

Manual for
WILSEN.sonic.level
WS-UCC*-F406-B15-B41*

Manual



With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

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1 Introduction

1.1 Content of this Document

This document contains information required to use the product in the relevant phases of the product life cycle. This may include information on the following:

- Product identification
- Delivery, transport, and storage
- Mounting and installation
- Commissioning and operation
- Maintenance and repair
- Troubleshooting
- Dismounting
- Disposal



Note

For full information on the product, refer to the further documentation on the Internet at www.pepperl-fuchs.com.

The documentation comprises the following parts:

- This document
- Datasheet

In addition, the documentation may comprise the following parts, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Instruction manual
- Other documents

1.2 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismounting of the product. The personnel must have read and understood the instruction manual and the further documentation.

Prior to using the product make yourself familiar with it. Read the document carefully.

1.3 Symbols Used

This document contains symbols for the identification of warning messages and of informative messages.

Warning Messages

You will find warning messages, whenever dangers may arise from your actions. It is mandatory that you observe these warning messages for your personal safety and in order to avoid property damage.

Depending on the risk level, the warning messages are displayed in descending order as follows:



Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.



Warning!

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.



Caution!

This symbol indicates a possible fault.

Non-observance could interrupt the device and any connected systems and plants, or result in their complete failure.

Informative Symbols



Note

This symbol brings important information to your attention.



Action

This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

1.4 Intended Use

The WILSEN.sonic.level wireless ultrasonic sensor is used to remotely monitor fill levels in containers, tanks, and silos. It is part of Pepperl+Fuchs' WILSEN (wireless sensor) IoT sensor product family, which wirelessly transmits data directly to the internet.

The sensor allows fill level to be continuously measured and sent in regular intervals to the internet via a wireless interface. The frequency of measurements and data transfer can be parameterized via Bluetooth using an app for mobile devices.

The wireless sensor also features a GPS geolocation function. Temperature and battery control functions are used to monitor the status of the sensor.



Note

The device must not be used in explosion-hazardous areas.

Only use recommended original accessories.

1.5 General Safety Information

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismantling lies with the plant operator.

Installation and commissioning of all devices may be performed only by trained and qualified personnel.

It is dangerous for the user to carry out modifications and/or repairs and doing so will void the warranty and exclude the manufacturer from any liability. In the event of any serious errors, stop using the device. Secure the device against unintended operation. To have the device repaired, return it to your local Pepperl+Fuchs representative or your sales center.



Warning!

Risk of fire due to improper use.

Damaged or defective lithium-ion batteries are a major fire hazard. Ensure that the battery is protected from mechanical damage, short circuits, and excessive heat load during servicing and while the wireless ultrasonic sensor is being operated. The permissible ambient temperatures from -25 °C to +70 °C and the permissible storage temperatures from -40 °C to +85 °C must always be observed. The device enclosure and ultrasonic sensor enclosure comply with flammability class V-0(AO) according to IEC 60695-11-10 and therefore must not be operated in areas with an automatic extinguishing system. Devices with damaged batteries must be removed immediately, taken out of operation, and stored safely in accordance with local fire prevention regulations.



Caution!

Risk of unauthorized sensor access due to unprotected access data.

To use and operate the WILSEN.sonic.level wireless ultrasonic sensor safely, access data such as passwords and the application key must be protected. The plant operator is responsible for protecting this data; the operator must document the access data, protect it from unauthorized access, and keep it safe.



Note

Disposal

Electronic waste is hazardous. When disposing of the equipment, observe the current statutory requirements in the respective country of use, as well as local regulations.

1.6 Declaration of Conformity

This product was developed and manufactured in line with the applicable European standards and directives.



Note

A declaration of conformity can be requested from the manufacturer.

The product manufacturer, Pepperl+Fuchs Group, 68307 Mannheim, Germany, has a certified quality assurance system that conforms to ISO 9001.



2 System Description

The WILSEN.sonic.level wireless ultrasonic sensor is used to remotely monitor fill levels in containers, tanks, and silos. It is part of Pepperl+Fuchs' WILSEN (wireless sensor) IoT sensor product family, which wirelessly transmits data directly to the internet.

The sensor allows fill level to be continuously measured and sent in regular intervals to the internet via a wireless interface. The frequency of measurements and data transfer can be parameterized via Bluetooth using an app for mobile devices.

To transfer the measurement data, you must integrate the IoT sensors with LoRaWAN interface into a LoRaWAN network. This requires additional system components such as a LoRa gateway and LoRa network server (LNS).

The following figure illustrates the topology of integrating a WILSEN.sonic.level wireless ultrasonic sensor into a LoRaWAN network.

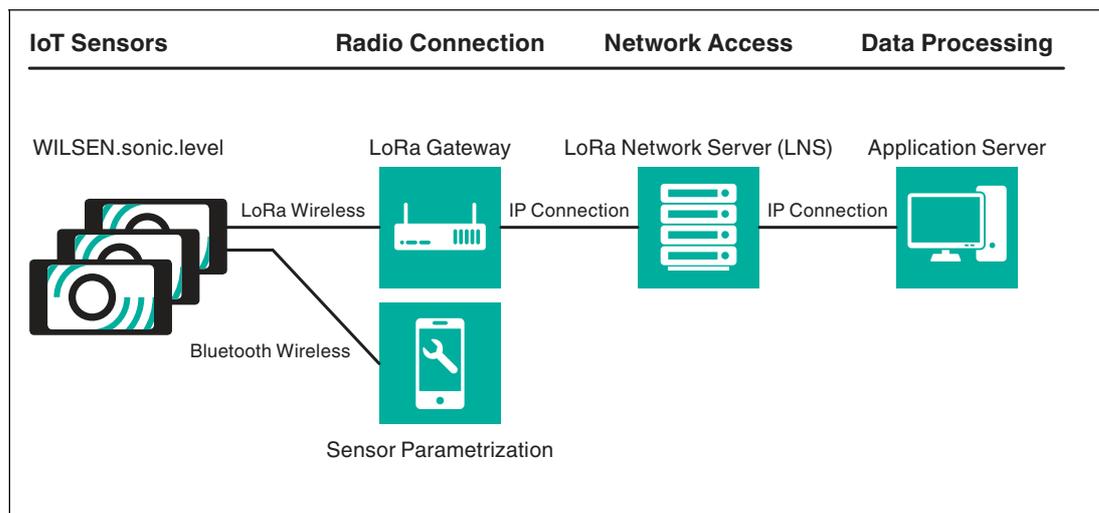


Figure 2.1



Note

You can find further information on the LoRaWAN standard at:

<https://lora-alliance.org>

3 Integration into a LoRa Network

The WILSEN.sonic.level wireless ultrasonic sensor sends the cyclically transmitted measurement data in the standardized LoRaWAN protocol via a radio interface. To do this, the sensor must be logged into a corresponding LoRaWAN network. The sensor can log into a network once it has been registered with the LoRa network server.

The following figure illustrates the topology of integrating a WILSEN.sonic.level wireless ultrasonic sensor into a LoRaWAN network.

