POOLPRO™

Operation Manual

MYRON L COMPANY

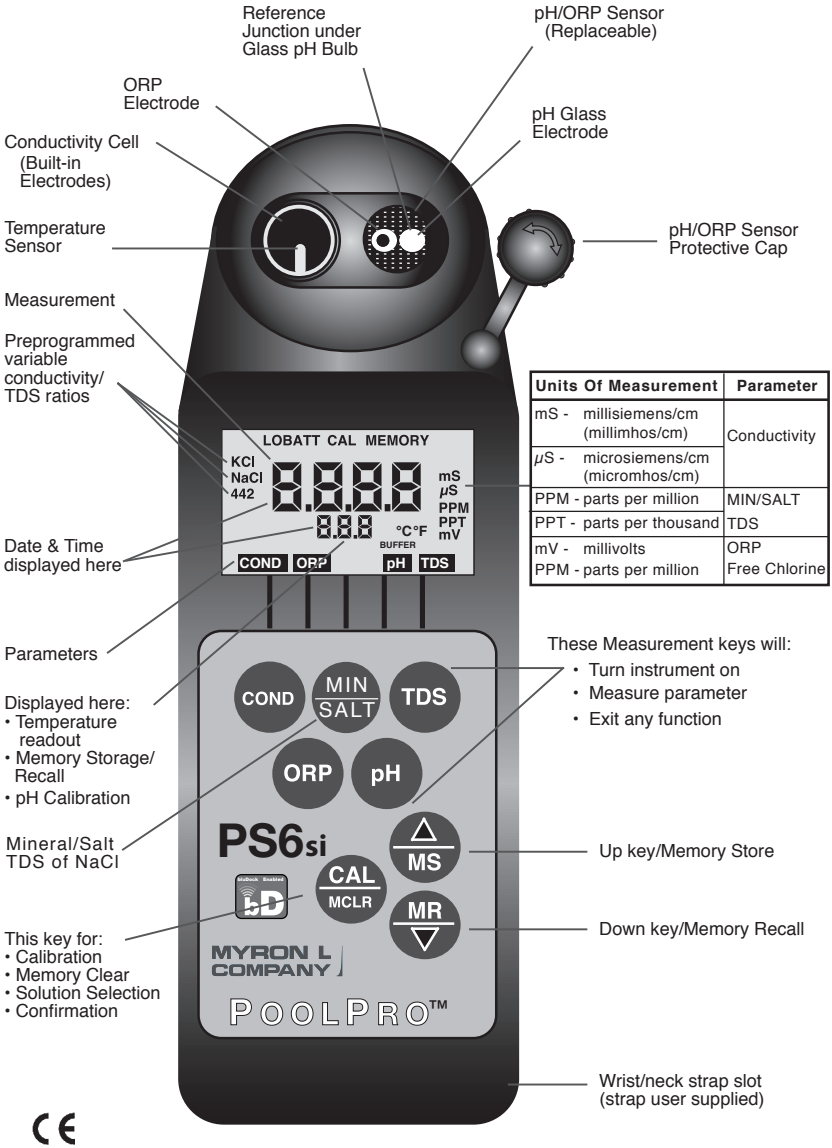
Water Quality Instrumentation

Accuracy • Reliability • Simplicity

16 November 10

PLEASE NOTE:
Because of our commitment to product improvement, the substance and style of this manual may change. When changes are made, the updated manual is posted for download in PDF format from the Myron L Website: **www.myronl.com**

Instrument Illustration



Units Of Measurement	Parameter
mS - millisiemens/cm (millimhos/cm)	Conductivity
µS - microsiemens/cm (micromhos/cm)	
PPM - parts per million	MIN/SALT
PPT - parts per thousand	TDS
mV - millivolts	ORP
PPM - parts per million	Free Chlorine

MODEL PS6si
Shown with bluDock™ option installed

For detailed explanations see Table of Contents

13 May 10

I. INTRODUCTION

Thank you for selecting the feature-packed PoolPro™, one of the Myron L Company's latest in an increasing line of instruments utilizing advanced microprocessor-based circuitry and SMT manufacturing processes. This circuitry makes the instrument extremely accurate, reliable and very easy to use.

The PoolPro measures conductivity, Mineral/SALT (Sodium Chloride/ NaCl), Total Dissolved Solids (TDS), pH, ORP/Redox and Temperature in one simple to use instrument. Model PS6si has been redesigned to include free chlorine measurements, an LSI & Hardness Calculator for water balance analysis, and *Bluetooth®* data transfer with the bluDock™ option. Additional features include a clock with time and date, a memory of up to 100 locations with time and date stamp, the ability of the user to adjust the timeout "Auto OFF", and enhanced performance. See Features and Specifications on pages 2 & 3.

The most exciting new feature is data logging with the ability to download the memory or stored test data wirelessly with its corresponding time, date and instrument name. This feature allows the user to create spreadsheets and graphs with ease, and quickly and accurately manipulate data more effectively. The optional bluDock™ and accompanying U2CI software is compatible with most computers using either Microsoft Windows XP™, Vista™ or 7™, or Macintosh OSX™. The data may be imported into a variety of spreadsheet formats like Microsoft Excel CSV™.
Please Note: Although the Myron L Company has performed extensive testing, we cannot guarantee compatibility of all applications and formats. We suggest testing your application and format for compatibility before relying on it.

For your convenience, a brief set of instructions is provided on the bottom side of your PoolPro.

Special note.....Conductivity, Mineral/Salt, and TDS require mathematical correction to 25°C values (ref. Temperature Compensation, pg. 33). On the left of the PoolPro'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 may be KCl, NaCl, or 442™. Selection affects the temperature correction of conductivity, and the calculation of TDS from compensated conductivity (ref. Conductivity Conversion to Total Dissolved Solids (TDS), pg. 36). 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 Mineral/Salt, and 442 for TDS will reflect present industry practice for standardization. This is how your instrument, as shipped from the factory, is set to operate.

II. FEATURES and SPECIFICATIONS

A. Features

- *Bluetooth®* wireless download capability with optional bluDock™
- ORP mV to ppm free chlorine conversion
- Langelier Saturation Index & Hardness Calculator
- Ranges:
  Conductivity, Min/Salt, TDS — 0-200,000 μS/ppm
  pH – 0-14
  ORP – ±999 mV; 0.20-9.99 ppm free chlorine
- Superior resolution 4 digit LCD displays full 9999 μS/ppm
- Accuracy of BETTER than ±1% of reading in a handheld instrument ±0.1% at calibration point
- All sensors are internal for maximum protection
- Improved 4 electrode sensor technology
- Waterproof to 1 meter/3 feet
- Autoranging conductivity/TDS
- Factory calibrations stored in microprocessor
- Prompts for easy pH calibration
- 3 conductivity/TDS solution conversions preprogrammed into microprocessor
- Real Time Clock with Time and Date
- Data Logging with TIME and DATE in memory
- Memory stores 100 readings
- User adjustable timeout “Auto OFF”

B. General Specifications

Display	4 Digit LCD
Dimensions (LxWxH)	196 x 68 x 64 mm/ 7.7 x 2.7 x 2.5 in.
Weight	352 g/12.4 oz.
Case Material	VALOX*
Cond/MIN/SALT/TDS Cell Material	VALOX*
Cond/TDS Electrodes (4)	316 Stainless Steel
Cond/MIN/SALT/TDS Cell Capacity	5 ml/0.2 oz.
pH/ORP Sensor Well Capacity	1,2 ml (6Psi)/0.04 oz.
Power	9V Alkaline Battery
Battery Life	>100 Hours/5000 Readings
Operating/Storage Temperature	0-55°C/32-132°F
Protection Ratings	IP67/NEMA 6 (waterproof to 1 meter/3 feet)
CE EMI/EMC Ratings (Conformité Européenne)	EN61326-1: 2006 + Annex A: 2008 (hand-held devices) CISPR 11: 2003 IEC 61000-4-2: 2001 and, IEC 61000-4-3: 2002

