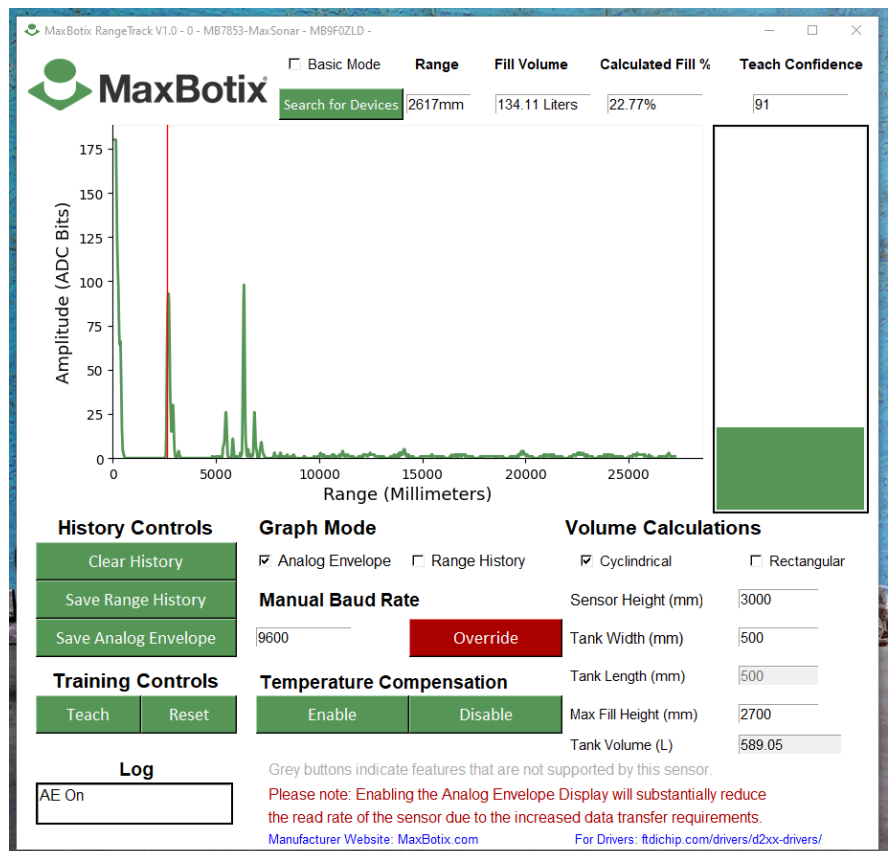


1. Introduction

MaxBotix Inc. is a leading manufacturer of high performance, ultrasonic rangefinders. These devices transmit and receive high frequency sound waves to detect and determine the distance to objects within the sensor's field of view. For more information on the fundamental principles of Ultrasonic technology, please visit our website at: <https://maxbotix.com/blogs/blog/how-ultrasonic-sensors-work/>

MaxBotix has developed a software application named *RangeTrack* to make the introduction and successful deployment of ultrasonic sensors in end user applications easier. RangeTrack's primary purpose is to speed up development by allowing engineers and technicians to quickly gather data on how MaxBotix sensors can help in their applications, and to isolate and eliminate any problems that may arise when integrating a new application.