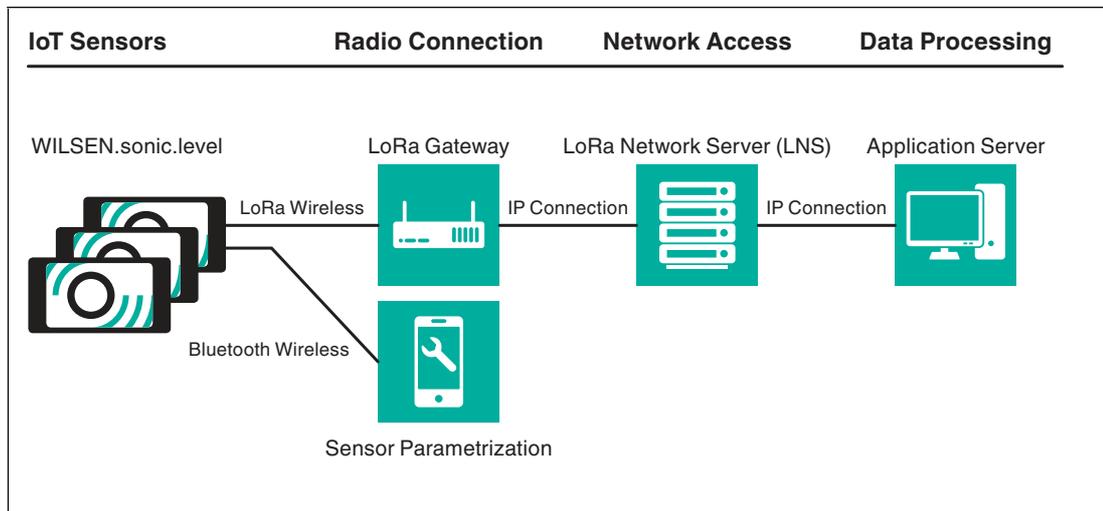


Figure 3.1

LoRa Wireless Connection

The measurement data collected by the sensor is transmitted to the LoRaWAN network at regular time intervals in the format of an encrypted hexadecimal value chain (payload). This payload is received by one or more gateways and translated into the internet protocol (IP format). The translated payload is transmitted from the gateway to the LoRa network server via a cable Ethernet line or a wireless connection.

LoRa Network Server and Application Server

The LoRa network server (LNS) filters the incoming data packets, assigns them to the corresponding sensors, and forwards them to an application server. The application server decrypts the data packets and saves the sensor data contained in them. The data can be retrieved and displayed from the application server memory at a later time by the processing software application of the data user.

Registering the Sensor with a LoRa Network Server

To register the WILSEN.sonic.level with a LoRa network server, a customer account with the corresponding software service is required. Services usually make their registration procedure available in dialog form. Familiarize yourself with the details of your network server.

Note

In a separate document, Pepperl+Fuchs describes the procedure for registering a WILSEN.sonic.level using the example of registering with "The Things Network (TTN)" community network.

You can download the document online from the product detail page for the respective WS-UCC*-F406-B15-B41-* wireless ultrasonic sensor at www.pepperl-fuchs.com.

The objective of the registration procedure is to exchange software keys, which contain the unique device authentication and an encryption of the sensor data to be transmitted (measurement data).

Device Authentication

When using LoRaWAN, the device is uniquely identified via the **Device EUI**. This is provided by the device manufacturer and transferred to the LoRa network server (LNS).

With the WILSEN.sonic.level, you will find this 16-digit number in hexadecimal format by connecting to the device using the WILSENcontrol app. (See chapter 4.2 or the brief commissioning instructions supplied with the device). The device-specific **Device EUI** is displayed under the "LORA PARAMETERS" tab of the app.

To structure the system, some LNS services still use a 16-digit **Application EUI** as another identification feature.

For more information, familiarize yourself with the details in the description provided by your LNS provider. If an Application EUI is provided by the LNS, you must enter it in the **Application EUI** field in the WILSENcontrol app (See chapter 6.3).

Encryption of Telemetry Data

With LoRaWAN, sensor data is always transmitted from the sensor to the application server in an encrypted format. The AES128 standard is used for this end-to-end encryption.

WILSEN.sonic.level uses the 32-digit application key to encrypt the measurement data to be transmitted. Select the over-the-air activation (OTAA) registration procedure for your LoRa network server. The network server will usually provide you with an application key.

This must be transferred to the sensor using the WILSENcontrol app. (See chapter 6.3).

Once the registration information has been exchanged between WILSEN.sonic.level and the LoRaWAN network server or application server, the data transfer can be started. For this to happen, the sensor's Bluetooth connection to the mobile device must be disconnected.

If the sensor is within the detection range of a LoRa gateway and is connected to this gateway, the sensor immediately starts to contact the LoRa network server.

See chapter 6 "Parameterization/Information with the WILSENcontrol App" for setting the transmission intervals using the WILSENcontrol app.

Payload

The regularly measured sensor data is transmitted to the LoRa network server on the internet at adjustable transmission intervals. The structure of this data is referred to as a payload.

The payload of a transmission packet is a string of up to 51 bytes of hexadecimal numbers—the contents of which must be interpreted on the receiving side using a payload decoder. The structure of the payload for the WILSEN.sonic.level is described in an additional document regarding the payload.

LoRa network server providers make available various tools for decoding the payload on the receiving side. Some providers make it very easy to create such a decoder using a form template, e.g., in JavaScript. Other providers offer an input field for a finished piece of program code in JavaScript. Please familiarize yourself with the specific details of the payload decoder of your respective provider.

On its homepage, Pepperl+Fuchs provides a payload decoder for download in JavaScript format. You can open this script using a text editor and copy and paste it into the input field for the payload decoder of the LNS provider.



Note

You can download the payload description and the payload decoder for your WILSEN.sonic.level online from the product detail page for the respective WS-UCC*-F406-B15-B41-* wireless ultrasonic sensor at www.pepperl-fuchs.com. See the Documents and Software areas.

4 Activation and Establishing a Connection

4.1 Activating the Device



Figure 4.1



1. Open the locking mechanism of the enclosure using a screwdriver.
2. Open the enclosure cover.

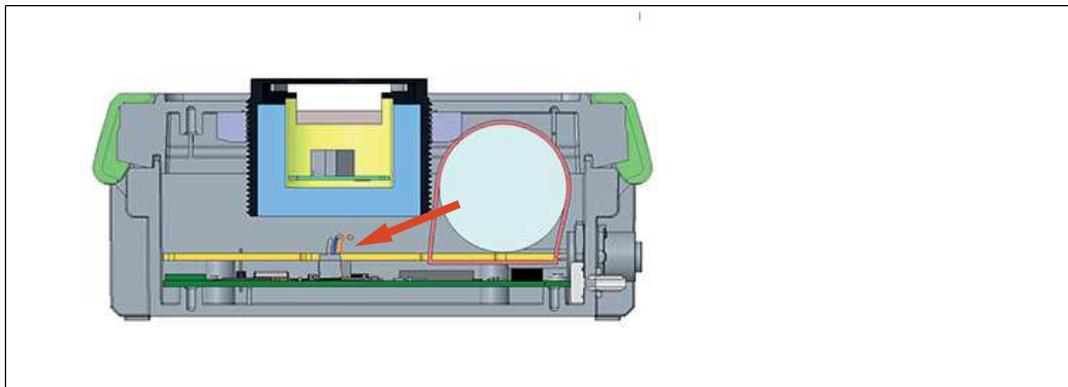


Figure 4.2

3. Plug the battery connection cable on the motherboard into one of the white connectors. Since the cables are connected internally, the plug-in position does not matter.
4. Check that the LED is flashing. This signals that the device is ready for operation and indicates the transmission frequency of the data transmission.