* ™ SABIC Innovative Plastics IP BV

Additional information is available on our website:
www.myronl.com

MADE IN USA

C. Specification Chart

	pH	ORP Free Chlorine	Conductivity	Mineral/Salt*	TDS	Temperature
Ranges	0-14 pH	±999 mV 0.2- 9.9 ppm	0-9999 µS/cm 10-200 mS/cm in 5 autoranges	0-9999 ppm 10-200 ppt in 5 autoranges	0-9999 ppm 10-200 ppt in 5 autoranges	0-71 °C 32 - 160 °F
Resolution	.01 pH	1 mV 0.1 ppm	0.01 (<100 µS) 0.1 (<1000 µS) 1.0 (<10 mS) 0.01 (<100 mS) 0.1 (<200 mS)	0.01 (<100 ppm) 0.1 (<1000 ppm) 1.0 (<10 ppt) 0.01 (<100 ppt) 0.1 (<200 ppt)	0.01 (<100 ppm) 0.1 (<1000 ppm) 1.0 (<10 ppt) 0.01 (<100 ppt) 0.1 (<200 ppt)	0.1° C/F
Accuracy	±.01 pH**	±1 mV ± 2.5% of reading ppm***	±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	
Cond/TDS Ratios Preprogrammed			KCl, NaCl, 442™			

*NaCl - Sodium Chloride ** ± .2 in the presence of RF fields ≥ 3 V/m and > 300 MHz
***Given water is sanitized by chlorine only within 5<pH<9

The LSI Calculator hardness range is limited to 0.0 - 1710 ppm and 0.0 - 100 grains of hardness.

D. Warranty/Service

The Myron L PoolPro™, excluding the pH/ORP sensor, has a Two (2) year limited warranty. The pH/ORP sensor has a six (6) month limited warranty for materials and workmanship. If an instrument fails to operate properly, see Troubleshooting Chart, pg. 30. The battery and pH/ORP sensor are user-replaceable. For other service, return the instrument prepaid to the Myron L Company.

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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 PoolPro only. The Myron L Company assumes no other responsibility or liability.

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III. 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. Temperature and/or measurement extremes will require additional rinses for maximum accuracy.
- Press the desired measurement key to start measurement. Pressing the key again does no harm and restarts the 15 second auto “off” timer.
- Note the value displayed or press the MS key to store the reading (ref. Memory Storage, pg.19). It’s that simple!

B. Characteristics of the Keys

- Though your PoolPro 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). User adjustable up to 75 seconds.
- Rarely is it necessary to press and *hold* a key (as in Procedure to Select a Solution, pg.11; or Cond. or TDS Calibration, pg.12).

C. Operation of the Keys (See Instrument Illustration on pg. i)

1. Measurement Keys in General

Any of the 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 cancel a change (ref. Leaving Calibration, pg. 13).

2. COND, MIN/SALT 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), refer to Why Solution Selection is Available, pg. 11 and Procedure to Select a Solution, pg. 11.

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.

b. MIN/SALT key

A press of (MIN / SALT) displays Total Dissolved Solids with units (PPM & PPT).

on the right. On the left is shown solution type selected (NaCl) for mineral/salt (ref. Solution Selection, pg. 11). An overrange condition will show only [- - - -].

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, pg. 38). The protective cap is removed and the sensor well is filled and rinsed with the sample enough times to completely replace the pH Sensor Storage Solution.

After use, the pH/ORP sensor well must be refilled with Myron L pH Sensor Storage Solution, and the protective cap reinstalled securely (ref. Maintenance of the pH/ORP Sensor, pg. 9 and Cleaning Sensors, 2. pH/ORP, pg. 28).

a. pH Key

A press of (pH) displays pH readings. No units are displayed on the right.

b. ORP Key

A press of (ORP) displays Oxidation-Reduction Potential/REDOX

reading in millivolts, “mV” is displayed.

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. 13).

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. 19).

5. UP or DOWN Keys

While measuring in any parameter, the MR ▼ or ▲ MS 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 scroll the display up and down through the stack of records (ref. Memory Recall, pg. 19).

IV. AFTER USING the PoolPro

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. 28)

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 Myron L pH Sensor Storage Solution. If unavailable, you can use an almost saturated KCl solution, pH 4 buffer or at least a strong table salt solution. NEVER USE DISTILLED WATER. (ref. pH and ORP Practices, pg. 18).

V. SPECIFIC RECOMMENDED MEASURING PROCEDURES

If the proper solution is not selected (KCl, NaCl, 442), 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 that 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 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 both sensor wells with sample.

4. Press (pH).

5. Note value displayed.

6. **IMPORTANT:** After use, fill pH/ORP sensor well with Myron L pH Sensor Storage Solution and replace protective cap. If Myron L pH Sensor Storage Solution is unavailable, you can use a strong KCl solution, a pH 4 buffer, or a saturated solution of table salt and tap water (ref. Cleaning Sensors, 2. pH/ORP, pg. 28). *Do not allow pH/ORP sensor to dry out.*

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 both sensor wells with sample.

4. Press (ORP).

5. Take reading.

NOTE: When ppm free chlorine units are selected (ref. free chlorine unit selection, pg. 43), annunciators alert you when the concentration is outside the specified measurement range. "**Or**" (over range) will display when the concentration is over the range limit (> 9.9 ppm). "**Ur**" (under range) will display when the concentration is below the range limit (< 0.2 ppm).

6. **IMPORTANT:** After use, fill pH/ORP sensor well with Myron L pH Sensor Storage Solution and replace protective cap. If Myron L pH Sensor Storage Solution is unavailable, you can use a strong KCl solution, a pH 4 buffer, or a saturated solution of table salt and tap water (ref. Cleaning Sensors, 2. pH/ORP, pg. 28). *Do not allow pH/ORP sensor to dry out.*

NOTE: FOR INFORMATION REGARDING THE ORP mV TO ppm CONVERSION FEATURE, PLEASE SEE SECTION XXVI. ADDENDUM, PG. 43.

VI. SOLUTION SELECTION

A. Why Solution Selection is Available

Conductivity, MIN/SALT, and TDS require temperature correction to 25°C values (ref. Standardized to 25°C, pg. 33). Selection determines the temperature correction of conductivity and calculation of TDS from compensated conductivity (ref. Cond. Conversion to TDS, pg. 36).

B. The 3 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 Mineral/Salt, 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. 36).

C. Calibration of Each Solution Type

There is a separate calibration for each of the 3 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. 13) is performed separately for each type of solution one wishes to measure (ref. Conductivity/TDS Standard Solutions, pg. 32).

D. Procedure to Select a Solution

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

1. Press (COND), (MIN/SALT) or (TDS) to select the parameter on which you wish to change the solution type.

2. Press and hold key (CAL/MCLR) for 3 seconds to make "**SEL**" appear (see Figure 1).

Figure 1

(For demonstration purposes, all 3 solution types are shown simultaneously.)

3. Use the (▲ MS) or (MR ▼) key to select type of solution desired (ref. Solution Characteristics, pg. 36). The selected solution type will be displayed: KCl, NaCl, or 442.

