

# SonicLink Software Quick Start Guide

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## 1 OVERVIEW

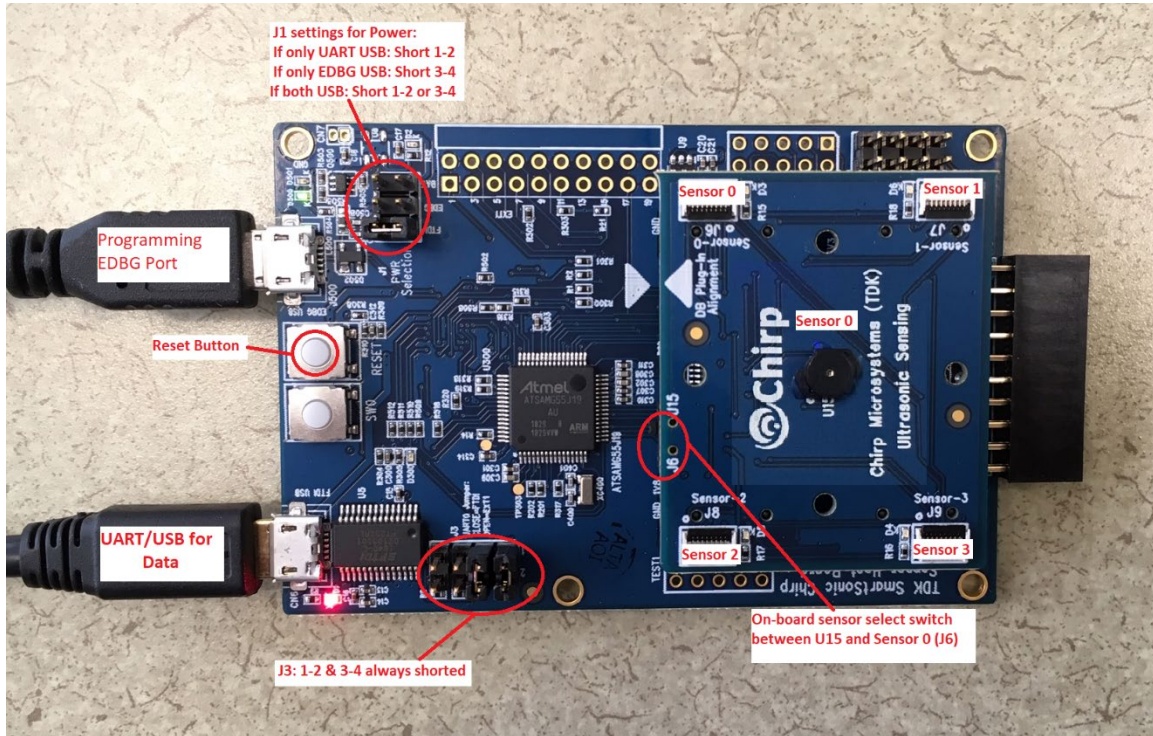
This document is a guide for installing and using the SonicLink software tool in combination with the TDK/Chirp SmartSonic board. Users will gain hands-on experience with the unique ultrasonic sensing technology of the Chirp CH101 and CH201 sensors, which provides accurate range measurements in a compact, low-power device.

### 1.1 REQUIREMENTS

1. PC with Windows OS. (Tested on Windows 8 64-bit, and Windows 10 64-bit.)
2. TDK/Chirp Microsystems SmartSonic evaluation board.
3. Two Micro USB cables.
4. Atmel Studio 7.0 IDE.
5. Internet connection (if the .NET framework and Atmel/FTDI drivers/tools are not previously installed on the target PC).

## 2 HARDWARE CONFIGURATION

The SmartSonic board is used with an external evaluation board as shown below. For initial hardware setup and programming of the Atmel chip, two micro USB cable connections are required but once the MCU is flashed then only the UART/USB Data connection is required. The board jumpers should be set in their default configuration as shown in the figure below.



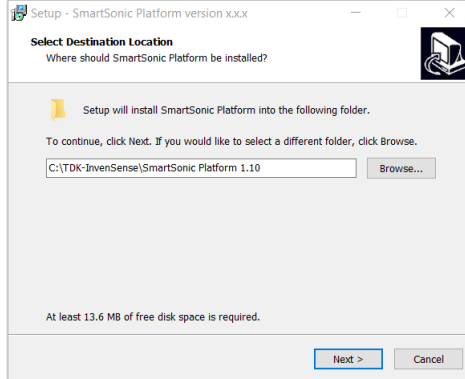
To connect an external sensor to the daughterboard, the flex cable will be inserted silver side up at the SmartSonic board and external sensor board. You can see in the pictures below that the blue side of the flex cable faces downward, away from the sensor. When connected properly, an external sensor should lie flat on the work surface, facing upwards.



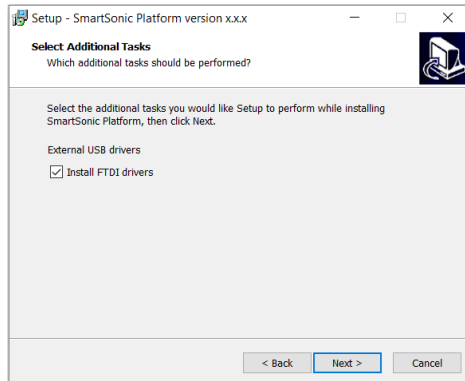
For best performance, external CH101 sensor modules that have the omnidirectional housing (part number MOD\_CH101-03-01) should be mounted in a flat plate of at least 100 mm (4”) diameter with the sensor’s acoustic housing flush with the surface of the plate. Consult the MOD\_CH101 module datasheet for more information.

