ULTRASONIC LEVEL TRANSMITTER TU2000

USER GUIDE – V1.0x

Scigiene
1295 Morningside Avenue, Unit 16-18
Scarborough, ON M1B 4Z4 Canada
Phone: 416-261-4865 Fax: 416-261-7879
www.scigiene.com

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1 SAFETY ALERTS

The symbols below are used throughout this manual to draw the user's attention to valuable information related to device safety and use.

CAUTION Read the manual fully before installing and operating the device.	**CAUTION OR HAZARD** Risk of electric shock.	**ATTENTION** Electrostatic-sensitive device. Make sure you take the necessary precautions before handling it.

Safety recommendations must be followed to ensure personal safety and prevent damage to the equipment or system. If the equipment is used in a manner other than that specified in this manual, the safety precautions may not be effective.

2 GLOSSARY

The **TU2000** uses some terms, such as level, distance, and height, which are explained below:

- **Level:** Term used to represent the height of the liquid or solid relative to the bottom of the tank.
- **Distance:** Term used to represent the distance between the surface of the liquid or solid and the **TU2000** (Offset = 0).
- **Tank height:** Term used to represent the total height of the tank.
- **Installation Offset:** Term used to represent the difference between the height at which the **TU2000** is installed and the maximum height of the tank. The value must be entered into the configured measurement unit. When the maximum tank height and the installation height of the **TU2000** are not the same, you must set an installation Offset.
- **Full tank (URV):** Term used to represent the tank height at which the analog output will present its maximum value.
- **Empty tank (LRV):** Term used to represent the tank height at which the analog output will present its minimum value.

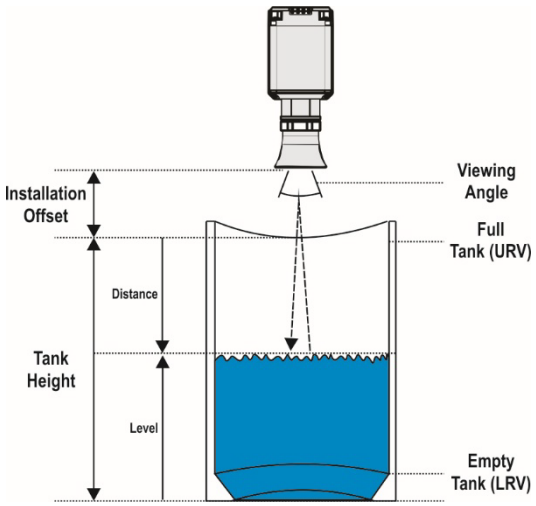


Figure 1

3 PRESENTATION

The **TU2000** is an ultrasonic level transmitter designed for a wide range of applications, with a measurement range of up to 20 meters. It operates using the time-of-flight principle of a 33 kHz ultrasonic sound wave, which is above the audible range.

It can be used to measure the level of solids and liquids in silos and tanks, even in dusty environments and areas exposed to water jets. It is also suitable for measuring water levels in cooling-system tanks (HVAC) and building automation applications.

The **TU2000** features a BLE (Bluetooth Low Energy) interface, allowing configuration through the **SigNow** software (Windows) or mobile app (Android and iOS), as well as monitoring the level of the tank or reservoir where it is installed.

With **SigNow**, you can:

- Configure the analog output.
- Configure the digital/alarm output.
- Configure a custom tank profile using up to 20 level-percentage points.
- Perform real-time sensor diagnostics.
- Adjust the best filter suited to the application.
- Analyze the echo profile of the tank and adjust the sensor sensitivity and/or detection threshold.
- Update the firmware to the latest version available on the **NOVUS** website.

4 IDENTIFICATION

4.1 OVERVIEW

The housing is made of durable plastic, complies with UL94, has an IP67 rating, and is flame-retardant:

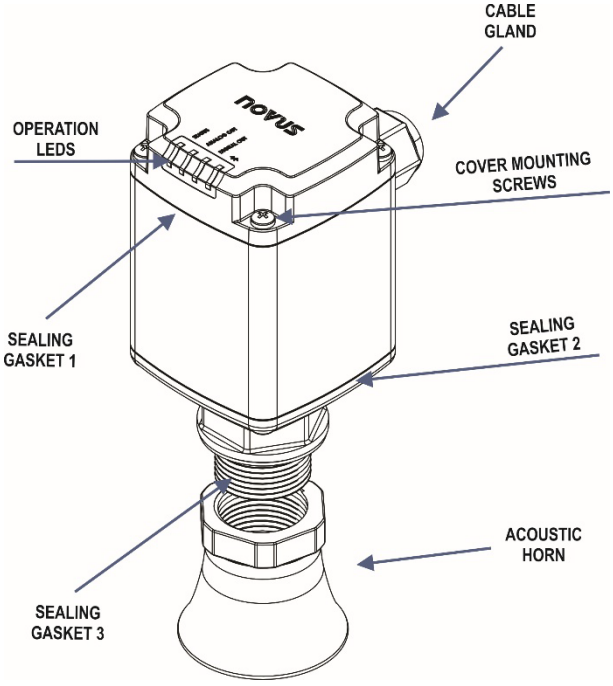


Figure 2

4.2 IDENTIFICATION

The laser engraving on the side of the housing contains the device code and a link to **NOVUS'** Web Portal. To view the manual, you can scan the QR code.

Figure 3

5 INSTALLATION

5.1 ELECTRICAL INSTALLATION

5.1.1 INSTALLATION RECOMMENDATIONS

- Electronic and analog signal conductors should be routed separately from the output and supply conductors. If possible, in grounded conduits.
- The power supply for electronic instruments must come from a power network dedicated to instrumentation.
- It is recommended to use RC FILTERS (noise suppressors) in contactor coils, solenoids, etc.
- In control applications, it is essential to consider what can happen when any part of the system fails. The internal safety features of the equipment do not guarantee full protection.
- You must remove the terminal block before making the electrical connections. Before connecting them, make sure that the connections have been made correctly.

5.1.2 POWER SUPPLY CONNECTIONS

To perform the electrical installation of the **TU2000**, proceed as follows:

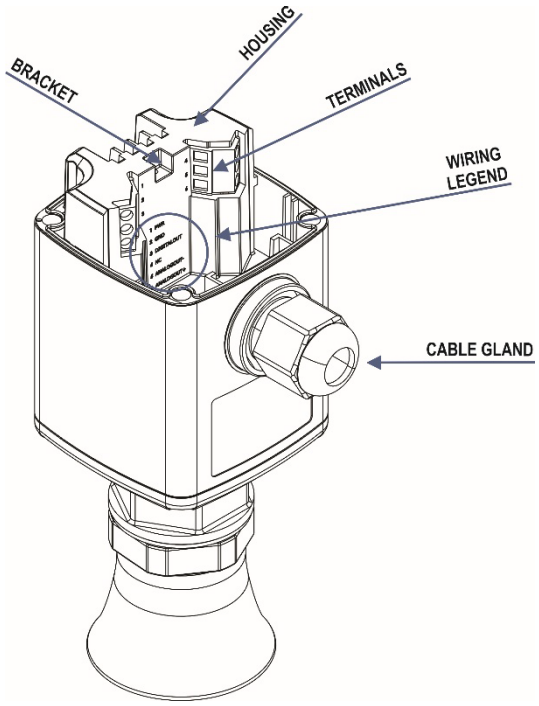


Figure 4

1. Remove the 4 screws from the cover.
2. Remove the cover from the device.
3. Loosen the cable gland cover.
4. Insert the cables through the cable gland.
5. Make the electrical connections as shown in the figure on the left.
6. Tighten the cable gland cover.
7. Reinstall the cover.
8. Reinstall the 4 screws on the cover.

The electrical connections for the analog output must be made as follows:

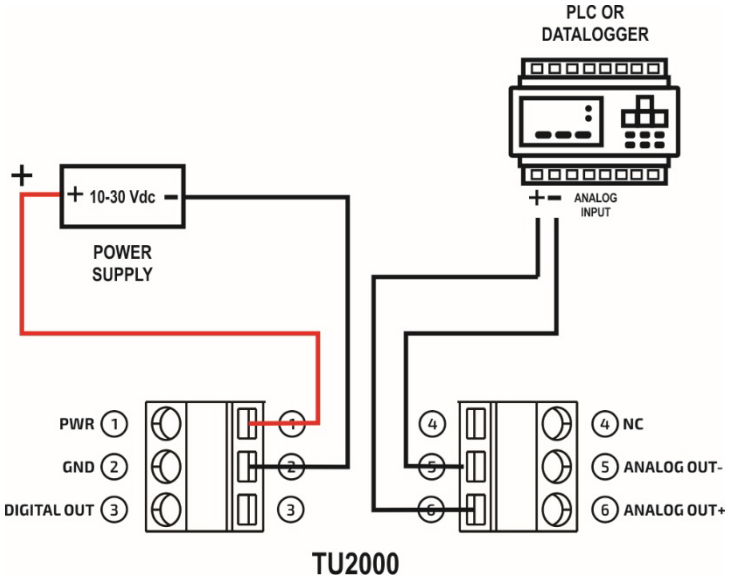


Figure 5

Once the electrical connections have been made, you can use **SigNow's Bench Test** function to verify that the device is working properly (see BENCH TEST MODE).

5.1.3 DIGITAL OUTPUT CONNECTIONS

The digital output can be configured as PNP (Sourcing – equivalent to the PWR terminal) or NPN (Sinking – equivalent to the GND terminal), according to the corresponding schematic shown below:

PNP DIGITAL OUTPUT	NPN DIGITAL OUTPUT

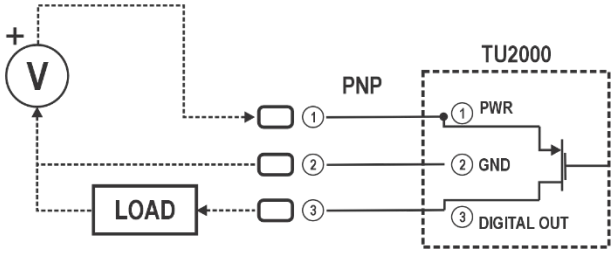
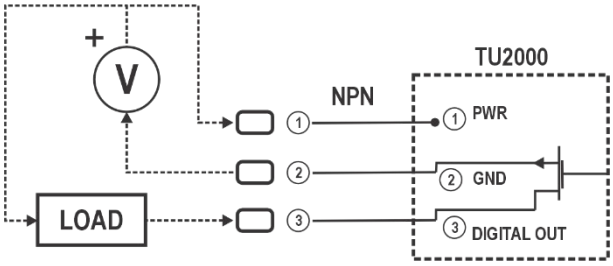

	

Figure 6	Figure 7

5.1.4 OPERATION LEDS

The **TU2000** has 4 status LEDs, located on the front of the housing:

Figure 8

5.1.4.1 NAMUR NE 107 COMPATIBILITY

The **TU2000** is compatible with NAMUR NE 107. According to this standard, LED status messages are divided into the following categories:

COLOR	DEFINITION	DESCRIPTION
Red	FAILURE	This indicates that a failure or malfunction has occurred.
Flashing red	FUNCTIONAL TEST	This indicates that the device is undergoing a functional test.
Yellow	OUT OF SPECIFICATION	This indicates that the settings are outside the specified range.
Green	OK	This indicates that the device is operating normally.
Off	OFF	This indicates that the device is turned off.

Table 1

5.1.4.2 STATUS LED

COLOR	DESCRIPTION
Green	This indicates that the device is operating normally.
Yellow	This indicates that normal operating conditions are outside the specified range.
Red	This indicates an error in the sensor circuitry or another internal failure detected by the device itself.
Flashing red	This indicates a forced input (Level, volume, or distance).
Off	This indicates that the device is turned off.

Table 2

5.1.4.3 ANALOG OUTPUT LED

COLOR	DESCRIPTION
Green	This indicates that the device is operating normally.
Yellow	This indicates that normal operating conditions are outside the specified range.
Red	This indicates that the 4–20 mA output has an error of 3.6 mA or 21 mA.
Flashing red	This indicates that the device is testing the function by forcing a current output.

Table 3

5.1.4.4 DIGITAL OUTPUT LED

COLOR	DESCRIPTION
Green	This indicates that the alarm is enabled and no alarm condition has been detected.
Flashing green	This indicates that the alarm is enabled and an alarm condition has been detected.
Yellow	This indicates that the device has detected an overcurrent outside the product specifications (see TECHNICAL SPECIFICATIONS).
Flashing red	This indicates that the device is testing the function by forcing the alarm output.
Off	This indicates that the alarm is disabled.

Table 4

5.1.4.5 BLUETOOTH LED

COLOR	DESCRIPTION
Green	This indicates that the Bluetooth signal is available for connection.
Flashing green	This indicates that the device is connected for setup via Bluetooth.
Flashing blue	This indicates that the device is updating its firmware via OTA (Over The Air).
Off	This indicates that Bluetooth is disabled.

Table 5

NAMUR NE 43 also uses icons that correspond to the categories listed above and will be displayed in the **SigNow** software or app diagnostics (see SOFTWARE COMPATIBILITY WITH NAMUR NE 43).