4. Press (CAL/MCLR) to accept new solution type.

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

VII. 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. 17).

B. Rules for Calibration of the PoolPro

1. Calibration Steps

a. Starting Calibration

Calibration is begun by pressing CAL/MCLR while measuring Conductivity, MIN/SALT, 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 3 solution types may be performed in 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
Cond	Gain only
MIN/SALT	Gain only
TDS	Gain only
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

Calibration is complete when the “**CAL**” icon goes out. Pressing any measurement key cancels 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 an aging pH/ORP sensor (ref. Troubleshooting Chart, pg. 30).

C. Calibration Procedures

1. Conductivity, MIN/SALT or TDS Calibration

a. Rinse conductivity cell three times with proper standard (KCl, NaCl, or 442) (ref. Cond/TDS Standard Solutions, pg. 32).

b. Refill conductivity cell with same standard. NACL-7500 shown.

c. Press COND, MIN/SALT or TDS, then press CAL/MCLR, “**CAL**” icon will appear on the display (see Figure 5).

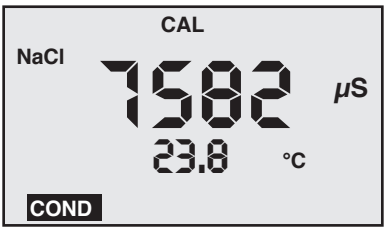


Figure 5

d. Press or to ▲/MS or MR/▼ to step the displayed value toward the

standard's value (7582 >7501) 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. Reloading Factory Calibration (Cond, MIN/SALT or TDS)

If calibration is suspect or known to be incorrect, 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 PoolPros, 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 MIN/SALT or TDS.

b. Press CAL/MCLR

c. Press ▲/MS key until "**FAC**" appears and release.

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

3. pH Calibration

Important: Always "zero" your PoolPro with a pH 7 buffer solution before adjusting the gain with acid or base buffers, i.e., 4 and/or 10.

a. pH Zero Calibration

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

2. Refill both sensor wells with 7 buffer solution.

3. Press pH to verify pH calibration. If the display shows 7.00, skip the pH Zero Calibration and proceed to section b. pH Gain Calibration.

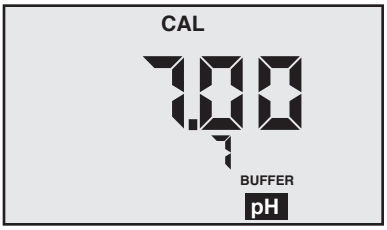


Figure 6

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 PoolPro 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 7.00.

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. 30) 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 may press CAL/MCLR to accept the preset factory value, or you may 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. pH Gain Calibration

Important: Always calibrate or verify your PoolPro 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 displayed (see Figures 7 and 8).

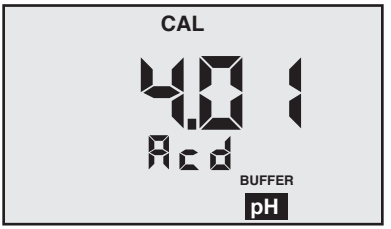


Figure 7

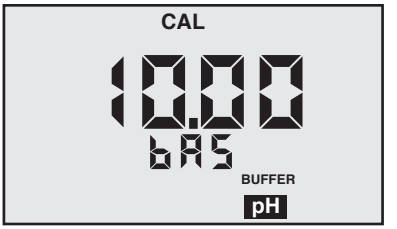


Figure 8

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 indicates 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 

to accept 3rd point of calibration, which completes the Calibration procedure. Fill sensor well with Myron L Storage Solution and replace protective cap.

4. 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 PoolPro has an electronic ORP calibration. This causes the zero point on the reference electrode to be set whenever pH 7 calibration is done.

5. Temperature Calibration

Temperature calibration is not necessary in the PoolPro.

VIII. CALIBRATION INTERVALS

There is no simple answer as to how often one should calibrate an instrument. The PoolPro 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 must be checked against chemical standards occasionally.

A. Suggested Intervals

On the average, we expect calibration need only be checked monthly for the Conductivity, MIN/SALT 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 PoolPro 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's lifetime, and it should be replaced.

C. Conductivity, MIN/SALT, 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. 34), 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 taking 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 that 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 caustic, and ±5% is considered very accurate. By using the pH zero setting (0 mV = 7 pH) for ORP and precision electronics for detection, the PoolPro delivers better accuracy without calibration than a simpler instrument could using calibration solutions.

IX. MEMORY

This feature allows up to 100 readings with their temperatures to be stored simultaneously for later recall. At the same time, the TIME and DATE are also recorded. To download the memory to a computer, (ref. bluDock™ Wireless Data Transfer Instructions, pg. 25).

A. Memory Storage

1. While displaying a measurement, press ▲/MS to record the displayed value.

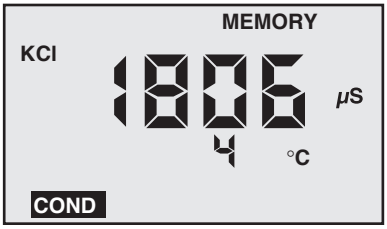


Figure 9

2. "**MEMORY**" will appear and the temperature display will be momentarily replaced by a number (1-100) showing the position of the record. Figure 9 shows a reading of 1806 µS stored in memory record #4.

B. Memory Recall

1. Press any measurement key.
2. Press MR/▼, "**MEMORY**" will appear, and the display will show the last record stored.
3. Press ▲/MS or MR/▼ to scroll to the record location desired (the temperature display alternates between temperature recorded and location number).
4. Press CAL/MCLR to display time and date stamp.
5. 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 and HOLD CAL/MCLR to clear that memory. This space will be the place for the next memory record, unless you scroll to another empty 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 and wish 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 and HOLD 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. "**CLr ALL**" will be displayed (see Figure 10).

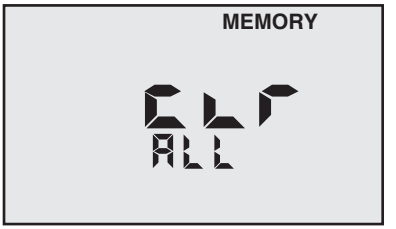


Figure 10

7. Press CAL/MCLR. All records will be cleared.

X. TIME and DATE

The Time and Date may easily be changed as you travel.

A. Setting TIME

Time is always displayed in 24 hour time.
Example shown in Figure 11, 16:05 equals 4:05 PM.

1. Press COND.

2. Press MR until the time is displayed (stored readings, PC OFF, CLr ALL, time i.e. "**16:05**").

3. Press CAL/MCLR to initiate. **CAL** will be displayed along with the time, (see Figure 11).

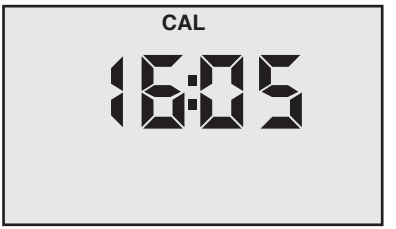


Figure 11

4. Press MS or MR to change the time.

5. Press CAL/MCLR to accept the change (new time).

B. Setting DATE

Example shown in Figure 12, is in US format i.e. mo/dy/yr. NOTE: The default format is US. Date format may be changed (ref. Date Format “US and International (Int)”, pg. 22).