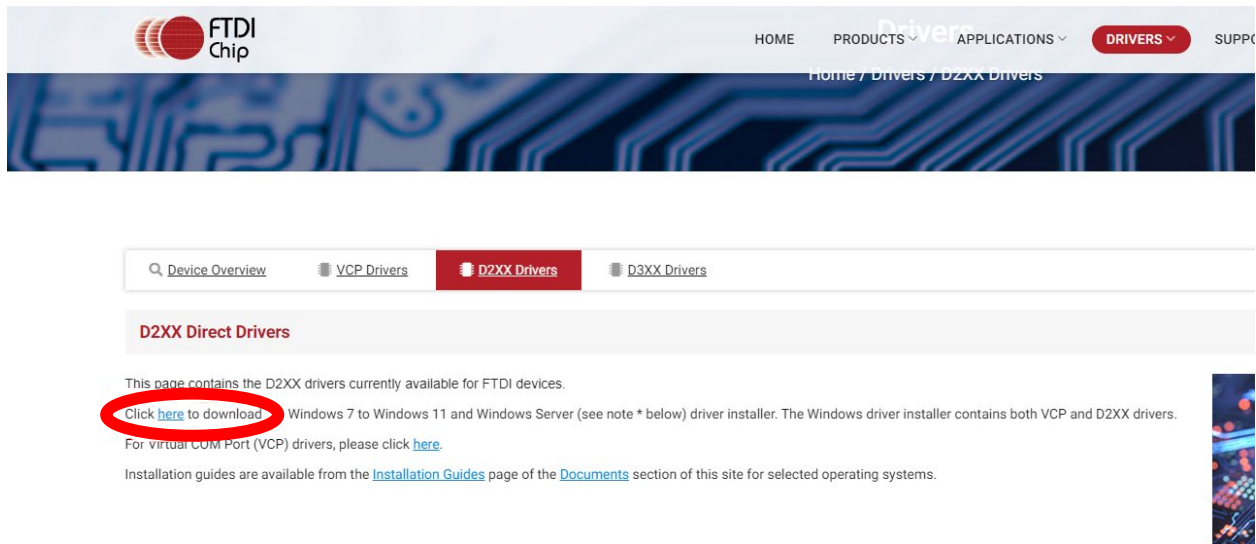
RangeTrack is designed to operate with any MaxSonar sensor with onboard USB capabilities, or with any MaxSonar with an attached USB cable. *RangeTrack* has been specifically designed with liquid level applications in mind and therefore includes various features which can be used to measure the volume of liquid in a tank. Two operating modes have been provided, *Tank Mode* and *Standard Mode*. Standard mode does not include all the tank specific calculations for a simpler user experience.



2. Getting Started

Begin by installing the FTDI D2XX driver which can be found at:

<https://ftdichip.com/drivers/d2xx-drivers/>



FTDI Chip

HOME PRODUCTS APPLICATIONS DRIVERS SUPPORT

Home / Drivers / D2XX Drivers

Device Overview VCP Drivers **D2XX Drivers** D3XX Drivers

D2XX Direct Drivers

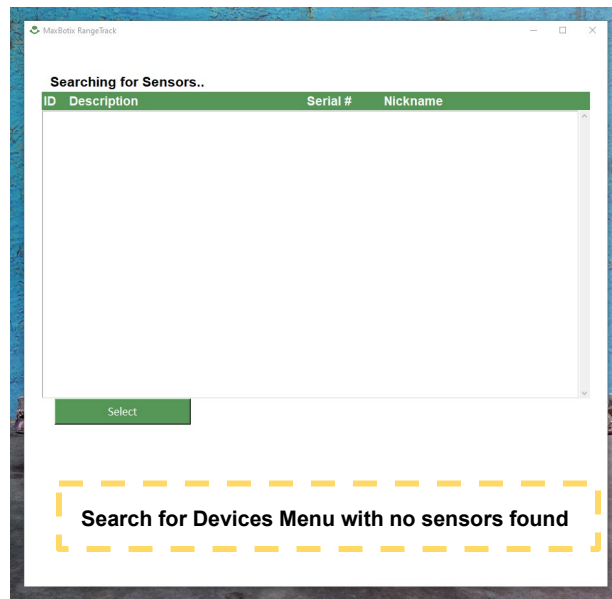
This page contains the D2XX drivers currently available for FTDI devices.

Click here to download Windows 7 to Windows 11 and Windows Server (see note * below) driver installer. The Windows driver installer contains both VCP and D2XX drivers. For virtual COM Port (VCP) drivers, please click [here](#).

Installation guides are available from the [Installation Guides](#) page of the [Documents](#) section of this site for selected operating systems.

1. **Please ensure you have installed the drivers before plugging in a sensor.** There have been known instances where Windows will not properly install the required drivers if the sensor was plugged in before installation.
2. Download MaxBotix *RangeTrack* from: www.MaxBotix.com/pages/rangetrack
3. Extract the downloaded zip file, run the executable, and follow the prompts.
4. Plug in your USB sensor.
5. Double click on the applicable shortcut file in the root directory.
 - a. Two options are provided for your convenience. *RangeTrack* can automatically calculate volume information for use in liquid level measurement applications. If you would like to see this information, choose the “Tank Mode” shortcut. Otherwise, choose the “Standard Mode” shortcut and this information will be hidden. Otherwise, these two applications will operate exactly the same.

