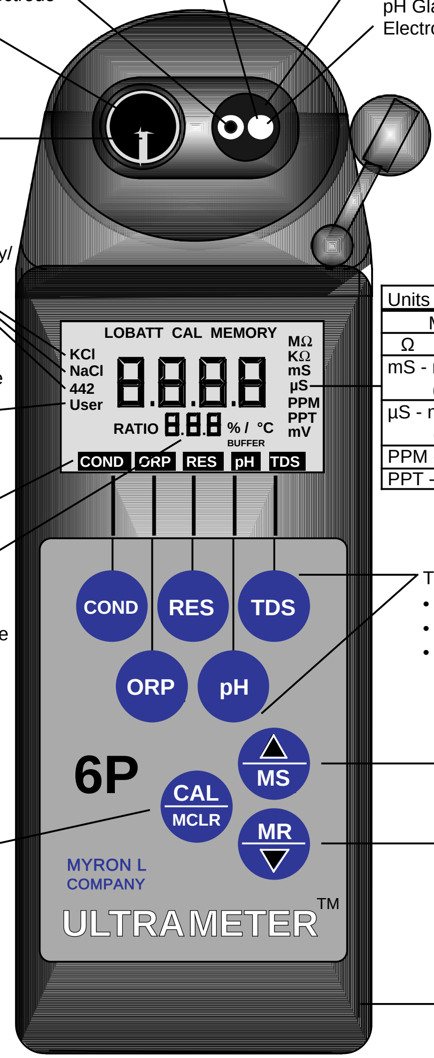
Ultrameter™ Operation Manual

Model 6P

MYRON L
COMPANY
10 - 02 (WEB) EG

Instrument Illustration



Units of Measurement	Parameter
Megohms - cm	Resistivity
Ω Kilohms - cm	Resistivity
mS - millisiemens/cm (millimhos/cm)	Conductivity
µS - microsiemens/cm (micromhos/cm)	Conductivity
PPM - parts per million	TDS
PPT - parts per thousand	TDS

7-11-00

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

CE

C. Specification Chart

6P	pH	ORP	Conductivity	TDS	Resistivity	Temperature
Ranges	0-14 pH	±999 mV	0-9999 µS 10-200 mS in 5 autoranges	0-9999 ppm 10-200 ppt in 5 autoranges	10K - 30M ohmsΩ	0-71°C 32 - 160 °F
Resolution	±.01 pH	±1 mV	0.01 (<100 µS) 0.1 (<1000 µS) 1.0 (>1000 µS)	0.01 (<100 ppm) 0.1 (<1000 ppm) 1.0 (>1000 ppm)	0.01 (<100K ohm) 0.1 (<1000K ohm) 1.0 (>1MΩohm)	0.1 °C/F
Accuracy	±.01 pH	±1 mV	±1% of reading*	±1% of reading*	±1% of reading**	±0.1 °C
Auto Temperature Compensation	0-71°C 32 - 160 °F		0-71°C 32 - 160 °F	0-71°C 32 - 160 °F	0-71°C 32 - 160 °F	
Adjustable Temperature Compensation			0 - 9.99%/°C	0 - 9.99%/°C	0 - 9.99%/°C	
Cond/TDS Ratios Preprogrammed			KCl, NaCl, 442™			
Adjustable Cond/TDS Ratio Factor			0.20 - 7.99			

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

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 Troublshooting 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
PARAMETERS	pH/ORP/Temp.	Conductivity/TDS Resistivity/Temp.	Conductivity/TDS/pH Resistivity/ORP/Temp.

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Addendum

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 present 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 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. pH key

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

b. ORP key

A press of ORP displays Oxidation-Reduction Potential/REDOX reading in millivolts.

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 CAL/MCLR 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

conversion. 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 COND, RES or TDS to select the parameter on which you wish to change the solution type.
2. Press and hold CAL/MCLR key about 3 seconds to make "**SEL**" appear (see Figure 1). (For demonstration purposes, all 4 solution types are shown simultaneously.)

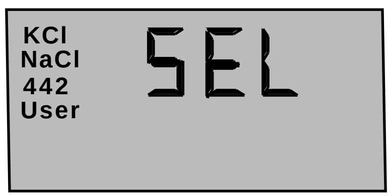


Figure 1

3. Use ▲/MS or 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 CAL/MCLR 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 CAL/MCLR. You may now adjust a temperature compensation from .00%/°C to 9.99%/°C, by pressing ▲/MS or MR/▼. See example in Figure 2.