5.2 MECHANICAL INSTALLATION

5.2.1 DIMENSIONS

The **TU2000** has the following dimensions:

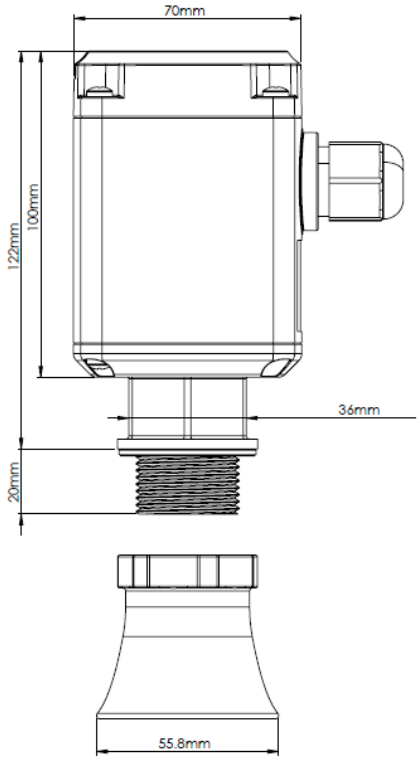


Figure 9

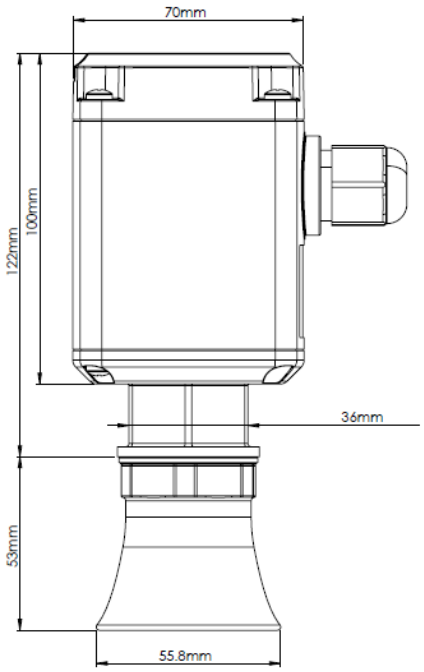
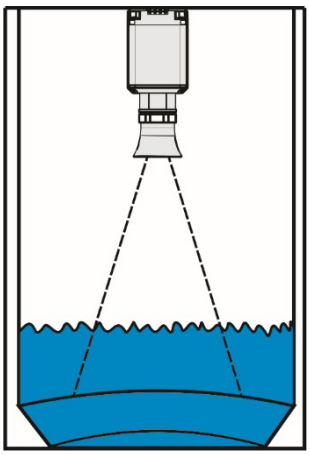
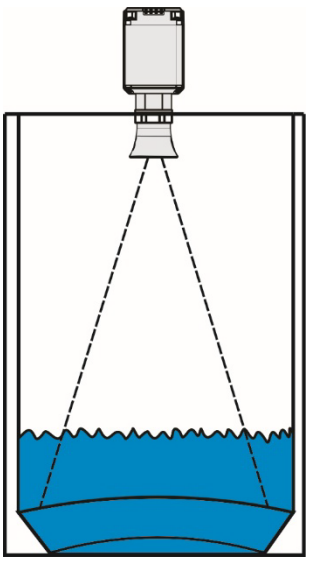


Figure 10

5.2.2 TU2000 INSTALLATION

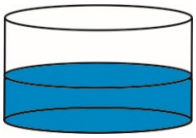
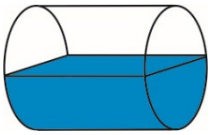
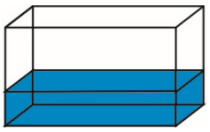
Once the electrical setup of the equipment has been completed (see POWER SUPPLY CONNECTIONS), you can install the **TU2000** at the measurement site.

INTERIOR INSTALLATION OR ROOM TEMPERATURE	EXTERNAL INSTALLATION
 **Figure 11**	 **Figure 12**

For more information on how to position the device, see MOUNTING POSITION.

5.3 CUSTOM TANK

The **TU2000** can be used with various types of tanks, as shown in the examples below:

VERTICAL CYLINDER	HORIZONTAL CYLINDER	RECTANGULAR
 Figure 13	 Figure 14	 Figure 15

If none of the options match the type of tank to be used, the **TU2000** also allows you to create custom tanks. This feature is useful for tanks with curved shapes, elevations, and other irregularities.

By selecting the «**Custom**» option under the «**Tank Type**» parameter (see the TANK section of the SETUP VIA SIGNOW chapter), you will need to perform linearization at specific points on the tank.

Up to 20 linearization points are allowed. The values set in these parameters will always be in centimeters.

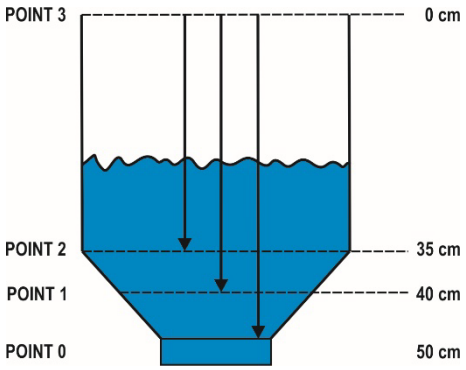


Figure 16

The custom curve can be used to correct any nonlinearity in the level sensor's measurement. To use this feature for that purpose, go to the Diagnostics tab.

6 RECOMMENDATIONS FOR USE AND APPLICATION

The **TU2000** is designed to measure the level of solids or liquids, typically in reservoirs or tanks of various shapes. The sensor emits and detects an ultrasonic pulse and, based on the return signal, can estimate the distance to the surface level. Factors such as sunlight, smoke, color, and optical reflectivity should not affect the measurement.

6.1 SURFACE REFLECTION

From an acoustic standpoint, soft surfaces or those with foam-like characteristics have lower reflectivity. In cases of low-reflectivity surfaces, proper sensor alignment and sensitivity and threshold settings may be essential for correct operation. In applications involving highly uneven surfaces, it is possible to increase the sensor's sensitivity via **SigNow**.

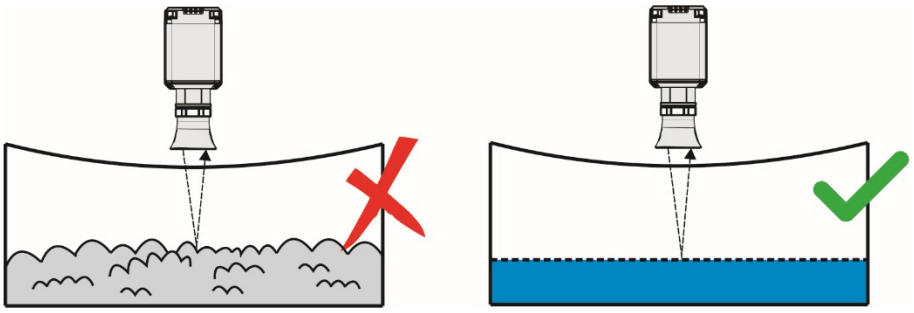


Figure 17

6.2 OBSTACLES BETWEEN SENSOR AND LEVEL

In many cases, you can use advanced settings and the Wizard to remove unwanted objects. However, in situations where the obstacle occupies a larger portion of the sensor's solid angle, it won't be possible to obtain a reliable level measurement.

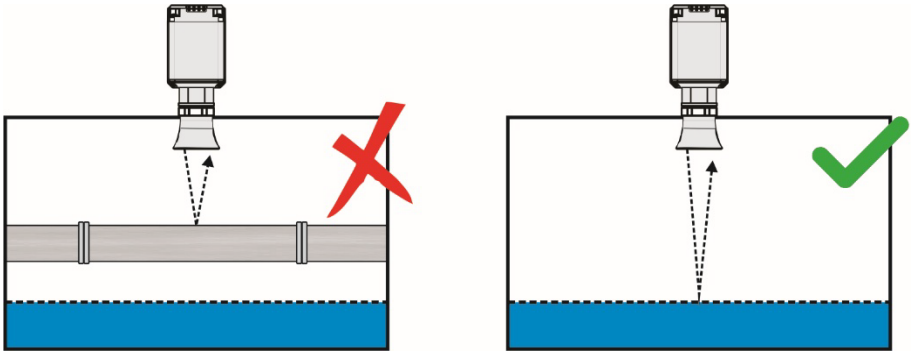


Figure 18

6.3 MOUNTING POSITION

The figures below show examples of how to position the device, based on the environment where it will be installed and considering the application:

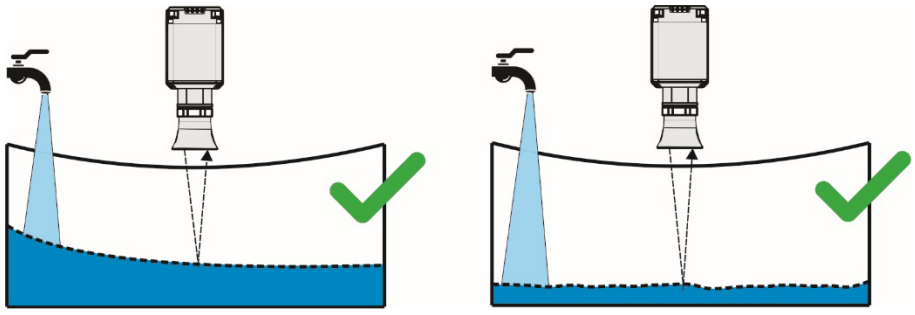
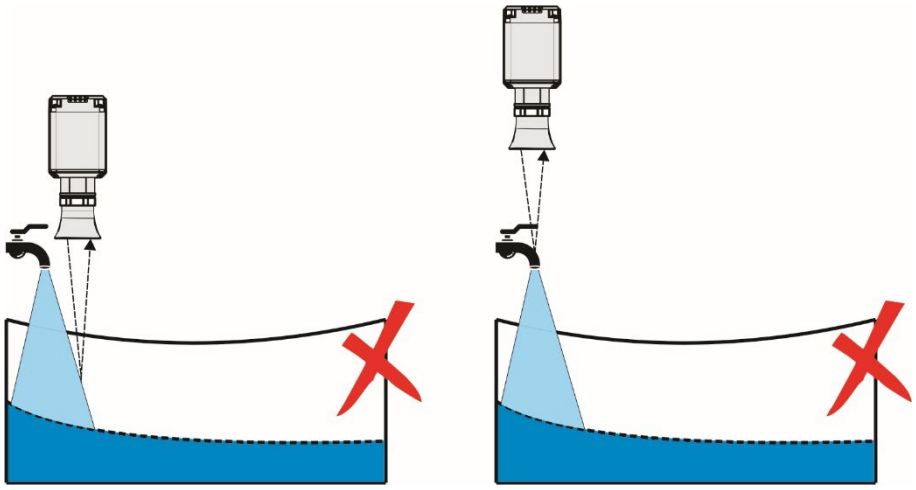


Figure 19

- Install the device so that the sonar is perpendicular to the surface of the substance being monitored.
- Ensure that the device is positioned away from the area where the liquid or solid will be poured into the tank or reservoir.

The figures below show examples of situations to avoid during the installation process, as they can affect the performance:



- **Do not** install the device on its side or with the sonar pointing toward the area where the liquid or solid will be poured into the tank.
- **Do not** install the device over the faucet, as this will completely block the laser.

Figure 20

Improper use will prevent the device from accurately measuring the area to be monitored. Therefore, **you should always ensure that it is positioned perfectly perpendicular to the surface.**

6.3.1 TANKS WITH ROUND COVERS

The **TU2000** must be installed at a minimum distance of 200 mm from the tank wall. When mounted at the center of a domed or curved tank cover, echoes may occur.

If it is not possible to maintain this distance and there is a possibility of buildup on the reservoir walls, you must suppress false signals by performing a calibration as soon as the device is put into operation (see SETUP VIA SIGNOW).

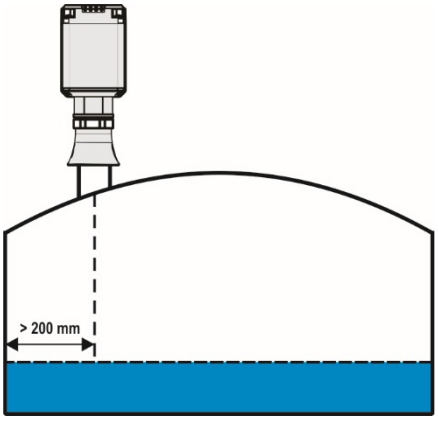


Figure 21

6.3.2 TANKS WITH CONICAL BOTTOMS

In conical-bottom tanks, it is recommended to install the **TU2000** in the center of the tank. This allows for measurement all the way to the bottom.

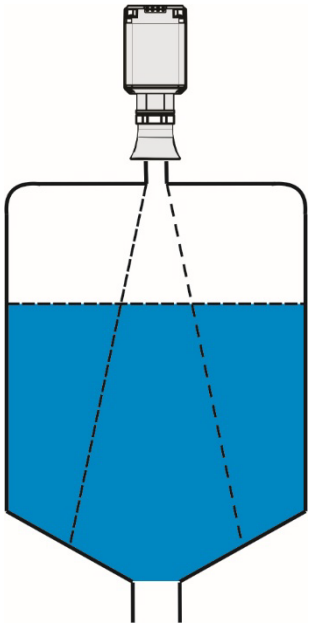


Figure 22

6.4 ALIGNMENT WITH SOLID PRODUCTS

For the **TU2000** to detect the entire volume of a solid-product tank, the device must be aligned so that the ultrasonic signal reaches the lowest level. In a silo with a conical output, installation must be carried out using a mounting sleeve, which should be positioned between 1/3 and halfway along the radius of the tank.

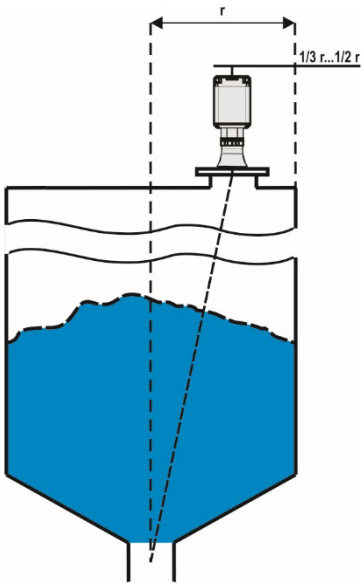


Figure 23

6.5 AGITATORS

If there is an agitator in the tank, false signals must be suppressed while the agitator is in operation. This ensures that the interference reflections from the agitator are stored at different positions.

