

SOP 1.6: Use of Hydrolab DS5X Sonde: Communication, Calibration, Sensor Checks, and Operation

This document provides the guidelines for the operation of the Hydrolab DS5X water quality sonde. For additional guidance and troubleshooting please refer to the [Hydrolab DS5X, DS5, and MS5 Water Quality Multiprobes user manual](#).

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I. Equipment and Supplies

Equipment:

- Hydrolab DS5X Sonde
- Laptop with Hydras3LT software
- Fully charged Trimble Recon (Handheld controller)
- Hydrolab Communications Cable
- Calibration cup for DS5X
- Rinse bottle for DI water
- Rinse containers for calibration fluids
- Thermometer
- YSI ProPlus Meter
- YSI 650 MDS

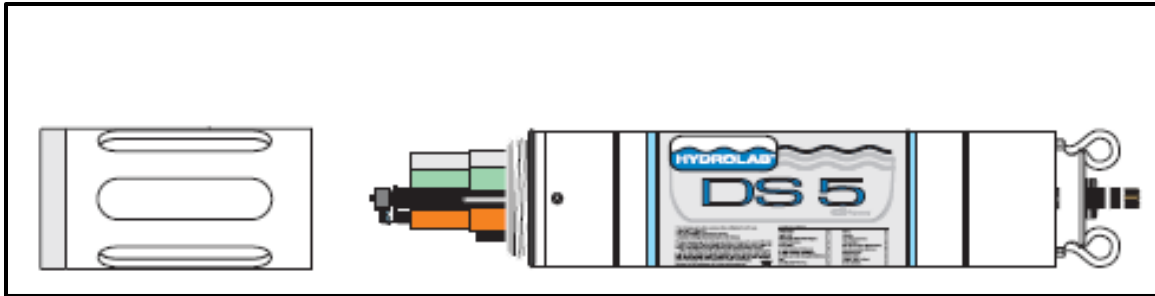


Figure 1. Image of Hydrolab DS5X.

Supplies:

- Calibration standards
 - o pH (4, 7, 10)
 - o Conductivity (typically 1412)
 - o Calibration check solutions (pH, conductivity)
 - o Deionized (DI) or distilled water
- 5-gallon bucket (for DO calibration)
- Aquarium pump with airstone
- 1-litre bottle
- 5-gallon bucket (for waste fluids)
- Lint-free wipes (e.g. Kimwipes)
- 8 C- Batteries
- Multiple soft bristled toothbrushes
- Cotton swabs and balls
- Data Sheets

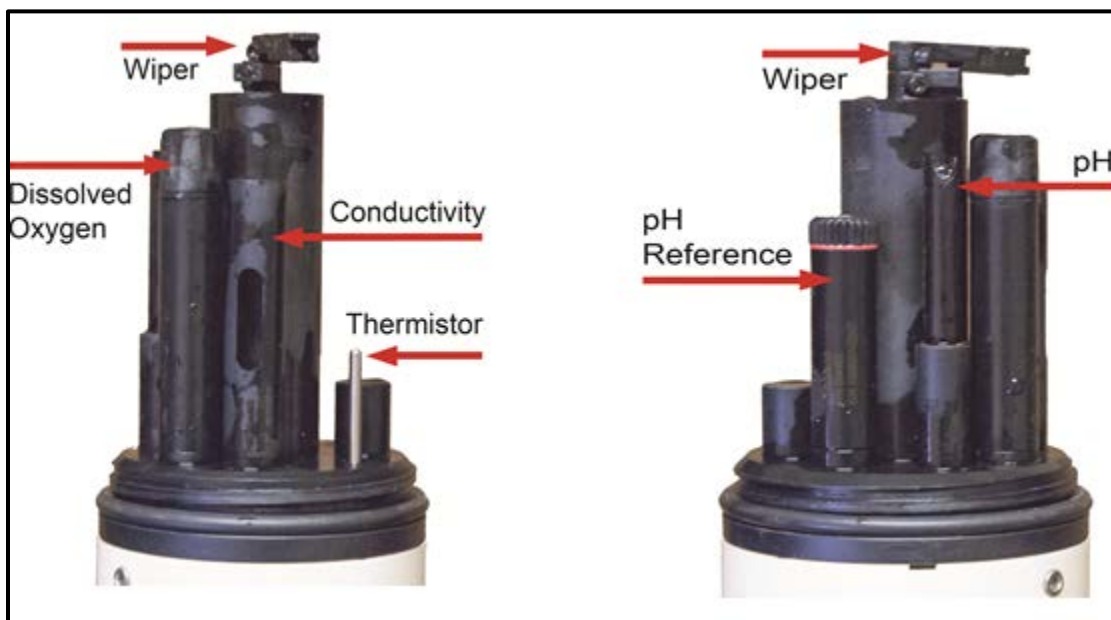


Figure 2. Image of DS5X sensors.

II. Communication

A. Hydrolab DS5X Sonde to laptop pc with Hydras3L software

Prior to calibration or deployment of the DS5X sonde the unit must be connected to and programmed by a laptop pc running Hydras3L software.

- (1) Connect Hydrolab communication cable to serial port (9-pin) on pc
- (2) Connect the other end of the cable to communication port (6-pin) on DS5X sonde (found under rubber guard at the top of the unit)
 - a. Ensure proper alignment of female port on cable with male communication post
 - i. One post is larger than the other 5 posts, raised nipple on cover indicates the location of the larger female port on the cable

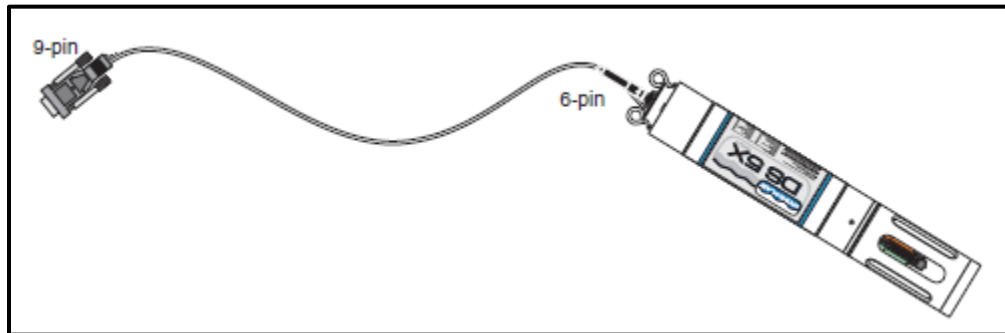


Figure 3. DS5X with communication cable.

- (3) Ensure both ends of cable and seated fully in the ports (be sure air is “burped” between the o-rings on the communication port of the sonde and the cable)
- (4) Launch Hydras3L software and scan for sondes
- (5) Highlight connected sonde and click button to Operate Sonde

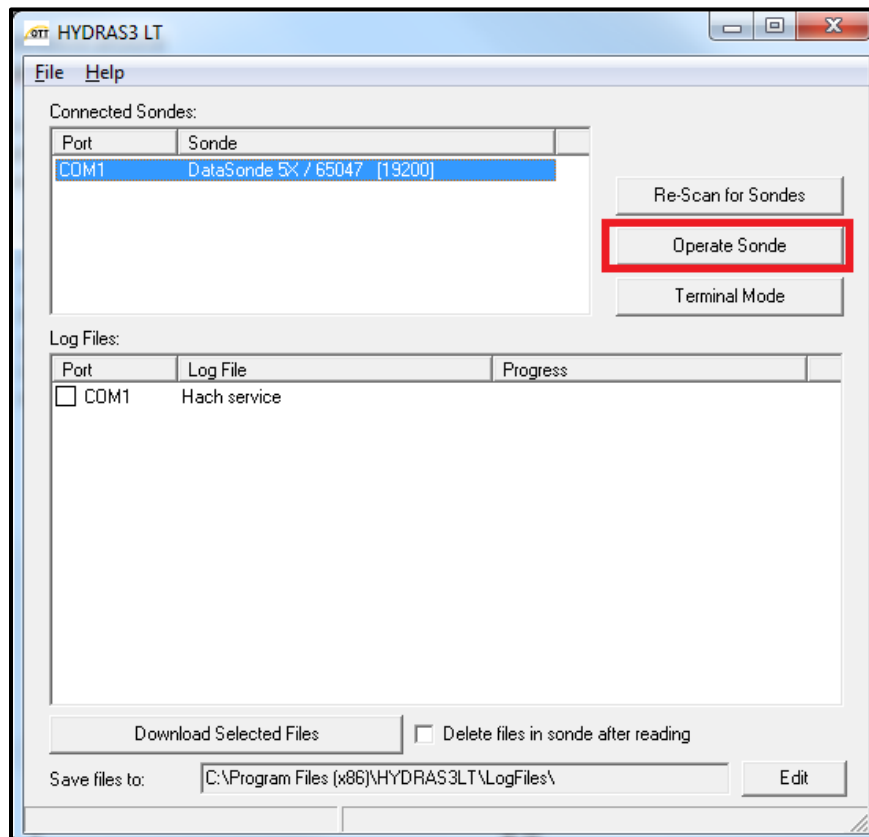


Figure 4. Hydras3 LT launch screen.

III. Configure DS5X Sonde

Prior to initial deployment, the DS5X sonde must be configured using the Hydras3L to ensure proper setup. There are numerous options concerning which parameters are recorded as well as the interval which the data will be logged to the sonde's internal memory. To expedite the post processing of data, it is important that a uniform format is used when setting up the log file to record unattended data with the sonde. The parameters logged will be set prior to deployment in the field. During the initial deployment of a sonde or after any factory maintenance event, the parameter set up should be reset to MIDN preferences as follows:

A. Initial parameter setup:

Establish and check that the sonde is configured correctly to carry out full calibration and deployment procedures.

- (1) Connect DS5X to the pc and launch Hydras3L software (See § II. Communication)
- (2) In System Tab select "Set clock to PC time"

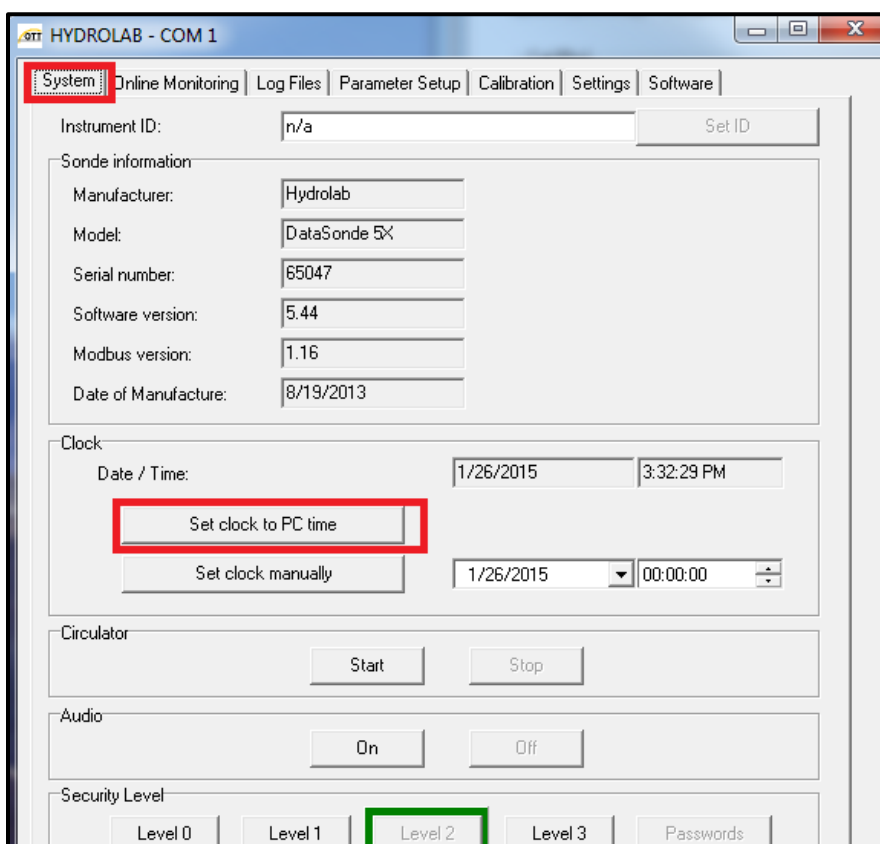


Figure 5. Hydras3LT sonde main menu.

