POOLPRO™

Operation Manual

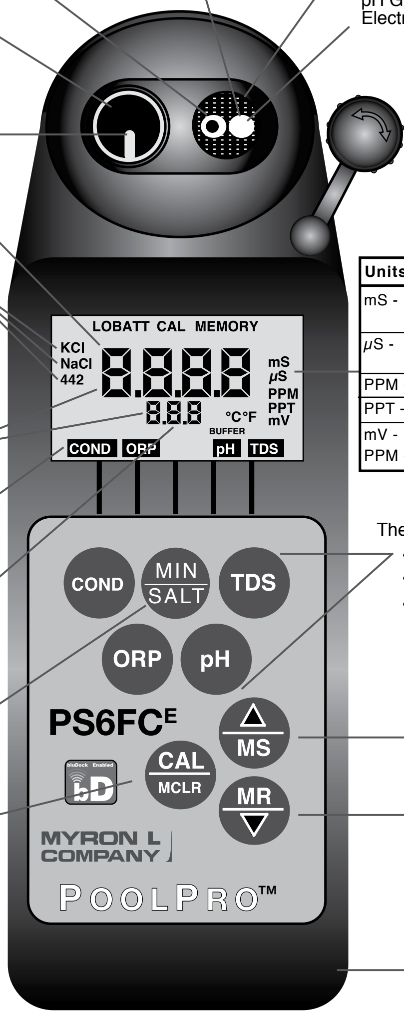
MODEL PS6FC^E

MYRON L COMPANY
Water Quality Instrumentation
Accuracy • Reliability • Simplicity

02 March 2012

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)	Conductivity
PPM - parts per million	MIN/SALT
PPT - parts per thousand	TDS
mV - millivolts	ORP
PPM - parts per million	Free Chlorine

CE

MODEL PS6FC^E

Shown with bluDock™ option installed

For detailed explanations see Table of Contents

24 January 2012

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 now includes Myron L Company's exclusive Free Chlorine Equivalent (FC^E) feature for making ORP-based free chlorine measurements, as well as *Bluetooth®* wireless data transfer with the bluDock™ option. You can also measure conductivity, Mineral/SALT (Sodium Chloride/NaCl), Total Dissolved Solids (TDS), pH, ORP/Redox and Temperature, all with one simple-to-use instrument. 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.

<u>Special note</u>.....Conductivity, Mineral/Salt, and TDS require mathematical correction to 25°C values (ref. Temperature Compensation, pg. 37). 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. 40). 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

- ORP-based FC^E free chlorine measurement, displayed as ppm concentration
- Ranges:
  Conductivity, Min/Salt, TDS — 0-200,000 μS/ppm
  pH – 0-14
  ORP – ±999 mV; 0.00-9.99 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"
- *Bluetooth®* wireless download capability with optional bluDock™

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/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	0.00-9.99 ppm*** 350 mV ≤ ORP < 725 mV and 0.0 ≤ pH < 9.9 725 mV ≤ ORP < 825 mV and 0.0 ≤ pH <8.9	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	0.01 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**	±0.3 ppm <1.00ppm ±0.2 ppm ≥1.00ppm **	±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	0-71 °C 32 - 160 °F	
Adjustable Temperature Compensation				0 - 9.99%/ °C		0 - 9.99%/ °C	
Cond/TDS Ratios Preprogrammed				KCl, NaCl, 442™			
Adjustable Cond/TDS Ratio Factor				0.20 - 7.99			

* NaCl - Sodium Chloride

± .2 pH in presence of RF fields ≥ 3 V/m and > 300 MHz ***If either ORP or pH is outside the specified limits, the instrument will display "-Or**-".

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. 34. 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. 23). 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. 15; or Cond. MIN/SALT or TDS Calibration, pg.17).

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. 17).

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. 14 and Procedure to Select a Solution, pg. 15.

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. 14). 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. 14).

3. pH and ORP/Fr Chl Keys

Measurements are made on solution held in the pH/ORP sensor well (ref. pH and ORP, pg. 42). 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. 32).

a. pH Key

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

b. ORP/Fr Chl 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. 17).

If CAL/MCLR is held down for about 3 seconds, CAL mode is not entered, but

“**SEL**” appears to allow Solution Selection (ref. pg. 14) 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. 23).

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. 23).

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. 32)

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. 22).

V. SPECIFIC RECOMMENDED MEASURING PROCEDURES

If the proper solution is not selected (KCl, NaCl, 442), see Solution Selection, pg. 14.

