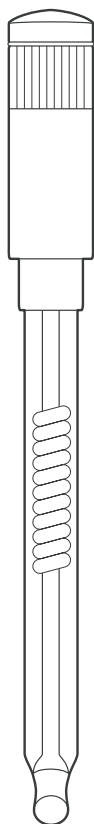


pH

Orion 8102BNU, 8102SCU,
8103BNU, 8103SCU,
8104BNU, 8104SCU,
8115BNU, 8115SCU,
8135BNU, 8135SCU,
8156BNU, 8156SCU,
800500U

Orion ROSS Ultra[®] pH Electrode

INSTRUCTION MANUAL



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ORION Series A meters and 900A printer are protected by U.S. patents 5,108,578, 5,198,093 and German patents D334,208 and D346,753.

Sure-Flow electrodes are protected by European Patent 278,979 and Canadian Patent 1,286,720.

ionplus electrodes and Optimum Results solutions are protected by US Patent 5,830,338.

ROSS Ultra electrodes have patents pending.

ORION ORP Standard is protected by US Patent 6,350,367.

ORION Series A conductivity meters are protected by US Patent 5,872,454.

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The specifications, descriptions, drawings, ordering information and part numbers within this document are subject to change without notice.

This publication supersedes all previous publications on this subject.

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GENERAL INFORMATION

Introduction

This manual contains instructions for the Orion ROSS Ultra® series of pH electrodes. Operation and maintenance instructions for the following electrodes are included.

Orion	Description
800500U	ROSS Ultra Reference Electrode, glass body, pin tip
8102BNU	ROSS Ultra Combination pH Electrode, 0-14 pH, glass body, BNC
8103BNU	ROSS Ultra Combination Semi-micro pH Electrode, 0-14 pH, glass body, BNC
8104BNU	ROSS Ultra Combination pH Electrode, 0-14 pH, glass body with rugged bulb, BNC
8115BNU	ROSS Ultra Combination Semi-micro pH Electrode, 0-14 pH, epoxy body, BNC
8135BNU	ROSS Ultra Combination Flat Surface Electrode, 0-14 pH, epoxy body, BNC
8156BNU	ROSS Ultra Combination pH Electrode, 0-14 pH, epoxy body, BNC
8102SCU	ROSS Ultra Combination pH Electrode, 0-14 pH, glass body, SC*
8103SCU	ROSS Ultra Combination Semi-micro pH Electrode, 0-14 pH, glass body, SC*
8104SCU	ROSS Ultra Combination pH Electrode, 0-14 pH, glass body with rugged bulb, SC*
8115SCU	ROSS Ultra Combination Semi-micro pH Electrode, 0-14 pH, epoxy body, SC
8135SCU	ROSS Ultra Combination Flat Surface Electrode, 0-14 pH, epoxy body, SC
8156SCU	ROSS Ultra Combination pH Electrode, 0-14 pH, epoxy body, SC

* Screw cap requires cable, Orion 91CBNC to connect to BNC meters.

The ROSS Ultra series of electrodes provides readings stable to 0.01 pH in less than 30 seconds, even in the extreme case of samples varying from one another by 50 °C or more. Results are three to five times more precise than those obtained with conventional electrodes.

Required Equipment

Meter — Any Orion pH or ion selective meter, or other pH/ISE meter with appropriate connectors.

Electrode — ROSS Ultra® Combination electrodes or ROSS Ultra reference electrode with ROSS 8101 ROSS pH Half-cell electrode.

ATC Probe — for temperature measurement. Select ATC probe compatible with meter.

Beakers — Plastic or glass.

Magnetic Stirrer — Suggested for precision measurements.

Required Solutions

pH Buffers — Two are recommended for precise measurement. The first, near the electrode isopotential point (pH 7) and the second near the expected sample pH (e.g., pH 4 or 10).

ROSS™ Internal Filling Solution - 3M KCl, Orion 810007. Do not use any filling solution which contains silver. (Electrode damage may result.)

