Instruction Manual
ABM Switch Gateway Software

Instruction Manual Revision A.6

Table of Contents

Section 1: Getting Started

This instruction manual describes the ABM Switch Gateway software. In this document the ABM Switch Gateway software will be referred to as the "Gateway". The ABM Switch Gateway software provides a PC interface to ABM Ultrasonic Level Switches with switch firmware. Using the ABM Switch Gateway users can calibrate, configure and troubleshoot ABM Level Switches. In this guide the ABM Ultrasonic Level Switch will be referred to as "level switch", "switch" or "sensor".

1.1 Setup Procedure

The following 8 steps will assist you in setting up the Gateway software and connecting an ABM Level Switch.

1. **RS485 Adaptor Required**
   ABM Ultrasonic Level Switches use RS485 to communicate. Before installing the ABM Switch Gateway software please install a RS485 adaptor on your computer. RS485 adaptors are available as USB devices.

2. **Install the ABM Switch Gateway Software**
   Install the ABM Switch Gateway Software on the PC by selecting SETUP.EXE from the CD and follow the instructions on the screen. The latest software can be downloaded from www.abmsensor.com.

3. **Start the ABM Switch Gateway Software**
   Click the Windows "Start" button, "Programs", "ABM Switch Gateway" and select the "ABM Switch Gateway" program.

4. **Select a Serial Port**
   When the Switch Gateway software is started for the first time a dialog box will appear as shown in Figure 1. Click the drop down arrow and select the desired serial port from the drop down list. The selected serial port will be saved and used each time the Switch Gateway software is started.

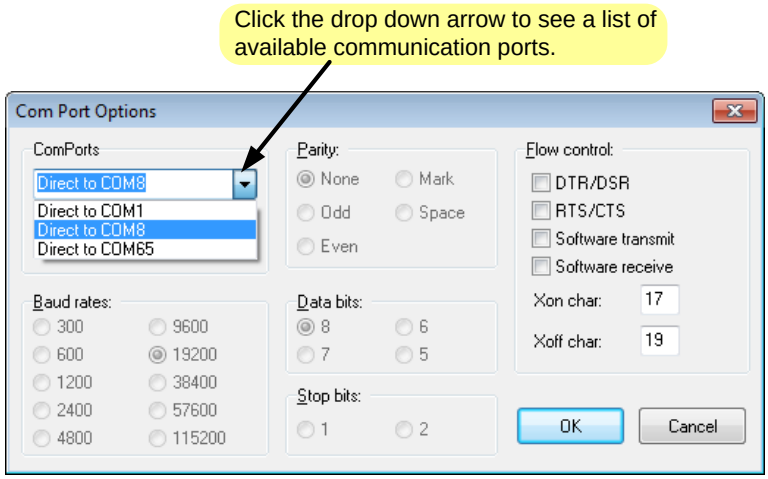


Figure 1. When the Switch Gateway software is started the first time, this serial communication dialog box will appear.

After selecting a valid serial port the Startup screen will appear as shown in Figure 2. The Startup screen will automatically try to detect the sensor and determine which mode of operation it is currently running in. If the sensor is using the default Thick Walled Tank mode then the Thick Wall screen will appear as shown in Figure 3.

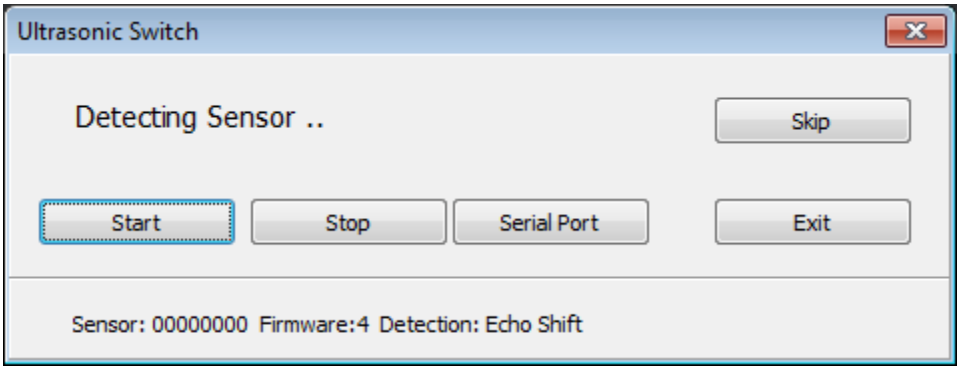


Figure 2. The Ultrasonic Switch startup screen detects which mode the sensor is running in.

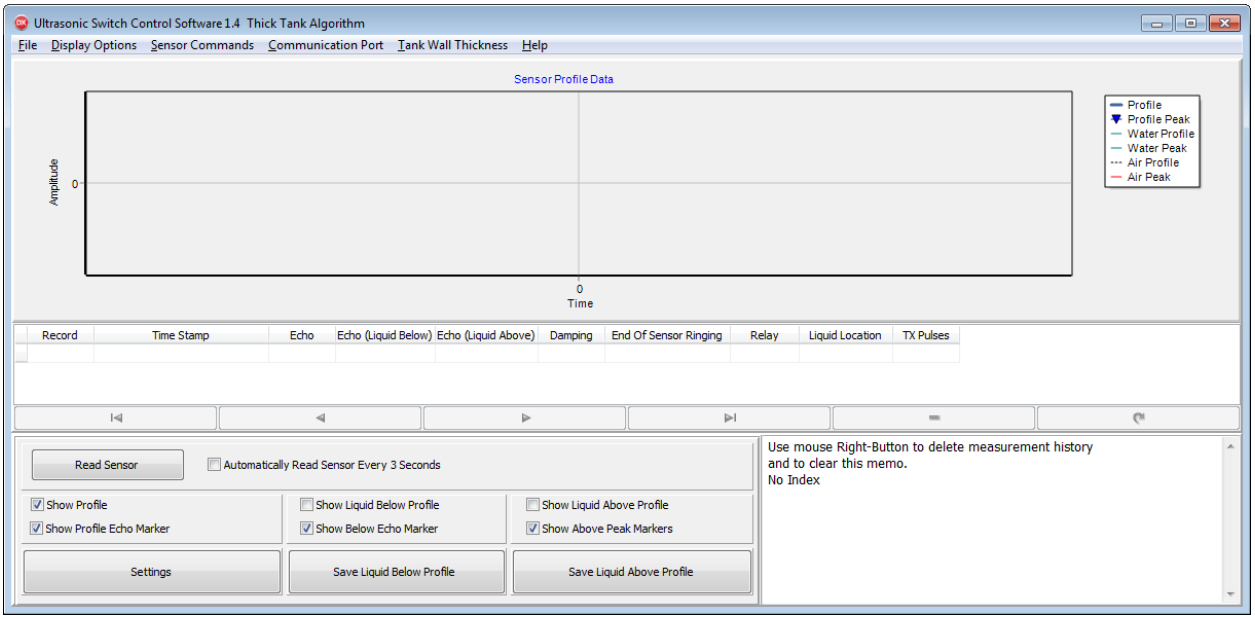


Figure 3 Gateway main screen when the Switch is running in Thick Walled Tank mode.

If the sensor is running in the Thin Walled Tank mode then the Thin Wall screen will appear as shown in Figure 4.

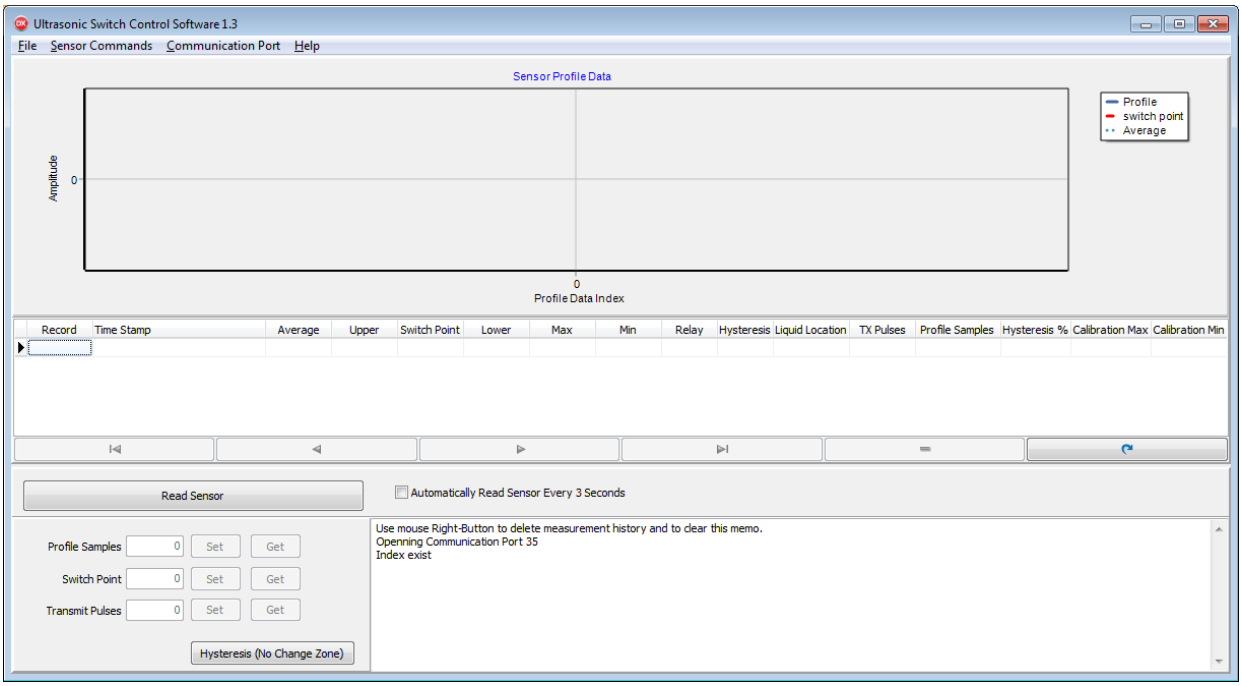


Figure 4. Gateway main screen when the Switch is running in Thin Walled Tank mode.

5. Changing The Serial Port

The serial port can be changed at any time by clicking on the "Communication Port" menu as shown in Figure 5.

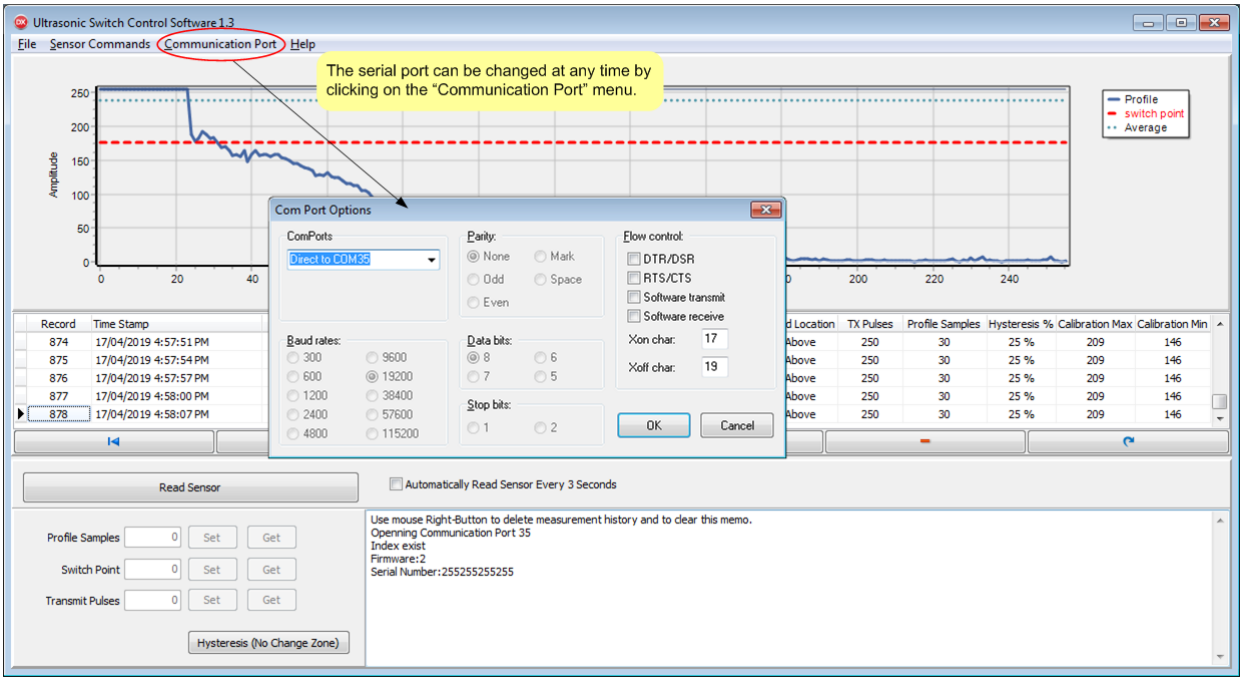


Figure 5. The "Communication Port" menu allows the selected serial port can be changed at anytime.

6. Mounting the Sensor Transducer on the Tank

The sensor installation must be done correctly or the sensor will not operate correctly. For more information see Section 6: Sensor Installation.

7. Connecting the Sensor

Connect your RS485 adaptor to the RS485 wires from the sensor as shown in Figure 6. Connecting the RS485 wires incorrectly will cause communication problems.

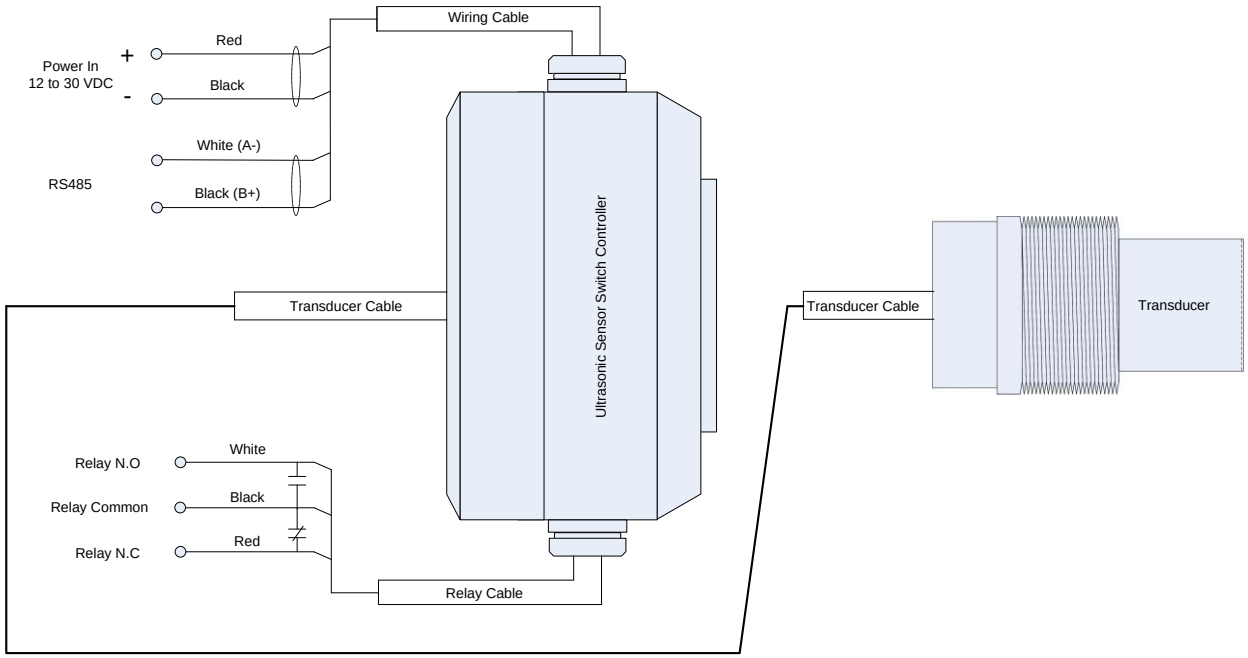


Figure 6. Wiring diagram for the Sensor. The communication wiring is shown in the bottom left.

8. Power the Sensor

Connect power to the sensor power in wires as shown in Figure 6. *Please note*: power requirements are 12 to 30 VDC.

9. Ready to Use

The Gateway is now ready to be used. The next section will describe how to use the Gateway software.

Section 2: Gateway Software - Thin Walled Tank Mode

As shown in Figure 7 the Gateway user interface is divided into different sections. Control menus at the top of the screen, the profile charting section, the data logging section with navigation controls, the tool bar section, the control panel section and the memo section at the bottom of the form.