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 MIN/SALT & 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), (MIN/SALT) or (TDS).
4. Take reading. A display of [- - - -] indicates an overrange condition.

B. <u>Measuring pH</u>

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. 32). *Do not allow pH/ORP sensor to dry out.*

C. <u>Measuring ORP</u>

The PS6 features the ability to measure the activity of oxidizing or reducing chemicals in solution as ORP mV. The instrument also includes an innovative Free Chlorine Equivalent (FC^{E}) feature (Measuring Free Chlorine Using FC^{E}, pg. 12) that uses ORP and pH to measure free available chlorine (FAC) concentration in ppm. ORP mV and ppm of free available chlorine (FAC) are the two most commonly used sanitizer units of measure in water quality management.

1. <u>ORP / FC^{E} Mode Selection</u>

The PS6 allows the user to choose between measuring oxidizing sanitizers using either ORP mV or as parts per million (ppm) of equivalent free chlorine. Use ORP to directly measure the oxidizing power of all sanitizers like ozone, bromine, peracetic acid or chlorine. Use FC^{E} to measure the strength of oxidizing sanitizers as ppm of equivalent free chlorine. To select between ORP and Free Chlorine modes:

1. Press (ORP / Fr Chl).

2. Press and hold (CAL / MCLR) for approximately 3 seconds.

The current preference for ORP units of measure is displayed.

Factory setting for this preference is ORP mV. (See Figure 1, next page.)

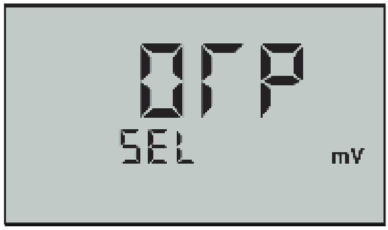

Figure 1

3. Press the  or  keys to toggle between mV (standard ORP mode) and FC^E ppm. The setting chosen is displayed. (See Figure 2.)

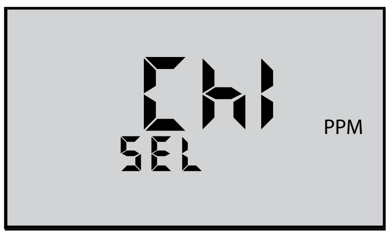

Figure 2

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

2. <u>Measuring ORP</u>

1. Ensure the PS6FC^E is in ORP mode (ref. ORP/FC^E Mode Selection, pg. 10).

2. Remove protective cap by rotating while grasping and pulling up.

3. Rinse sensor well and cell cup 3 times with sample to be measured. Shake out each sample to remove any residual liquid.

4. Refill both sensor well and cell cup with sample.

5. Press .

6. Take reading.

7. Press **MS** to store reading in memory, if desired.

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. 32). Do not allow pH/ORP sensor to dry out.

D. Measuring Free Chlorine Using FC^{E}

The FC^{E} function can be used to measure discrete samples, flowing solution and bodies of water. Measurement technique is particular to the type of sample. For accurate results, use the FC^{E} Flow Method described in section 2 below to measure discrete or flowing samples. Use the FC^{E} Immersion Method described in section 3 below in situations where the PS6FC^{E} can be dipped to obtain a sample. Read through section 4. FC^{E} Best Practices before you begin.

1. Prepare for FC^{E} Measurement

1. For ease of measurement, set the instrument's Auto oFF feature to 75 sec (ref. Auto oFF, pg. 28).

2. Ensure the FC^{E} mode has been activated (ref. ORP/FC^{E} Mode Selection, pg. 10).

3. Remove protective cap from the pH/ORP sensor by rotating while grasping and pulling up.

2. FC^{E} Flow Method

1. Empty the pH/ORP sensor well of all storage solution.

2. Hold the PS6FC^{E} at a 30° angle (cup sloping downward).

3. Thoroughly flush the sensor well and cell cup with a steady stream of the solution you intend to measure by allowing the solution to flow into and out of the sensor well and cell cup for at least 10 seconds.

4. Let sample flow continuously into conductivity cell with no aeration.

5. Allow both the sensor well and cell cup to remain filled with sample.

6. Press 

. The instrument will begin alternating between a predicted final ORP value and a free chlorine equivalent concentration in ppm. Both readings will change rapidly at first.

7. Wait for the readings to stabilize. When the mV and ppm values are unchanging for 5 consecutive readings, the FC^E reading has reached a stable level. This may take 1 to 2 minutes.