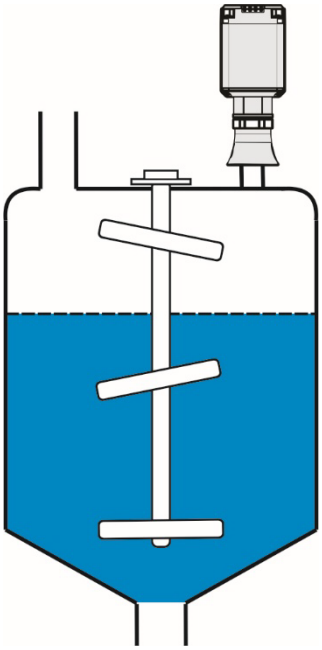


Figure 24

7 SETUP VIA SIGNOW

Available for Windows PCs and Android and iOS smartphones, the **SigNow** software and app are the primary tools for configuring and diagnosing your **TU2000**. The device can be connected via Bluetooth.

The **SigNow** software and its user manual can be downloaded for free from **NOVUS'** website: www.novusautomation.com.

The **SigNow** app can be downloaded for free from the Google Play Store or the App Store. If your smartphone does not support BLE technology, runs a version of Android earlier than 9, or runs a version of iOS earlier than 12, the app will not be available for download.

	This manual provides basic information on configuring the TU2000. For more information about SigNow's features, please refer to the user manual.

7.1 BLUETOOTH INTERFACE

The **TL2000** features a Bluetooth Low Energy (BLE) interface, compatible with devices equipped with Bluetooth version 4.0 or higher. The Bluetooth interface allows you to configure the device using the software or the app.

7.2 SIGNOW SOFTWARE

Once launched, **SigNow** will display the following screen and buttons:

Figure 25

Configuration: Allows the software to read the device being configured.

Create Configuration: Allows you to create the configuration of the device selected on the connection screen.

Diagnostic: Allows you to view diagnosis information abou the connected device.

Open Configuration: Allows you to open a configuration file created through the **Create Configuration**.

Connections: Allows you to manage and configure RS485 and Modbus-TCP connections.

Firmware: Allows you to update the firmware of the connected device.

Settings: Allows you to access the settings screen.

: Allows you to access the **SigNow** manual.

7.3 PAIRING THE TU2000 WITH THE SOFTWARE

Once the software has been installed and the **TU2000** is powered on, click the **Configuration** button and select the BLE pairing mode and the desired device:

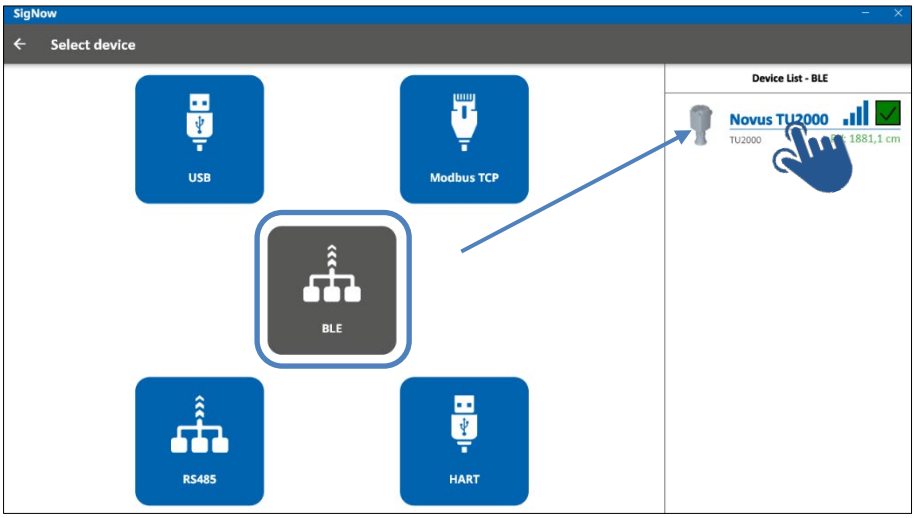


Figure 26

When you select the device, if pairing is successful, the software will display the following options:

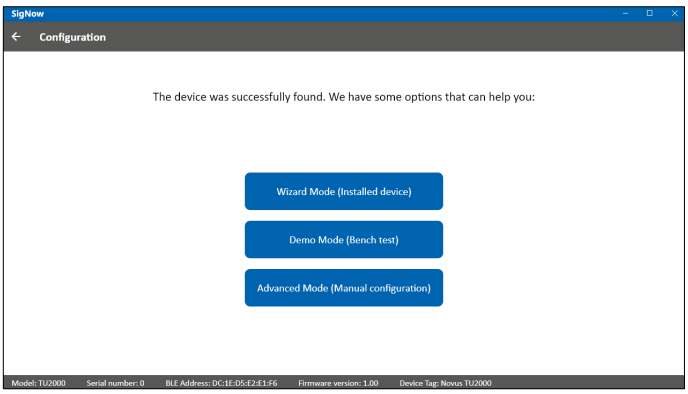


Figure 27

Wizard Mode: Wizard Mode helps you find the best settings for the type of tank or surface where the device is installed.

Demo Mode: Demo Mode allows you to perform a basic functional test of the device.

Advanced Mode: Advanced Mode allows you to manually configure all device settings.

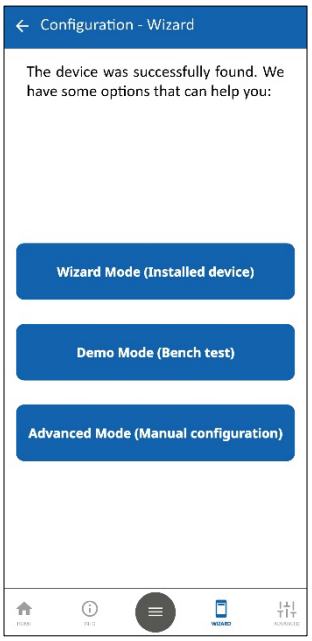
7.4 PAIRING THE TU2000 WITH THE SMARTPHONE

Once the **SigNow** app has been installed, you must enable your smartphone's Bluetooth to connect to the **TU2000**. Once you've done that, just open the app and follow the steps below:

Click the **Configuration** button.

Select the configuration mode.

Click on the desired device and wait for the connection process to complete.



Done! Simply select the configuration mode you want to use.

When you select the **Wizard Mode** option, the installation wizard will guide you through setting up the device based on the type of tank or surface where it is installed:

SOFTWARE	APP

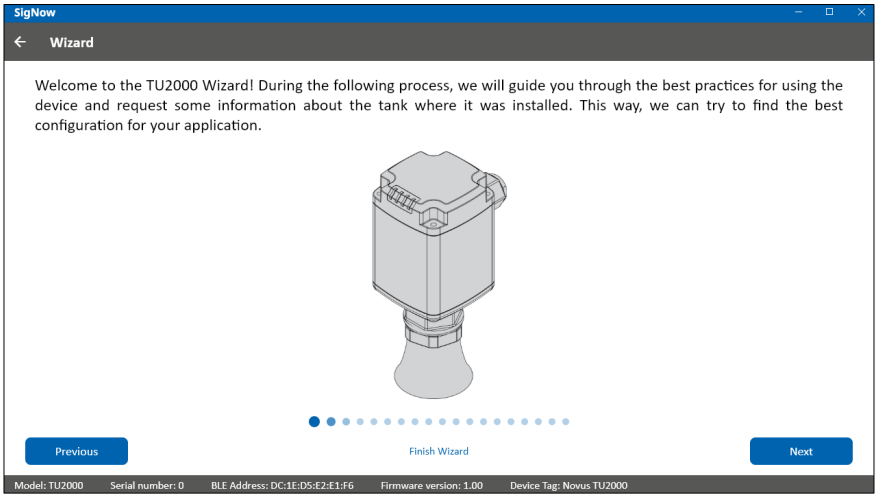
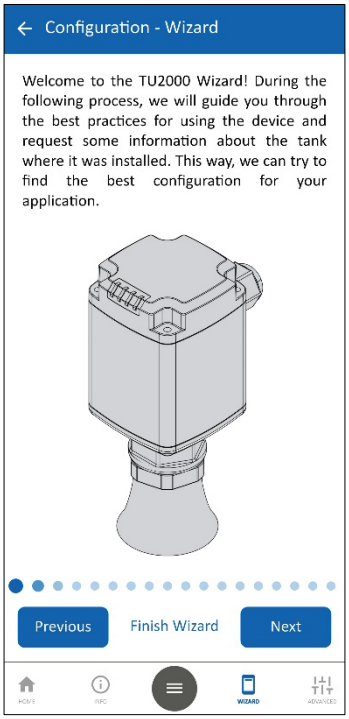

	

Figure 28	Figure 29

During this process, **SigNow** will collect information about the tank, the sensor's position, the type of measurement (Level, volume, or distance), the installation Offset, and the rate at which the level changes within the tank, to help you find the most suitable configuration for the application.

Once you have entered the information step by step, as guided by the Wizard, simply click the «**Send Data**» button to start the process. Once it is complete, an analysis will be displayed. Based on the values, you can use the **Auto Echo (Teach-in)** function:

SOFTWARE	APP

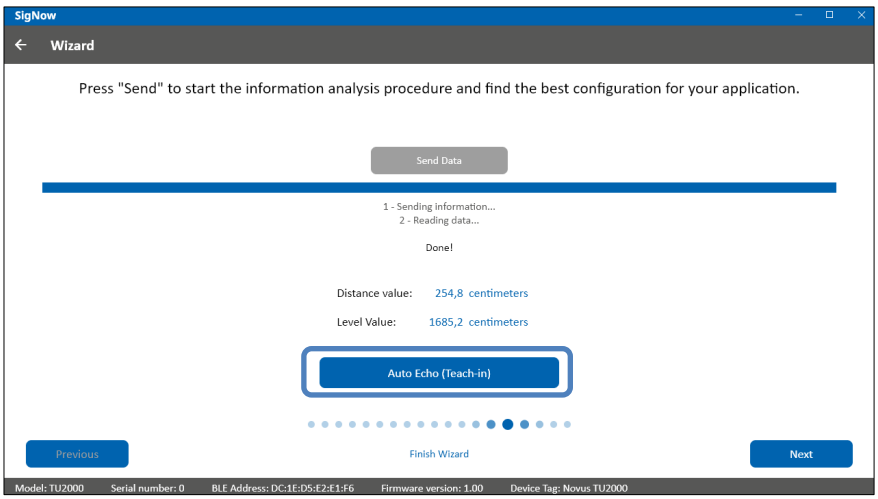
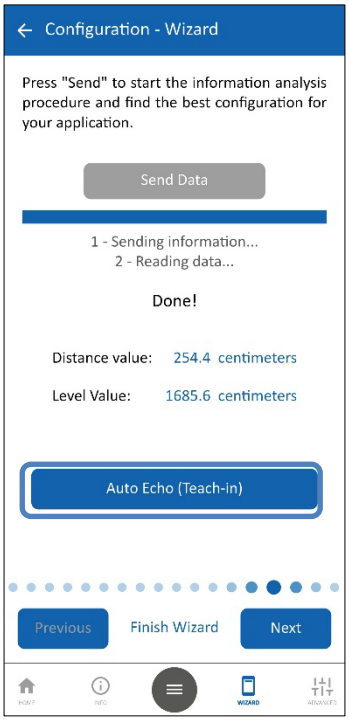

	

Figure 30	Figure 31

Auto-Echo assumes that the most significant obstacle is the operational level.

At the end of the process, the distance or level found will be displayed. If the values obtained differ significantly, it most likely means that the sensor is incorrectly configured for that application. To resolve this issue, you must run the automatic tank mapping algorithms (Teach-In), which consist of auto-sensitivity and auto-threshold, respectively.

The auto-sensitivity algorithm can find the best sensitivity curve for the application, but it is essential that the device is installed, the tank is not full and, if possible, that it is as close to empty as possible.

After that, the software will display an updated sensor reading:

SOFTWARE	APP

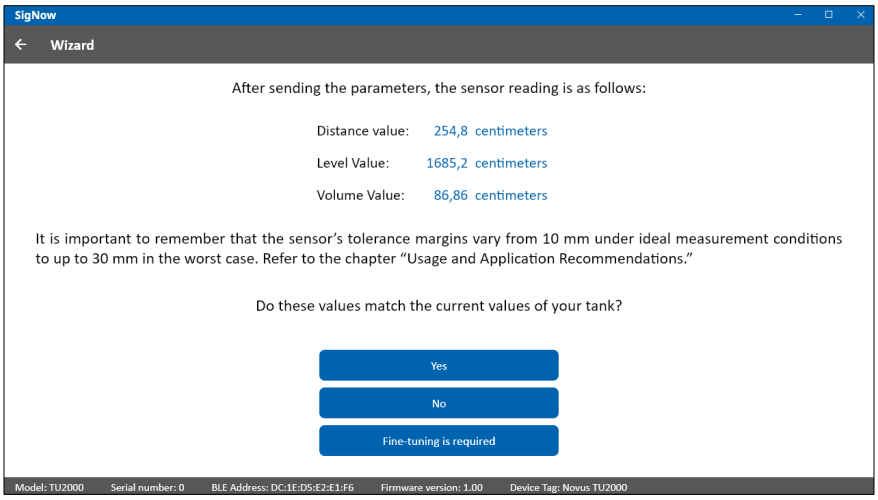
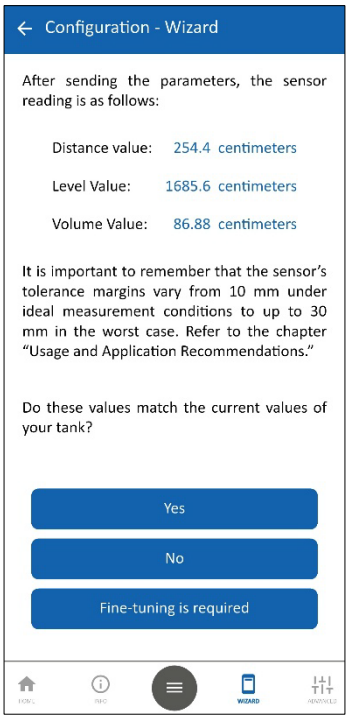

	

Figure 32	Figure 33

7.5 BENCH TEST MODE

Demo Mode allows you to test how the device works. In this mode, **SigNow** will help you configure the device so that you can easily test its operation, for example, by moving it between the workbench and the floor.

