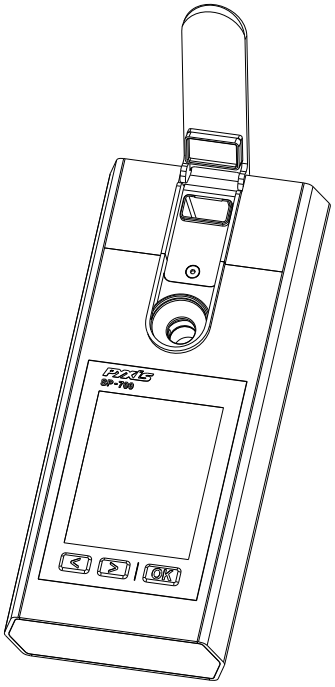
SP-700 Water Multimeter
Operation Manual



Rev. A

Firmware version 1.2.2r161

Pyxis Lab, Inc.
120 Jeffrey Ave.
Holliston, MA 01746
USA
www.pyxis-lab.com
service@pyxis-lab.com

1 Contents

Confidentiality

Standard Limited Warranty

Pyxis Lab warrants its products for defects in materials and workmanship. Pyxis Lab will, at its option, repair or replace instrument components that prove to be defective with new or remanufactured components (i.e., equivalent to new). The warranty set forth is exclusive and no other warranty, whether written or oral, is expressed or implied.

Warranty Term

The Pyxis warranty term is thirteen (13) months ex-works. In no event shall the standard limited warranty coverage extend beyond thirteen (13) months from original shipment date.

Warranty Service

Damaged or dysfunctional instruments may be returned to Pyxis for repair or replacement. In some instances, replacement instruments may be available for short duration loan or lease.

Pyxis warrants that any labor services provided shall conform to the reasonable standards of technical competency and performance effective at the time of delivery. All service interventions are to be reviewed and authorized as correct and complete at the completion of the service by a customer representative, or designate. Pyxis warrants these services for 30 days after the authorization and will correct any qualifying deficiency in labor provided that the labor service deficiency is exactly related to the originating event. No other remedy, other than the provision of labor services, may be applicable.

Repair components (parts and materials), but not consumables, provided in the course of a repair, or purchased individually, are warranted for 90 days ex-works for materials and workmanship. In no event will the incorporation of a warranted repair component into an instrument extend the whole instrument's warranty beyond its original term.

Shipping

A Repair Authorization Number (RA) must be obtained from the Technical Support (service@pyxis-lab.com) before any product can be returned to the factory. Pyxis will pay freight charges to ship replacement or repaired products to the customer. The customer shall pay freight charges for returning products to Pyxis. Any product returned to the factory without an RA number will be returned to the customer.

1 General Description

The Pyxis SP-700 is a hand-held multimeter that measures simultaneously six key parameters in a water sample: pH, conductivity, PTSA (Pyrene tetrasulfonic acid tetra sodium), fluorescein, ORP, and temperature.

The SP-700 is a cuvette-less device. It has two sample cells. Less than 5 ml water is needed to fill in the cells for the measurement of the six parameters.

The PTSA measurement uses custom signal processing algorithms to compensate for sample color and turbidity conditions that normally cause erroneous readings.

1.1 Specification

Item		Specification
Analysis	PTSA Fluorescein	0~300 ppb, ±1 ppb or 1% precision 0-60.0 ppb, ±0.2 ppb
	Conductivity	1~15,000 µS/cm with ATC. ±1% or ±1 µS/cm precision
	pH	0~14 with ATC, ±0.01 pH unit precision
	ORP	±1500 mV, ±1 mV precision
	Temperature	0~70 ℃ (32~160 °F), ±0.1℃(±0.2 °F)
Storage Temperature		-20 °C ~ 60° C (-4~140°F)
Operational Temperature		0° C ~ 40° C (32~104°F)
Sensor Module		pH/ORP, replaceable
Typical Senor Life		pH/ORP - 2 years PTSA/Conductivity - 5 years
Protection Grade		IP67, full dust and water proof
Regulation		CE
Display		Color LCD, visible under direct sunlight
Power Supply		(4) AA alkaline batteries
Typical Battery Life		10,000 readings
Dimension (L x W x H)		180 x 80 x 32.6 mm (7.06 x 3.15 x 1.30 inches)
Weight		380g (0.85 lbs) batteries excluded

*With Pyxis' continuous improvement policy, this specification is subject to change without notice.

1.2 Major Features

- Breakthrough technology combines PTSA / Fluorescein with Conductivity / pH and ORP in a single rugged one-handed meter.
- Custom pH/ORP modular design with extra-large junction capacity provides increased service life
- Easy replacement of the pH/ORP electrode module without the need to open the meter enclosure.
- Long battery life - 10,000+ readings
- Self-diagnosis during calibrations
- Custom product names and tracer/product ratios can be configured via Bluetooth-enabled devices.

1.3 Unpacking the Instrument

Remove the instrument and accessories from the shipping container and inspect each item for any damage that may have occurred during shipping. Verify that all items listed on the packing slip are included. If any items are missing or damaged, please contact Pyxis Customer Service at service@pyxis-lab.com.

1.4 Standard Accessories

- Four (4) AA alkaline batteries
- Bluetooth USB adapter
- Full instrument manual is available from www.pyxis-lab.com

1.5 Optional Accessories

- Carrying case for SP-700 (MA-700)
- 100 ppb PTSA + 1000 μS/cm (KCl) combined standard (MA-1010C)
- 220 mV ORP calibration standard
- 100 ppb PTSA calibration standard (PTSA-100)
- 20 ppb fluorescein calibration standard (FLSN-20)
- 20 ppb fluorescein + pH 10 calibration standard (FLPH-2020)

1.6 Dual Functional Light Shield

The SP-700 light shield has two functions. It shields ambient light from potentially interfering PTSA or fluorescein measurement. When in storage, the rubber gasket on the side of the light shield facing the pH/ORP cell seals the cell, maintaining a moisture environment for the electrodes. The light shield is shown in Figure 1.

If the meter is to be stored for more than two weeks, fill the pH/ORP cell with 0.5 ml the pH 4 buffer solution or any pH electrode storage solution.

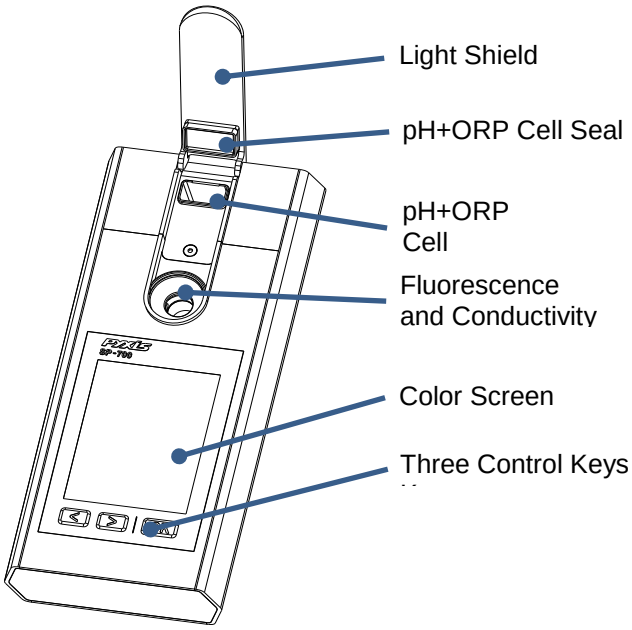


Figure 1 Light Shield in the Open Position

2 Start Pyxis SP-700

2.1 Battery Installation

The SP-700 is powered by four (4) AA alkaline batteries. Do not use rechargeable nickel cadmium (NiCad) or lithium batteries. Typical battery life after replacing a new battery set will be 10,000 measurements or 10 months. When the battery capacity is critically low, the SP-700 will display a LOW BATTERY warning for 5 seconds and then automatically turn off.