Figure 2

c. Press CAL/MCLR 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 CAL/MCLR. If the display does not show .00%/°C, hold MR/▼ long enough to bring the tempco to .00%/°C (see Fig. 3).

c. Press CAL/MCLR twice (3 times if in TDS mode). Temperature compensation is now disabled (=0) for measurements in USER mode.

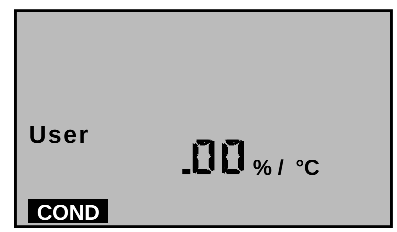


Figure 3

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 TDS .

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

c. Adjust with ▲ MS or MR ▼ keys until new conversion ratio is displayed.

Figure 4

d. Press 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 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 ▲ MS and 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.

	KCl, NaCl or 442	User
Cond	Gain only	Tempco, then Gain
Res	Done in conductivity	Done in conductivity or TDS
TDS	Gain only	Tempco, Ratio, then Gain
pH	7, acid and/or base	
ORP	Zero set with pH 7 automatically	

The CAL MCLR becomes an “ACCEPT” key. At each point, pressing 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 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 COND or TDS, then press CAL/MCLR, "**CAL**" icon will appear on the display (see Fig. 5).

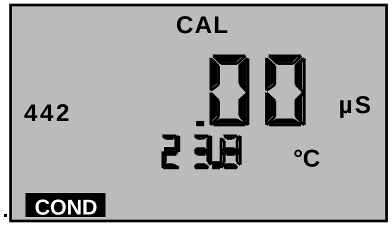


Figure 5

d. Press ▲/MS or 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 CAL/MCLR 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 **USER** mode, see Section V. Solution Selection, page 11.

a. Rinse conductivity cell three times with <u>your</u> standard.

b. Refill conductivity cell with same standard.

c. Press COND or TDS, then press CAL/MCLR twice in COND/three times in TDS. The "**CAL**" icon will appear on the display.

d. Press ▲/MS or 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 CAL/MCLR 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 COND or TDS.

b. Press CAL/MCLR. (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 ▲/MS key until "**FAC**" appears and release.

d. Press CAL/MCLR to accept the factory calibration setting.

5. pH Calibration

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 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.

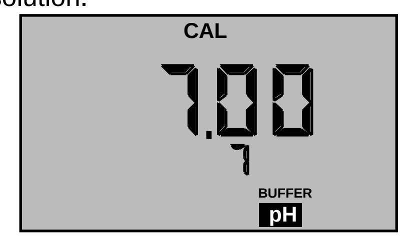


Figure 6

4. Press CAL/MCLR to enter calibration mode. The "**CAL**", "**BUFFER**" and "**7** annunciators will appear (see Figure 6). Displayed value

will be the uncalibrated sensor.

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 ▲/MS or MR/▼ 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 (ref. Troubleshooting pg. 27) or fresh buffer solution. <u>The "FAC" internal electronic calibration is not intended to replace calibration with pH buffers. It assumes an ideal pH sensor</u>. Each "FAC" indicates a factory setting for that calibration step (i.e., 7, acid, base).

You can press CAL/MCLR to accept the preset factory value, or you can reduce your variation from factory setting by pressing ▲/MS or MR/▼.

6. Press CAL/MCLR 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. <u>pH Gain Calibration</u>

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 "Acd" or "bAS".

1. The pH calibration mode is initiated by either completion of the pH Zero Calibration, or verifying 7 buffer and pressing the CAL/MCLR twice while in pH measurement mode.

2. At this point the "**CAL**", "**BUFFER**" and "**Acd**" or "**bAS**"

annunciators will be lit (see Figures 7 and 8).

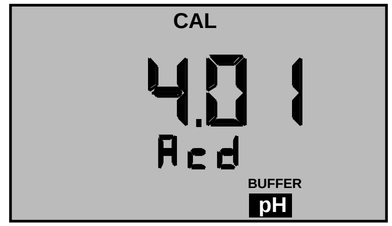


Figure 7

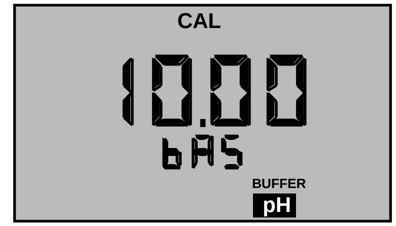


Figure 8

NOTE: If the "Acd" and "bAS" indicators are blinking, the unit is indicating an error and needs either an acid or base solution present in the sensor well.