7.5.1 APP

In the app, you can test how the device works by moving it between the sensor and the floor:

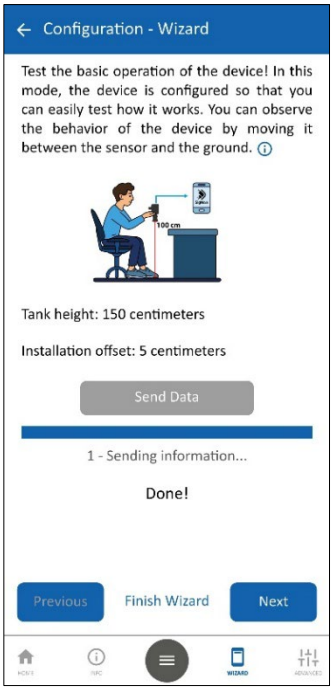


Figure 34

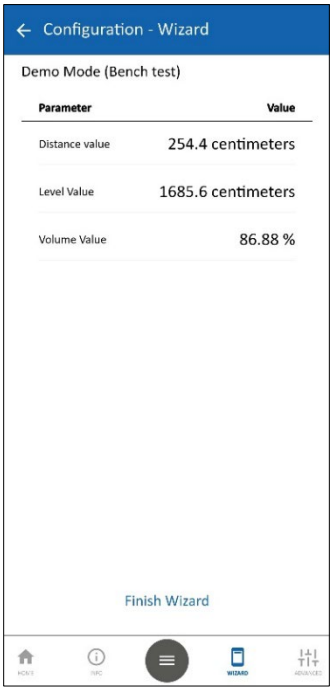


Figure 35

7.5.2 SOFTWARE

7.5.2.1 STATUS

This screen displays information about the status LEDs:

Figure 36

STATUS LED

- **Green:** Indicates normal operation.
- **Yellow:** Indicates that normal operating conditions are outside the specified range.
- **Red:** Indicates a sensor reading error or other internal failure detected by the device.
- **Flashing red:** Indicates a forced input (Level, volume, or distance).
- **Off:** Indicates that the device is turned off.

ANALOG OUTPUT LED

- **Green:** Indicates normal operation.
- **Yellow:** Indicates that the 4-20 mA output is operating in the extended range between 3.8 and 4 mA or between 20 and 20.5 mA.
- **Red:** Indicates an error signal on the 4–20 mA output (3.5 mA or 21.5 mA).
- **Flashing red:** Indicates that the device is performing a functional test, forcing the current output.

DIGITAL OUTPUT LED

- **Green:** Indicates that the alarm is enabled and no alarm condition has been detected.
- **Flashing green:** Indicates that the alarm is enabled and an alarm condition has been detected.
- **Yellow:** Indicates that the device has detected an overcurrent outside the specification, temporarily disabling the digital output.
- **Flashing red:** Indicates that the device is performing a functional test, forcing the alarm output.
- **Off:** Indicates that the alarm is disabled.

BLUETOOTH LED

- **Green:** Indicates that the Bluetooth signal is available for connection.
- **Flashing green:** Indicates that the device is available for configuration via Bluetooth.
- **Flashing blue:** Indicates that the device is updating its firmware via OTA (Over The Air).
- **Off:** Indicates that Bluetooth is disabled.

7.5.2.2 FORCING

This screen allows you to set specific values for the sensor input (distance, level, and volume), the digital output, and the analog output:

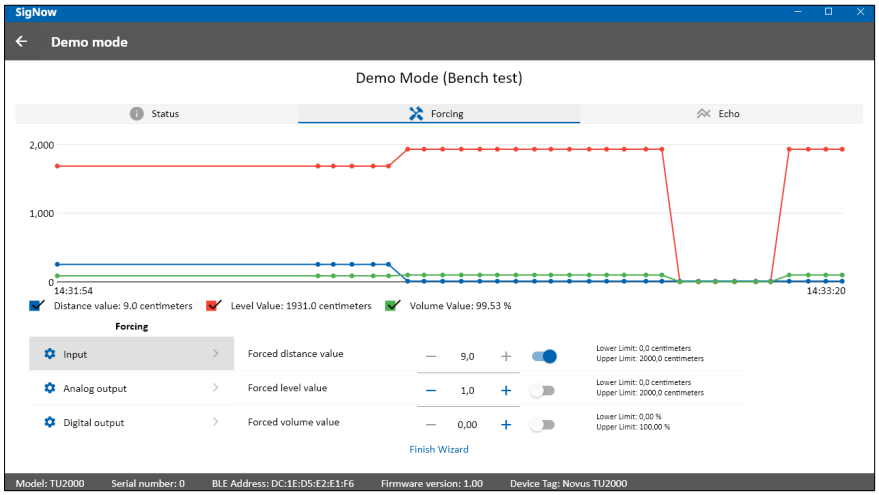


Figure 37

7.5.2.3 ECHO

This screen displays information about the configured echo threshold curve and the echo:

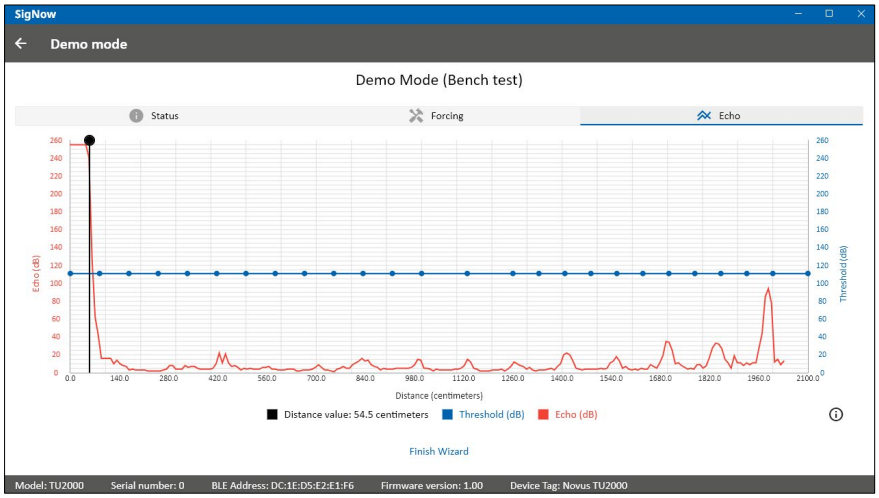


Figure 38

Hovering your mouse over the desired point will display information about the X and Y axes.

7.6 ADVANCED MODE

By selecting the **Advanced Mode** option, you can manually configure each setting.

7.6.1 IDENTIFICATION

By clicking the **Identification** option, **SigNow** will display parameters related to the basic configuration:

SOFTWARE	APP

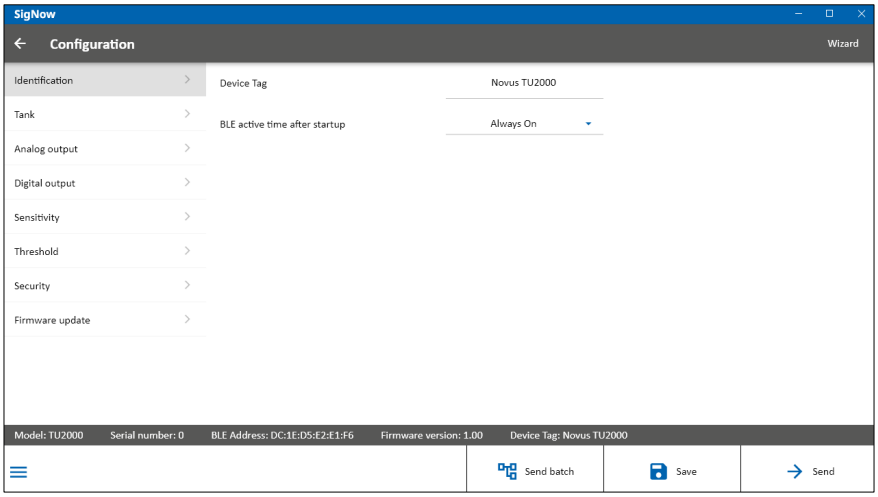
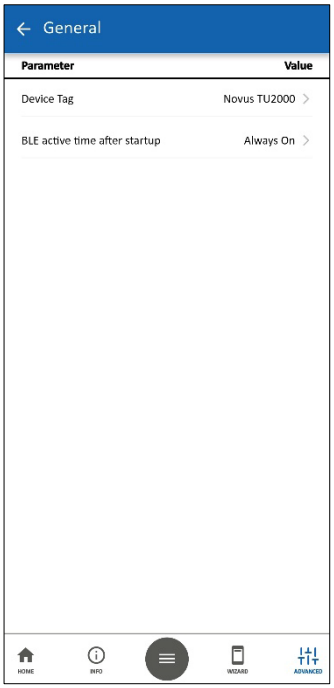

	

Figure 39	Figure 40

- **Device tag:** Allows you to enter a tag of up to 13 characters to identify the device.
- **BLE: Active time after start-up:** Allows you to set the period during which Bluetooth will remain active after the device is turned on.

7.6.2 TANK

By clicking the **Tank** option, **SigNow** will display parameters related to the configuration of the tank in which the device will be installed:

SOFTWARE	APP

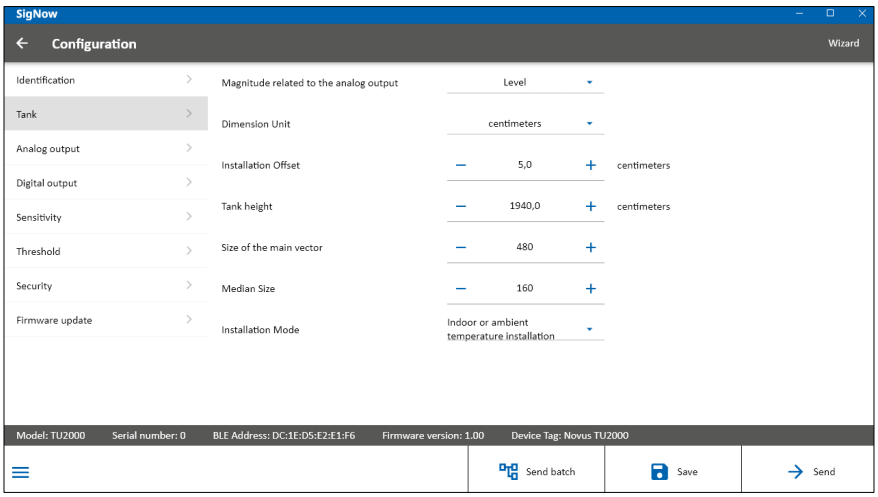
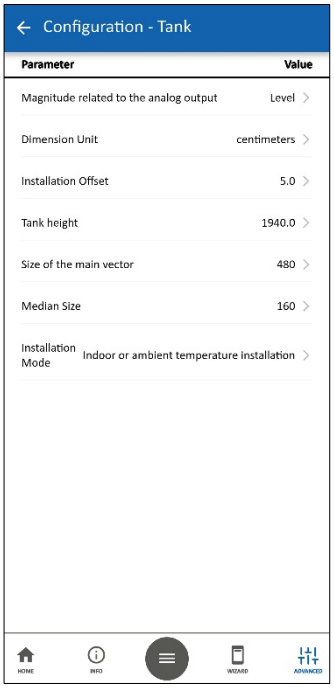

	

Figure 41	Figure 42

By default, the «**Magnitude related to the analog output**» parameter is set to «**Level**», which allows you to configure the following parameters:

- **Level and distance unit:** Allows you to set the unit of measurement to be used.
- **Installation Offset:** Allows you to set the installation Offset.
- **Tank height:** Allows you to set the height of the tank to be used.
- **Filter time constant in seconds:** Allows you to reduce fluctuations or data spikes detected by the device. When the actual value changes, it will take a time proportional to the value set in this parameter to reach a new actual value.

If the «**Magnitude related to the analog output**» parameter is set to «**Distance**», those same parameters will be displayed.