Replace the batteries to resume operation after the battery warning. The SP-700 will not automatically turn itself on after the new battery installation until the OK key is pressed for 1 second.

The SP-700 has a calendar timer. In order to prevent the calendar from being reset to the default date and time (01/01/1970 00:00:00), please install four new batteries within 4 minutes after the old batteries are removed from the battery compartment. The SP-700 date and time will be synchronized to your PC automatically when it is connected with Nebula software via Bluetooth adapter.

The SP-700 battery compartment, shown in Figure 2, is on the back side of the instrument.

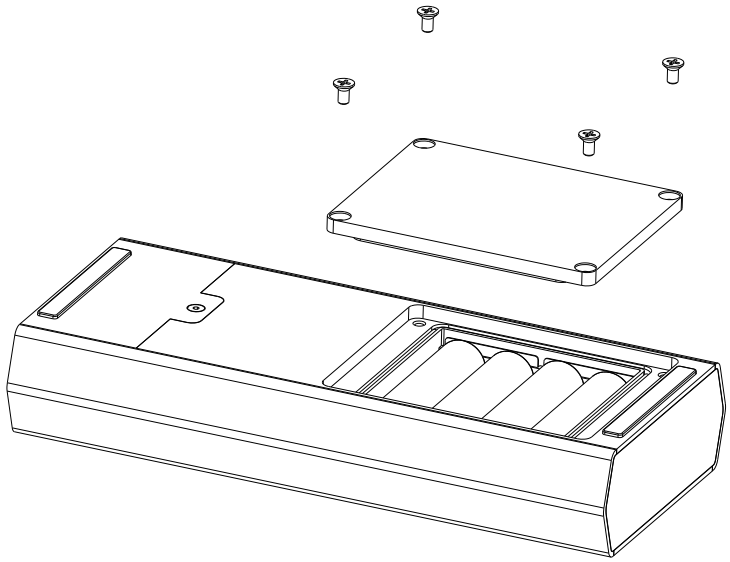


Figure 2 Battery Installation

2.2 Install battery as follows:

1. Remove the battery compartment cover by loosening four screws.
2. Follow the positive and negative signs in the compartment bottom and snap batteries firmly into the battery holder.
3. Replace the battery compartment cover, making sure that the sealing O-ring is lying flat on the battery holder. Failure to do so may result in water/moisture damage to the meter. To prevent the SP-700 from accidently being turned on or off due to vibration, please firmly tighten the four screws.

2.3 Description of the Control Keys

The SP-700 has three keys as shown in Figure 3. The left (<), right (>) and OK keys are used to launch an action indicated on the LCD screen directly above the keys. Please note that the LCD screen is not a touch enabled device. The labels above the keys indicate the function associated with the keys and its functions can be changed in different operation modes.

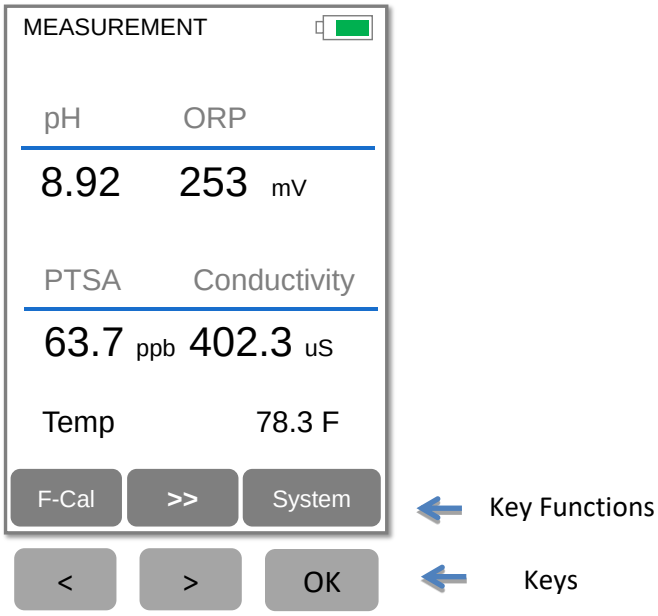


Figure 3 Keys and associated functions

2.4 Turning On/Off Pyxis SP-700

To turn on the SP-700, press OK momentarily and release.

To turn off the SP-700, press and hold the OK key for about 3 seconds. Release the OK key when the LCD display turns off. The SP-700 will turn itself off after 60 seconds without user interaction through the keys.

3 Multiple Parameter Measurement

3.1 Measurement

When powered on, the SP-700 will be in the measurement mode (see figure 3).

The water sample can be transferred to the measurement cells using a pipette or filled directly from a faucet or a sample bottle.

Rinse. Use the sample water to rinse the cells at least three times. Rinse the surface between and around the cells will help reduce cross contamination when measuring multiple samples, especially when switching to a sample with conductivity/pH/ORP significantly different than the previous one.

Light Shield. The light shield should be in the closed position in order to measure PTSA. If fluorescence measurement is not the interest, the light shield can be left in the open position without affecting the reading and accuracy of conductivity, pH or ORP.

Allow 5 seconds for the SP-700 to reach stable readings for the 6 parameters. The time required to reach a stable reading may be slightly longer if the water sample temperature is significantly different than the environmental temperature at which the SP-700 had been equilibrated (stored).

For a sample with conductivity in the range of 100 to 6000 μS/cm, the measured conductivity value should be stabilized in the range of 98 – 102 to 5940 – 6060 μS/cm, respectively. For a sample containing 100 ppb PTSA, the measured PTSA should be stabilized within the range of 98 to 102 ppb.

3.2 Temperature Measurement

The SP-700 has a 100Ω platinum RTD located in the PTSA/Conductivity cell. The temperature sensor is individually calibrated in the factory and does not need to be calibrated during use. The temperature value measured is used in the conductivity temperature compensation calculation and in converting the measured cell potential to the pH value at the sample temperature. Note that the pH/ORP cell does not have a temperature sensor. You must fill the PTSA/conductivity cell to measure the sample temperature. If the PTSA/conductivity cell is dry and empty, the temperature value used in the pH calculation is the ambient environmental temperature, which may be different from the sample temperature.

3.3 Conductivity Temperature Compensation

The displayed conductivity value is automatically corrected to the nominal value at the reference temperature 25.0 °C with using the sample temperature measured. The commonly used linear correction equation is used:

Conductivity at 25°C = (Conductivity at $T_{measure}$)/ [1 + 0.02($T_{measure}$ – 25)], where $T_{measure}$ is the sample temperature in Celsius.

3.4 High Color and Turbidity Warning

The SP-700 has extra channels to measure sample turbidity and color to automatically compensate sample color and turbidity interference. If sample turbidity and color values determined are too high and beyond the compensation range, a PTSA measurement warning will be displayed. In such a case, the user should filter or dilute the sample for PTSA measurement.

3.5 pH Measurement

The SP-700 uses the standard electrochemical cell for the pH measurement. The cell consists of a glass electrode and a Ag/AgCl reference electrode. Potassium chloride (KCl) electrolyte filling gel is sealed in the Ag/AgCl electrode. The amount of reference electrolyte in the SP-700 is significantly larger than that used in a common laboratory pH electrode. This reduces the chance of the filling solution being diluted or contaminated, and increases the electrode life.

The pH value is calculated from the measured cell potential (EMF).

$pH = EMF/ S(T) + pH_o$

S(T) in the above equation is the calibration slope and theoretically equal to 0.1986(T + 273.15), where T is temperature in Celsius, or 59.17 mV at 25 ^oC. pH_o is the calibration intercept. The calibration slope S(T) at the nominal temperature 25.00 ^oC and the intercept pH_o are determined in the two-point or three-point calibration procedure. pH_o is determined as well in the singe-point pH 7.00 calibration.

The temperature value measured by the SP-700 is used in the above equation to calculate the pH value at the measurement temperature. Note that the temperature involved in the pH value calculation is quite different from the temperature compensation in the conductivity measurement. The temperature-compensated conductivity value is a would-be value at the reference temperature 25 ^oC while the pH value displayed by the SP-700 is the true pH value at the sample temperature.