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

4. Refill sensor well again with same buffer solution.

5. Press ▲/MS or MR/▼ until display agrees with buffer value.

6. Press CAL/MCLR 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 CAL/MCLR to accept 3rd point of calibration which ends Calibration procedure. Fill sensor well with Myron L Storage Solution and replace protective cap.

6. <u>ORP Calibration</u>

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.

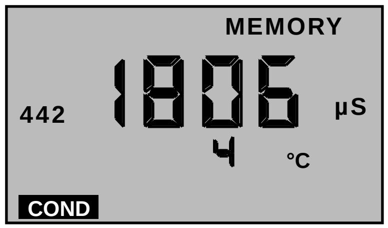


Figure 9

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 MCLR 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 MCLR to clear old record #**3**.

3. Fill pH/ORP sensor well with sample.

4. Press pH to measure sample and press ▲ MS to store reading in location #**3**.

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).

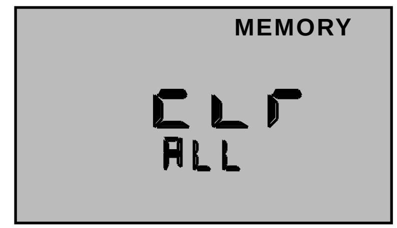


Figure 10

7. Press CAL MCLR. 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).

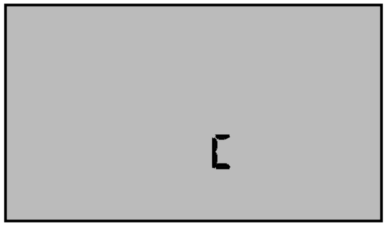


Figure 11

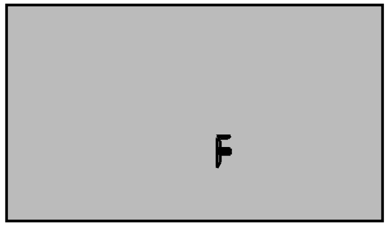


Figure 12

4. Press CAL/MCLR ; the display will change to the other unit.

5. Press COND ; all temperature readings are now in degrees last shown.

NOTE: Tempco will still be shown in %/°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 COND.

2. Press MR/▼ to display the stored memory records.

3. Press MR/▼ repeatedly until you pass the CLr ALL and the C-F locations. The display will show a "**FAC SEL**" (see Figure 13).

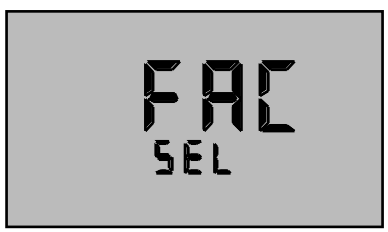


Figure 13

4. Press 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 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 pH calibration are best recorded in pH units.

Calibration is purposely limited in the Ultrameter to ±10% for the conductivity cell because more than that indicates damage, not drift. Likewise, calibration changes are limited to ±1 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

fluid washes into the conductivity cell.

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

Ultrameters 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 cup 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:

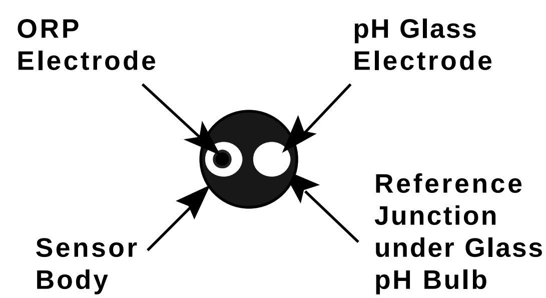
1. Pour a HOT salt solution ~60°C (140°F), preferably potassium chloride (KCl) solution — HOT tap water with table salt (NaCl) will work fine — in the sensor well and allow to cool. Retest.

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.



pH/ORP Sensor Top View

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

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

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

® Registered trade mark of DuPont

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.

