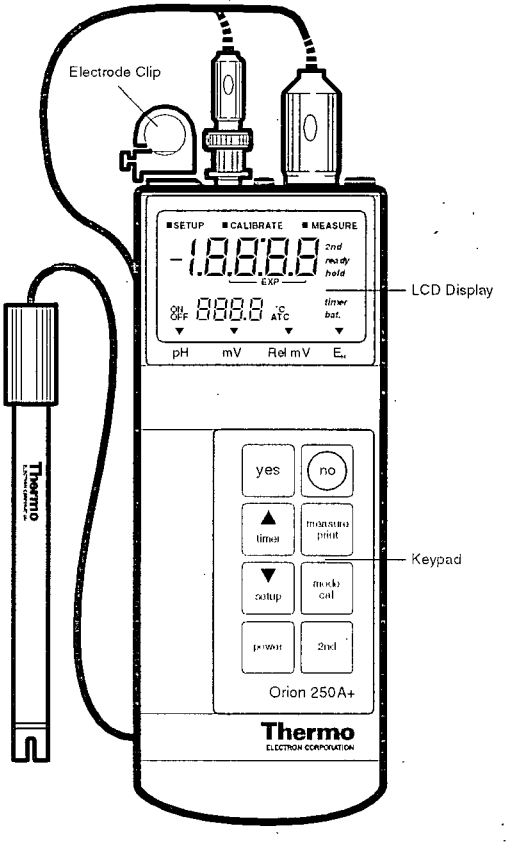

Figure 1: Front Panel Orion 250Aplus

A. Top Panel

1. Electrode Connections: Accepts BNC connector from combination or half-cell sensing electrode(s) (1A). A separate pin tip (1B) accepts a reference electrode.
2. ATC Probe Jack: Accepts thermistor type Automatic Temperature Compensation probe with DIN connector.
3. Line Converter Jack: Accepts an AC line converter for use without batteries.

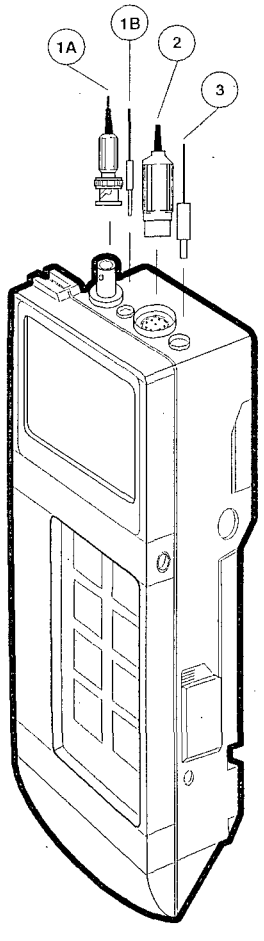

Figure 2: Top Panel Orion 250Aplus

B. Rear Panel

1. Battery Compartment: Accepts one 9 V battery, either alkaline or lithium.
2. Setup Menu Label: Identifies setup parameters and corresponding I.D. codes.
3. Electrode Clip: Attaches an electrode directly to the meter for one-handed operation.
4. Electrode Storage Compartment: Stores electrode in between measurements. Compartment can contain electrode storage solution to keep electrode moist and ready for use.
5. Cable Management: The cable(s) from the electrode(s) will slide under the left side of the storage compartment.

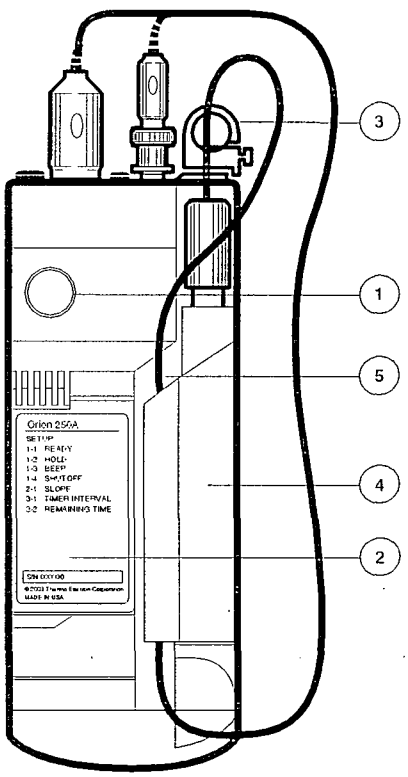

Figure 3: Rear Panel Orion 250Aplus

C. Electrode Clip

The electrode clip allows easy one-handed dip and read operation. Two or more electrodes may be joined together and then attached directly to the meter.