Caution!

Do not clamp the battery cable.

When closing the enclosure cover, take care to ensure that the battery connection cable is completely in the enclosure and is not clamped by the closing edge.

5. Close the enclosure cover and snap the device locking mechanism into place.

4.2 Establishing a Connection to the Device

Prerequisites

A mobile device that meets the following prerequisites is required to connect and subsequently parameterize the device:

- Operating system: Android version 6 or higher
- Minimum Bluetooth version: 4.0 or higher (Bluetooth Low Energy must be supported)
- Bluetooth is enabled on the mobile device
- Location detection is enabled on the mobile device
- Mobile device has an internet connection
- A Google Play account is set up on the mobile device



1. Go to the App Store on your mobile device and search for the Pepperl+Fuchs "WILSENcontrol" app or scan the following QR code.



2. Follow the instructions to download and install the app.



Note

On the mobile device, make sure that Bluetooth and location detection (GPS) are switched on and that the associated app permissions have not been restricted by the user.

3. Open the app by tapping the app icon.



↳ The **WILSEN Control** menu appears.

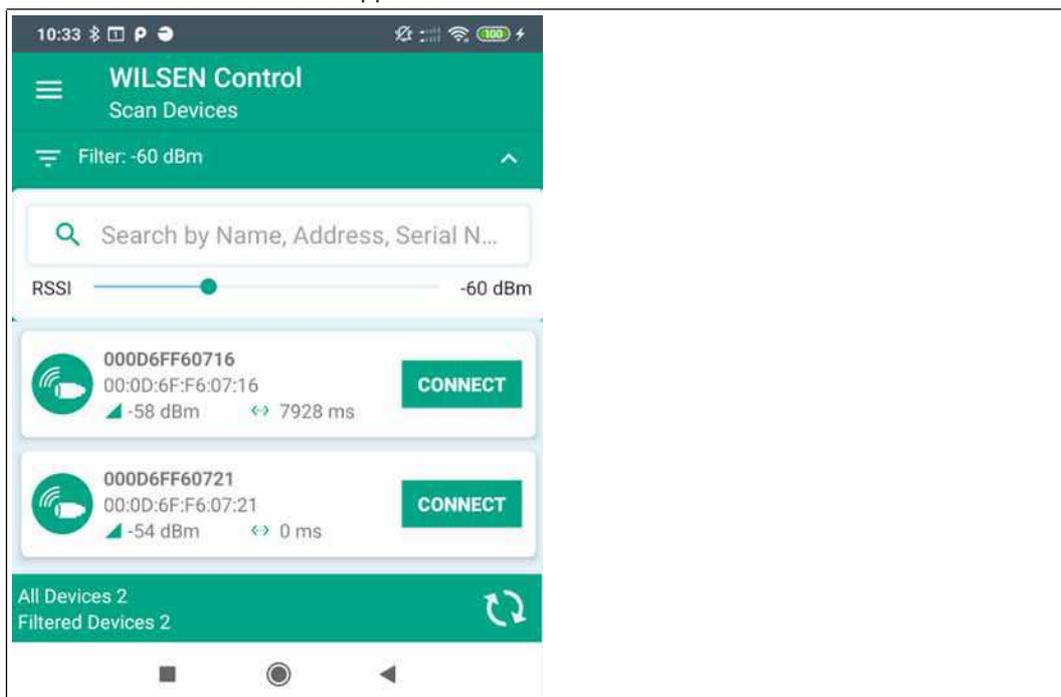


Figure 4.3

4. Tap **CONNECT** to connect the respective device to the app.

↳ By adjusting the signal strength on the RSSI controller, you can exclude remote devices from the list of devices found.

5. Enter the default password `00000000` within 30 seconds when commissioning a new device or enter the valid password for a device that is already known and confirm with **APPLY**.

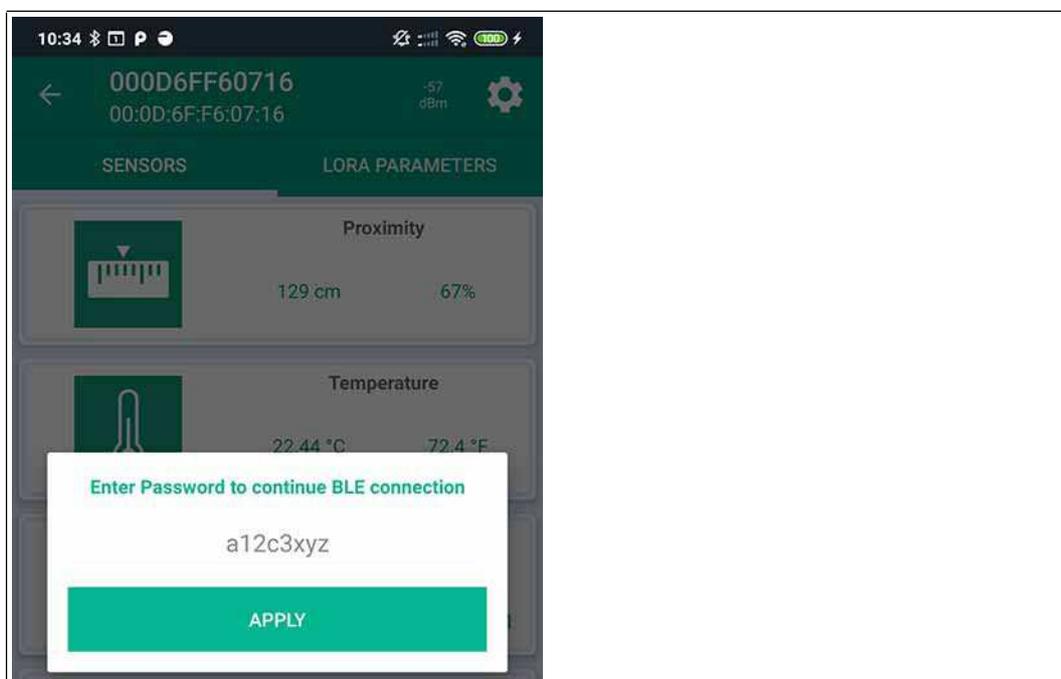


Figure 4.4

↳ The app switches to the **Sensor** menu, which displays current sensor values.

