Manual
WILSEN.sonic.level
WS-UC*-F406-B41*

Manual



CE

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1 Introduction

1.1 Content of this Document

This document contains information that you need in order to use your product throughout the applicable stages of the product life cycle. These can include 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.

Note

For specific device information such as the year of construction, scan the QR code on the device. As an alternative, enter the serial number in the serial number search at www.pepperl-fuchs.com/device-information.

The documentation consists of the following parts:

- Present document
- Datasheet

Additionally, the following parts may belong to the documentation, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Instruction manual
- Functional safety manual
- Cybersecurity documentation
- 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.



Tip

This symbol brings an useful tip to your attention.



Example

This symbol provides an example of the issue described.



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 fill level is measured at regular intervals and transmitted to the internet via a radio interface. The measurement and transmission intervalcan be parameterized via a Bluetooth interface and by using an app for mobile end devices. It is also possible to access the device remotely via the radio interface. This allows you to query or change parameter values.

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 hazardous areas.

Only use recommended original accessories.

1.5 General Safety Notice

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting 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 make changes and/or repairs. Additionally, doing so voids the warranty and excludes 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.

Warning!

Risk of injury if battery is defective!

This device uses a high-energy cell for voltage supply. This battery contains lithium and thionyl chloride. If these substances are released, the appropriate protective measures must be observed. Refer to the safety data sheet.

In case of leakage, contact with the skin or eyes may cause severe irritation and burns. Inhalation of electrolyte vapors may affect the upper respiratory tract and lungs.

Note

The safety data sheet for lithium-thionyl chloride batteries can be found online at www.pepperl-fuchs.com, on the product detail page for the respective wireless ultrasonic sensor WS-UCC*-F406-B15-B41-* under "Documents."

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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 dangerous. When disposing of the equipment, observe the current statutory requirements in the relevant country of use and local regulations.

1.6 Declaration of Conformity FCC, Canada

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

Note

This chapter refers to WILSEN devices working on LoRaWAN frequency plan US915 only (type code of respective products: WS*-B41-02-02*).

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s) and complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation of the device area.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Changes or modifications made to this equipment not expressly approved by Pepperl+Fuchs may void the FCC authorization to operate this equipment.

Note

Class A

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. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Note

Class B

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Radiofrequency Radiation Exposure Information:

- This equipment complies with FCC and ISED radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body.
- Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

FCC ID : IRE-WILSENLORA

IC ID : 7037A-WILSENLORA

HVIN/PMN : WSB4102

1.7 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.

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 fill level is measured at regular intervals and transmitted to the internet via a radio interface. The measurement and transmission intervalcan be parameterized via a Bluetooth interface and by using an app for mobile end devices. It is also possible to access the device remotely via the radio interface. This allows you to query or change parameter values.

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.

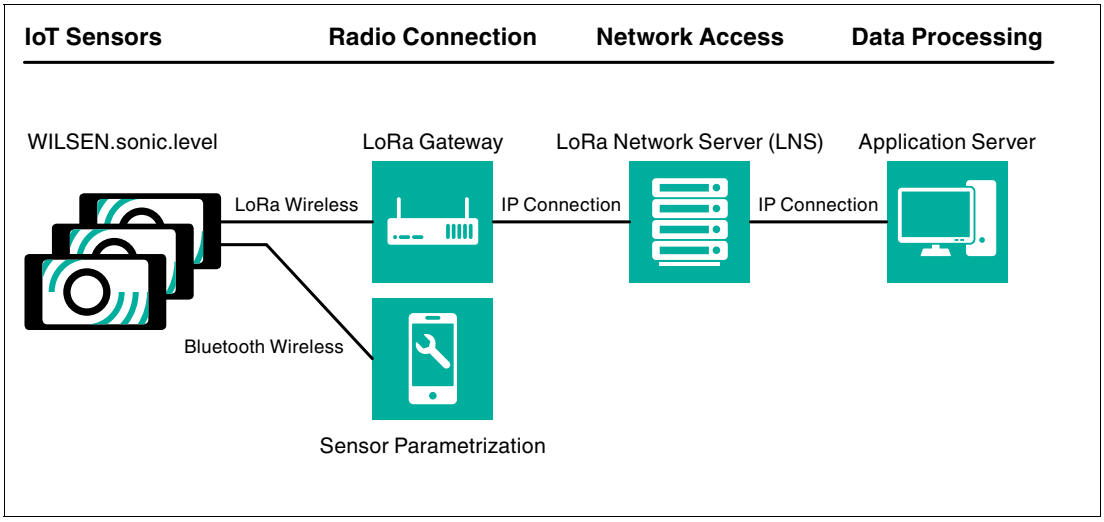


Figure 2.1

Note

You can find more information on the LoRaWAN standard at:

https://lora-alliance.org

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3 Integration into a LoRa Network

A WILSEN device sends the measurement data to be transmitted in the standardized LoRaWAN protocol via a radio interface. To do this, the WILSEN device must have joined a corresponding LoRaWAN network. The device can join a network once it has been registered with the LoRa network server.

The following figure illustrates the topology of integrating a WILSEN device into a LoRaWAN network.

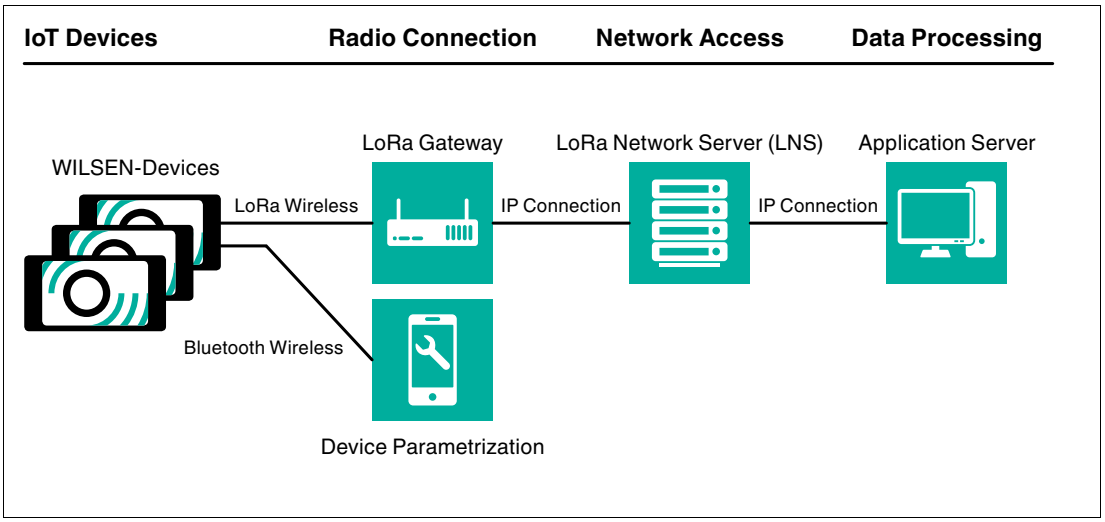


Figure 3.1

LoRa Wireless Connection

The measurement data collected by the WILSEN device is transmitted to the LoRaWAN network in the form 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 gateway transmits the translated payload to the LoRa network server via an Ethernet cable 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 IoT devices, and forwards them to an application server. The application server decrypts the data packets and stores the device data (measurement data, states) that they contain. The data user's processing software application can retrieve and display the data from the application server memory at a later time.

Registering the Sensor with a LoRa Network Server

To register the WILSEN device 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 device using registering with "The Things Network (TTN)" community network as an example.

You can download the document online from the product detail page for the respective WILSEN device 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 authenticated via the **Device EUI**. This is provided by the device manufacturer and transferred to the LoRa network server (LNS).

With WILSEN devices, you will find this 16-digit number in hexadecimal format by connecting to the device using the WILSEN app. The device-specific **Device EUI** is displayed in the "LoRaWAN Configuration" menu of the app. You can also find the Device EUI on the nameplate and the packaging label of the device, or in the individual serial number credential list in csv format provided by Pepperl+Fuchs on request.

To structure the system, some LNS services use a 16-digit **Application EUI/Join EUI** as an additional identifier to structure the system.

For more information, familiarize yourself with the details in the description supplied by your LNS provider. If the LNS supplies an Application EUI/Join EUI or you create one yourself, you must enter it in the **Application EUI/Join EUI** field in the WILSEN app.

