These 5 Measurement keys will:
• Turn instrument on.
• Measure parameter.
• Exit any function.

For detailed explanations see Table of Contents
FEATURES and SPECIFICATIONS

A. Features:
• Superior resolution 4 digit LCD displays full 9999 µS/ppm.
• Accuracy of ±1% of reading (not merely full scale).
• All electrodes are internal for maximum protection.
• Latest 4 electrode cell technology.
• Waterproof to 3 feet/1 meter.
• Autoranging conductivity/TDS/resistivity.
• Prompts for easy pH calibration.
• Memory saves 20 readings.
• Factory calibrations stored in microprocessor.
• 3 conductivity/TDS solution conversions preprogrammed into microprocessor.
• USER feature allows:
  Programming your own cond/TDS conversion factor.
  Programming your own temperature compensation factor.
  Disabling temperature compensation.

B. General Specifications
Display 4 Digit LCD
Dimensions (LxWxH) 7.7x2.7x2.5 in.
196x68x64 mm
Weight 13.5oz./383g
Case Material VALOX*
Cond/Res/TDS Cell Material VALOX*
Cond/Res/TDS Cell Capacity 0.2 oz./5 ml
pH/ORP Sensor Well Capacity 0.04 oz./1.2 ml
Power 9V Alkaline Battery
Battery Life >100 Hours/5000 Readings
Operating/Storage Temperature 32-132°F/0-55°C
Protection Ratings IP67/NEMA 6 (waterproof to 3 feet/1 meter)

* ™ GE Corp.

Additional information available on our web site at: www.myronl.com

C. Specification Chart

<table>
<thead>
<tr>
<th>6P</th>
<th>pH</th>
<th>ORP</th>
<th>Conductivity</th>
<th>TDS</th>
<th>Resistivity</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranges</td>
<td>0-14 pH</td>
<td>±999 mV</td>
<td>0-9999 µS</td>
<td>0-9999 ppm</td>
<td>10K - 30M ohms</td>
<td>0-71°C</td>
</tr>
<tr>
<td>Resolution</td>
<td>±0.01 pH</td>
<td>±1 mV</td>
<td>0.01 (&lt;100 µS)</td>
<td>0.1 (100 - 1000 µS)</td>
<td>1.0 (&gt;1000 µS)</td>
<td>0.01 (&lt;1000 ohm)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.01 pH</td>
<td>±1 mV</td>
<td>±1% of reading*</td>
<td>±1% of reading*</td>
<td>±1% of reading**</td>
<td>±0.1 °C</td>
</tr>
<tr>
<td>Auto Temperature Compensation</td>
<td>0.71°C</td>
<td>32 - 160 °F</td>
<td>0.71°C</td>
<td>32 - 160 °F</td>
<td>0.71°C</td>
<td>32 - 160 °F</td>
</tr>
<tr>
<td>Cond/TDS Ratios Preprogrammed</td>
<td>KCl, NaCl, 442™</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjustable Cond/TDS Ratio Factor</td>
<td>0.20 - 7.99</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* up to 100mS/ppt; 100 - 200mS/ppt: ± 1 - 2% typ.
**10K ohms - 10M ohms

D. Warranty/Service
All Myron L Ultrameters have a 2 year warranty except for pH sensors which have a 6-month limited warranty. If an instrument fails to operate properly, see the Troubleshooting Chart, pg. 27. The battery and pH/ORP sensor are user replaceable. For other service, return the instrument prepaid to the Myron L Company.

MYRON L COMPANY
2450 Impala Drive
Carlsbad, CA 92010
USA
760-438-2021

If, in the opinion of the factory, failure was due to materials or workmanship, repair or replacement will be made without charge. A reasonable service charge will be made for diagnosis or repairs due to normal wear, abuse or tampering. This warranty is limited to the repair or replacement of the Ultrameter only. The Myron L Company assumes no other responsibility or liability.

E. Ultrameter Models

ULTRAMETER MODELS 3P 4P 6P
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I. INTRODUCTION

Thank you for selecting the Ultrameter™ Model 6P, one of the Myron L Company's latest in a new line of instruments utilizing advanced microprocessor-based circuitry. This circuitry makes it extremely accurate and very easy to use (see pages 2 & 3 for Features and Specifications on this and other models). For your convenience, on the bottom side of your Ultrameter is a brief set of instructions, and a pocket sized card with abbreviated instructions is also included with the instrument. Special note ...... Conductivity, Resistivity, and TDS require mathematical correction to 25°C values (ref. Temperature Compensation, pg. 29). On the left of the Ultrameter’s liquid crystal display is shown an indicator of the salt solution characteristic used to model temperature compensation of conductivity and its TDS conversion. The indicator can be KCl, NaCl, 442 or USER. Selection affects the temperature correction of conductivity, and the calculation of TDS from compensated conductivity (ref. Conductivity Conversion to Total Dissolved Solids (TDS), pg. 32). The selection can affect the reported conductivity of hot or cold solutions, and will change the reported TDS of a solution. Generally, using KCl for conductivity, NaCl for resistivity, and 442™ (Natural Water characteristic) for TDS will reflect current industry practice for standardization. This is how your instrument, as shipped from the factory, is set to operate.

II. RULES of OPERATION

A. Operation

Using the instrument is simple:
- Individual or multiple parameter readings may be obtained by filling individual sensors or entire cell cup area.
- Rinse the conductivity cell or pH/ORP sensor well with test solution 3 times and refill.
- Press the desired measurement key to start measurement. Pressing the desired measurement key again does no harm and restarts the 15 second “off” timer.
- Note the value displayed or press the MS key to store (ref. Memory Storage, pg. 20). It’s that simple!

B. Characteristics of the Keys
- Though your Ultrameter has a variety of sophisticated options, it is designed to provide quick, easy, accurate measurements by simply pressing one key.
- All functions are performed one key at a time.
- There is no “off” key. After 15 seconds of inactivity the instrument turns itself off (60 seconds in CAL mode).
- Rarely will a key be required to be held down (as in Procedure to Select a Solution, pg. 12; or Cond. or TDS Calibration, pg. 15).
C. Operation of the Keys (See Instrument Illustration on page 1)

1. Measurement Keys in General

Any of the 5 measurement keys in the upper part of the keypad turns on the instrument in the mode selected. The mode is shown at the bottom of the display, and the measurement units appear at the right. Pressing a measurement key does this even if you are in a calibration sequence and also serves to abandon a change (ref. Leaving Calibration, pg. 15).

2. COND, RES and TDS keys

These 3 keys are used with solution in the Conductivity Cell.

Precautions:

• While filling cell cup ensure no air bubbles cling on the cell wall.
• If the proper solution is not selected (KCl, NaCl, 442 or USER), refer to Why Solution Selection is Available, pg. 11 and Procedure to Select a Solution, pg. 12.

a. COND Key

Solution to be tested is introduced into the conductivity cell and a press of COND displays conductivity with units on the right. On the left is shown the solution type selected for conductivity. An overrange condition will show only [- - - -] (ref. Solution Selection, pg. 11).

b. RES Key

A press of RES displays resistivity with units on the right. On the left is shown solution type selected for resistivity (ref. Solution Selection, pg. 11). The range of display of Resistivity is limited to between 10 kilohms (KΩ) and 30 megohms (MΩ). A solution outside that range will only show [- - - -] in the display.

c. TDS key

A press of TDS displays Total Dissolved Solids with units on the right.