   NOTE: If the reading takes more than 1 minute to stabilize, press the ORP/Fr Chl after 1 minute to prevent Auto oFF feature from disturbing the measurement process. Annunciators will alert you when either the pH or ORP of the final FC^E ppm value are Out of Range ("**-Or-**").

8. Press **MS** to store reading in memory if desired.

3. <u>FC^E Immersion Method</u>

NOTE: Use this method for pools, spas and other large standing bodies of water.

1. Hold instrument beneath the surface of the water to avoid surface effects on the water's chemistry.

2. Swirl the instrument around for at least 10 seconds to thoroughly rinse the cell cup and sensor well.

3. Continue holding the instrument under the surface while taking the reading.

4. Press ORP/Fr Chl.

5. The instrument will begin alternating between a predicted final ORP value and a free chlorine equivalent concentration in ppm. Both readings will change rapidly at first.

6. Wait for the readings to stabilize. When the mV and ppm values are unchanging for 5 consecutive readings, the FC^E reading has reached a stable level. This may take 1 to 2 minutes. **NOTE:** If the reading takes longer than 1 minute to stabilize, press ORP/Fr Chl after 1 minute to prevent Auto-OFF feature from disturbing the measurement process. Annunciators will alert you when either the pH or ORP of the final FC^E ppm value are Out of Range ("**-Or-**").

7. Press **MS** to store reading in memory if desired.

4. FC^E Best Practices

For best results it is recommended that you:

1. Take 3 consecutive FC^E measurements and record the readings.

2. Calculate the average of the 3 measurements. Use this value.

3. Ignore measurements that are significantly different from the others. Ex: 3.20 ppm, ~~1.15 ppm~~, 3.10 ppm

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. 32). Do not allow pH/ORP sensor to dry out.

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. 37). Selection determines the temperature correction of conductivity and calculation of TDS from compensated conductivity (ref. Cond. Conversion to TDS, pg. 40).

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. 40).

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, MIN/SALT or TDS Calibration, pg. 17) is performed separately for each type of solution one wishes to measure (ref. Conductivity/TDS Standard Solutions, pg. 36).

D. <u>Procedure to Select a Solution</u>

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 (CAL/MCLR) key for 3 seconds to make "**SEL**" appear (see Figure 3).

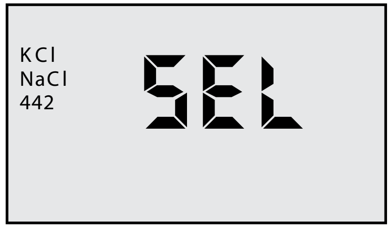

Figure 3

(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. 40). 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. 21).

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. <u>Leaving Calibration</u>

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. <u>Calibration Limits</u>

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. 34).

C. <u>Calibration Procedures</u>

1. <u>Conductivity, MIN/SALT or TDS Calibration</u>

a. Rinse conductivity cell three times with proper standard (KCl, NaCl, or 442) (ref. Cond/TDS Standard Solutions, pg. 36).

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 4).

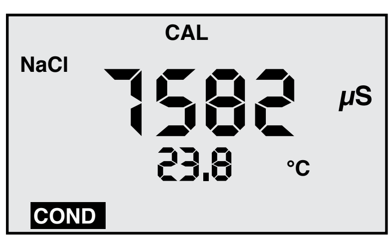

Figure 4

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.

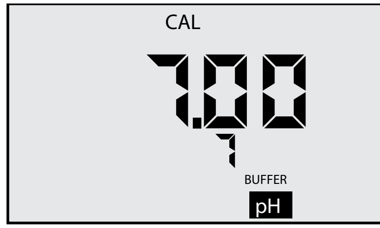

Figure 5

4. Press CAL/MCLR to enter calibration mode. The "**CAL**", "**BUFFER**" and "**7**" annunciators will appear (see Figure 5). 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. 34) 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. <u>pH Gain Calibration</u>

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 6 and 7).

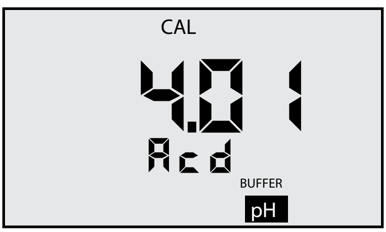

Figure 6

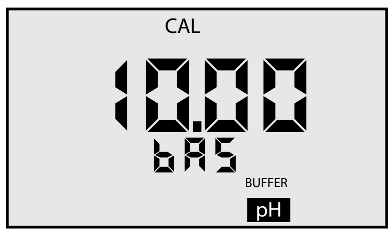

Figure 7

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 (CAL/MCLR) 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/Fr Chl 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. 38), 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. 29).