### 3 INSTALLATION

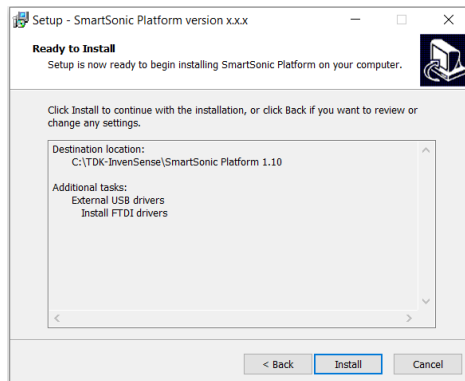
1. Run the **SonicLink\_X.X.X\_Installer.exe** installer. It will prompt for the installation directory. Once the desired installation directory is selected, click **Next**.



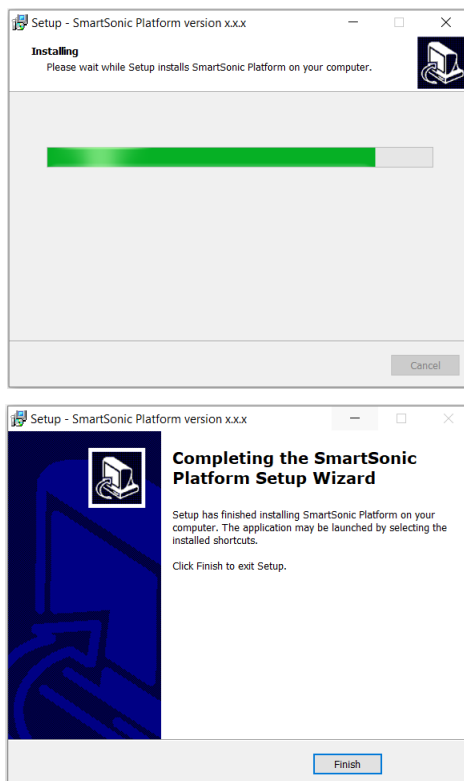
2. Check the **Install FTDI drivers** box, then click **Next**.



3. Verify the destination folder and start the installation by clicking on **Install**.



4. Wait for the installation to complete, and then click **Finish**.



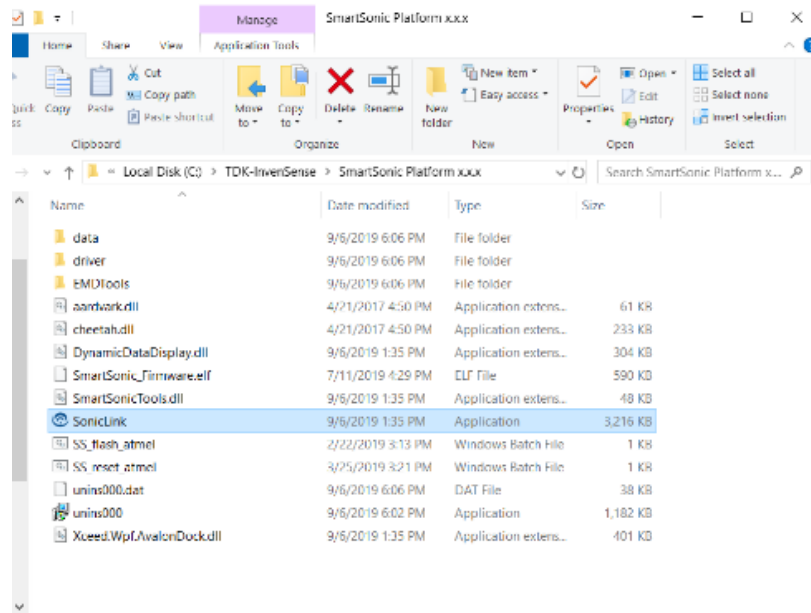
### 3.1 INSTALLING ATMEL STUDIO 7 AND FTDI DRIVER

Connect the SmartSonic evaluation board to the computer using the two USB ports (**Note:** A sensor daughter card should first be installed on the SmartSonic board). Install the following tool to allow Flash MCU Firmware:

ATSAMG55 (web installer) If you haven't installed Atmel Studio 7, you can download the installer here: <https://www.microchip.com/mplab/avr-support/atmel-studio-7>

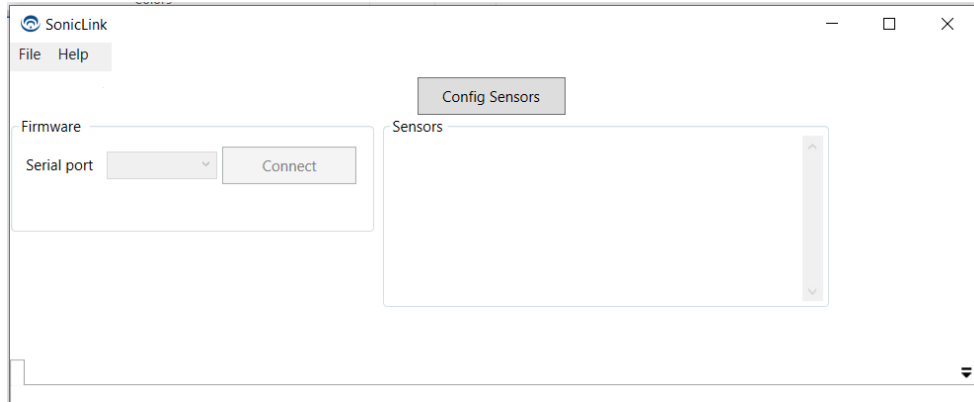
## 4 STARTING THE SONICLINK APPLICATION

1. Navigate to the installation directory and run the **SonicLink.exe** executable or the SonicLink icon on the desktop.

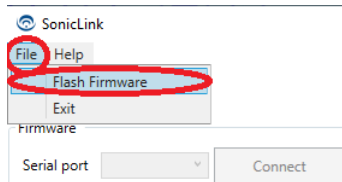


## 5 CONNECTING THE SMARTSONIC BOARD

1. If no SmartSonic boards are connected to the USB/COM ports, the Serial Port and **Connect** button will be grayed out. If you do not observe a connected SmartSonic board in the serial port list, close and restart the SonicLink application as hardware discovery only occurs during launch of the app.