This is a display of the concentration of material calculated from compensated conductivity using the characteristics of a known material. On the left is shown solution type selected for TDS (ref. Solution Selection, pg. 11).

3. pH and ORP keys

Measurements are made on solution held in the pH/ORP sensor well (ref. pH and ORP Measuring, pg. 34). The protective cap is removed and the sensor well is filled and rinsed with sample enough times to completely replace the storage solution.

After use, the pH/ORP sensor well must be refilled with Myron L Storage Solution, and the protective cap reinstalled securely (ref. Maintenance of the pH/ORP Sensor, pg. 9 and Cleaning pH/ORP Sensors, pg. 25).

A press of pH displays pH readings. No units are displayed.

b. ORP key


4. CAL/MCLR key

A press of CAL/MCLR allows you to enter the calibration mode while measuring conductivity, TDS or pH. Once in CAL mode, a press of this key accepts the new value. If no more calibration options follow, the instrument returns to measuring (ref. Leaving Calibration, pg. 15).

If “SEL” is held down for about 3 seconds, CAL mode is not entered, but “SEL” appears to allow Solution Selection (ref. pg. 11) with the Up or Down keys. As in calibration, the CAL key is now an “accept” key.

While reviewing stored records, the MCLR side of the key is active to allow clearing records (ref. Clearing a Record/Memory Clear, pg. 20).

5. UP or DOWN keys

While measuring in any parameter, the MS or MR keys activate the Memory Store and Memory Recall functions. While in CAL mode, the keys step or scroll the displayed value up or down. A single press steps the display and holding either key scrolls the value rapidly.

While in Memory Recall, the keys move the display up and down the stack of records (ref. Memory Recall, pg. 20).

III. AFTER USING the ULTRAMETER

A. Maintenance of the Conductivity Cell

Rinse out the cell cup with clean water. Do not scrub the cell. For oily films, squirt in a foaming non-abrasive cleaner and rinse. Even if a very active chemical discolors the electrodes, this does not affect the accuracy; leave it alone (ref. Cleaning Sensors, pg. 25).

B. Maintenance of the pH/ORP Sensor

The sensor well must be kept wet with a solution. Before replacing the rubber cap, rinse and fill the sensor well with (in order of preference): Myron L Storage Solution, an almost saturated KCl solution, pH 4 buffer...
or at least a strong table salt solution. Not distilled water. (ref. pH and ORP Practices, pg. 24)

IV. SPECIFIC RECOMMENDED MEASURING PROCEDURES

If the proper solution is not selected (KCl, NaCl, 442 or USER), see Solution Selection, Pg. 11.

NOTE: After sampling high concentration solutions or temperature extremes, more rinsing may be required. When sampling low conductivity solutions, be sure the pH cap is well seated so no solution washes into the conductivity cell from around the pH cap.

A. Measuring Conductivity/Total Dissolved Solids (TDS)

1. Rinse cell cup 3 times with sample to be measured. (This conditions the temperature compensation network and prepares the cell.)
2. Refill cell cup with sample.
3. Press **COND** or **TDS**.
4. Take reading. A display of [ - - - - ] indicates an overrange condition.

B. Measuring Resistivity

Resistivity is for low conductivity solutions. In a cell cup the value may drift from trace contaminants or absorption from atmospheric gasses, so measuring a flowing sample is recommended.

1. Make sure pH protective cap is secure to avoid contamination.
2. Hold instrument at 30° angle (cup sloping downward).
3. Let sample flow continuously into conductivity cell with no aeration.
4. Press **RES** key; use best reading.

NOTE: If reading is lower than 10 kilohms display will be dashes: [ - - - - ]. Use Conductivity.

C. Measuring pH

1. Remove protective cap by squeezing its sides and pulling up.
2. Rinse sensor well 3 times with sample to be measured. Shake out each sample to remove any residual liquid.
3. Refill sensor well with sample.
4. Press **pH**.
5. Take reading.
6. IMPORTANT: After use, fill pH/ORP sensor well with Myron L Storage Solution, a strong KCl solution or pH 4 buffer, and replace protective cap. Do not allow pH/ORP sensor to dry out.

NOTE: If none of the above are available, use a saturated solution of table salt and tap water (ref. Cleaning pH/ORP Sensors, pg. 25).

D. Measuring ORP

1. Remove protective cap by squeezing its sides and pulling up.
2. Rinse sensor well 3 times with sample to be measured. Shake out each sample to remove any residual liquid.
3. Refill sensor well with sample.
4. Press **ORP**.
5. Take reading.
6. IMPORTANT: After use, fill pH/ORP sensor well with Myron L Storage Solution, a strong KCl solution or pH 4 buffer and replace protective cap. Do not allow pH/ORP sensor to dry out.

NOTE: If none of the above are available, use a saturated solution of table salt and tap water (ref. Cleaning pH/ORP Sensors, pg. 25).

V. SOLUTION SELECTION

A. Why Solution Selection is Available

Conductivity, Resistivity, and TDS require temperature correction to 25°C values (ref. Standardized to 25°C, pg. 29). Selection determines the temperature correction of conductivity and calculation of TDS from compensated conductivity (ref. Cond. Conversion to TDS, pg. 32).

B. The 4 Solution Types

On the left side of the display is the salt solution characteristic used to model temperature compensation of conductivity and its TDS.
Generally, using KCl for conductivity, NaCl for resistivity, and 442 (Natural Water characteristic) for TDS will reflect present industry practice for standardization. This is the setup as shipped from the factory (ref. Solution Characteristics, pg. 32). The USER selection allows a custom value to be entered for the temperature compensation of conductivity and also the conversion ratio if measuring TDS.

C. Calibration of Each Solution Type
There is a separate calibration for each of the 4 solution types. Note that calibration of a 442 solution does not affect the calibration of a NaCl solution. For example: Calibration (ref. Conductivity or TDS Calibration, pg. 15) is performed separately for each type of solution one wishes to measure (ref. Conductivity/TDS Standard Solutions, pg. 28).

D. Procedure to Select a Solution

**NOTE**: Check display to see if solution displayed (KCl, NaCl, 442 or USER) is already the type desired. If not:

1. Press \( \text{COND} \), \( \text{RES} \) or \( \text{TDS} \) to select the parameter on which you wish to change the solution type.
2. Press and hold \( \text{CAL} \) key about 3 seconds to make “SEL” appear (see Figure 1). (For demonstration purposes, all 4 solution types are shown simultaneously.)
3. Use \( \text{MS} \) or \( \text{MR} \) key to obtain type of solution desired (ref. Solution Characteristics, pg. 32). The selected solution type will be displayed: KCl, NaCl, 442 or User.
4. Press \( \text{CAL} \) to accept new solution type.

E. Application of USER Solution Type

1. User Programmable Tempco
   This feature allows you to change your Ultrameter’s temperature compensating factor to another factor between 0-9.99%/°C (ref. Temperature Compensation, pg. 29). This feature does not apply to pH or ORP.

   a. As in Procedure to Select a Solution, pg. 12, select “USER” mode.
   b. With “USER” mode now selected, press \( \text{CAL} \). You may now adjust a temperature compensation from .00%/°C to 9.99%/°C, by pressing \( \text{MS} \) or \( \text{MR} \). See example in Figure 2.
   c. Press \( \text{CAL} \) twice to skip calibration adjustment and accept the new tempco (3 times if in TDS mode). You are now ready to measure samples with your new temperature compensation factor.