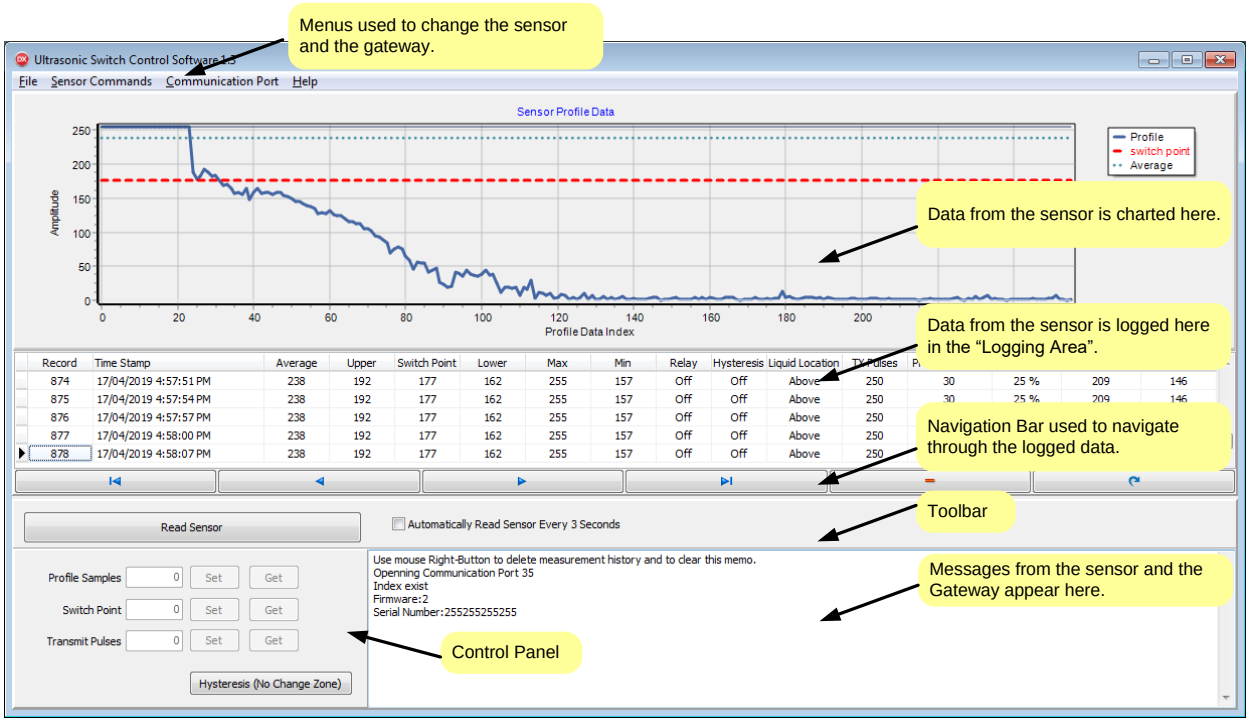
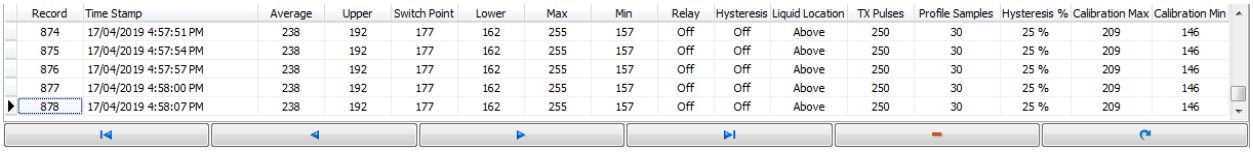


Figure 7 The Gateway User Interface controls with descriptions.

2.1 Sensor Data (Thin Walled Tank Mode)

The sensor emits a short burst of ultrasonic energy and then listens and captures the resulting signal. The captured data is processed to produce a dampened averaged value. As the Gateway software communicates with the sensor it logs the sensor data as shown in Figure 8.



Record	Time Stamp	Average	Upper	Switch Point	Lower	Max	Min	Relay	Hysteresis	Liquid Location	TX Pulses	Profile Samples	Hysteresis %	Calibration Max	Calibration Min
874	17/04/2019 4:57:51 PM	238	192	177	162	255	157	Off	Off	Above	250	30	25 %	209	146
875	17/04/2019 4:57:54 PM	238	192	177	162	255	157	Off	Off	Above	250	30	25 %	209	146
876	17/04/2019 4:57:57 PM	238	192	177	162	255	157	Off	Off	Above	250	30	25 %	209	146
877	17/04/2019 4:58:00 PM	238	192	177	162	255	157	Off	Off	Above	250	30	25 %	209	146
878	17/04/2019 4:58:07 PM	238	192	177	162	255	157	Off	Off	Above	250	30	25 %	209	146

Figure 8 The data log section of the Gateway interface showing 5 data record from the sensor.

The data log shown in Figure 8 displays 16 different columns. Table 1 below provides a brief description of each of these columns.

Record	Record is the record number of the captured data. Record numbers are added and displayed in sequential order.
Time Stamp	Time stamp shows the date and time the data was captured.
Average	The average value is calculated from the profile data using mathematical algorithms. The average value is compared to the switch point value to determine if the tank liquid is above or below the switch point.
Switch Point	The switch point is the value used to determine the level of the liquid. When the average is greater than the switch point the liquid level is above the switch point. When the average is below the switch point then the liquid level is below the switch point.
Upper Value and Lower Value	The sensor calculates a hysteresis zone (no change zone) around the switch point. When the liquid level crosses the switch point, the hysteresis zone prevents the relay from changing state until the liquid level has passed either the upper or lower value.
Max	This value represents the historical maximum average value during normal operation.
Min	This value represents the historical minimum average value during normal operation.
Relay	Shows the state of the relay.
Hysteresis	Shows if the sensor is using the hysteresis zone to filter the liquid level.
Liquid Level	Shows if the liquid level is above or below the sensor.
TX Pulses	Shows the number of ultrasonic pulses used to vibrate the tank.
Profile Samples	The number of data points used to calculate during the average calculation.
Hysteresis %	The hysteresis percent column shows the amount of hysteresis used by the sensor.
Calibration Max	This value represents the highest profile value found during the “above” level calibration. This value is used to calculate the switch point.
Calibration Low	This value represents the lowest profile value found during the “below” level calibration. This value is used to calculate the switch point.

Table 1 A brief description of the terms shown in the data log.

2.2 Sensor Data Chart (Thin Walled Tank Mode)

Profile data received from the sensor is automatically charted as shown in Figure 9. The chart shows three pieces of information. The captured profile is displayed as a dark blue solid line. The switch point is displayed as a red dotted line. The calculated average value is displayed as a light blue dotted line.

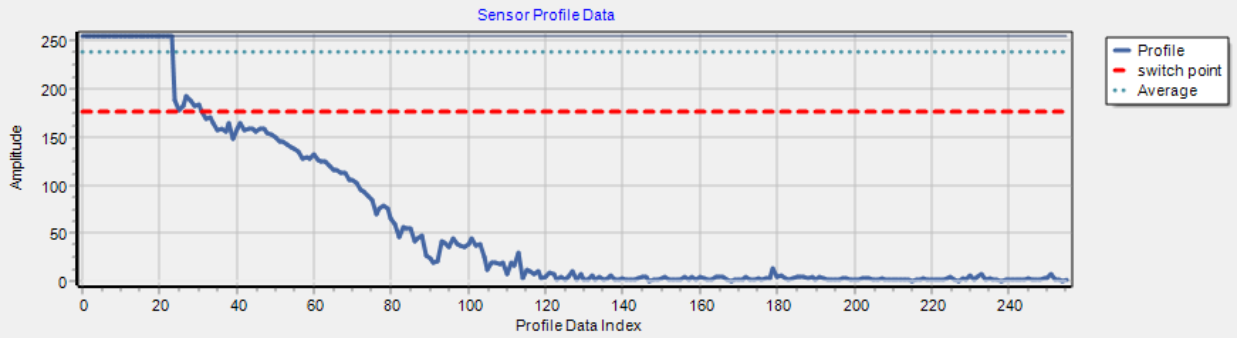


Figure 9 Profile data from the sensor is automatically charted.

The chart provides a valuable diagnostic tool. If the sensor is not mounted correctly the profile will show the transmission pulse and very low data values afterwards. The average value will always be very low regardless of the liquid level in the tank. To see examples of good and bad profiles see section 6.2 Profiles from Good and Bad Installations.

2.3 Collecting Sensor Data

To transfer a single sensor record, click the Read Sensor button shown in Figure 10. The Gateway will communicate with the sensor and a new data record will appear in the data log after a couple seconds. To automatically collect data from the sensor click the checkbox on the toolbar labeled “Automatically Read Sensor Every 3 Seconds”. When the checkbox is “checked” the Gateway reads data from the sensor every 3 seconds until the checkbox is “unchecked”.
It is important to note, while using the automatic transfer functionality the “Read Sensor” button and the “menus bar” at the top of the screen are disabled. When the automatic transfer features is unchecked the “Read Button” and the “Menu Bar” are enabled.

Figure 10 The Gateway toolbar showing the “Read Sensor” button and the automatic data transfer checkbox.

2.4 Data Log and Charting (Thin Walled Tank Mode)

Records read from the sensor are automatically logged, charted and saved to disk. Logged data can be displayed on the chart by clicking the desired data record. Using the up and down arrow keys you can navigate through the data log displaying each record as you go. The data log has a navigation bar with buttons to move to the first and last record, iterate through the records using the next and previous buttons, a delete button to delete a record and a button to refresh the data log browser. The navigation bar and a description of each button is shown in Figure 11.

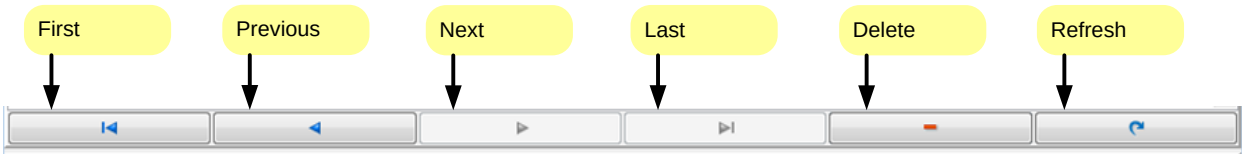


Figure 11 The data log navigation bar with a description of each button.

To delete all of the records in the data log, right click over the data log to show the pop-up menu and select “Delete Measurement History” as shown in Figure 12 with a red circle around it.

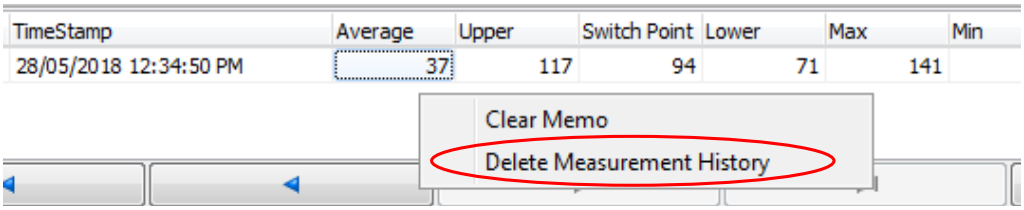


Figure 12 To delete all records right click over the data log to display the pop-up menu.

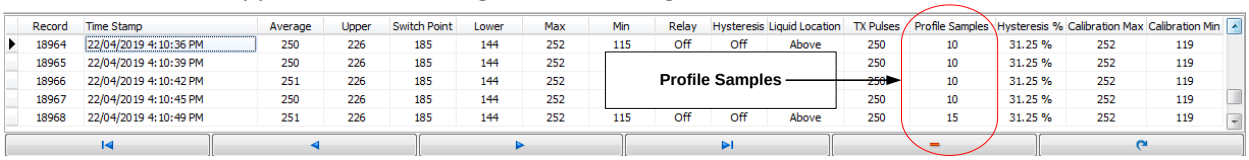
2.5 Profile Sampling (Thin Walled Tank Mode)

The average value is calculated from the profile data using a sample size. The "*Profile Samples*" value defines how many samples are used during the average calculation. The default value is 15. This value may need to be increased or decreased depending on the properties of the tank. On Gateway startup the "Profile Samples" will be read from the sensor after the first "Read Sensor" event.

To change the "Profile Samples" enter a new value in the edit box and click on the "Set" button as shown in Figure 13. The new "Profile Samples" value will be written to the sensor.

Figure 13 Profile Samples can be set or read from the sensor.

The new value will appear in the data log as shown in Figure 14.



Record	Time Stamp	Average	Upper	Switch Point	Lower	Max	Min	Relay	Hysteresis	Liquid Location	TX Pulses	Profile Samples	Hysteresis %	Calibration Max	Calibration Min
18964	22/04/2019 4:10:36 PM	250	226	185	144	252	115	Off	Off	Above	250	10	31.25 %	252	119
18965	22/04/2019 4:10:39 PM	250	226	185	144	252					250	10	31.25 %	252	119
18966	22/04/2019 4:10:42 PM	251	226	185	144	252					250	10	31.25 %	252	119
18967	22/04/2019 4:10:45 PM	250	226	185	144	252					250	10	31.25 %	252	119
18968	22/04/2019 4:10:49 PM	251	226	185	144	252	115	Off	Off	Above	250	15	31.25 %	252	119

Figure 14 The data log shows the updated Profile Samples.

2.6 Switch Point (Thin Walled Tank Mode)

The switch point is the value used to determine the level of the liquid. When the "average" value is greater than the switch point the liquid level is **above** the switch point and the single pole double throw (SPDT) relay will deactivate. When the average is below the switch point then the liquid level is **below** the switch point and the relay will activate.

The switch point is automatically calculated by the sensor during sensor calibration see section 2.9 Sensor Calibration – Liquid Level Below Sensor (Thin Walled Tank Mode) and section 2.10 Sensor Calibration – Liquid Level Above Sensor (Thin Walled Tank Mode).

The switch point value can be changed using the switch point edit box. The default value of the sensor is 170. This value may need to be increased or decreased depending on the properties of the tank. A sensor should always be calibrated after installation for the sensor to operate correctly.

On Gateway startup the "switch point" will be read from the sensor after the first "Read Sensor" event.

To change the "switch point" enter a new value in the edit box and click on the "Set" button as shown in Figure 15. The new "switch point" value will be written to the sensor.

Figure 15 Switch point value can be set or read from the sensor.

The new switch point value will appear in the data log as shown in Figure 16.

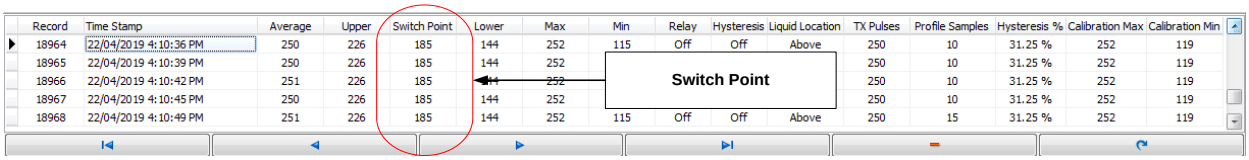


Figure 16 The data log shows the updated switch point.

2.7 Transmit Pulses (Thin Walled Tank Mode)

The sensor emits a short burst of ultrasonic energy and then captures the resulting signal referred to as a profile. The default number of pulses is 250.

On Gateway startup the “Transmit Pulses” will be read from the sensor after the first “Read Sensor” event.

The number of transmit pulses must be in the range of 3 to 254. For thin walled tanks, keep the number of transmit pulses high. To change the number of “Transmit Pulses” enter a new value in the edit box and click on the “Set” button as shown in Figure 17. The new “Transmit Pulses” value will be written to the sensor.

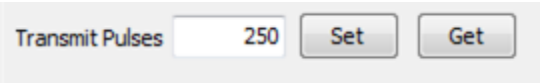


Figure 17 The number Transmit Pulses can be set or read from the sensor.

The new value will appear in the data log as shown in Figure 18.

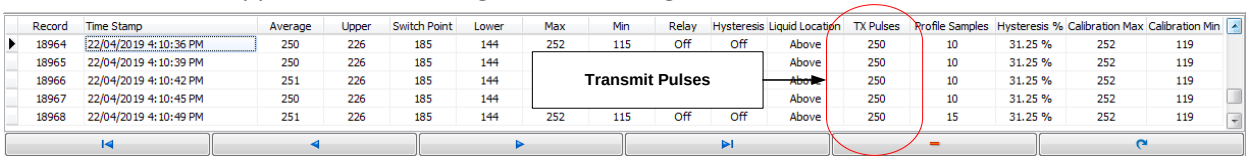


Figure 18 The data log shows the updated Transmit Pulses

2.8 Hysteresis (Thin Walled Tank Mode)

When the liquid level in the tank is sitting at the switch point level, small waves in the liquid will cause the liquid level to rise above and fall below the switch point. Without hysteresis this rising and falling movement would cause the sensor's state to toggle between above and below and the relay to repeatedly activate and deactivate (known as relay chatter). Once active the hysteresis filter, filters out small movements in the liquid as shown in Figure 19.