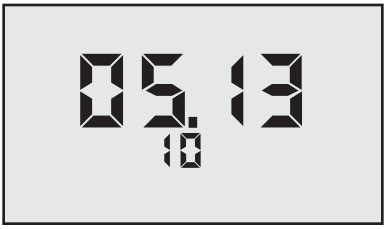


Figure 12

1. Press COND.

2. Press MR repeatedly until the date is displayed (stored readings, PC OFF, CLr ALL, time, date, i.e. **05/13/10** (May 13, 2010)).

3. Press CAL/MCLR to initiate. **CAL** will be displayed along with the YEAR, (see Figure 13).

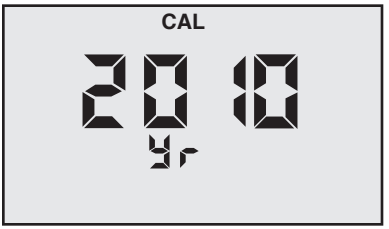


Figure 13

4. Press MS or MR to change the YEAR.

5. Press CAL/MCLR to accept the change (new year).

6. Press MS or MR to change the month.

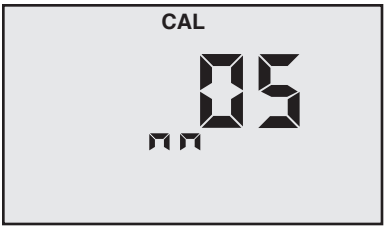


Figure 14

7. Press CAL/MCLR to accept the change (new month), (see Figure 14).

8. Press MS or MR to change the day.

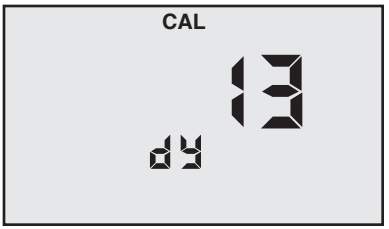


Figure 15

9. Press CAL/MCLR to accept the change (new day) (see Figure 15).

C. DATE FORMAT “US & International (Int)”

1. Press COND .

2. Press MR repeatedly until the format is displayed (stored readings, PC OFF, CLr ALL, time, date, date **format**).

3. Press CAL/MCLR to change. Display will now indicate other format (see Figures 16 & 17).

4. Press any measurement key or allow to automatically turn off. (see Figures 16 &17)

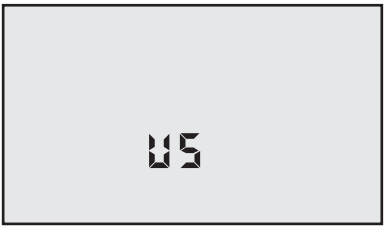


Figure 16

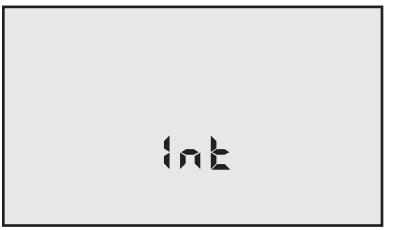


Figure 17

XI. TEMPERATURE FORMAT “Centigrade & Fahrenheit”

1. Press COND .

2. Press MR to display the stored memory records.

3. Press MR repeatedly until you pass the “**US**” or “**Int**” date format location. The display will show a “**C**” or “**F**” (see Figures 18 and 19).

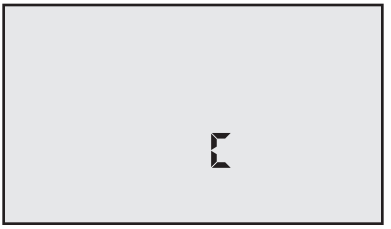


Figure 18

Figure 19

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

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

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

XII. 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.
NOTE: All stored data will be lost.

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 20).

Figure 20

4. Press CAL/MCLR to accept the resetting. Display will return to Conductivity mode.

XIII. CELL CHECK

The cell check verifies the cleanliness of the conductivity/TDS/MIN/SALT sensor. In normal use the cell may become dirty or coated and require cleaning. If the display is showing "**.00**" when the cell cup is dry, the sensor is probably clean. No matter what a manufacturer claims, a sensor can and will become contaminated or coated; therefore require cleaning. A true 4-wire sensor, as in the PoolPro, helps to mitigate contamination, however, NO SENSOR IS 100% IMMUNE.

1. Press (COND).

2. Press (MR ▼) to display the stored memory records.

3. Press (MR ▼) repeatedly until you pass the **FAC SEL** location. The display will show a "**CELL ch**" (see Figure 21).

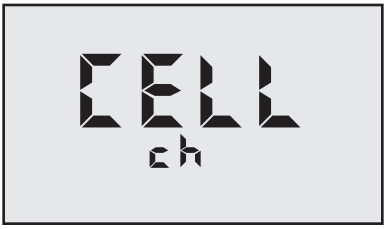


Figure 21

4. Press (CAL/MCLR) to test.

If cell is clean, **Good** will momentarily be displayed (see Figure 22). If cell is dirty, "**CELL cLn"** will be displayed (see Figure 23), (ref. Cleaning Sensors, pg. 28).

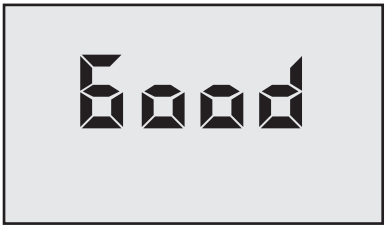


Figure 22

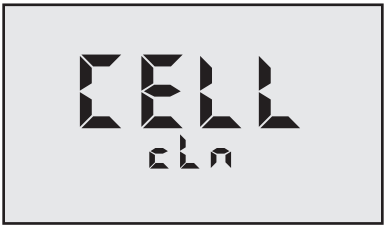


Figure 23

XIV. AUTO OFF

Auto off allows the user to adjust the time the instrument is ON (up to 75 seconds) after each press of a key. Default time is 15 seconds with 60 seconds in CAL (calibration) mode.

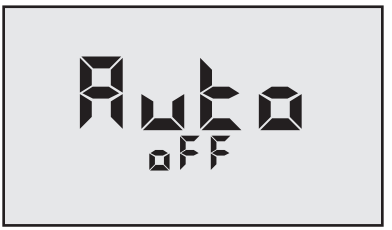


Figure 24

1. Press (COND).

2. Press (MR ▼) to display the stored memory records.

3. Press (MR ▼) repeatedly until you pass the CELL ch location.

The display will show "**Auto oFF**" (see Figure 24).

4. Press CAL/MCLR to initiate. **CAL** will be displayed along with the "**15 SEC**" (see Figure 25).

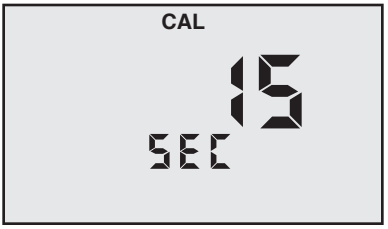


Figure 25

5. Press ▲/MS or MR/▼ to change the time (see Figure 26). Maximum time is shown.

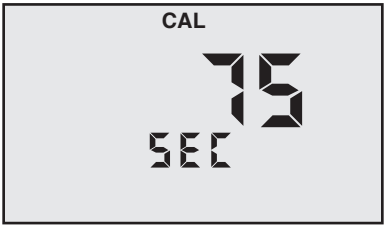


Figure 26

6. Press CAL/MCLR to accept the change (new time).

XVI. bluDock™ WIRELESS DATA TRANSFER INSTRUCTIONS

NOTE: *Bluetooth®* is a registered trademark of Bluetooth SIG. The bluDock *Bluetooth* module is a registered *Bluetooth* device.