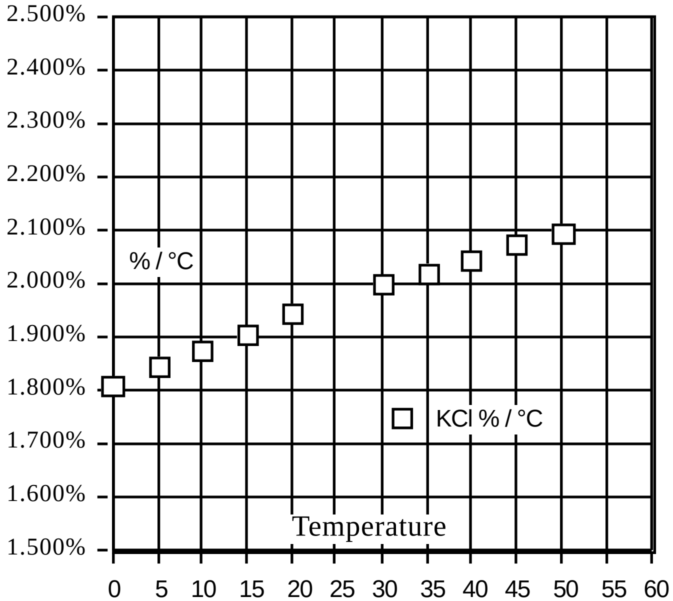


Chart 1

C. An Example of 2 different solution selections and the resulting compensation:

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%.

D. A Chart of Comparative Error:

In the range of 1000 µS, the error using KCl on a solution that should be compensated as NaCl or as 442, is shown in the graph below.

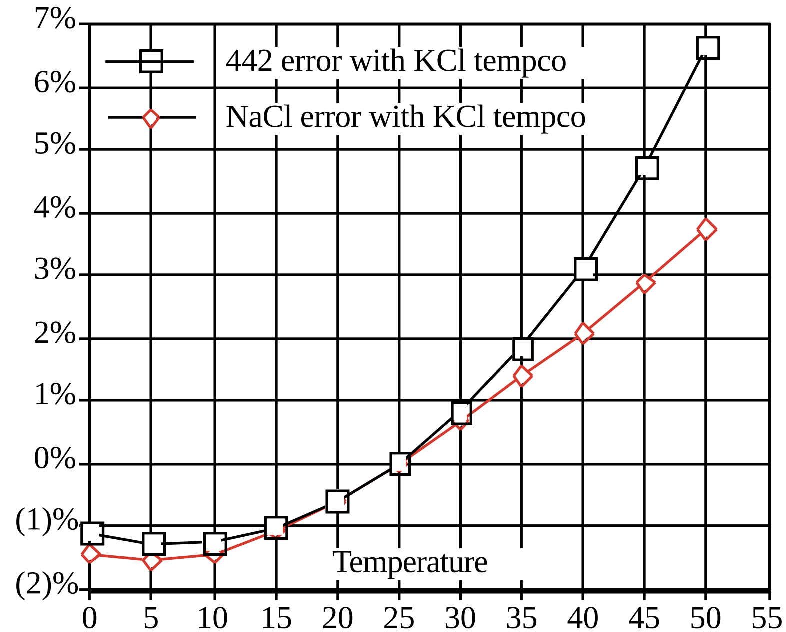


Chart 2

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 some with 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^{-7}mol/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^{-9}mol/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.

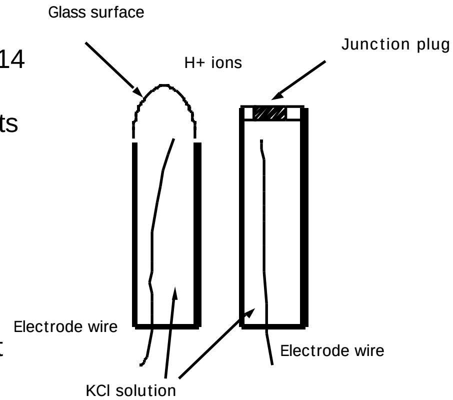


Figure 14

4. <u>The Myron L Integral pH Sensor</u>

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.

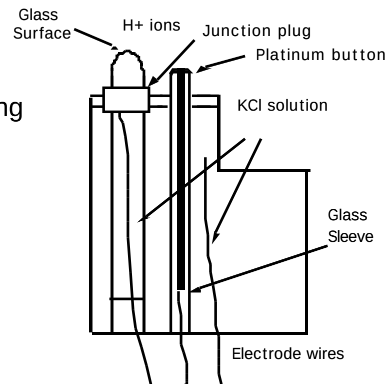


Figure 15

5. <u>Sources of Error</u>

The basics are presented in pH/ORP, pg. 25.

a. <u>Reference Junction</u>

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. <u>Sensitivity Problems</u>

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. <u>Temperature Compensation</u>

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. <u>ORP/Oxidation-Reduction Potential/REDOX</u>

1. <u>ORP as an Indicator</u>

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. <u>ORP Units</u>

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. <u>The ORP Sensor</u>

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. <u>The Myron L ORP Sensor</u>

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. <u>Sources of Error</u>

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.
Algorithm -	A procedure for solving a mathematical problem. See Temperature Compensation and TDS Derivation, pg. 33.
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™.