- (3) Select "Parameter Setup" tab
- (4) Select "pH [Units] tab
- (5) Change Cal[pts] to "3" for three point calibration
- (6) Select "Save Settings"

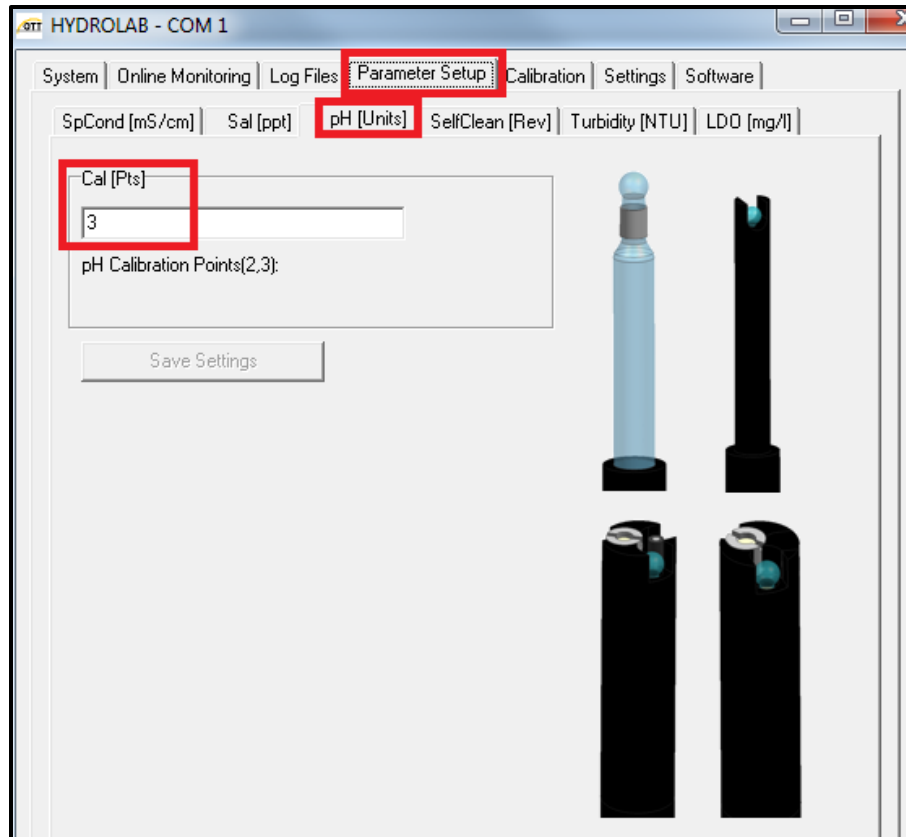


Figure 6. Hydras3LT parameter setup screen.

(7) Maintain default settings for all other parameters

- a. SpCond
 - i. Cond Temp Comp: Fresh
 - ii. Set Range: Auto
 - iii. Set Cal Points: 1:2 Cal
- b. Sal
 - i. Salinity Method: 1:2311
- c. SelClean
 - i. Rotations: 1
- d. Turbidity
 - i. Points: 2
- e. LDO
 - i. Average: 10

(8) Select "Calibration" tab; the sonde is now ready to be calibrated.

IV. Calibrate Hydrolab DS5X Sonde

To ensure reliable, accurate data is collected the sonde should be calibrated on a regular basis along with calibration checks. There are a variety of sensors available for the sonde and calibration procedures vary accordingly. The following section will describe the procedure for the most common sensors available with the sonde. For more specific information or procedures for alternate sensors please contact MIDN staff or refer to [Hydrolab documentation](#). Calibration procedures are generally

performed in a laboratory setting unless changes in barometric pressure require field calibrations (e.g., change in elevation to calibrate depth sensor).

****It is critically important to record all calibration data on calibration data sheets and take clear, concise notes on any abnormal conditions. Calibration data can be used to apply corrections to field data and can be used in the data grading procedures (see SOP 2.3 for more detail)****

A. General Calibration Procedures

The sonde housing and sensors should be thoroughly cleaned prior to calibration. Prior to calibration of **each** parameter the user must complete the full rinse procedure:

*****For each sensor there is a common rinse and priming procedure to ensure accurate environmental conditions in the calibration chamber (i.e. the pH 10 buffer is not contaminated by pH 4 buffer). *****

- (1) Triple rinse calibration cup and sonde sensors thoroughly with distilled or deionized water
- (2) Triple rinse calibration cup and sonde sensors with appropriate calibration fluid

*****When new calibration fluids are used once they should be retained in a container clearly marked "Rinse" for that particular fluid. This fluid can then be used to complete the initial two rinses called for under this procedure*****

- a. Fill calibration cup with appropriate calibration fluid from "Rinse" container
 - i. Use enough fluid to thoroughly rinse all surfaces within the calibration cup once attached to sonde housing
 - ii. Attach calibration cup to sonde housing
 - iii. Rinse all surfaces within the cup with the calibration fluid by rotating and shaking the sonde housing
 - iv. Discard fluid in waste container
 - b. Repeat rinse procedure with used ("Rinse") fluid (when available)
 - c. On the third and final rinse use **only new** calibration fluid and retain the new calibration fluid in the "Rinse" container for that fluid
- (3) Calibration cup and sensors are now primed and ready for actual calibration **with new calibration fluid**

Table 1. Rinse procedures.

Rinse #	Fluid	Source Container
1	Distilled Water	Gallon Jug
2	Distilled Water	Gallon Jug
3	Distilled Water	Gallon Jug
4	Used Calibration Fluid	Rinse Container
5	Used Calibration Fluid	Rinse Container
6	New Calibration Fluid	New Standard Bottle
Calibrate	New Calibration Fluid	New Standard Bottle

New calibration fluid used during the actual calibration should also be retained in the appropriate “Rinse” container

B. Available Parameters for Calibration

A variety of sensors are available for use in the Hydrolab DS5X multi-parameter sonde. In this monitoring program the 4 “core parameters” will be calibrated with optional additional sensors (e.g., depth, turbidity). These sensors should be calibrated in a specific order to follow best practices and further limit the chance for errors in calibrations due to contamination. Calibrations should occur in the following order:

- (1) Temperature Check
- (2) Specific Conductance
- (3) pH (7→10→4)
- (4) Dissolved Oxygen
- (5) Depth

C. Calibration Procedures

All Calibration information is to be recorded on a calibration data sheet in the water quality log book for the site where the sonde was deployed.

- (1) Connect DS5X to pc and launch Hydras3L software (see Communication section above)
- (2) Select “**Calibration**” tab
- (3) For each parameter that follows, select the appropriate tab to calibrate that sensor

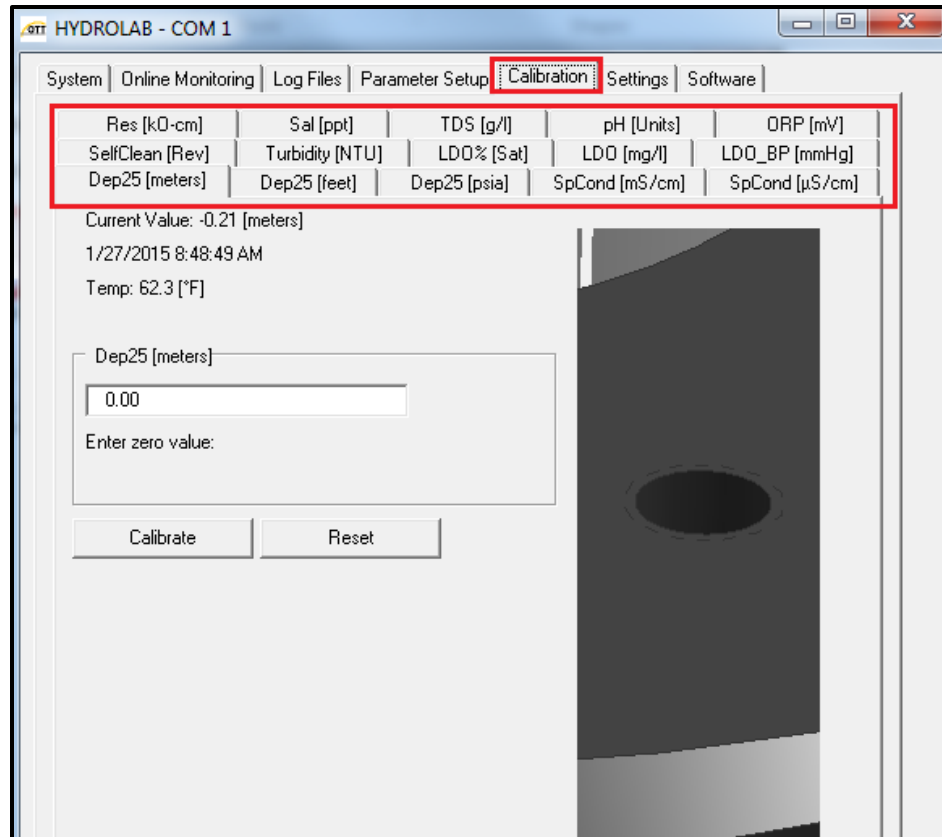


Figure 7. Hydras3LT calibration screen.

1. Temperature

The thermistor on the sonde cannot be calibrated outside of the factory setting. However, this probe should be sensor checked during each calibration using an alternate device.

(1) During calibration procedure:

- a. Submerge sonde thermistor and alternate thermometer in ambient temperature fluid
- b. On a calibration data sheet in the WQ log book, record:
 - i. Reference Thermometer value
 - ii. DS5X thermistor value
- c. If sensor check fails, repeat sensor check in alternate fluid
 - i. Be sure there is no contact between temperature sensing equipment on container walls, only contact with liquid
- d. If sensor check continues to fail troubleshoot equipment or replace sensor

Table 2. Temperature error check limit.

