Laser Level Transmitter

TL400-I

USER GUIDE – V1.0x

We Measure, We Control, We Record

13883-22-07089

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1 SAFETY ALERTS

The symbols below are used in the device and 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** Material sensitive to static charge. Check precautions before handling.

All safety recommendations appearing in this manual must be followed to ensure personal safety and prevent damage to the instrument or system. If the instrument is used in a manner other than that specified in this manual, the device safety protections may not be effective.

This product emits radiation in the infrared range and uses LASER technology. It has been developed to meet the class 1 requirements of IEC 60825-1:2014 (Third Edition). Provided that the user follows **NOVUS** recommendations described in this manual, the radiation emission will remain within the limits of class 1. Lenses or any form of optical device should not be used to alter the product performance.

2 PRESENTATION

TL400-I is a non-intrusive level transmitter with no moving parts, using an infrared laser technology (~920 nm) that is completely safe to the human eye (LASER CLASS-1). Its measurement principle is based on ToF (Time of Flight), providing an accurate and reliable distance measurement, regardless of the color or transparency of the surface[1] . It can be used to measure from grains and solids to transparent liquids such as water and diesel.

It has a robust housing, withstanding pressures up to 8 bar, and excellent resistance to flammable materials such as diesel, gasoline, or alcohol.

With a measurement capacity up to 4 meters and 1 Hz sampling, **TL400-I** is an excellent alternative to level sensors based on ultrasonic, capacitive, or floating technology since it does not need to be in contact with the surface to be measured.

The transmitter has a dedicated filter for non-static tank applications based on machine learning algorithms that have been validated in real-life situations and have configurable parameters for specific applications.

The sensor allows you to configurate the opening angle, ranging from 12° degrees for irregular tank or reservoir applications to 27° degrees for tanks where the base diameter is half the height to be measured.

TL400-I has a BLE (Bluetooth Low Energy) interface. With it you can:

- Configure the **analog output** (4-20 mA), according to the specific application
- Configure the **opening angle** of the sensor (from 12° to 27° opening degrees)
- Customize the tank with up to 20 points in level percentage
- Perform sensor **diagnostics** in real time
- Configure the dynamic **filter** based on the application
- Update the **firmware** to the most current version, which will always be available on **NOVUS** website

These functions can be adjusted through the **SigNow** app, available for Android and iOS.

The sensor can retransmit the analog output in **Level**, **Volume**, or **Distance**. Level and distance are set in your preferred unit (mm, cm, m, inches, or feet) and volume is always displayed in percent.

[1] In sunlit environments or in small to medium sized tanks that have reflective walls, the sensor may have difficulty to make an accurate measurement. See recommendations for use and application.

3 IDENTIFICATION

3.1 OVERVIEW

The housing of the equipment is made of polycarbonate, an extremely resistant material, and was built to meet the IP68 protection index. It has a gasket in NBR material.

Figure 1 – Overview

3.2 IDENTIFICATION

The identification label, located on the top of the housing, shows the model, serial number, and product code. To make it easier to see the serial number, you can also scan the QR Code.

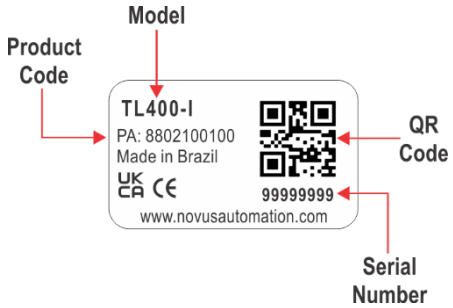


Figure 2 – Equipment identification

3.3 TL400-I

TL400-I is suitable for industrial installation. It can be installed on a tank lid and has a cable with an M12 connector.

Figure 3 – TL400-I

4 INSTALLATION

4.1 ELECTRICAL INSTALLATION

4.1.1 INSTALLATION RECOMMENDATIONS

- Electronic and analog signal drivers must run the plant separately from the output and power leads. If possible, in grounded conduits.
- The power supply for the electronic instruments must come from a proper power grid for 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 device internal security features do not guarantee full protection.

4.1.2 ELECTRICAL CONNECTIONS

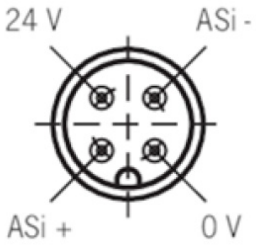


Figure 4 – Electrical connections

4.1.3 DIMENSIONS

4.1.3.1 TL400-I

The figures below show the dimensions of the **TL400-I** and an overview of the equipment:

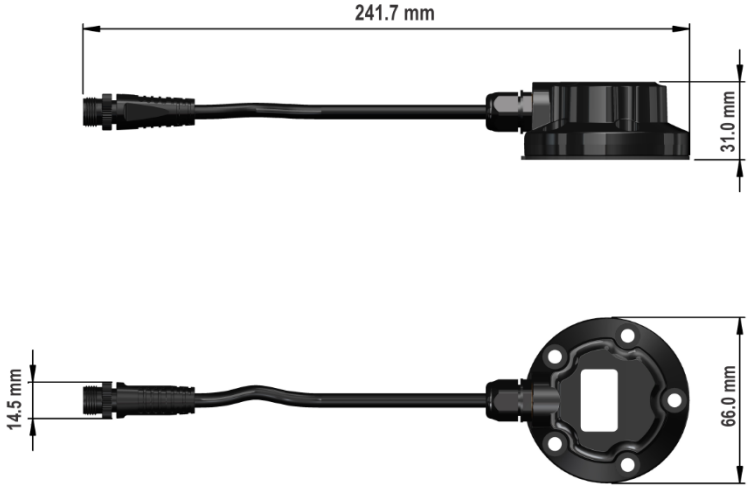


Figure 5 – Dimensions

4.1.3.2 5-HOLE TO 4-HOLE ADAPTER

The 5-hole to 4-hole adapter is an accessory for tanks that already have standard 4-hole drilling. The figure below shows the dimensions and drilling of the adapter for attaching the equipment:

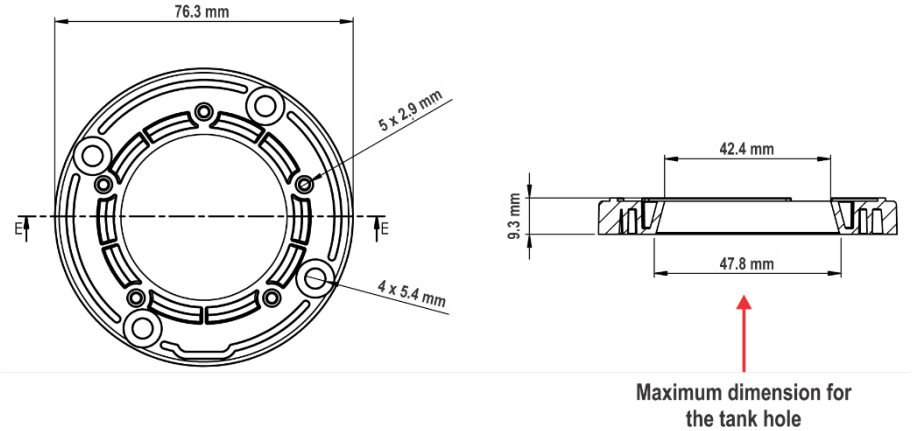


Figure 6 – Adapter

4.2 MECHANICAL INSTALLATION

To install the level sensor, the following tools are required:

- 4.0 to 4.2 mm drill for the screws
- 20 to 40 mm hole saw for the sensor
- Pencil for marking the hole points

After that, you must follow the steps below:

1. **Perform the marking:** While the tank is empty, use the gasket to mark the hole points of the 5 screws and the sensor in the center of the ring. When using an adapter, mark the hole points of the 4 screws and the sensor in the center of the ring.

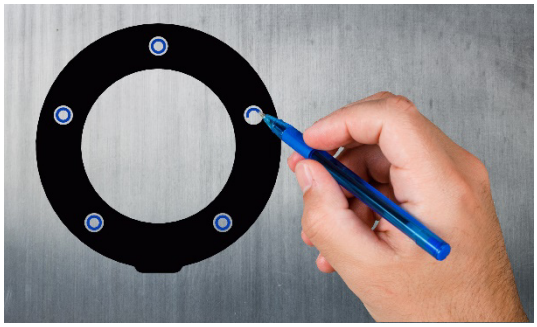


Figure 7 – Marking the gasket

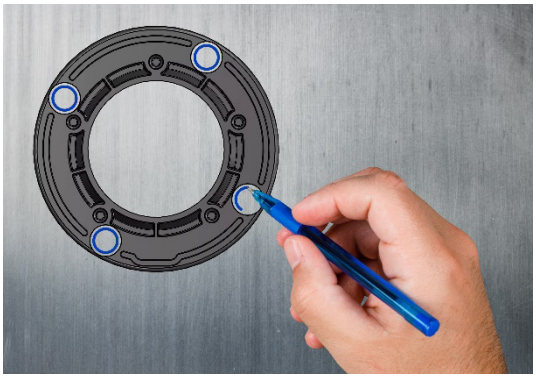


Figure 8 – Marking the adapter (accessory)

2. **Install:** Use a drill with the hole saw to drill the tank in the center, where the sensor will be installed. Then drill 4 mm holes at the marked positions. The gasket has a small cutout between the longer distance holes where the sensor output cable will be positioned.
3. **Make the connections:** After placing the equipment in the desired location, tighten the screws and then make the electrical connections (see ELECTRICAL CONNECTIONS section).
4. **Configure:** Use the **SigNow** app to configure the equipment (see SIGNOW APP chapter).