2. Disabling Temperature Compensation

   a. As in Procedure to Select a Solution, pg. 12, select “USER” mode.
   b. With “USER” selected, press \( \text{CAL} \). If the display does not show .00%/°C, hold \( \text{MR} \) long enough to bring the tempco to .00%/°C (see Fig. 3).
   c. Press \( \text{CAL} \) twice (3 times if in TDS mode). Temperature compensation is now disabled (=0) for measurements in USER mode.

3. User Programmable Conductivity to TDS Ratio
   This feature allows you to select a custom conductivity to TDS conversion ratio for USER mode measurements.

   For example: The conversion ratio range is 0.20-7.99 (ie., if conductivity is 100 µS and TDS is 75 ppm, you would adjust to 0.75) (ref. Conductivity Conversion to TDS, pg. 32).
a. While in “USER” mode, press \( \text{TDS} \).

b. Press \( \text{CAL MCLR} \) twice (to skip over tempco adjustment), and “RATIO” will appear (see Figure 4).

c. Adjust with the \( \text{MS} \) or \( \text{MR} \) keys until new conversion ratio is displayed.

d. Press \( \text{CAL MCLR} \) twice (to skip over calibration adjustment) to accept new conversion ratio. You are now ready to measure samples with the new conductivity/TDS ratio.

**In these first five sections, you have learned all you need to make accurate measurements. The following sections contain calibration, advanced operations and technical information.**

**VI. CALIBRATION**

A. Calibration Intervals

Generally, calibration is recommended about once per month with Conductivity or TDS solutions. Calibration with pH solutions should be checked twice a month. Calibration of ORP is not necessary (ref. Calibration Intervals, pg. 23).

B. Rules for Calibration in the Ultrameter

1. Calibration Steps
   a. Starting Calibration

   Calibration is begun by pressing \( \text{CAL MCLR} \) while measuring Conductivity, TDS or pH. Measuring continues, but the CAL icon is on, indicating calibration is now changeable.

   The reading is changed with the \( \text{MS} \) and \( \text{MR} \) to match the known value. The calibration for each of the 4 solution types may be performed from either conductivity or TDS mode.

   Depending on what is being calibrated, there may be 1, 2 or 3 steps to the calibration procedures.

<table>
<thead>
<tr>
<th>KCl, NaCl or 442</th>
<th>User</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cond Gain only</td>
<td>Tempco, then Gain</td>
</tr>
<tr>
<td>Res Done in conductivity</td>
<td>Done in conductivity or TDS</td>
</tr>
<tr>
<td>TDS Gain only</td>
<td>Tempco, Ratio, then Gain</td>
</tr>
<tr>
<td>pH 7, acid and/or base</td>
<td>Zero set with pH 7 automatically</td>
</tr>
<tr>
<td>ORP Zero set with pH 7 automatically</td>
<td></td>
</tr>
</tbody>
</table>

   The \( \text{CAL MCLR} \) becomes an “ACCEPT” key. At each point, pressing \( \text{CAL MCLR} \) accepts the new calibration value and steps you to the next adjustment (or out of CAL mode if there are no more steps).

   To bypass a calibration step, just press \( \text{CAL MCLR} \) to accept the present value as is.

   b. Leaving Calibration

   You know you are finished when the “CAL” icon goes out. Pressing any measurement key abandons changes not yet accepted and exits calibration mode.

   Leaving pH after the 2nd buffer results in the same gain being entered in place of the 3rd buffer.

   2. Calibration Limits

   There are calibration limits. A nominal “FAC” value is an ideal value stored by the factory. Attempts to calibrate too far, up or down, from there will cause the displayed value to be replaced with “FAC”. If you accept it (press the “Cal” key), you will have the original default factory calibration for this measurement. The need to calibrate so far out that “FAC” appears indicates a procedural problem, wrong standard solution, a very dirty cell cup or a dying pH/ORP sensor (ref. Troubleshooting Chart, pg. 27).

   C. Calibration Procedures

   1. Conductivity or TDS Calibration

   a. Rinse conductivity cell three times with proper standard (KCl, NaCl, or 442) (ref. Cond./TDS Standard Solutions, pg. 28). For user calibration see User Calibration Conductivity/TDS, pg. 16.
b. Refill conductivity cell with same standard.

c. Press \text{COND} or \text{TDS}, then press \text{CAL}. “CAL” icon will appear on the display (see Fig. 5).

d. Press \text{MS} or \text{MR} to step the displayed value toward the standard’s value or hold a key down to cause rapid scrolling of the reading.

e. Press \text{CAL} once to confirm new value and end the calibration sequence for this particular solution type.

If another solution type is also to be measured, change solution type now and repeat this procedure.

2. User Calibration Conductivity/TDS

Instrument must be in \text{USER} mode, see Section V. Solution Selection, page 11.

a. Rinse conductivity cell three times with your standard.

b. Refill conductivity cell with same standard.

c. Press \text{COND} or \text{TDS}, then press \text{CAL} twice in COND/three times in TDS. The “CAL” icon will appear on the display.

d. Press \text{MS} or \text{MR} to step the displayed value toward the standard’s value or hold a key down to cause rapid scrolling of the reading.

e. Press \text{CAL} once to confirm new value and end the calibration sequence for this particular solution type.

3. Resistivity Calibration

Resistivity is the reciprocal of Conductivity. Resistivity is calibrated only if conductivity is calibrated for the same solution type.

4. Reloading Factory Calibration (Cond or TDS)

If calibration is suspect or known to be wrong, and no standard solution is available, the calibration value can be replaced with the original factory value for that solution. This “FAC” value is the same for all Ultrameters, and returns you to a known state without solution in the cell. The “FAC” internal electronics calibration (which bypasses the electrodes and cell) is not intended to replace calibration with conductivity standard solutions. If another solution type requires resetting, change solution type and repeat this procedure.

a. Press \text{COND} or \text{TDS}.

b. Press \text{CAL}. (If in USER solution mode, press CAL key twice if in Conductivity, and three times if in TDS to skip over tempco and ratio adjustments.)

c. Press \text{MS} key until “FAC” appears and release.

d. Press \text{CAL} to accept the factory calibration setting.

5. pH Calibration

\textbf{Important}: Always “zero” your Ultrameter with a pH 7 buffer solution before adjusting the gain with acid or base buffers, i.e., 4 and/or 10, etc.

a. pH Zero Calibration

1. Rinse sensor well 3 times with 7 buffer solution.

2. Refill sensor well with 7 buffer solution.

3. Press \text{pH} to verify the pH calibration. If the display reads 7.0, skip the pH Zero Calibration and proceed to section b. pH Gain Calibration.

4. Press \text{CAL} to enter calibration mode. The “CAL”, “BUFFER” and “7” annunciators will appear (see Figure 6). Displayed value
NOTES: If a wrong buffer is added (outside of 6-8 pH), “7” and “BUFFER” will flash, and the Ultrameter will not adjust. The uncalibrated pH value displayed in step 4 will assist in determining the accuracy of the pH sensor. If the pH reading is above 8 with pH 7 buffer solution, the sensor well needs additional rinsing or the pH sensor is defective and needs to be replaced.

5. Press \( \text{CAL} \) until the display reads 7.0.

NOTE: Attempted calibration of >1 pH point from factory calibration will cause “FAC” to appear. This indicates the need for sensor replacement (refer Troubleshooting pg. 27) or fresh buffer solution. The “FAC” internal electronic calibration is not intended to replace calibration with pH buffers. It assumes an ideal pH sensor. Each “FAC” indicates a factory setting for that calibration step (i.e., 7, acid, base).