Sensor Check Error Limit		
CORE PARAMETER	Sensor Measurement (NPS acceptance/rejection criteria)	Optimum Goal/Target (Range) (USGS criteria)
Temperature	$\pm 0.3^{\circ} \text{C}$	$\pm 0.2^{\circ} \text{C}$

2. Conductivity (as specific conductance)

- (1) Rinse calibration cup and all sensors following rinse procedure

Rinse #	Fluid	Source Container
1	Distilled Water	Gallon Jug
2	Distilled Water	Gallon Jug
3	Distilled Water	Gallon Jug
4	Wipe sensor dry	kemwipes
Calibrate	air	air

- (2) Ensure conductivity sensor is dry
(3) From “Calibration” tab select “SpCond($\mu\text{S}/\text{cm}$)” tab
(4) Enter 0 for SpCond standard in the calibration screen
(5) Observe “Current Value” data and wait for specific conductance data ($\mu\text{S}/\text{cm}$) to stabilize
- stable reading is where specific conductance does not change by more than 1 $\mu\text{S}/\text{cm}$ in 10 seconds
- (6) On a calibration data sheet in the WQ log book, record:
- Pre-Calibration SPC value
 - Temperature
 - Standard solution SPC value
- (7) Select “**Calibrate**”
(8) Rinse calibration cup and all sensors following rinse procedure

Rinse #	Fluid	Source Container
1	Distilled Water	Gallon Jug
2	Distilled Water	Gallon Jug
3	Distilled Water	Gallon Jug
4	Used Calibration Fluid	Rinse Container
5	Used Calibration Fluid	Rinse Container
6	New Calibration Fluid	New Standard Bottle
Calibrate	New Calibration Fluid	New Standard Bottle

- (9) Fill calibration cup with the specific conductance standard solution so that the conductivity probe and thermistor are completely submerged in the calibration solution
(10) Note the standard solution value from the bottle on the calibration data sheet (typically a 1412 $\mu\text{S}/\text{cm}$ standard solution is used for calibration)
(11) From “Calibration” tab select “SpCond($\mu\text{S}/\text{cm}$)” tab
(12) Enter standard solution value from bottle in the calibration screen
(13) Observe “Current Value” data and wait for conductivity data ($\mu\text{S}/\text{cm}$) to stabilize
(14) On a calibration data sheet in the WQ log book, record:
- Pre-Calibration SPC value
 - Temperature
 - Standard solution SPC value

(15) Select “Calibrate”

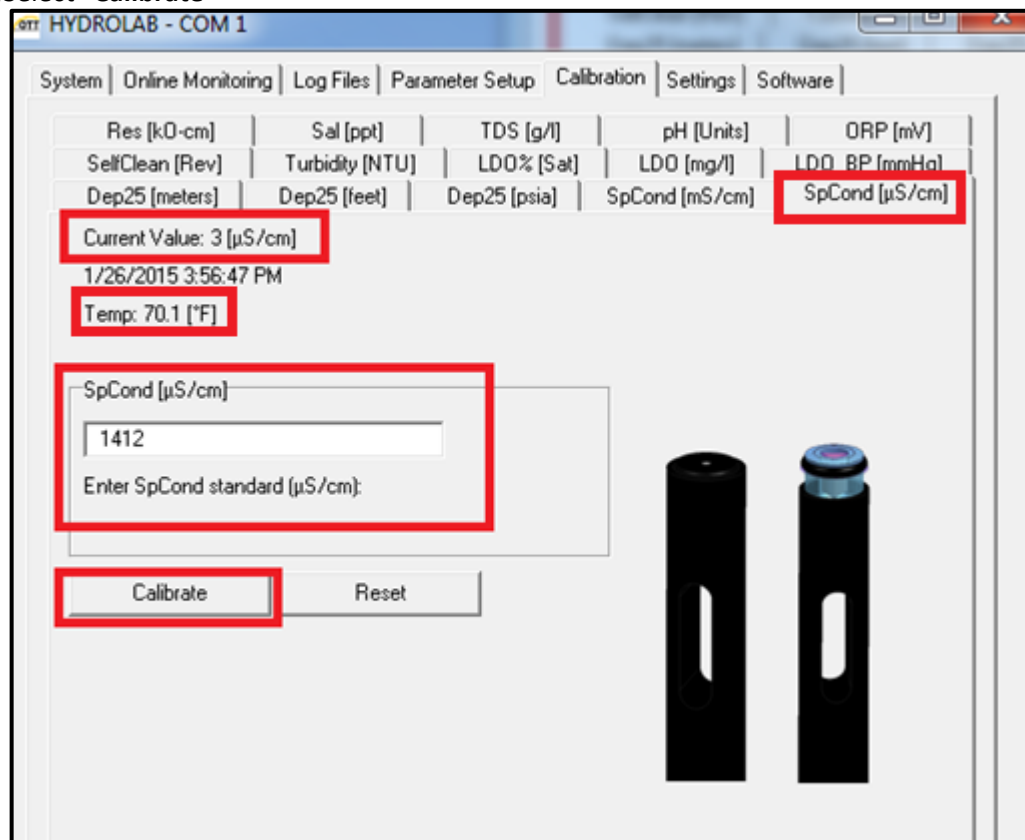


Figure 8. Hydras 3LT specific conductance calibration screen.

(16) If you do not receive a successful calibration message stop and troubleshoot

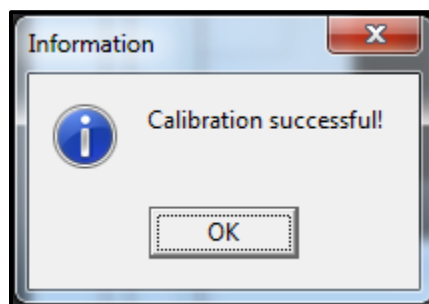


Figure 9. Calibration message.

(17) On calibration data sheet in the WQ log book, record:

- a. Post-Calibration SPC value
- b. Temperature

(18) Ensure post-calibration value meets quality control criteria (Table 3)

Table 3. Specific conductance error check limit.

Sensor Check Error Limits		
CORE PARAMETER	Sensor Measurement (NPS acceptance/rejection criteria)	Optimum Goal/Target (Range) (USGS criteria)
Specific Conductance	$\pm 5 \mu\text{S/cm}$ or $\pm 3\%$ ⁽¹⁾	$\pm 5 \mu\text{S/cm}$ or $\pm 3\%$ ⁽¹⁾

(1) whichever is greater

3. pH

A three point calibration procedure is used to bracket the expected pH range found in environmental waters. The sensor should be calibrated in order starting with the pH 7, then pH10, and finish with the pH 4. This is a best practice as pH 7 serves as the 0 point for a linearity check and pH 10 is more sensitive to contamination than the pH 4 solution.

- (1) Check Teflon pH reference junction
 - a. If excessively fouled replace with alternate junction (see DS5X user manual)
- (2) Remove pH reference probe housing and replace pH reference electrolyte

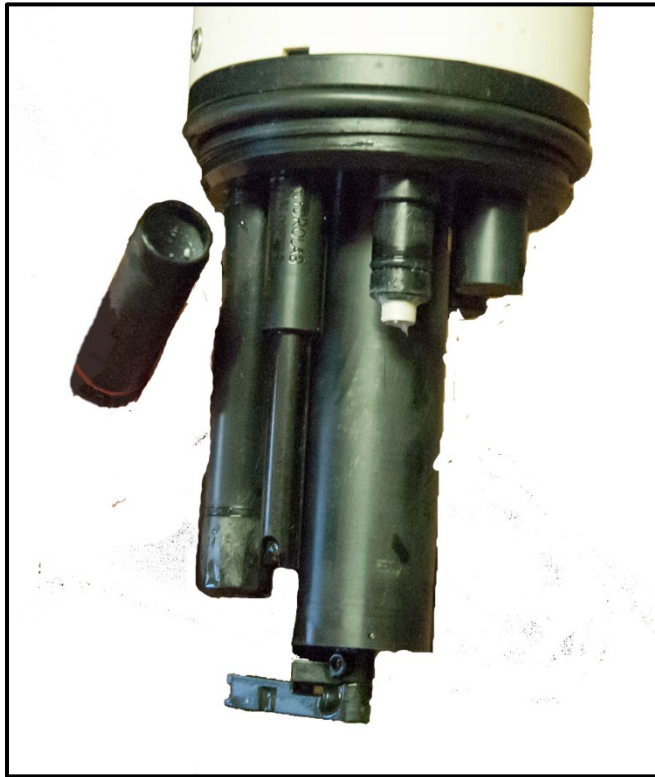


Figure 10. Sensor bulkhead with pH reference housing removed.

- a. Discard electrolyte in sensor housing
 - b. Refill with Hydrolab reference electrolyte (Catalog # 005308HY)
 - c. Add two-three salt pellets (Catalog # 005376HY) to reference electrolyte in housing
 - d. Ensure o-ring on sonde bulkhead is clean and in good condition
- (3) Re-install pH reference housing onto sonde bulkhead
 - a. A small amount electrolyte should pass through the Teflon junction

- i. If this does not happen or junction is discolored the Teflon junction should be replaced
 - b. Ensure housing is fully seated against sensor bulkhead
- (4) Rinse calibration cup and all sensors following rinse procedure

Rinse #	Fluid	Source Container
1	Distilled Water	Gallon Jug
2	Distilled Water	Gallon Jug
3	Distilled Water	Gallon Jug
4	Used Calibration Fluid	Rinse Container
5	Used Calibration Fluid	Rinse Container
6	New Calibration Fluid	New Standard Bottle
Calibrate	New Calibration Fluid	New Standard Bottle

- (5) Fill calibration cup with enough pH buffer to submerge the pH sensor along with the thermistor
- (6) From “Calibration” tab select “**pH [Units]**” tab

****pH should be set for a three point calibration (see Configure DS5X sonde above). If not this must be corrected and the communication with the sonde must be completely severed and the Hydras3L software launched again. To check, there should be a field to enter “Cal Point on the pH tab****

- (7) Enter the appropriate Cal Point and temperature corrected pH value for the **pH7 buffer** (pH values vary depending on ambient temperatures, temperature corrected values can be found printed on the label of the appropriate buffer solution)

Table 4. pH order of calibration.

Order of Calibration	pH Buffer Value
First	7
Second	10
Third	4

- (8) Observe Current Value data and wait for pH data to stabilize
 - a. stable reading is where pH does not change by 0.02 pH units in 10 seconds

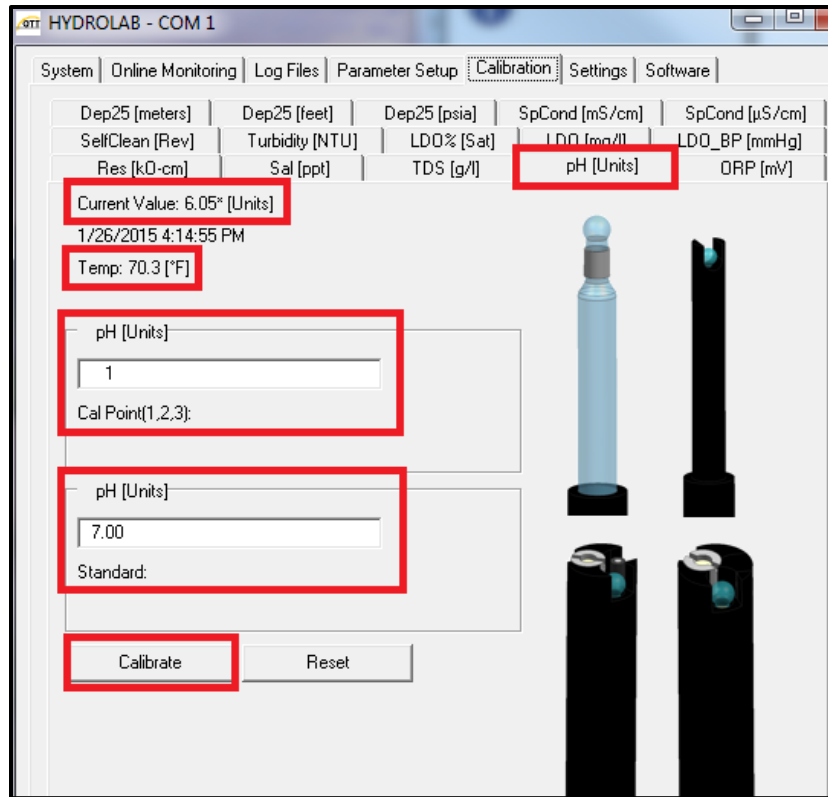


Figure 11. Hydras 3LT pH calibration screen.