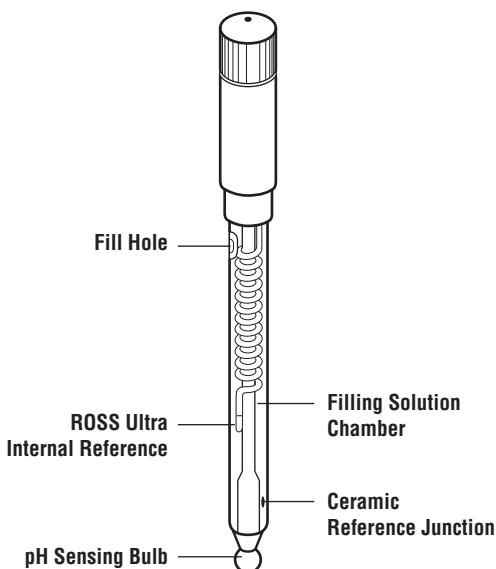


Figure 1: Orion 8102BNU ROSS Ultra Combination Electrode

USING THE ELECTRODE

Electrode Preparation

1. Remove the protective shipping cap from sensing element and save for storage.
2. Clean any salt deposits from exterior by rinsing with distilled water.
3. Uncover fill hole and add ROSS™ Filling Solution, Orion 810007, to electrode. See **Figure 2**. To maintain an adequate flow rate, the level of filling solution must cover the end of the coil and be at least one inch above the sample level on immersion. The fill hole should be open whenever the electrode is in use.
4. Place the electrode in the electrode holder and suspend in air for 15 minutes to thoroughly wet the reference junction. Once the junction is wet, do not allow the electrode to dry out.
5. Carefully shake down the electrode (as a clinical thermometer) to remove air bubbles.
6. Soak electrode in pH Electrode Storage Solution, Orion 910001, for one hour.
7. Connect electrode to meter.

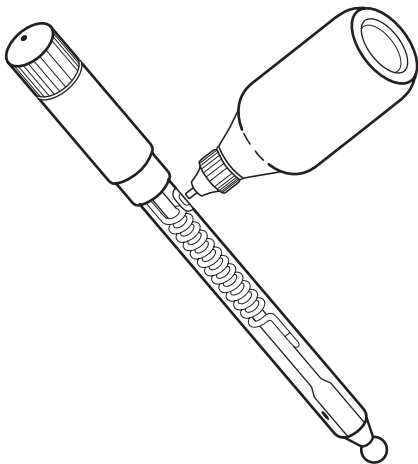


Figure 2: Filling an Electrode

Sample Requirements

One of the benefits of the ROSS Ultra® pH Electrode is that the reference electrode filling solution composition may be changed depending on sample requirements.

The ROSS™ pH Electrode Filling Solution, Orion 810007 is 3M KCl. For solutions with components that precipitate in the presence of chloride ion, the ROSS Ultra pH Electrode could be filled with 10% KNO₃, Orion 900003.

Samples should be aqueous if using epoxy body electrodes (e.g., Orion 8115, 8135, 8156 ROSS Ultra electrodes).

In organic solutions, use an all glass ROSS Ultra Electrode (e.g., Orion 8102, 8103 and 8104 ROSS Ultra electrodes). For good results a minimum of 20% water must be present in the sample. If there is a great deal of drift when using the ROSS Ultra Electrode filled with ROSS Filling Solution, Orion 810007, try filling the electrode with a mixture of methanol and water saturated with KCl.