3.6 ORP Measurement

The SP-700 measures the sample ORP with the platinum electrode and the Ag/AgCl reference electrode in the pH/ORP cell. A ORP value without specifying the reference scale has no meaning. The ORP value reported by the SP-700 could be referenced to the standard hydrogen electrode (SHE), i.e, in the unit of Eh, or a Ag/AgCl electrode. **The value displayed by the SP-700 depends on the ORP value of the ORP standard used in the calibration.** If the ORP value of the standard is referenced to the standard hydrogen electrode (SHE), the ORP value reported by the SP-700 will be SHE based, i.e., in the unit of Eh. If the ORP value of the standard is referenced to the Ag/AgCl (3M KCl) electrode, the ORP value reported by the SP-700 will be referenced to the same, commonly noted as mV (Ag/AgCl, 3M KCl).

The ORP electrode is calibrated using the Zobell's standard using the value of 221 mV at 25 ^oC before shipping. The default ORP scale of the SP-700 before a user calibration is the Ag/AgCl (3M KCl).

It is difficult to measure ORP of a field sample accurately or/and precisely. ORP of water samples with low conductivity and low redox buffer capacity, such as unchlorinated surface water, is even more difficult to measure. If the SP-700 is exposed to an extremely high (>600 mV) or extremely low (<-200 mV) ORP sample, you may have to rinse the pH/ORP cell excessively when switching to measure a lower or higher redox buffer capacity sample.

For a typical cooling water sample treated with oxidizing biocides, a ±20 mV accuracy and ± 10 mV precision can be expected.

4 Calibration

The PTSA, fluorescein, pH, ORP, and conductivity measurements can be calibrated separately with using the corresponding standards.

PTSA calibration requires the 100, 200, or 300 ppb PTSA standard solution. A standard with conductivity value 500, 1000, 2500, or 5000 **µS** can be used to calibrate conductivity. Optionally, the user can use a standard with any conductivity value in the range of 500 to 5000 **µS,** such as the

commonly used 1412 (or 1413) **µS** standard, to calibrate the SP-700. For convenience, the SP-700 can be calibrated using a combined standard with 100 ppb PTSA + 1000 **µS** KCl conductivity.

4.1 PTSA Standalone Calibration (2 Point with Zero)

It is highly recommended to use the PTSA standalone calibration procedure if the user desires to achieve higher accuracy for low range PTSA measurements (< 20 ppb). The Combined PTSA/Conductivity Calibration procedure yields the PTSA calibration slope only and does not change the zero point.

1) Rinse sample cell with DI water. Fill the sample cell with DI water. Close the light shield.
NOTE: In emergency, "non-PTSA" water, such as city water, may be used, but re-calibrate using DI water for the zero step as soon as it is available.

2) Power on by a short press of OK key. Allow 5-10 seconds for meter to stabilize.

3) A screen similar to Figure 4 appears. The unit is actively reading and displaying both PTSA and Conductivity. The values will be very low if DI water is used; The conductivity value is not critical but PTSA value should be near zero. A low non-zero value (e.g. 0.2 or 0.4, etc.) is not problematic.

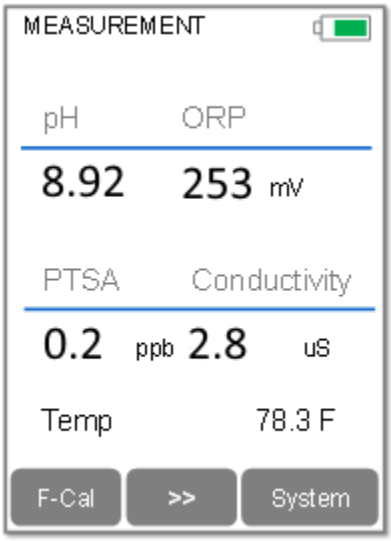


Figure 4

4) Press F-Cal labeled key (<).
5) Figure 5, the first screen of the PTSA (alone) calibration, appears.

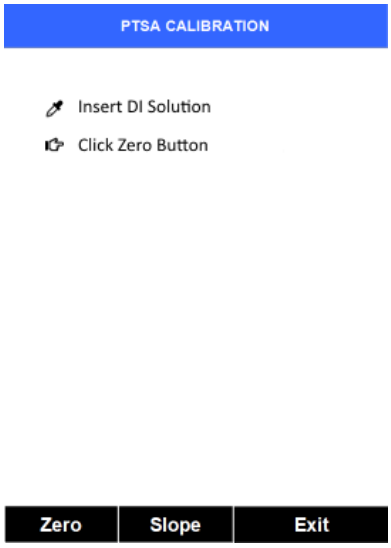


Figure 5

6) Press Zero labeled key (<) to set the zero point.
7) After successful zero set, a checkmark symbol will appear next to “Click Zero Button” to confirm success. The screen will also update to show the Slope steps, as in Figure 6. The Cycle command replaces Zero command on the black bar and the possible PTSA selection is displayed in red. The default is 100 ppb.

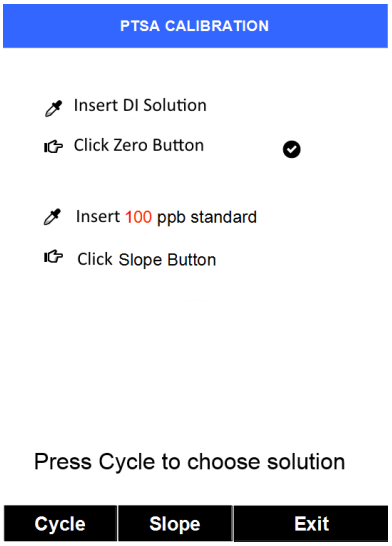


Figure 6

8) Rinse the sample cell out thoroughly (twice at least) with the desired PTSA standard and with the measurement cell near full, close the light shield.
9) If the 100 ppb PTSA default is not the desired PTSA for calibration, press the Cycle labeled key (<) to cycle between the PTSA standards 100-200-300 ppb (it repeats). The value in red will update as the setting is changed. If the default of 100 is desired then the use of Cycle (<) is not required. Ensure the value selected matches the standard actually present.

10) Press the Slope labeled key (>) to set the slope of the standard desired and complete PTSA calibration.
11) If calibration is successful, the screen will update with a second checkmark for the Slope setting as in Figure 7, and the message Calibration Succeed will appear.

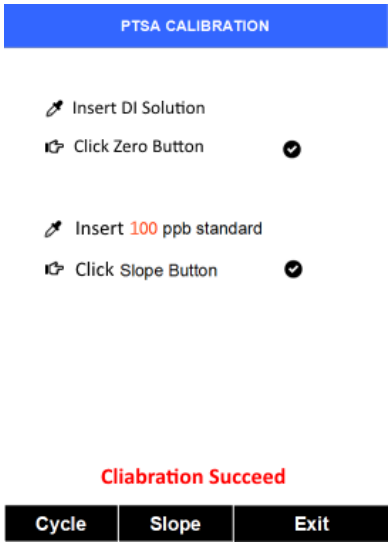


Figure 7

12) Press the Exit labeled key (OK) to return to the measurement screen. The screen will be similar to Figure 8. Slight variance in the PTSA value is not problematic. If Exit is done before the second checkmark appears, the calibration will not be completed and must be re-done.

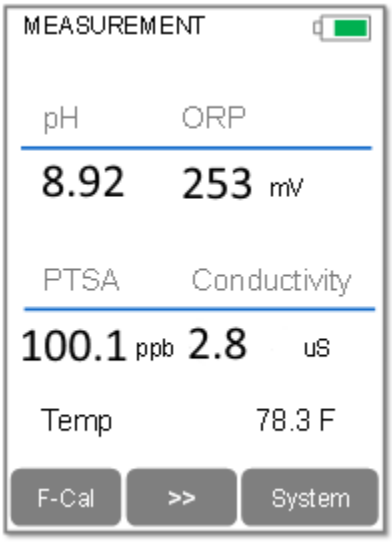


Figure 8

Quick Tips

1) If the 100 ppb PTSA concentration (the default) is the desired calibration and it is what has been added to the measurement cell for the slope (step 9), then the key presses from the beginning,

including the power on, are: OK, <, <, {refill with PTSA standard}, >, then after completion, Exit to return to Measurement Mode.