1. Slide electrode clip onto electrode.
2. If using two electrodes, slide second electrode clip into opening on the first electrode clip (see illustration).
3. Attach electrode(s) to meter by sliding clip from left to right into meter until securely seated.

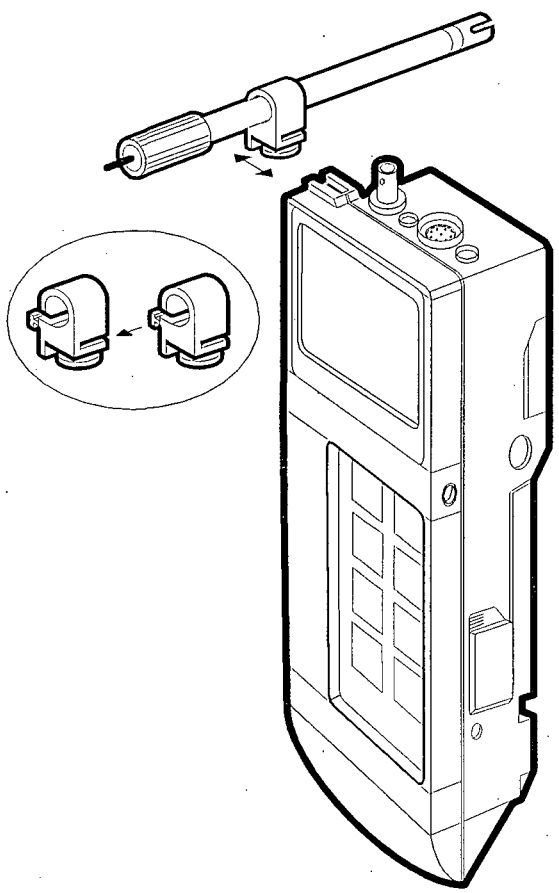

Figure 4: Electrode Clip

D. Electrode Storage Compartment

The electrode storage compartment provides a convenient place for electrode storage between measurements and in the field. Add a few drops of pH electrode storage solution Orion No. 910001 to the storage compartment cap to ensure your electrode will be ready for use. The entire compartment is removable for easy cleaning.

The right-hand side of the compartment (when the meter is turned over and facing down) provides a space for the electrode cables. Slide the cable underneath the edge of the compartment.

1. With the meter facing down slide the compartment to the right to remove.
2. Rinse with distilled or deionized water.
3. Replace compartment by lining up pins on meter with slides on electrode storage compartment then slide to the left until firmly in place.

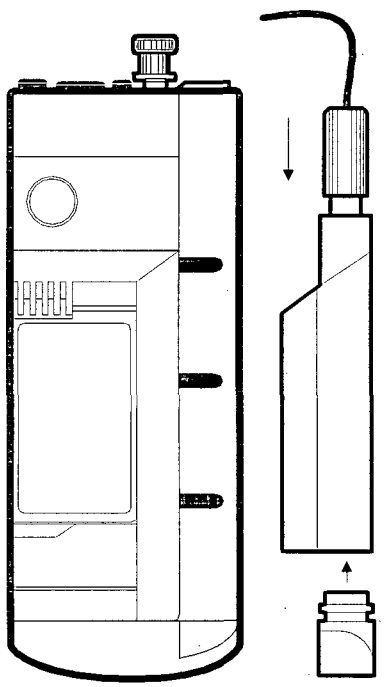

Figure 5: Electrode Storage Compartment

E. RS232-C Interface

Both the Orion 250Aplus and 290Aplus have an RS232-C interface for use printers or serial peripherals.