Name	Date modified	Type	Size
Bin	4/17/2024 12:05 PM	File folder	
MaxBotix RangeTrack Standard Mode	4/17/2024 12:05 PM	Shortcut	2 KB
MaxBotix RangeTrack Tank Mode	4/17/2024 12:05 PM	Shortcut	2 KB

**Searching for Sensors..**

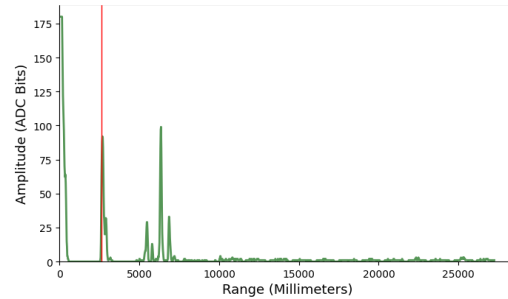
ID	Description	Serial #	Nickname
0	MB7853 HR-TankSensor-WRMAL	MB9F0ZLD	

Search for Devices Menu with 1 sensor found

6. Connect to a sensor
 - a. If there is only one sensor connected to the system, RangeTrack will immediately begin displaying range information.
 - b. If there are multiple sensors connected, RangeTrack will prompt the user to select which sensor should be displayed. Click on a sensor and then click “select” to proceed. Multiple instances of RangeTrack can be run simultaneously on one system.
 - c. If there are no sensors connected to the computer when RangeTrack is launched, the interface will display a blank sensor search menu which will continuously search for new sensors. As soon as a sensor is connected, it will be displayed in this menu and can then be selected by the user.
7. RangeTrack will begin displaying sensor information.

3. RangeTrack Detailed Description

Graph - The large graph in the top of the window displays the range value reported by the sensor on the vertical axis, and time on the horizontal axis. The vertical axis is displayed in Millimeters (Inch and Centimeter resolution sensors will be converted to Millimeter in software) and the horizontal axis is displayed as a count of the number of readings taken. If the sensor is operating in Analog Envelope Mode (see below), this graph will be replaced with a display of the analog acoustic waveform.



Fill Indicator - The bar to the right of the Graph displays a visual representation of the current fill level of the tank. Using the most recent range value as well as the tank dimensions provided in the entry boxes in the bottom right of the screen, *RangeTrack* will determine a percentage fill level and display it visually and in numerical form below the Fill Indicator. Note: that this indicator will only be present if *RangeTrack* is run in Tank Mode



Range, Fill Volume, Calculated Fill %, and Teach Confidence - Along the top bar, four numerical values are displayed. Note: that Fill Volume and Calculated Fill % will only be displayed if *RangeTrack* is run in Tank Mode.

Range	Fill Volume	Calculated Fill %	Teach Confidence
2617mm	134.11 Liters	22.77%	92

Range - This is the current range reading from the sensor in numerical form in units of Millimeters. This is a filtered value. (In other words, it takes several range cycles to update if there is a sudden change.)

Fill Volume - This is intended to be used in liquid level monitoring applications. This is a calculated value based on the current range reading, and the dimensions in the volume calculation entry boxes and represents the amount of liquid present in a tank.

Calculated Fill % - This is intended to be used in liquid level monitoring applications and represents what percentage of the volume of the tank is full. This is based on the current range reading and the information provided in the volume calculation entry boxes.

Teach Confidence - This is a number that represents the sensor's confidence in its training data. This value is output directly from the sensor. If this value drops too low, it is recommended to teach the sensor. Note: this is only supported by our *TankSensor* line of products.

Volume Calculations - RangeTrack is capable of calculating the total volume of liquid in a tank based on the sensor range readings. Four entry boxes and two checkboxes are provided to collect the necessary dimensions for these calculations. Located immediately underneath the fill indicator, these allow the user to enter information about the size of the tank they are installing the sensor in. This information will be used to calculate the fill percentage, volume, and to display the bar on the Fill Indicator. The total volume of the tank will also be calculated and displayed in a grayed-out entry box. Note: this section will only be visible if *RangeTrack* is run in Tank Mode.

Cylindrical vs. Rectangular - These checkboxes select which shape tank is being used, which will affect the volume calculations.