When you set the «**Magnitude related to the analog output**» parameter to «**Volume**», in addition to the parameters shown in the previous figure, you can also change the «**Tank Type**» parameter (Vertical Cylindrical, Horizontal Cylindrical, Rectangular, or Custom):

SOFTWARE	APP

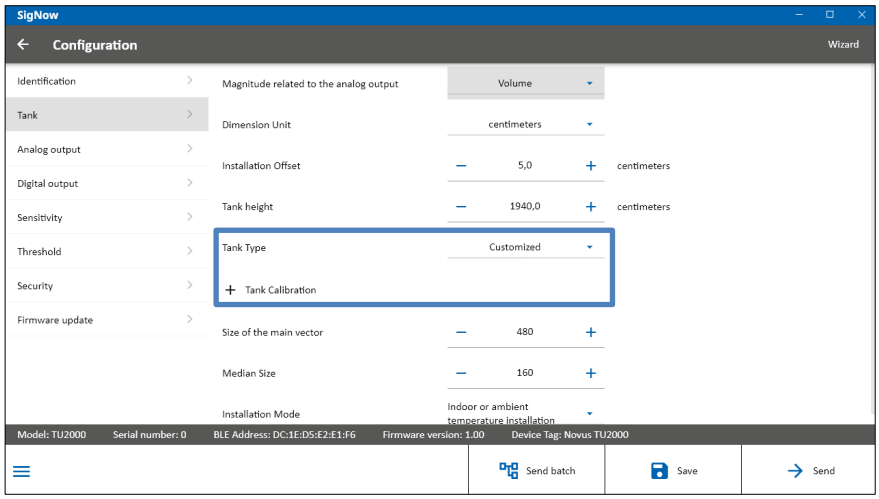
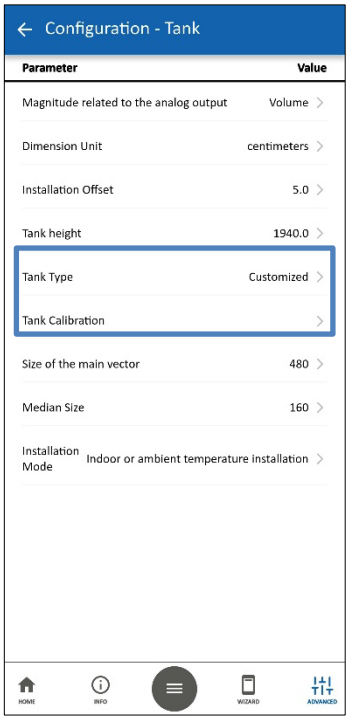

	

Figure 43	Figure 44

Depending on the type of tank selected, **SigNow** will display configurable parameters to determine the size and exact dimensions of the tank to be used.

If none of the standard tank types meet your needs, you can select the «**Customized**» option. When using the «**Customized**» option, calibration points for the tank must be added. You can configure up to 20 linearization points by entering the appropriate values.

Custom-designed tanks can be useful for tanks with curved shapes, elevations, or other irregularities.

When set to «**Customized**», the calibrated points should range from the greatest distance to the shortest distance and from the smallest volume to the largest volume, as shown in the example below:

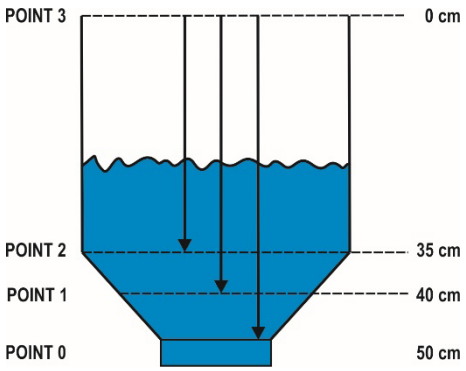


Figure 45

POINT	DISTANCE	VOLUME (%)
0	50	0
1	40	10
2	35	20
3	0	100

Table 6

7.6.3 ANALOG OUTPUT

By clicking the **Analog Output** option, **SigNow** will display parameters related to the analog output settings:

SOFTWARE	APP

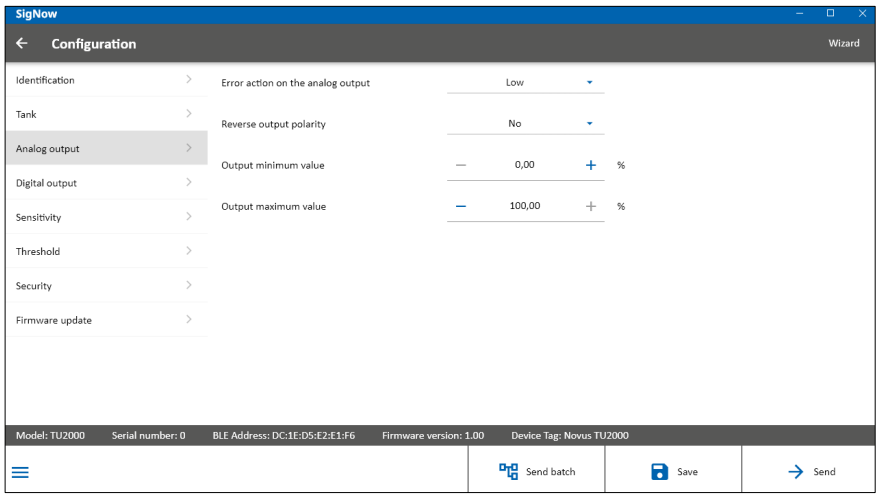
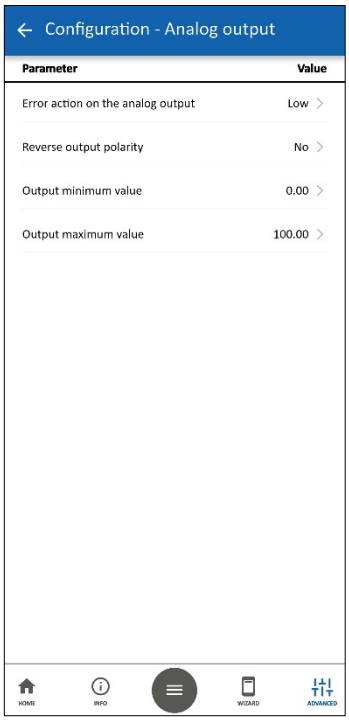

	

Figure 46	Figure 47

- **Error action on the analog output:** Allows you to configure the action to be taken by a device that suffers an analog output error:
  - Low (3.5 mA)
  - High (21.5 mA)
- **Reverse output polarity:** When enabled, this function allows you to invert the relationship between the control value and the analog output signal, applying the minimum and maximum output values in reverse relative to the control signal, according to the limits configured in the parameters below.
- **Output minimum value:** Allows you to set a minimum value to be used.
- **Output maximum value:** Allows you to set a maximum value to be used.

7.6.3.1 COMPATIBILITY WITH NAMUR NE 43

The **TU2000** is compatible with NAMUR 43 (NE 43), a standard that specifies the retransmission limits and failure modes for the analog output.

The analog output error threshold can be set to a level below **3.6 mA** or above **21 mA**, based on the recommendations of the NE 43 standard. In addition, using the configured minimum (**4.0 mA**) and maximum (**20 mA**) values as a reference, the **TU2000** will scale its signal within the range to **3.8 mA** and **20.5 mA** as appropriate.

7.6.4 DIGITAL OUTPUT

By clicking the **Digital Output** option, **SigNow** will display parameters related to the digital output settings:

SOFTWARE	APP

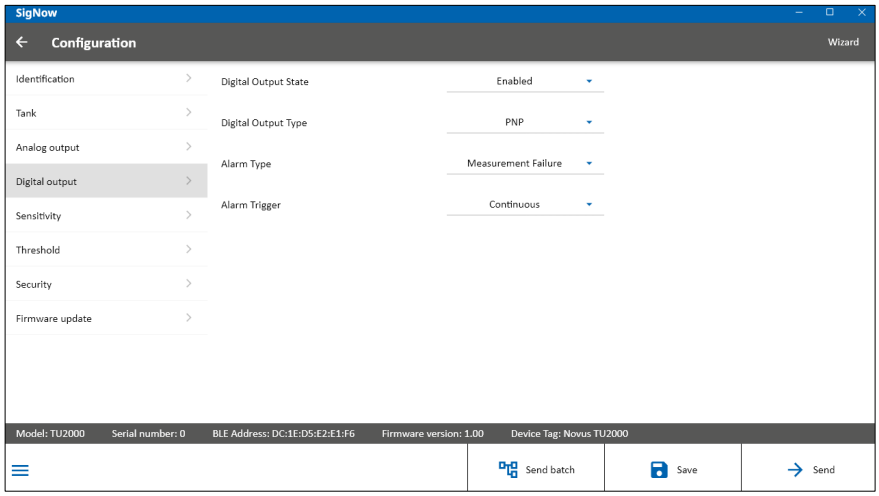


Figure 48

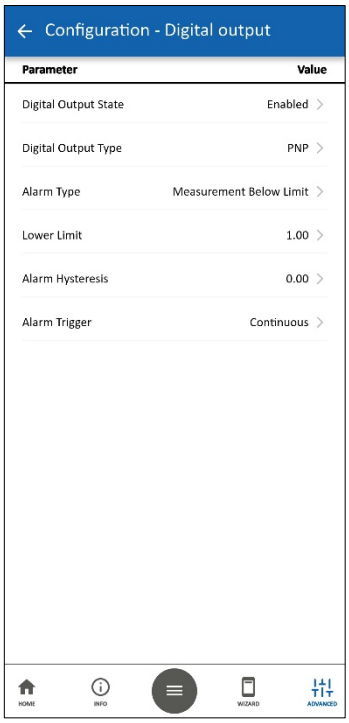


Figure 49

- **Digital output type:** Allows you to set the polarity of the digital output.
- **Alarm type:** Allows you to set the type of alarm to be used:
  - **Measurement failure:** The alarm will be triggered when the device detects a measurement failure, such as a sensor error, an invalid signal, or no signal.
  - **Measurement below limit:** The alarm will be triggered when the measured value falls below the configured lower limit.
  - **Measurement above limit:** The alarm will be triggered when the measured value exceeds the configured upper limit.
  - **Measurement within range:** The alarm will be triggered when the measured value falls within the range defined by the configured lower and upper limits.
  - **Out-of-range measurement:** The alarm will be triggered when the measured value falls outside the defined range, that is, below the lower limit or above the upper limit.
- **Lower limit:** Allows you to set the lower limit for the alarm. Available when selecting the options «**Measurement below limit**», «**Measurement within the range**», or «**Measurement outside the range**».
- **Upper limit:** Allows you to set the upper limit for the alarm. Available when selecting the options «**Measurement above limit**», «**Measurement within the range**», or «**Measurement outside the range**».
- **Alarm hysteresis:** Allows you to set the hysteresis to be used by the alarm. Available when selecting the options «**Measurement below limit**», «**Measurement above limit**», «**Measurement within the range**», or «**Measurement outside the range**».
- **Alarm trigger:** Allows you to set the output triggering mode:
  - **Continuous:** The output will remain active until the device exits the configured alarm condition.
  - **Intermittent:** The output will be activated intermittently, according to the on and off periods set in the «**Alarm ON Time**» and «**Alarm OFF Time**» parameters.
    - **Alarm ON time:** Allows you to set the period during which the output remains active. From 1 to 65535 seconds.
    - **Alarm OFF time:** Allows you to set the period during which the output remains inactive. From 1 to 65535 seconds.

7.6.5 SENSITIVITY

By clicking the **Sensitivity** option, **SigNow** allows you to view and adjust the sensor's behavior based on distance, correlating the received echo with the configured sensitivity, to optimize detection and measurement stability:

APP

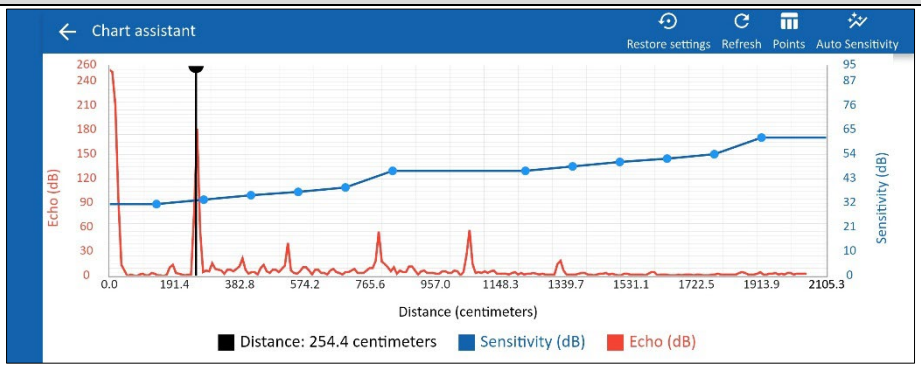


Figure 50

SOFTWARE

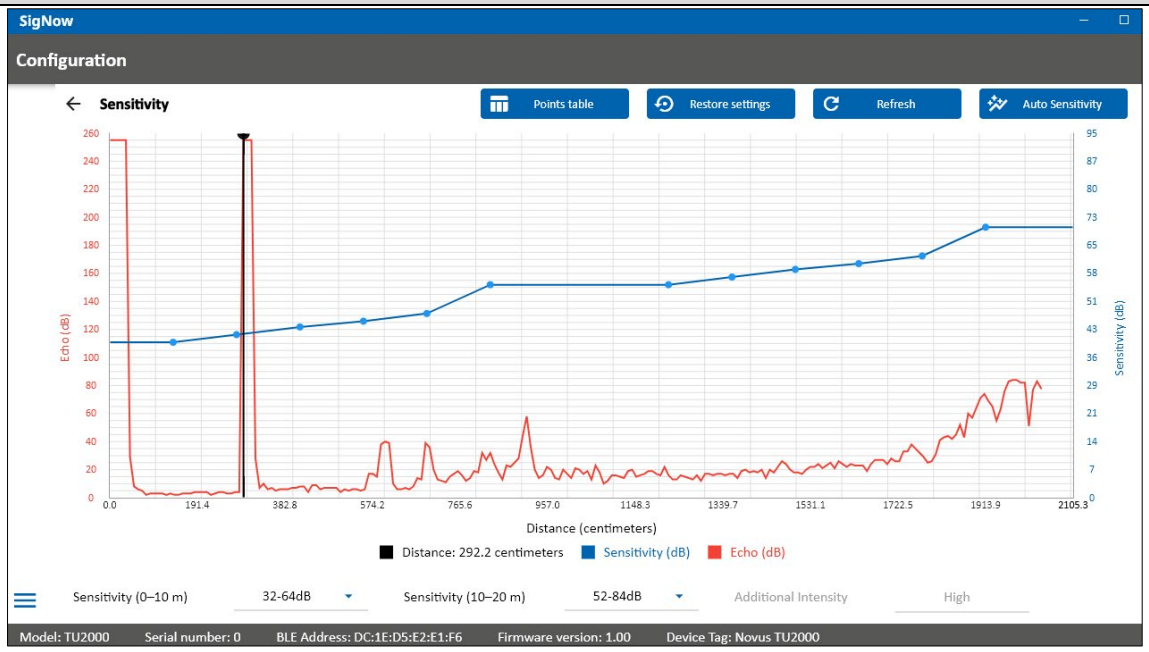


Figure 51

The distance-dependent intensity curve is used to smooth out the signal picked up by the sensor. This signal is then used to calculate level, volume, or distance. Therefore, it is necessary to configure the curve for each application.