The Orion 250Aplus has a one way interface for communication with the Orion 900A printer or other device. The instrument can send (but not receive) information via this port.

The Orion 290Aplus has a bi-directional interface for communication with printers or computers. The instrument can send or receive information using this port.

The Orion 900A printer is battery operated and attaches directly to either meter making a compact package for field measurement and recording. See printer manual, part no. 213377-001.

Chapter III

Set Up and Self-Test Procedures

A. Power Source

The Orion Portable Meters operate on either one 9V alkaline battery, one 9V lithium battery, or an AC line adapter. The estimated battery life is 50 hours of continuous operation for an alkaline battery and 100 hours of continuous operation for a lithium battery. Insert battery as described below or plug in the line adapter.

B. Battery Installation

1. Open battery compartment by pushing closure up. This is most easily accomplished by using a coin (such as a dime) and inserting it into the slot on the side of the meter.
2. Insert battery pushing gently until it locks in place. Ensure polarity is correct as shown in the battery compartment.
3. Replace battery compartment cover.

NOTE: After replacing the battery, recalibrate meter. Without the battery installed or meter plugged into line power, the meter loses calibration data and other information in memory. To prevent loss of data in the field, turn meter off if the low battery signal comes on. Check and replace batteries regularly prior to field use.

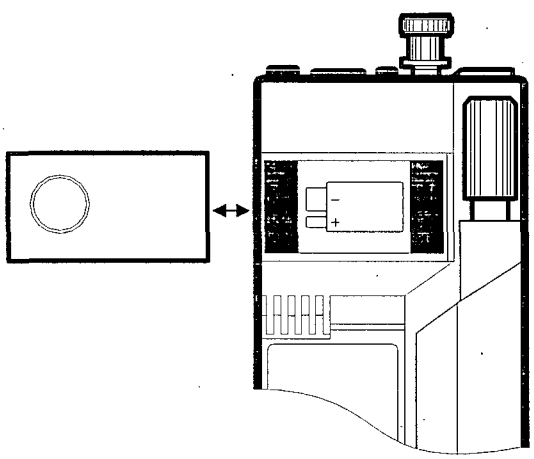

Figure 6: Battery Compartment

C. Power Up and Self-Test

NOTE: Use this procedure when the instrument is first received and whenever troubleshooting becomes necessary.

1. Attach the BNC Shorting Plug (Orion No. 090045) to BNC connector on top of meter.
2. Press the **power** key to turn meter on.
3. If battery indicator remains on, replace battery or use line adapter.
4. Press the **power** key to turn meter off.
5. Press the **power** key and quickly press the **yes** key to start the self-test. (Alternatively, press and hold the **yes** key while pressing the **power** key). The instrument automatically performs electronic and hardware diagnostic tests. For a more detailed explanation, see the self-test section of the troubleshooting guide.
6. When the code 7 appears in the lower display field, "0" will be displayed, press each key, including the **power** key, one at a time. A numeric digit will be displayed upon each key press.

   NOTE: All keys must be pressed within 10 seconds to complete test 7.

7. For Orion 210Aplus or Orion 230Aplus: After the keypad test, the meter will shut off.

   For Orion 250Aplus or Orion 290Aplus: After the keypad test, the meter will turn off then back on again. After completing the self-test, the meter will resume normal operation.

8. If any problems are found during self-test, the meter will display the operator assistance code until acknowledged by pressing the **yes** key. See **Troubleshooting** section.

D. Electrode Connections

Orion Triode

Attach Orion TRIODE electrode by sliding the BNC connector onto the sensor input then push down and turn clockwise to lock into position. Slide the DIN connector into the ATC jack until it is firmly seated.

Other Electrodes

Attach electrodes with BNC connectors to sensor input by sliding connector onto input, pushing down and turning clockwise to lock into position. Connect reference electrodes with pin tip connectors by pushing connector straight into reference input.

> *NOTE: If using a combination electrode with a BNC connector, the reference pin-tip is not used.*

ATC Probe

Attach the ATC probe to the ATC jack by sliding the connector straight on until firmly in place. The connector has a special sealing mechanism, which is engaged when the connector is properly attached, to prevent moisture from penetrating the meter.