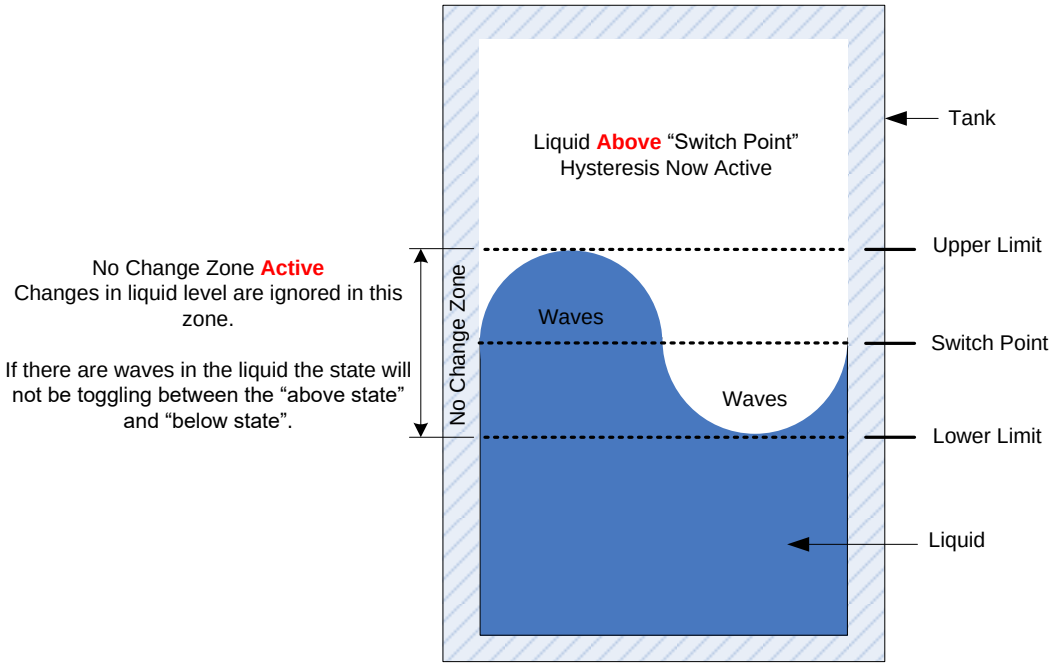


Figure 19 Hysteresis creates a no change zone around the switch point. The diagram shows the sensor in the "liquid above" state. The waves in the liquid will not change the sensor state until the waves exceeds either the upper or lower limit.

Depending on the amount of liquid movement in the tank more or less hysteresis may be required. (Please Note: Before changing hysteresis the Switch should be calibrated for the tank it is installed on.)

The hysteresis upper and lower limits shown in Figure 19 are calculated as a percentage of the calibration span. The data log (see Figure 20) also shows the upper and lower limits, the hysteresis state (ON or OFF) and the hysteresis percent used to calculate the hysteresis limits.

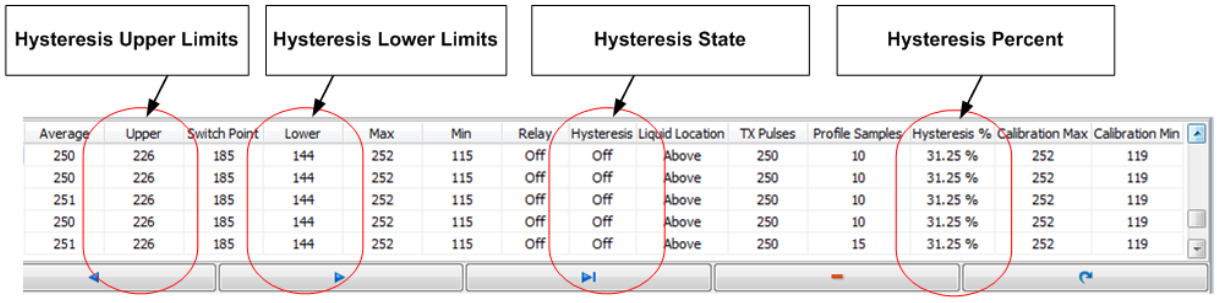


Figure 20 The data log shows the hysteresis limits, state and percent.

The sensor has 6 hysteresis settings that can be selected using the Hysteresis control form. The Hysteresis control form can be accessed by clicking on the "Hysteresis (No Change Zone)" button shown in Figure 21.

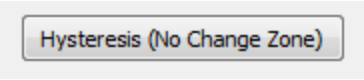


Figure 21 Activate the Hysteresis control form by clicking the Hysteresis button.

The hysteresis form shown in Figure 22 shows the 6 hysteresis percentage values that can be selected: 37.5%, 31.25%, 25%, 18.75%, 12.5% and 6.25%. Selecting a percentage value will automatically cause the diagram on the right side of the dialog box to be updated.

Select the desired percentage value and click the “Save” button to update the sensor. If no change is desired click the “Cancel & Close” button.

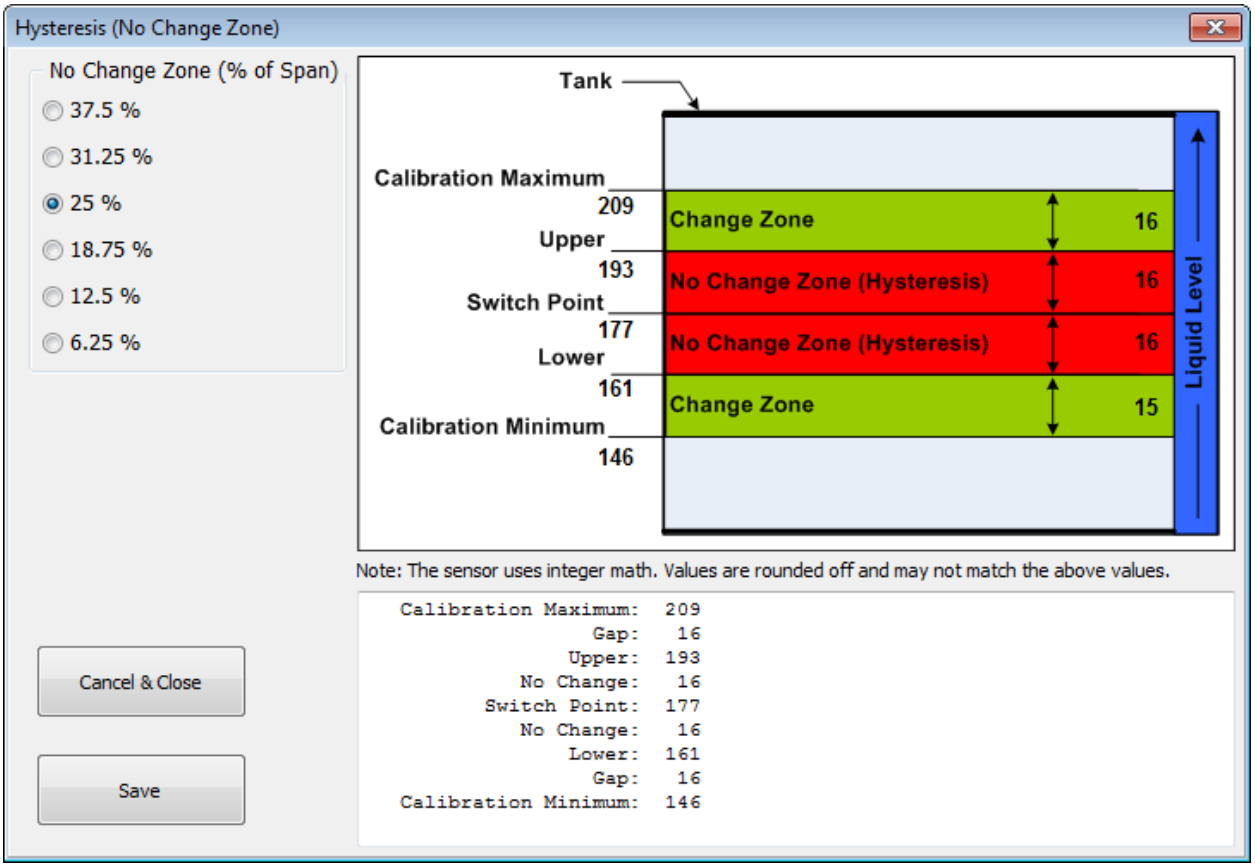


Figure 22 The amount of hysteresis the sensor uses can be programmed.

After each measurement the sensor calculates if hysteresis is “ON” or “OFF”. If hysteresis is “OFF”, measurements are not filtered. If hysteresis is “ON”, it will remain “ON” until the liquid level causes the average value to be greater than the “upper” value or less than the “lower” value.

2.9 Sensor Calibration – Liquid Level Below Sensor (Thin Walled Tank Mode)

The sensor must be calibrated to accurately work on a tank. This section describes the calibration process using the Gateway Software. Fill the tank until the liquid level is 2" (5cm) **below** the sensor. Figure 23 shows the profile chart with the liquid 2" below the sensor. Notice in Figure 23 that the average is well below the switch point line.

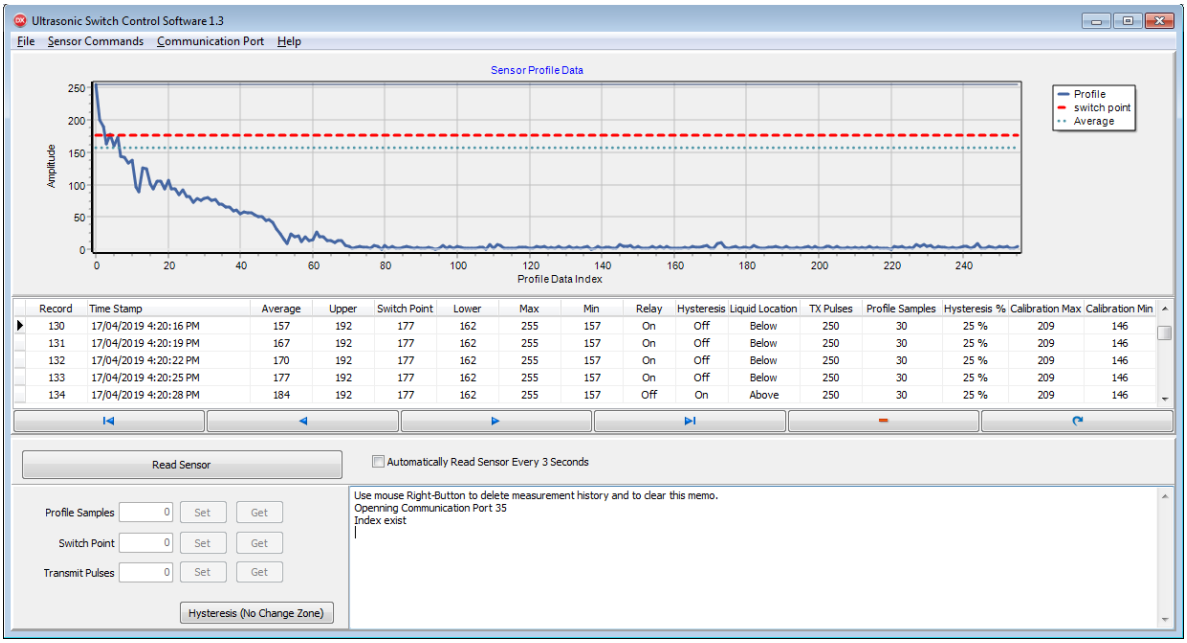


Figure 23 The tank has been filled to 2" (5cm) below the sensor. The chart shows the average value well below the switch point.

To calibrate the Switch, click on the "Sensor Commands" menu and then the "Switch Calibration" menu item. The Switch Calibration dialog box will appear as shown in Figure 24. Click on the "Liquid is Below the Sensor" radio button and then click the "Save" button. The Switch Calibration dialog box will close and the menus and control bar will be disabled for 10 seconds while the sensor goes through the calibration cycles.
During calibration the sensor will calculate the switch point, upper and lower hysteresis values and store these values in the sensor's EEPROM. To see the sensor's new values, click the "Read Sensor" button.

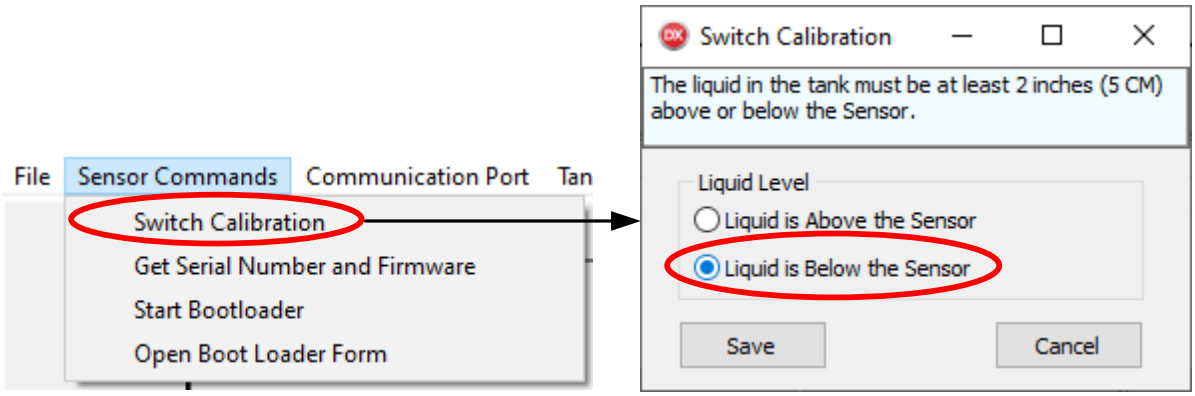


Figure 24 Use the Sensor Command menu to activate the Switch Calibration.

During sensor calibration a progress bar will appear on the control bar showing the status of the calibration as shown in Figure 27.

2.10 Sensor Calibration – Liquid Level Above Sensor (Thin Walled Tank Mode)

The sensor must be calibrated to accurately work on a tank. This section describes the calibration process using the Gateway Software. Fill the tank until the liquid level is 2" (5cm) **above** the sensor. Figure 25 shows the profile chart with the liquid 2" above the sensor. Notice in Figure 25 that the average is well above the switch point line.

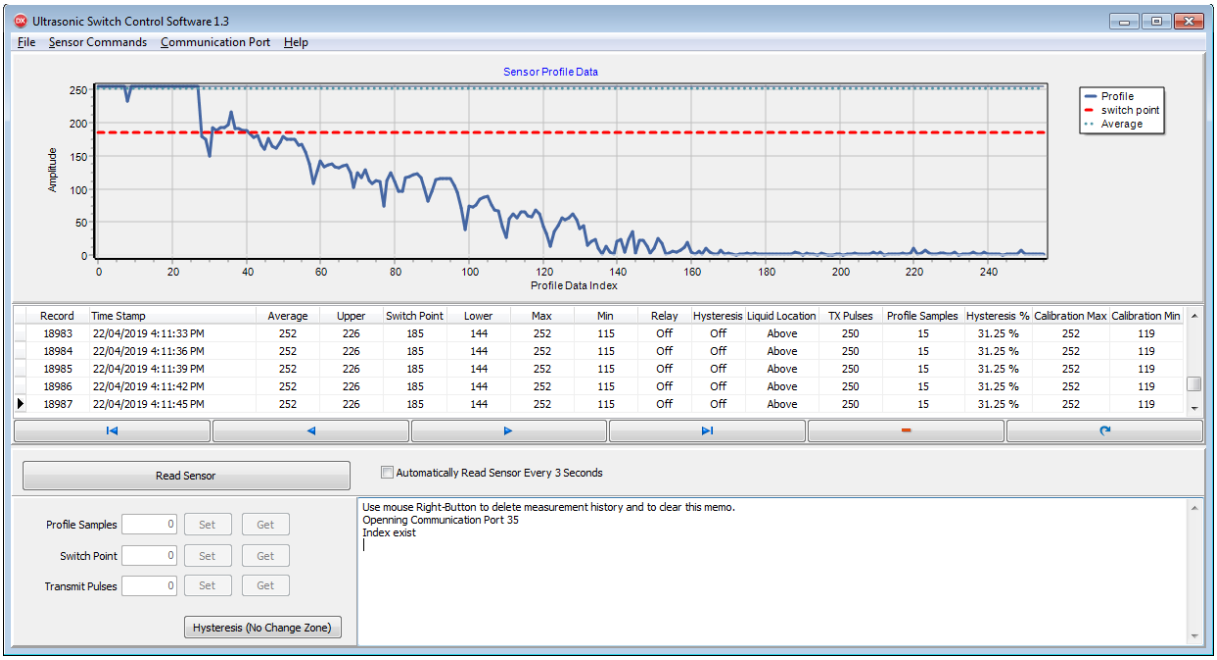


Figure 25 The tank has been filled to 2" (5cm) above the sensor. The chart shows the average value well above the switch point.