- (9) On a calibration data sheet in the WQ log book, record:
 - a. Temperature corrected pH standard value
 - b. Pre-Calibration pH value
 - c. Temperature
- (10) Select **“calibrate”**
- (11) If you do not receive a “Calibration Successful” message stop and troubleshoot

After the first calibration point has been recorded in the sonde memory an asterisk (*) should appear next to the “Current Value” data. This asterisk will no longer appear once the third calibration point has been entered
- (12) On a calibration data sheet in the WQ log book, in the post calibration field record:
 - a. “Current Value” in pH Post-Calibration field
 - b. Ensure that Post-Calibration values fall within sensor check error limits (see table below)
 - i. If Post-Calibration values fall outside of error check limits stop and troubleshoot sensor
- (13) Repeat steps 1-2 ensuring you complete the full rinse procedure for **pH 10 buffer**
- (14) Repeat steps 4-10 for **pH 10 buffer**
- (15) Repeat steps 1-2 ensuring you complete the full rinse procedure for **pH 4 buffer**
- (16) Repeat steps 4-10 for **pH 4 buffer**
- (17) **After last calibration point is entered and “Calibration Successful” message has been dismissed the “*” will disappear**
- (18) Ensure post-calibration values meet quality control criteria (Table 5)

Table 5. pH error check limit.

Sensor Check Error Limits		
CORE PARAMETER	Sensor Measurement (NPS acceptance/rejection criteria)	Optimum Goal/Target (Range) (USGS criteria)
pH	± 0.3 S.U.	± 0.2 S.U.

4. Dissolved Oxygen

Dissolved oxygen (DO) is calibrated in an air-saturated water environment which results 100% DO saturation. Hydrolab recommends two methods for calibrating 100% saturation values for the LDO sensor. The preferred method to create a 100% saturated environment requires a common aquarium air pump and a five gallon bucket. Alternatively, 100% saturation environment can be achieved using a 1 liter bottle.

- (1) Air-saturated water environment (Aquarium pump method):
 - a. Fill a 5-gallon bucket 1/2 - 3/4 full of tap water
 - b. Use a common aquarium air pump with air stone for at least 12 hours to obtain 100% saturation of dissolved oxygen



Figure 12. Air-saturated water aquarium pump setup.

- c. Triple rinse sensors on sonde with distilled or deionized water prior to calibration
- d. Install field sensor guard on sonde to protect sensors when the sonde is placed in the 5-gallon bucket

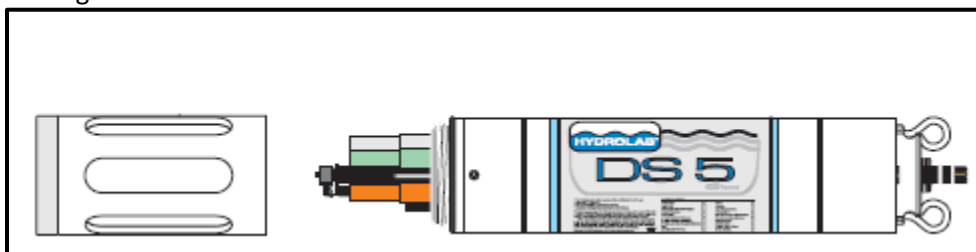


Figure 13. DS5X with sensor guard.

- e. The **air stone should be removed** from the 5-gallon bucket prior to the sonde being placed in the bucket for the calibration procedure
 - f. See section (3) below to continue calibration procedure
- (2) To create air-saturated water environment (1 liter bottle method):
- a. Triple rinse sensors with distilled or deionized water
 - b. Fill 1 liter bottle ~50% with water (water should be at equilibrium with atmospheric pressure and ambient temperature)
 - c. Seal the bottle and shake it vigorously for 60 seconds
 - d. Position sonde so that the sensor is upright with the calibration cup fully attached to the sonde housing
 - e. Remove cap at the end of the calibration cup and fill the calibration cup with aerated water from the 1-liter bottle so that the LDO sensor and thermistor are fully submersed
 - f. Flip the calibration cup cap and place the flat end so that it rests fully over the calibration cup (prevent exchange of air between the open environment and the calibration chamber)
 - g. Ensure the calibration cup is not in direct sunlight or any other heat source, a stable temperature environment between the thermistor and LDO sensor is important

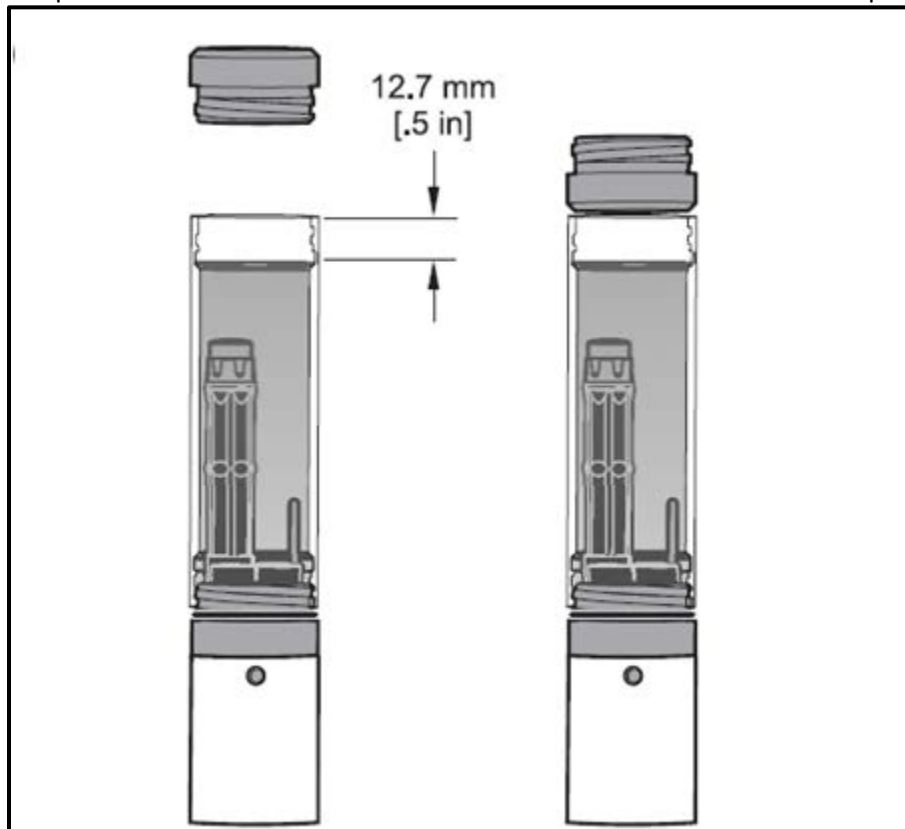


Figure 14. Bottle method for creating air-saturated water.

- (3) After 100% DO saturated environment has been achieved:
- a. From “Calibration” tab select “LDO% [Sat]” tab

- b. Obtain local barometric pressure from alternate meter listed below (c) or local weather bureau station (d)
- c. Both YSI ProPlus meters and YSI 650MDS have integrated barometers
- d. If local weather bureau is used, ensure that the barometric pressure value is the local value and not corrected to sea level which is common practice
 - i. $BP' = BP - 2.5(E_m/30.5)$
 - 1. BP' = Local barometric pressure
 - 2. BP = Barometric pressure at sea level
 - 3. E_m = Elevation in meters

***** Using local barometric pressure from the YSI ProPlus or YSI 650MDS is preferred to using a value from a weather bureau*****

- (4) Enter local barometric pressure value into LDO_BP [mmHg] field
- (5) Observe “Current Value” data and wait for Saturation data to stabilize
 - a. Stable DO reading is one where temperature values do not change more than 0.1 °C and DO values do not change more than 0.01 mg/L within 10 seconds
 - b. Allow approximately 3-5 minutes to ensure the temperature of the LDO sensor cap and thermistor have equalized

*****Do not select calibrate until after steps 8 – 11 have been completed*****

- (6) On a calibration data sheet in the WQ log book, record:
 - a. Circle Calibration Method
 - b. Start time (when sonde entered 100% saturated environment) and time at calibration
 - c. Current value [Sat]
 - d. Local barometric pressure value
 - e. Temperature

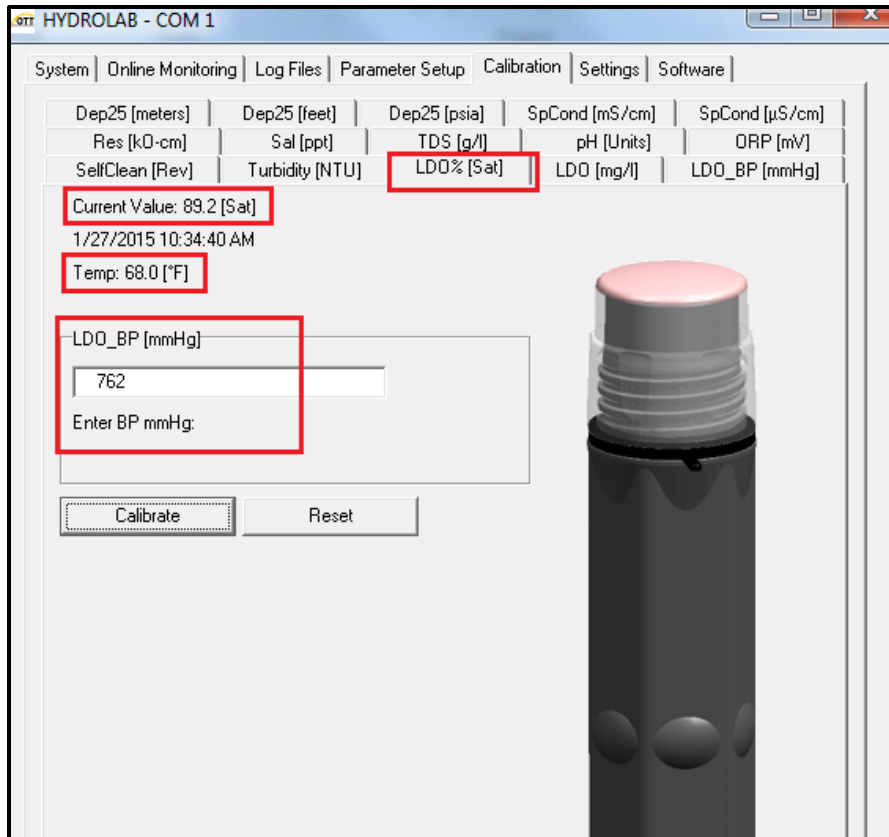


Figure 15. Hydras 3LT LDO % saturation calibration screen.