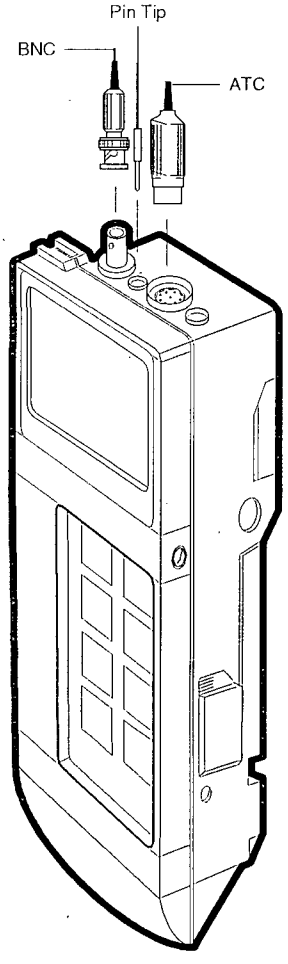

Figure 7: Electrode Connections

Chapter IV

Orion 210Aplus

A. Display

Operating Mode	Indicates instrument operating mode.
SETUP	*Indicates meter is in setup mode. Used to define operating parameters.*
CALIBRATE	*Indicates meter is in calibration mode.*
MEASURE	*Indicates meter is in measurement mode.*
Main Field	Displays pH readings, electrode slope and other significant information.
Lower Field	Displays temperature in degrees Celsius. The °C designation is displayed when temperature is displayed.
ATC	Displayed when a temperature probe is attached.
READY	Displayed when the electrode signal has stabilized. The Ready function may be turned on or off in the setup menu.
BAT	Displayed when the battery is low and needs to be replaced.

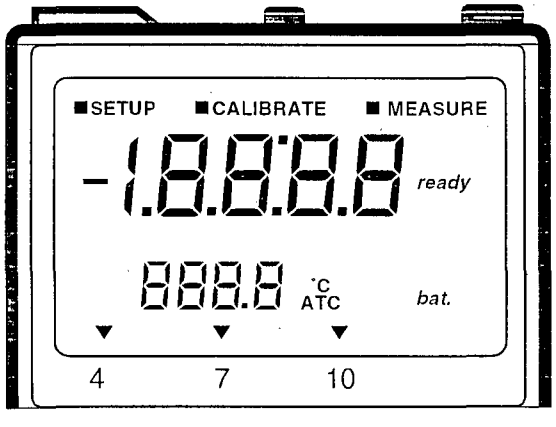

Figure 8: 210Aplus Display

B. Keypad

yes Press to enter a value during calibration or setup. May also be used to scroll through the setup menu without changing any parameters.

no Press to cancel a change to a parameter before entering. May also be used to initiate a change in current setup parameter.

mode Press to select operating mode: SETUP, CALIBRATE or MEASURE.

power Press to turn meter on or off.

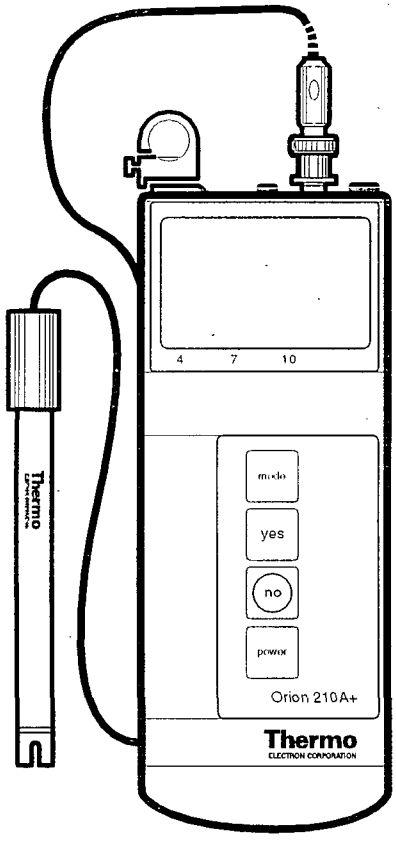

Figure 9: 210Aplus Keypad

C. Self Test and Checkout Procedure

This procedure should be performed when the meter is received and when operation problems arise. This procedure verifies the proper operation of the Orion 210Aplus Meter.