Requires Myron L bluDock™ accessory package, Model # BLUDOCK. Package includes PoolPro hardware modification that allows the unit to communicate wirelessly with a personal computer configured for wireless device communication. Package also includes U2CI software application that will operate on Windows XP, Vista and 7*, and Macintosh OSX** based computer systems and *Bluetooth* USB adapter (dongle) for computers that do not have *Bluetooth* capability.

A. Software Installation

1. Place Myron L PoolPro U2CI Installation CD v2.0.0 & later into your computer or download U2CI application from the Myron L website: http://myronl.com/main/U2CI_Application_DL.htm
2. Upon opening, select the folder for your operating system.
3. Install U2CI application. See detailed installation instructions on CD or Myron L website: http://myronl.com/main/U2CI_Application_DL.htm
4. Additional drivers may be required. See our website for the latest information.

B. Hardware Setup

For a computer without *Bluetooth* capability:
If you don't have the dongle that came with the BLUDOCK, one can be ordered separately from the Myron L Company. Order Model # BDDO.

Plug in your dongle and install per manufacturer's instructions.

For computers with *Bluetooth* capability/ *Bluetooth* dongle installed:

First time use of the bluDock:

1. Press any parameter button to turn the PoolPro on.
2. Put the PoolPro in "**PC On**" mode by pressing the MR key until "**PC OFF**" appears (see Figure 30).
3. Then press the CAL/MCLR key. "**PC On**" will be displayed (see Figure 31).

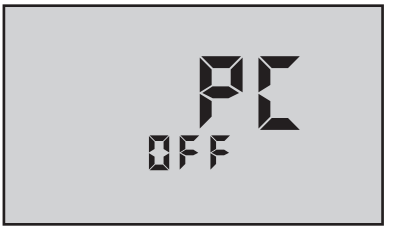


Figure 30

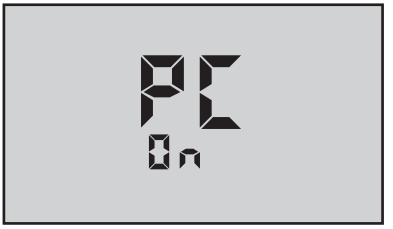


Figure 31

NOTE: "**PC Ini**" may momentarily be displayed while initializing (see Figure 32).

4. Add bluDock to your *Bluetooth* devices per your operating system procedure. **THE BLUDOCK DEVICE PASSKEY IS 1234.**
5. After pairing, note the number of the COM port assigned by the computer. In Windows XP, note the number of the outgoing COM port assigned by the computer.

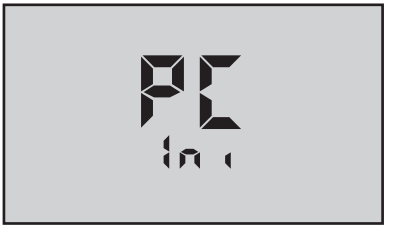


Figure 32

NOTE: The unit will automatically power down after 60 sec. If the unit powers down during pairing, repeat steps 1-3 above and continue.

C. Memory Stack Download

1. With the PoolPro in "**PC On**" mode, open the U2CI software application.
2. Verify that the port selected matches the COM port number noted (first time only). This is the outgoing COM port on Windows XP.
3. In the U2CI application, click on the data download button. A data transfer bar will appear while the data is being downloaded.

Once downloaded, the data may be manipulated, printed or stored within the Myron L U2CI application, or the data may be exported to another more powerful spreadsheet† such as Excel*.

† Please Note: Although the Myron L Company has performed extensive

testing, we cannot guarantee compatibility of all applications and formats. We suggest testing your application and format for compatibility before relying on it.

Additional features, such as assigning a name to the instrument, setting time and date and erasing data are available. See U2CI software installation CD or visit our website for the latest instructions: http://myronl.com/main/U2CI_Application_DL.htm

4. Upon completion, click on the “disconnect” icon.
5. Turn off PoolPro PC download mode by selecting any measurement function. Failure to do so will reduce battery life.

* Windows 2000, 2007, XP & Vista are registered trademarks of Microsoft Corporation.

** Macintosh OS9.2 & OSX are registered trademarks of Apple Computer Inc.

XVI. CARE and MAINTENANCE

PoolPros 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 71°C/160°F should not be placed in the cell cup area; this may cause damage. The pH sensor may fracture if the PoolPro temperature is allowed to go below 0°C/32°F. Care should be exercised not to exceed rated operating temperature.

Leaving the PoolPro in a vehicle or storage shed on a hot day can easily subject the instrument to over 66°C/150°F. This will void the warranty.

B. Battery Replacement

Dry Instrument THOROUGHLY. Remove the four (4) bottom screws. Open instrument carefully. 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. However, loss of time and date may occur if battery is removed for longer than 3 minutes (180 seconds).*

C. pH/ORP Sensor Replacement

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

D. Cleaning Sensors

1. Conductivity/TDS/MIN/SALT

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 isopropyl alcohol or a foaming non-abrasive household cleaner. Rinse out the cleaner and your PoolPro is ready for accurate measurements.

2. pH/ORP

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

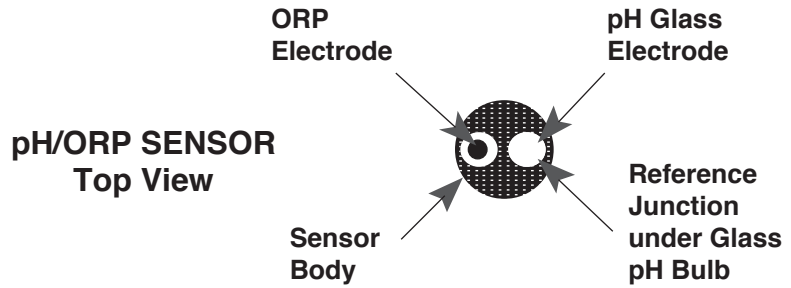
Then use one of the following methods:

1. Pour a HOT salt solution ~60°C/140°F, preferably potassium chloride (KCl) solution (Myron L pH/ORP Sensor Storage 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, the sensor must be replaced.



“Drifting” can be caused by a film on the pH sensor bulb and/or reference. Use isopropyl alcohol (IPA) or 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 is harmful and will cause damage. Rinse such liquids from the pH/ORP sensor well and refill it with Myron L Storage Solution to extend the useful life of the sensor. If unavailable, you can use a saturated KCl solution, pH 4 buffer, or a saturated solution of table salt and tap water, but this should be replaced with storage solution as soon as possible.

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 that reduces (adds 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.

XVII. TROUBLESHOOTING CHART

Symptom	Possible Cause
No **display**, even though measurement key pressed	Battery weak or not connected.
Inaccurate **pH** readings	1. pH calibration needed (ref. pH Cal., pg. 14). 2. Cross-contamination from residual pH buffers or samples in sensor well. 3. Calibration with expired pH buffers.
No response to **pH** changes	Sensor bulb is cracked or there is an electromechanical short caused by an internal crack.
Will not adjust down to **pH** 7	pH/ORP sensor has lost KCl.
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 is clogged or coated.
Unstable **Conductivity/TDS** readings	1. Dirty electrodes.
Unable to calibrate **Conductivity/TDS**	Film or deposits on electrodes.