2. If a SmartSonic board is connected through a COM port it will appear in the **Serial port** list. Select the SmartSonic board from the list and click **Connect**. If the board needs to be initialized with firmware click **File** drop down menu and select **Flash Firmware** to program the MCU. Otherwise go to the next step.

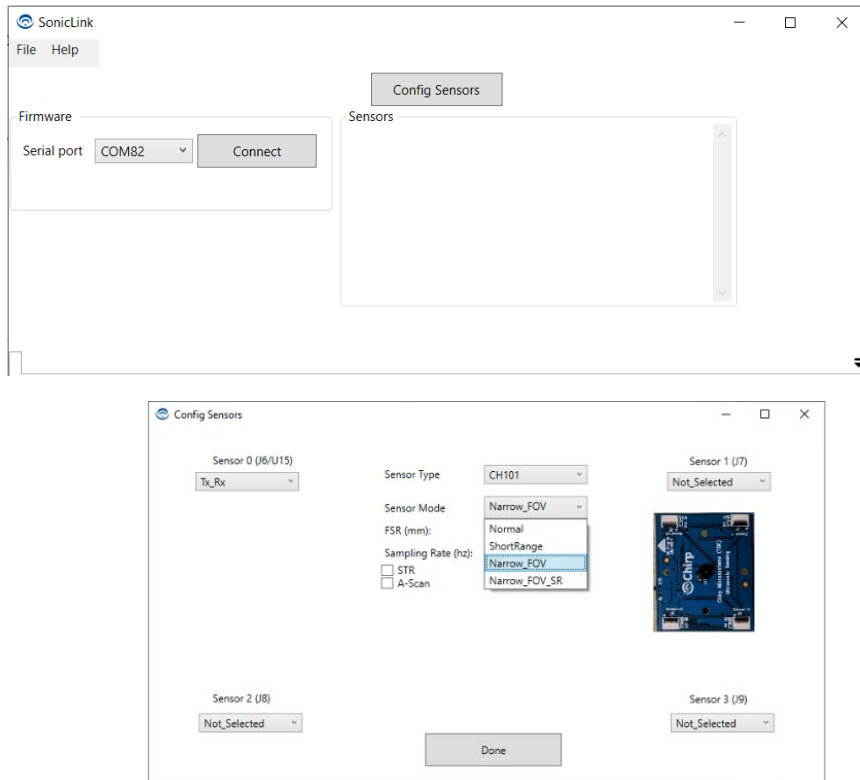


3. Add a configuration to match the sensor(s) by clicking **Config Sensors**. Configure the sensor(s) in the order set on the next page.



**Note:** CH101 and CH201 sensors cannot be run at the same time on a single SmartSonic board. All sensors attached must all be either CH101 or CH201.

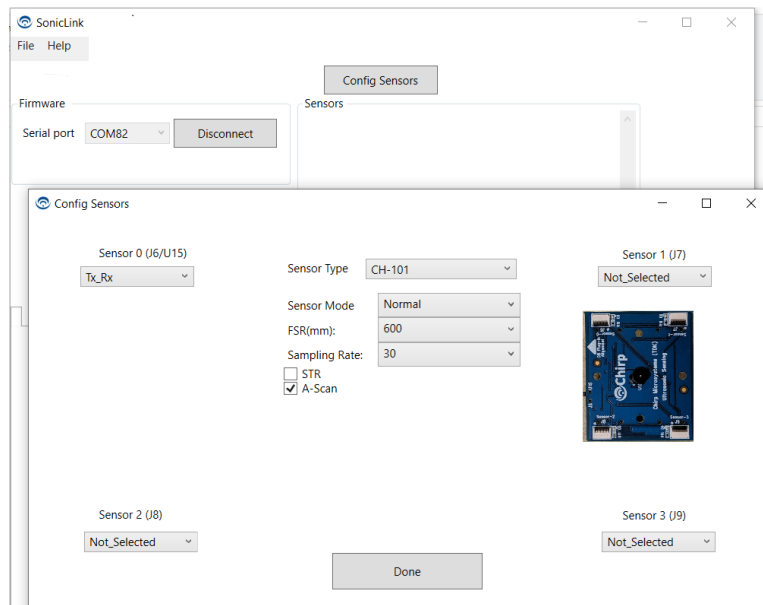
In addition, DO NOT try to run CH101 firmware configuration on CH201 hardware or CH201 firmware configuration on CH101 hardware.