To calibrate the Switch, click on the "Sensor Commands" menu and then the "Switch Calibration" menu item. The Switch Calibration dialog box will appear as shown in Figure 26. Click on the "Liquid is Above the Sensor" radio button and then click the "Save" button. The Switch Calibration dialog box will close and the menus and control bar will be disabled for 10 seconds while the sensor goes through the calibration cycles. During calibration the sensor will calculate the switch point, upper and lower hysteresis values and store these values in the sensor's EEPROM.

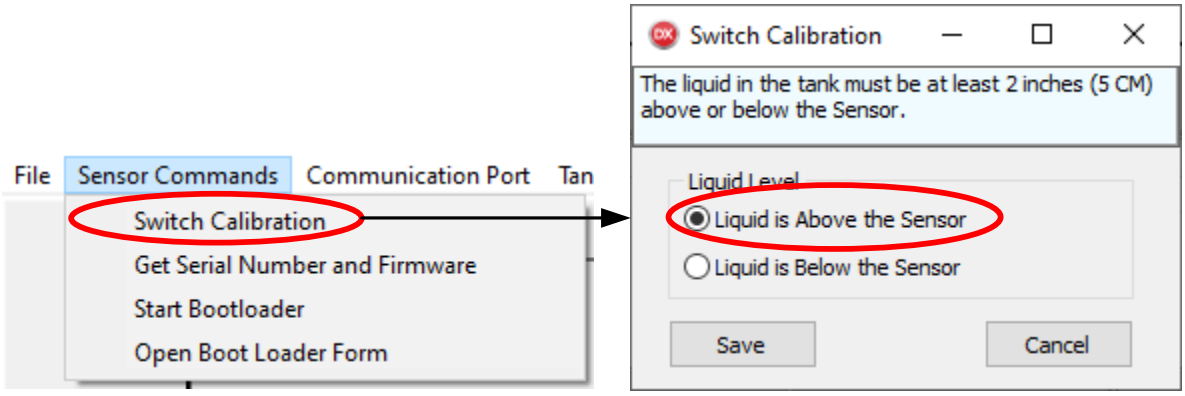


Figure 26 Use the Sensor Command menu to start Switch calibration.

During sensor calibration a progress bar will appear on the control bar showing the status of the calibration as shown in Figure 27.

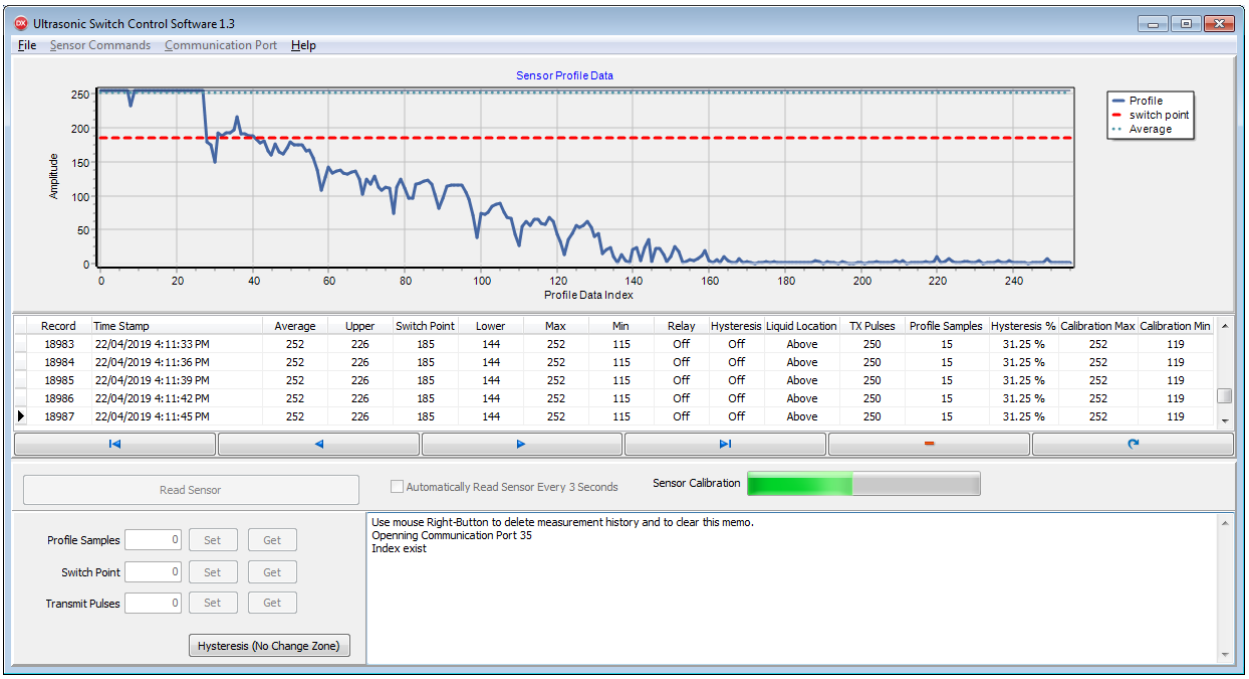


Figure 27 When sensor calibration is activated, menus and controls are disabled and a progress bar will appear.

2.11 Calibrating Your Level Switch – Using the Sensor Button.

After the Ultrasonic Switch has been installed a simple 2 step calibration process must be performed using either the calibration button on the Switch or the Gateway Software. This section describes the calibration process using the calibration push button. The Switch must be calibrated to the tank to know the echo locations of the tank when the liquid level is above and below the Switch.

Your Switch is equipped with a calibration button that can be used to calibrate your Switch to match your tanks characteristics. The button can also be used to change from Thick Walled Tank Mode (flashing green LED) to Thin Walled Tank mode (Solid Green LED). To access the calibration button on the Switch remove the Switch's lid by unscrewing it. To activate the calibration mode using the button, power must be supplied to the Switch and the button must be pressed for the time specified in Table 2. Press the button until the LED turns the desired color and then release the button.

Table 2 Calibration Button Timing and LED Color

Button Timing of the Ultrasonic Level Switch.		
Seconds Pressed	LED Color	Description
< 5	Off	If the button is pressed for less than 5 seconds it is ignored and no action is taken.
> 5	Yellow	**Thin Tank Calibration** - Releasing the button while the LED is yellow indicates that the tank liquid is below the Switch and calibrates the Switch for "liquid below" Switch tank characteristics.
> 10	Red	**Thin Tank Calibration** - Releasing the button while the LED is red indicates that the tank liquid is above the Switch and calibrates the Switch for "liquid above" Switch tank characteristics
> 15	Off	Toggle between the Thick Walled Tank algorithm and the Thin Walled Tank Algorithm. After 15 seconds the sensor will change the detection modes and reboot. After the sensor reboots the LED will indicate the sensor's mode. Thick Walled Tank Mode (flashing green LED) Thin Walled Tank mode (Solid Green LED)

Where: < means less than and > means greater than.

Calibrating the Level Switch - Liquid Level Below the Sensor (Thin Walled Tank)

For this step the liquid level must be a minimum of 2 inches (5 centimeters) below the Switch as shown in Figure 28. With the Switch powered on the LED should be green. Press and hold the calibration button. The LED will turn off, 5 seconds later it will turn yellow. Release the button when the LED turns yellow. The LED will blink green for 10 seconds while it is calibrating. When the Switch is finished its calibration cycle the LED will stop blinking and remain green.

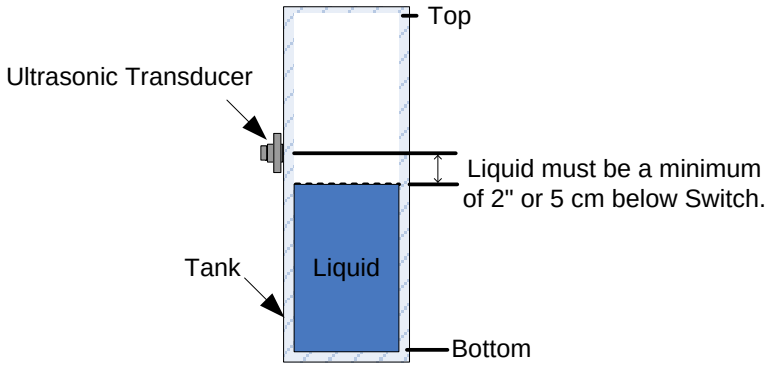


Figure 28 Calibrating the Switch when the liquid level is below the Switch.

Calibrating the Level Switch - Liquid Level Above the Sensor (Thin Walled Tank)

For this step the liquid level must be a minimum of 2 inches (5 centimeters) above the Switch as shown in Figure 29. With the Switch powered on the LED should be green. Press and hold the calibration button. The LED will turn off, after 5 seconds the LED will turn yellow, after another 5 seconds the LED will turn red. Release the button when the LED turns red. The LED will blink green for 10 seconds while it is calibrating. When the Switch is finished its calibration cycle the LED will stop blinking and remain green.

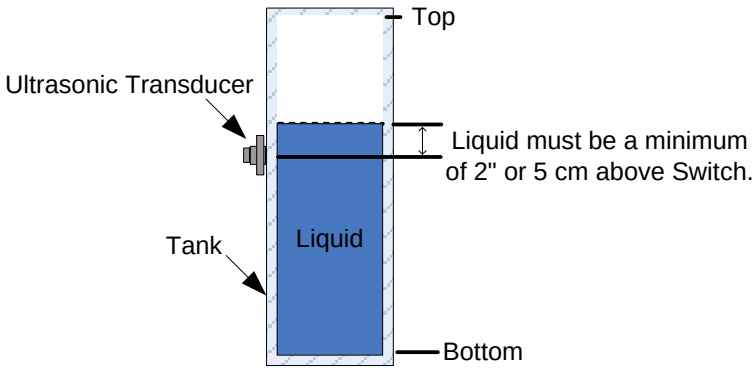


Figure 29 Calibrating the Switch when the liquid level is above the Switch.

Section 3: Gateway Software - Thick Walled Tank Mode

As shown in Figure 30 the Gateway user interface is divided into different sections. Control menus at the top of the screen, the profile charting section, the data logging section with navigation controls, the toolbar section and the memo section at the bottom right of the form.

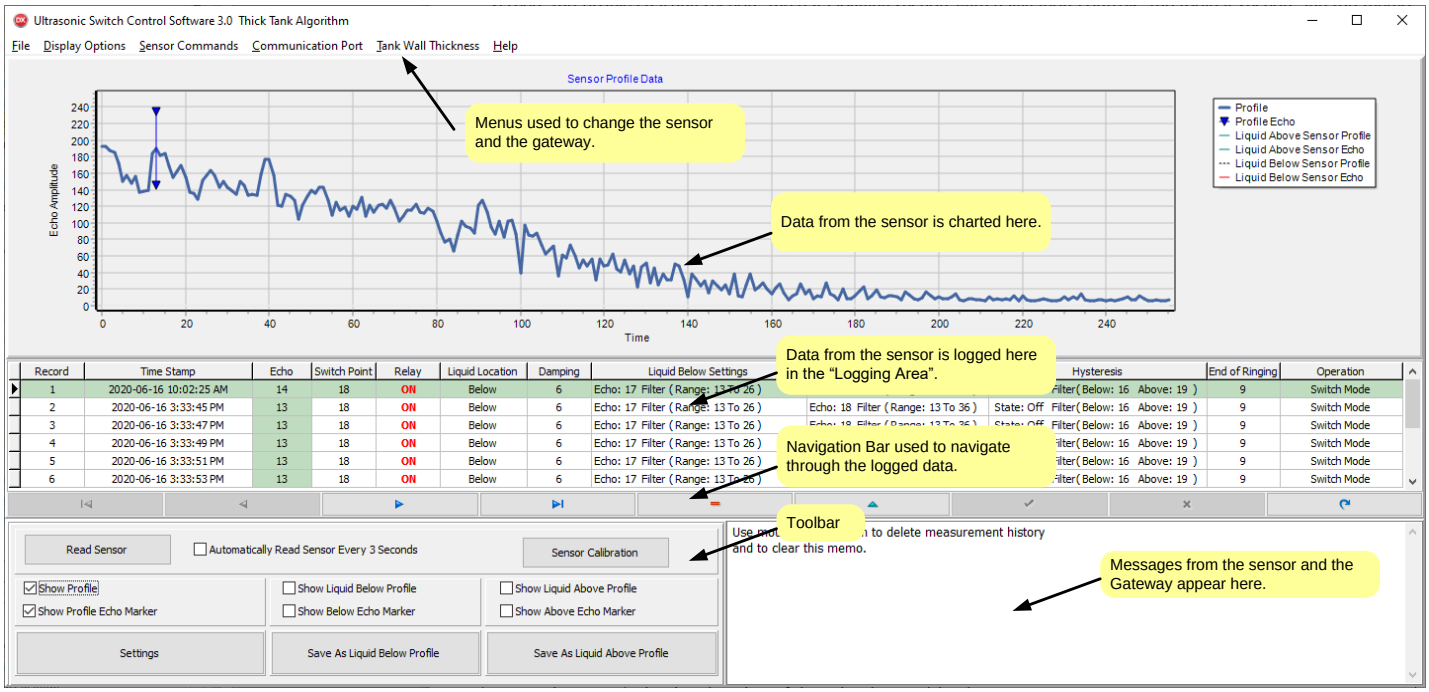


Figure 30 The Gateway Thick Walled Tank User Interface controls with descriptions.

3.1 Sensor Data (Thick Walled Tank Mode)

The Level Switch emits a short burst of ultrasonic energy and then listens and captures the resulting signal. The captured data is processed to determine the echo location. As the Gateway software communicates with the sensor it logs the sensor data and profiles as shown in Figure 31.

Record	Time Stamp	Echo	Switch Point	Relay	Liquid Location	Damping	Liquid Below Settings	Liquid Above Settings	Hysteresis	End of Ringing	Operation
1	2020-06-16 10:02:25 AM	14	18	ON	Below	6	Echo: 17 Filter (Range: 13 To 26)	Echo: 18 Filter (Range: 13 To 36)	State: Off Filter(Below: 16 Above: 19)	9	Switch Mode
2	2020-06-16 3:33:45 PM	13	18	ON	Below	6	Echo: 17 Filter (Range: 13 To 26)	Echo: 18 Filter (Range: 13 To 36)	State: Off Filter(Below: 16 Above: 19)	9	Switch Mode
3	2020-06-16 3:33:47 PM	13	18	ON	Below	6	Echo: 17 Filter (Range: 13 To 26)	Echo: 18 Filter (Range: 13 To 36)	State: Off Filter(Below: 16 Above: 19)	9	Switch Mode
4	2020-06-16 3:33:49 PM	13	18	ON	Below	6	Echo: 17 Filter (Range: 13 To 26)	Echo: 18 Filter (Range: 13 To 36)	State: Off Filter(Below: 16 Above: 19)	9	Switch Mode
5	2020-06-16 3:33:51 PM	13	18	ON	Below	6	Echo: 17 Filter (Range: 13 To 26)	Echo: 18 Filter (Range: 13 To 36)	State: Off Filter(Below: 16 Above: 19)	9	Switch Mode
6	2020-06-16 3:33:53 PM	13	18	ON	Below	6	Echo: 17 Filter (Range: 13 To 26)	Echo: 18 Filter (Range: 13 To 36)	State: Off Filter(Below: 16 Above: 19)	9	Switch Mode

Figure 31. Shown above is the data log section of the Gateway "Thick Walled Tank" form. The data log provides summary information. Clicking on any row in the log will cause that record to be charted.

The data log shown in Figure 31 displays 12 different columns. Table 3 below provides a brief description of each of the column values.

<table>
<tr><td>Record</td><td>Record is the record number of the captured data. Record numbers are added and displayed in sequential order.</td></tr>
<tr><td>Time Stamp</td><td>Time stamp shows the date and time the data was captured.</td></tr>
<tr><td>Echo</td><td>The time location of the echo detected by the sensor.</td></tr>
<tr><td>Switch Point</td><td>The switch point is the echo time when the sensor will switch from liquid below to liquid above.</td></tr>
<tr><td>Relay</td><td>Shows the state of the relay.</td></tr>
<tr><td>Liquid Location</td><td>Shows if the liquid level is above or below the sensor.</td></tr>
<tr><td>Damping</td><td>Damping prevents the sensor from toggling between “above” and “below” state. The damping value can be set to any value from 5 to 250. The default value is 5. When set to 5 the sensor must detect a change in state 5 times in a row in order to change.</td></tr>
<tr><td>Liquid Below Settings</td><td>This column shows the settings used by the Switch to detect and filter liquids below the sensor.