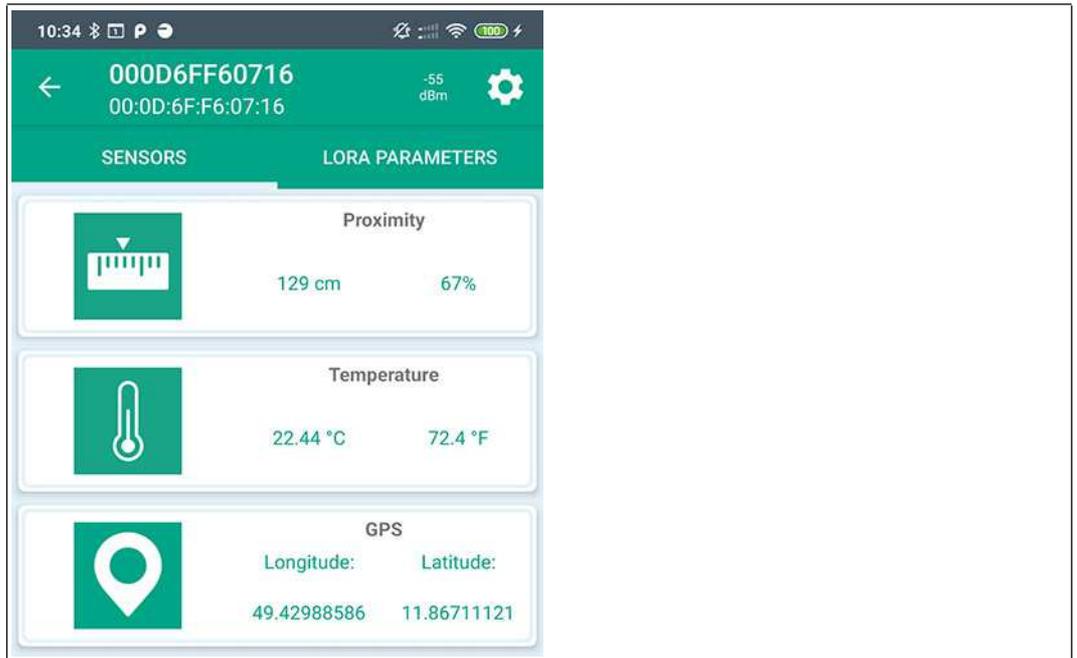


Figure 4.5

You can attach the mounting base to an installation location via the following points:

- Via the front sides using two 9 mm thru-holes with M8 screws and washers.
- Via the underside of the mounting base using the eight M6 threaded holes with a maximum screw-in depth of 7 mm and a tightening torque of ≤ 1 Nm.

6 Parameterization/Information with the WILSENcontrol App

6.1 Menu Structures

The **Sensor** menu is the central overview page for further navigation once the user has been successfully authenticated and Bluetooth has been connected.

The menu displays current device information and contains further submenus that allow parameterization of the device.

The app has the following structure and functions:

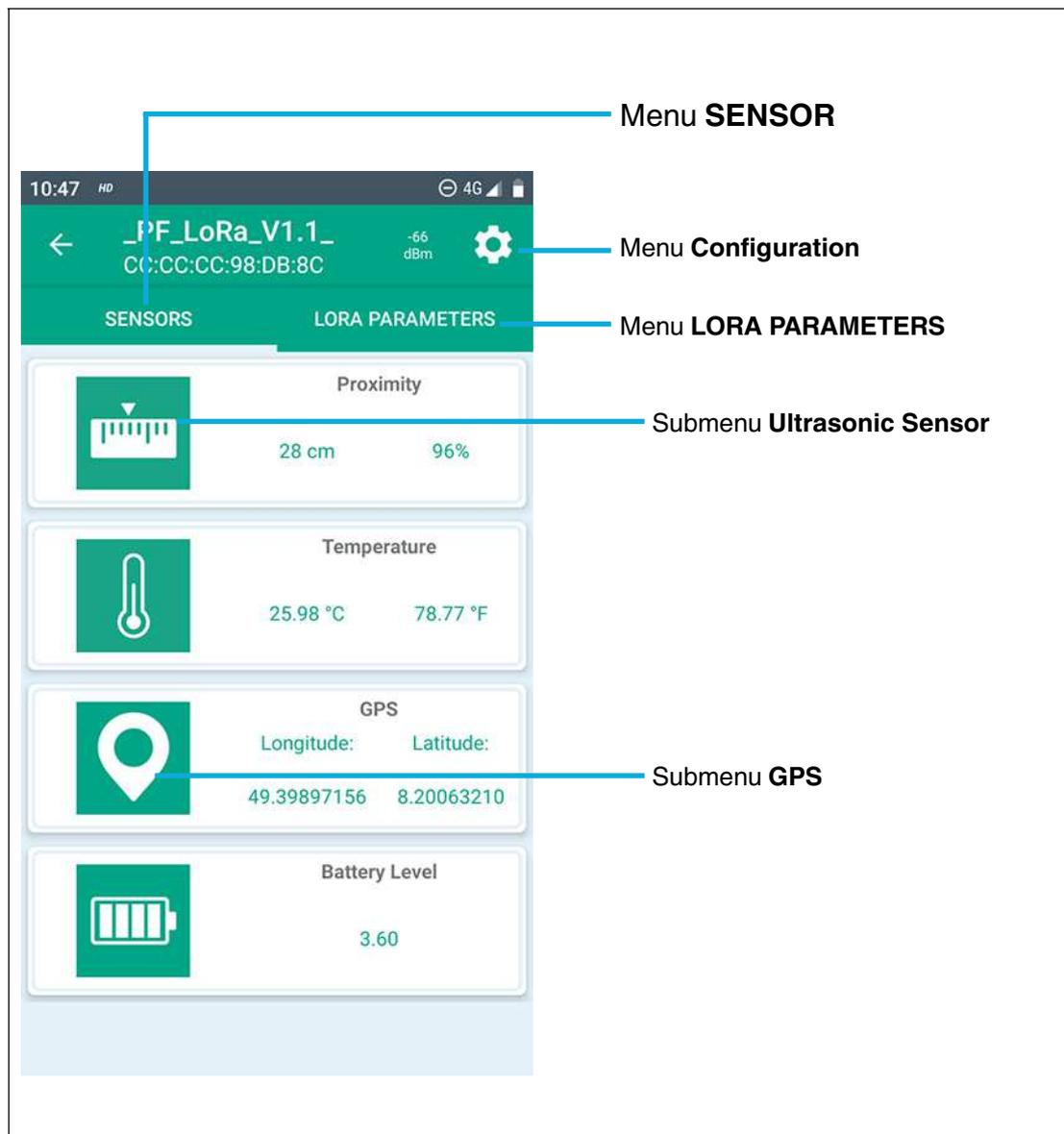


Figure 6.1

Menu	Task/content
SENSOR	Main menu with submenus and displays for the device: <ul style="list-style-type: none"> • Ultrasonic sensor submenu: for setting the ultrasonic measurement parameters such as sound beams (profiles), resolution, minimum and maximum limits for fill-level determination, measurement frequency, etc., and expert mode • GPS submenu: for setting the interval for GPS position determination and wireless transmission to the internet • Displays the proximity measurement from the ultrasonic sensor, device temperature, and battery status
LORA PARAMETERS	For setting the parameters specific to LoRaWAN and the frequency for wirelessly transmitting measurement values to the internet
Configuration	For device system information and password setting

Table 6.1

6.2 Sensor Menu

The **Sensor** menu is used to adjust the settings of the wireless ultrasonic sensor in accordance with the requirements of the application and local conditions. It also displays current device information.