Corrective Action
Check connections or replace battery (ref. Battery Replacement, pg. 27).
1. Recalibrate instrument. 2. Thoroughly rinse sensor well. 3. Recalibrate using fresh buffers (ref. pH Buffer Solutions, pg. 32).
Replace pH/ORP sensor (ref. Replacement pH/ORP Sensor, pg. 33).
Clean and rejuvenate sensor (ref. Cleaning Sensors, pg. 28) and recalibrate. If no improvement, replace pH/ORP sensor (ref. Replacement pH/ORP Sensor, pg. 33).
Clean and rejuvenate sensor (ref. Cleaning Sensors, pg. 28) and recalibrate. If no improvement, replace pH/ORP sensor (ref. Replacement pH/ORP Sensor, pg. 33).
Clean cell cup and electrodes (ref. Cleaning Sensors, pg. 28).
Clean cell cup and electrodes (ref. Cleaning Sensors, pg. 28).

XVII. ACCESSORIES

A. Conductivity/TDS Standard Solutions

Your PoolPro 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, the ppm/TDS equivalents based on our 442 Natural Water™ and NaCl standards. All standards are within ±1.0% of reference solutions. Available in 2 oz., quarts/liters, and gallon/~3.8 liter bottles.

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 four decades ago. It is used around the world for measuring both conductivity and TDS in drinking water, ground water, lakes, streams, etc. 3000 ppm is the recommended standard.
Order 442-3000

3. Sodium Chloride (NaCl)

This is especially useful in salt water pools and spas, as sodium chloride is the major salt component. Most Myron L standard solution labels show the ppm NaCl equivalent to the conductivity and to ppm 442 values. The 7500 ppm is the recommended standard. Order NACL-7500.

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.
Available in 2 oz., quarts/liters, and gallon/~3.8 liter bottles.

C. pH Sensor Storage Solution

Myron L pH Sensor Storage Solution prolongs the life of the pH sensor. Available in 2 oz., quarts/liters, and gallon/~3.8 liter bottles.

D. Soft Protective Carry Cases

Padded Nylon® carrying case features a belt clip for hands-free mobility.

Two colors to choose from;
Blue - Model #: UCC
Desert Tan - Model #: UCCDT

® Registered trade mark of DuPont

E. Hard Protective Carry Cases

Large case with 2 oz. bottles of calibration standard solutions (KCl-7000, NaCl-7500, 442-3000, 4, 7, & 10 pH buffers and pH storage solution). Model #: PKPS

Small case (no calibration standard solutions) - Model #: UPP

F. Replacement pH/ORP Sensor

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

G. bluDock™ Wireless Data Transfer Accessory Package

This accessory allows the operator to download the PoolPro memory stack to a spreadsheet on a computer. The package includes bluDock modified circuit board in the unit, software CD, installation and operating instructions, and dongle.
Model #: BLUDOCK

XIX. 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 PoolPro 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 that of KCl solutions for correction to 25°C. The correction to an equivalent KCl solution is a standard set by chemists that standardizes the measurements and allows calibration with precise KCl solutions. In the PoolPro, 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 PoolPro uses corrections that change with concentration and temperature instead of single average values. See Chart 1.

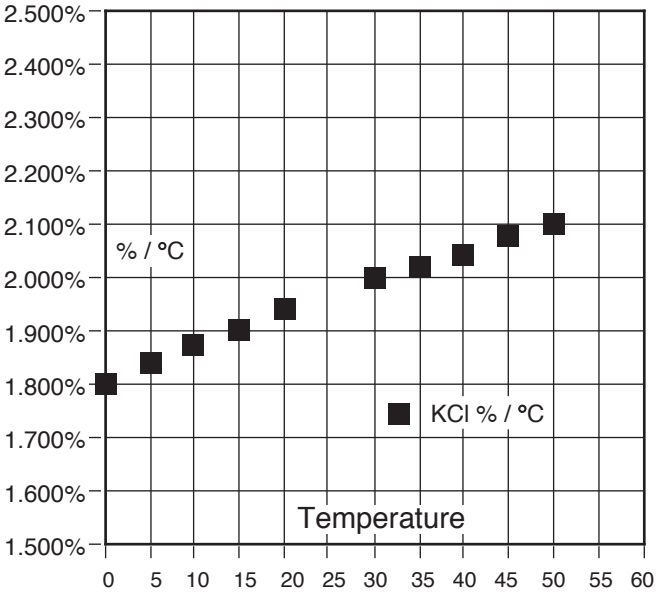


Chart 1

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/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 illustrated in the graph below.

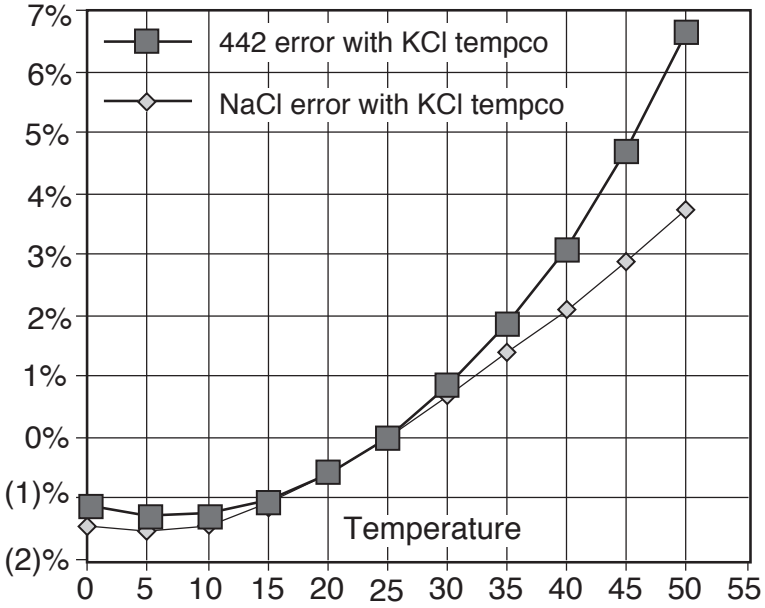


Chart 2

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. Users 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 PoolPro will provide the repeatability and convertibility of data necessary for relative values for process control.

E. Other Solutions

A salt solution like sea water 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, however, are still referenced to one of these for the purpose of commonality.

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 PoolPro gives the user the capacity to take data in the "KCl conductivity

units" to compare to older published data, in terms of NaCl or 442, or may be appropriate. The PoolPro can be used to reconcile data taken with other compensation assumptions.

XX. 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. 37).

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 with 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 address this problem, industrial users commonly use the characteristics of a standard material as a model for their solution, such as KCl, which is 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 PoolPro contains algorithms for these 3 most commonly referenced compounds. In the LCD display, the solution type being used is displayed on the left.

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 RO. 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.

XXI. TEMPERATURE COMPENSATION (Tempco) and TDS DERIVATION

The PoolPro contains internal algorithms for characteristics of the 3 most commonly referenced compounds. In the display, the solution type being used is shown to the left.

When taking 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 10ºC. the solution is said to have a tempco of 2.2 %/ºC.

Tempco always varies among solutions because it is dependent on their individual ionization activity, temperature and concentration. This is why the PoolPro features mathematically generated models for known salt characteristics that also vary with concentration and temperature.

XXII. pH and ORP

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 increases acidity, while an increase in (OH^-) ions increases 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 that 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 dilemma 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 wire coated with silver chloride. This is the most inert connection possible from a metal to an electrolyte. It can still produce an offset voltage, but using the same materials to connect to the solution on the other side of the membrane causes the 2 equal offsets to cancel.

The problem is, on the other side of the membrane is an unknown 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 30 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 may be damaged if dried out because insoluble crystals may form in a layer, obstructing contact with test solutions. See pH/ORP, pg. 38.