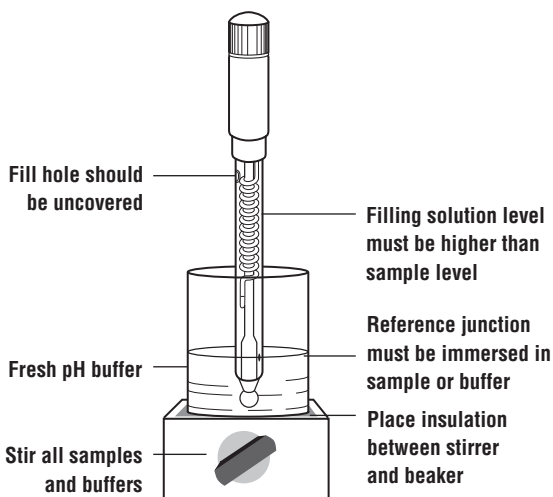


Figure 3: Measuring Hints

Measuring Hints

See **Figure 3**

- Always use fresh buffers for calibration. Choose buffers that are no more than 3 pH units apart.
- Check electrode slope daily by performing two buffer calibration. Slope should be 92 to 102%.
- Only use ROSS™ Internal Filling Solution, Orion 810007, for ROSS Ultra® Combination pH Electrodes. **Do not use any filling solution which may contain silver.**
- Remove fill hole cover during measurement to ensure uniform flow of filling solution.
- Between measurements, rinse electrodes with distilled water and then with the next solution to be measured.
- Stir all buffers and samples.
- Place a piece of insulating material (e.g., Styrofoam or cardboard) between magnetic stirrer and beaker to prevent error from transfer of heat to sample. Since ROSS Ultra Electrodes respond faster than conventional electrodes, changes in pH which result from temperature changes will be noticed. See **Electrode Characteristics**.
- Avoid rubbing or wiping electrode bulb, to reduce chance of error due to polarization.
- Orion 8135BNU may be used on any moist surface or in liquids. See **Figure 4**.

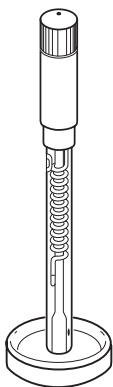


Figure 4:
Use of Orion 8135BNU

pH CALIBRATION & MEASUREMENT

General Calibration Procedure

For detailed calibration and temperature compensation procedures, consult your meter instruction manual.

Single Buffer Calibration

1. Choose a buffer near expected sample pH.
2. Buffer should be at same temperature as sample. If buffer and samples are at varying temperatures, temperature compensation is recommended.
3. Set up meter according to meter instruction manual.
4. Rinse electrode first with distilled water and then with the buffer being used for calibration.
5. Place the electrode in the buffer. Wait for a stable display. Set the meter to the pH value of the buffer at its measured temperature. See **Table 1**. (A table of pH values at various temperatures is supplied on the buffer bottle.) Proceed to **pH Measurement** section.

Table 1
pH Values of Buffers at Various Temperatures

Nominal value at 25 °C Temperature

Buffer	0 °C	5 °C	10 °C	20 °C	30 °C
1.68	1.67	1.67	1.67	1.67	1.68
3.78	3.86	3.84	3.82	3.79	3.77
4.01	4.00	4.00	4.00	4.00	4.02
5.00			5.12	5.04	4.97
6.86	6.98	6.95	6.92	6.87	6.85
7.00	7.11	7.08	7.06	7.01	6.98
7.41	7.53	7.50	7.47	7.43	7.40
9.18	9.46	9.40	9.33	9.23	9.14
10.01	10.32	10.25	10.18	10.06	9.97

40 °C	50 °C	60 °C	70 °C	80 °C	90 °C
1.69	1.71	1.72	1.74	1.77	1.79
3.75	3.75				
4.04	4.06	4.09	4.13	4.16	4.21
4.93	4.92	4.88			
6.84	6.83	6.84	6.85	6.86	6.88
6.97	6.97	6.97	6.99	7.03	7.08
7.38	7.37				
9.07	9.01	8.96	8.92	8.89	8.85
9.89	9.83				

Two Buffer Calibration

This procedure is recommended for precise measurement.