You can press \( \text{CAL} \) to accept the preset factory value, or you can reduce your variation from factory setting by pressing \( \text{MS} \) or \( \text{MR} \).

6. Press \( \text{CAL} \) to accept the new value. The pH Zero Calibration is now complete. You may continue with pH Gain Calibration or exit by pressing any measurement key.

   b. pH Gain Calibration

   **Important:** Always calibrate or verify your Ultrameter with a pH 7 buffer solution before adjusting the gain with acid or base buffers, i.e., 4 and/or 10, etc. Either acid or base solution can be used for the 2nd point “Gain” calibration and then the opposite for the 3rd point. The display will verify that a buffer is in the sensor well by displaying either “Acid” or “bAS”.

1. The pH calibration mode is initiated by either completion of the pH Zero Calibration, or verifying 7 buffer and pressing the \( \text{CAL} \) twice while in pH measurement mode.

2. At this point the “\( \text{CAL} \)”, “\( \text{BUFFER} \)” and “\( \text{Acid} \)” or “\( \text{bAS} \)” annunciators will be lit (see Figures 7 and 8).

3. Rinse sensor well 3 times with acid or base buffer solution.

4. Refill sensor well again with same buffer solution.

5. Press \( \text{CAL} \) until display agrees with buffer value.

6. Press \( \text{CAL} \) to accept 2nd point of calibration. Now the display shows the next type of buffer to be used.

   Single point Gain Calibration is complete. You may continue for the 3rd point of Calibration (2nd Gain) or exit by pressing any measurement key. Exiting causes the value accepted for the buffer to be used for both acid and base measurements. To continue with 3rd point calibration, use basic buffer if acidic buffer was used in the 2nd point, or vice-versa. Again, match the display to the known buffer value as in step 2 and continue with the following steps.

7. Repeat steps 3 through 6 using opposite buffer solution.

8. Press \( \text{CAL} \) to accept 3rd point of calibration which ends Calibration procedure. Fill sensor well with Myron L Storage Solution and replace protective cap.

6. ORP Calibration

ORP electrodes rarely give false readings without problems in the reference electrode. For this reason, and because calibration solutions
for ORP are highly reactive and potentially hazardous, your Ultrameter has an electronic ORP calibration. This causes the zero point on the reference electrode to be set whenever pH 7 calibration is done.

7. **Temperature Calibration**
Temperature calibration is not necessary in the Ultrameter.

**VII. MEMORY**
This feature allows up to 20 readings with their temperatures to be stored simultaneously for later recall.

A. **Memory Storage**
1. While displaying a measurement, press [MS] to record the displayed value.
2. “MEMORY” will appear and the temperature display will be momentarily replaced by a number (1-20) showing the position of the record. Figure 9 shows a reading of 1806 µS stored in memory record #4.

B. **Memory Recall**
1. Press one of the five measurement keys.
2. Press [MR], “MEMORY” will appear, and the display will show the last record stored.
3. Press the [MS] or [MR] to scroll to the record location desired (the temperature display alternates between temperature recorded and location number).
4. Press any measurement key to leave memory recall or allow to automatically turn off.

C. **Clearing a Record/Memory Clear**
After recalling a certain record location, press [CAL] to clear that memory. This space will be the place for the next memory record, unless you scroll to another position before ending the recall sequence. The next memory stored will go into the next highest available memory location.

Example: You have locations 1-7 filled. You want to clear the conductivity reading stored in record location #3 and replace it with a pH reading.

1. Press [MR] and scroll to location #3.
2. Press [CAL] to clear old record #3.
3. Fill pH/ORP sensor well with sample.
5. The next memory stored will go into location #8.
6. To clear all records: After pressing [MR], scroll down to “CLR ALL” in measurement and temperature area (see Figure 10).
7. Press [CAL]. All records will be cleared.

**VIII. CHANGING from CENTIGRADE to FAHRENHEIT**

1. Press [COND].
2. Press [MR] to display the stored memory records.
3. Press [MR] repeatedly until you pass the memory “CLR ALL” location. The display will show a “C” or “F” (see Figures 11 & 12).
4. Press \( \text{CAL MCLR} \); the display will change to the other unit.

5. Press \( \text{COND} \); all temperature readings are now in degrees last shown.

NOTE: Tempco will still be shown in \(^\circ\text{C}/\%\).

IX. TOTAL RETURN to FACTORY SETTINGS “FAC SEL”
There may come a time when it would be desirable to quickly reset all the recorded calibration values in the instrument back to the factory settings. This might be to ensure all calibrations are set to a known value, or to give the instrument to someone else free of adjustments or recorded data for a particular application.

1. Press \( \text{COND} \).

2. Press \( \text{MR} \) to display the stored memory records.

3. Press \( \text{MR} \) repeatedly until you pass the CLR ALL and the C-F locations. The display will show a “FAC SEL” (see Figure 13).

4. Press \( \text{CAL MCLR} \) to accept the resetting.

X. CALIBRATION INTERVALS
There is no simple answer as to how often one should calibrate an instrument. The Ultrameter is designed to not require frequent recalibration. The most common sources of error were eliminated in the design, and there are no mechanical adjustments. Still, to ensure specified accuracy, any instrument has to be checked against chemical standards occasionally.

A. Suggested Intervals
On the average, we expect calibration need only be checked monthly for the Conductivity, RES or TDS functions. The \( \text{pH} \) function should be checked every 2 weeks to ensure accuracy. Measuring some solutions will require more frequent intervals.

B. Calibration Tracking Records
To minimize your calibration effort, keep records. If adjustments you are making are minimal for your application, you can check less often.

Changes in conductivity calibration should be recorded in percent. Changes in \( \text{pH} \) calibration are best recorded in \( \text{pH} \) units.

Calibration is purposely limited in the Ultrameter to \( \pm 10\% \) for the conductivity cell because more than that indicates damage, not drift. Likewise, calibration changes are limited to \( \pm 1 \) \( \text{pH} \) unit because more than that indicates the end of the sensor lifetime, and it should be replaced.

C. Conductivity, RES, TDS Practices to Maintain Calibration

1. Clean oily films or organic material from the cell electrodes with foaming cleaner or mild acid. Do not scrub inside the cell.

2. Calibrate with solutions close to the measurements you make. Readings are compensated for temperature based on the type of solution. If you choose to measure tap water with a KCl compensation, which is often done (ref. An Example, pg. 30), and you calibrate with 442 solution because it is handy, the further away from 25°C you are, the more error you have. Your records of calibration changes will reflect temperature changes more than the instrument’s accuracy.

3. Rinse out the cell with pure water after making measurements. Allowing slow dissolving crystals to form in the cell contaminates future samples.

4. For maximum accuracy, keep the pH sensor cap on tight so no
D. pH and ORP Practices to Maintain Calibration.

1. Keep the sensor wet with Myron L Storage Solution.
2. Rinse away caustic solutions immediately after use.

ORP calibration solutions are not only caustic, but 5% is considered very accurate. By using the pH zero setting (0 mV = 7 pH) for ORP and precision electronics for detection, the Ultrameter delivers better accuracy without calibration than a simpler instrument could using calibration solutions.

XI. CARE and MAINTENANCE

Ulrameters should be rinsed with clean water after use. Solvents should be avoided. Shock damage from a fall may cause instrument failure.