****Do not calibrate at this point, the LDO value in mg/l must be recorded prior to calibration of the sensor****

- (7) Select "LDO [mg/l]" tab
- (8) On a calibration data sheet in the WQ log book, record:
 - a. Current Value [mg/l]

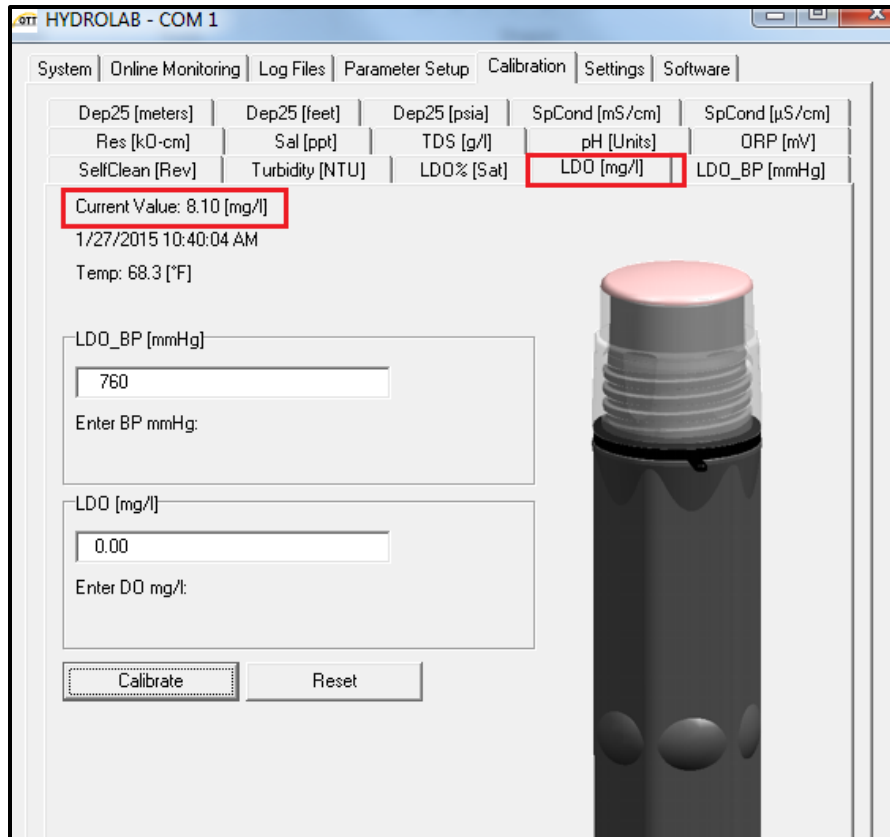


Figure 16. Hydras 3LT LDO (mg/l) calibration screen.

- (9) Return to “LDO% [Sat]” tab
- (10) Select “**Calibrate**”, this will recalibrate the sensor.
- (11) If you do not receive a “Calibration Successful message stop and troubleshoot
- (12) On a calibration data sheet in the WQ log book, in the post calibration field record:
 - a. Current Value [Sat]
- (13) Select “LDO [mg/l]” tab
- (14) On a calibration data sheet in the WQ log book, in the post calibration field record:
 - a. Current Value [mg/l]
- (15) Ensure post-calibration value meets quality control criteria (Table 6)
 - a. Compare observed post-calibration value to theoretical value
 - i. See DO table in log book or [USGS Calculator](#)

Table 6. Dissolved oxygen error check limit.

Sensor Check Error Limits		
CORE PARAMETER	Sensor Measurement (NPS acceptance/rejection criteria)	Optimum Goal/Target (Range) (USGS criteria)
Dissolved Oxygen	± 0.4 mg/L, ± 5% saturation	± 0.3 mg/L, ± 5% saturation

5. Depth

Depth is calibrated with the sensor exposed to atmospheric pressure. The calibration cup should be removed and the sensor bulkhead should be oriented in the same direction as the sonde will be deployed (horizontal or vertical). With the sonde bulkhead exposed to the air, ensure that nothing has plugged the access port to the pressure transducer prior to calibration.

****Sonde must be positioned in the same orientation as it will be within the deployment structure at the stream site****

- (1) Select “Dep25 [meters]” tab
- (2) Enter **0.00** in Depth25 [meters] field
- (3) Observe current value data and wait for depth data to stabilize
- (4) On a calibration data sheet in the WQ log book, record:
 - a. Pre-Calibration depth value
 - b. Barometric pressure
- (5) Select “**calibrate**”

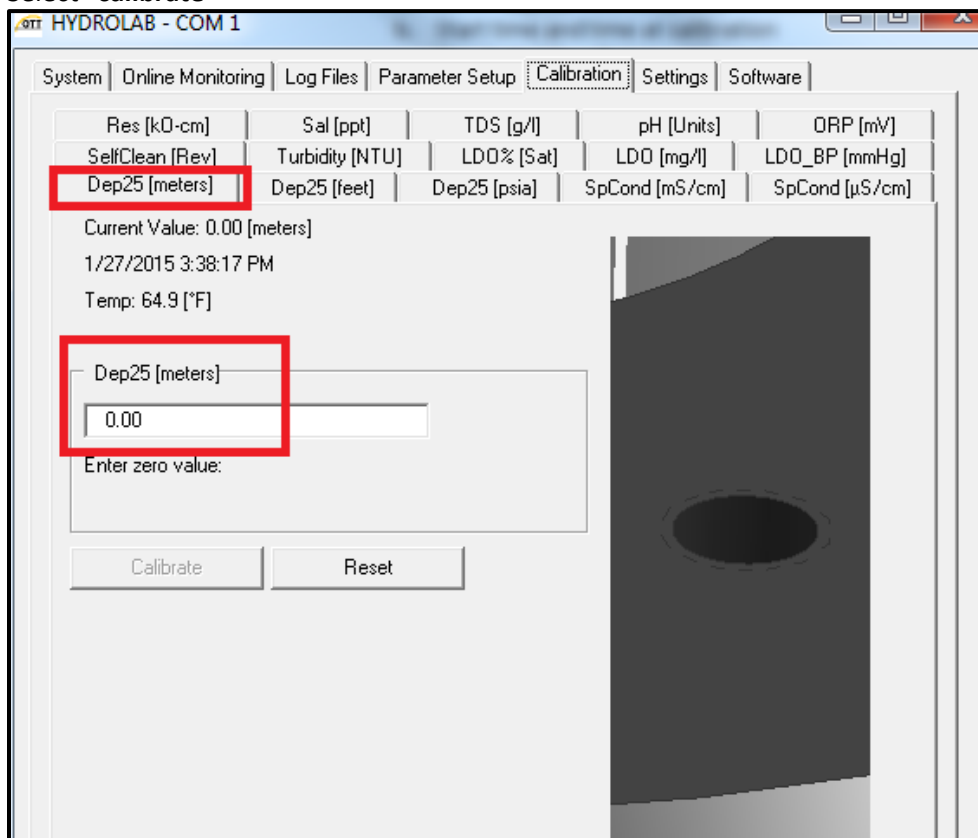


Figure 17. Hydras 3LT depth calibration screen.

- (6) On a calibration data sheet in the WQ log book, record:
 - a. Post-Calibration depth value

V. Calibration Check

Following each calibration and prior to field deployment, each sensor should be checked against known standards for adherence to quality control objectives. Sensor calibrations should occur as soon as

possible following removal from the field site. Calibration checks should occur no more than two days prior to scheduled field deployment of sonde. See Site Visit Procedures for Maintaining Continuous Monitoring Equipment (SOP 1.10) for guidance on when a sonde requires calibration after a field deployment.

Table 7. Sensor error check limits for water quality parameters.

Sensor Check Error Limits		
CORE PARAMETER	Sensor Measurement (NPS acceptance/rejection criteria)	Optimum Goal/Target (Range) (USGS criteria)
Temperature	$\pm 0.3^{\circ} \text{C}$	$\pm 0.2^{\circ} \text{C}$
Specific Conductance	$\pm 5 \mu\text{S/cm}$ or $\pm 3\%$ ⁽¹⁾	$\pm 5 \mu\text{S/cm}$ or $\pm 3\%$ ⁽¹⁾
pH	$\pm 0.3 \text{ S.U.}$	$\pm 0.2 \text{ S.U.}$
Dissolved Oxygen	$\pm 0.4 \text{ mg/L}$, $\pm 5\%$ saturation	$\pm 0.3 \text{ mg/L}$, $\pm 5\%$ saturation
Turbidity	$\pm 3 \text{ NTU}$ or 5%	$\pm 0.5 \text{ NTU}$ or 5%

1. Temperature

- (1) Connect DS5X to pc and launch Hydras3L software (see Communication section above)
- (2) Select “Online Monitoring” tab
- (3) Select “Start” to initiate live sampling

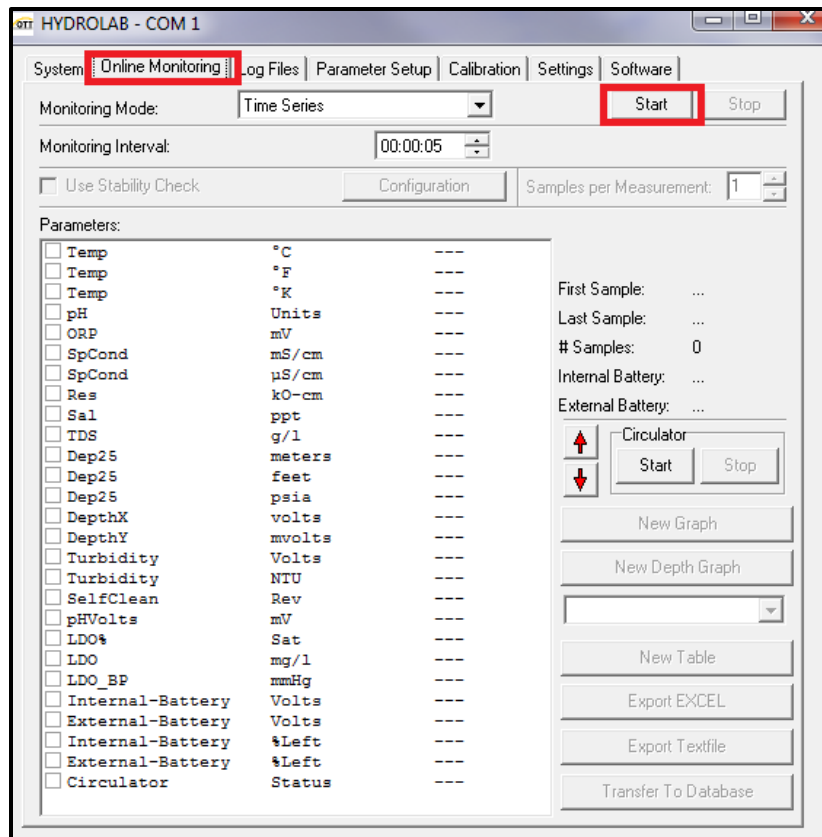


Figure 18. Hydras3LT live values screen.

- (4) Check "Internal Battery" status to ensure it is greater than 7 v

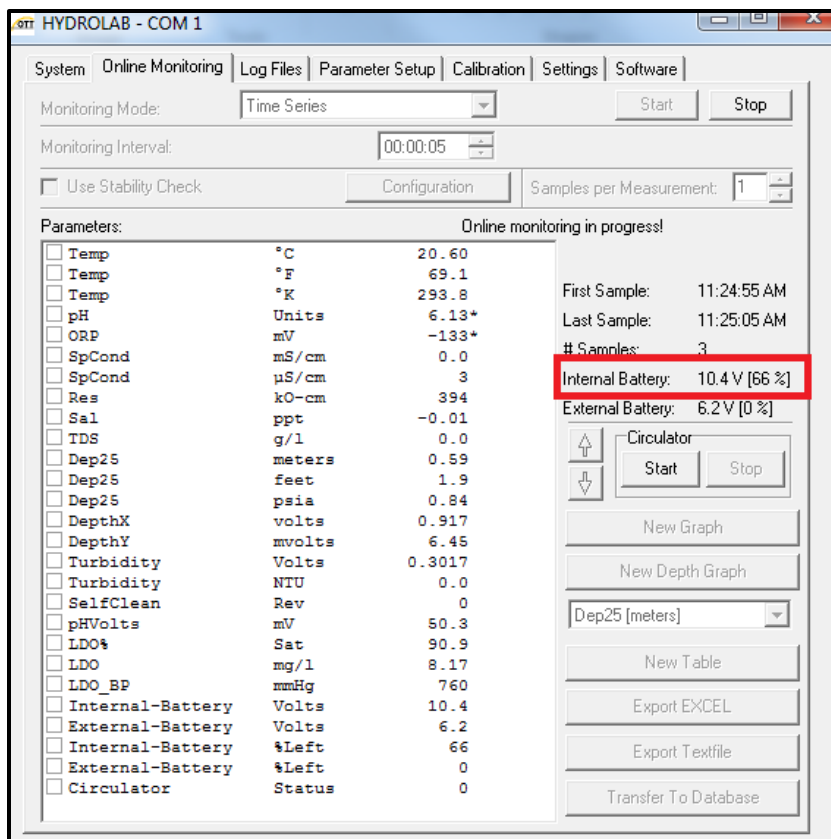


Figure 19. Live values screen with battery status highlighted.