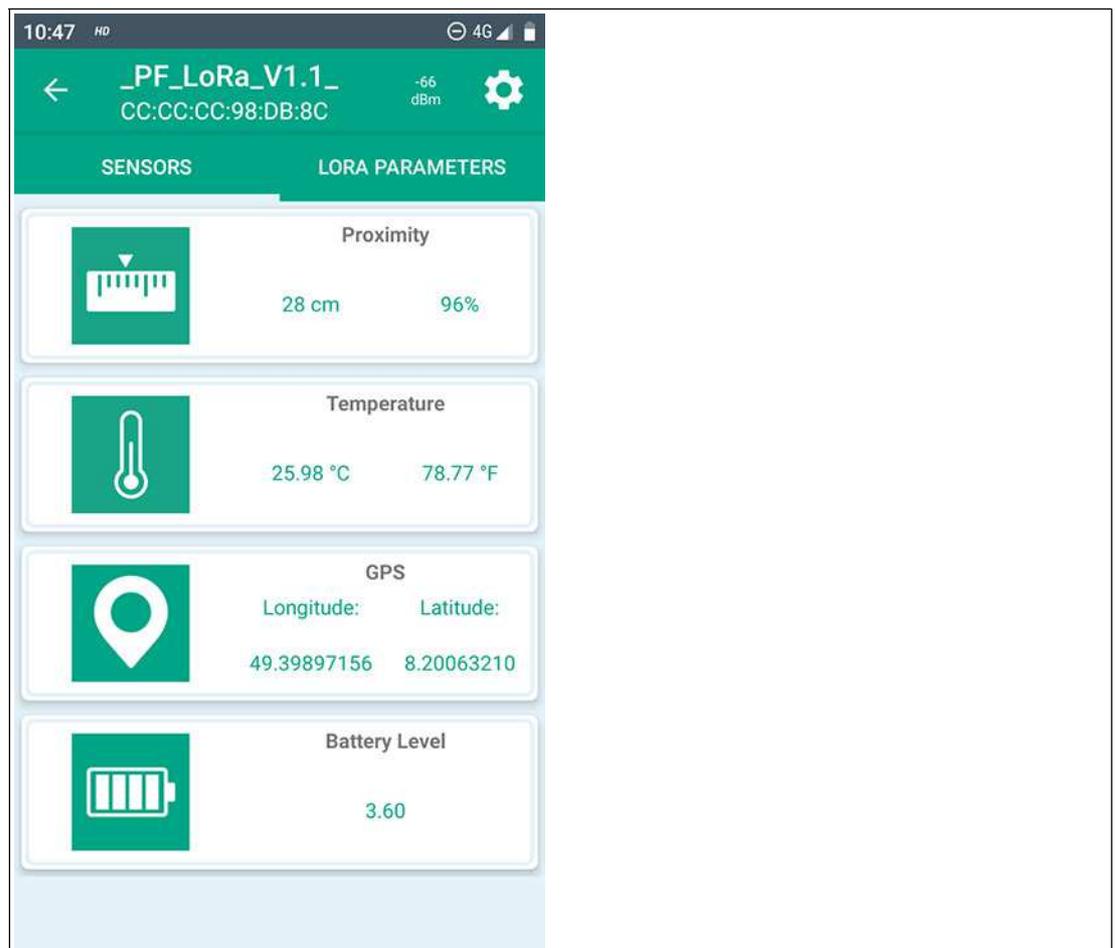


Figure 6.2

Ultrasonic Sensor Submenu

In this submenu, you can set parameters for ultrasonic proximity measurement.

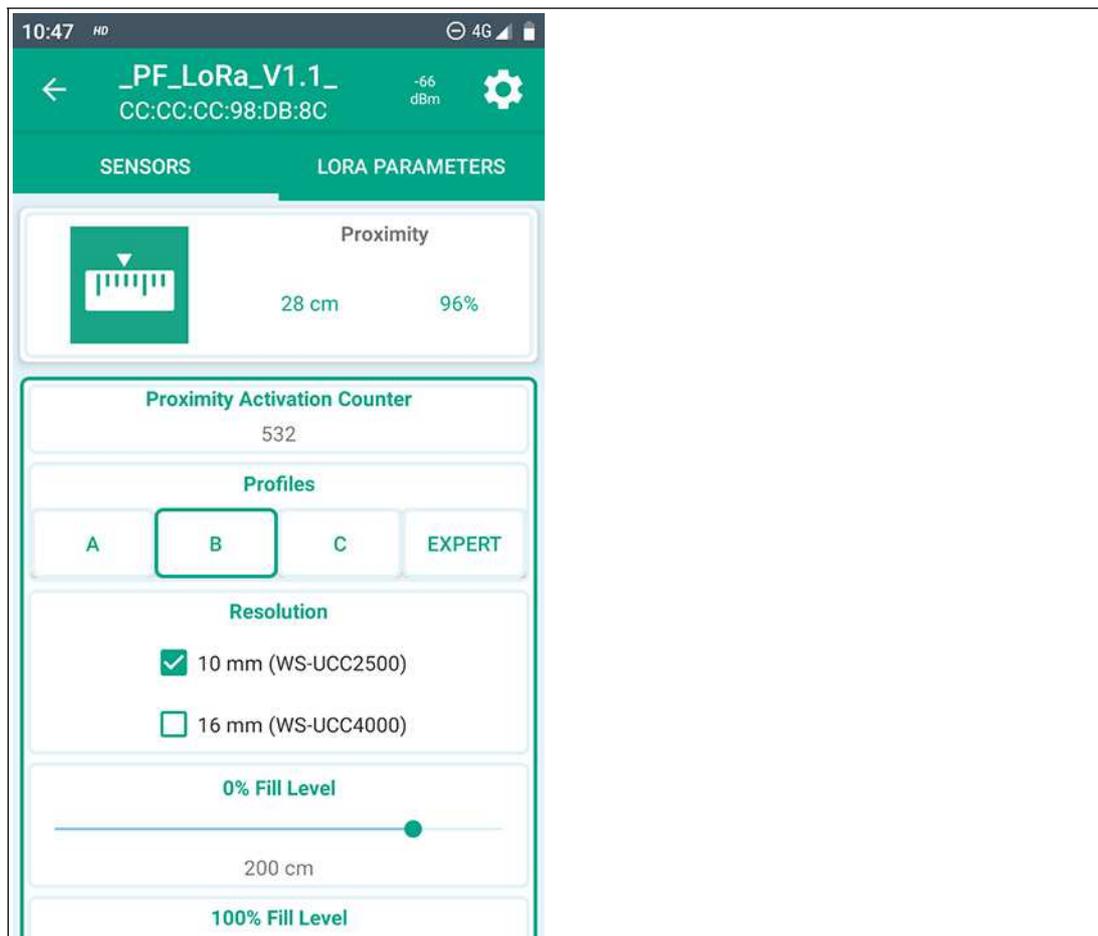


Figure 6.3

Proximity Activation Counter

The display value indicates how many ultrasonic proximity measurements the sensor has taken so far.