A. <u>Memory Storage</u>

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

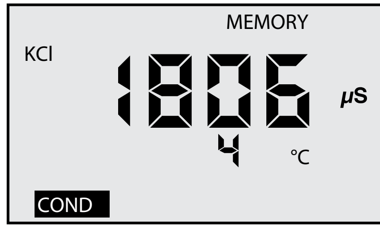

Figure 8

2. "**MEMORY**" will appear and the temperature display will be momentarily replaced by a number (1-100) showing the position of the record. Figure 8 shows a reading of 1806 *µ*S stored in memory record #4.

B. <u>Memory Recall</u>

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. <u>Clearing a Record/Memory Clear</u>

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 **<u>all</u>** records: After pressing [MR/▼], scroll down. "**CLr ALL**" will be displayed (see Figure 9).

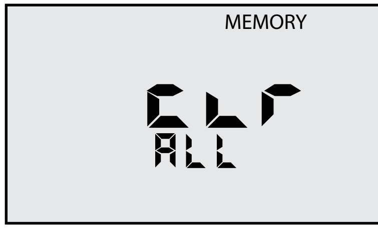

Figure 9

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

X. <u>TIME and DATE</u>

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

A. <u>Setting TIME</u>

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 10).

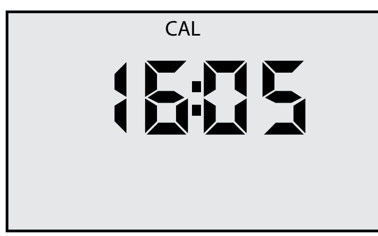

Figure 10

4. Press [▲/MS] or [MR/▼] to change the time.

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

B. <u>Setting DATE</u>

Example shown in Figure 11, 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. 26).

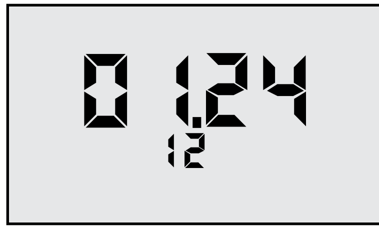

Figure 11

1. Press (COND).

2. Press (MR ▼) repeatedly until the date is displayed (stored readings, PC OFF, CLr ALL, time, date, i.e., **01/24/12** (January 24, 2012)).

3. Press (CAL/MCLR) to initiate. **CAL** will be displayed along with the YEAR, (see Figure 12).

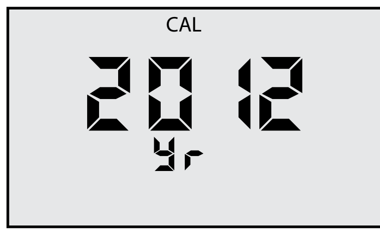

Figure 12

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.

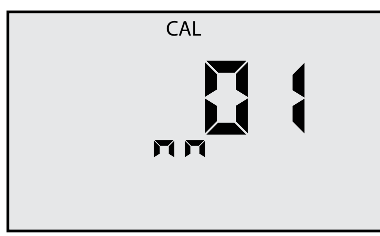

Figure 13

7. Press (CAL/MCLR) to accept the change (new month), (see Figure 13).

8. Press (▲ MS) or (MR ▼) to change the day.

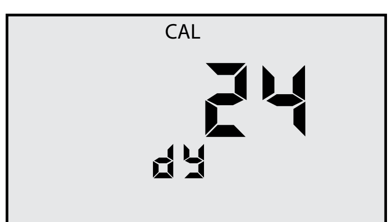

Figure 14

9. Press (CAL/MCLR) to accept the change (new day) (see Figure 14).

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 15 & 16).

4. Press any measurement key or allow to automatically turn off.

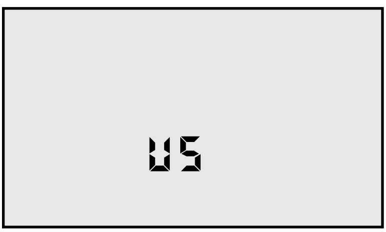

Figure 15

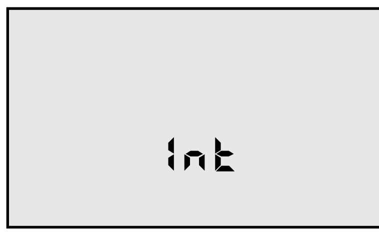

Figure 16

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 17 and 18).