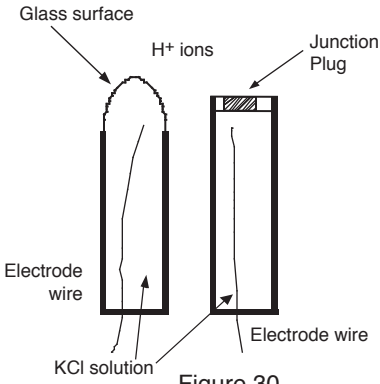


Figure 30

4. The Myron L Integral pH Sensor

The sensor in the PoolPro (see Figure 31) 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 permeable interface, and is located under the glass pH sensing electrode. This construction combines all the best features of any pH sensor known.

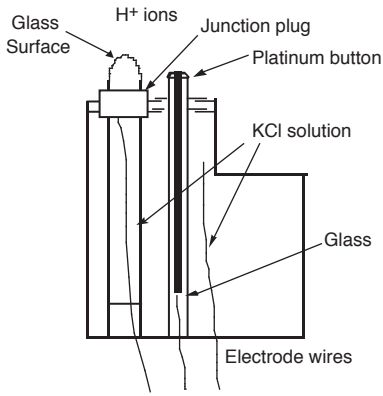


Figure 31

5. Sources of Error

The basics are presented in pH/ORP, pg. 38.

a. Reference Junction

The most common sensor problem will be a clogged junction because a sensor was allowed to dry out. The symptom is a drift in the "zero" setting at 7 pH. This is why the PoolPro 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. This problem also causes 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 PoolPro senses the sensor well 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). For instance, chlorinated water will show a positive ORP value.

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 indicates 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 31, pg. 39, 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 PoolPro 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. 38, 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.

XXIV. SOFTWARE VERSION

Contact the Myron L Company to see if a software upgrade is available.

1. Press COND key.

2. Press MR ▼ key until three numbers are displayed as shown in Figure 32.

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

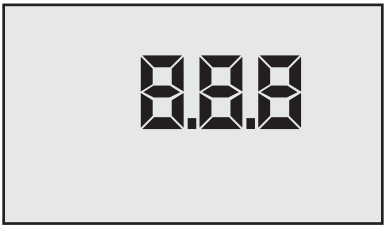


Figure 32

XXIV. GLOSSARY

Anions Negatively charged ions.
See Solution Characteristics, pg. 36.

Algorithm A procedure for solving a mathematical problem.
See Temperature Compensation and TDS Derivation, pg. 37.

Logarithm An arithmetic function. See pH Units, pg. 38.

Mineral A term used in the pool & spa industry for SALT (Sodium Chloride - NaCl). Expressed in parts per million (ppm).

ORP Oxidation-Reduction Potential or REDOX, See ORP/ Oxidation-Reduction Potential/REDOX, pg. 40.

TDS Total Dissolved Solids or the Total Conductive Ions in a solution. See Conductivity Conversion to TDS, pg. 36.

Tempco Temperature Compensation
See Temperature Compensation, pg. 33.

For details on specific areas of interest refer to the Table of Contents.

XXV. ADDENDUM: New ORP ppm Free Chlorine Feature For Software V.4.2.1 and later (see pg. 41). Earlier versions may be upgraded. Contact the Myron L Company for more information: www.myronl.com

A convenient new feature has been added to the POOLPRO™ that allows the user to choose between ORP millivolts (mV) and parts per million (ppm) free chlorine readings. mV and ppm free chlorine are the two most commonly used sanitizer measurement units in the pool and spa industries. The POOLPRO mV to ppm free chlorine conversion algorithm is based on a published conversion curve that assumes a pH of 5-9 in water sanitized by chlorine only and bench testing performed at the Myron L Company. We have increased the accuracy of low-range ppm free chlorine readings by extrapolating from the published data. With this new feature the POOLPRO can measure a dynamic range of sanitizer concentrations that is wider than the range of a colorimetric test kit.

Additional ORP Specifications	
Spec	**Value**
Ranges	**± 999 mV** **0.2 – 9.9 ppm**
Resolution	**mV resolution: 1 mV** **ppm resolution: 0.1 ppm**
Accuracy	**± 1 mV** **± 2.5% of reading ppm***

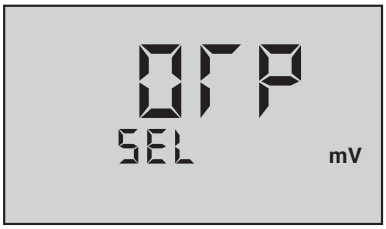
Given water is sanitized by only chlorine at a pH of 5-9

NOTE: FOR COMPLETE INSTRUCTIONS ON MEASURING ORP, REFER TO MEASURING ORP, PG. 10, IN THE OPERATION MANUAL.

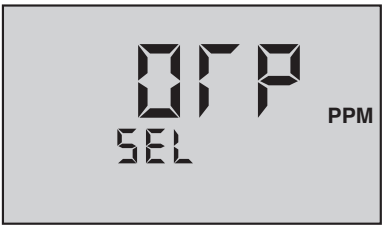
To change the ORP measurement format preference:

1. Press (ORP).
2. Press and hold (CAL / MCLR) for approximately three seconds.

   The current preference for ORP units of measure is displayed. Factory setting for this preference is mV. (Shown below.)



4. Press the ▲ MS or MR ▼ keys to toggle between mV and ppm free chlorine measurement format. The setting chosen is displayed (ppm shown as example below).



5. Press any parameter key to exit ORP unit preference selection or let the unit time out. ORP unit preference will be saved.

XXVI. ADDENDUM: NEW LSI & HARDNESS CALCULATOR

The new LSI calculator makes it easy to analyze the scaling nature of water in the lab or in the field. Using a calcium carbonate saturation index algorithm developed by Dr. Wilfred Langelier in 1936, the calculator computes the saturation index of a sample based on measured and inferred values for pH, temperature, hardness and alkalinity. You can then change any of these values in “User” adjust mode to analyze the effect of the change on water balance. “User” mode also allows you to input measured values for alkalinity and hardness as determined by other independent testing for a precise saturation index value.

The PS6SI LSI calculator computes a saturation index value using the following formula:

SI = PH + TF + CF + AF – 12.1

Where:
PH is the measured value of pH in pH units as determined by the PS6SI
TF = 0.0117 x Temp – 0.4116
CF = 0.4341 x ln(Hrd) – 0.3926
AF = 0.4341 x ln(AL) – 0.0074

The following is a general industry guideline for interpreting LSI values:

- An index between -0.5 and +0.5 indicates balanced water
- An index of more than +0.5 indicates scale-forming water
- An index below -0.5 indicates corrosive water

How to Use the PS6SI LSI Calculator

In LSI Calculator mode, accept all PS6SI variable values to obtain the PS6SI saturation index value. Once the PS6SI saturation index value is displayed, you can enter “User” mode to change values for pH, temperature, hardness (ppm or grains), and alkalinity (ppm $CaCO_3$), then recalculate the saturation index based on those changes. The most accurate way to generate a saturation index value is to accept PS6SI measured values for pH and temperature and input values in “User” mode for hardness and alkalinity based on titration testing.

NOTE: You can exit the LSI calculator at any time by pressing any of the parameter keys or by letting the unit time out.

A. **LSI Calculator Mode**

1. Press any parameter key to turn the instrument on.

2. To access the LSI calculator, press (MR ▼) repeatedly or hold down (fast scroll) until "**CALC LSI**" is displayed (see Figure 38).