A. Temperature Extremes

Solutions in excess of 160°F/71°C should not be placed in the cell cup area; this may cause damage. The pH sensor may fracture if the Ultrameter temperature is allowed to go below 0°C (32°F). Care should be exercised not to exceed rated operating temperature. Leaving the Ultrameter in a vehicle or storage shed on a hot day can easily subject the instrument to over 150°F. This will void the warranty.

B. Battery Replacement

Dry Instrument THOROUGHLY. Remove the four (4) bottom screws. Open instrument carefully; it may be necessary to rock the bottom slightly side to side to release it from the RS-232 connector. Carefully detach battery from circuit board. Replace with 9 volt alkaline battery. Replace bottom, ensuring the sealing gasket is installed in the groove of the top half of case. Re-install screws, tighten evenly and securely.

NOTE: Because of nonvolatile EEPROM circuitry, all data stored in memory and all calibration settings are protected even during power loss or battery replacement.

C. pH/ORP Sensor Replacement

Order model RPR. When ordering, be sure to include the model and serial number of your instrument to ensure receiving the proper type. Complete installation instructions are provided with each replacement sensor.

D. Cleaning Sensors

1. Conductivity/TDS/Resistivity

The conductivity cell should be kept as clean as possible. Flushing with clean water following use will prevent buildup on electrodes. However, if very dirty samples — particularly scaling types — are allowed to dry in the cell cup, a film will form. This film reduces accuracy. When there are visible films of oil, dirt, or scale in the cell cup or on the electrodes, use a foaming non-abrasive household cleaner. Rinse out the cleaner and your Ultrameter is ready for accurate measurements.

2. pH/ORP

The unique pH/ORP sensor in your Ultrameter is a nonrefillable combination type which features a porous liquid junction. It should not be allowed to dry out. If it does, the sensor can sometimes be rejuvenated by first cleaning the sensor well with a liquid spray cleaner such as Windex™ or Fantastic™ and rinsing well. Do not scrub or wipe the pH/ORP sensor.

Then use one of the following methods:

1. Pour a HOT salt solution ~60°C (140°F), preferably potassium chloride (KCl) solution — HOT tap water with table salt (NaCl) will work fine — in the sensor well and allow to cool. Retest.
   Or
2. Pour DI water in the sensor well and allow to stand for no more than 4 hours (longer can deplete the reference solution and damage the glass bulb). Retest.

If neither method is successful, sensor must be replaced.

"Drifting" can be caused by a film on the pH sensor bulb. Spray a liquid cleaner such as Windex™ or Fantastic™ into the sensor well to clean it. The sensor bulb is very thin and delicate. Do not scrub or wipe the pH/ORP sensor.
Leaving high pH (alkaline) solutions in contact with the pH sensor for long periods of time can damage it. Rinsing such liquids from the pH/ORP sensor well and refilling well with Myron L Storage Solution, a saturated KCl solution, pH 4 buffer, or a salty tap water, will extend the sensor’s useful life.

Samples containing chlorine, sulfur, or ammonia can “poison” any pH electrode. If it is necessary to measure the pH of any such sample, thoroughly rinse the sensor well with clean water immediately after taking the measurement. Any sample element which will reduce (add an electron to) silver, such as cyanide, will attack the reference electrode.

Replacement sensors are available only from the Myron L Company or its authorized distributors.
### XII. TROUBLESHOOTING CHART

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No display, even though measurement key pressed</td>
<td>Battery weak or not connected.</td>
<td>Check connections or replace battery (ref. Battery Replacement, pg. 24).</td>
</tr>
<tr>
<td>Inaccurate pH readings</td>
<td>1. pH calibration needed (ref. pH Cal., pg. 17).</td>
<td>1. Recalibrate instrument.</td>
</tr>
<tr>
<td></td>
<td>2. Cross-contamination from residual pH buffers or samples in sensor well.</td>
<td>2. Thoroughly rinse sensor well.</td>
</tr>
<tr>
<td></td>
<td>3. Calibration with expired pH buffers.</td>
<td>3. Recalibrate using fresh buffers (ref. pH Buffer Solutions, pg. 28).</td>
</tr>
<tr>
<td>No response to pH changes</td>
<td>Sensor bulb is cracked or an electromechanical short caused by an internal crack.</td>
<td>Replace pH/ORP sensor (ref. pH/ORP Sensor Replacement, pg. 29).</td>
</tr>
<tr>
<td>Will not adjust down to pH 7</td>
<td>pH/ORP sensor has lost KCl.</td>
<td>Clean and rejuvenate sensor (ref. Cleaning Sensors, pg. 25) and recalibrate. If no improvement, replace pH/ORP sensor (ref. pH/ORP Sensor Replacement, pg. 29).</td>
</tr>
<tr>
<td>pH readings drift or respond slowly to changes in buffers/samples or “FAC” is displayed repeatedly</td>
<td>1. Temporary condition due to “memory” of solution in pH sensor well for long periods.</td>
<td>Clean and rejuvenate sensor (ref. Cleaning Sensors, pg. 25) and recalibrate. If no improvement, replace pH/ORP sensor (ref. pH/ORP Sensor Replacement, pg. 29).</td>
</tr>
<tr>
<td></td>
<td>2. Bulb dirty or dried out.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Reference junction clogged or coated.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Test samples greater than 1 megohm.</td>
<td>2. Minimize test sample exposure to air (ref. Measuring Resistivity, pg. 10).</td>
</tr>
<tr>
<td>Unable to calibrate Conductivity/TDS</td>
<td>Film or deposits on electrodes.</td>
<td>Clean cell cup and electrodes (ref. Cleaning Sensors, pg. 25).</td>
</tr>
<tr>
<td>Resistivity readings much lower than expected</td>
<td>1. Contamination from previous sample or from pH sensor well.</td>
<td>1. Rinse cell cup more thoroughly before measurement. Ensure pH cap is snugly in place.</td>
</tr>
<tr>
<td></td>
<td>2. Carbon dioxide in test sample.</td>
<td>2. See Measuring Resistivity, pg. 10.</td>
</tr>
</tbody>
</table>
XIII. ACCESSORIES

A. Conductivity/TDS Standard Solutions
Your Ultrameter has been factory calibrated with the appropriate Myron L Company NIST traceable KCl, NaCl, and our own 442 standard solutions. Most Myron L conductivity standard solution bottles show three values referenced at 25°C: Conductivity in microsiemens/micromhos and the ppm/TDS equivalents based on our 442 Natural Water™ and NaCl standards. All standards are within ±1.0% of reference solutions.

1. Potassium Chloride (KCl)
The concentrations of these reference solutions are calculated from data in the International Critical Tables, Vol. 6. The 7000 µS is the recommended standard. Order KCl-7000.

2. 442 Natural Water™
442 Natural Water Standard Solutions are based on the following salt proportions: 40% sodium sulfate, 40% sodium bicarbonate, and 20% sodium chloride, which represent the three predominant components (anions) in freshwater. This salt ratio has conductivity characteristics approximating fresh natural waters and was developed by the Myron L Company over three decades ago. It is used around the world for measuring both conductivity and TDS in drinking water, ground water, lakes, streams, etc. The 3000 ppm is the recommended standard. Order 442-3000.

3. Sodium Chloride (NaCl)
This is especially useful in sea water mix applications, as sodium chloride is its major salt component. Most Myron L standard solution labels show the ppm NaCl equivalent to the conductivity and to ppm 442 values. The 14.0 mS is the recommended standard. Order NaCl-14.0.