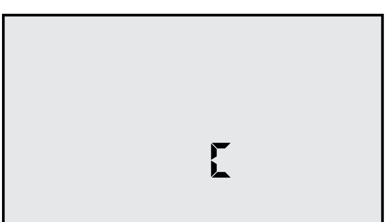

Figure 17

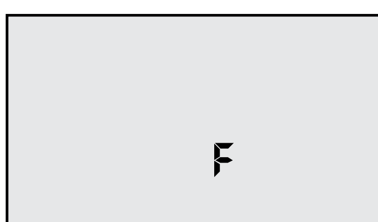

Figure 18

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. <u>TOTAL RETURN to FACTORY SETTINGS "FAC SEL"</u>

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 19).

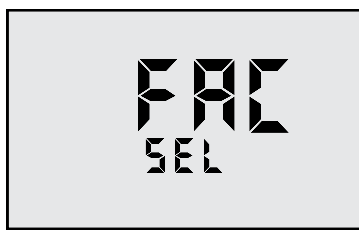

Figure 19

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

XIII. <u>CELL CHECK</u>

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, <u>NO SENSOR IS 100% IMMUNE.</u>

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 20).

4. Press (CAL/MCLR) to test.

   If cell is clean, **Good** will momentarily be displayed (see Figure 21). If cell is dirty, "**CELL cLn**" will be displayed (see Figure 22), (ref. Cleaning Sensors, pg. 32).

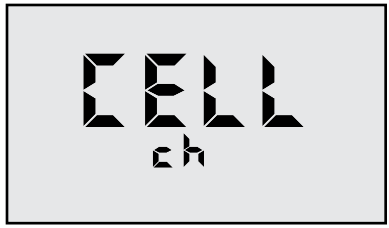

Figure 20

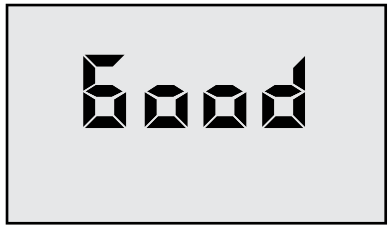

Figure 21

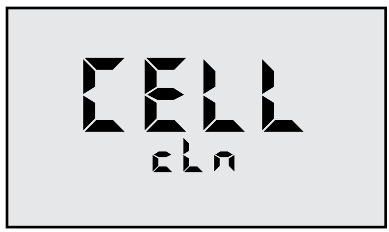

Figure 22

XIV. <u>AUTO OFF</u>

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.

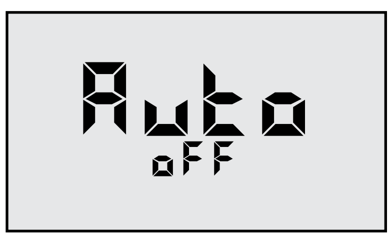

Figure 23

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 23).

4. Press CAL MCLR to initiate. **CAL** will be displayed along with the "**15 SEC**" (see Figure 24).

5. Press ▲ MS or MR ▼ to change the time (see Figure 25). Maximum time is shown.

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

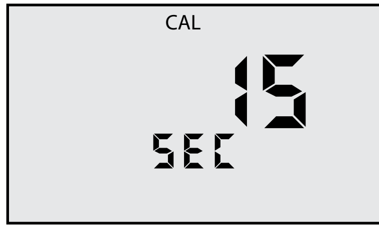

Figure 24

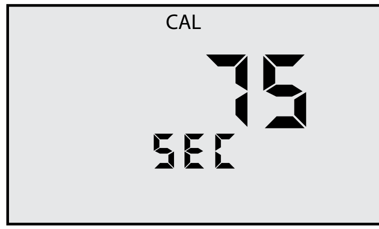

Figure 25

XV. <u>bluDock™ WIRELESS DATA TRANSFER INSTRUCTIONS</u>

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[1], and Macintosh OSX[2] based computer systems and *Bluetooth* USB adapter (dongle) for computers that do not have *Bluetooth* capability.

A. <u>Software Installation</u>

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.

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1 Windows, XP, Vista, 7 & Excel are registered trademarks of Microsoft Corporation.

2 Macintosh OSX is a registered trademark of Apple Computer, Inc.

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.