- (5) Submerge sonde thermistor and alternate thermometer in ambient temperature fluid
- (6) On a Pre-Deployment data sheet (see attached) in the WQ log book, record:
 - a. Reference Thermometer Value
 - b. Sonde Thermistor Value
 - c. If sensor check fails, repeat sensor check in alternate fluid
 - i. Be sure there is no contact between temperature sensing equipment on container walls, only contact with liquid
 - d. If sensor check continues to fail troubleshoot equipment or replace sensor
- (7) Stop the live reading from the Online Monitoring Tab

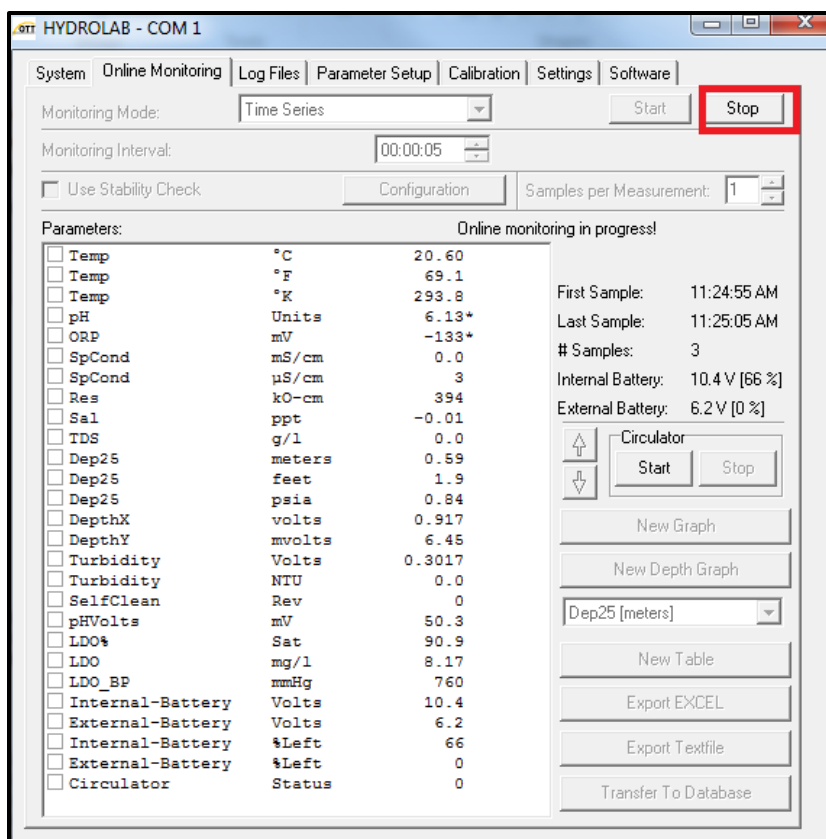


Figure 20. Live values screen with stop monitoring highlighted.

2. Conductivity (as specific conductance)

Conductivity sensor checks should be performed with either the standard solution which was used to calibrate the sensor (typically 1412 $\mu\text{S}/\text{cm}$) or a lower value which better approximates conditions in environmental waters (100 $\mu\text{S}/\text{cm}$ for many MIDN streams) .

- (1) Rinse calibration cup and all sensors following rinse procedure (see above)

Rinse #	Fluid	Source Container
1	Distilled Water	Gallon Jug
2	Distilled Water	Gallon Jug
3	Distilled Water	Gallon Jug
4	Used Calibration Fluid	Rinse Container
5	Used Calibration Fluid	Rinse Container
6	New Calibration Fluid	New Standard Bottle
Calibrate	New Calibration Fluid	New Standard Bottle

- (2) Fill calibration cup with conductivity standard check solution (typically 100 $\mu\text{S}/\text{cm}$ but the 1412 $\mu\text{S}/\text{cm}$ can be used) to completely submerge the conductivity/thermistor probe

- (3) Select "Start" from Online Monitoring tab
- (4) Observe onscreen data and wait for conductivity data ($\mu\text{S}/\text{cm}$) to stabilize
 - a. stable reading is where conductivity does not change by $1 \mu\text{S}/\text{cm}$ in 10 seconds
- (5) On a pre-deployment data sheet in the WQ log book, record:
 - a. Observed SPC value
 - b. Temperature
 - c. Standard SPC solution value
- (6) Check observed value against Specific Conductance quality control standard to ensure value falls within error limits (Table 3)
 - a. If sensor check fails, repeat entire rinse procedure and repeat sensor check
 - b. If this is a pre-deployment check and the sensor continues to fail, repeat calibration procedure and contact Hydrolab technical support
- (7) Stop the live reading from the Online Monitoring Tab

*****Record any relevant information in notes section of data sheet if sensor check fails and is repeated or recalibrated*****

3. pH

pH sensor checks should be performed with a standard value which is near the expected values found in environmental waters.

- (1) Rinse calibration cup and all sensors following rinse procedure

Rinse #	Fluid	Source Container
1	Distilled Water	Gallon Jug
2	Distilled Water	Gallon Jug
3	Distilled Water	Gallon Jug
4	Used Calibration Fluid	Rinse Container
5	Used Calibration Fluid	Rinse Container
6	New Calibration Fluid	New Standard Bottle
Calibrate	New Calibration Fluid	New Standard Bottle

- (2) Fill calibration cup with pH standard to cover pH sensor and thermistor
- (3) Select "Start" from Online Monitoring tab
- (4) Observe onscreen data and wait for pH data to stabilize
 - a. stable reading is where pH does not change by 0.02 units in 10 seconds
- (5) On a Pre-Deployment data sheet in the WQ log book, record:
 - a. Observed value for pH
 - b. Temperature
 - c. Standard pH solution value
- (6) Check observed value against pH quality control standard to ensure pH value falls within error limits (Table 5)
 - a. If sensor check fails, repeat entire rinse procedure and repeat sensor check
 - b. If this is a pre-deployment check and the sensor continues to fail, repeat calibration procedure and contact YSI technical support
- (7) Stop the live reading from the Online Monitoring Tab

*****Record any relevant information in notes section of data sheet if sensor check fails and is repeated or recalibrated*****

4. Dissolved Oxygen

The dissolved oxygen calibration check should occur in the lab along with the other sensor checks **and again immediately prior to deployment at the field site** if there is a change in elevation. This is to ensure that changes in calibration conditions have not occurred due to changes in conditions due to elevation.

- (1) Select “Start” from Online Monitoring tab
- (2) Triple rinse the sensors with distilled or deionized water
- (3) Follow procedures above in Dissolved Oxygen Calibration section to create a 100% oxygen saturation environment
- (4) Place sonde in oxygen saturated environment and allow to stabilize
 - a. stable DO reading is one where temperature values do not change more than 0.1 °C and DO values do not change more than 0.01 mg/L within 10 seconds
- (5) On a pre-deployment data sheet in the WQ log book, record:
 - a. Calibration method (circle one)
 - b. Start time (when sonde entered 100% saturated environment) and time at calibration
 - c. % Saturation value
 - d. mg/l value
 - e. barometric pressure
 - f. temperature
- (6) Ensure DO values fall within error limits (Table 6)
 - a. Compare observed sensor check value to theoretical value
 - i. See DO table in log book or [USGS Calculator](#)
 - b. If sensor check fails, repeat calibration procedure
 - c. Repeat sensor check if sensor is not within error limits (Table 6)
 - d. If this is a pre-deployment check and the sensor continues to fail, repeat calibration procedure and contact Hydrolab technical support

*****Record any relevant information in notes section of data sheet if sensor check fails and is repeated or recalibrated*****

5. Depth

Depth is calibrated with the sensor exposed to atmospheric pressure. The calibration cup should be removed and the sensor bulkhead should be oriented in the same direction as the sonde will be deployed (horizontal or vertical). With the sonde bulkhead exposed to the air, ensure that nothing has plugged the access port to the pressure transducer prior to calibration.

- (1) Select “Start” from Online Monitoring tab
- (2) On a Pre-Deployment data sheet in the WQ log book, record:
 - a. Observed depth value
- (3) Stop the live reading from the Online Monitoring Tab

VI. Operation of Sonde

A. Obtaining Live Readings

This section will describe how to obtain discrete, live values using a Hydrolab DS5X sonde.

- (1) Connect Hydrolab communication cable to serial port (9-pin) on Trimble Recon PDA
- (2) Connect the other end of the cable (6-pin) to communication port on DS5X sonde (found under rubber guard at the top of the unit)
- (3) Ensure both ends of cable and seated fully in the ports (**be sure air is “burped” between the o-rings on the communication port of the sonde and the cable**)
- (4) Launch Hydras3LT Pocket software from Windows start menu on Trimble Recon PDA
- (5) Navigate to live readings:
 - a. Select **“Connect”**

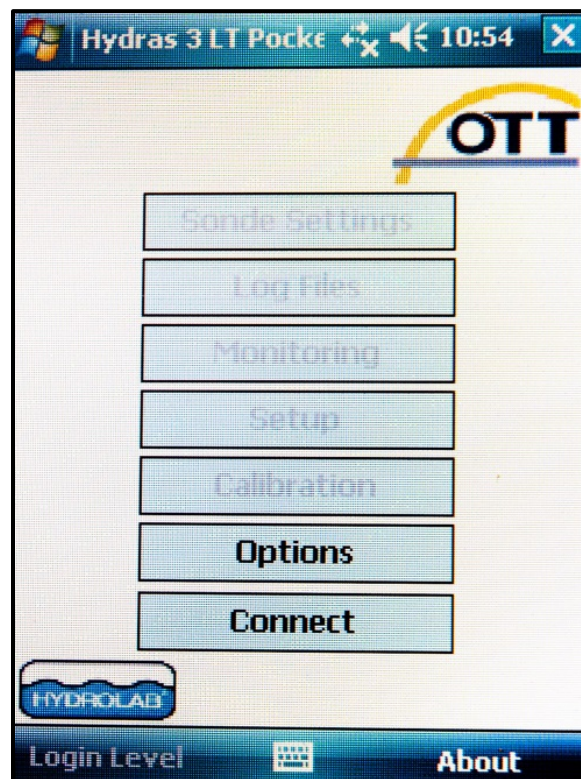


Figure 21. Start menu for Hydras3LT Pocket.