<table><tr><td>Echo</td><td>This echo time indicates “Liquid Below”. This value was detected by the sensor during calibration.</td></tr><tr><td>Filter (Range:13 to 26)</td><td>Shows the selected filter setting. The filter is set to accept echoes in the range of 13 to 26. Filters can be turned off, set to a range or set to auto.</td></tr></table></td></tr>
<tr><td>Liquid Above Settings</td><td>This column shows the settings used by the Switch to detect and filter liquids above the sensor.

<table><tr><td>Echo</td><td>This echo time indicates “Liquid Above”. This value was detected by the sensor during calibration.</td></tr><tr><td>Filter (Range:13 to 26)</td><td>Shows the selected filter setting. The filter is set to accept echoes in the range of 13 to 26. Filters can be turned off or a range can be specified.</td></tr></table></td></tr>
<tr><td>Hysteresis</td><td>This column shows the Hysteresis settings used by the Switch to prevent the Switch from toggling between “Liquid Above” and “Liquid Below”. For a better understanding of hysteresis see 2.8 Hysteresis (Thin Walled Tank Mode).

<table><tr><td>State</td><td>On or Off. When hysteresis is on, the sensor’s state cannot toggle between “Liquid Above” and “Liquid Below”.</td></tr><tr><td>Below: 16</td><td>This example value shows that when the liquid level is below the sensor, the echo time must be less than or equal to 16 to turn hysteresis off.</td></tr><tr><td>Above: 19</td><td>This example value shows that when the liquid level is above the sensor, the echo time must be greater than or equal to 19 to turn hysteresis off.</td></tr></table></td></tr>
<tr><td>End of Sensor Ringing</td><td>Each time the sensor transmits the transducer is pulsed with high energy. The energy causes the transducer to vibrate. The transducer will continue to vibrate for a period of time after the transmitting process is finished. This continued vibration is known as ringing. Echoes cannot be detected while the transducer is ringing. The End of Sensor Ringing value is used to ignore the profile data during the ringing period.</td></tr>
<tr><td>Operation</td><td>The column indicates what mode the Switch is operating in.
<table><tr><td>Switch Mode</td><td>In this mode the Switch operates normally.</td></tr><tr><td>Calibration Mode</td><td>The sensor is in calibration mode.</td></tr></table></td></tr>
</table>

Table 3 The table provides a brief description of each of the terms shown in the Thick Walled Tank data log.

3.2 Collecting Sensor Data (Thick Walled Tank Mode)

To transfer a single sensor record, click the Read Sensor button shown in Figure 32. The Gateway will communicate with the sensor and a new data record will appear in the data log after a few seconds. To automatically collect data from the sensor click the checkbox on the toolbar labeled “Automatically Read Sensor Every 3 Seconds”. While the checkbox is “checked” the Gateway will read data from the sensor every 3 seconds.

It is important to note, while using the automatic transfer functionality the “Read Sensor” button and some of the “menus bar” at the top of the screen are disabled. When the automatic transfer feature is unchecked the “Read Button” and the “Menu Bar” are enabled.

Figure 32 The Gateway toolbar “Read Sensor” button and the automatic data transfer checkbox.

3.3 Echo Profile Chart (Thick Walled Tank Mode)

Profile data received from the sensor is automatically charted as shown in Figure 33. The chart shows four pieces of information. The captured profile is displayed as a dark blue solid line. A dark blue vertical line with blue triangles indicates where the echo was detected (time 14). The red vertical line indicates the last echo was detected while the liquid in the tank was below the sensor. This value was determined during calibration. The green vertical line indicates where the switching point that was detected during calibration. The switching point is the point where the sensor detected liquid in front of the transducer face.

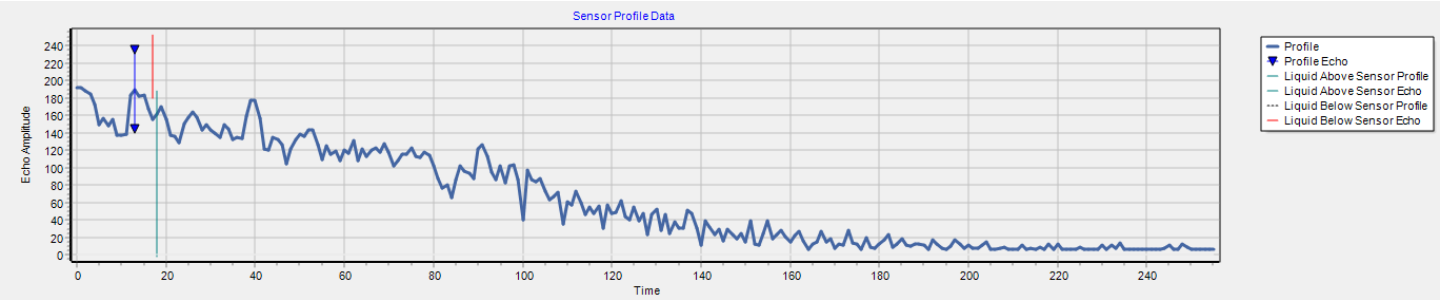


Figure 33 Profile data from the sensor is automatically charted. The chart shows the profile data (line chart), the echo marker (blue vertical line), the "echo when the liquid was below" (red vertical line) and the "echo when the liquid was at" the sensor (green vertical line).

The chart provides a valuable diagnostic tool. If the sensor is not mounted correctly the profile will show the transmission pulse and very low data values afterwards. The profile of a correctly mounted sensor should be similar to the profile in Figure 33.

3.4 Profile Charting Options (Thick Walled Tank Mode)

The Gateway software has the ability to store and display up to 3 profiles simultaneously along with the echo marker and both calibration echo markers. The profile charting is controlled by the controls in the toolbar section see Figure 30. The toolbar contains 6 checkboxes as described in Table 4.

Checkbox	Description
Show Profile	When checked the selected profile in the data log will be charted in blue. By default the latest profile transferred from the sensor is automatically selected and charted.
Show Profile Echo Marker	When checked the echo location of the selected profile in the data log will be charted by a blue vertical line with triangles.
Show Liquid Below Profile	If a profile has been saved by using the "Save Liquid Below Profile" button, then it can be displayed by checking the box. The profile will be charted in black.
Show Below Echo Marker	When checked the "Liquid Below Sensor" calibration echo location will be charted by a red vertical line.
Show Liquid Above Profile	If a profile has been saved by using the "Save Liquid Above Profile" button, then it can be displayed by checking the box. The profile will be charted in green.
Show Liquid Above Marker	When checked the "Liquid Above Sensor" calibration echo location will be charted by a green vertical line.

Table 4 Provides a brief description of each of the checkbox controls on the toolbar.

The following figures show the 3 different profiles that can be displayed individually. Figure 34 shows the Gateway screen when the “Liquid Below” profile is being displayed.

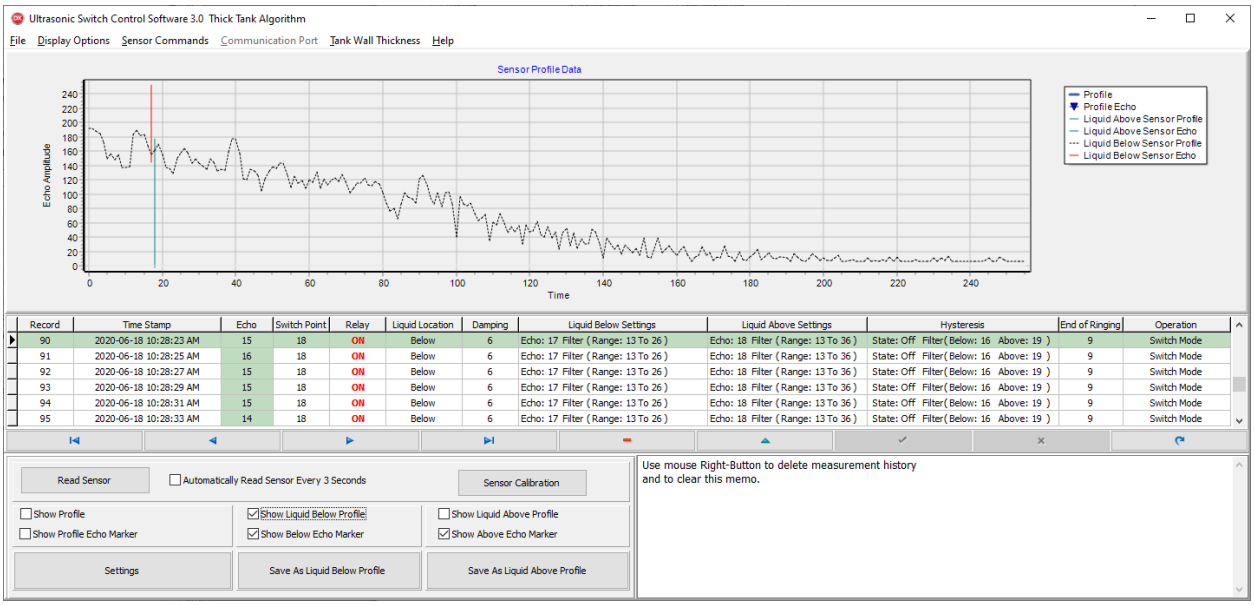


Figure 34 The chart shows the saved “liquid below sensor” profile. The profile is shown in black and is displayed when the “show liquid below profile” checkbox is checked.

Figure 35 shows the Gateway screen when the “Liquid Above” profile has been selected.

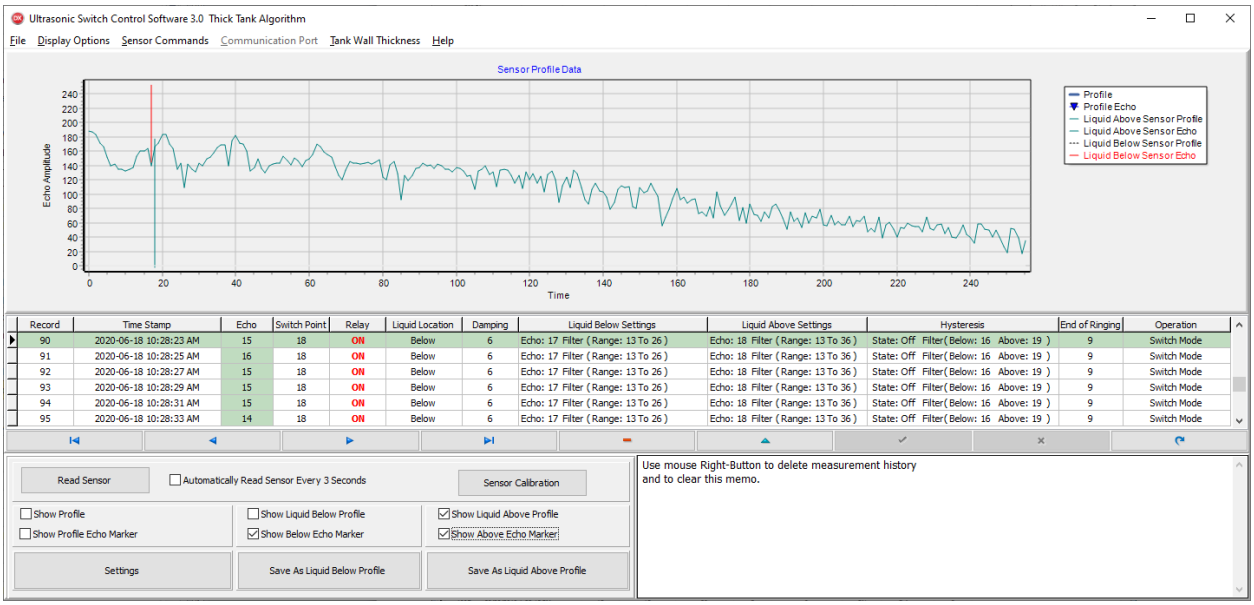


Figure 35 The chart shows the saved “liquid above sensor” profile. The profile is shown in green and is displayed when the “show liquid above profile” checkbox is checked.

Figure 36 shows the Gateway screen when all 3 profile options are selected.

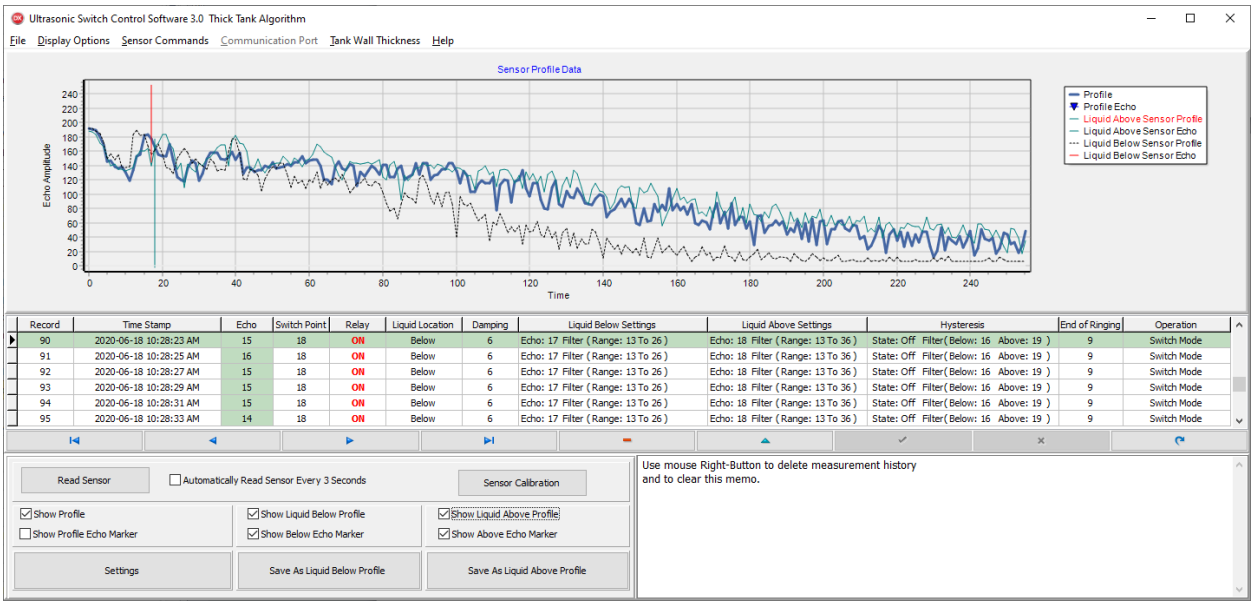


Figure 36 The chart shows the profile selected in the data log area and both saved profiles. It is possible from the chart to see where the profiles overlap.

3.5 Data Log and Charting (Thick Walled Tank Mode)

Records read from the sensor are automatically logged, charted and saved to disk. Logged data can be displayed on the chart by clicking the desired data record. Using the up and down arrow keys you can navigate through the data log displaying each record as you go. The data log has a navigation bar with buttons to move to the first and last record, iterate through the records using the next and previous buttons, a delete button to delete a record and a button to refresh the data log browser. The navigation bar and a description of each button is shown in Figure 37.

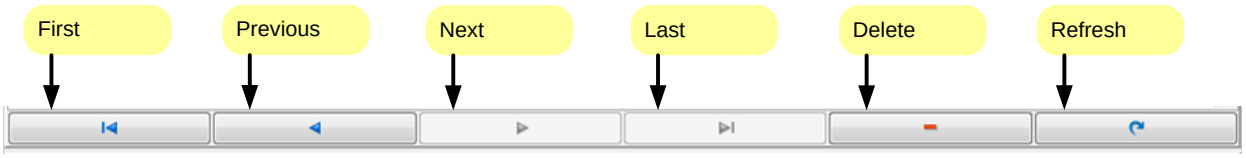


Figure 37 The data log navigation bar with a description of each button.

To delete all of the records in the data log, right click over the data log to show the pop-up menu and select “Delete Measurement History” as shown in Figure 38 with a red circle around it.