1. Attach the Orion shorting cap to the meter.
2. Press the **power** key to turn meter on.
3. If the low battery indicator remains on, replace the battery or use a line adapter.
4. Press the **power** key to turn meter off.
5. Press the **power** key and quickly press the **yes** key to start the self-test. The meter automatically performs electronic and hardware diagnostic tests.
6. When the code 7 appears in the lower display field, "0" will be displayed, press each key, including the **power** key, one at a time. A numeric digit will be displayed upon each key press.
7. After the self-test is complete, the meter will automatically shut off. To restart the meter, press the **power** key.
8. If any problems are found during the self-test, the meter will beep and an operator assistance code will be displayed until acknowledged by pressing the **yes** key. See **Troubleshooting**.

D. SETUP Menu

Select SETUP mode by pressing the **mode** key until SETUP is displayed. The SETUP mode is used to define, change or view meter operating parameters. While in the SETUP mode, the **yes** key is used to scroll through the menu without changing parameters and to enter new parameters into meter memory. The **no** key is used to scroll through options within each parameter. To exit the SETUP mode, press the **mode** key at any time.

The following parameters are accessed in the SETUP mode:

Resolution

The current pH resolution will be displayed. The default setting is two decimal places (i.e. pH 7.00). Press the **yes** key to agree with setting or press the **no** key to change to 7.0 and then press the **yes** key to accept the new setting.

Slope

The current electrode slope in meter memory will be displayed. The value is displayed as a percent of theoretical slope. The default setting is 100%. This function is for display purposes only. The value can not be changed in the SETUP menu. To change the slope value, perform a two buffer calibration or set slope during a one buffer calibration. Press the **yes** key to advance to next menu option.

Cal. Buffer Option

The current calibration buffer option in meter memory will be displayed as STD "570" or SET "5E7" on the temperature display.

Auto Calibration Buffer Option

When the "570" option is selected, calibration may only be performed with standard buffers: pH 4.01, 7.00 and 10.01.

Manual Calibration Buffer Option

When the "5E7" option is selected, calibration may be performed with user defined buffers within the range of 0 to 14 pH.

> *NOTE: The chosen buffers must be greater than one (1) pH unit but less than four (4) pH units from each other.*

E. Calibration and Measurement Procedures

pH Measurements

A one or two buffer calibration should be performed before pH is measured. It is recommended that a two buffer calibration, using buffers that bracket the expected sample range, be performed at the beginning of each day to determine the slope of the electrode. This serves the dual purpose of determining if the electrode is working properly and storing the slope value in memory. Perform a one buffer calibration every two hours to compensate for electrode drift.

Prior to calibration, scroll through the setup menu and ensure all parameters are set correctly for the analysis you want to perform.

There are two ways of calibrating the 210Aplus Meter: autocalibration or manual calibration. Following are descriptions and instructions for each method.

Autocalibration

Autocalibration is a feature of the Orion 210Aplus Meter that automatically recognizes the buffers 7.00, 4.01 and 10.01 within a range of (0.5 pH units. Simply select the buffer sequence that best fits your application, choose between, 7 - 10; 7 - 4; or a one point autocalibration with pH 7. During calibration wait for READY to be displayed, indicating electrode stability. Once the electrode is stable, the meter automatically recognizes and displays the temperature-corrected value for that buffer. Press the **yes** key to enter the value into memory.

The 210Aplus Meter compares actual values to theoretical values to determine if the buffer is within range. Results greater than (0.5 pH units from the theoretical value will trigger an operator assistance code. For best results, it is recommended that an ATC probe be used. If an ATC probe is not used all samples and buffers should be at the same temperature or manual temperature compensation should be used.