It is recommended to perform this configuration with the tank at a low level.

The **Sensitivity** graph includes the following elements:

- **Echo (dB):** Represents the intensity of the signal detected by the sensor when the pulse it emitted is reflected. Higher values indicate stronger reflections; lower values indicate no reflection or reflection from small surfaces.
- **Sensitivity (dB):** Indicates the sensitivity level set for the sensor in each distance range. You can change the points on the graph or in the point table. To change them, drag them up or down by clicking and holding the left mouse button, or by touching and dragging your finger on mobile devices. The curve configuration values may vary within the configured sensitivity range. You may need to adjust them to access other values.
- **Distance:** The horizontal axis of the graph, which represents the distance measured by the sensor in the unit configured by the user.

The positions of the echo and the sensitivity points on the X-axis correspond to the absolute distance measured by the sensor, ignoring the mounting Offset setting.

For the measurement to be stable, the sensitivity must be set appropriately so that the signal received by the sensor is strong and reliable regardless of the distance. Echoes that are too weak relative to the sensitivity may result in unstable readings or measurement errors.

Setting the sensitivity correctly allows you to:

- Reduce interference.

- Improve long-range detection.
- Improve measurement reliability.

This screen displays the following buttons:

- The «**Point Table**» button displays a table listing the distance and sensitivity of each point.
- The «**Restore Settings**» button allows you to restore the default sensitivity settings.
- The «**Refresh**» button allows you to update the data displayed on the graph based on the current measurements.
- The «**Auto Sensitivity**» button allows you to automatically adjust the sensitivity curve based on actual measurement conditions, optimizing echo detection.

7.6.5.1 SENSITIVITY ADJUSTMENT BY RANGE

Sensitivity can be configured separately for different distance ranges, allowing for compensation for signal loss as the distance increases. These adjustments improve measurement reliability in applications with wide variations in distance.

- **Sensitivity (0 to 10 m):** Allows you to set the sensitivity range used for measurements between 0 and 10 meters.
- **Sensitivity (10 to 20 m):** Allows you to set the sensitivity range used for measurements between 10 and 20 meters.
- **Transmission intensity:** Displays the transmission intensity of the ultrasonic pulse by setting the «**Sensitivity (0 to 10 m)**» and «**Sensitivity (10 to 20 m)**» parameters.

By clicking the «**Point Table**» button in the upper-right corner of the screen, **SigNow** will display a table listing the distance and sensitivity for each configured point:

APP

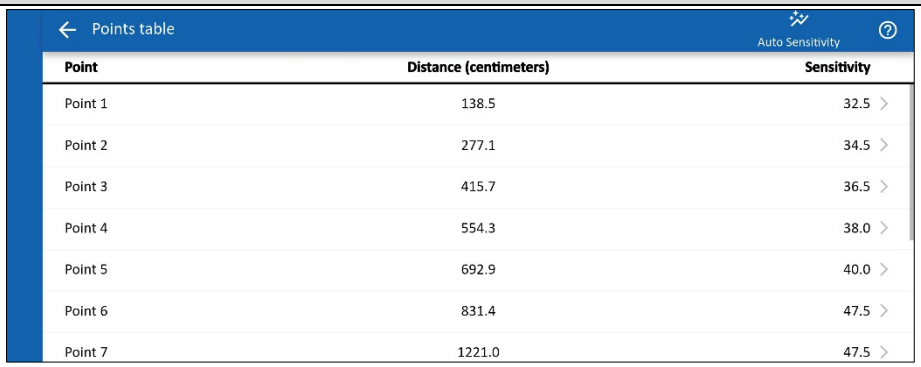


Figure 52

SOFTWARE

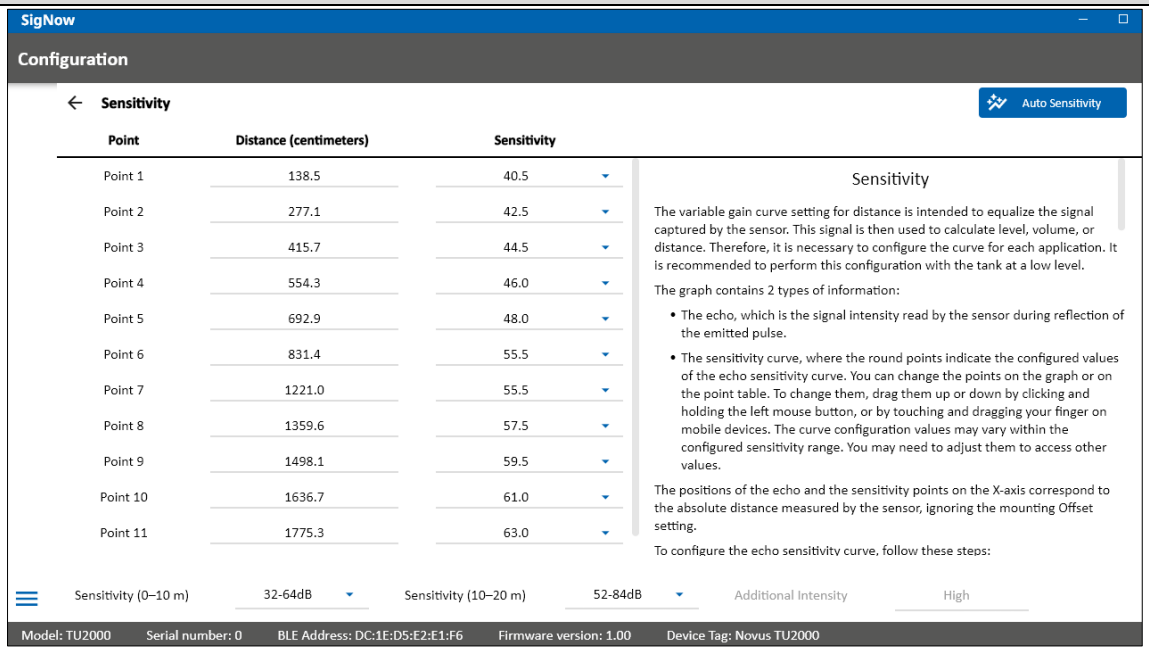


Figure 53

7.6.5.2 MANUALLY ADJUSTING THE SENSITIVITY

To manually adjust the sensitivity, follow the steps below:

- On the graph, identify the distance from the peak that corresponds to the tank's current distance, level, or volume. From this point on, any other peaks shown on the graph should be ignored, as they will be mapped later during the echo threshold configuration. The X-axis shows the absolute distance measured by the sensor, ignoring the mounting Offset setting.

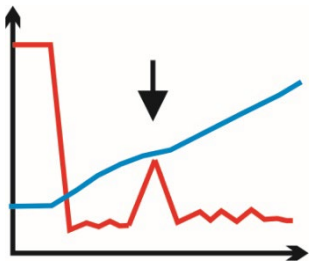


Figure 54

- After identifying it, adjust the sensitivity to the desired peak position so that the height is between 225 and 255, ensuring detection by the sensor.

	After sending the configuration, it is recommended to refresh the graph a few times to ensure that the peak height is adequate. If there is wind in the measurement environment or if the liquid in the tank is in motion, the peak height may vary significantly between updates.

Figure 55

- Adjust the sensitivity points between the sensor and the desired peak so that the echo intensity increases with distance. This adjustment should result in a rising echo curve from the first point up to the peak position. If there are other significant peaks to the left of the desired peak, ignore them and use the remaining lower echo points to perform the configuration.

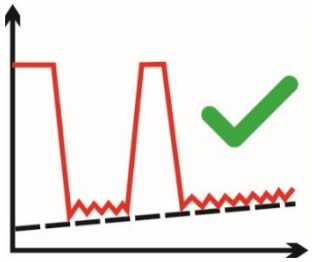


Figure 56

- Adjust the sensitivity points after the object (if any) to extend the already built sensitivity curve, maintaining the rate of sensitivity growth. Ignore echo points after the desired peak, guided only by the previously configured sensitivity.

After configuring the sensitivity, it may be necessary to fine-tune specific points. If, after installation and configuration, the sensor indicates failures at static level thresholds, use the diagnostic function to check whether part of the sensitivity curve needs to be readjusted.

If the peak corresponding to the expected measurement frequently shows intensity below 225, it is recommended to reconfigure the sensitivity.

7.6.6 THRESHOLD

By clicking the **Threshold** button, **SigNow** allows you to view and adjust the echo threshold used by the sensor to validate the received echo based on distance, ensuring that only echoes of sufficient intensity are considered valid for the measurement:

APP

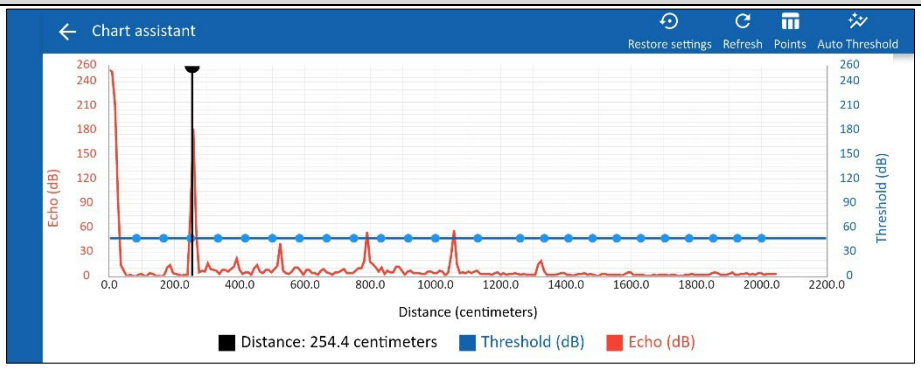


Figure 57

SOFTWARE

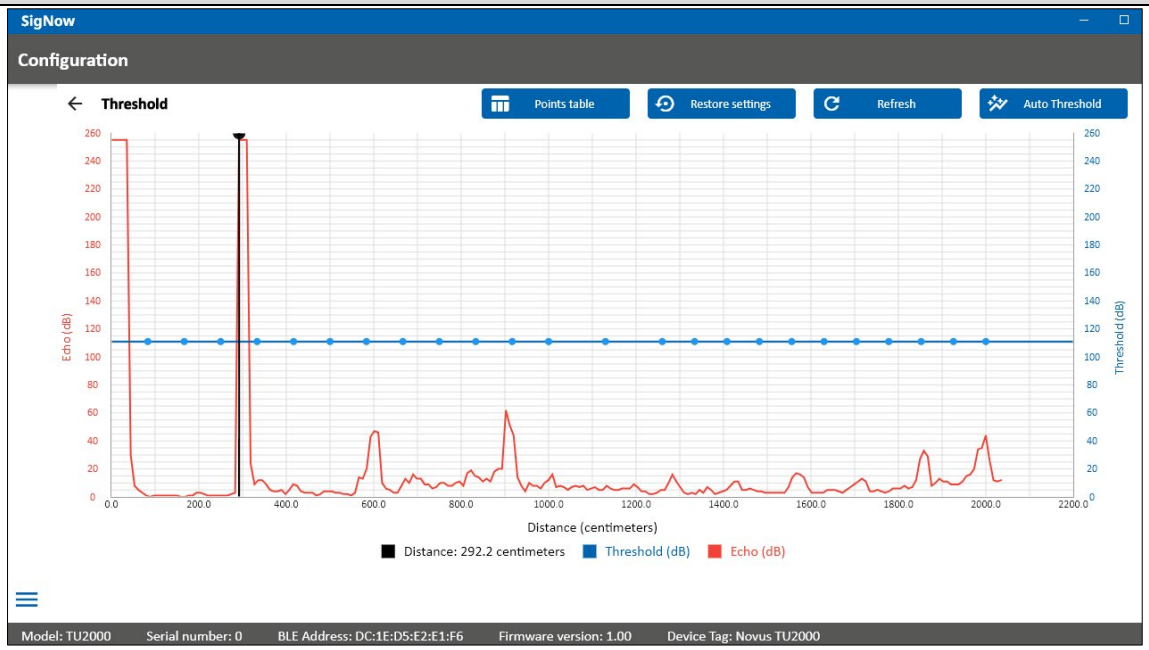


Figure 58

The **Threshold** graph displays the following elements:

- **Echo (dB):** Represents the intensity of the echo received by the sensor over the measured distance. Fluctuations indicate variations in echo quality caused by multiple reflections, obstacles, or environmental conditions.
- **Echo threshold (dB):** Indicates the minimum intensity threshold that the echo must reach to be considered valid by the sensor. You can change the points on the graph or on the point table. To change them, drag them up or down by clicking and holding the left mouse button, or by touching and dragging your finger on mobile devices.
- **Distance:** The horizontal axis of the graph, which represents the distance measured by the sensor in the unit configured by the user.

The positions of the echo and intensity points on the X-axis correspond to the absolute distance measured by the sensor, ignoring the mounting Offset setting.