1. First select **Sensor Type**: CH101 or CH201.
2. For CH101 sensors, select Normal, Short Range, Narrow FOV, or Narrow FOV SR operating mode under **Sensor Mode**
  - a. **Normal** mode: allows detection of targets from 10 cm to 120 cm
  - b. **Short-Range** mode: allows detection of targets from 4 cm to 25 cm
  - c. **Narrow\_FOV** mode: allows detection using the 45 degree narrow FoV horn. Thresholds are increased in Narrow FOV mode to accommodate the higher amplitude signal from horns narrower than the omnidirectional cap.
  - d. **Narrow\_FOV\_SR** mode: allows detection using the 45 degree narrow FoV horn from 4 cm to 25 cm. Thresholds are increased in Narrow\_FOV\_SR mode to accommodate the higher amplitude signal from horns narrower than the omnidirectional cap.
3. Select the full-scale range in millimeters, **FSR (mm)**.
4. Select **Sample Rate**.
5. Select **Sensor 0** through **Sensor 3** configuration settings from the following
  - a. **Not Selected**: sensor not used

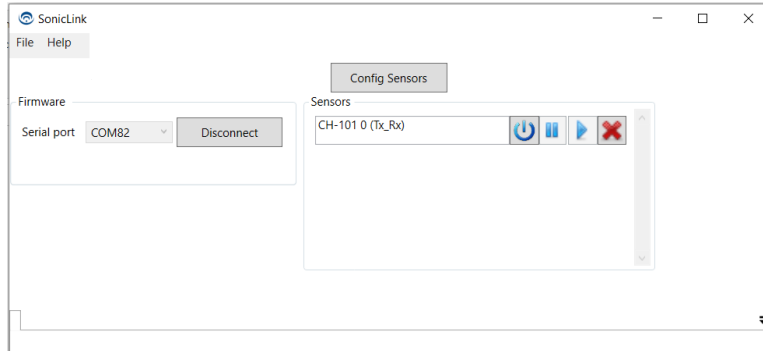
- b. **Tx\_Rx**: Transmit and Receive Mode
  - c. **Rx Only**: Receive Only Mode
6. Optional selections can be made by checking the box for the following features:
- a. Static Target Rejection (STR)
    - i. This feature is available for both CH101 and CH201.
    - ii. The STR mode is used to reject echoes from stationary objects that are in the sensor’s field-of-view. In this mode, only the range of moving targets will be reported in the sensor’s range output. This feature is useful when the sensor must operate in a cluttered environment.
  - b. Amplitude-scan (A-scan)
7. This feature is available for both CH101 and CH201.
8. Sample Rates are limited to 30 S/s for CH101 and 10 S/s for CH201 when A-scan is enabled. This limitation is due to the additional time required to read the A-scan data from each measurement over the I<sup>2</sup>C bus.

Once you have the connected sensor(s) configured appropriately, click **Done**.




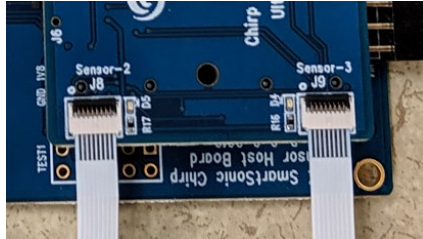
## 5.1 REMOVING A SENSOR CONFIGURATION

To remove a sensor configuration, click the  button.

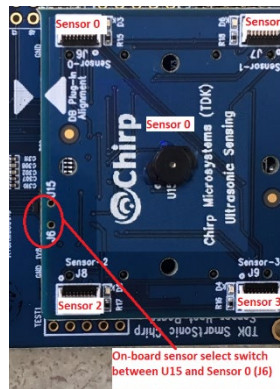


## 6 ADDING SENSORS TO THE CONFIGURATION

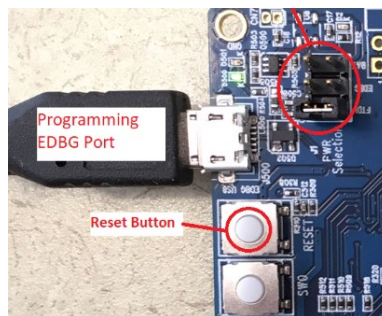
1. To add sensor(s) to an existing configuration, press the  button in the main sensors window to remove any current configurations.
2. Next, press **Disconnect** to end the serial port connection and allow the board to be reset and firmware loaded to the new sensors connected to the SmartSonic board.
3. Additional sensors can be connected to the daughterboard using flex cables



1. The on-board sensor U15 shares the same bus with Sensor 0 at connector J6. To use an off-board sensor that is connected to the flex connector Sensor 0 / J6, you will need to select **J6** using the switch on the edge of the daughterboard, as shown circled in red below.





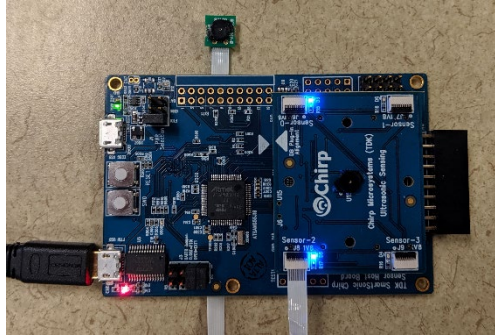
2. Next press the physical **Reset** button on the SmartSonic host board to clear the configurations.



1. Click **Connect** on the SonicLink GUI.
2. Add a configuration to match the sensor(s) by clicking **Config Sensors**.
3. Once you have the sensor(s) connected to the SmartSonic board configured appropriately, click **Done**.

## 7 STARTING THE DATA CAPTURE

After a configuration has been added, click on the  button to initialize the board and sensor you want to launch. After the initialization completes, a set of tabs will open in the main window, and data collection will begin as shown below. Click on the  button for each sensor you want to collect data from. You will note that each sensor initialized will light a blue LED next to the corresponding connector on the daughterboard. In the example below, sensor 0 and sensor 2 have been initialized. The Blue LED next to J6 will illuminate when the onboard sensor is initialized.