B. pH Buffer Solutions
pH buffers are available in pH values of 4, 7 and 10. Myron L Company buffer solutions are traceable to NIST certified pH references and are color-coded for instant identification. They are also mold inhibited and accurate to within ±0.01 pH units @ 25°C. Order 4, 7 or 10 Buffer.

C. pH Sensor Storage Solution
Myron L Storage Solution prolongs the life of the pH sensor. It is available in quarts and gallons. Order SSQ or SSG.

D. Soft Protective Case
Padded Cordura® Nylon carrying case features a belt clip for hands-free mobility. Model: UCC

E. Replacement pH/ORP Sensor
Model RPR is gel filled and features a unique porous liquid junction. It is user-replaceable and comes with easy to follow instructions.

F. Data Port
There is a 4 pin connector marked “Factory Use Only” on the bottom of the Ultrameter. It is used to interrogate the instrument during final inspection. Applications in the future for downloading recorded data are being considered, but not implemented, as of this printing.

XIV. TEMPERATURE COMPENSATION (Tempco) of Aqueous Solutions

Electrical conductivity indicates solution concentration and ionization of the dissolved material. Since temperature greatly affects ionization, conductivity measurements are temperature dependent and are normally corrected to read what they would be at 25°C.

A. Standardized to 25°C
Conductivity is very accurately measured in the Ultrameter by a method that ignores fill level, electrolysis, electrode characteristics, etc., and uses a microprocessor to perform temperature compensation. In simpler instruments, conductivity values are usually assigned an average correction similar to KCl solutions for correction to 25°C. The correction to an equivalent KCl solution is a standard set by chemists. It standardizes the measurements and allows calibration with precise KCl solutions. In the Ultrameter, this correction can be set to other solutions or tailored for special measurements or applications.

B. Tempco Variation
Most conductivity instruments use an approximation of the temperature characteristics of solutions, perhaps even assuming a constant value. The value for KCl is often quoted simply as 2%/°C. In fact, KCl tempco varies with concentration and temperature in a non-linear fashion. Other solutions have more variation still. The Ultrameter uses corrections that change with concentration and temperature instead of single average values. See Chart 1 on next page.
How much error results from treating natural water as if it were KCl at 15°C?

A tap water solution should be compensated as 442 with a tempco of 1.68% / °C, where the KCl value used would be 1.90% / °C.

Suppose a measurement at 15°C (or 59°F) is 900 microsiemens of true uncompensated conductivity.

Using a 442 correction of 10 (degrees below 25) x 1.68% indicates the solution is reading 16.8% low. For correction, dividing by (.832) yields 1082 microsiemens as a compensated reading.

A KCl correction of 10 (degrees below 25) x 1.9% indicates the solution is reading 19% low. Dividing by (.81) yields 1111 microsiemens for a compensated reading. The difference is 29 out of 1082 = 2.7%.

Users wanting to measure natural water based solutions to 1% would have to alter the internal compensation to the more suitable preloaded “442” values or stay close to 25°C. Some who have standardized to KCl based compensation may want to stick with it, regardless of increasing error as you get further from 25°C. The Ultrameter will provide the repeatability and convertibility of data needed for relative values for process control.

E. Other Solutions

A salt solution like sea water or liquid fertilizer acts like NaCl. An internal correction for NaCl can be selected for greatest accuracy with such solutions. Many solutions are not at all similar to KCl, NaCl or 442. A sugar solution, or a silicate, or a calcium salt at a high or low temperature may require a “User” value peculiar to the application to provide readings close to the true compensated conductivity.

Clearly, the solution characteristics should be chosen to truly represent the actual water under test for rated accuracy of ±1%. Many industrial applications have always been relative measurements seeking a number
to indicate a certain setpoint or minimum concentration or trend. The
Ultrameter gives the user the capability to take data in “KCl conductivity
units” to compare to older published data, in terms of NaCl or 442, or as
may be appropriate. The Ultrameter can be used to reconcile data taken
with other compensation assumptions, especially with its ability to allow
custom characteristics through the USER mode.

XV. CONDUCTIVITY CONVERSION to TOTAL
DISSOLVED SOLIDS (TDS)

Electrical conductivity indicates solution concentration and ionization of
the dissolved material. Since temperature greatly affects ionization,
conductivity measurements are temperature dependent and are normally
corrected to read what they would be at 25°C (ref. Temperature
Compensation, pg. 29).

A. How it’s Done
Once the effect of temperature is removed, the compensated
conductivity is a function of the concentration (TDS). Temperature
compensation of the conductivity of a solution is performed automatically
by the internal processor, using data derived from chemical tables. Any
dissolved salt at a known temperature has a known ratio of conductivity to
concentration. Tables of conversion ratios referenced to 25°C have been
published by chemists for decades.

B. Solution Characteristics
Real world applications have to measure a wide range of materials and
mixtures of electrolyte solutions. To solve this problem, industrial users
commonly use the characteristics of a standard material as a model for
their solution, like the KCl favored by chemists for its stability.

Users dealing with sea water, etc., use NaCl as the model for their
concentration calculations. Users dealing with freshwater work with
mixtures including sulfates, carbonates and chlorides, the three
predominant components (anions) in freshwater that the Myron L
Company calls “natural water”. These are modeled in a mixture called
“442” which the Myron L Company markets for use as a calibration
standard, as it does standard KCl and NaCl solutions.

The Ultrameter contains internal algorithms for these 3 most commonly
referenced compounds. In the LCD display, the solution type being used
is shown on the left. Besides KCl, NaCl, and 442, there is the “USER”
choice. The benefit of USER is that one may enter the temperature
compensation and TDS ratio by hand, greatly increasing accuracy of
readings for a specific solution. That value remains a constant for all
measurements, and should be reset for different dilutions or
temperatures.

C. When does it make a lot of difference?
First, the accuracy of temperature compensation to 25°C determines the
accuracy of any TDS conversion. Assume we have industrial process
water to be pretreated by R.O. Assume it is 45°C and reads 1500 µS
uncompensated.

1. If NaCl compensation is used, an instrument would report 1035
µS compensated, which corresponds to 510 ppm NaCl.

2. If 442 compensation is used, an instrument would report 1024
µS compensated, which corresponds to 713 ppm 442.

The difference in values is 40%.

In spite of such large error, some users will continue to take data in the
NaCl mode because their previous data gathering and process
monitoring was done with an older NaCl referenced device.

Those who want true TDS readings that will correspond to evaporated
weight will select the correct Solution Type. If none of the 3 standard
solutions apply, the User mode must be used. Temperature
Compensation (Tempco) and TDS Derivation below, details the USER
mode.

XVI. TEMPERATURE COMPENSATION (Tempco)
and TDS DERIVATION

The Ultrameter contains internal algorithms for characteristics of the 3
most commonly referenced compounds. In the display, the solution type
being used is shown on the left. Besides KCl, NaCl, and 442, there is the
“USER” choice. The benefit of USER mode is that one may enter the
tempco and TDS conversion values of a unique solution from the
keyboard.

A. Conductivity Characteristics
When making conductivity measurements, the Solution Selection
determines the characteristic assumed as the instrument reports what a
measured conductivity would be if it were at 25°C. The characteristic is
represented by the tempco, expressed in %/°C. If a solution of 100 µS at
25°C increases to 122 µS at 35°C, then a 22% increase has happened
over this change of 10°C. The solution is said to have a tempco of 2.2
%/°C.
Another solution would have a different tempco because of its ionization activity. And, that tempco may be a little different at a different concentration or temperature. This is why the Ultrameter uses mathematically generated models for known salt characteristics that vary with concentration and temperature.