2) If screen darkens, the timer will shortly power down the meter. Any key press will reset the timer, but this press does not perform any activity other than timer restart. The next key press needed must still be done after this timer re-set press. The timer is set to help maximize battery life. After the key press to set the zero point, there is 40 seconds to rinse and refill the measurement cell with PTSA standard (and close the light shield), before the next key press of either “Cycle” (<) to change PTSA setting or “Slope” (>) to execute the final part of the calibration.
3) After returning to read mode after calibration, rinse several times with the first sample. The unit will continue to read the sample values without any further key presses if it has not powered off. If there are no key presses for 20 seconds the screen will darken (40 seconds in a calibration mode), and after another 20 seconds without key activity will power down. If you have multiple samples a quick press on OK or the other keys will keep the timer going, giving you time to add the next one. To ensure accurate results and avoid sample carry-over/contamination, rinse at least twice with the next sample before closing light shield.
4) Always rinse the unit with clean water after use and dry by clean tissue or paper towel. Be gentle handling the open light shield.
5) After a successful calibration, the unit does not automatically return to the measurement mode. If Exit is held down too long the unit will power down rather than returning to the measurement mode.

4.2 Standard Conductivity Calibration (500, 1000, 2500, or 5000 µS)

Example based on 1000 µS

1) Rinse sample cell with desired conductivity standard.
2) Power on by a press of OK key. Allow 5-10 seconds for meter to stabilize.
3) A screen similar to Figure 9 will appear. The unit is reading both conductivity and PTSA if the light shield is in the closed position. For conductivity measurement or calibration, the light shield is not required to be closed. The conductivity reading should be close but not necessarily the same as the value of the standard added.

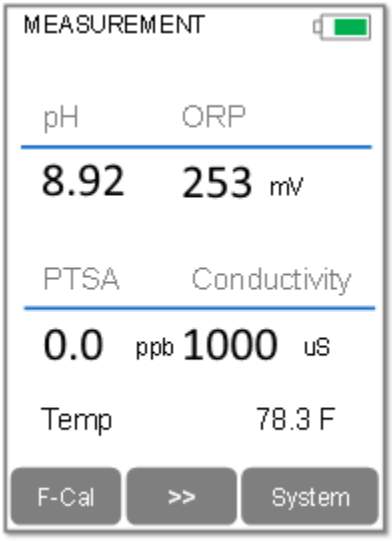


Figure 9

4) Click >> key to cycle to conductivity calibration mode (C-Cal).
5) Press C-Cal labeled key (<).
6) A screen similar to Figure 10 will appear. This is the default conductivity calibration mode, which is a Combined Calibration (this requires a combined standard with both PTSA and Conductivity). It is easily changed to the other calibration modes as desired.

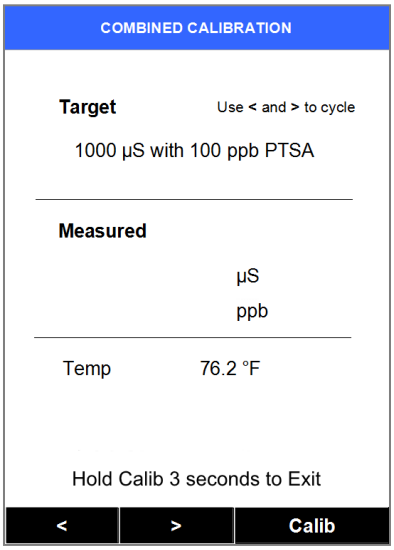


Figure 10

7) Use the > key to cycle to the desired calibration, e.g. 1000 µS. The Standard Conductivity selections are 500, 1000, 2500 or 5000 µS. For other conductivity values the User Defined calibration mode must be used. With each press of >, various elements of the display will update, such as the calibration title, the type ("Target"), and the black bar. When the 1000 µS calibration is selected the screen will appear as in Figure 11.

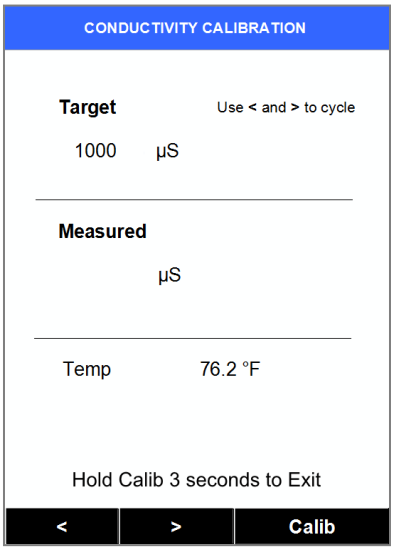


Figure 11

8) Press OK key (labeled Calib) to confirm the specific Conductivity calibration desired. The screen will update as in Figure 12.

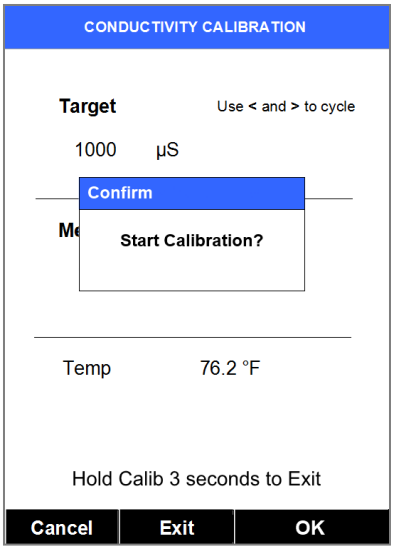


Figure 12

9) Start the calibration by a press of OK key (skip 9 and 10).
10) Or, press Cancel (< key) to return to the Conductivity calibration selection screen (as in Figure 10). If desired, the conductivity calibration type can be changed with use of “>” or “<”.
11) Or, press Exit (> key) to abandon calibration, and return to the basic read mode (Figure 1). No calibration will be done.
12) After successful conductivity calibration, the meter will read the sample and display the value in the measured section. A slight variance from the target is not problematic. A message will display in red “Calibration Succeed”. The meter display will appear similar to Figure 13.

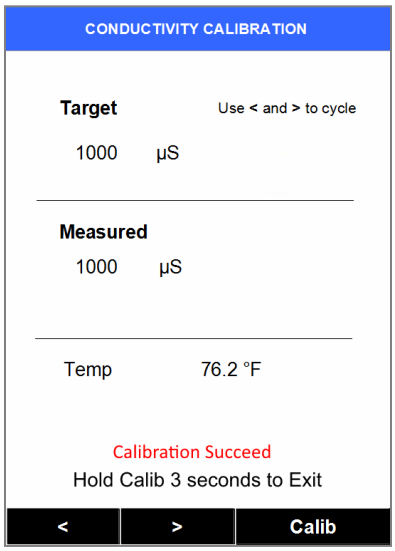


Figure 13

13) After successful calibration, press and hold OK key for 3 seconds (labeled Calib), to return to the basic read (measurement) screen. Return to read mode is not automatic, except through a power-off cycle.

14) The unit will auto-read the conductivity and PTSA of a fresh sample in the measurement cell without further key presses. Allow 5-10 seconds for the meter to stabilize after closing the light shield. The new sample should be rinsed at least twice in and out of the chamber to ensure no carryover from the standard or other samples. If the display darkens, press any key to re-set the timer. If multiple samples are being done this will be necessary to prevent the automatic power down that protects the battery life.