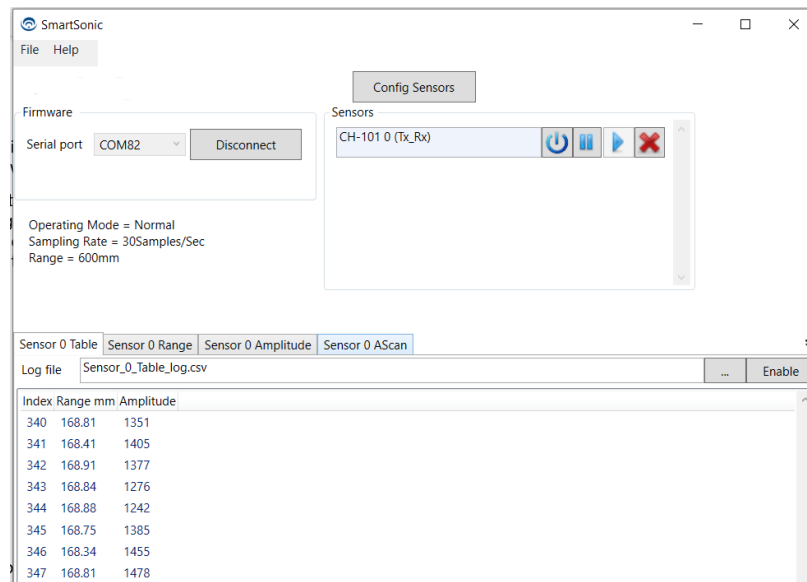


As the sensor module receives echoes from a target, the table displays the target's range and the echo amplitude. Depending on how many sensors are connected to the evaluation kit board (1 to 4) the software will generate the corresponding range data table and graph tabs.

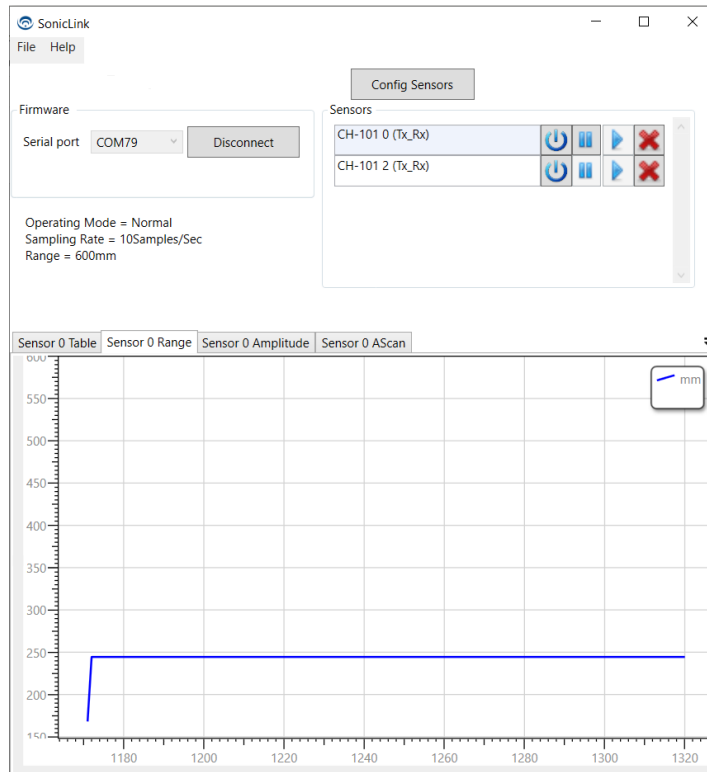
Index	Range mm	Amplitude
340	168.81	1351
341	168.41	1405
342	168.91	1377
343	168.84	1276
344	168.88	1242
345	168.75	1385
346	168.34	1455
347	168.81	1478

## 8 VIEWING THE DATA

1. Once the data capture has started, click on the tabs to view the data from the sensor. Each tab is labeled with the corresponding sensor number (sensor 0 through 3). The following shows an example with one CH101 sensor connected as sensor 0.
  - a. The **Sensor 0 Table** tab shows the live range (in mm) and amplitude values as they are returned from sensor 0. You can choose to log the captured range and amplitude data to a text file – see **Storing the Data** in the next section.

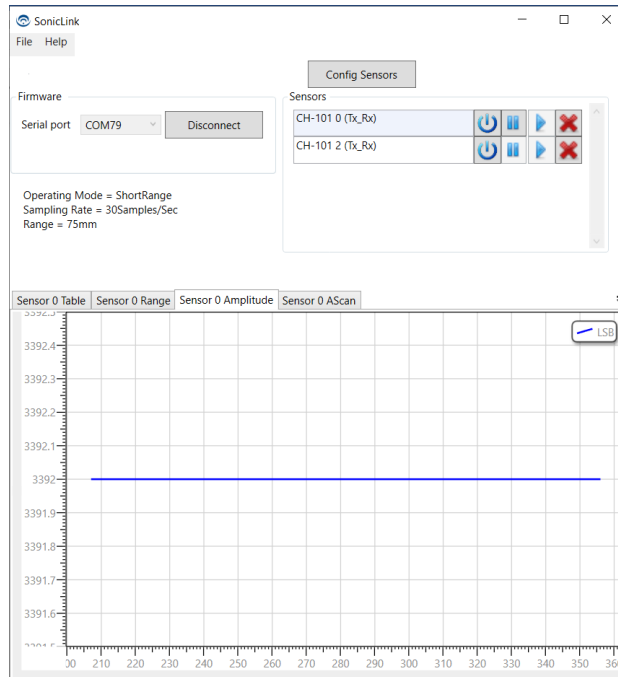


b. The **Sensor 0 Range** shows live range data in a graphical representation.



The chart displays the measured range to the closest target over time. Depending on how many sensors are connected to the evaluation kit board (1 to 4), the software will generate the corresponding range display windows.