- b. Select **“Monitoring”** after the Trimble Recon has established a connection with the sonde
- c. Select **“Manual Mode”** tab and Select **“Start>>”** button

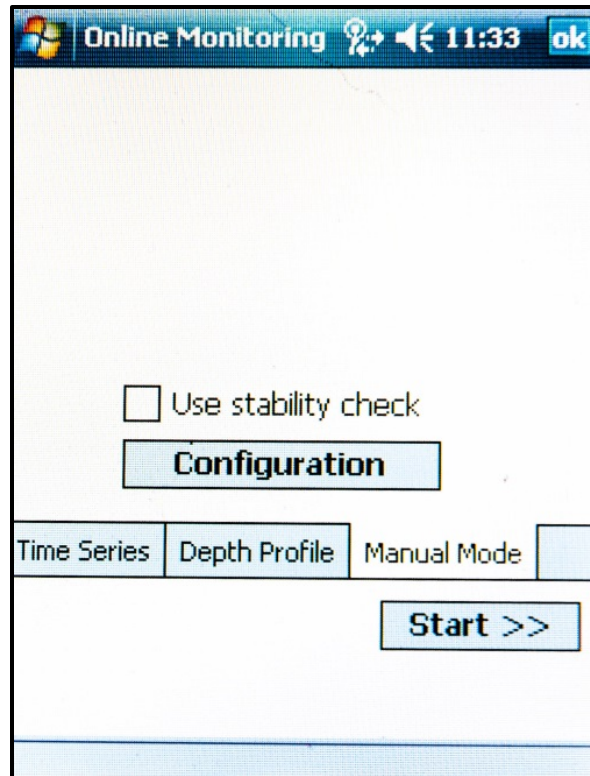


Figure 22. Online monitoring start screen.

- d. Select "**Current Values**" button
 - i. Battery voltage can be captured on this screen

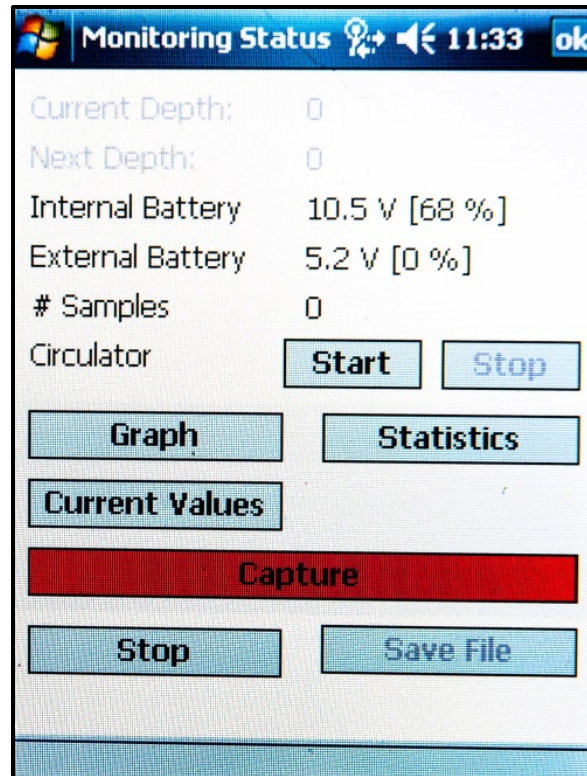


Figure 23. Online monitoring current values screen.

- e. Live reading should now be displayed on the screen

Online Monitoring 11:33 ok	
Parameter	Value
SPCOND [μ S/CM]	0.5
PH [UNITS]	6.12*
LDO% [SAT]	78.8
LDO [MG/L]	7.12
LDO_BP [MMHG]	760
TEMP [°C]	20.34
INTERNAL-BATTERY [VO...]	10.5

Parameter:	LDO_BP [MMHG]
Add	Delete
Capture	

Figure 24. Live values from online monitoring.

- f. Select “ok” from upper right corner to return to previous screen
- g. Select “Stop” button
- h. Do not save file

B. Battery Replacement

- (1) Prior to deployment replace batteries in the sonde

- a. Remove battery cover from the top of sonde to access battery compartment
- b. Replace the 8 C batteries **ensure proper polarity alignment**

*****Pay careful attention to the polarity of the batteries as damage can result to the sonde if the batteries are not installed correctly*****

- c. Check that o-rings on battery cover are in good repair and clean, replace if there is any damage or wear
- d. Replace battery cover of sonde to seal battery compartment

C. Log File Creation, Termination, and Transfer to Trimble Recon PDA

Log files should be created, terminated, and uploaded at the field site. New batteries should always be installed into a sonde prior to deployment before the log file is started.

1. Establish Log File

- (1) Connect DS5X to Trimble Recon and navigate to Log Files screen and set log file properties
 - a. Select “Log Files” button from Main Menu screen

- b. Select “New” button from Log Files screen

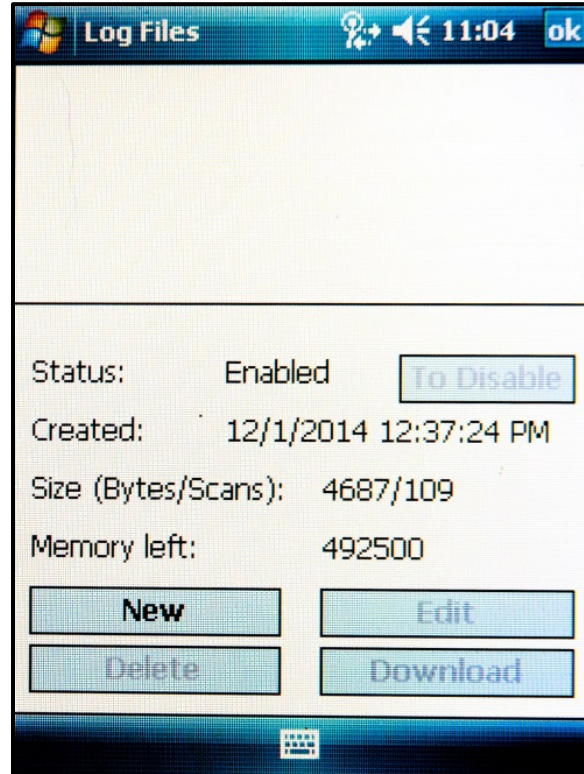


Figure 25. Log files main menu screen.

- c. Name Log File
- i. Log Files should follow a standard format (e.g., APCO2015JAN05_QW)
 - 1. Four character park code (e.g., APCO)
 - 2. Four Digit Year (e.g., 2015)
 - 3. Three Character Month (e.g., JAN for January)
 - 4. Two digit day (e.g., 05)
 - 5. QW

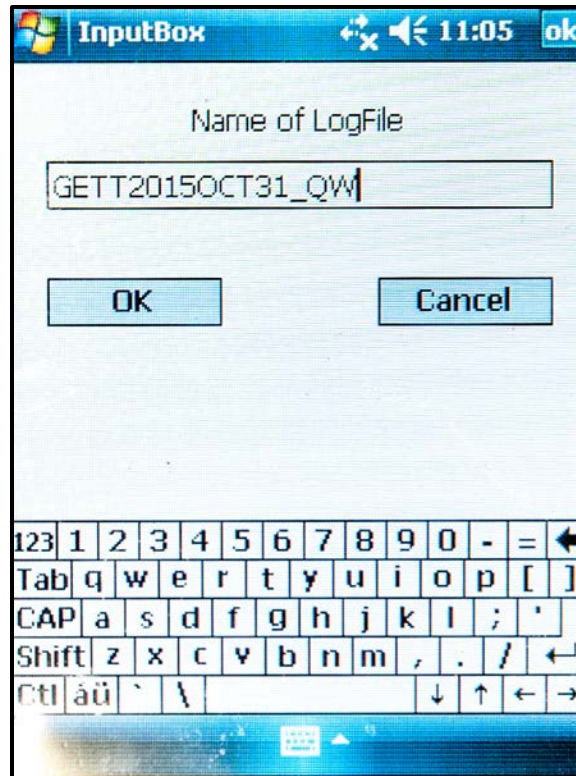


Figure 26. Log file naming screen.

- d. Set logging interval settings for log file under the **General** Tab

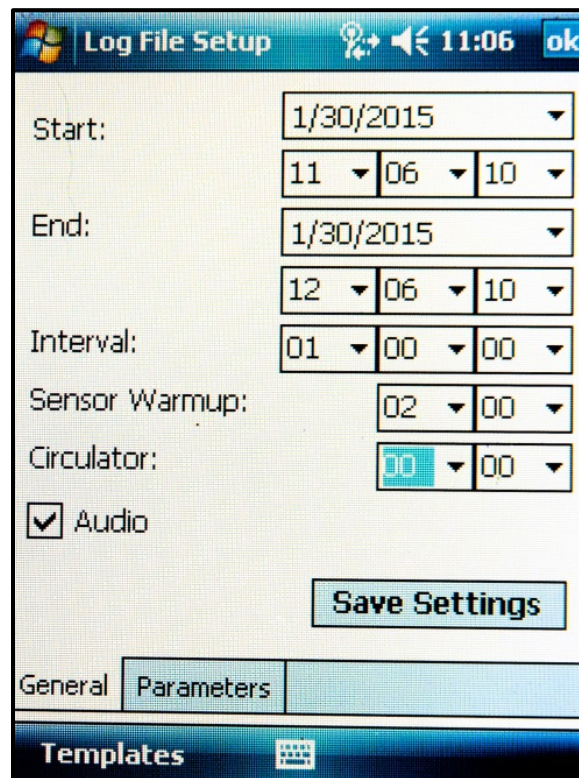


Figure 27. Log file setup screen.

- i. Set "Start Date" (should default to current day)
- ii. Set "Start Time"
 1. Set start time so that you have enough time to finish your settings and disconnect from the sonde prior to the log file activating (typically about 10 minutes)
- iii. Set "End Date"

The default setting is the current day, this must be changed!

 1. Set "End Date" to approximately two months from the current day to ensure the log file will be enabled when the next maintenance event occurs
- iv. Set "End Time"
 1. This can remain the default value
- v. Set "Interval:" (HHMMSS)
 1. The logging interval should be set at 1 hour for all DS5X sondes
- vi. Set "Sensor Warmup:" MM:SS)
 1. Sensor Warmup should be set to 02:00
- vii. Set "Circulator" (MM:SS)
 1. This should be set to 00:00
- viii. Select check box for Audio
- e. Set logging parameters for the log file under the **Parameters** Tab

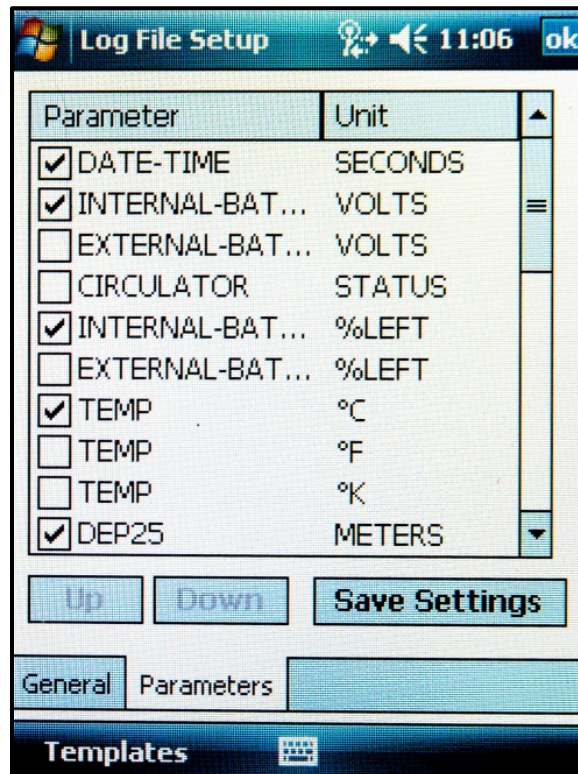


Figure 28. Log file parameter setup screen.