Setting the correct intensity allows you to:

- Reject echoes caused by interference.
- Ignore echoes caused by objects such as pipes.
- Improve measurement stability in noisy environments.

	It is recommended to perform this configuration only after sensitivity has been successfully set.

This screen displays the following buttons:

- The «**Point Table**» button displays a table listing the distance and sensitivity of each point.

- The «**Restore Settings**» button allows you to restore the default sensitivity settings.
- The «**Refresh**» button allows you to update the data displayed on the graph based on the current measurements.
- The «**Auto Threshold**» button allows you to automatically adjust the intensity curve based on actual measurement conditions.

By clicking the «**Point Table**» button in the upper-right corner of the screen, **SigNow** will display a table listing the distance and echo threshold for each configured point:

APP

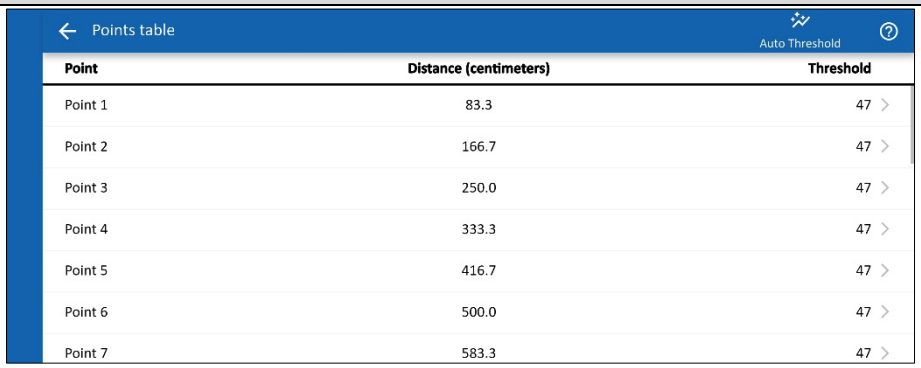


Figure 59

SOFTWARE

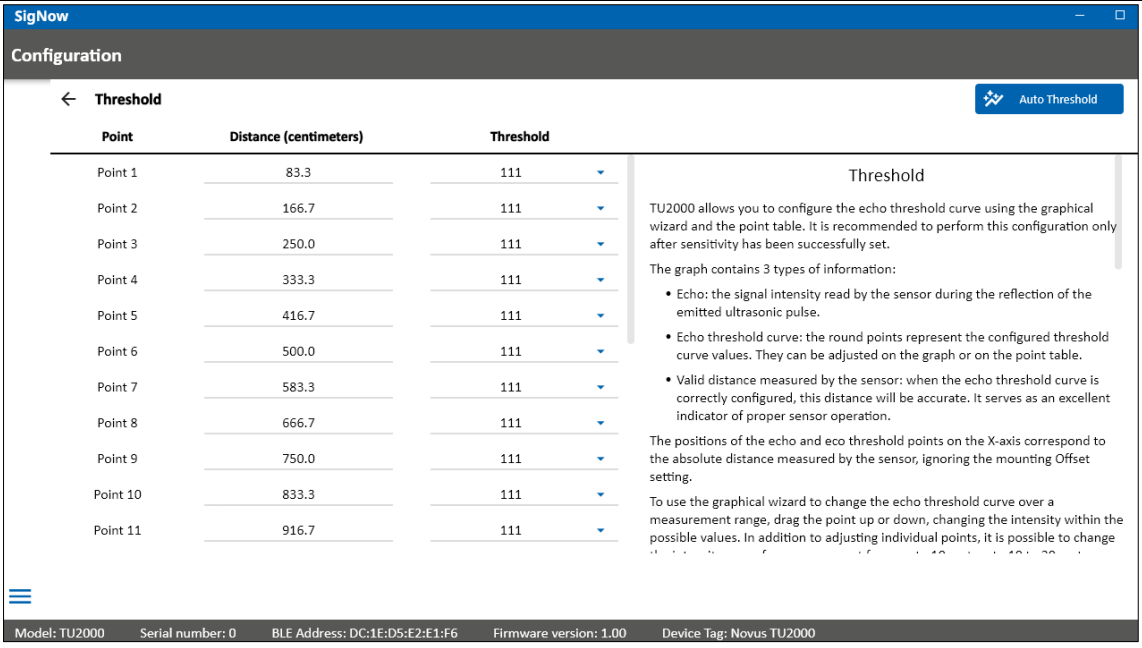


Figure 60

7.6.6.1 MANUALLY ADJUSTING THE ECHO THRESHOLD

To change the echo threshold within a measurement range, drag the point up or down to adjust the intensity within the available range. After making any changes, clicking the «**Send Configuration**» button will send the updates to the device and display an updated echo reading.

To manually configure the echo threshold, follow the steps below:

- On the graph, identify the distance from the peak that corresponds to the tank's current distance, level, or volume. The X-axis shows the absolute distance measured by the sensor, ignoring the mounting Offset setting.

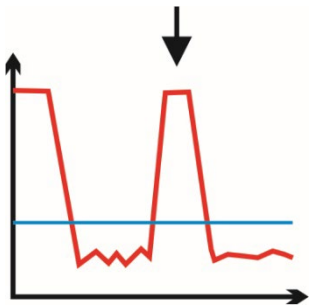


Figure 61

- Set all echo threshold points to an intensity 10 dB above half the peak height identified earlier.

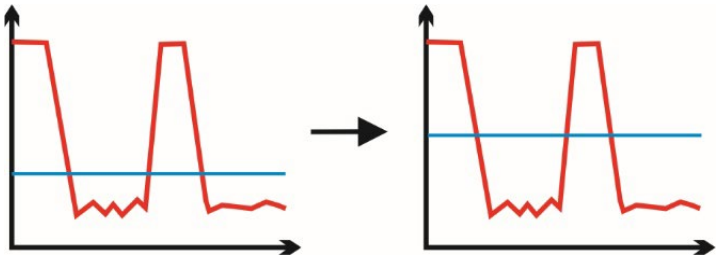


Figure 62

- Check whether there is another peak of lower intensity prior to the peak identified as the correct one. This peak may be caused by an object between the sensor and the surface being measured, such as a pipe. If there is one, increase the height of the echo threshold points that cover it by the same amount that this unwanted peak is higher than the other echo points around it. **Example:** If a peak is 30 dB above the surrounding noise, the level of the 3 points (at least) closest to the unwanted peak should be increased by 30 dB.

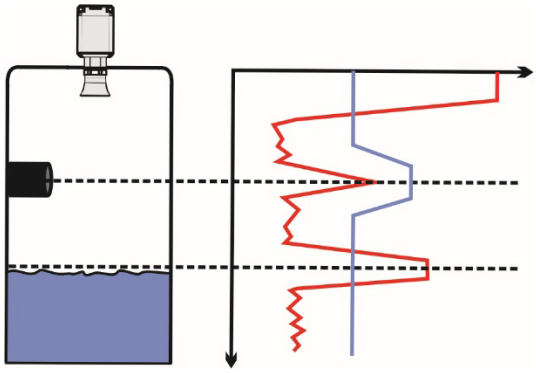


Figure 63

After configuration, variations in level may reveal an unwanted obstacle, which will be mistakenly detected by the sensor and reported as a valid measurement. Therefore, if variations in the tank contents occur and the sensor output remains stuck at an incorrect distance, level, or volume value, you should use the diagnostic function to check whether an unmapped unwanted peak has appeared. If so, return to this screen and mask the unwanted peak as instructed above.

7.6.7 SECURITY

By clicking the **Security** option, **SigNow** will allow you to set a password to protect the device:

SOFTWARE	APP

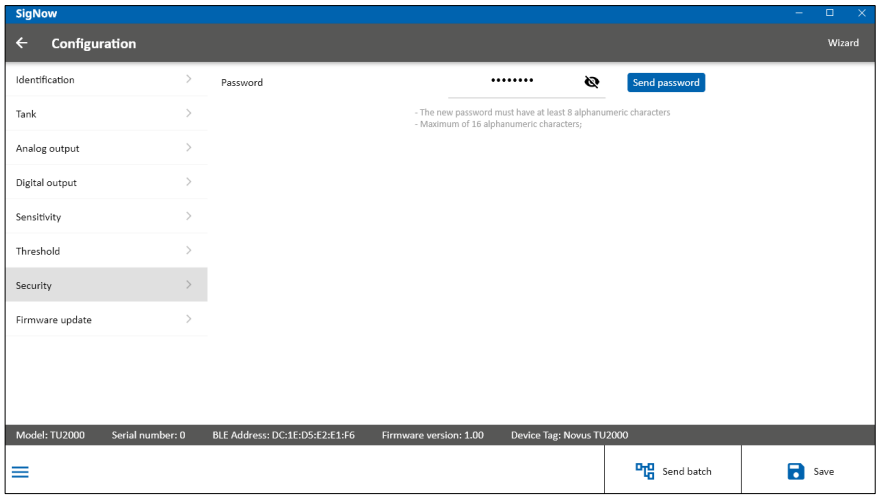
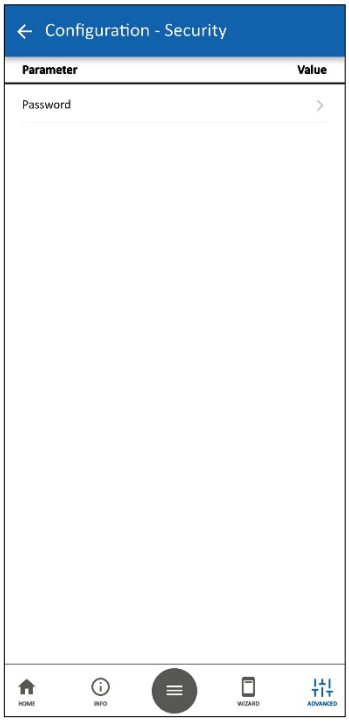

	

Figure 64	**Figure 65**

- **Password:** Allows you to set a password with at least 8 alphanumeric characters to protect the device. The field allows up to 16 characters.

7.6.8 FIRMWARE UPDATE

Figure 66

Figure 67

To update the firmware through the app, click on the **Firmware** button at the bottom of the home screen.

Then, select the equipment to be updated and perform the pairing process.

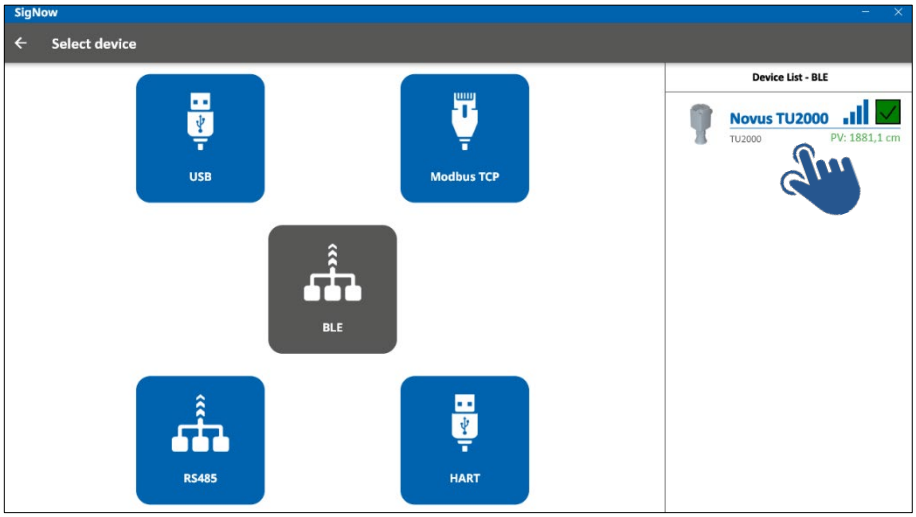


Figure 68

To update the firmware through the software, click on the **Firmware** button on the home screen.

Then, select the equipment to be updated and perform the pairing process.

By clicking on the «**Search files**» button, located in the left corner of the screen, you can search for previously downloaded files on your smartphone.

By clicking on the «**Check files online**» button, located in the right corner of the screen, you can check online for firmware files.

After that, simply select the file to be used by **SigNow** and perform the update process.

The SigNow manual provides step-by-step instructions on how to update the device's firmware.

7.7 DIAGNOSTIC

By clicking the **Diagnostics** button on the **SigNow** home screen and selecting the connection mode, the available devices will be displayed:

SOFTWARE	APP

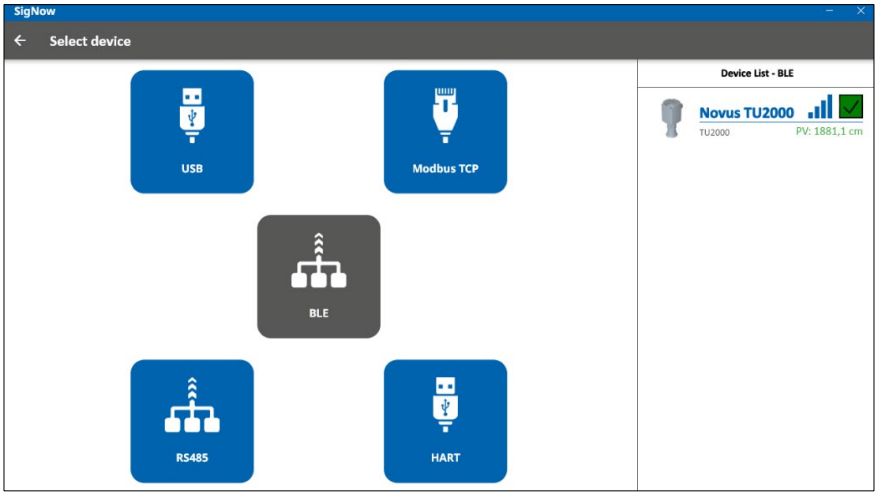



Figure 69	Figure 70

7.7.1 NAMUR NE 107 COMPATIBILITY

The **TU2000** is compatible with NAMUR 107 (NE 107), a standard that defines the status and self-diagnostic signals displayed via LEDs and icons.
If the **TU2000** experiences a malfunction that compromises any of the sensor's main functions (whether of the sensor itself or the analog output), it will display the symbol . To fix this, check the device settings.