1. Ensure that all buffers are at the same temperature. If samples are at varying temperatures, temperature compensation is recommended. (See Meter Instruction manual).
2. Select two buffers which bracket the expected sample pH. The first should be near the electrode isopotential point (pH 7) and the second near the expected sample pH (e.g., pH 4 or pH 10).
3. Rinse electrode first with distilled water and then with first (pH 7) buffer.
4. Place the electrode in first (pH 7) buffer. Wait for a stable display. Set the meter to the pH value of the buffer at its measured temperature. (A table of pH values at various temperatures is supplied on the buffer bottle). See **Table 1**.
5. Rinse electrode first with distilled water and then with the second buffer.
6. Place the electrode in the second buffer. When display is stable, set meter to the pH value of the buffer at its measured temperature as described in the meter instruction manual.
7. If all steps are performed correctly, proceed to the **pH Measurement** section. If any of the above procedures does not work, refer to **Troubleshooting**.

pH Measurement

1. Calibrate the electrode as described in previous section.
2. Rinse the electrode with distilled water and then with sample.
3. Place the electrode in the sample.
4. When the display is stable, record sample pH.

Electrode Storage

To ensure a quick response and free-flowing liquid junction, the sensing bulb and reference junction must not be allowed to dry out.

NOTE: The reference chamber should remain filled at all times.

Short-term Storage (up to one week): Soak electrode in pH Electrode Storage Solution, Orion 910001.

Long-term Storage: The reference chamber should be filled and the filling hole securely covered. Cover the sensing element and reference junction with its protective cap containing a few drops of storage solution. Before returning the electrode to use, prepare it as a new electrode.

Electrode Maintenance

1. Inspect the electrode for scratches, cracks, salt crystal build-up, or membrane/junction deposits.
2. Rinse off any salt build-up with distilled water, and remove any membrane/junction deposits as directed in the cleaning procedures below.
3. Drain the reference chamber, flush it with fresh ROSS™ Filling Solution, Orion 810007, and refill the chamber.

Cleaning Electrode

Thermo Electron offers Orion pH electrode cleaning kits in the following configurations:

pH Cleaning Solution Sample Kit (Orion 900020) — Includes one bottle each of cleaning solution A, B, C and D, 15 mL Beaker and Pipette.

pH Cleaning Solution A (Orion 900021) — Protein removal.

pH Cleaning Solution B (Orion 900022) — Removal of bacterial contaminant's.

pH Cleaning Solution C (Orion 900023) — General cleaning.

pH Cleaning Solution D (Orion 900024) — Removal of oil and grease contaminant's.

TROUBLESHOOTING

Troubleshooting Guide

Follow a systematic procedure to isolate the problem. The pH measuring system can be divided into four components for ease in troubleshooting: pH meter, electrodes, sample/application, and technique.

pH meter

The meter is the component which is easiest to eliminate as a possible cause of error. Thermo Electron pH meters are provided with an instrument checkout procedure and shorting cap for convenience in troubleshooting. Consult your pH meter instruction manual for directions.

Electrodes

To test electrode operation:

1. Connect electrode to a working meter.
2. Set function switch to absolute mV mode.
3. Immerse electrode in fresh pH 7 buffer.
4. Displayed value should be 0 ± 30 mV.
5. Rinse electrode and immerse in fresh pH 4 buffer.
6. Displayed value should be approximately 160 mV to 180 mV greater than in step 4. (Actual mV values may change as electrode ages, but mV differences will remain 160 to 180 mV).

If electrode fails this procedure, clean thoroughly as directed in Maintenance.

If electrode response is slow or drifting, drain and refill with fresh ROSS™ Filling Solution, Thermo Electron Orion 810007. See **Measuring Hints**. If cleaning and maintenance fail to rejuvenate the electrode, replace the entire electrode.

Sample/Application

The electrode and meter may operate with buffers but not with your sample. In this case, check sample composition for interferences, incompatibilities, or temperature effects. Some samples, by their nature, drift or change in pH.

Technique

If trouble persists, review operating procedures. Reread calibration and measurement sections, to be sure proper technique has been followed.