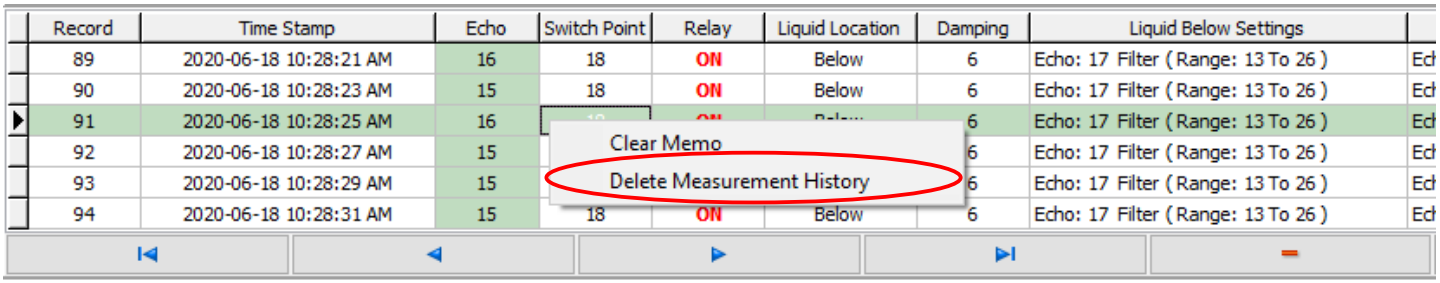


Figure 38. To delete all records, right click over the data log to display the pop-up menu.

3.6 Settings (Thick Walled Tank Mode)

Operation of the sensor can be fine-tuned using the controls on the settings form as shown in Figure 39.

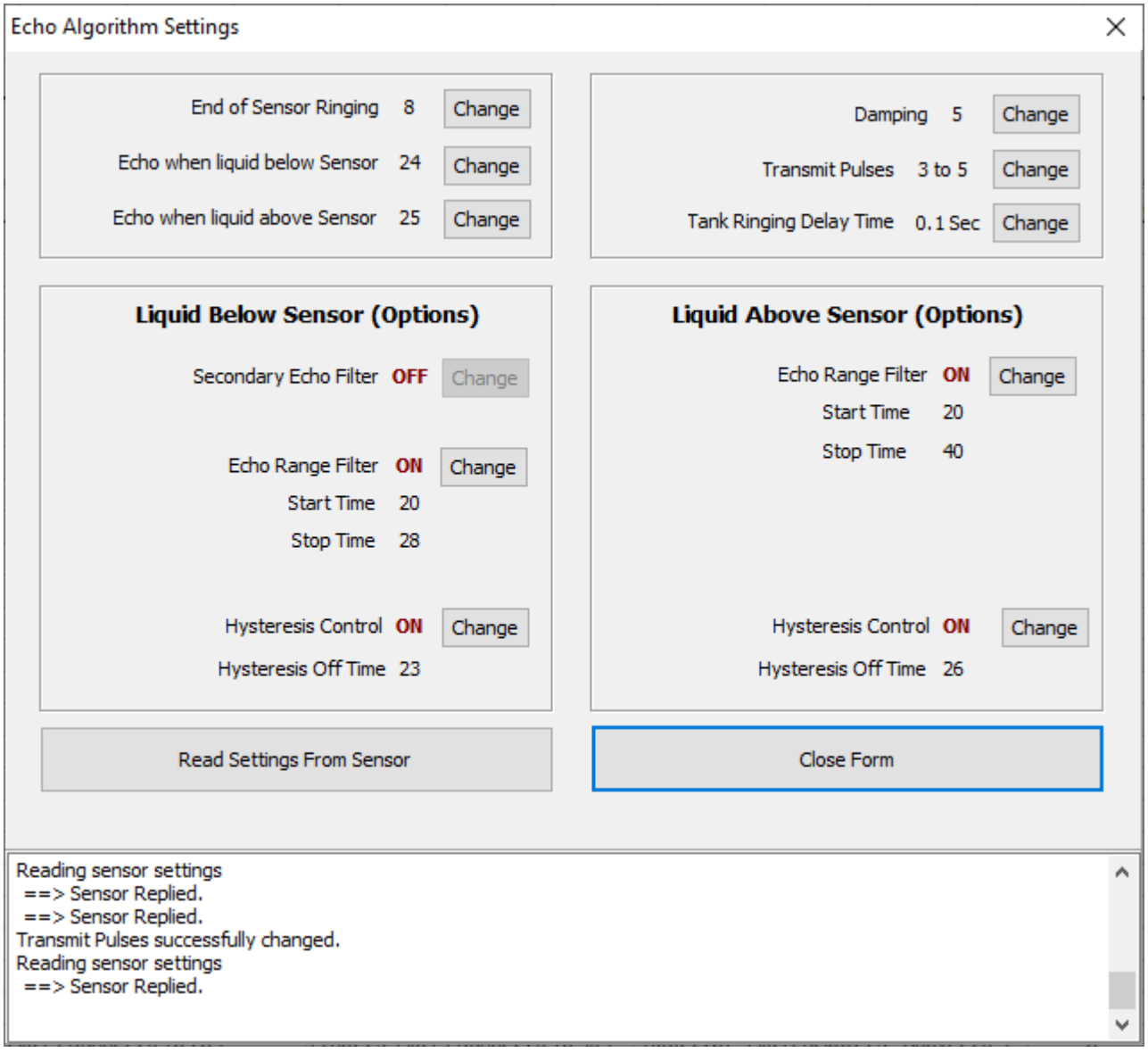


Figure 39 The Settings form provides access to the control values used by the sensor and optional filter settings.

A description of each of these settings is provided in the General Settings Table 5, the Liquid Below Sensor Options Table 6 and the Liquid Above Sensor Options Table 7.

General Settings

Figure 40 shows the sensor's general settings and controls.

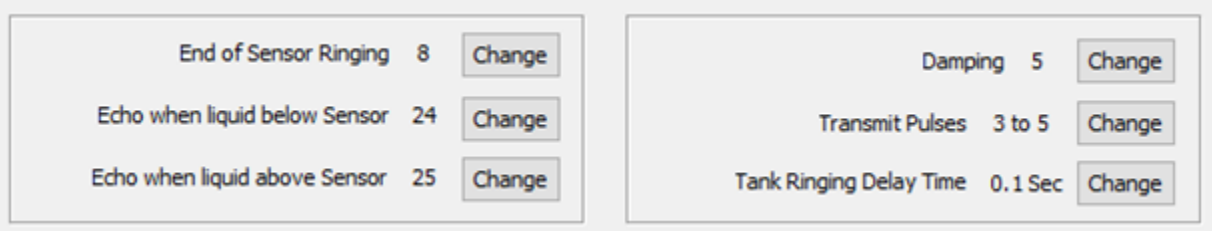


Figure 40 Controls from the general settings section of the settings dialog box.

Table 5 below provides a description of each of the general setting controls.

Descriptions of General Settings

Setting	Description
End of Sensor Ringing	The "End of Sensor Ringing" value instructs the sensor to ignore the profile data values up to the point where ringing ends. (For a definition of Sensor Ringing see Table 3).
Echo when liquid below Sensor	This value is set during calibration. During calibration the sensor detects the echo when the liquid is just below the sensor. The echo value is used to determine the liquid location. The value is critical to the correct operation of the sensor.
Echo when liquid above Sensor	This value is set during calibration. During calibration the sensor detects the echo when the liquid is in front of the transducer face. The echo value is used to determine the liquid location. The value is critical to the correct operation of the sensor.
Damping	The damping value controls the switching of states from liquid above to below or from below to above. The damping value is used to filter out echo fluctuations and noise. In order for the sensor to change states it must repeatedly receive echoes that fall within the time zone of the opposite state.
Transmit Pulses	The number of transmit pulses determines the amount of transmit power the Ultrasonic Switch is using. A minimum and maximum number of transmit pulses can be set in the range of 3 to 30. The default range is 3 to 5.
Tank Ringing Delay Time	Ultrasonic pulses from the Switch cause the attached tank to vibrate at very high frequencies. This vibration typically has a very short span. The "Tank Ringing Delay Time" is the amount of time the Switch waits before transmitting again. The purpose of the delay is to allow the tank to stop vibrating before the next measurement occurs. During calibration the Tank Ringing Time delay is measured and stored. The default value is 0.1 seconds.

Table 5 A description of sensor settings used for both "liquid above" and "liquid below" states.

Liquid Below Sensor Options

This section describes the controls shown in Figure 41 used to control the functionality of the Switch when the liquid level is below the sensor.

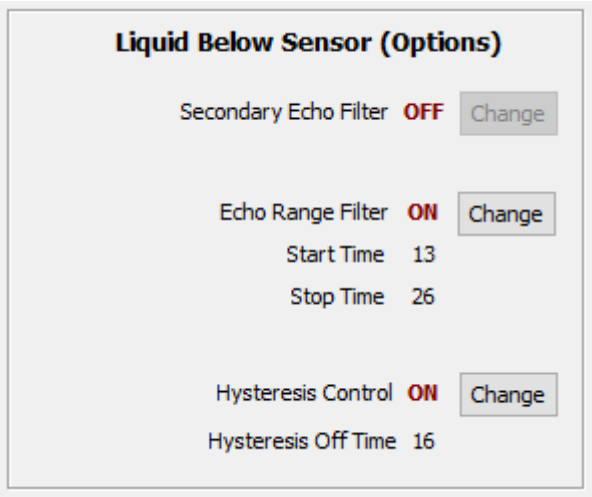


Figure 41 These options control the operation of the Switch when the liquid level is below the sensor.

When the liquid is below the sensor the echo will be equal to or less than the “Echo when liquid below sensor” value. While in the “below” state the sensor uses the “Liquid Below Sensor Options”. These options control the echo detection algorithm by limiting the time range where an echo can be detected. If none of the options listed in Table 6 are selected the sensor will use the full time span to detect an echo. When the liquid is below the sensor, secondary reflections in the tank may cause the sensor to switch states. Secondary reflections can be eliminated by using the “Secondary Echo Filter” or the “Echo Range Filter”. For other undesired echoes the “Echo Range Filter” should be used. Only one filter can be enabled at a time. If “Secondary Echo Filter” is enabled then the “Echo Range Filter” option will not be available. Table 6 provides a description of each of these controls.

Descriptions Liquid Below Sensor Options

Setting	Description
Filter Out Secondary Echo	When selected, this filter automatically filters out secondary reflections.
Echo Range Filter	The Echo Range Filter allows the user to define the time range where valid “below Sensor” echoes will be detected. The range “**Start Time**” should contain a value at or near to the “end of sensor ringing” and the “**Stop Time**” should contain a value that is greater than the “Echo when liquid above sensor” value. This filter is on by default.
Hysteresis Control	Hysteresis prevents the sensor from toggling between “Liquid Above” and “Liquid Below” state. The sensor cannot change from the “Liquid Below” state to the “Liquid Above” state until the echo time is below the Minimum Time.

Table 6 A description of the "Liquid Below Sensor" options.

Liquid Above Sensor

This section describes the controls shown in Figure 42 used to control the functionality of the Switch when the liquid level is above the sensor.

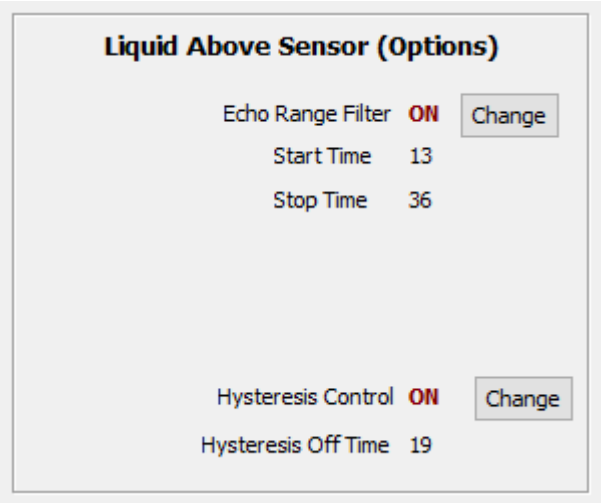


Figure 42 These options control the operation of the Switch when the liquid level is above the sensor.

When the liquid is above the sensor the echo will be greater than the “Echo when liquid below sensor” value. While in the “above” state the sensor uses the “Liquid Above Sensor Options”. These options control the echo detection algorithm by limiting the time range where an echo can be detected. If none of the options listed in Table 7 are selected the sensor will use the full time span to detect an echo. Table 7 provides a description of each of these controls.

Descriptions Liquid Above Sensor Options

Setting	Description
Echo Range Filter	The Echo Range Filter allows the user to define the time range where valid “Above Sensor” echoes will be detected. The range “**Start Time**” should contain a value between the “end of sensor ringing” and the “Below Sensor Echo time”. The “**Stop Time**” should contain a value that is greater than the “Echo when liquid above sensor” value.
Hysteresis Control	Hysteresis prevents the sensor from toggling between “Liquid Above” and “Liquid Below” state. The sensor cannot change from the “Above” state to the “Below” state until the echo time is above the Maximum Time.

Table 7 A description of the "Liquid Above Sensor" options.

3.7 Calibrating Your Level Switch Using the Gateway (Thick Walled Tank Mode)

The sensor must be calibrated to accurately work on a tank. In thick wall mode the sensor is calibrated while the tank is being filled. There are 6 steps to calibrating the Switch.

Step 1 – Tank Setup

Start with the tank empty, if that is not possible then start with the liquid a minimum of 2” or 5 cm below the sensor.

Step 2 – Put the Sensor in Calibration Mode

For this and all proceeding steps the Switch must be powered on and communicating with the Gateway software. The “Switch Calibration” dialog box can be displayed by clicking on the Sensor Command Menu (Figure 43) or by clicking the Sensor Calibration button on the toolbar (Figure 44).

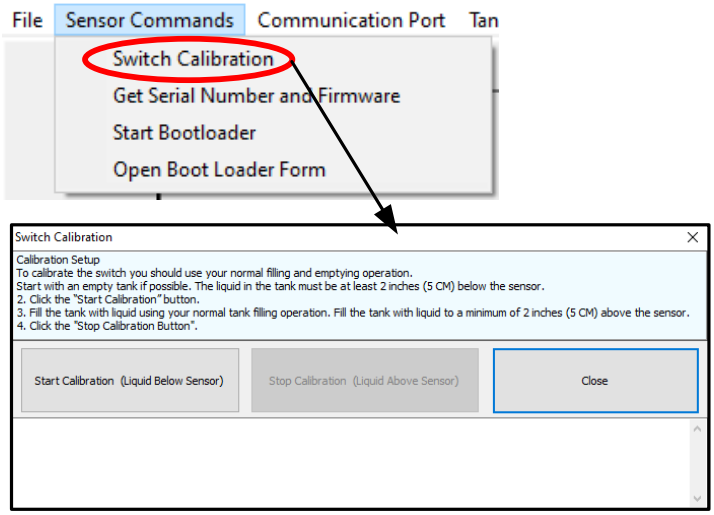


Figure 43. The “Sensor Commands” menu can be used to show the Switch Calibration dialog box.

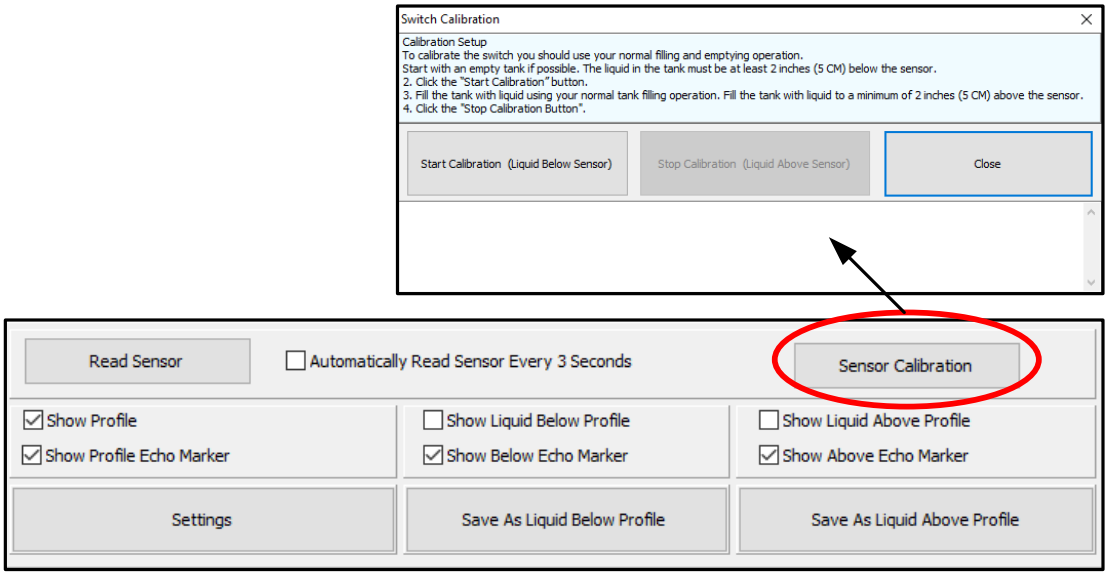


Figure 44. The Sensor Calibration Button located on the toolbar can be used to show the Switch Calibration dialog box

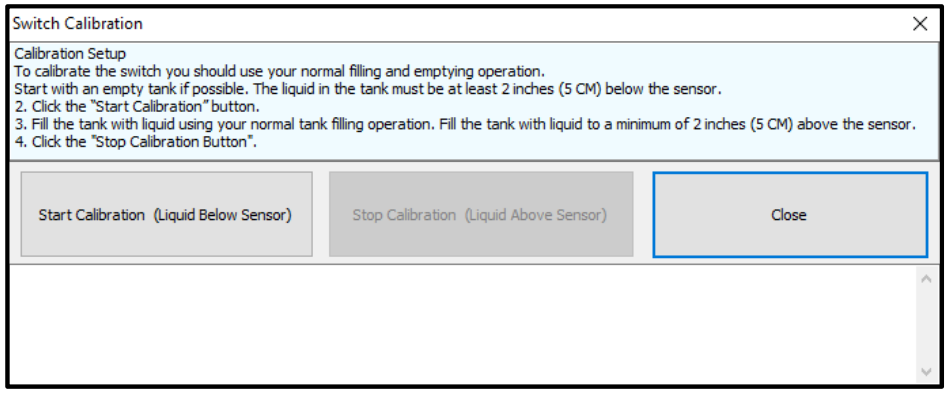


Figure 45. The Switch Calibration dialog box is used to start and stop the Switch's calibration process.