If the **TU2000** is outside the specification range for the analog output or the sensor's measurement range, it will display the symbol .

If any forcing is enabled on the **TU2000**, it will display the symbol .

If the **TU2000** does not detect any failure, it will display the symbol .

These symbols are for reference only and do not prevent connection or diagnostics.

SYMBOL	DESCRIPTION
	Normal operation (OK).
	Out of specification.
	Function check.
	Failure.

Table 7

7.7.2 STATUS

By clicking the **Status** option, **SigNow** will display parameters related to the operating LEDs:

SOFTWARE	APP

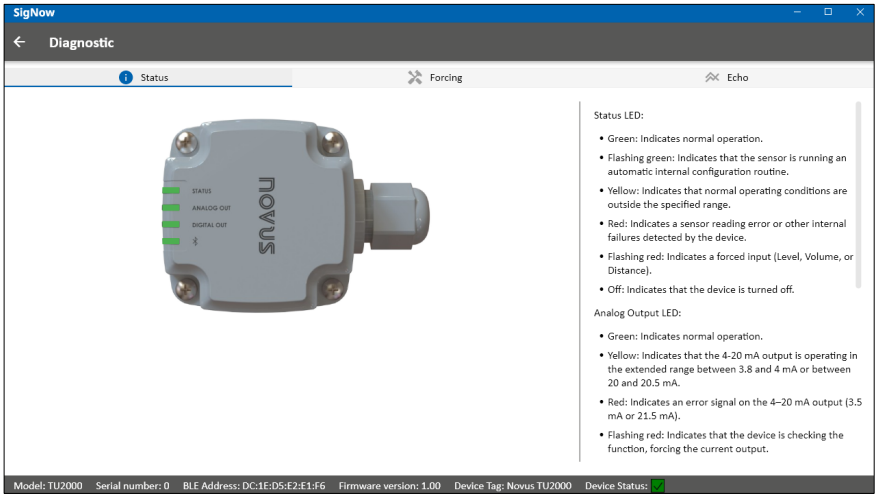



Figure 71	Figure 72

7.7.2.1 STATUS LED

- **Green:** Indicates normal operation.
- **Yellow:** Indicates that normal operating conditions are outside the specified range.
- **Red:** Indicates a sensor reading error or other internal failure detected by the device.
- **Flashing red:** Indicates a forced input (Level, volume, or distance).
- **Off:** Indicates that the device is turned off.

7.7.2.2 ANALOG OUTPUT LED

- **Green:** Indicates normal operation.
- **Yellow:** Indicates that the 4-20 mA output is operating in the extended range between 3.8 and 4 mA or between 20 and 20.5 mA.
- **Red:** Indicates an error signal on the 4–20 mA output (3.5 mA or 21.5 mA).
- **Flashing red:** Indicates that the device is performing a functional test, forcing the current output.

7.7.2.3 DIGITAL OUTPUT LED

- **Green:** Indicates that the alarm is enabled and no alarm condition has been detected.
- **Flashing green:** Indicates that the alarm is enabled and an alarm condition has been detected.
- **Yellow:** Indicates that the device has detected an overcurrent outside the specification, temporarily disabling the digital output.
- **Flashing red:** Indicates that the device is performing a functional test, forcing the alarm output.
- **Off:** Indicates that the alarm is disabled.

7.7.2.4 BLUETOOTH LED

- **Green:** Indicates that the Bluetooth signal is available for connection.
- **Flashing green:** Indicates that the device is available for configuration via Bluetooth.
- **Flashing blue:** Indicates that the device is updating its firmware via OTA (Over The Air).
- **Off:** Indicates that Bluetooth is disabled.

7.7.3 FORCING

By clicking the **Forcing** option, **SigNow** will allow you to force values on the input, analog output, and digital output to verify that the device is functioning properly:

SOFTWARE	APP

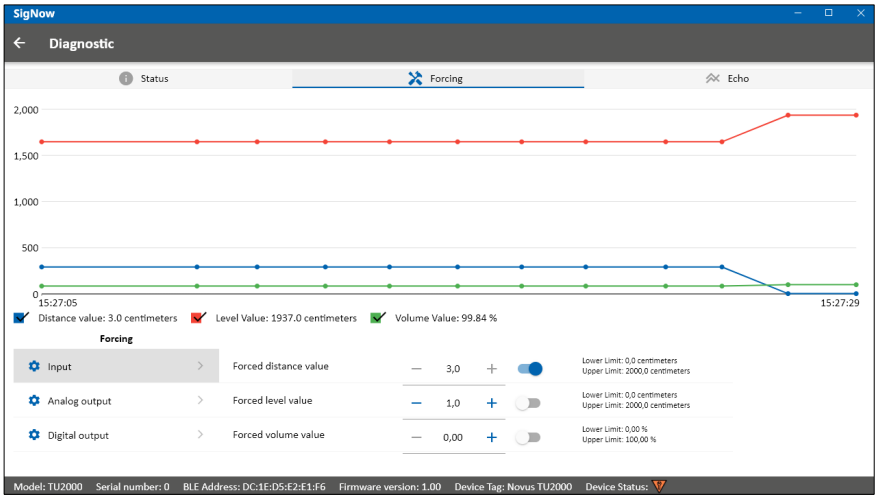
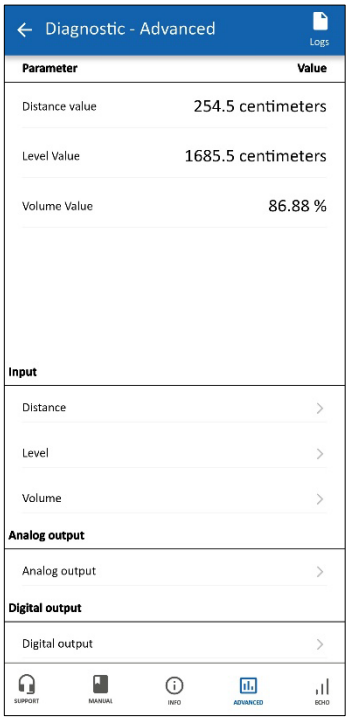

	

Figure 73	Figure 74

When using the **Forcing** section, you can:

- Force distance, level, and volume values for the input.
- Force current values for the analog output.
- Force the digital output to PNP or NPN mode.

7.7.4 ECHO

By clicking on the **Echo** option, **SigNow** will display a real-time graph:

APP

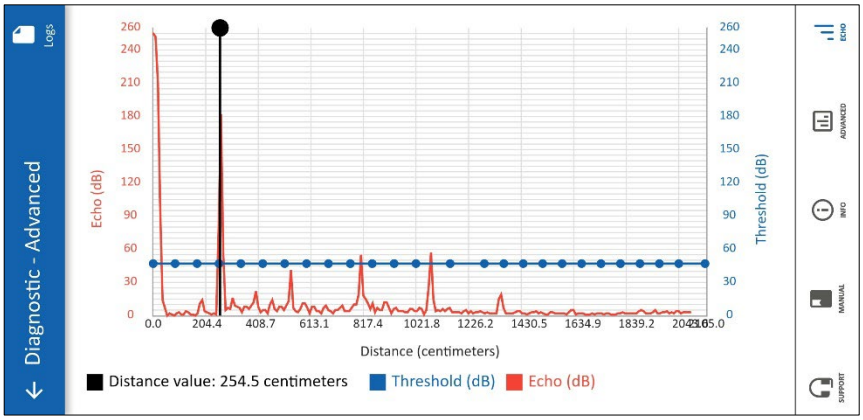



Figure 75

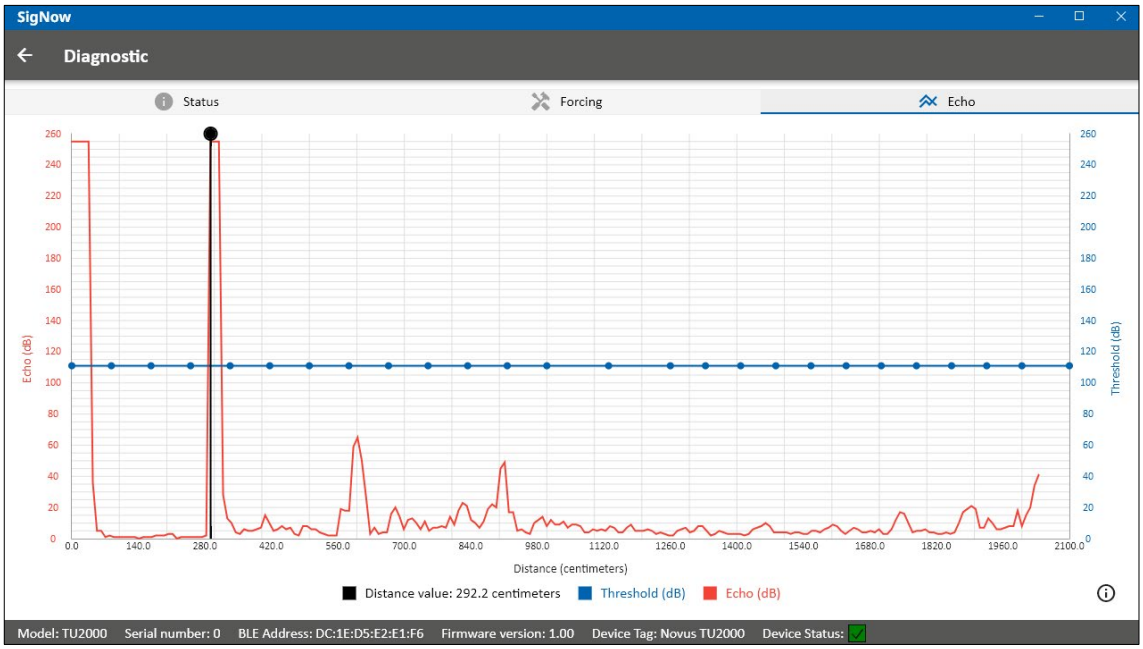


Figure 76

This graph allows real-time analysis of the behavior of the received echo and the configured echo threshold. If the echo peak corresponding to the correct distance remains below the intensity threshold, the measurement may be considered invalid. If the echo consistently exceeds the threshold, the measurement tends to be stable and reliable.

Echo fluctuations can help identify:

- Interference along the signal path.
- Installation or sensor alignment issues.

8 TECHNICAL SPECIFICATION

8.1 TECHNICAL SPECIFICATION

FEATURES	TU2000
Dimensions	175 x 110 x 70 mm
Distance measurement	Configurable from 0 to 20000 mm
Accuracy	30 mm minimum, which may be as low as 2 mm under optimal measurement conditions[1]
Precision	0,1 %
Process pressure	Up to 2 bars
Resolution	1 mm
Blind zone	500 mm[2]
Sampling	1 Hz (1 second)[3]
Sensor startup time	2.5 seconds
Connector	Internal terminals with cable gland output
Analog output	4 to 20 mA with 0.01 mA resolution
Alarm output	NPN or PNP up to 200 mA
Assembly	32 mm flange and horn with hexagonal opening
Consumption	<70 mA @ 12 V or <40 mA @ 24 V
Power supply	8~33 Vdc
Storage temperature	-20 to 80 °C
Operation temperature	-20 to 80 °C
Temperature compensation	Maximum error of 2 °C (average error of 0.1% with temperature)
Protection degree	IP67
Housing	UL94 Polycarbonate
Software	**SigNow** (for smartphones and PCs)
Certification	CE
The device's specifications were validated for the factory-set sensitivity and threshold settings by measuring a target with a radius of 2 meters, with no obstacles between the sensor and the target.	

Table 8

8.2 FACTORY SETTINGS

The **TU2000** comes from the factory configured as follows:

SECTION	FACTORY SETTINGS	
	PARAMETER	VALUE
IDENTIFICATION	**BLE: Active time after startup**	60
TANK	**Quantity associated with the analog output**	Level
	Units of level and distance	Centimeters
	Installation Offset	50.0 cm
	Tank height	1950.0 cm
	Filter time constant in seconds	0
ANALOG OUTPUT	**Error action on analog output**	Low
	Reverse output polarity	No

[1] Factors related to sound reflection, such as surface hardness, the presence of obstacles in front of the sensor, and the alignment of the sensor with the surface being measured, affect the ultrasonic sensor.

[2] By default, the blind zone is 500 mm. For tanks smaller than 10 m, it can be reduced to about 250 mm. Simply adjust the additional intensity in the Sensitivity settings.

[3] For tanks <= 10 meters, the sampling is 2 Hz (500 ms).

SECTION	FACTORY SETTINGS	
	PARAMETER	VALUE
	Minimum output value	0.0 cm
	Maximum output value	1950.0 cm
DIGITAL OUTPUT	**Digital output type**	Disabled
SAFETY	**Password**	No password

Table 9

8.3 CERTIFICATIONS

CE MARK

This is a Class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

8.4 NAMUR RECOMMENDATIONS

The **TU2000** is compatible with the following NAMUR standards:

- **Standard 43:** Regarding the analog output.
- **Standard 107:** Regarding diagnostics, with LEDs and icons.

9 WARRANTY

Warranty conditions are available on our website www.scigiene.com.

Scigiene
1295 Morningside Avenue, Unit 16-18
Scarborough, ON M1B 4Z4 Canada
Phone: 416-261-4865 Fax: 416-261-7879
www.scigiene.com