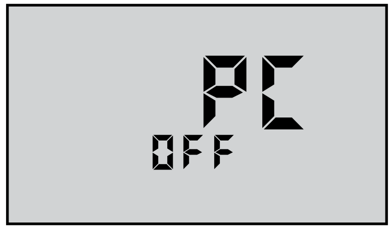

Figure 26

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 26).
3. Then press the CAL/MCLR key. "**PC On**" will be displayed (see Figure 27).

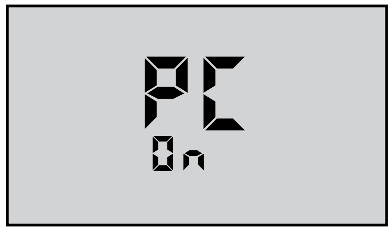

Figure 27

NOTE: "**PC Ini**" may momentarily be displayed while initializing (see Figure 28).

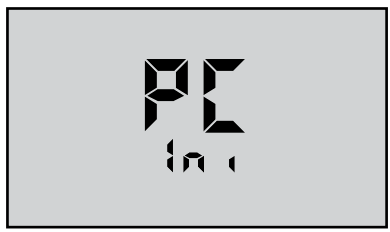

Figure 28

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.

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[1] such as Excel[2].

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.

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

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1 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.

2 Windows, XP, Vista, 7 & Excel are registered trademarks of Microsoft Corporation.

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 (see Figure 29). 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.

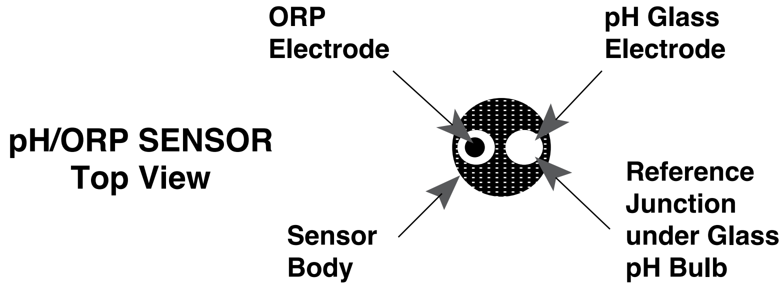

Figure 29

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. 18. 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 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 clogged or coated.
Unstable **Conductivity/TDS/ MIN/SALT** readings	Dirty electrodes.
Unable to calibrate **Conductivity/ TDS/MIN/SALT**	Film or deposits on electrodes.
Low **ORP** Reading Slow or no response to **ORP** changes	ORP platinum electrode is dirty.
FC^E responds very slowly or returns an atypically high Predictive **ORP** value	1. Dirty platinum electrode (see above). 2. ORP sensor memory/battery effect. Some ORP sensors exhibit a residual charge when measuring LOW Free Chlorine concentrations soon after measuring a HIGH Free Chlorine concentration.

	Corrective Action
	Check connections or replace battery. Ref. Battery Replacement, pg. 31.
	1. Recalibrate instrument. 2. Thoroughly rinse sensor well. 3. Recalibrate using fresh buffers. Ref. pH Buffer Solutions, pg. 36.
	Replace pH/ORP sensor. Ref. Replacement pH/ORP Sensor, pg. 37.
	Clean and rejuvenate sensor (ref. Cleaning Sensors, pg. 32) and recalibrate. If no improvement, replace pH/ORP sensor (ref. Replacement pH/ORP Sensor, pg. 37).
	Clean and rejuvenate sensor (ref. Cleaning Sensors, pg. 32) and recalibrate. If no improvement, replace pH/ORP sensor (ref. Replacement pH/ORP Sensor, pg. 37).
	Clean cell cup and electrodes. Ref. Cleaning Sensors, pg. 32.
	Clean cell cup and electrodes. Ref. Cleaning Sensors, pg. 32.
	Check the ORP sensor functioning. Take an ORP reading of Myron L pH/ORP Sensor Storage Solution (ref. pH Sensor Storage Solution, pg. 36. If the reading is outside the range of 350-400 mV, clean ONLY the platinum ORP electrode with Myron L ORP Conditioner solution-soaked cotton swab (ref. ORP Sensor Conditioner Solution, pg. 36), being careful not to touch the swab to the glass bulb of the pH sensor.
	1. Rinse the pH/ORP sensor well briefly with a small amount of ORP Sensor Conditioner Solution. **DO NOT** leave the conditioning solution in the sensor well for more than 10 seconds. 2. Rinse the pH/ORP sensor 3 times with Sensor Storage Solution. 3. Fill the sensor well with Sensor Storage Solution and let rest for 5 minutes.