Click the "Start Calibration" button on the "Switch Calibration" Dialog box shown in Figure 45. Once the sensor changes to calibration mode the "Operation" column of each record in the data log will display "**Calibration Mode**".

Step 3 – Fill the Tank

Start filling the tank using your normal filling process. Fill the tank to the normal full level. If the tank cannot be filled completely, it must be filled to at least 2" or 5 cm above the sensor.

Step 4 – Complete the Calibration

To complete the calibration the Level Switch needs to know that the tank is full. Click the "Stop Calibration" button on the "Switch Calibration" Dialog box shown in Figure 45.

Step 5 – Determine Calibration Results

The calibration results are shown in the "Operation" column of the logging area (Figure 46). If the calibration was successful the "Operation" column will show "Switch Mode" in the next row after "**Calibration Mode**".

If the calibration failed the "Operation" column will indicate the error by displaying "**Failed: Range to Small**" in the next row after "**Calibration Mode**". If the calibration failed the sensor will use the previous calibration from the sensor's EEPROM.

If the calibration failed please refer to the section "Cause of Calibration Failure".

Data log messages after calibration.	Operation **Calibration Mode** Switch Mode Switch Mode	Operation **Calibration Mode** **Failed: Range to Small** Switch Mode
Calibration Results	**Calibration Successful**	**Calibration Failed**

Figure 46. The table above shows a summary of the possible messages in the Operation column of the data log when the sensor finishes the calibration process.

Cause of Calibration Failure

During thick tank calibration the sensor records the echo characteristics of the tank as it fills. A minimum range of echoes are required to calibrate the Switch to the tank. If the minimum range of echoes is not collected during calibration the calibration will fail and the LED will blink red 10 times to indicate the failure. The gateway software will display an error message in the “Operation” column of the logging area.

To fix the problem the calibration will need to be performed again. Ensure the tank is empty or that the liquid level is a minimum of 2” (5 cm) below the center of the sensor before starting the calibration process. Once calibration is started the liquid in the tank should be filled to a minimum of 2” (5 cm) above the center of the sensor before completing the calibration process. The tank should be filled using the normal filling process.

Step 6 – Test New Calibration

The sensor uses the calibration process described in steps 1 to 5 to automatically detect your tank’s characteristics. If the sensor detected a wide range of echoes during the calibration process the sensor will calculate the switch point for the tank. Many factors influence the calibration including the tank shape, size, wall thickness, mounting, welded seams and the interior shape and design of the tank. The calibration must always be tested and may need to be repeated or fine-tuned using the Settings dialog box (see Figure 39).

3.8 Calibrating Your Level Switch Using the Sensor's Button

After the Ultrasonic Switch has been installed a simple 6 step calibration process must be performed using the calibration button located on the Switch. The Switch must be calibrated to the tank to know the echo locations of the tank while being filled.

Your Switch is equipped with a calibration button that can be used to calibrate your Switch to match your tanks characteristics. The button can also be used to change from Thick Walled Tank Mode (flashing green LED) to Thin Walled Tank mode (Solid Green LED). To access the calibration button on the Switch remove the Switch's lid by unscrewing it. To activate the calibration mode using the button, power must be supplied to the Switch and the button must be pressed for the time specified in Table 8. Press the button until the LED turns the desired color and then release the button.

Table 8 Calibration Button Timing and LED Color

Button Timing of the Ultrasonic Level Switch.		
Seconds Pressed	LED Color	Description
< 5	Off	If the button is pressed for less than 5 seconds it is ignored and no action is taken.
> 5	Yellow	**Thick Tank Calibration** – Releasing the button while the LED is yellow starts Thick Tank calibration mode.
> 10	Red	**Thick Tank Calibration** – Releasing the button while the LED is red ends Thick Tank calibration mode. After releasing the button wait to see if the LED blinks green or red. Blinking only green indicates that the calibration was successful. Blinking red 10 times indicates that the calibration failed.
> 15	Off	If the button is pressed for greater than 15 seconds the sensor toggles between the Thick Walled Tank algorithm and the Thin Walled Tank Algorithm. The sensor LED indicates the sensor's mode. Thick Walled Tank Mode (flashing green LED) Thin Walled Tank mode (Solid Green LED)

Where: < means less than and > means greater than.

Step 1 – Tank Setup

Start with the tank empty, if that is not possible then start with the liquid a minimum of 2” or 5 cm below the sensor as shown in Figure 47.

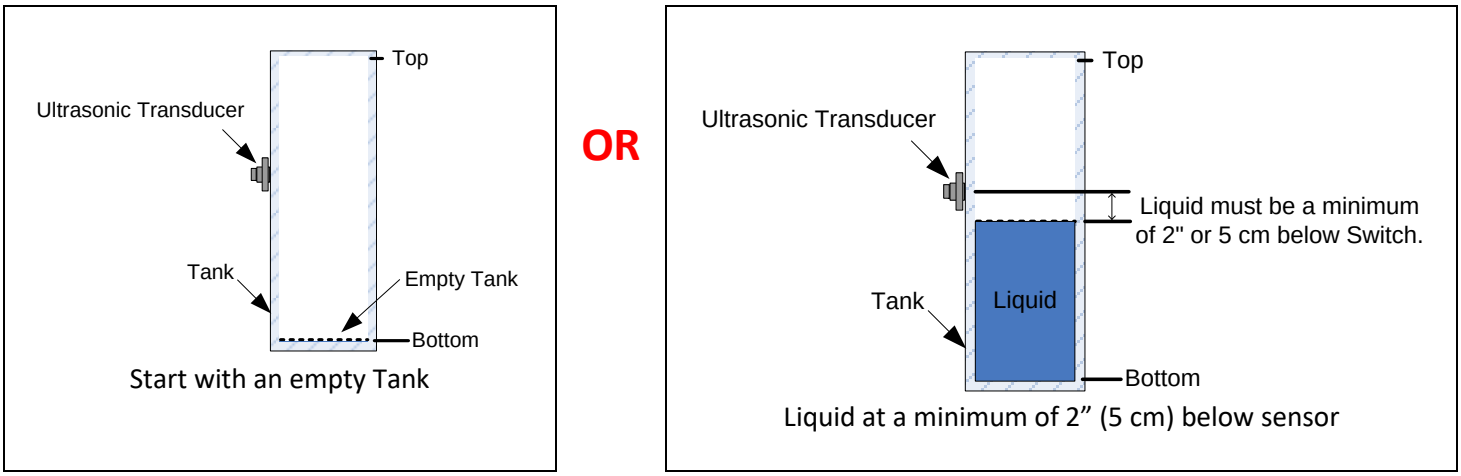


Figure 47 Before starting Thick Walled Tank calibration the tank should be empty or the liquid level should be 2” or 5 cm below the sensor.

Step 2 – Put the Sensor in Calibration Mode

With the Switch powered on the LED should be green. Press and hold the calibration button. The LED will turn off and 5 seconds later it will turn yellow. Release the button when the LED turns yellow. The Level Switch is now in calibration mode and the LED will blink green.

Step 3 – Fill the Tank

Start filling the tank using your normal filling process. Fill the tank to the normal full level. If the tank cannot be filled completely, it must be filled to at least 2” or 5 cm above the sensor as shown in Figure 48.

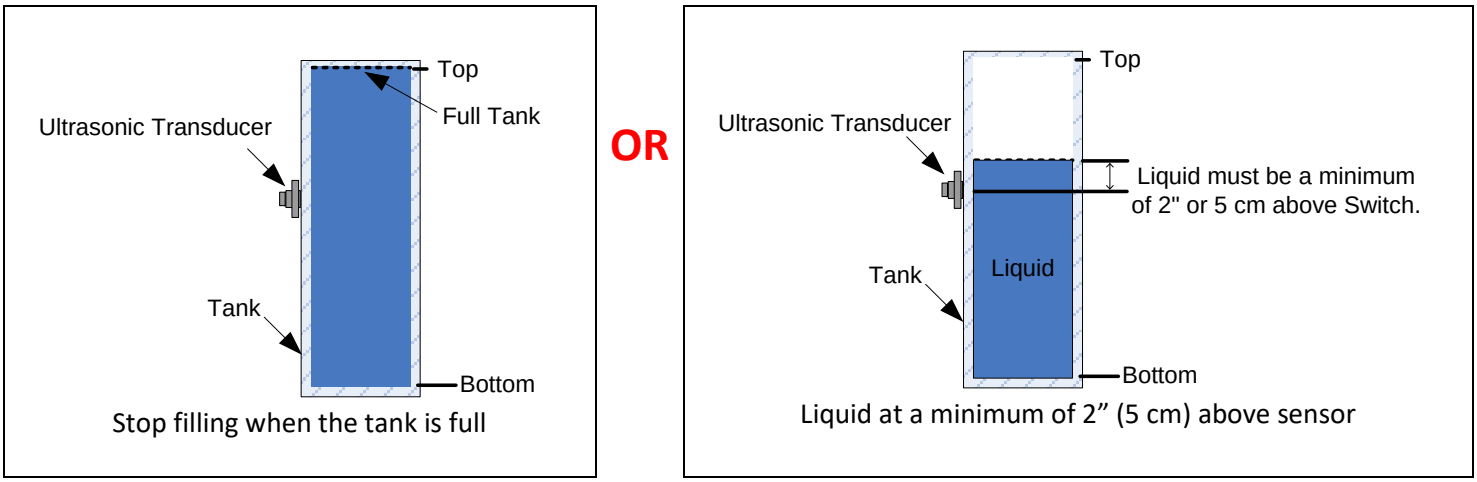


Figure 48 Fill the tank until full or at a minimum of 2” or 5 cm above the Level Switch.

Step 4 –Complete the Calibration.

To complete the calibration the Level Switch needs to know that the tank is full. Press and hold the calibration button. The LED will turn off, after 5 seconds the LED will turn yellow, after another 5 seconds the LED will turn red. Release the button when the LED turns red. The LED will blink green. Calibration is now complete and the LED color will indicate if the calibration was successful (see step 5).

Step 5 – Determine Calibration Results

If the calibration was successful, the LED will blink green. If the calibration process failed, the LED will blink red 10 times. If the calibration failed the sensor will load the previous calibration from the sensor's EEPROM.

Cause of Calibration Failure

During thick tank calibration the sensor records the echo characteristics of the tank as it fills. A minimum range of echoes are required to calibrate the Switch to the tank. If the minimum range of echoes is not collected during calibration the calibration will fail and the LED will blink red 10 times to indicate the failure.

To fix the problem the calibration will need to be performed again. Ensure the tank is empty or that the liquid level is a minimum of 2" (5 cm) below the center of the sensor before starting the calibration process. Once calibration is started the liquid in the tank should be filled to a minimum of 2" (5 cm) above the center of the sensor before completing the calibration process. The tank should be filled using the normal filling process.

Step 6 – Test New Calibration

The sensor uses the calibration process described in steps 1 to 5 to automatically detect your tanks characteristics. If the sensor detected a wide range of echoes during the calibration process the sensor will calculate the switch point for the tank. Many factors influence the calibration including the tank shape, size, wall thickness, mounting, welded seams and the interior shape of the tank. The calibration must always be tested and may need to be repeated or fine-tuned using the Gateway software's Settings dialog box (see Figure 39).

Section 4: Reading the Sensor Serial Number and Firmware Version

To read the sensor's serial number and firmware version click on the "Sensor Commands" menu, then "Get Serial Number and Firmware" menu item as shown in Figure 49. The Gateway will query the sensor and display the serial number and the firmware version in the memo.

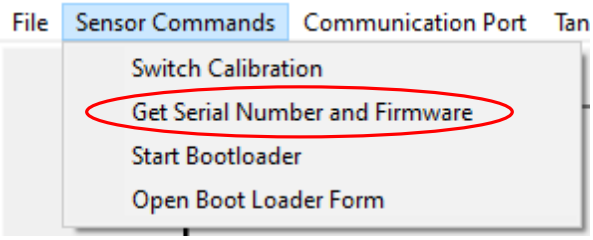


Figure 49 The sensor's serial number and firmware can be read from the sensor using the "Get Serial Number and Firmware" menu.

Section 5: Updating Sensor Firmware

5.0 Updating the Sensor Firmware

There are two methods of updating a sensor's firmware.
Method 1 (Start Bootloader)

- The firmware can be updated using only the gateway software. This method is described in Section 5.1 Updating the Sensor Firmware Method 1 below. Using this method the Gateway sends a command to the sensor to activate the sensor's boot loader program. This method is used to update the sensor remotely without needing to open the sensor's lid to access the sensor's button.

Method 2 (Manual Method).

- This method requires the user to press the sensor's push button to activate the sensor's boot loader program. This method is described in Section 5.2 Updating the Sensor Firmware Method 2.

5.1 Updating the Sensor Firmware Method 1

The sensor's firmware can be updated using the sensor boot loader. To start the boot loader click on the "Sensor Commands" menu, then "Start Bootloader" menu item as shown in Figure 50. The Gateway will communicate with the sensor changing the sensor to the bootloader mode and the bootloader dialog box will appear. Click the "Load Hex" button to select the new firmware hex file. Once a file has been selected click the "Start Download" button to start the download process. When the download is complete click the "Close" button.

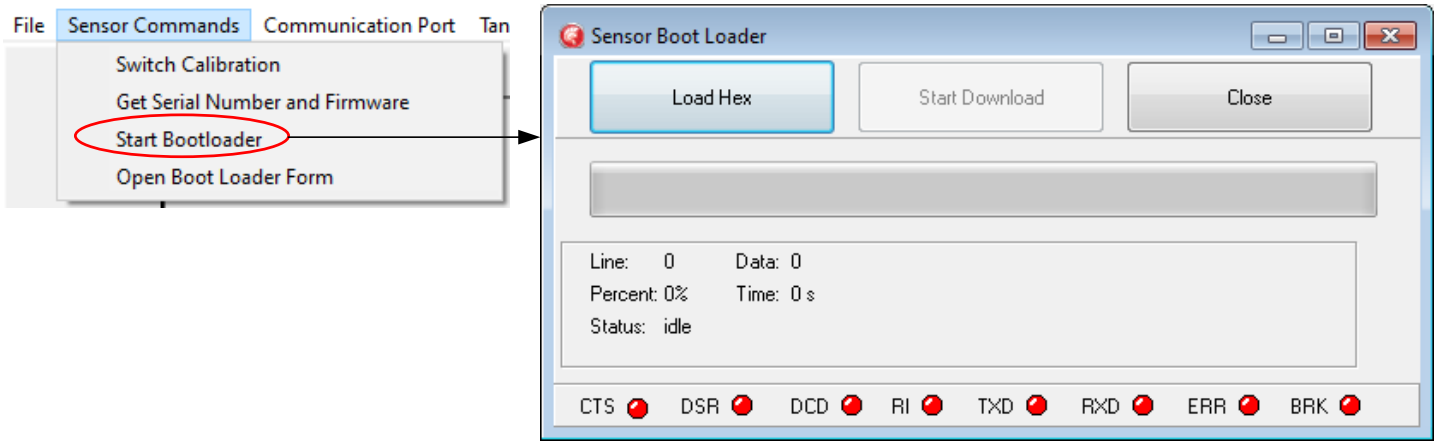


Figure 50 The latest firmware can be loaded into the sensor using the "Start Bootloader" menu.