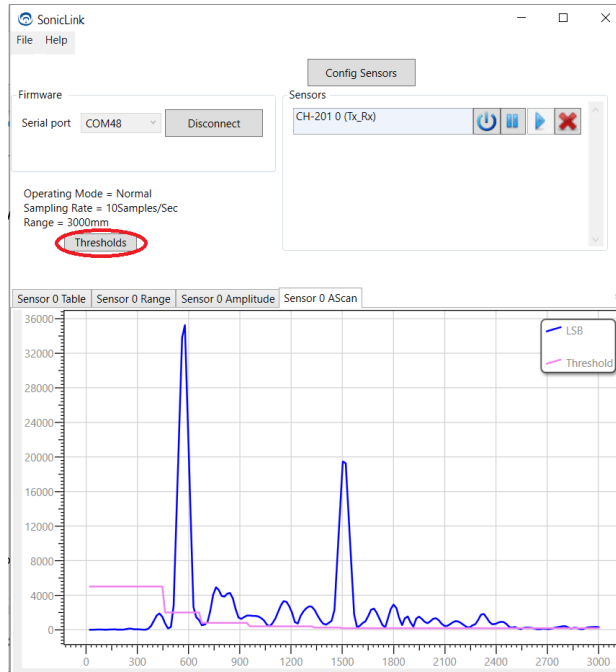
- c. The **Sensor 0 Amplitude** shows the live Amplitude data in graphical format.



The Amplitude tab shows amplitude of the received echo over time. The units of this display are least-significant bits (LSBs) of the sensor’s on-chip ADC. The full-scale value is 32,768. The amplitude varies based on the object’s size, surface texture and shape. As the object moves further away from the sensor the amplitude diminishes.



- d. The **Sensor 0 A-scan** tab shows the live Amplitude scan (A-scan) data in graphical representation.

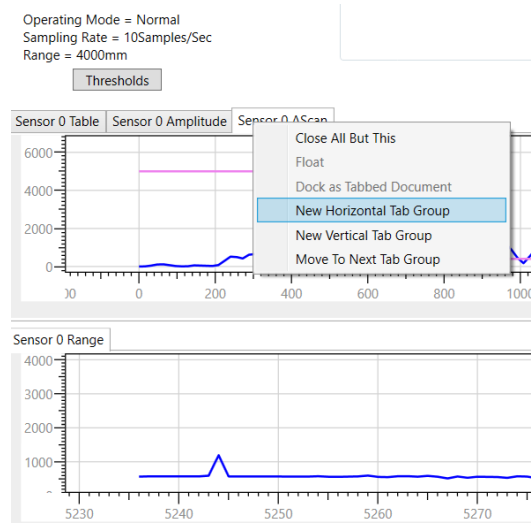


While the range and amplitude tabs display the range and amplitude of the nearest target, the A-scan tab displays the ultrasound amplitude at all range points for the current pulse-echo measurement, commonly known as an A-scan. In this plot, the vertical axis represents the echo (received signal) amplitude (in LSBs) and the horizontal axis represents the range in mm. The distance to a given object can be determined by the position of the corresponding echo on the horizontal range axis. The size, orientation, and surface texture of the object will affect the echo’s amplitude.

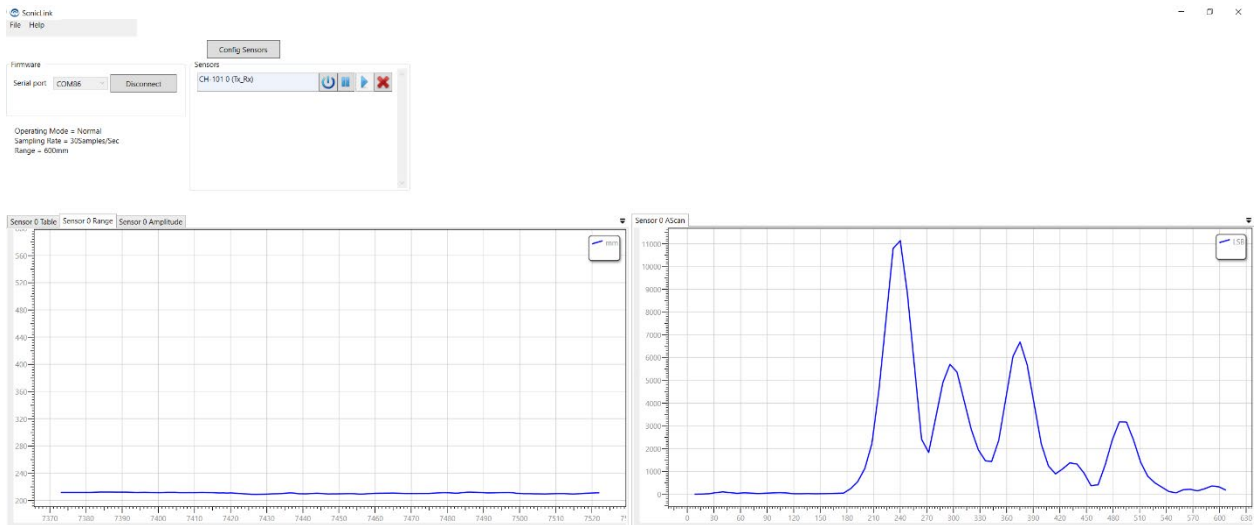
For CH201 sensors, A-scan graphs will also show a pink line that corresponds to the detection thresholds set for the sensor. The user can change the detection thresholds by clicking on **Thresholds** button (circled in red in the picture above).