Sensor Height - This is the distance from the zero point of the sensor (see applicable product datasheet on our website) to the bottom of the tank. In other words, this is the range reading that is expected when the tank is empty. This is expressed in Millimeters.

Tank Width - This is the width of the tank in Millimeters. This is the diameter if using a cylindrical tank.

Tank length - This is the length of the tank in Millimeters. This will be disabled if the cylindrical checkbox is selected.

Max Fill Height - This represents the highest point liquid is expected to reach in the tank. This affects the fill percentage calculation. Often this will be set to the Sensor Height minus the minimum distance of the sensor but depends mostly on the mounting configuration.

Tank Volume - This is a calculated value and represents the maximum capacity of the tank given the provided information.

Volume Calculations

Cylindrical Rectangular

Sensor Height (mm)

Tank Width (mm)

Tank Length (mm)

Max Fill Height (mm)

Tank Volume (L)

Manual Baud Rate - An entry box and override button are provided to manually configure the Baud Rate of the serial connection to the sensor. In general, this will be set up automatically when a sensor is connected but this functionality is provided should the user have a use for it.

Manual Baud Rate

Override

Log - A log box is displayed in the bottom left of the window. This box will display various messages indicating that commands were successfully executed as requested.

Log

Command Buttons - On the left of the window, seven buttons are provided to issue various commands to the sensor or to RangeTrack. The Teach, Reset Training, Enable and Disable Temperature Compensation and Save Analog Envelope buttons are only available with select sensors, and will be displayed in gray rather than green if the connected sensor does not support them.

History Controls <input type="button" value="Clear History"/> <input type="button" value="Save Range History"/> <input type="button" value="Save Analog Envelope"/>	Graph Mode <input checked="" type="checkbox"/> Analog Envelope <input type="checkbox"/> Range History Manual Baud Rate <input type="text" value="9600"/> <input type="button" value="Override"/>
Training Controls <input type="button" value="Teach"/> <input type="button" value="Reset"/>	Temperature Compensation <input type="button" value="Enable"/> <input type="button" value="Disable"/>

Clear History - This will clear the Range Graph of all historical data and clear all internal buffers.

Teach - This will issue the teach command to the sensor, causing it to memorize the environment immediately in front of it. Please reference the applicable product datasheet on our website or the explanation of the teach feature below for more information

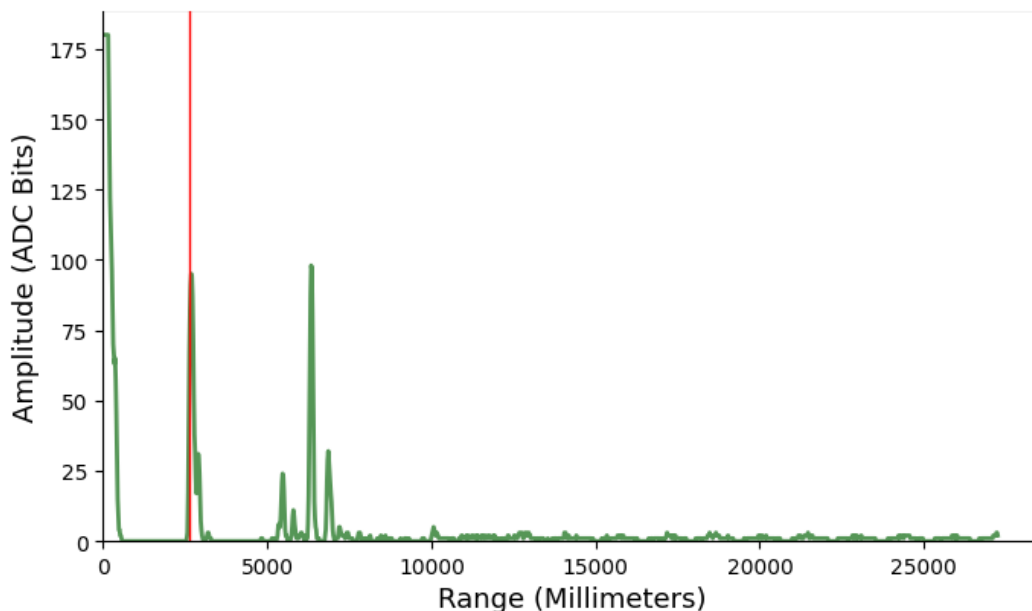
Reset Training - This will reset the sensor's teach status to factory conditions. Please reference the applicable product datasheet on our website for more information.