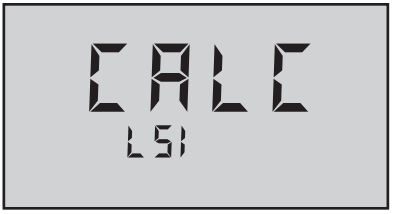


Figure 38

3. Press (CAL/MCLR). "**FILL LSI**" will display (see Figure 39).

Figure 39

4. Rinse both the pH/ORP sensor well and the conductivity cell cup three times with sample solution.

5. Fill both the sensor well and cell cup with sample solution and press (CAL/MCLR).

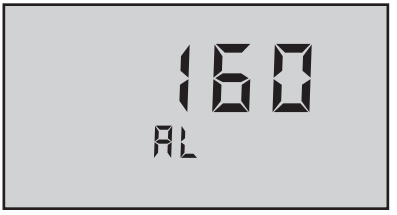


Figure 40

6. The PS6SI inferred value for alkalinity and "**AL**" will display (see example in Figure 40). Press (CAL/MCLR).

7. The PS6SI inferred value for hardness and "**Hrd**" will display (see example in Figure 41). Press (CAL/MCLR).

Figure 41

8. The pH value measured by the PS6SI and "**PH**" will display (see example in Figure 42). Press (CAL/MCLR).

Figure 42

9. The temperature value measured by the PS6SI and "**°C**" or "**°F**" will display (see example in Figure 43).

   Press CAL/MCLR.

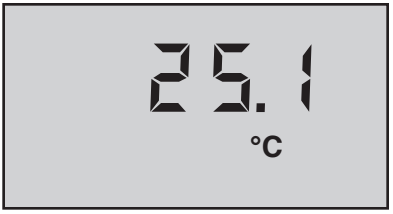


Figure 43

10. The PS6SI generated LSI value will display (see example in Figure 44).

    To store this LSI value in memory, press ▲/MS.

    If you do not wish to change any of the variable values, exit the LSI calculator by pressing any parameter key or by letting the unit time out.

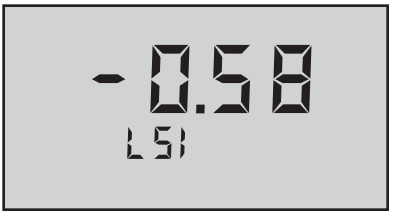


Figure 44

B. <u>LSI Calculator "User" Mode</u>

LSI Calculator "User" mode allows you to change any or all of the variable values then recalculate the saturation index using the adjusted value(s).
NOTE: You can only enter "User" mode AFTER PS6SI LSI value is displayed.

1. Press CAL/MCLR <u>after the PS6SI generated LSI value is displayed</u>.

2. "**LSI AdJ**" will display (see Figure 45).

   Press CAL/MCLR.

   The PS6SI inferred value for alkalinity and "**AL**" will display (see example in Figure 46).

3. Press ▲/MS or MR/▼ to adjust the displayed value to the desired value.

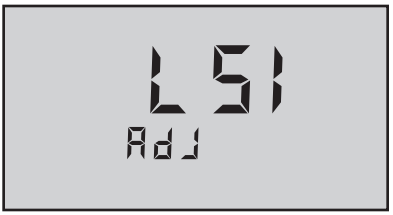


Figure 45

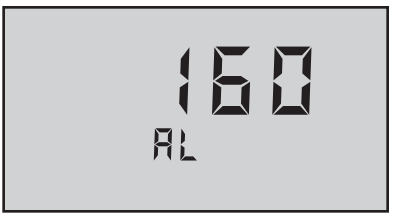


Figure 46

Press CAL/MCLR to accept the value displayed.

The PS6SI inferred value for hardness and "**Hrd**" will display (see example in Figure 47).

Figure 47

4. Press the ▲ MS or MR ▼ keys to adjust the displayed value to the desired value.

Press CAL/MCLR to accept the value displayed.

The pH value measured by the PS6SI and "**PH**" will display (see example in Figure 48).

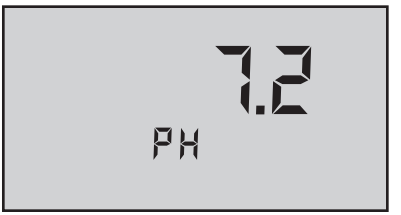


Figure 48

5. Press the ▲ MS or MR ▼ keys to adjust the displayed value to the desired value.

Press CAL/MCLR to accept the value displayed.

The value for temperature measured by the PS6SI and "**°C**" or "**°F**" will display (see example in Figure 49).

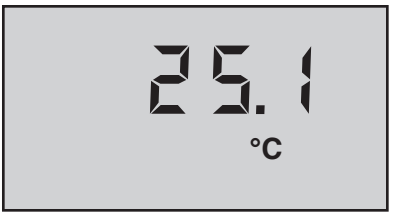


Figure 49

6. Press the ▲ MS or MR ▼ keys to adjust the displayed value to the desired value.

Press CAL/MCLR to accept the value displayed.

"**User**", the user adjusted LSI value and "**LSI**" will display (see example in Figure 50).

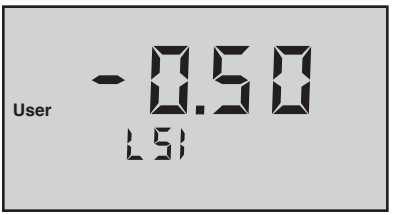


Figure 50

C. Hardness Unit Preference Selection

The LSI Calculator allows you to select either ppm or grains of hardness units for saturation index calculation.

The hardness unit conversion is based on the following equivalency:

17.1 ppm (mg/L) = 1 grain

The hardness range is limited to 0.0 - 1710 ppm and 0.0 - 100 grains of hardness in the PS6SI.

NOTE: The PS6SI MUST be in the hardness screen (**Hrd**) in LSI Calculator mode or LSI Calculator "User" mode for hardness unit preference selection.

Figure 51

By default, hardness unit preference is set to ppm (see Figure 51).

1. While in the **Hrd** screen in CALC LSI or LSI Adj mode, press and hold the CAL/MCLR key. **HArd SEL** will display along with the current unit preference (see Figure 52).

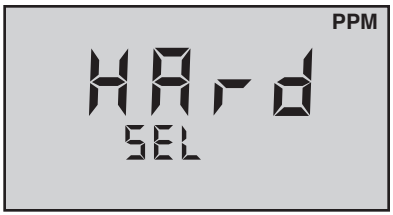


Figure 52

2. Press ▲/MS or MR/▼ to toggle between ppm and grains of hardness. No unit icon is lit when grains is selected (see Figure 53).

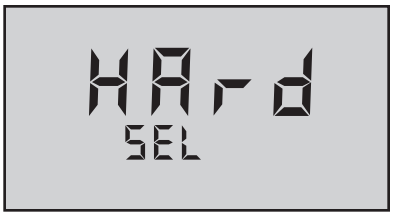


Figure 53

3. Press CAL/MCLR to accept the change. The LSI calculator will resume in the **Hrd** screen. The unit change will be reflected on the display (see Figure 54).

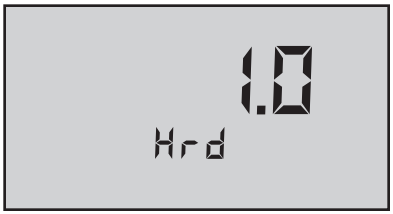


Figure 54

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