Quick Tips

1) If the 1000 µS Conductivity is the desired calibration, then the key presses from the beginning (including power on) are: OK, > (C-CAL), > and > (to move to 1000 µS), OK (confirm 1000), and OK (start calibration). A final long press of OK (3 seconds) exits to read.
2) 500, 2500 and 5000 µS all work like 1000 µS except there will be different numbers of > presses to cycle to the one desired. The screens will appear as above except for the value of the target.
3) Other conductivity values can be calibrated. The User Defined procedure will be required, and the appropriate conductivity solution desired. Ensure the value set matches the conductivity standard used. See the User Defined procedure.

4.3 User Defined Conductivity Calibration Procedure

1) Rinse sample cell with desired conductivity standard.
2) Power on by a press of OK key. Allow 5-10 seconds for meter to stabilize.
3) A screen similar to Figure 14 will appear. The unit is reading both conductivity and PTSA. The PTSA will be low or zero if the standard is solely a conductivity one. The conductivity reading should be close but not necessarily the same as the value of the standard added.

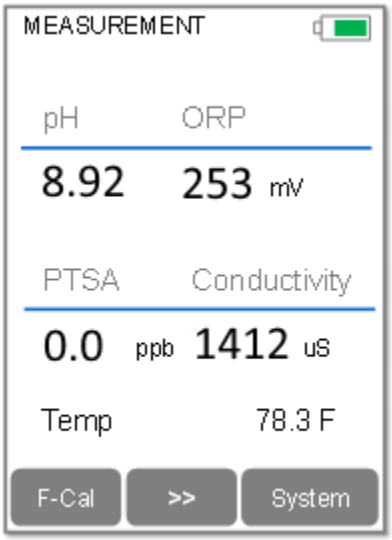


Figure 14

Press C-Cal labeled key (>).

4) A screen similar to Figure 15 will appear. The normal default conductivity calibration mode is the Combined Calibration, but is easily changed to the other calibration modes as desired.

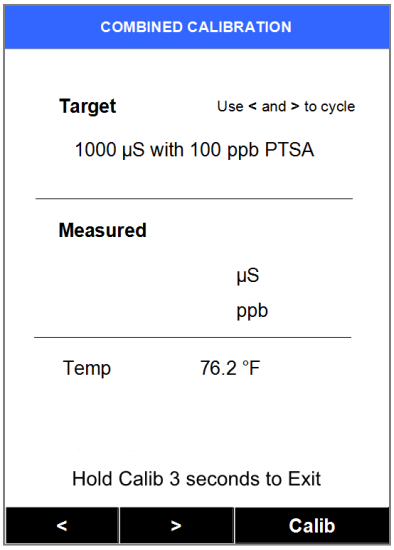


Figure 15

5) Use the < or > keys to cycle to the User Defined calibration. With each press various elements of the display will update, such as the calibration title, the type (“Target”), and the black bar. When the User Defined calibration is selected the screen will appear similar to Figure 16.

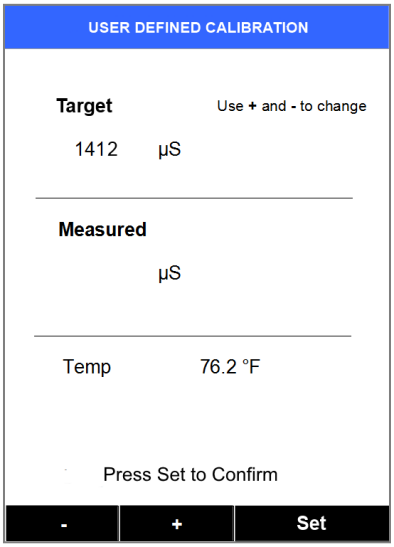


Figure 16

6) If the displayed Target numeric value is not that desired, use the - and + labeled keys (< or >) to adjust the value to that desired. Holding them down will scroll the values at a speedier rate. Once the value is as desired, press Set (OK) to confirm the numeric value to be used. Ensure the selected value matches the standard being calibrated with. The black bar will update as in Figure 17 (it now shows Calib rather then Set). Press Calib (OK). The screen will update to Figure 18 with the Confirmation popup.

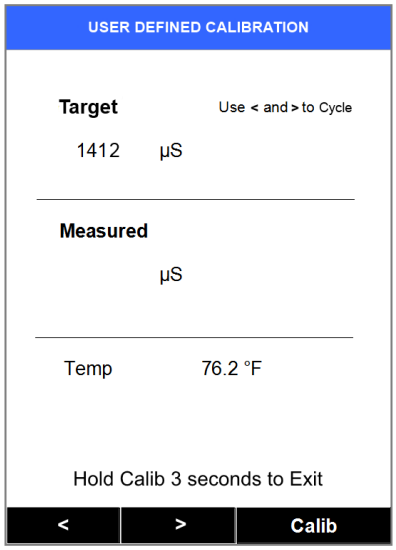


Figure 17

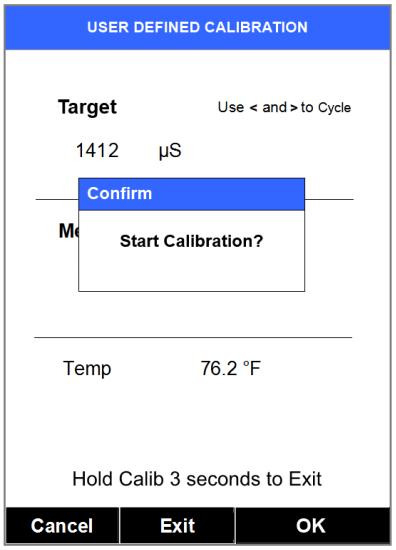


Figure 18

7) Press OK key to execute the User Defined Conductivity calibration. (Skip 9 and 10.)
8) Or, press Cancel (< key) to return to the User Defined Calibration (as in Fig. 3), where if desired, the numeric valued of the desired User Defined calibration value can be changed with use of "-" or "+".
9) Or, press Exit (> key) to abandon calibration, and return to the basic read mode (Figure 14). No calibration will be done.
10) After successful User Defined calibration, the meter will read the sample value and display the value in the measured section. A slight variance from the target is not problematic. A message will display in red "Calibration Succeed". The meter will appear similar to Figure 19, depending on the value selected for the User Defined numeric value.

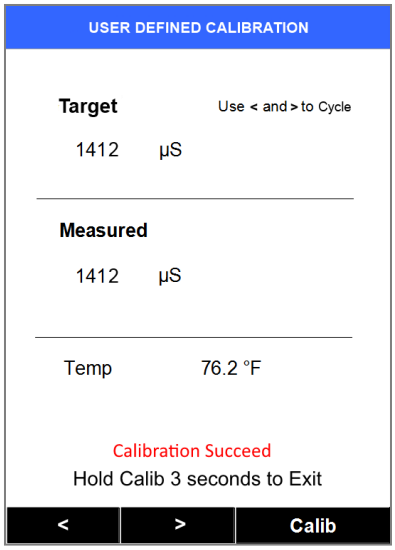


Figure 19

11) After successful calibration, hold for a long press (3 seconds) the Calib key, to return to the basic read (measurement) screen. Return to read mode is not automatic, except through a power-off cycle.
12) The unit will auto-read the conductivity and PTSA of a fresh sample in the sample cell without further key presses. Allow 5-10 seconds for the meter to stabilize after closing the light shield. The new sample should be rinsed at least twice in and out of the chamber to ensure no carryover from the standard or other samples. The unit will power down if no further key presses, after 40 seconds (darkens at 20). Press of any key will re-set the timer, and allow additional time. If multiple samples are being done, this will be necessary to prevent the automatic power down that protects the battery life.