Enable and Disable Temperature Compensation - These buttons issue commands to the sensor to enable or disable the temperature compensation feature. Some sensors support the ability to apply a speed of sound compensation based on the ambient temperature as measured by the sensor thereby increasing accuracy. On all tank sensors, this feature is disabled by default. This is because in heated tanks the temperature difference between the inside of the tank and the outside (where the sensor is typically mounted) may cause substantial error in these measurements. In applications with uniform ambient temperatures this can be enabled to help increase accuracy.

Save Range History - This will prompt the user to save a text file containing the history of range readings currently displayed on the graph. This file can be used for analyzing the range data or sent to MaxBotix to help with troubleshooting.

Save Analog Envelope and Analog Envelope Checkbox - On supported sensors, the digitized analog envelope of the acoustic waveform can be transmitted over the USB connection to the host system and displayed. This can be extremely useful in troubleshooting issues with ultrasonic sensor installations and can be used to check the quality of a mounting configuration. When the checkbox is checked, the graph will be replaced with a graph showing this information.

The large spike at the beginning of the graph (in this case reaching over 175 counts) is the ultrasonic transmit pulse. All other spikes on this graph are acoustic targets. The vertical axis displays the amplitude of the return, and the horizontal axis displays the range in millimeters. In general, for tank sensors, the largest amplitude return will be selected though several other factors are considered. The vertical red line shows the location of the target that the sensor has selected. Note: the location of the red line does not make use of any reading-to-reading filtering, while the reported range does. As such, on sensors with a higher amount of reading-to-reading filtering such as the high-resolution tank sensors, the red line will react to changes in the acoustic waveform much more quickly than the numerical range value will.



Additionally, this information can be saved to a text file using the “Save Analog Envelope” button. This can be used for analysis outside of RangeTrack or can be sent to MaxBotix for assistance in troubleshooting.



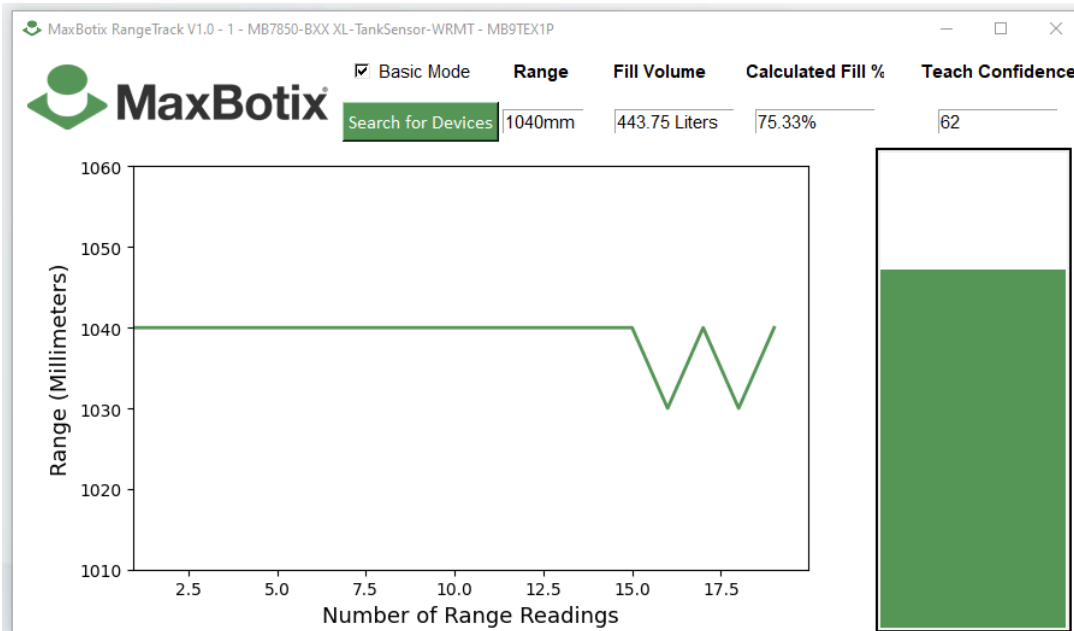
Search for Devices - This button will disconnect from the current sensor and open the search menu, which can be used to switch between multiple sensors that are connected to the system. Note: multiple instances of *RangeTrack* can also be used simultaneously if desired.