4.2.1 TL400-I WITH AND WITHOUT ADAPTER

The figures below show versions of the equipment with and without the adapter (optional accessory):

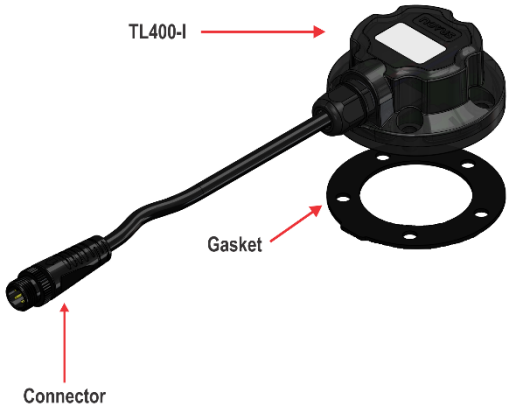


Figure 9 – TL400-I

Figure 10 – TL400-I with adapter

To install the adapter and the gasket, the correct position must be observed:

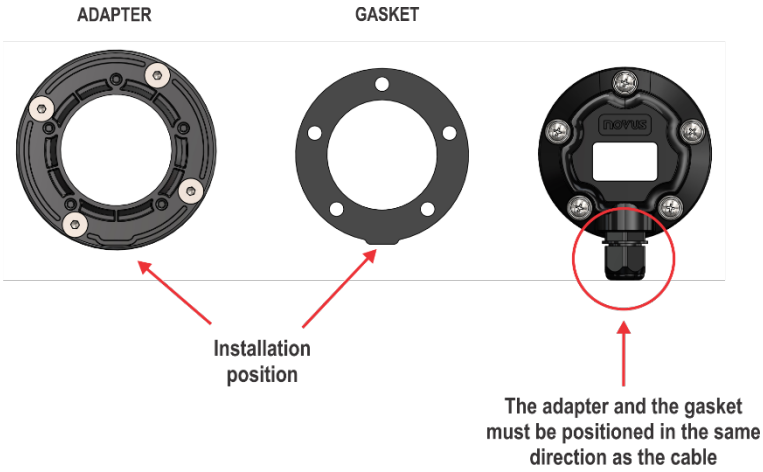
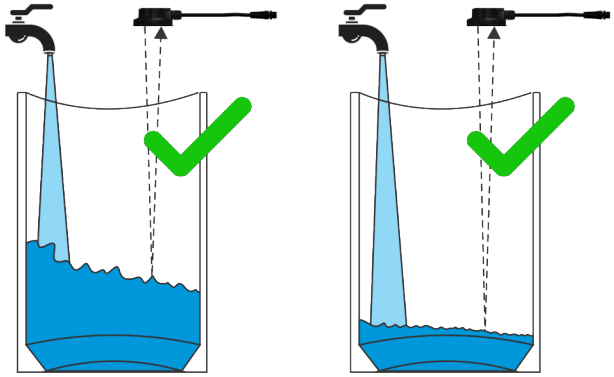


Figure 11 – Installation position

4.2.2 INSTALLATION EXAMPLES

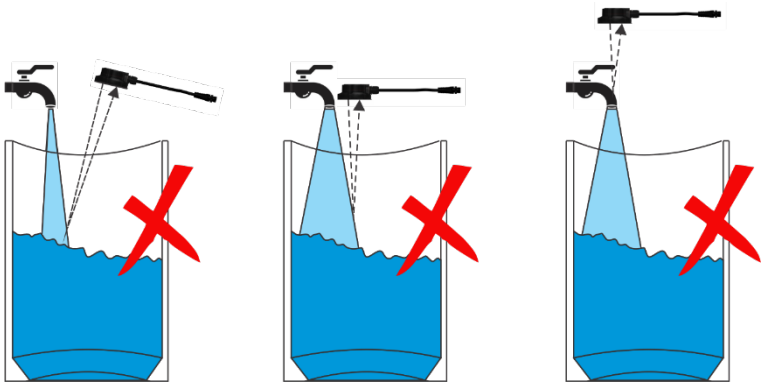
The figures below show examples of how to position the equipment, according to the environment where it will be installed and considering the application:



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

Figure 12 – Installation examples

The figures below show examples of situations to be avoided during the installation process:



- **Do not** install the equipment sideways or with the laser pointing into the area where the liquid or solid will be poured into the reservoir.
- **Do not** install the equipment over a faucet, which will completely block the laser.

Improper application will block the equipment from measuring the area to be monitored as intended. **For this reason, you must always ensure that it is positioned perfectly perpendicular to the surface**.

Figure 13 – Examples of improper installations

TL400-I is not recommended for applications in environments with direct sunlight. In such cases, measurement may be affected.

5 DEFINITIONS

This chapter presents definitions of terms to be considered throughout the manual.

5.1 TECHNICAL TERMINOLOGY

TL400-I uses a few specific terms, such as ullage, level, distance, and height, which can be analyzed below:

- **Ullage:** Term used to describe the difference between the height of the tank and the surface of the liquid or solid.
- **Level:** Term used to describe the height of the liquid or solid when compared to the bottom of the tank.
- **Distance:** Term used to describe to the height between the surface of the liquid or solid and **TL400-I** (Offset = 0).
- **Tank Heigh:** Term used to describe the total tank height.
- **Installation Offset:** Term used to describe the difference between the height where **TL400-I** was installed and the maximum tank height. The value must be inserted in the configured unit of measure. You must define an installation Offset when the maximum tank height and the height at which **TL400-I** is installed are not the same.
- **Full Tank (URV):** Term that corresponds to the height of the tank at which the analog output will show a maximum value.
- **Empty Tank (LRV):** Term that corresponds to the height of the tank at which the analog output will show a minimum value.