Profiles/Sound Beam Width

For quick and easy adjustment, you can choose from measurement profiles A, B, and C to select one of the sound beam widths: wide, medium, and narrow.

Adjusting the sound beam width may be necessary in some cases. For example, if in the application objects can be detected in the boundary area of the sound beam, leading to incorrect data. Note that using a reduced sound beam with materials that do not reflect sound well can result in the fill level no longer being measured reliably over the complete sensing range specified in the datasheet.

Note

Detailed information on the sound beams of your sensor can be found in the corresponding datasheet in the "Characteristic Curve" section.

You can download the datasheet online from the product detail page for the respective WS-UCC*-F406-B15-B41-* wireless ultrasonic sensor at www.pepperl-fuchs.com.



Expert

"Expert" mode allows individual adjustment of the sound beams and other parameters as an alternative to using standard profiles A, B, and C. For settings in this area, we recommend consulting application specialists from Pepperl+Fuchs.

Resolution

The resolution depends on the sensing range of the ultrasonic sensor type. It specifies the minimum increment size of the displayed and output proximity value. Finer resolution of the proximity value is not possible.

Choose the resolution as follows:

- For UCC2500 devices, choose a resolution of 10 mm
- For UCC4000 devices, choose a resolution of 16 mm

**Caution!**

Incorrect settings result in incorrect proximity values.

The specified assignment of the device type and resolution must be set. Otherwise, the sensor will output incorrect proximity values.

0 %/100 % Fill Level

When these two values are set, the fill level of your container is displayed in the form of a corresponding percentage value. The corresponding proximity values for "0 % Fill Level" and "100 % Fill Level" must be specified in cm.

Number of Measurements per Day

This parameter allows you to set how often an ultrasonic proximity measurement is to take place per day.

In some applications, it may be useful to take measurements more frequently than they are transmitted so as to achieve corresponding smoothing and therefore lower fluctuations in the transferred percentage fill-level value.

When adjusting this setting, bear in mind that a high number of measurements per day results in increased power consumption and therefore a shorter battery life.

**Note**

In addition to the "Number of Measurements per Day" parameter, there is the "LoRa Payload Interval" parameter, which allows you to set the frequency at which the measurement values are transmitted via LoRa. (See chapter 6.3).

Only one proximity value is transmitted with each LoRaWAN transmission. The sensor itself does not store proximity measurements for transmission. Therefore, with frequent ultrasonic proximity measurements per day and a lower transmission frequency via LoRaWAN, only the most recently measured proximity value is transferred via the radio interface.

However, with each LoRa transmission, another new measurement is automatically taken beforehand, regardless of the set "Number of Measurements per Day." This ensures that transmitted measurement values are always up to date at the time of transmission.

If you would like to transfer all proximity values recorded by the sensor, you must set the transmission frequency and measurement frequency to the same value. Another option is to control the measurement frequency solely via the transmission frequency setting, since a new measurement is carried out before each transmission, as mentioned above.

"APPLY" Button

Any settings/changes to parameters are only transferred to the sensor once the "APPLY" button has been pressed; they are then saved to the sensor permanently.

GPS Submenu

In this submenu, you can set the frequency of determination of the GPS position and its transmission to the internet in stages.

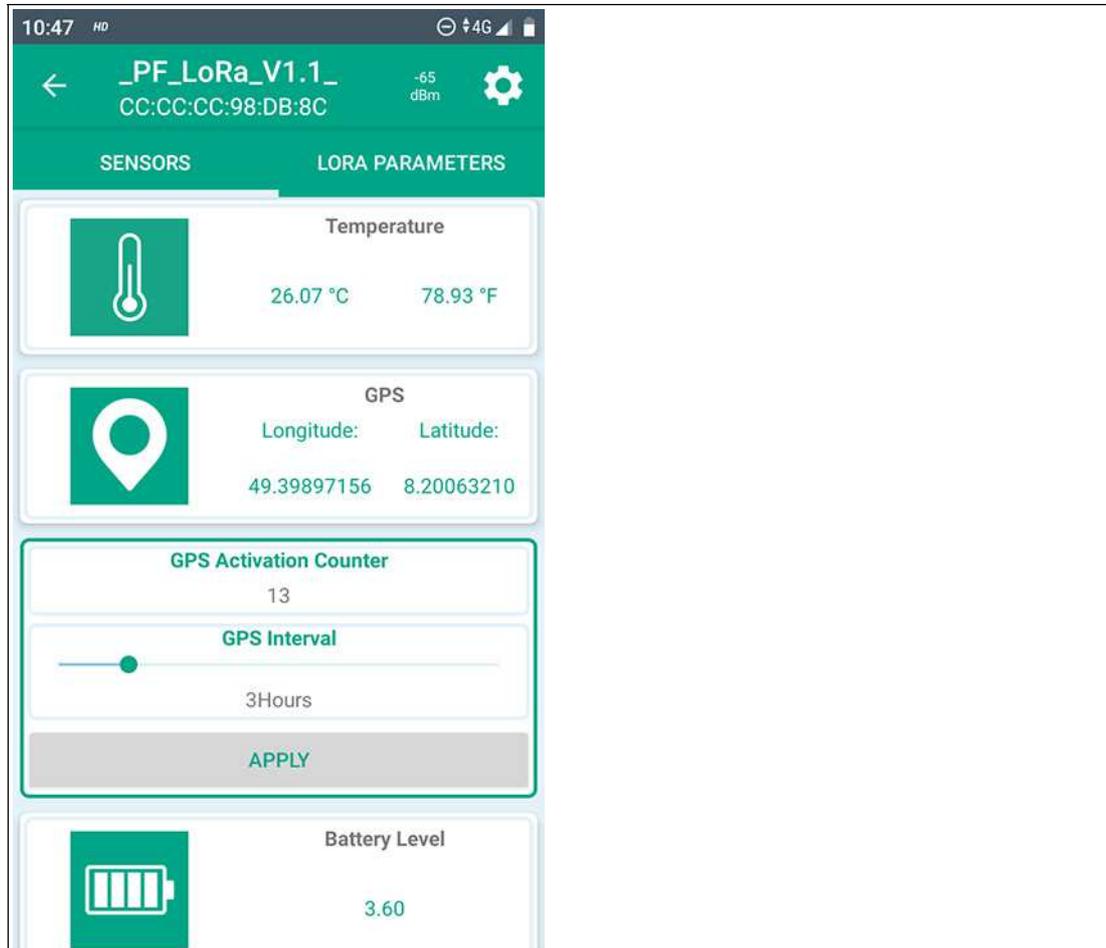


Figure 6.4

GPS Activation Counter

The value displayed here indicates how many GPS position measurements the sensor has taken so far.