Assistance

For the most current warranty information, visit www.thermo.com.

After troubleshooting all components of your measurement system, contact The Technical EdgeSM for Orion products. Within the United States call 1.800.225.1480, outside the United States call 978.232.6000 or fax 978.232.6031. In Europe, the Middle East and Africa, contact your local authorized dealer. For the most current contact information, visit www.thermo.com.

ELECTRODE CHARACTERISTICS

Temperature Effects

The most common cause of error in pH measurement is temperature. Ordinary electrodes drift with temperature changes. The ROSS Ultra™ pH Electrode eliminates the stability problems associated with the use of conventional electrodes in samples of varying temperature.

There are, however, two effects of temperature change that should be kept in mind.

1. Electrode slope will change with varying temperature. This slope change may be compensated for either manually, or automatically with an automatic temperature compensator (ATC) probe and properly designed pH meter. Consult your pH meter instruction manual for details.
2. Buffer and sample pH values vary with temperature because of the temperature dependent chemical equilibrium. The problem of varying pH values is easily solved by calibrating the electrode with characterized standard buffers whose true pH values at different temperatures are known. Buffer values at different temperatures are given in **Table 1**. The problem of the sample equilibrium varying with temperature in an uncharacterizable manner will always remain. Therefore, pH values should be reported along with the temperature at which the measurement was made.

Interferences

Sodium ion is the principle interference of the pH electrode, causing increasing error at higher pH (lower hydrogen ion activities) and at higher temperatures. Because the ROSS Ultra® pH membrane is composed of special low sodium error glass, error due to sodium is negligible when measuring at pH values less than 12. When measuring at pH values greater than 12, add the correction value from the nomography in Figure 6 to the observed pH reading.

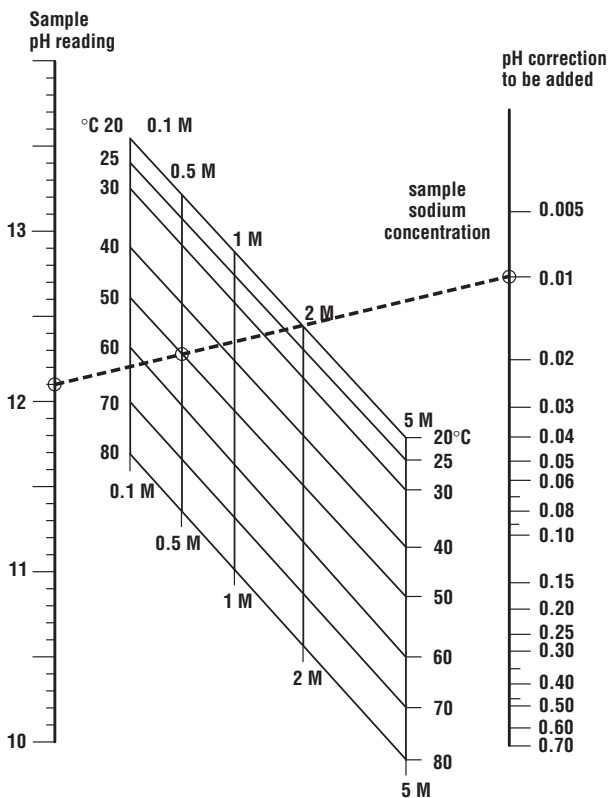


Figure 6: Typical Sodium Error Observed at pH > 12

Example:

pH reading	12.10
Sodium concentration	0.5 N
Temperature	50 °C
Correction	0.01
Corrected pH reading	12.11