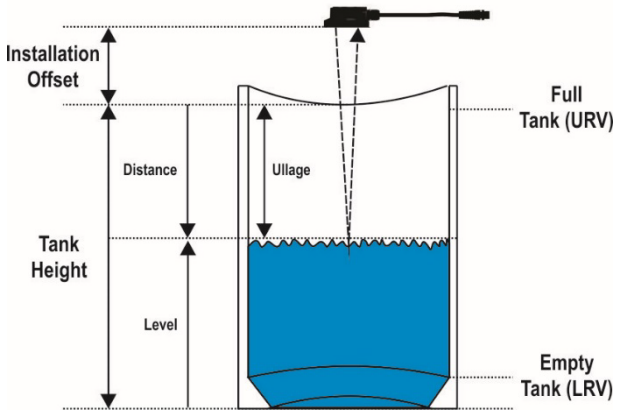
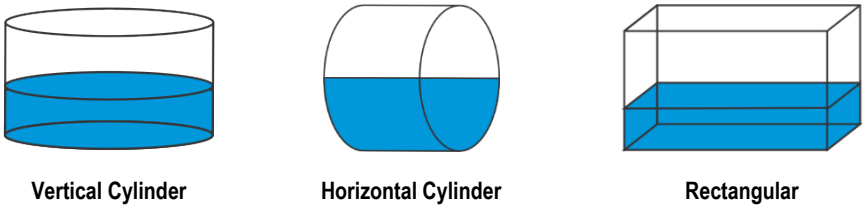


Figure 14 – Example

5.2 SOME TYPES OF TANKS

TL400-I can be used with several types of tanks, as shown in the examples below:



Vertical Cylinder **Horizontal Cylinder** **Rectangular**

Figure 15 – Types of tanks

If the options do not fit the type of tank being used, **TL400-I** also allows you to create custom tanks. This feature is useful for tanks that are shaped with curves, rises, and other irregularities.

When you select this option, you will need to perform a linearization at specific points on the tank. Up to 20 linearization points are allowed. The data configured in these parameters will always be in centimeters.

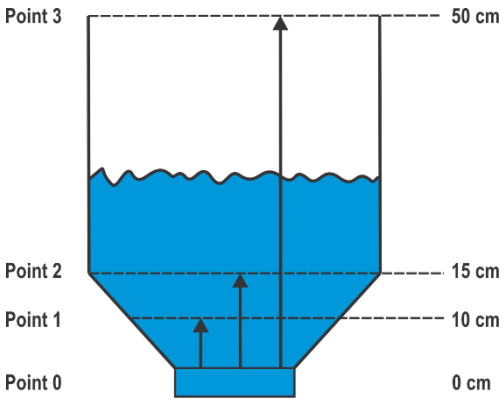


Figure 16 – Example of a customized tank

6 SIGNOW APP

SigNow app is the ideal tool to use your **TL400-I** on a daily basis. Available for Android and iOS smartphones, it allows you to configure or perform diagnostics on the equipment. Connection to the equipment can be made via the Bluetooth interface.

SigNow can be downloaded for free from *Google Play Store* or *App Store*.

If your smartphone does not support BLE technology, has an Android version lower than 9 or an iOS version lower than 12, the application will not be available for download.

This manual provides basic information about configuring your **TL400-I**. For more information about **SigNow** features, see the specific manual.

6.1 BLUETOOTH INTERFACE

TL400-I has a Bluetooth Low Energy (BLE) interface, compatible with smartphones that have Bluetooth modules with version 4.0 or higher.

The Bluetooth interface allows you to configure the equipment through the **SigNow**.

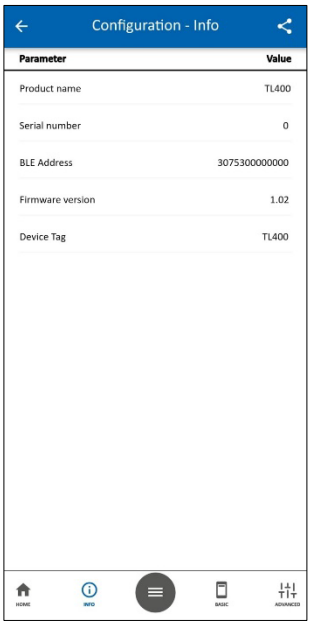
6.2 PAIRING TL400-I WITH YOUR SMARTPHONE

Once the **SigNow** app has been installed, you must enable the Bluetooth interface of your smartphone to connect to the **TL400-I**. After that, simply open the app and follow the steps below:

1. Click on the **Configuration** button.

2. Click on the **TL400-I** icon.

3. Wait for the connection process to finish.



4. Okay, that is it. **SigNow** will display the equipment configuration screens.

6.3 CONFIGURING YOUR TL400-I

6.3.1 INFORMATION

Upon successfully completing the pairing process between smartphone and device, **SigNow** will display the configuration screens. The **Information** screen is the first one:

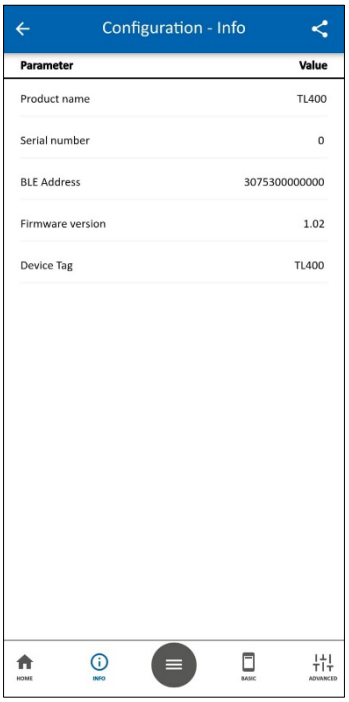


Figure 17 – Configuration: Info

The **Info** section of the **Configuration** screen presents information such as serial number, firmware version, BLE address and device tag, which can be set in the **Device Tag** parameter of the **Basic** section.

None of this information is editable.

By clicking the **Home** button, you will be redirected to the **SigNow** home page.

By clicking the button, **SigNow** will display a set of buttons, as shown in the figure below.

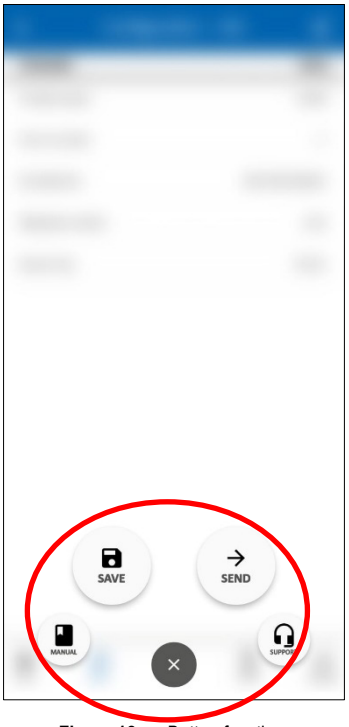


Figure 18 – Button functions

By clicking the **Manual** button, you will be redirected to the online manual for the equipment.

By clicking the **Support** button, you will be redirected to **NOVUS** Technical Support page.

The **Send** button allows you to send the settings to the equipment.

The **Save** button allows you to save these configurations in a file with a .sigc extension, which can be used later by clicking the **Open Configuration** button on **SigNow**.

6.3.2 BASIC CONFIGURATION

By clicking the **Basic** button, **SigNow** will display parameters regarding the basic configuration of the equipment:

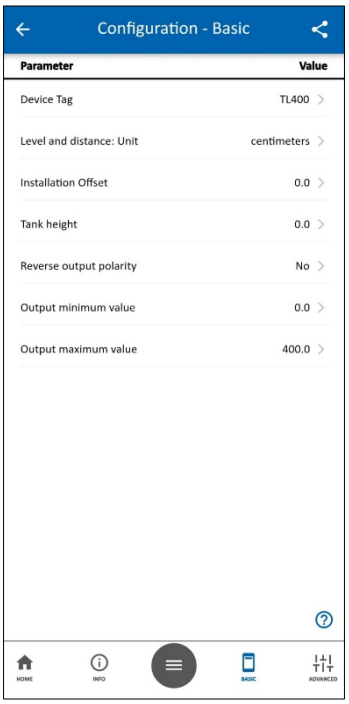


Figure 19 – Basic configuration

By default, the equipment is already configured with the magnitude **Level** (the magnitude can be changed in the **Input** subsection of the **Advanced** section, as will be shown later), which allows you to configure the following parameters:

- **Device Tag:** Allows you to define a tag with up to 20 characters for the equipment.
- **Level and distance: Unit:** Allows you to define the unit of measurement to be used (meters, centimeters, millimeters, inches, feet).
- **Installation Offset:** Allows you to define the installation Offset.
- **Tank heigh:** Allows you to define the height of the tank to be used.
- **Reverse output polarity:** Allows you to invert the output polarity.
- **Output minimum value:** Allows you to define a minimum level value.
- **Output maximum value:** Allows you to define a maximum level value.

6.3.3 ADVANCED CONFIGURATION

By clicking the **Advanced** button, **SigNow** will display sections regarding the advanced configuration of the equipment:

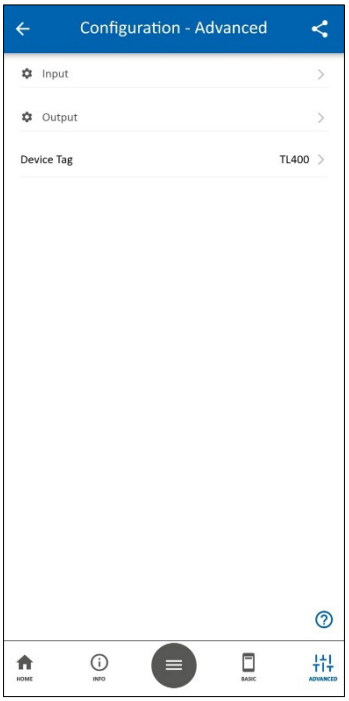


Figure 20 – Advanced configuration

Here you can select the parameter group to be configured: **Input** or **Output**. You can also change the equipment tag.