XVIII. ACCESSORIES

NOTE: MSDSs are available on the Myron L website for all solutions: **http://www.myronl.com/main/Material_Safety_DS_DL.htm**

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. ORP Sensor Conditioner Solution

Myron L ORP Conditioner Solution removes contaminants and conditions the ORP electrode. *Available in 2 oz. and quarts/liters. Order ORPCOND*.

E. 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

F. 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

G. 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

H. 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.

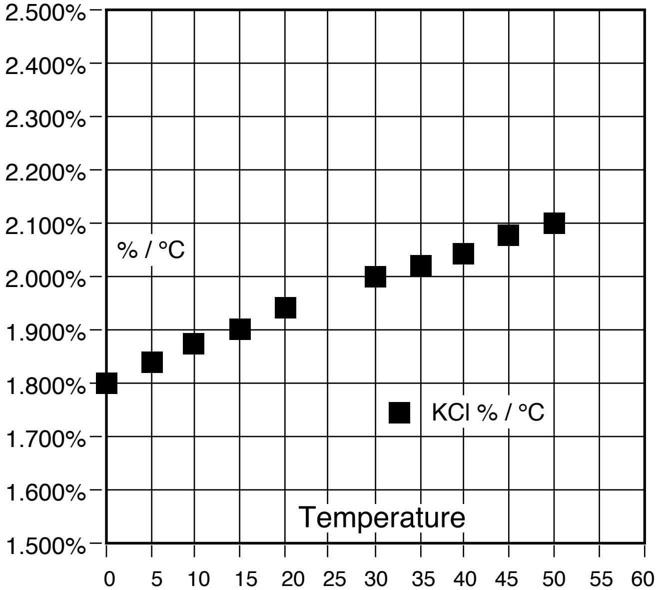

Chart 1

C. <u>An Example of 2 different solution selections and the resulting compensation</u>

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. <u>A Chart of Comparative Error</u>

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 Chart 2 below.

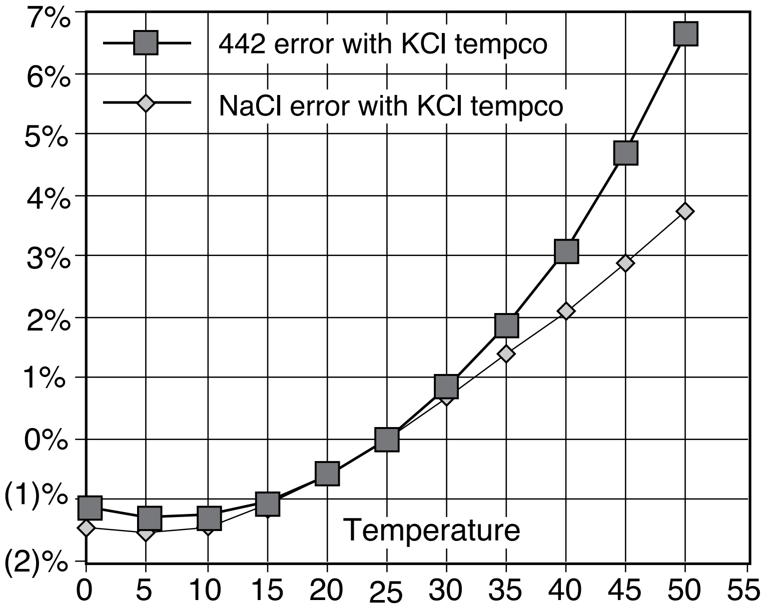

Chart 2

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. <u>Other Solutions</u>

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. 41).

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. 42.

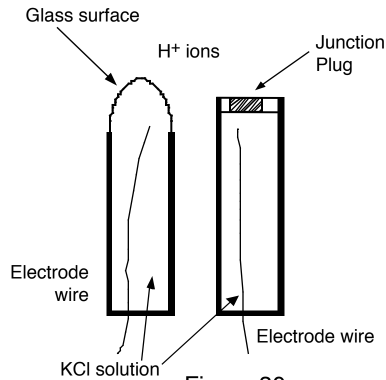

Figure 30

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

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.