B. Finding the Tempco of an Unknown Solution
One may need to measure compensated conductivity of some solution unlike any of the 3 standard salts. In order to enter a custom fixed tempco for a limited measurement range, enter a specific value through the “USER” function. The tempco can be determined by 2 different methods:

1. Heat or cool a sample of the solution to 25°C, and measure its conductivity. Heat or cool the solution to a typical temperature where it is normally measured. After selecting USER function, set the tempco to 0 °C as in Disabling Temperature Compensation, pg. 13 (No compensation). Measure the new conductivity and the new temperature. Divide the % decrease or increase by the 25°C value. Divide that difference by the temperature difference.

2. Heat or cool a sample of the solution to 25°C, and measure its conductivity. Change the temperature to a typical measuring temperature. Set the tempco to an expected value as in User Programmable Tempco, pg. 12. See if the compensated value is the same as the 25°C value. If not, raise or lower the tempco and measure again until the 25°C value is read.

C. Finding the TDS Ratio of an Unknown Solution
Once the effect of temperature is removed, the compensated conductivity is a function of the concentration (TDS). There is a ratio of TDS to compensated conductivity for any solution, which varies with some concentration. The ratio is set during calibration in USER as in section User Programmable Conductivity to TDS Ratio, pg. 13. A truly unknown solution has to have its TDS determined by evaporation and weighing. Then the solution whose TDS is now known can be measured for conductivity and the ratio calculated. Next time the same solution is to be measured, the ratio is known.

XVII. pH and ORP MEASURING
A. pH
1. pH as an Indicator
pH is the measurement of Acidity or Alkalinity of an aqueous solution. It is also stated as the Hydrogen Ion activity of a solution. pH measures the effective, not the total, acidity of a solution.

A 4% solution of acetic acid (pH 4, vinegar) can be quite palatable, but a 4% solution of sulfuric acid (pH 0) is a violent poison. pH provides the needed quantitative information by expressing the degree of activity of an acid or base.

In a solution of one known component, pH will indicate concentration indirectly. However, very dilute solutions may be very slow reading, just because the very few ions take time to accumulate.

2. pH Units
The acidity or alkalinity of a solution is a measurement of the relative availabilities of hydrogen (H+) and hydroxide (OH-) ions. An increase in (H+) ions will increase acidity, while an increase in (OH-) ions will increase alkalinity. The total concentration of ions is fixed as a characteristic of water, and balance would be 10^-7mol/liter (H+) and (OH-) ions in a neutral solution (where pH sensors give 0 voltage).

pH is defined as the negative logarithm of hydrogen ion concentration. Where (H+) concentration falls below 10^-7, solutions are less acidic than neutral, and therefore are alkaline. A concentration of 10^-5mol/liter of (H+) would have 100 times less (H+) ions than (OH-) ions and be called an alkaline solution of pH 9.

3. The pH Sensor
The active part of the pH sensor is a thin glass surface which is selectively receptive to hydrogen ions. Available hydrogen ions in a solution will accumulate on this surface and a charge will build up across the glass interface. The voltage can be measured with a very high impedance voltmeter circuit; the trick is to connect the voltmeter to solution on each side.

The glass surface encloses a captured solution of potassium chloride holding an electrode of silver coated with silver chloride. This is as inert a connection as can be made from metal to an electrolyte. It still can produce an offset voltage, but using the same materials to connect to the solution on the other side of the membrane allows the 2 equal offsets to cancel.

The problem is...the other side of the membrane is some test solution, not potassium chloride. The outside electrode, also called the Reference Junction, is of the same construction with a porous plug in place of a glass barrier to allow the junction fluid to contact the test solution without
significant migration of liquids through the plug material. Figure 14 shows a typical 2 component pair. Migration does occur, and this limits the lifetime of a pH junction, from depletion of solution inside the reference junction or from contamination. The junction is damaged by drying out because insoluble crystals may form in a layer, obstructing contact with test solutions. See pH/ORP, pg. 25.

4. The Myron L Integral pH Sensor
The sensor in the Ultrameter (figure 15) is a single construction in an easily replaceable package. The sensor body holds an oversize solution supply for long life. The reference junction “wick” is porous to provide a very stable, low permeability interface. It is located under the glass pH sensing electrode. The construction combines all the best features of any pH sensor known.

5. Sources of Error
The basics are presented in pH/ORP, pg. 25.

a. Reference Junction
The most common sensor problem will be a clogged junction because a cell was allowed to dry out. The symptom is a drift in the “zero” setting at 7 pH. This is why the Ultrameter does not allow more than 1 pH unit of offset during calibration. At that point the junction is unreliable.

b. Sensitivity Problems
Sensitivity is the receptiveness of the glass surface, which can be diminished by a film on the surface, or a crack in the glass. These problems also cause long response time.

c. Temperature Compensation
pH sensor glass changes its sensitivity slightly with temperature, so the further from pH 7 one is, the more effect will be seen. A pH of 11 at 40°C would be off by 0.2 units. The Ultrameter senses the cell temperature and compensates the reading.

B. ORP/Oxidation-Reduction Potential/REDOX

1. ORP as an Indicator
ORP is the measurement of the ratio of oxidizing activity to reducing activity in a solution. It is the potential of a solution to give up electrons (oxidize other things) or gain electrons (reduce).

Like acidity and alkalinity, the increase of one is at the expense of the other, so a single voltage is called the Oxidation-Reduction Potential, with a positive voltage showing, a solution wants to steal electrons (oxidizing agent). Chlorinated water will show a positive ORP value, for instance.

2. ORP Units
ORP is measured in millivolts, with no correction for solution temperature. Like pH, it is not a measurement of concentration directly, but of activity level. In a solution of only one active component, ORP does indicate concentration. Also, as with pH, a very dilute solution will take time to accumulate a readable charge.

3. The ORP Sensor
An ORP sensor uses a small platinum surface to accumulate charge without reacting chemically. That charge is measured relative to the solution, so the solution “ground” voltage comes from a reference junction - same as the pH sensor uses.

4. The Myron L ORP Sensor
Figure 15 pg. 36 shows the platinum button in a glass sleeve. The same reference is used for both the pH and the ORP sensors. Both pH and ORP will indicate 0 for a neutral solution. Calibration at zero compensates for error in the reference junction.

A zero calibration solution for ORP is not practical, so the Ultrameter uses the offset value determined during calibration to 7 in pH calibration (pH 7 = 0 mV). Sensitivity of the ORP surface is fixed, so there is no gain adjustment either.

5. Sources of Error
The basics are presented in pH/ORP, pg. 25, because sources of error are much the same as for pH. The junction side is the same, and though the platinum surface will not break like the glass pH surface, its protective glass sleeve can be broken. A surface film will slow the response time and diminish sensitivity. It can be cleaned off with detergent or acid, as with the pH glass.
XVIII. GLOSSARY

Anions - Negatively charged ions. See Solution Characteristics, pg. 32.


Logarithm - An arithmetic function. See pH Units, pg. 35.

ORP - Oxidation-Reduction Potential or REDOX, See ORP/Oxidation-Reduction Potential/REDOX, pg. 37.

Reduce - As in ORP.

TDS - Total Dissolved Solids or the Total Conductive Ions in a solution. See Conductivity Conversion to TDS, pg. 32.