Search for Devices Menu - The search menu will be displayed when *RangeTrack* is launched with zero or multiple sensors connected, and when the user clicks the “Search for Devices” button in the main interface.

In this example, two sensors are connected to the system. An MB7853 and a MB1443. When one sensor is selected, *RangeTrack* will provide an entry box that allows the user to assign a nickname to the sensor. This data is associated with the serial number and is stored locally on the system running *RangeTrack*. (This means that these nicknames will not be transferred if the sensor is moved from one system to another.) This can be a useful tool if many sensors of the same type are being used on one system.

Note: the ID number represents the order that the devices are enumerated on the system and are not guaranteed to remain consistent between reboots or between systems. Instead, the serial number should be used to identify individual sensors. See image in section 2.

Basic Mode Checkbox - This checkbox will toggle a simplified user interface. If checked, all of the command buttons and several other UI items near the bottom will be hidden, and the window will be shrunk leaving only the graph, fill indicator, and top bar remaining. This allows the user to fit more instances of RangeTrack on a single display, or to increase the size of the graph by expanding the window.



4. Additional Information

There are a few things worth keeping in mind when using *RangeTrack*. This section contains a few notes and descriptions of features that should help you through this process.

Teach Feature - MaxBotix's line of TankSensors comes equipped with a teach feature which allows the sensor to memorize the environment in which it is installed. Liquid tanks are often very acoustically complex environments with many different reflections. There are often various mounting brackets and structures near the mounting location of the sensor. The sensor can be commanded to take a range reading and memorize the acoustic waveform for the first 1-2 meters of space in front of the sensor. This process is referred to as "Teaching the sensor", and once complete the sensor will have enhanced ability to detect and range to targets in the first 1-2 meters of its range. This should be done in an empty tank, or in an environment where there is nothing in front of the sensor. If this feature is used while there are targets immediately in front of the sensor, this can result in dramatically reduced sensitivity and the potential to miss targets in the near field.

RangeTrack Logging - *RangeTrack* has features designed to allow for better analysis of the data the sensor provides. Two buttons are provided to export sensor data to .csv format for further analysis.

The Save Range History button - This button takes all historical range and volume data and writes it to a .csv file which the customer can use to perform any analysis they may wish on the data. When *RangeTrack* is running, it will continuously record all sensor readings it receives to memory. The *Save Range History* button allows the user to record these values to a file. Note: this data is stored in RAM, and as such this memory is erased whenever *RangeTrack* is closed, when the user switches between connected sensors, or when the *Clear History* button is pressed. This includes any unexpected power loss to the computer. As such, it is recommended that if any long-term testing is being conducted that it be done on a battery backed computer such as a laptop, or a desktop computer with a UPS backup.

Additionally, these files can be sent to MaxBotix for assistance in troubleshooting any issues. The file will also contain a full log of the serial stream received from the sensor. If the user intends to send this data back to MaxBotix for troubleshooting, it can be very helpful if *RangeTrack* is in Analog Envelope mode while the data is collected, because in this mode substantially more data is collected about each ranging cycle.

The *Save Analog Envelope* button - When operating in Analog Envelope mode, the *Save Analog Envelope* button becomes available. This will capture a single Acoustic waveform from the sensor and write it to a file on disk. Additionally, when operating in Analog Envelope mode, the waveforms are captured in the raw serial stream. If the user wishes to save many analog envelopes, including those captured over a long period of time, they can be saved in bulk using the *Save Range History* button described above. In this case, the acoustic data will be visible in the raw serial stream in the file.

Tank Mode vs. Standard Mode - *RangeTrack* can be run in either Tank Mode or Standard Mode which can be selected by choosing between the separate shortcuts found in the root directory of *RangeTrack*. The only difference between these modes is that in Tank Mode the software will conduct volume calculations which can be useful for liquid level measurements. In Standard mode, all the UI elements related to these volume calculations are hidden.

Please let us know if you have any questions,
Contact us at sensors@maxbotix.com or visit www.maxbotix.com