Quick Tips

1) If the initial displayed numeric value for the User Defined target in Figure 16 is that desired, then a short key press path (including power on) are: OK, >, <, OK, OK, OK, and a long 3 second press of OK to return to read mode. (Using < here will go directly to User Defined rather than all possible target calibration types.)
2) If after Figure 15 (Step 6) a path showing all calibration targets types is desired, use a > rather than < as above (< goes directly to User Defined, > goes in the "opposite direction). This will need more > presses then the single < press above.
3) If in Figure 16, the user defined numeric value must be adjusted, additional use of + or – (as < or >) in Step 7 will be required, in addition to the keys listed in Quick Tip 1.
4) Once the target selection focus has been moved to User Defined as in Figure 16 and show the - and + labels on the black bar, the keys are no longer set to cycling through the calibration types but to adjust the User Defined numeric value. To get back to being able to cycle the types, you must go forward to the pop up screen of Figure 18 and Exit. From Figure 16, press OK, twice (once as Set and once as Calib), until the pop up appears. Then press > (Exit). ("Cancel" will return you to adjusting the User Defined target numeric value.) Press C-CAL and you will be able to cycle through the conductivity calibrations as desired.

4.4 Combined Calibration Procedure

The combined 100 ppb PTSA and 1000 µS calibration requires the Pyxis PTSA-1010C PTSA/Combined stamdard.

1) Rinse sample cell with Combined Standard and close light shield.
2) Power on by a press of OK key. Allow 5-10 seconds for meter to stabilize.
3) A screen similar to Figure 20, the basic Measurement (read) screen, appears.

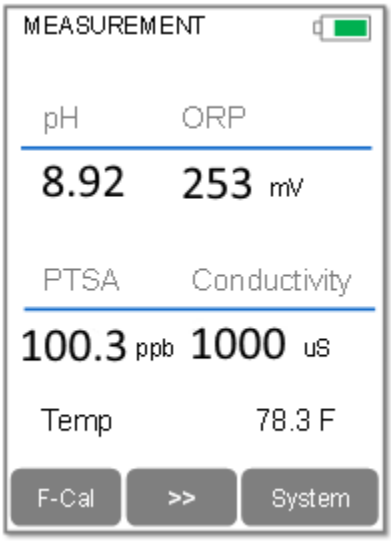


Figure 20

The unit is actively reading and displaying both PTSA and Conductivity.

4) Press C-Cal labeled key (>).
5) The default conductivity calibration screen appears (Figure 21), the Combined Calibration. This will calibrate both Conductivity (at 1000 µS) and PTSA (at 100 ppb) when using the appropriate Combined Standard. However, if desired the conductivity calibration that is to be performed can be easily changed to several others (see the other Calibration Procedures). Otherwise, proceed with the steps below for use with the Combined Standard.

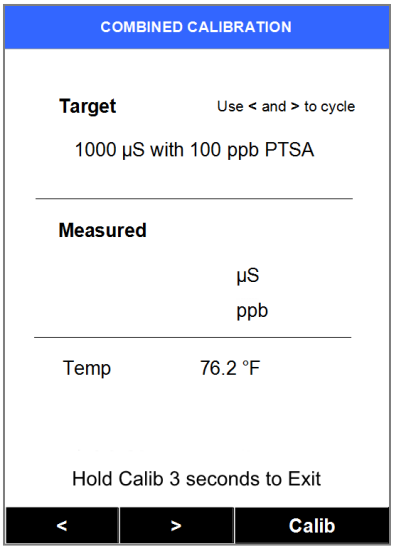


Figure 21

6) Ensure the Meter is filled with Combined Standard and press Calib labeled key (OK) to confirm the desired calibration.
7) A Confirmation popup will appear as in Figure 22.

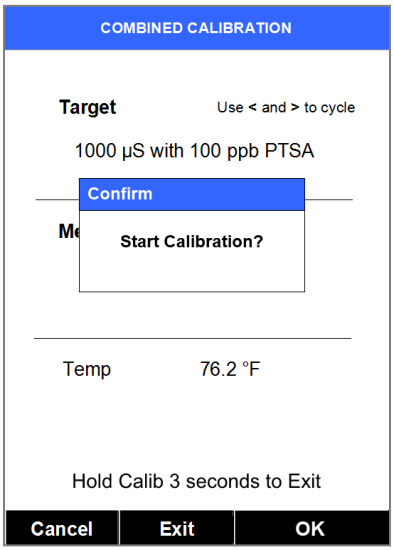


Figure 22

8) Press OK key to execute both conductivity and PTSA calibrations. (Skip 9 and 10.) Only 1 key press is needed.
9) Or, press Cancel (< key) to return to the conductivity calibration type selection screen (as in Figure 21), where if desired the calibration can be changed with use of "<" or ">". (In this case

ensure the correct standard is present for the conductivity calibration desired. See the other Conductivity Calibration Procedures.)

10) Or, press Exit (> key) to abandon calibration, and return to the basic read mode (Figure 20). No calibration will be done.

11) If Combined Calibration is successful, the Measured field will update to the Target conductivity value (1000 µS), or very close. A small variance is not problematic. A checkmark will show. The screen will momentarily appear as in Figure 23.

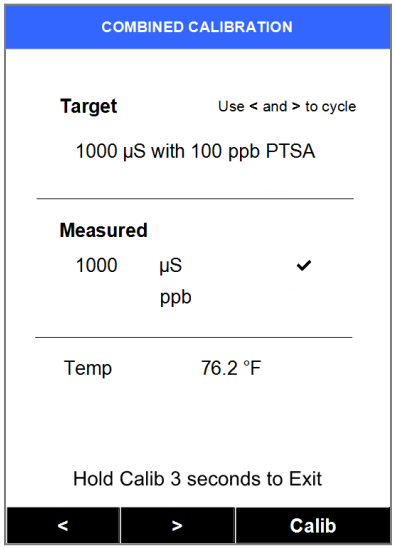


Figure 23

12) After a second, if the PTSA calibration is successful, the PTSA value will also be displayed in the Measured section below the conductivity value, and a checkmark will appear. A small variance is acceptable. The message “Calibration Succeed” will appear in red, as in Figure 24.

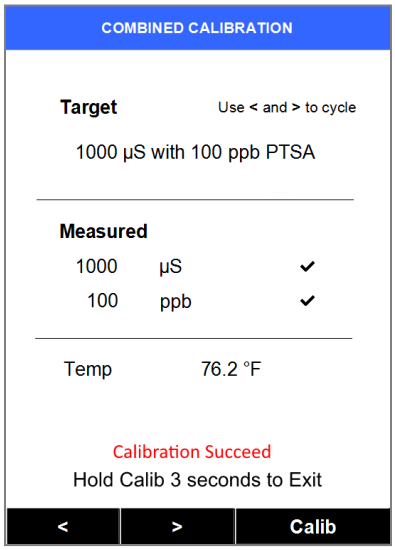


Figure 24

13) After successful calibration, press and hold the Calib key for 3 seconds to return to the basic read screen (Figure 20). Return is not automatic, except through a power-off cycle. Do not do so before the second checkmark and the message appear, or the calibration will not complete.

Quick Tips:

1) If the Combined Calibration is default, the key presses from the beginning including power on are OK, >, OK, OK. Then a 3 second long press of OK to return to the read mode.
2) Rinse the sample chamber well, at least twice, with the standard, before turning on.
3) After returning to read mode after calibration, rinse several times with the first sample. The unit will continue to read the sample values without any further key presses if it has not powered off. If there are no key presses for 20 seconds the screen will darken, and after another 20 seconds without key activity will power down. The press of any key while the screen is dark will re-set the timer and the screen will re-light. (This press will not step along the calibration process; the next press needed will still be required in the sequence).
4) Always rinse the unit with clean water after use and dry by clean tissue or paper towel. Be gentle handling the open light shield.

5 pH and ORP Calibrations

The commonly used pH 4.00, 7.00, and 10.00 buffer standards can be used to calibrate the SP-700 pH measurement.

Unlike the pH calibration, ORP calibration procedure and the calibration standards are not standardized by the industry or government institutions. We recommend that you use Zobell's ORP standards to calibrate the SP-700 and pay attention to the reference electrode on which the ORP value is referenced. The reference information must be specified by the standard supplier.