GPS Interval

Use this parameter to set whether and how often a GPS position will be determined. When adjusting this setting, bear in mind that taking frequent position measurements results in increased power consumption and therefore a shorter battery life.

Note

When the GPS position detection function is activated, the measurement data is transferred in a longer payload, since the GPS coordinates are also part of the payload. See the "Payload Description" additional document. You can download the payload description and the payload decoder for your WILSEN.sonic.level online from the product detail page for the respective WS-UCC*-F406-B15-B41-* wireless ultrasonic sensor at www.pepperl-fuchs.com. See the Documents and Software areas.

"APPLY" Button

Any settings/changes to parameters are only transferred to the sensor once the "APPLY" button has been pressed; they are then saved to the sensor permanently.



6.3 LORA PARAMETERS Menu

The **LORA PARAMETERS** menu is used to set the wireless connection parameters specific to LoRaWAN and to set the transmission frequency.

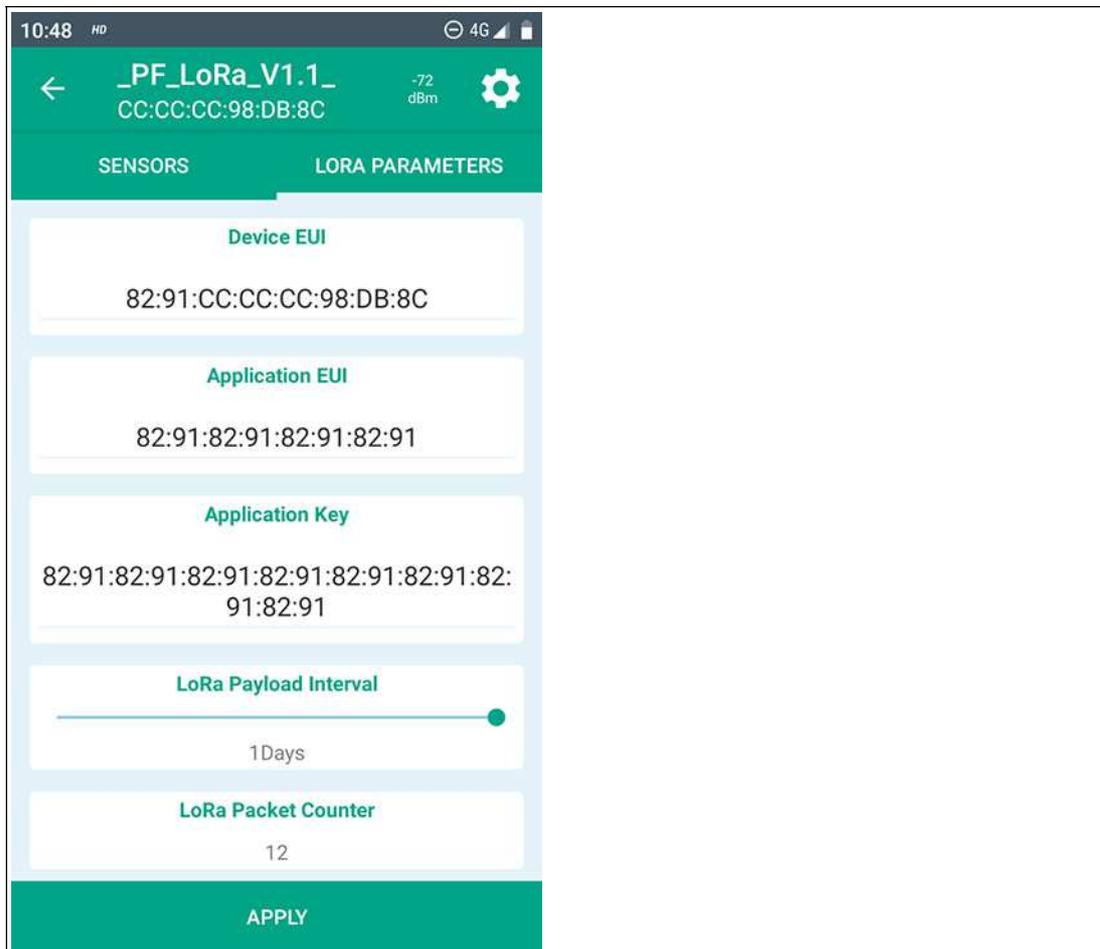


Figure 6.5

Device EUI

The "Device EUI" is a device-specific identifier that identifies the device in the LoRa network. It is similar to the MAC ID of a node in a computer network.

This number corresponds to IEEE specifications with regard to a unique identifier set at the factory.



Caution!

It is not advisable to change the Device EUI.

We strongly recommend that you do not change the Device EUI set at the factory.

However, if you want to change this identifier, make sure that you write down the Device EUI that is assigned at the factory. This is in case you are able to restore this original identifier at a later time. Otherwise, the user cannot recover this information themselves.

Application EUI

The Application EUI is an identifier optionally assigned by the LoRa network server (LNS), the remote station for the sensor in the LoRa network, for the respective application. If available and required, the Application EUI is provided by the LoRa network server (e.g., The Things Network) as part of the "onboarding process." In this case, you will need to enter it for the sensor at this point in the app, otherwise leave the value as "empty" for this parameter.

Application Key

The application key is a key issued by the LoRa network server (LNS) that encrypts the sensor measurement data for transmission. The key generated and provided by the LoRa network server must be entered for the sensor at this point in the app.

LoRa Payload Interval

You can use this parameter to set the frequency at which data should be transmitted via LoRaWAN. When adjusting this setting, bear in mind that frequent LoRa transmission results in increased power consumption and therefore a shorter battery life.

Note

The frequency set via the "LoRa Payload Interval" parameter refers solely to the transmission frequency of sensor measurement values (Payload 1). The transmission frequency of sensor measurement values, including GPS coordinates, (Payload 2) is determined via the "GPS Interval" parameter. The sensor heartbeat (Payload 3) is transmitted at a fixed, non-changeable time interval of "1x per day."

For details, see the "Payload Description" additional document. You can download the payload description for your WILSEN.sonic.level online from the product detail page for the respective WS-UCC*-F406-B15-B41-* wireless ultrasonic sensor at www.pepperl-fuchs.com. See the Documents area

LoRa Packet Counter

The value displayed here indicates how many LoRa packets the sensor has sent so far.

"APPLY" Button

Any settings/changes to parameters are only transferred to the sensor once the "APPLY" button has been pressed; they are then saved to the sensor permanently.



6.4 Configuration Menu

The **Configuration** menu displays device system information, such as the device type, serial number, and firmware and hardware status.

You can deactivate the Bluetooth interface of the sensor, change the device password, and reset the counters here.