6.3.3.1 INPUT

By clicking the **Input** button, **SigNow** will display sections regarding the input settings of the equipment:

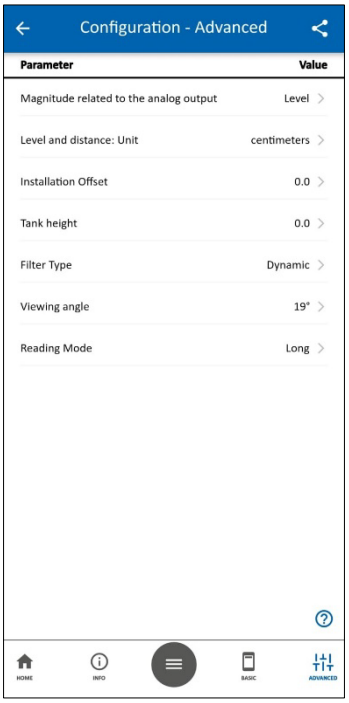


Figure 21 – Input advanced configurations

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

- **Level and distance: Unit:** Allows you to define the unit of measurement to be used (meters, centimeters, millimeters, inches, feet).
- **Installation Offset:** Allows you to define the installation Offset.
- **Tank heigh:** Allows you to define the height of the tank to be used.
- **Filter type:** Allows you to define the type of filter to be used.
- **Viewing angle:** Allows you to define the viewing angle of the equipment: 15°, 17°, 19°, 21°, 24°, or 27°.
- **Reading mode:** Allows you to set the measurement mode: 1 − SHORT (for distances shorter than 1 meter), 2 − MEDIUM (for distances up to 3 meters) or 3 − LONG (for distances up to 4 meters). LONG mode is the most recommended mode for most applications.

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

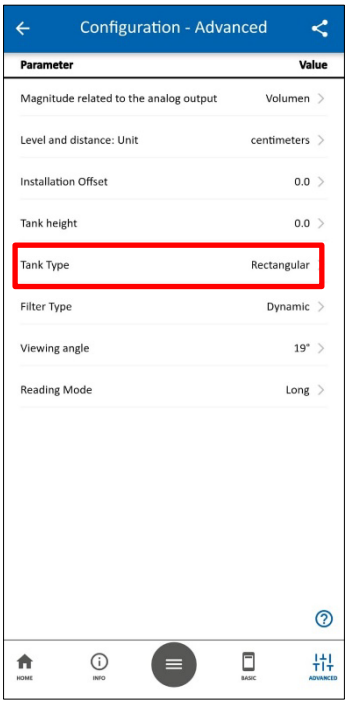


Figure 22 – Volume advanced configurations

When configuring the parameter **Magnitude related to the analog output** with the **Volume** option, in addition to the parameters shown in the previous figure, you can also change the parameter **Tank Type** (Vertical cylinder, Horizontal cylinder, Rectangular, or Custom).

According to the tank type selected, **SigNow** will present configurable parameters to determine the size and measurement of the tank to be used.

If none of the standard tank types suits your needs, you can select the **Custom** option.

Here, you can add calibration points for the tank. You can set up to 20 linearization points by adding the desired values.

The custom tank type can be useful for tanks that are shaped with curves, rises, or other irregularities.

When configured to **Custom**, the calibrated points should go from the greatest distance to the smallest distance (smallest volume to greatest volume), as shown in the example below:

POINT	DISTANCE	VOLUME (%)
1	200	0
2	75	50
3	20	100

Table 1 – Calibration points

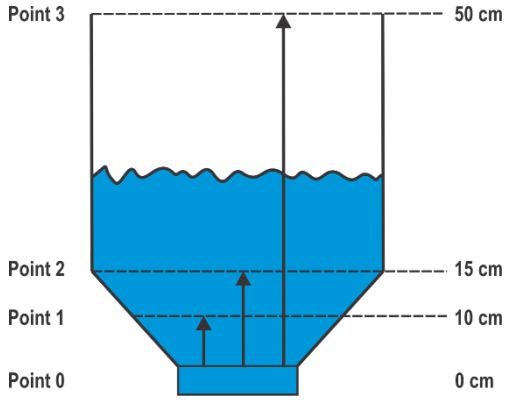


Figure 23 – Example of calibration points in an irregular tank

The figure at the side exemplifies the calibration points in a tank with an irregular form.