### 8.1 VIEWING MULTIPLE DATA WINDOWS

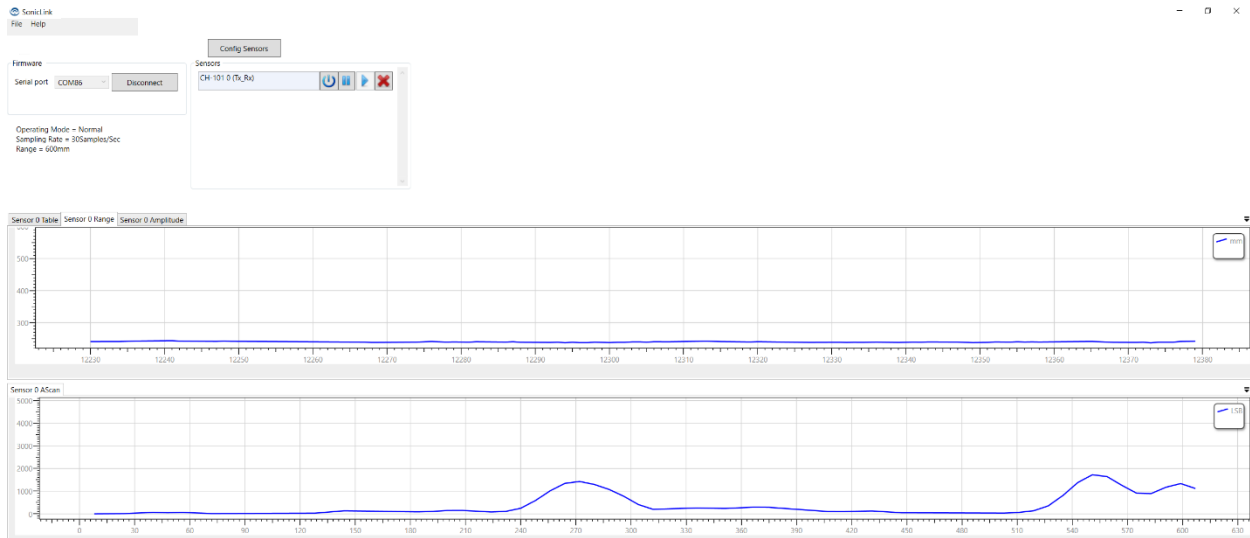
1. You have the option to open multiple window tabs to view in either horizontal or vertical tabs as shown in example below. To open a second data tab either horizontally or vertically, right click your mouse cursor on the tab you wish to tile and a drop-down menu will open. Select either **New Horizontal Tab Group** or **New Vertical Tab Group**.



Example of Vertical Tab Group for Range and A-scan

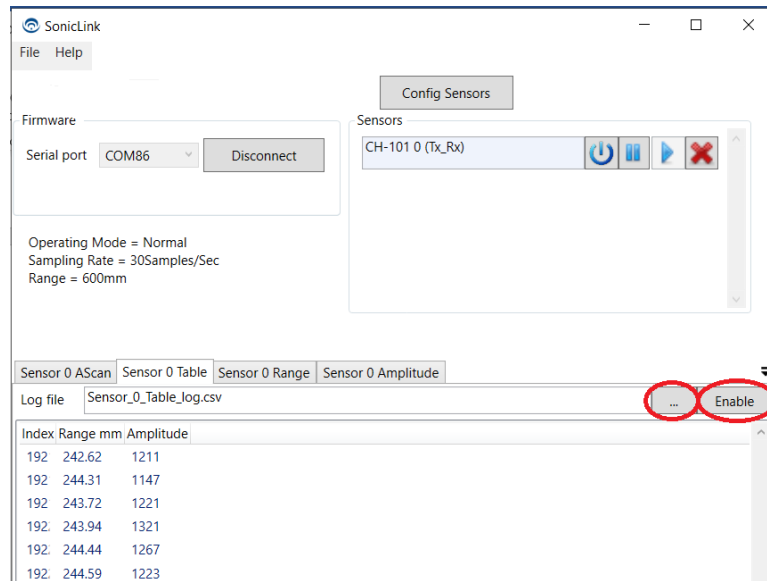


Example of Horizontal Tab Group for Range and A-scan

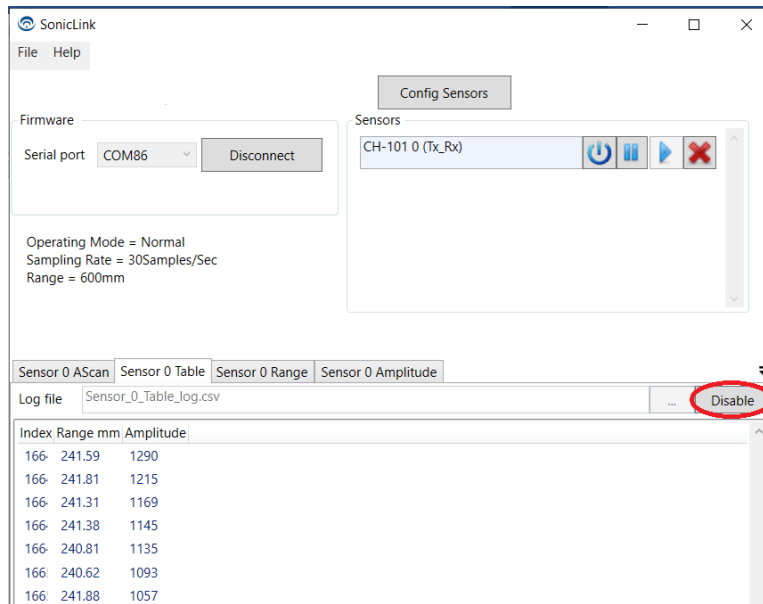


## 9 STORING THE DATA



1. You can choose to save the time-stamped Range and Amplitude data by entering a path/filename in the **Log file** field. You may set the directory for the log file by clicking the  button and browsing for the desired directory. Once the file and directory settings are correct, click **Enable** to begin logging the data to the file.