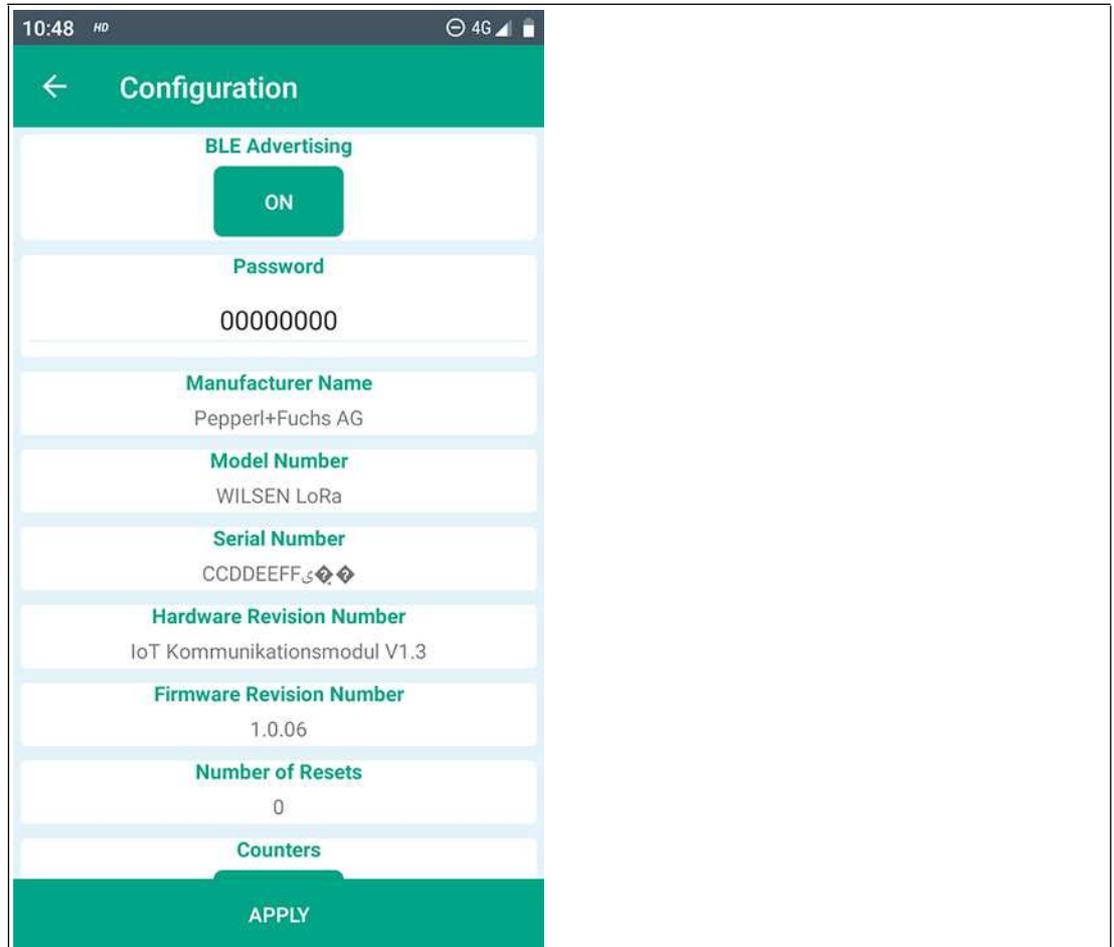


Figure 6.6

BLE Advertising

This button can be used to deactivate the Bluetooth interface of the sensor. This may be useful after commissioning and parameterizing the sensor to make unauthorized access to the sensor more difficult.

The command to deactivate the Bluetooth interface is executed only once the "APPLY" button is pressed.

You can only reactivate the Bluetooth interface by disconnecting the battery for approximately ten seconds and then reconnecting it. The Bluetooth interface is then available again as usual.



Note

Please note that deactivating the Bluetooth interface will immediately stop contact with the sensor through the app. In this case, the sensor can no longer be found in the device search list of the app.

Password

You can change the password for accessing sensor parameters here. The default value for the password is "00000000." Four to eight alphanumeric characters can be used as a password.

When commissioning the device, you should change the sensor password from the default password for security reasons.



Caution!

Note the new password to access the device in the future.

Write down the new password in a secure location. A forgotten or lost password cannot be reset or retrieved by the user or manufacturer.

Number of Resets

The value displayed indicates how many times the sensor counters have been reset.

Counters

Use this button to reset the counters that are running in the sensor to monitor the frequency with which ultrasonic measurements are taken, GPS position detection, and LoRa transmissions. This may be useful after a battery replacement.

"APPLY" Button

Any settings/changes to parameters are only transferred to the sensor once the "APPLY" button has been pressed; they are then saved to the sensor permanently.

7 Servicing

The device itself is maintenance-free. For this reason, it is not necessary to carry out regular adjustments or maintenance work on the device itself.

However, check that the device is securely fitted at the installation location within the scope of routine maintenance intervals.

8 Replacing the Battery

The device battery is replaceable. Replacement batteries are available from Pepperl+Fuchs.

The device battery is designed for a long service life. The energy consumption of the device depends on the device parameterization and the conditions at the operating location, such as the distance between the device and the LoRa gateway, and climatic conditions.



Warning!

Non-genuine batteries jeopardize operational safety.

Use only genuine replacement batteries from Pepperl+Fuchs; otherwise the function and safety of the device cannot be guaranteed. At worst, unapproved batteries can result in personal injury or property damage due to fire or may become discharged earlier than genuine batteries.

Observe the following rules when replacing the battery:

- Before opening the device, make sure that moisture cannot penetrate the device and, if necessary, rub the device dry.
 - Make sure that the new battery is well secured in the device by the hook-and-loop tape.
 - Make sure that the battery connection cable is only routed inside the device and cannot be clamped when the enclosure cover is closed.
-



Note

After replacing the battery, it may be useful to reset the operating hours counters of the sensor. If you want to do this, launch the WILSENcontrol app on your mobile device and switch to the "Configuration" menu. You can reset all operating hours counters using the "Counters" button. (See chapter 6.4).

9 Cleaning

It is not necessary to clean the device regularly.

If cleaning is required, please observe the following general rules:

- Only with water without chemicals
- Without pressure / high pressure
- Only by using a soft cloth
- No abrasive cleaning, scratching, or scrubbing

10 Repair

The device must not be repaired, changed, or manipulated. In case of failure, always replace the device with an original device.

11 Disposal

The device, built-in components, packaging, and any batteries contained within must be disposed in compliance with the applicable laws and guidelines of the respective country.

Your automation, our passion.

Explosion Protection

- Intrinsic Safety Barriers
- Signal Conditioners
- FieldConnex® Fieldbus
- Remote I/O Systems
- Electrical Ex Equipment
- Purge and Pressurization
- Industrial HMI
- Mobile Computing and Communications
- HART Interface Solutions
- Surge Protection
- Wireless Solutions
- Level Measurement

Industrial Sensors

- Proximity Sensors
- Photoelectric Sensors
- Industrial Vision
- Ultrasonic Sensors
- Rotary Encoders
- Positioning Systems
- Inclination and Acceleration Sensors
- Fieldbus Modules
- AS-Interface
- Identification Systems
- Displays and Signal Processing
- Connectivity

Pepperl+Fuchs Quality

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