6.3.3.2 OUTPUT

By clicking the **Output** button, **SigNow** will display sections regarding the output settings of the equipment:

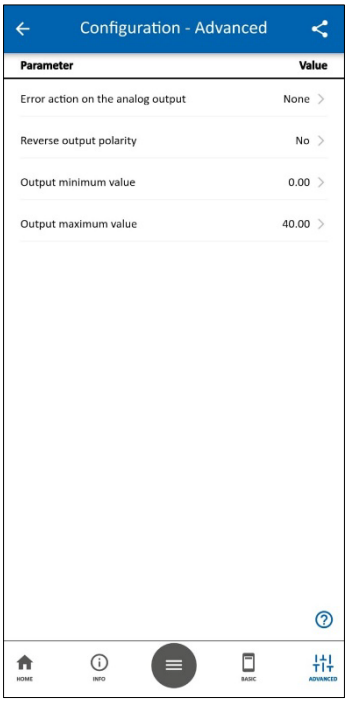


Figure 24 – Output advanced configurations

The parameter **Error action on analog output** allows you to configure the error action of an equipment with 4-20 mA output. This parameter has the following options:

- Low (4 mA)
- High (20 mA)
- None
- Low/High (4 mA / 20 mA)

In addition, you can set a minimum value and a maximum value for the output.

6.4 DIAGNOSTIC

By clicking the **Diagnostics** button on the **SigNow** home screen, the app displays information about the connected equipment:

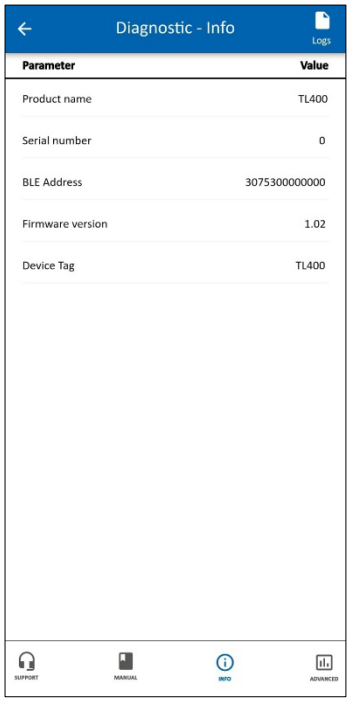


Figure 25 – Diagnostic – Info

The **Info** section of the **Diagnostics** screen presents information such as serial number, firmware version, BLE address and device tag, which can be set in the **Configuration** section.

None of this information is editable.

By clicking the **Manual** button, you will be redirected to the online manual for the equipment.

By clicking the **Support** button, you will be redirected to **NOVUS** Technical Support page.

The **Advanced** button is in the lower right corner of the **Info** screen. By clicking on this button, you can access the advanced diagnostic settings, which allow you to force values to check the correct operation of the equipment and evaluate the settings applied to it.

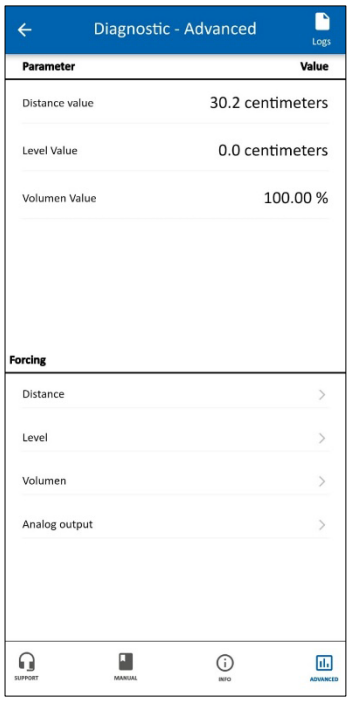


Figure 26 – Diagnostic – Advanced

The **Advanced** section of the **Diagnostics** screen allows you to:

1) In the first part of the screen, you can see the current values of the equipment, according to the configuration.
2) In the second part of the screen, in the **Forcing** subsection, you can force specific values by selecting any of the four available options:
   - **Distance:** This parameter allows you to force a distance value for the equipment.
   - **Level:** This parameter allows you to force a level value for the equipment.
   - **Volume:** This parameter allows you to force a volume value for the equipment.
   - **Analog Output:** This parameter allows you to force the analog voltage output.

In either case, the output **must be enabled** to force test values.

By selecting one of the forcing options in the section above, you will be redirected to the appropriate screen, where you can set specific values for each parameter:

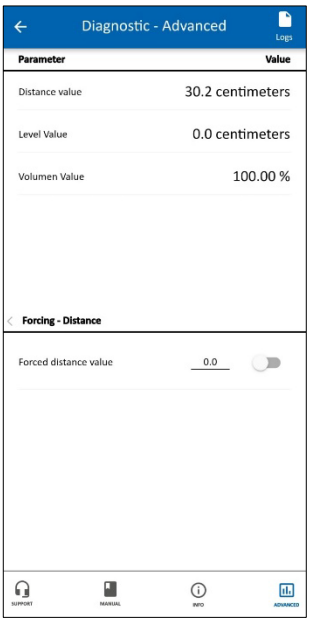


Figure 27 – Forcing: Distance

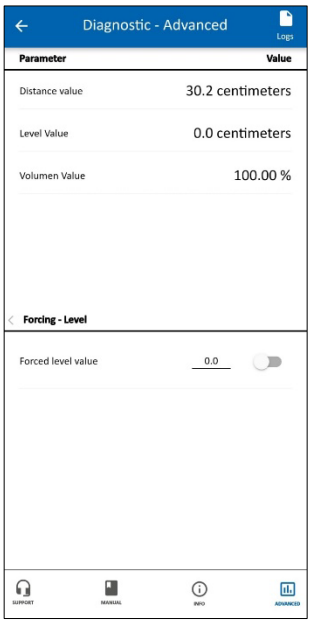


Figure 28 – Forcing: Level

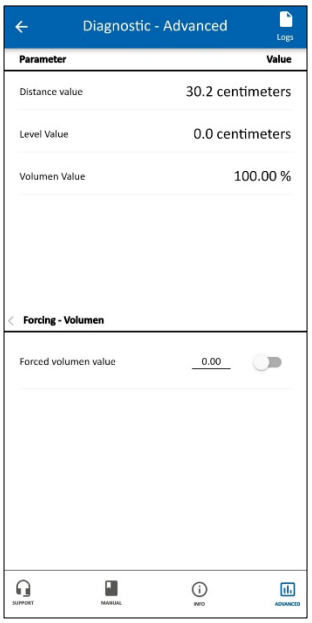


Figure 29 – Forcing: Volumen

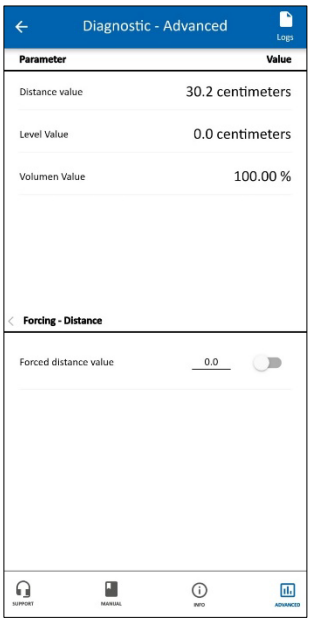


Figure 30 – Forcing: Analog Output

6.5 FIRMWARE UPDATE

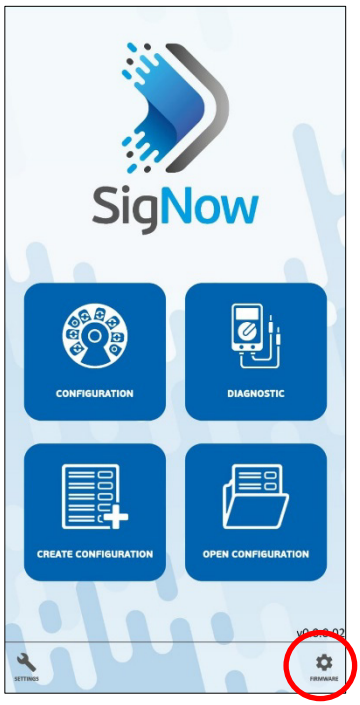


Figure 31 – Firmware update

Figure 32 – Pairing the equipment

To update the firmware, you must click on the **Firmware** button, located at the bottom of **SigNow** home screen.

After that, you must select the equipment to be used and perform the pairing process.

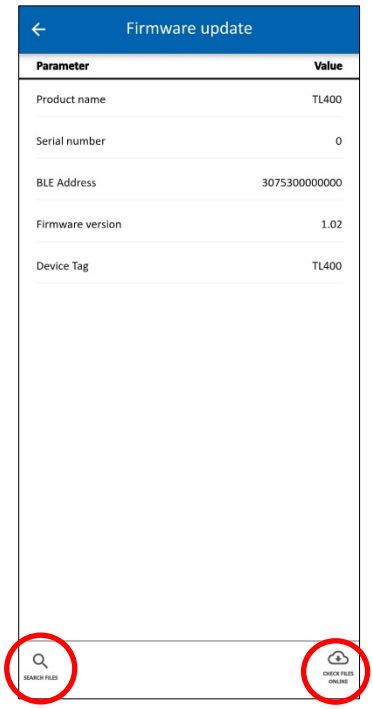


Figure 33 – Selecting a file

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.

7 TECHNICAL SPECIFICATIONS

FEATURES	TL400-I
Dimensions	241.7 x 66 x 31 mm
Distance Measurement	Configurable from 0 to 4000 mm.
Resolution	0.1 % F.S. up to 2 meters and 1 % up to 4 meters.
Sampling	1 Hz
Connector	M12 with 4 pins (Vcc, GND, ASi+, Asi-).
Output	0.5 – 4.5 Vdc with 1 mV resolution.
Assembly	Standard SAE 5 holes or adapter for standard 4 holes.
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
Protection Index	IP68
Housing	Polycarbonate
Configuration Application	SigNow (for smartphones)
Certifications	CE, FCC, Anatel (13883-22-07089), UKCA, LASER CLASS 1

Table 2 – Technical specifications

7.1 CERTIFICATIONS

FCC

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

RF Exposure: 20 cm shall be maintained between the antenna and users, and the transmitter module may not be co-located with any other transmitter or antenna.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

CE MARK / UKCA

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.

ANATEL

This device is homologated by ANATEL, according to the regulated procedures for conformity assessment of telecommunications products, and meets the technical requirements applied.

This equipment is not subject to the protection from harmful interference and may not cause interference with duly authorized systems.

For more information, see the ANATEL website www.anatel.gov.br.

8 WARRANTY

Warranty conditions are available on our website www.novusautomation.com/warranty.