If you decide not to update the sensor's firmware, click the "Close" button and reboot the sensor to return the sensor to normal operation.

5.2 Updating the Sensor Firmware Method 2

The sensor's firmware can be updated using the sensor boot loader. This method requires the user to manually start the sensor's boot loader using the push button located on the sensor. This method may be required when a sensor's firmware fails to load the boot loader using method 1.

Steps to manually start the sensor's Boot Loader:

1. Power off the sensor.
2. Remove the sensor lid.
3. Push and hold the sensor's button.
4. Power on the sensor
5. After the LED turns red (few seconds) release the push button.
6. The red LED indicates the sensor is in boot loader mode.

Using the Gateway click on the "Sensor Commands" menu, then "Open Boot loader Form" menu item as shown in Figure 51. The bootloader dialog box will appear. Click the "Load Hex" button to select the new firmware hex file. Once a file has been selected click the "Start Download" button to start the download process. When the download is complete click the "Close" button.

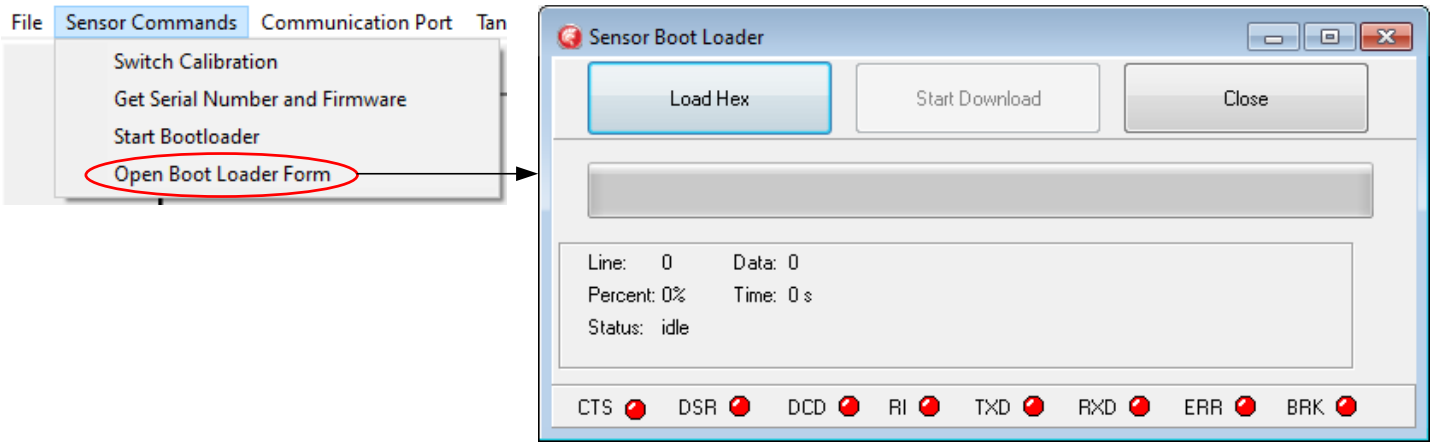


Figure 51 After manually starting the sensor's boot loader program, the boot loader form can be used to update the sensor's firmware.

If you decide not to update the sensor's firmware, click the "Close" button and reboot the sensor to return the sensor to normal operation.

Section 6: Sensor Installation

6.0 Sensor Installation - Grease Makes it Work

This step is critical, if not done correctly the system will not work. The transducer must be mounted to the tank with a layer of "DOW Corning High Vacuum Grease" between the transducer face and the tank. The grease serves two purposes. First it matches the transducer to the tank, providing the correct coupling required. Second, it helps remove any air from between the transducer and the tank. Air gaps or bubbles between the transducer and the tank will absorb the ultrasonic energy and the Switch will not function correctly. The complete transducer face must press firmly against the tank or the ultrasonic waves will not pass through the tank wall. For detailed installation instructions refer to the "*Ultrasonic Level Switch User Guide*" found on the ABM Sensor Technology website.

6.1 Installation Demonstration Video

ABM Sensor Technology offers a flange mounting system to simplify the installation of the Ultrasonic Switch on a round tank. The following short video (https://youtu.be/N5Qg9eZNe-8) shows the mounting flange and the application of the required vacuum grease to the transducer face. The rubber strap system used in the video is no longer recommended. A simple ratchet strap system is now recommended (refer to the "*Ultrasonic Level Switch User Guide*" found on the ABM Sensor Technology website).

6.2 Profiles from Good and Bad Installations

By observing the sensor profile we can determine if the sensor is making good contact with the tank.
When a sensor is installed correctly the profile should always have a sloped section caused by the tank vibrations or "ringing".

6.2.1 Thin Walled Tank Examples

The following section applies to Thin Walled Tank installations. For Thick Walled Tank installations see 6.2.2 Thick Walled Tank Example. Figure 52 and Figure 53 are examples of the type of profiles you should see when the sensor is installed and pressing against the tank correctly. Notice the sloped sections identified with the dotted line. The sloped section is caused by the Ultrasonic sensor vibrating the tank and the echoes received through the liquid and the tank wall.

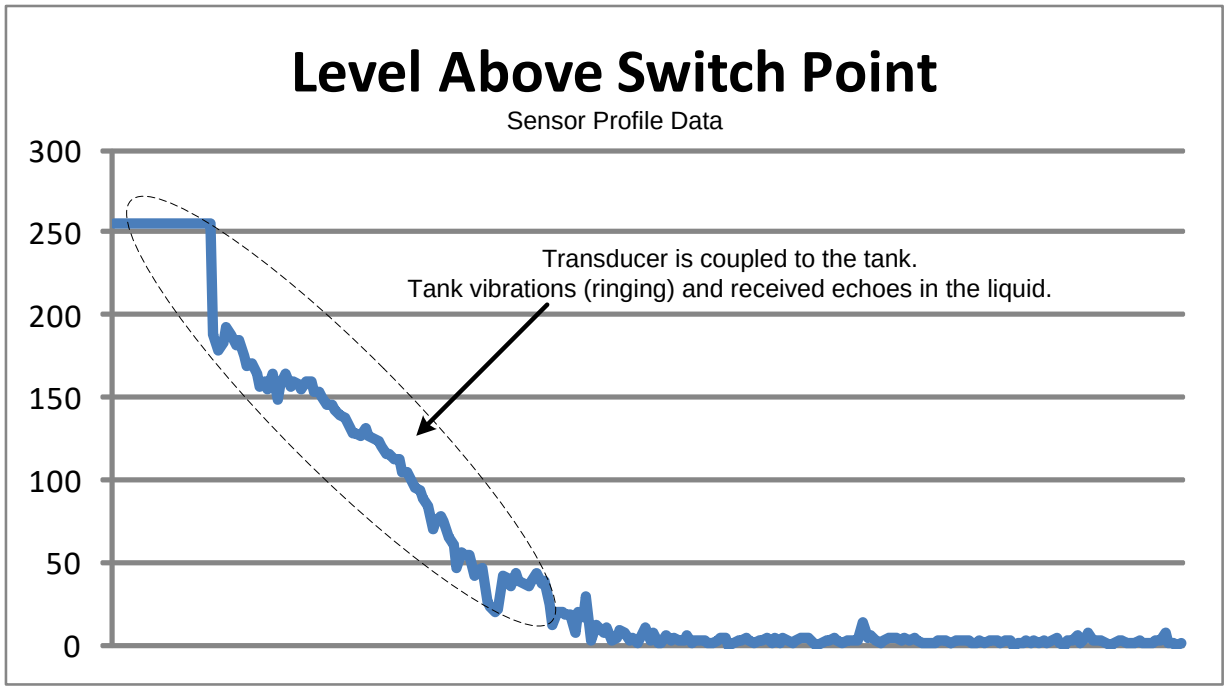


Figure 52 The profile of a correctly installed sensor where the liquid level is above the switch point. The dotted lines identify the sloped section of the profile where the "ringing" can be seen.

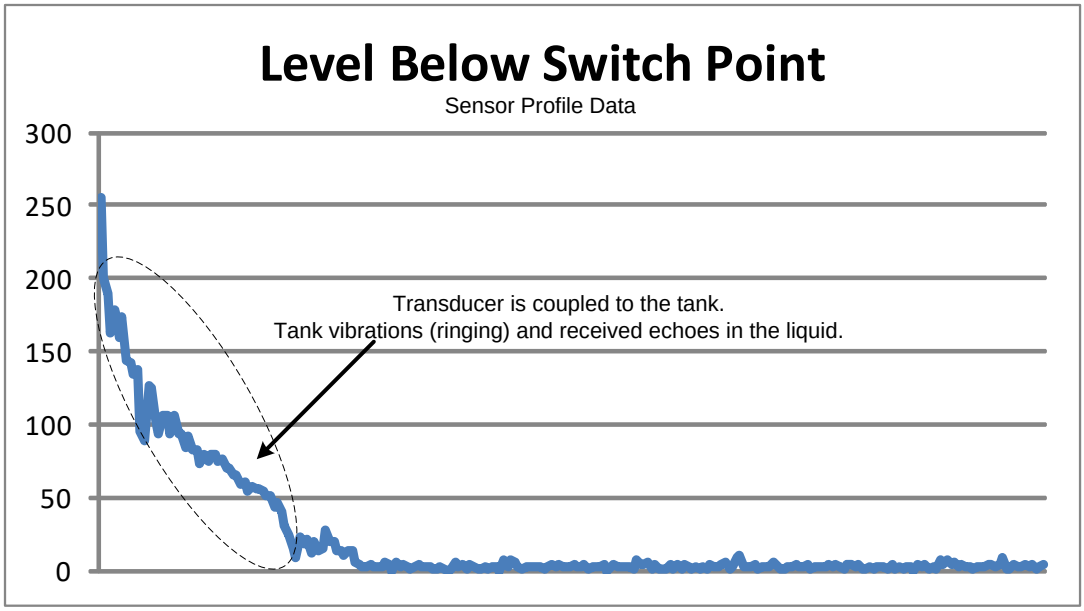


Figure 53 The profile of a correctly installed sensor where the liquid level is below the switch point. The dotted lines identify the sloped section of the profile where the "ringing" can be seen.

If a sensor is not coupled (pressed) to the tank correctly, the Ultrasonic sensor will not vibrate the tank and the profile will not have a sloped section showing the tank vibrations. Figure 54 shows an example profile of a sensor that is not installed correctly. The profile shows the transmit pulse from the sensor but no echoes or ringing is detected.

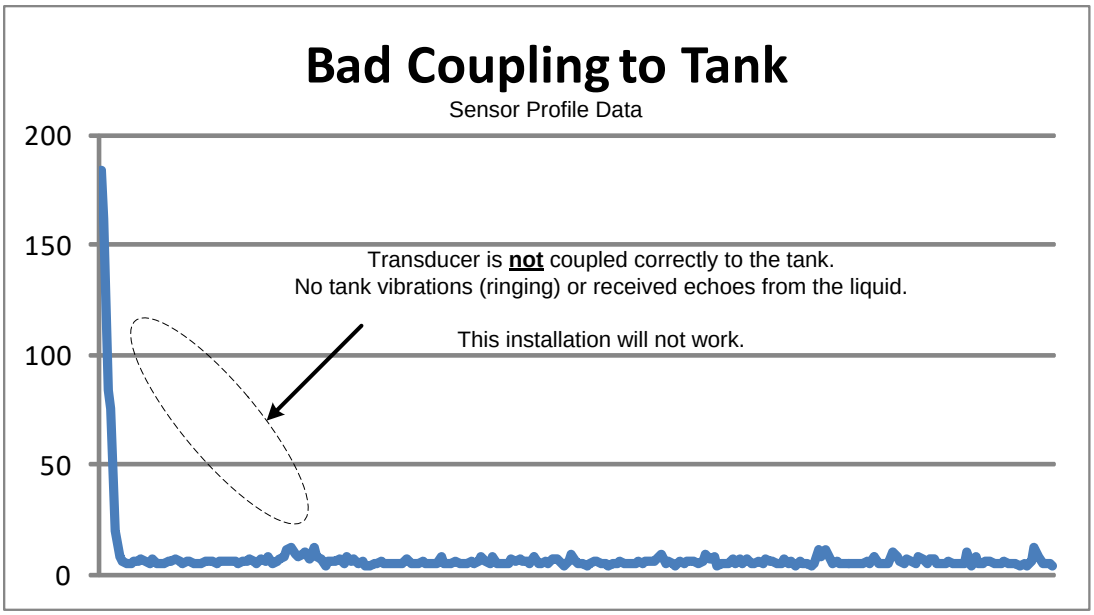


Figure 54 This sensor is not installed correctly. The ultrasonic pulses are not vibrating the tank. The dotted lines highlight the missing sloped section where "ringing" should occur.

6.2.2 Thick Walled Tank Example

Like the Thin Walled Tank installation, an incorrectly installed sensor on a Thick Walled Tank will produce a low amplitude sensor profile data. Figure 55 shows the profile from a correctly installed sensor.

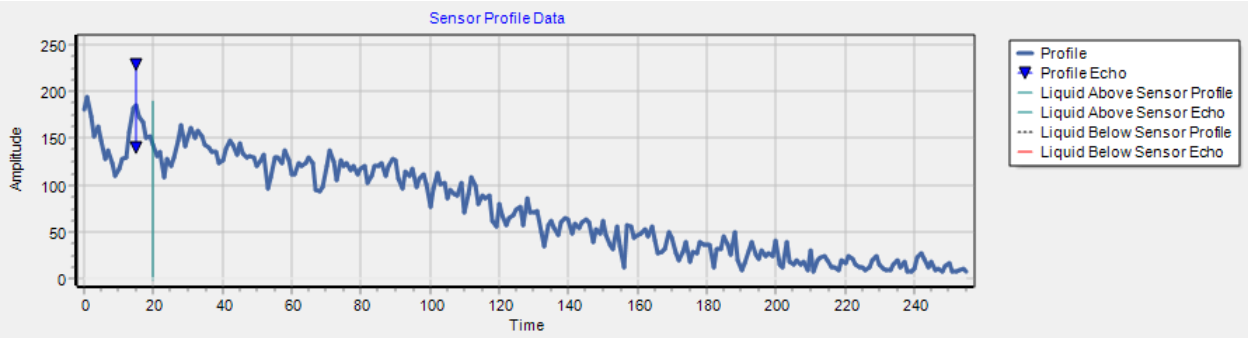


Figure 55 Thick Walled Tank profile from a sensor that is correctly installed. Notice the high amplitude signal.

6.3 Steps to fix a bad installations

When the sensor profiles indicate that the sensor is not coupling (pressed) to the tank correctly the following steps should be performed:

1. Power off the sensor.
2. Remove the transducer from the mounting flange.
3. Clean the transducer face.
4. Apply fresh grease to transducer face (DOW Corning High Vacuum Grease).
5. Insert the transducer into the mounting flange.
6. Gently tighten the transducer into mounting flange to squeeze out all air from between tank and the transducer.
7. Power on the sensor.
8. Request a profile from the sensor.
9. Repeat steps 1 to 8 until the profile shows the desired sloped section with ringing.

6.4 Transducer and Filling Pipe Location

When installing the sensor the filling pipe and the sensor should be located on opposite sides of the tank. Installing the sensor directly across from the filling pipe will help the sensor's performance during filling conditions.

6.5 Filling Tank – How to avoid aeration when using Thin Walled Tank mode?

The Ultrasonic Switch works well with liquids that do not contain a continuous supply of bubbles. For example ginger ale soda pop. Bubbles may be caused by oxygen or other gases. Air bubbles in liquids absorb and scatter ultrasonic energy.

Liquids will naturally absorb air when being poured through the "air" into a tank, or when air is pumped through a liquid. Pumps that use air to move the liquids in short burst will also cause the liquid to absorb air. The absorption of "air" is called aeration and should be avoided as much as possible.

The Ultrasonic Switch has been designed to transmit high energy pulses to displace and remove the air bubbles from around the tank area connecting to the sensor. The effects of the bubbles may be observed in the sensor profile. The amplitude of the profile and the calculated average will be reduced. Using a small number of profile samples will help with sensor response time.

6.6 Minimizing Aeration

To minimize aeration, tanks should be filled slowly through a filling tube with a continuous supply of the liquid being added. If possible avoid pouring the liquid through the air into the tank or using pumps that introduce air into the liquid as part of the pumping action.