Autocalibration with Two Buffers

1. Connect the electrode(s) to meter. Choose either 4.01 and 7.00, or 7.00 and 10.01 buffers, whichever will bracket your expected sample range.
2. Rinse the electrode(s) and place into the 7.00 buffer.
3. Press the **mode** key until CALIBRATE is displayed above the main readout. The last buffer sequence used will be displayed. Press the **yes** key to use this sequence, or press the **no** key to scroll through other choices, and then press the **yes** key when the desired sequence is displayed.
4. The buffer indicator along the bottom of the display will indicate the buffer chosen. P1 will be displayed in lower display field and buffer reading will be displayed in the main field.
5. When READY is displayed, indicating electrode stability, the temperature-corrected value for the buffer is displayed. Press the **yes** key. The display will remain frozen for two seconds. Then P2 is displayed in the lower field indicating the meter is ready for the second buffer. The buffer indicator along the bottom of the display will indicate the second buffer of the calibration sequence selected.
6. Rinse the electrode(s) and place into the second buffer.
7. When READY is displayed, indicating electrode stability, the temperature-corrected value for the buffer is displayed. Press the **yes** key. The display will remain frozen for two seconds.
8. After the second buffer value has been entered, the electrode slope will be displayed. SLP appears in the lower field while the actual electrode slope (in percent) appears in the main field for 5 seconds.
9. The meter will then automatically advance to the measure mode and MEASURE is displayed above the main display field.
10. Rinse the electrode(s) and place into the sample. Record pH and temperature directly from the meter display.

Autocalibration with One Buffer

NOTE: Autocalibration with one buffer can only be performed using buffer 7.00

1. Attach the electrode(s) to the meter.
2. Rinse the electrode(s) and place into 7.00 buffer.
3. Press the **mode** key until CALIBRATE is displayed above the main readout. The last buffer sequence used will be displayed. Press the **no** key until 7 is displayed. Then press the **yes** key.
4. The buffer indicator along the bottom of display will indicate the buffer selected (7) and P1 will be displayed in the lower field. The buffer reading will be displayed in the main field.
5. When READY is displayed, indicating electrode stability, press the **yes** key. The temperature-corrected value for that buffer is entered into the memory of the meter.
6. SLP will appear in the lower display field and the current electrode slope in memory is displayed in the main field. Press the **yes** key to accept value or press the **no** key to change value. The value in the main display will blink. Begin editing with the left most digit. Pressing the **no** key will scroll the value. Set digit to desired value and press the **yes** key. Continue editing each digit until desired slope value is entered into memory.
7. The meter will then automatically advance to the measure mode and MEASURE is displayed above the main display field. Rinse the electrode(s) and place into sample. Both the temperature-corrected pH reading and temperature reading are displayed. Record reading when READY is displayed.

Manual Calibration

Manual Calibration with Non-Standard Buffers

The Orion 210Aplus Meter features a manual calibration option when the use of non-standard buffers is required for calibration. Simply enter the values of the buffers to be used into the memory of meter in the SETUP menu. For best results, buffer values entered must be the value of the buffers at the temperature at which calibration is being performed. Once these values have been entered, SET (5E7) will appear in the buffer sequence selections. Select SET and the meter will automatically recognize the buffer values which were entered in the SETUP menu. These values will remain in the meter memory until new values are entered.

> *NOTE: The calibration buffers should be used during the calibration in the same sequence as they are entered in the SETUP mode.*

Setting the Manual Buffer Option

Two non-standard buffer values may be set for use in performing calibrations. The manual buffer pH range is 0 - 14. After these values have been entered into the memory of the meter, the meter will automatically use these values during calibration whenever the SET option is selected during buffer sequence selection at the start of calibration.

> *NOTE: The difference between the two non-standard buffers must be at least 1 pH unit and no more than 4 pH units.*

1. Select the SETUP mode, by pressing the **mode** key repeatedly until SETUP is displayed. Press the **yes** key twice.
2. STD (570) will be displayed. Press the **no** key. SET (5E7) will be displayed. Press the **yes** key.
3. The value in the main display will blink and P1 will be displayed in the lower display indicating that the first buffer value is being set.
4. Begin editing with the digit furthest to the left. Press the **no** key to scroll the value between 0 and 1. Set digit to desired value and press the **yes** key.
5. Continue editing the value for each digit until the desired buffer value has been entered then press the **yes** key to enter the buffer value into the meter memory.
6. The value in the main display will blink and P2 will be displayed in the lower display indicating that the second buffer value is being set.
7. Begin editing the value for each digit until the desired buffer value has been entered and press the **yes** key to enter the buffer value into the meter memory.
8. The meter will automatically return to the beginning of the SETUP menu. Press the **mode** key to exit the SETUP menu.