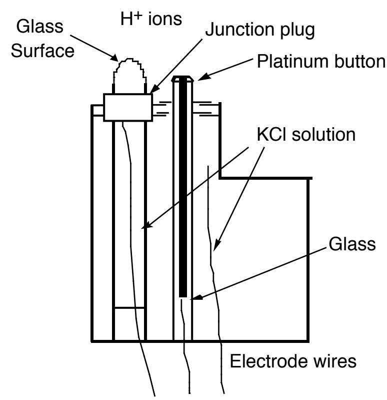

Figure 31

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

The basics are presented in pH/ORP, pg. 42.

a. <u>Reference Junction</u>

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. <u>Sensitivity Problems</u>

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. 43, 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. 42, 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.

C. Free Chlorine

1. Free Chlorine as an Indicator of Sanitizing Strength

Chlorine, which kills bacteria by way of its power as an oxidizing agent, is the most popular germicide used in water treatment. Chlorine is not only used as a primary disinfectant, but also to establish a sufficient residual level of Free Available Chlorine (FAC) for ongoing disinfection.

FAC is the chlorine that remains after a certain amount is consumed by killing bacteria or reacting with other organic (ammonia, fecal matter) or inorganic (metals, dissolved CO_2, Carbonates, etc) chemicals in solution. Measuring the amount of residual free chlorine in treated water is therefore the best method for determining its effectiveness in microbial control.

The Myron L Company FC^E method for measuring residual disinfecting power is based on ORP, the specific chemical attribute of chlorine (and other oxidizing germicides) that kills bacteria and microbes.

2. FC^E Free Chlorine Units

The $PS6FC^E$ is the first handheld device to detect free chlorine directly, by measuring ORP. The ORP value is converted to a concentration reading (ppm) using a conversion table developed by Myron L Company through a series of experiments that precisely controlled chlorine levels and excluded interferants.

Other test methods typically rely on the user visually or digitally interpreting a color change resulting from an added reagent-dye. The reagent used radically alters the sample's pH and converts the various chlorine species present into a single, easily measured species. This ignores the effect of changing pH on free chlorine effectiveness and disregards the fact that some chlorine species are better or worse sanitizers than others.

The Myron L Company $PS6FC^E$ avoids these pitfalls. The chemistry of the test sample is left unchanged from the source water. It accounts for the effect of pH on chlorine effectiveness by including pH in its calculation. For these reasons, the PS6's FC^E feature provides the best reading-to-reading picture of the rise and fall in sanitizing effectivity of free available chlorine.

The $PS6FC^E$ also avoids a common undesirable characteristic of other ORP-based methods by including a unique Predictive ORP value in its FC^E calculation. This feature, based on a proprietary model for ORP sensor behavior, calculates a final stabilized ORP value in 1 to 2 minutes rather than the 10 to 15 minutes or more that is typically required for an ORP measurement.

XXIII. <u>SOFTWARE VERSION</u>

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.

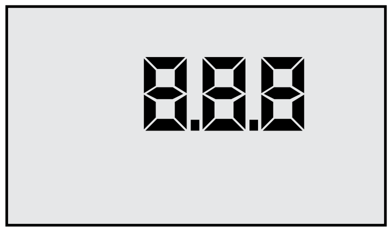

Figure 32

XXIV. GLOSSARY

Anions	Negatively charged ions. See Solution Characteristics, pg. 40.
Algorithm	A procedure for solving a mathematical problem. See Temperature Compensation and TDS Derivation, pg. 41.
FAC	Free Available Chlorine. The amount of chlorine that remains active in solution and is available for ongoing disinfection. See Free Chlorine as an Indicator, pg. 45.
FC^E	FC^E™ directly measures ORP, the germ killing property of chlorine and other oxidizing germicides. It displays both the ORP reading (in mVDC) as well as an equivalent free chlorine concentration (in familiar ppm). For more information see ***FC^E™: Groundbreaking Measurement of Free Chlorine Disinfecting Power in a Hand-Held Instrument*** on the Myron L Company website.
Logarithm	An arithmetic function. The inverse of an exponential function. See pH Units, pg. 42.
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. 44.
REDOX Reaction	An abbreviation for Reduction-Oxidation reactions. This is the basic electrochemical process by which chlorine destroys microbes by grabbing electrons from the microbe's proteins, denaturing the protein and killing the organism. ORP directly measures the strength of a solutions' REDOX potential and, therefore, sanitizing strength.
TDS	Total Dissolved Solids or the Total Conductive Ions in a solution. See Conductivity Conversion to TDS, pg. 40.
Tempco	Temperature Compensation See Temperature Compensation, pg. 41.

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

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