Tempco - Temperature Compensation See Temperature Compensation, pg. 29.

USER - A mode of operation that allows the instrument user (operator) to set a tempco and/or a TDS factor for their specific solution type. See Temperature Compensation, pg. 29 and Temperature Compensation (Tempco) and TDS Derivation, pg. 33.

For details on specific areas of interest refer to Table of Contents.
Ultrameter™
Operation Manual
Addendum
Models 4P & 6P
Software Versions 2.03, 2.10, 2.51 & Later*

* See page 5 to determine the version of software of your Ultrameter™.
I. ENHANCED HIGH RESISTIVITY MEASUREMENTS

The resistivity calculations in the Ultrameter have been improved for measuring waters greater than 10 Megohms. When the Ultrameter is in one of the solution modes (i.e. KCl, NaCl or 442) and the resistivity reading is greater than 10 Megohms, the Ultrameter performs automatic temperature compensation for high purity water. As such, the maximum possible value that should be displayed for water is 18.2. It may be possible to display readings higher than 18.2 if the instrument is not calibrated or if solutions other than water are being measured. To insure proper use of the instrument in this mode, readings greater than 20 Megohms will display "- - - - " indicating an over-range condition. To obtain resistivity readings for solutions other than water, the User mode should be selected. In User mode the Ultrameter will display resistivity measurements up to 30 Megohms.

An Offset Zero Calibration feature was added to software version 2.03, and must be performed by the user, see below. On all later versions this function is performed at time of manufacture. A Cell Check feature was added to these later versions. See page 2.

Offset Zero Calibration For Instruments with Software Version 2.03

When performing measurements of waters above 10 Megohms, the accuracy of the Ultrameter may be improved by performing an offset zero calibration. Follow the steps below to perform an offset zero calibration.

1. Press RES key to power up the unit.
2. Verify that the cell cup is empty of any solution and "- - - - " is displayed by the Ultrameter. If a reading other than "- - - - " is displayed, clean the cell cup and repeat steps 1 & 2. See "Cleaning Sensors".
3. Press the MR key until "CAL0" appears. Fig. 1.
4. Press the CAL key. The instrument should momentarily display a number of counts, and return to Resistivity mode.
5. If the calibration has failed the display will show "Err". If an error occurs during this step, the cell cup is probably contaminated. Rinse the cup with DI water several times to clean and Repeat steps 1-4.

Cell Check For Instruments with Software Version 2.10 & Later.

In these versions, a Cell Check feature has been added to further increase the performance of your instrument. This is especially important when in RES mode reading High Resistivity or Ultrapure waters. This feature, utilizing technological improvements, knows when the Conductivity Cell cup is dirty and calls it to your attention. You may then choose to clean the Conductivity Cell cup or ignore it by pressing the CAL key. Follow the steps below to perform a Cell Check.

1. Press RES key to power up the unit.
2. Verify that the cell cup is empty of any solution and "- - - - " is displayed by the Ultrameter. If a reading other than "- - - - " is displayed, clean the cell cup and repeat steps 1 & 2. See "Cleaning Sensors".
3. Press the MR key until "CELL ch " appears. Fig. 2.
4. Press the CAL key. If the cell is clean, "Good" will momentarily be displayed. Fig. 3.
5. If the Cell Check has failed the display will show "CELL cLn", Fig. 4, alternating with a number such as "53", Fig. 5, indicating a relative amount of contamination or dirt in the Conductivity Cell. To insure the highest quality readings, the Conductivity Cell cup should be cleaned before measuring High Resistivity solutions. Rinse the cup with DI water several times to clean, and Shake instrument well to remove excess water. Repeat steps 1-4.
II. USER MODE CALIBRATION LINK

A new function has been added to the Ultrameter that makes calibration of the unit while in "User" mode easier, and more repeatable and accurate than other calibration methods. It is recommended that this calibration method be used to provide the highest degree of confidence when the Ultrameter is used in "User" mode.

A. Calibration of Ultrameter for use in User Mode

1. Press the \textit{COND} or \textit{TDS} key to power up the Ultrameter.
2. Calibrate the unit using a Standard Solution. Refer to CALIBRATION in Operation Manual.
3. Place the Ultrameter in User mode. Refer to SOLUTION SELECTION in Operation Manual.
4. Verify/Set the calibration link. (See below – Setting User Mode Calibration Link).

B. Setting User Mode Calibration "Link"

The link function sets or "links" the calibration gain factor of a Standard Solution to the User solution mode. Once set, the "link" will stay intact with future calibrations unless the link has been canceled. For more information on canceling the User Mode Calibration Link refer to the section below "Canceling User Mode Calibration Link". Follow the steps below to set either the KCl, NaCl or 442 calibration factor to the User solution mode.

1. Press measurement key desired to be "Linked", i.e., \textit{COND}, \textit{RES} or \textit{TDS}.
2. Place the Ultrameter in User mode. Refer to SOLUTION SELECTION in Operation Manual for selecting the User Mode.
3. Press the \textit{MR} \textit{arrow} key until the menu "Linc" appears.

C. Canceling User Mode Calibration "Link"

The Ultrameter must be in User linked mode in order to cancel the "link". Refer to SOLUTION SELECTION in Operation Manual.

1. Press "Linked" measurement key \textit{COND} \textit{RES} or \textit{TDS}.
2. Press the \textit{MR} \textit{key} until the menu "Linc" appears. Fig. 6.
3. Press the \textit{CAL} \textit{key}, the unit will display "SEL" and the "User" Icon. Fig. 7.

Any additional display of KCl, NaCl or 442 icons indicates a link between the User solution and the other solution displayed.

4. Press the \textit{CAL} \textit{key}. The instrument will display "SEL" and the "User" Icon. Fig. 7.

Note: If none of the Solution Selection icons are displayed (i.e. KCl, NaCl or 442) nothing has been linked to User mode.

5. Press the \textit{MR} \textit{keys} to select a Standard Solution to be linked to the User mode calibration constant. (see Fig. 8, User linked to KCl).

6. Press the \textit{CAL} \textit{key} to accept the setting. Pressing any of the measurement keys will exit without changing the setting. User mode "link" is now complete. The User mode will now use the calibration gain constant used for the calibration of the Standard Solution as outlined above.
4. Press the key until "User" is the only solution icon being displayed.

5. Press the key.

6. The User mode calibration "Link" has now been canceled.

NOTES:
1. To maintain repeatability, use the same standard solutions for future calibrations.

2. Calibration of the Ultrameter Gain Factor for User mode is not available when the calibration link has been established. The other calibration functions (i.e. Temperature Compensation %/C settings and TDS Ratio settings) are still intact. To perform a calibration of the User mode as described in the manual, the User Mode Link should be canceled. See above Canceling User Mode calibration "Link".

3. Once a "link" has been established for User mode, the "link" will apply to all measurement modes using User solution selection (i.e. TDS/User, Cond/User or Res/User).

* CHECKING YOUR INSTRUMENTS SOFTWARE VERSION

1. Press key to power up the unit.

2. Press the key until three numbers are displayed as shown.

   *Fig. 9.* If one of the listed versions is displayed, the ENHANCED HIGH RESISTIVITY MEASUREMENTS, and the USER MODE CALIBRATION LINK are available.

3. Press key, instrument will time out in ~15 seconds.

   If one of the listed versions is NOT displayed, and these functions are required, contact the Myron L Company for information on upgrading your instrument.