Manual Calibration with Two Buffers

1. Attach the electrode(s) to the meter. Choose two buffers that will bracket your expected sample range.
2. Rinse the electrode(s) and place into the first buffer.
3. Enter the non-standard buffer values into meter memory as described in Setting Manual Buffer Option, page 21 .
4. Select calibration mode by pressing the **mode** key repeatedly until CALIBRATE is displayed.
5. The last buffer sequence used will be displayed for 2 seconds. If SET is displayed press the **yes** key, otherwise press the **no** key repeatedly until SET is displayed. Then press the **yes** key.
6. The buffer indicator along the bottom of the display will show MAN indicating manual buffer option selected. P1 will be displayed in the lower display field and the buffer reading will be displayed in the main field.
7. When READY is displayed, indicating electrode stability, press the **yes** key. P2 will be displayed in the lower display field indicating the meter is ready for the second buffer.
8. Rinse the electrode(s) and place into the second buffer.
9. When READY is displayed, press the **yes** key.
10. After the second buffer value has been accepted, the electrode slope will be displayed. SLP appears in the lower field while the actual electrode slope (in percent) is displayed in the main field for 5 seconds.

    The meter will then automatically advance to the measure mode and MEASURE is displayed above the main display field. The buffer indicator, indicates MAN, manual buffer calibration option was used in the last calibration.
11. Rinse the electrode(s) and place into the sample. If using an ATC probe, then both the temperature-corrected pH reading and temperature reading are displayed. Record the reading when READY is displayed.

    For best results, it is recommended that an ATC probe be used. If an ATC probe is not used, all samples and standards should be at the same temperature or manual temperature compensation should be used.

F. Dissolved Oxygen Measurements

Dissolved oxygen measurements are displayed in ppm when the Orion 97-08 Dissolved Oxygen Electrode is used with the Orion 210Aplus Meter. Follow these instructions for preparing the meter and calibrating the electrode.

1. Connect the Orion 97-08 to meter and leave electrode mode switch "OFF".
2. Disconnect the ATC probe.

   NOTE: ATC probe must not be connected to the meter
3. While in MEASURE mode, use the **no** key to change the temperature value to 25.0 °C.
4. Press the **mode** key repeatedly until CALIBRATE is displayed. The last buffer sequence used will be displayed. Press the **no** key until 7 is displayed, then press the **yes** key.
5. When READY is displayed, indicating electrode stability, press the **yes** key.
6. SLP will appear in the lower display field and the current electrode slope in memory is displayed in the main field. Press the **no** key to change value to 100.0, then press the **yes** key.
7. The meter will then automatically advance to the measure mode and MEASURE is displayed above the main display field.
8. Turn the mode switch on the electrode to BT CK. Good battery operation is indicated by a reading of 13.40 or greater on the meter.
9. Turn the mode switch on the electrode to ZERO. Use the zero calibration control to set the meter to read 0.00.

10. Insert the reservoir (funnel) into a BOD bottle containing enough water to just cover the bottom. Insert the electrode, making sure that the electrode tip is not immersed in the water and does not have water droplets clinging to the outside of the membrane. Let stand approximately 30 minutes to ensure water saturation of air in the BOD bottle. This bottle should be used for storage between measurements.
11. Turn the electrode mode switch to the AIR position. If measurements are being made at sea level use the AIR calibration control on the electrode to set the pH meter reading to the prevailing barometric pressure in mm Hg (divided by 100). If the barometric pressure is unknown, if the elevation is above sea level or if the sample has a salinity greater than 2 parts per thousand, consult Table 1 found in the Orion 97-08 Instruction Manual to obtain the correct AIR setting.
12. Turn the electrode mode switch to H_2O for sample analysis.