ORDERING INFORMATION

Electrodes

Orion	Description	Type of Connector
800500U	ROSS Ultra® Combination pH Electrode, glass body	Pin Tip
8102BNU	ROSS Ultra® Combination pH Electrode, glass body	BNC
8103BNU	ROSS Ultra® Combination Semi-micro pH Electrode, glass body	BNC
8104BNU	ROSS Ultra Combination pH Electrode, glass body with rugged bulb	BNC
8115BNU	ROSS Ultra Combination Semi-micro pH Electrode, epoxy body	BNC
8135BNU	ROSS Ultra Combination Flat Surface pH Electrode, epoxy body	BNC
8156BNU	ROSS Ultra Combination pH Electrode, epoxy body	BNC
8102SCU	ROSS Ultra Combination pH Electrode, glass body	Screw Cap Connector
8103SCU	ROSS Ultra Combination Semi-micro pH Electrode, glass body	Screw Cap Connector
8104SCU	ROSS Ultra Combination pH Electrode, glass body with rugged bulb	Screw Cap Connector
8115SCU	ROSS Ultra Combination Semi-micro pH Electrode, epoxy body	Screw Cap Connector
8135SCU	ROSS Ultra Combination Flat Surface pH Electrode, epoxy body	Screw Cap Connector
8156SCU	ROSS Ultra Combination pH Electrode, epoxy body	Screw Cap Connector

Accessories

Orion	Description
810007	ROSS® Internal Filling Solution, 3 M KCl, five 50 mL bottles
910001	pH Electrode Storage Solution, 475 mL
910104	pH 4.01 Buffer, 475 mL
910107	pH 7.00 Buffer, 475 mL
910110	pH 10.01 Buffer, 475 mL
910410	perpHect® Buffer pH 4, 10 pk
910425	perpHect Buffer pH 4, 25 pk
910710	perpHect Buffer pH 7, 10 pk
910725	perpHect Buffer pH 7, 25 pk
910110	perpHect Buffer pH 10, 10 pk
910125	perpHect Buffer pH 10, 25 pk
911110	perpHect Electrode Rinse, 10 pk
911125	perpHect Electrode Rinse, 25 pk
900020	pH Cleaning Solution Sample Kit
900021	pH Cleaning Solution A – Protein Removal
900022	pH Cleaning Solution B – Bacterial Removal
900023	pH Cleaning Solution C – General Cleaning
900024	pH Cleaning Solution D – Removal of Oil and Grease
91CBNC	Detachable Cable for Screw Cap Electrode, with BNC Connector
91USCB	Detachable Cable for Screw Cap Electrode, with US Standard Connector
91CDIC	Detachable Cable for Screw Cap Electrode, with E DIN Connector
91CBRA	Detachable Cable for Screw Cap Electrode, with Radiometer No.7 Connector

SPECIFICATIONS

Electrodes*	Length (excluding cap)	Electrodes Diameter
800500U	120 mm	12 mm
8102BNU	120 mm	12 mm
8102SCU	120 mm	12 mm
8103BNU	165 mm	6 mm**
8103SCU	165 mm	6 mm**
8104BNU	120 mm	12 mm
8104SCU	120 mm	12 mm
8115BNU	185 mm	8 mm***
8115SCU	185 mm	8 mm***
8135BNU	120 mm	12 mm
8135SCU	120 mm	12 mm
8156BNU	120 mm	12 mm
8156SCU	120 mm	12 mm

* ROSS Ultra® Electrodes operate in a 0-100 °C temperature range,
0-14 pH range

** 6 mm section is 100 mm long

*** 8 mm section is 100 mm long

Isopotential points are at pH 7

Standard cap diameters are 16 mm and cap lengths are 30 mm

NOTES

Environmental Instruments

Water Analysis

North America

166 Cummings Center
Beverly, MA 01915 USA
Tel: 978-232-6000
Dom. Fax: 978-232-6015
Int'l. Fax: 978-232-6031

Europe

12-16 Sedgeway Business Park
Witchford, Cambridgeshire
England, CB6 2HY
Tel: 44-1353-666111
Fax: 44-1353-666001

Far East

Room 1205 China Resources Bldg.
26 Harbour Road
Wanchai, Hong Kong
Tel: 852-2885-4613
Fax: 852-2567-4447

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