UMMA10-01
WEB

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.

<u>Offset Zero Calibration</u> 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 MCLR** 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.

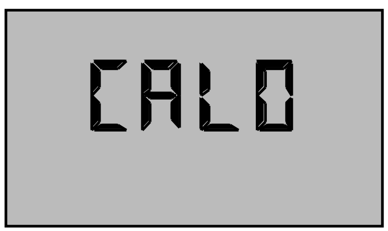


Figure 1

<u>Cell Check</u> 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 MCLR** key. If the cell is clean, "**Good**" will momentarily be displayed. Fig. 3.
5. If the **<u>Cell Check</u>** 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.

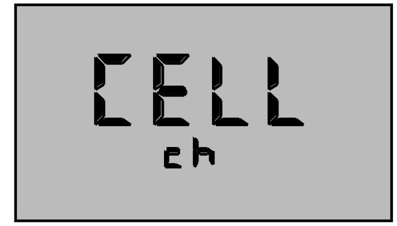


Figure 2

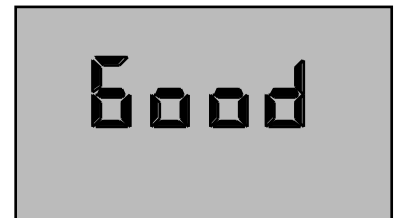


Figure 3

Figure 4

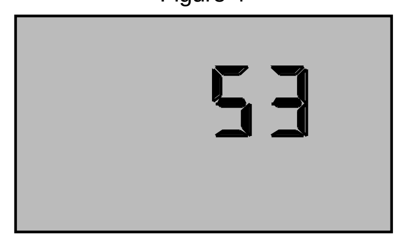


Figure 5

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 COND or 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., COND, RES or TDS.
2. Place the Ultrameter in User mode. Refer to SOLUTION SELECTION in Operation Manual for selecting the User Mode.
3. Press the MR ▼ arrow key until the menu "**Linc**" appears. Fig. 6.

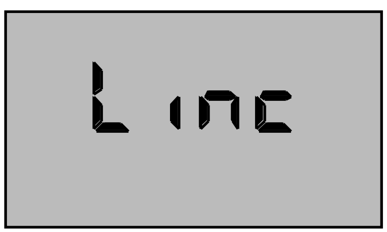


Figure 6

4. Press the CAL/MCLR key. The instrument will display "**SEL**" and the "**User**" Icon. Fig. 7.

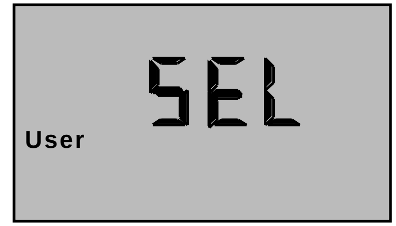


Figure 7

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

5. Press the ▲ MS / MR ▼ keys to select a Standard Solution to be linked to the User mode calibration constant. (see Fig. 8, **User** linked to **KCl**).

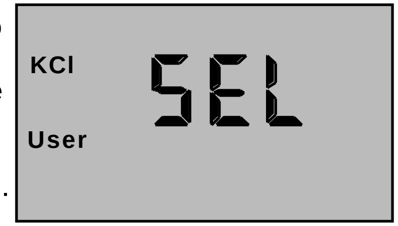


Figure 8

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

6. Press the CAL/MCLR 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.

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 COND, RES or TDS.

   Two solution icons will be shown the left side of display - "**User**" and another, i.e., "**KCl**".
2. Press the MR ▼ key until the menu "**Linc**" appears. Fig. 5.
3. Press the CAL/MCLR key, the unit will display "**SEL**" and the "**User**" Icon.

4. Press the MR ▼ key until "**User**" is the only solution icon being displayed.

5. Press the CAL/MCLR 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 COND key to power up the unit.

2. Press the MR ▼ key until three numbers are displayed as shown in Fig. 9. If one of the listed versions is displayed, the ENHANCED HIGH RESISTIVITY MEASUREMENTS, and the USER MODE CALIBRATION LINK are available.

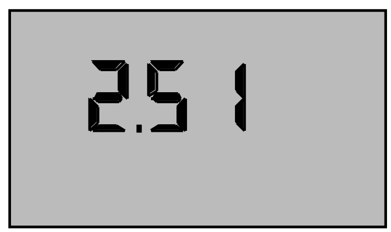


Figure 9

3. Press COND 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.