5.1 pH Electrode Calibration

The SP-700 software is designed to provide a flexible calibration procedure. You can start with the one-point pH 7 calibration and progressively add a second point and a third point calibration with the pH 4 buffer and the pH 10 buffer. This allows you to choose a procedure based on the need of measurement accuracy and the target pH range.

After the meter is powered on, press **>>** key until the left key label becomes **pH-Cal**, which indicate pH calibration. Press **pH-Cal** to start.

One-Point Calibration

pH 7 calibration is a must and the most important one for pH electrode calibration. Rinse the pH/ORP cell three times with the pH 7 buffer and fill the cell with the pH 7 buffer.

Click **pH-7** button to start one-point calibration. A check mark after **Click pH-7** will be displayed if the calibration succeeds. Otherwise a warning message will be displayed.

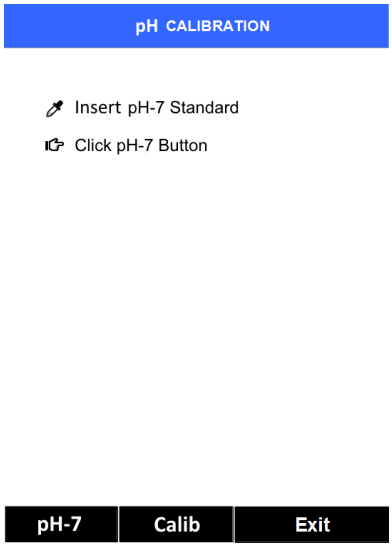


Figure 25

Second Point Calibration

When the one-point pH 7 calibration is done, you can exit by pressing **Exit** key or continue to the pH 4 or pH 10 calibration. If a second buffer is added into the cell, the SP-700 will automatically determine the buffer pH and display the determined buffer pH value for confirmation.

If you choose the pH 4 buffer to do the second-point calibration, the pH 4 buffer will be identified and the value 4.00 will be shown. Click **Calib** button to complete the pH 4 calibration. A check mark after **Click pH-4** will be displayed if the calibration succeeds. Otherwise a warning message will be displayed.

Alternatively, you can use the pH 10 buffer for the second-point calibration.

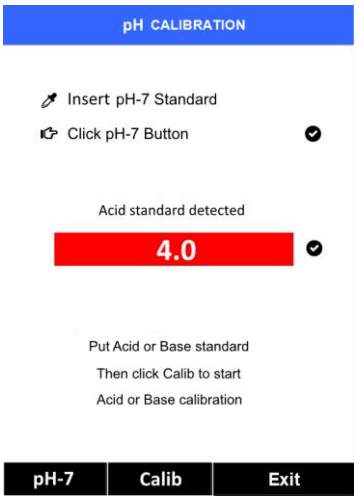


Figure 26

Third Point Calibration

When the second point calibration is done, you can exit by pressing **Exit** key or continue to a third point calibration. If you have used the pH 4 buffer in the second-point calibration, you will have to use the pH 10 buffer for the third-point calibration.

Rinse the pH/ORP cell three times and fill the cell with the pH 10 buffer. The pH 10 buffer will be automatically identified. Click Calib button to complete the third-point calibration. A check mark after Click pH-10 will be displayed if succeed. Otherwise a warning message will be displayed. Press Exit to finish the final calibration process.

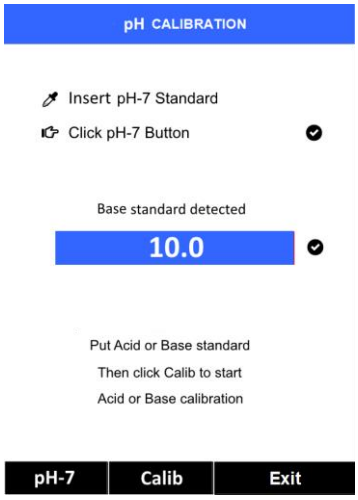


Figure 27

5.2 ORP Calibration

Press **<<** until the left key label becomes **O-cal**. Press **O-cal** to launch the ORP calibration screen.

Press **+** or **-** to select a ORP value to match your ORP standard. Press **Calib** to complete the calibration.

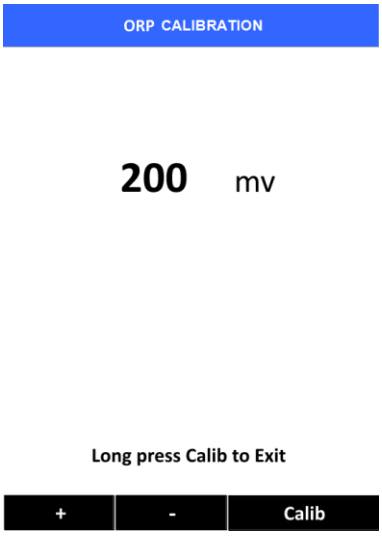


Figure 28

The ORP scale of the SP-700 depends on the ORP scale of the calibration standard. As an example, if the value of 220 mV for the common Zobell's standard at 25 °C is entered in the above calibration, the ORP value reported by the SP-700 after calibration will be referenced to the Ag/AgCl(3M KCl) scale. This is because the value of 220 mV is based the Ag/AgCl(3M KCl) reference electrode. If the value entered in the above calibration is 429 mV, the ORP value reported by the SP-700 will be referenced to the SHE because the value of 429 mV at 25 °C for the Zobell's standard is SHE based.

The value in the following table can be used to convert the Ag/AgCl reference electrode based ORP value to the SHE based ORP value. To obtain the SHE based ORP value, add the number in the table to the corresponding Ag/AgCl reference electrode based value. To use the table, the temperature of the standard solution measured by the SP-700 must be used.

Temperature	Ag/AgCl (1M KCl)	Ag/AgCl (3M KCl)	Ag/AgCl (saturation KCl)
68 °F (20 °C)	+234	+213	+202
77 °F (25 °C)	+231	+209	+199
86 °F (30 °C)	+228	+205	+196

6 Device Information and Diagnosis

The device information is shown when the Info labeled OK key in the measurement mode is pressed momentarily (Figure 3). The screen contains the device serial number, software version, and hardware version (Figure 34). The battery life as a percentage and the standard that was used in the last calibration are also shown.

Press the diagnosis labeled key to switch to the diagnosis screen where raw measurement data are displayed (Figure 35). The information has no use for normal operation. Please provide an image of both the device information screen and the diagnosis screen when you contact Pyxis (service@pyxis-lab.com) for troubleshooting your device.

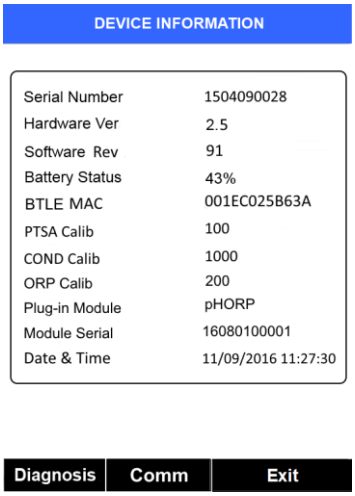


Figure 29

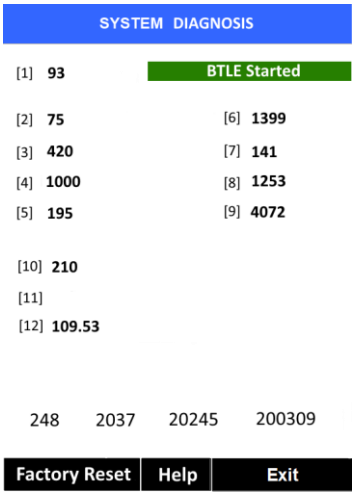


Figure 30

7 Maintenance

It will greatly improve the working life if following best practice of maintenance is followed:

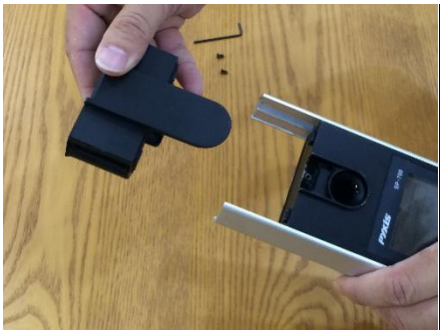
- As a general rule, rinse the meter with tap water or DI water after measurement and remove residual water using a paper towel.
- Close down the light shield firmly to keep the pH and ORP cell wet.
- Add the pH storage solution to the pH/ORP cell if the meter is not going to be used for more than a week.
- Use a Q-tip to gently clean the inside of fluorescence and conductivity cell to remove any deposit that may have attached to the optical and electrode surface.
- Completely wet the fluorescence and conductivity cell for an hour before a measurement, if the meter has not been used for more than a week.