- i. Select the check box for all parameters to be logged:

1. DATE-TIME (Seconds)
 2. Internal-BAT (VOLTS)
 3. INTERNAL-BAT (%LEFT)
 4. TEMP (°C)
 5. DEP25 (METERS)
 6. DEP25 (PSIA)
 7. SPCOND (μS/cm)
 8. PH (UNITS)
 9. PHVOLTS (MV)
 10. LDO% (SAT)
 11. LDO (MG/L)
 12. LDOBP (MMHG)
- f. Select the **“Save Settings”** button to return to the Log Files Main Menu screen
 - g. Check that log file was set up correctly
 - i. Highlight log file and select **“Edit”** button

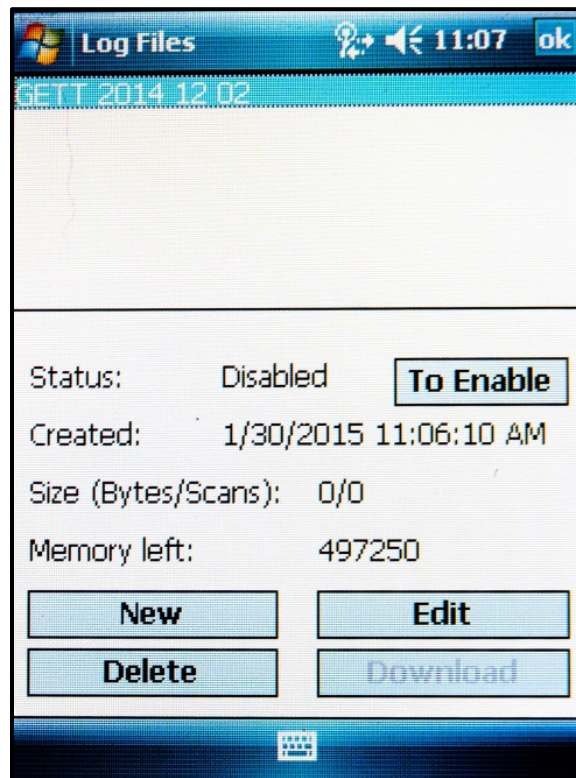


Figure 29. Log file main menu screen.

- ii. Review **General** and **Parameter** Tabs and ensure the log file was set up correctly
 1. If changes are made the **“Save Settings”** button should be used otherwise the **“ok”** button in the top right corner can be used
- h. Start log file

- i. Highlight log file in Log Files Main Menu Screen
- ii. Select **"To Enable"** button

****The created log file must be enabled after the log file is created for the sonde to actually start sampling****

- i. Return to Sonde Main Menu screen by selecting **"ok"** from the upper right corner of Log Files Main Menu Screen
 - j. Select **"Disconnect"** button
 - k. Disconnect communications cable from sonde and replace rubber guard
- (2) Ensure log file was properly enabled and started
- a. Sonde will produce an audible beep during the sensor warmup period

2. Terminating Log File

- (1) Connect DS5X to Trimble Recon and navigate to Log Files screen and set log file properties
- a. Select **"Log Files"** button from Main Menu screen
 - b. Highlight appropriate log file and select **"To Disable"** button

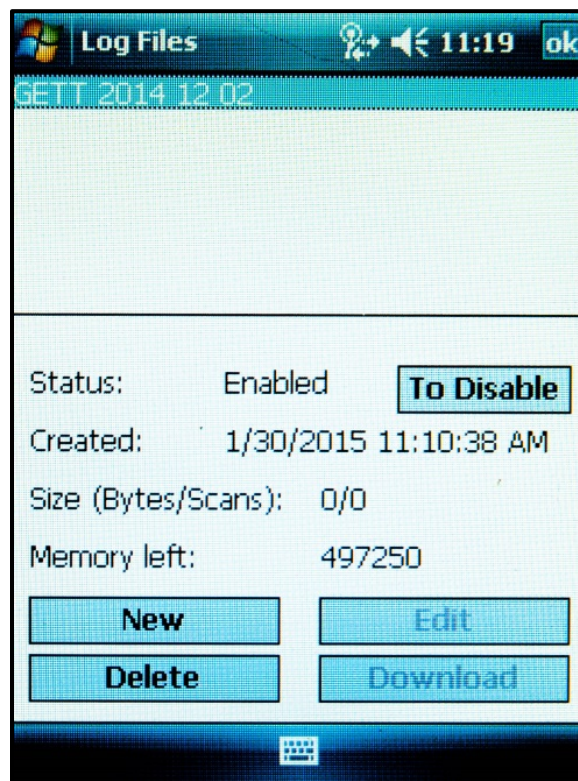


Figure 30. Log file main menu screen with disable button active.

3. Download to Trimble Recon and View Log File

- (1) From the **"Log Files"** menu page
- a. Highlight appropriate log file (if the file has not been disabled do so now)
 - b. Select **"Download"** button
 - c. Select **"ok"** to endtime warning message

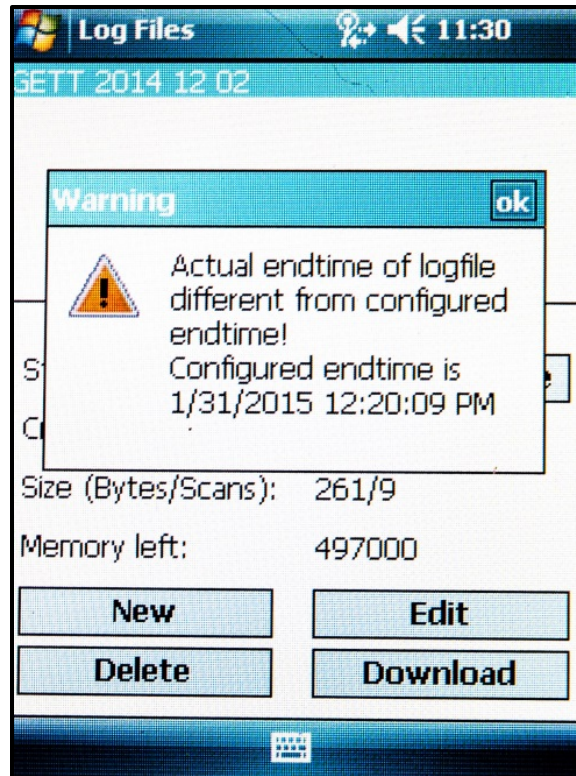


Figure 31. Log file termination warning message.

- d. Select "Complete" on download screen
- e. Select "Graph" button on Log File Preview screen

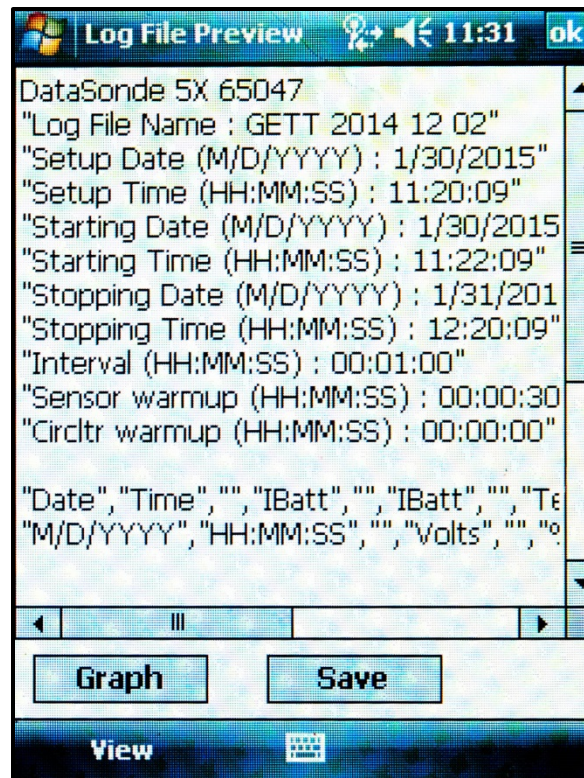


Figure 32. Log file download preview screen.

- i. Visually inspect each parameter to check for sensor failures

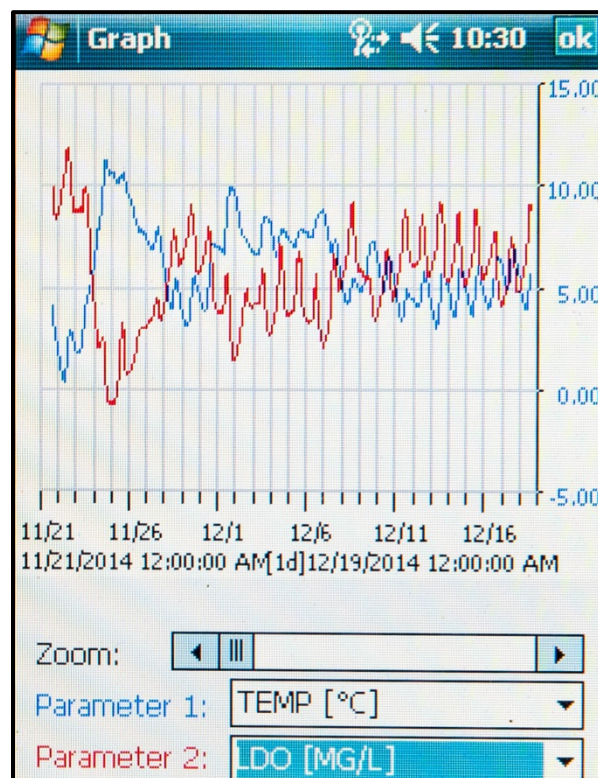


Figure 33. Log file preview graph screen.

- ii. Select “ok” in upper right corner to return to Log File Preview screen
- f. Select “Save” button on Log file Preview screen (see screen shot above)
- g. On “Save As” screen select appropriate park folder and select “Save” button

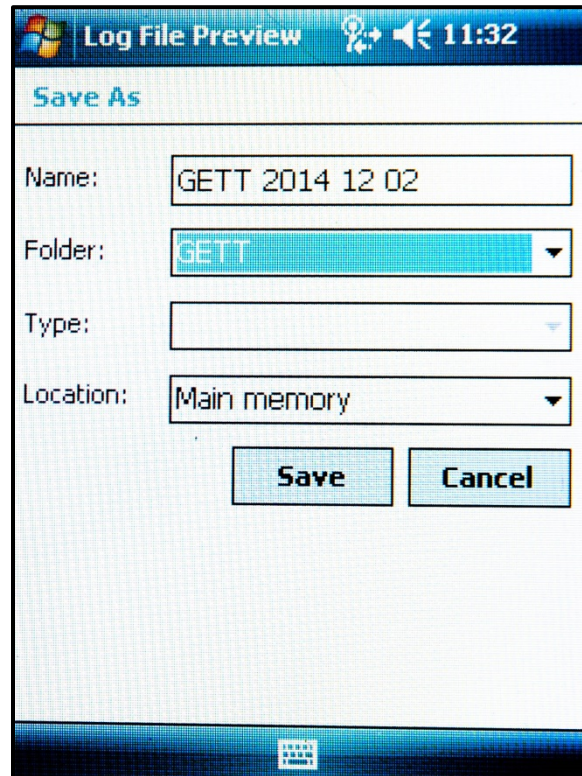


Figure 34. Log file save screen.

- h. Select “ok” in upper right corner to return to Log Files main screen
- (2) Navigate log file on Trimble Recon
- a. Open windows start menu and launch File Explorer
 - b. Select appropriate log file and visually inspect for complete data set
 - c. Select ok and close File Explorer to return to Hydras3LT Pocket software