2. To stop saving the data to a file, press the **Disable** button.



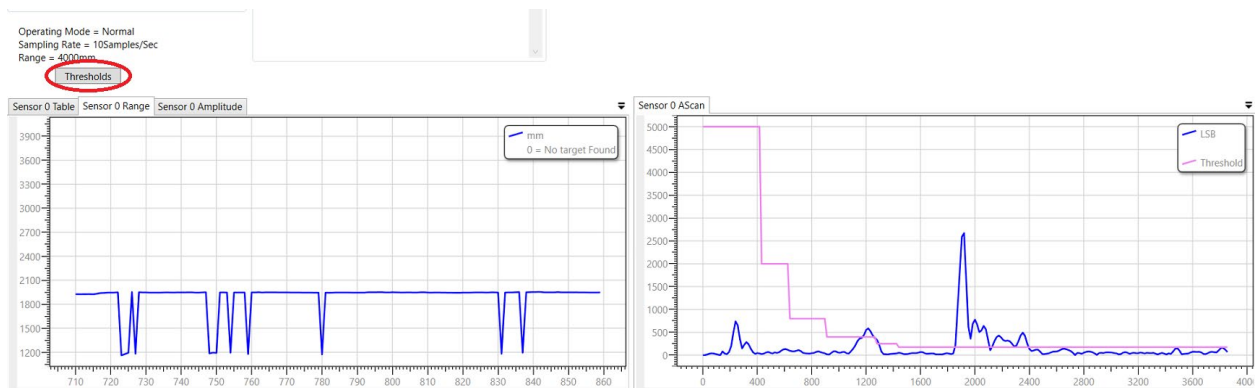
## 9.1 PAUSING OR RESUME THE DATA CAPTURE

1. To Pause the data capture for a given sensor, press the  button in the main Sensors Window
2. To Resume the data capture for a given sensor, press the  button in the main Sensors Window.

## 10 SETTING DETECTION THRESHOLDS (CH201 ONLY)

The CH101 and CH201 sensors use an on-chip algorithm to detect the time-of-flight to the nearest target. The algorithm identifies the time-of-flight of the first echo that is above a pre-programmed amplitude threshold. For CH101, these thresholds are hardcoded within the sensor firmware. For CH201, the user can configure six different range-dependent thresholds. Close targets produce much larger echoes than distant targets, so the close-range thresholds will usually be much higher than the far-range threshold. Using higher thresholds at close range allows targets of interest to be detected while rejecting “clutter” - echoes arising from close-range objects that may be outside the sensor’s desired field-of-view. A rule-of-thumb is that the echo amplitude will scale with range-squared – when a target is moved from 1m range to 5m range, the echo will decrease by a factor of 25.

In the A-scan plot, the thin pink line indicates the threshold level corresponding to the pre-programmed amplitude threshold. The blue amplitude trace shows the received signal from objects in the sensors field-of-view. To change the Threshold levels, open the dialog window by clicking on the **Thresholds** button (circled in red) at the top left above the data plot tabs.



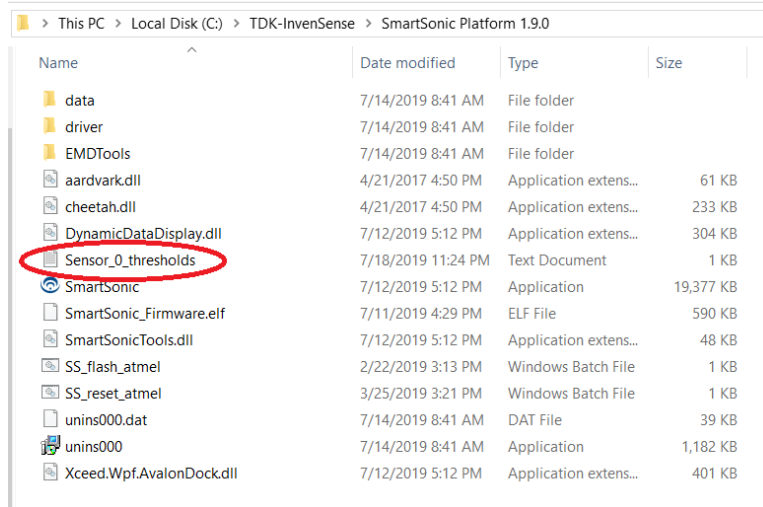
The threshold setting dialog is shown below.

The 'ThresholdSetting' dialog box contains a table with three columns: 'Threshold upto range(mm)', 'Range index', and 'Amplitude'. The table lists six rows of data. There are 'Load File' and 'Done' buttons on the left side of the table.

Threshold upto range(mm)	Range index	Amplitude
416	26	5000
624	39	2000
896	56	800
1264	79	400
1424	89	250
4800	300	175

**Threshold upto range** and/or **Amplitude** can be adjusted to suit the settings that work for a given HW design and the sensors field-of-view. After you have entered the desired values in the **Threshold upto range** and **Amplitude** fields, click **Done** for the changes in settings to be loaded to the device and close the dialog box.

The new threshold range and amplitude values will be automatically saved to a file, **Sensor\_0\_thresholds** in the SmartSonic directory. If you want to load the saved values to a sensor, open the **Threshold** dialog box and click on the **Load File** button.



## REVISION HISTORY

Revision Date	Revision	Description
03/31/2020	1.0	Initial release

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