8 Replacing pH and ORP Module

The pH/ORP module in the SP-700 can be replaced when the original module reaches its working life.

Order a replacement module from Pyxis and follow instructions as below.

1. Turn off the meter if it is powered on.
2. Make sure there is no water in the two measurement cells.
3. Use the provided hex wrench to remove the two hex screws that fasten the module to the main body of the SP-700 meter in the front and the back.
4. Use two hands to hold the SP-700 main body and push the pH//ORP module forward by two thumbs until it is unlocked from the main body.
5. Further push or pull the module away from the side aluminum rails.
6. Remove the new module from the sealed bag and carefully insert it into the rails.
7. Push firmly to make the module align with meter body.
8. Secure the two new hex screws using the hex wrench.



9 Bluetooth Connection

The Pyxis SP-700 can be connected to a smart phone or a computer via built-in Bluetooth Low Energy Connection (BTLE).

A laptop with Pyxis Nebula software, available at www.pyxis-lab.com/support.html, can use the Bluetooth adapter, coming with the SP-700 as standard accessory, to connect to the SP-700 for parameter configuration, firmware upgrading, and other tasks.

The SP-700 can scan, discover, and calibrate a nearby Pyxis inline probe with a Bluetooth adapter connected (see next section).

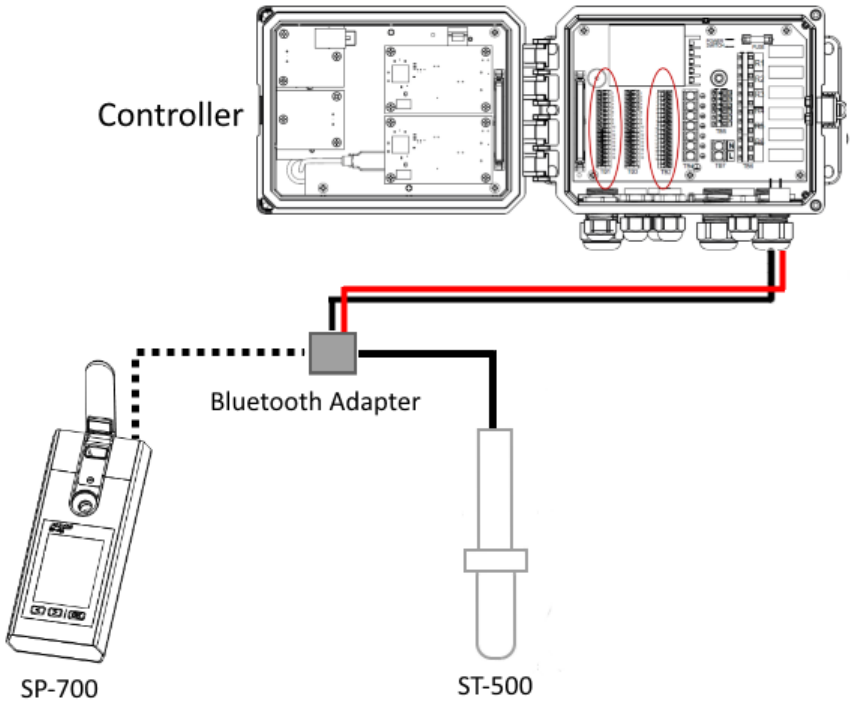


Figure 31

The SP-700 can be paired with other Pyxis devices for exchanging data over Bluetooth. In the normal operation modes, the Bluetooth function is turned off. To turn on the Bluetooth wireless function, please click **System**, then click **Comm.**

If you want to explore more and latest the SP-700 wireless functions, please contact Pyxis Lab Inc. (service@pyxis-lab.com) for support.

10 Calibrate ST-500 with SP-700

The SP-700 can be used to verify the result of inline Pyxis ST-500 and other probes by measuring the sample water taken from the inline probe sample line. The SP-700 can then be used to calibrate the inline probes over the Bluetooth connection.

Click **System** key and then **Comm** key to enter the communication module. The following interface then appears on the screen.

Figure 32

Click **Scan** key. A list of accessible ST-500(s) will be displayed. Use **>>** button to select the one to be calibrated. Click **Connect** key to connect the SP-700 to the selected ST-500.

Figure 33

Once the connection is established, the SP-700 will read the latest reading from the connected ST-500 and display the reading as shown in Figure 30.

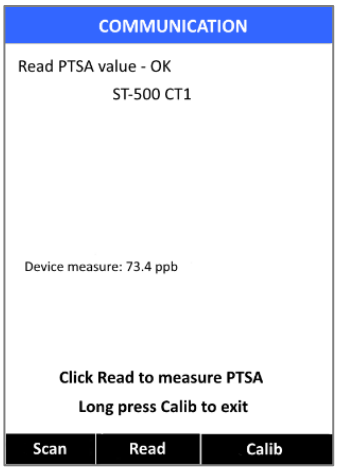


Figure 34

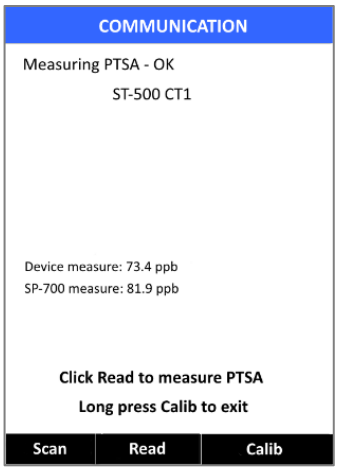


Figure 35

Use the SP-700 meter to measure the sample water by clicking **Read** key. The PTSA value will be displayed on the screen right below the ST-500 readings as shown in Figure 31. Click **Calib** to send the calibration instruction to the ST-500 via Bluetooth connection. After that, the connected ST-500 will be calibrated to the value measured by the SP-700. The SP-700 will read the ST-500 for three times to verify if the calibration is successful. Please note that it takes about a minute for the ST-500 to approach the calibrated reading and the three verifying readings may not be exactly the same as the value measured by the SP-700 as demonstrated in Figure 33. Click Read again to take more readings from the ST-500 if necessary.

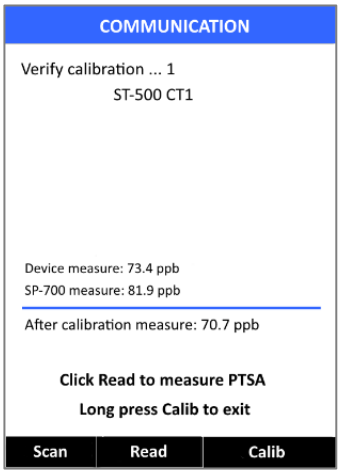


Figure 36

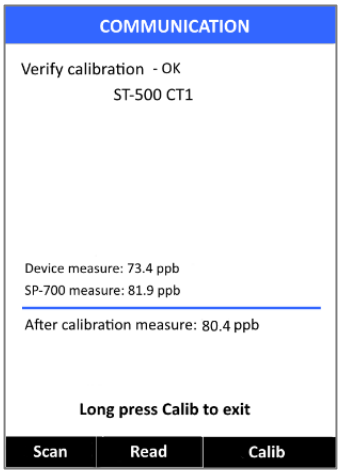


Figure 37