If you want to use the Application EUI/Join EUI provided by the WILSEN device, you will find it in the WILSEN app in the "LoRaWAN Configuration" menu. It is also in the individual serial number credential list in csv format provided by Pepperl+Fuchs on request.

Encryption of Telemetry Data

With LoRaWAN, device data (measurement data, states) 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 devices use 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. Some network servers will then provide you with an application key. Alternatively, the application key provided by the WILSEN device can be transferred to the intended LoRa environment.

You can find the application key provided by the WILSEN device via the WILSEN app in the "LoRaWAN Configuration" menu. It is also in the individual serial number credential list in csv format provided by Pepperl+Fuchs on request.

An application key provided by a network server must be transferred to the WILSEN device using the WILSEN app.

Once the credentials have been exchanged between the WILSEN device and the LoRaWAN network server or application server, the data transmission can start.

If the WILSEN device is within range of a LoRa gateway, it immediately starts contacting the LoRa network server.

Payload

The regularly determined measurement data is transmitted to the LoRa network server on the internet at adjustable transmission intervals. The structure of this usable 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 respective WILSEN device is described in an additional document for the payload.

LoRa network server providers offer 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.

Pepperl+Fuchs provides a downloadable payload decoder in JavaScript format on its homepage. 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.

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Note

You can download the payload description and the payload decoder for your WILSEN device online from the product details page for the relevant WILSEN device at www.pepperl-fuchs.com. See the Documents and Software areas.

4 Cybersecurity Information

This product has been developed according to best practices for cybersecurity.

The operator of the product is responsible for ensuring that suitable cybersecurity measures are implemented in the operating environment of the product.

Pepperl+Fuchs provides information in a suitable manner and updates this information depending on the threat situation.

Refer to cybersecurity information for further information.

Note

Further information is available on the product detail page of the device on the Internet at www.pepperl-fuchs.com.

Enter the order designation in the search field → Select the appropriate device → Open the product detail page → Open the **Product Documentation** tab.

5 Establishing a Connection to the Device

Prerequisites

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

- Operating systems: Android version 5 or higher / iOS version 12.4 or higher
- Bluetooth version 4.0 or higher (Bluetooth Low Energy must be supported)
- Bluetooth is enabled on the mobile device
- Geolocalization is enabled on the mobile device
- Mobile device has an internet connection
- Mobile device has an account set up on Google Play or the Apple App Store

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

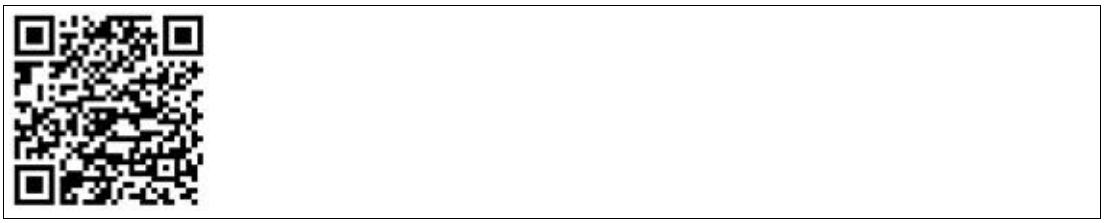


Figure 5.1 WILSEN in Google Play

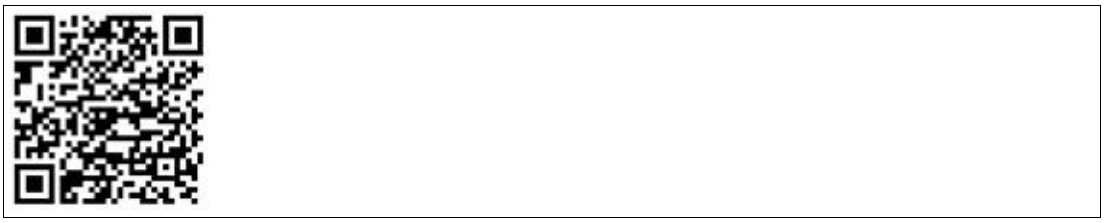


Figure 5.2 WILSEN in the Apple App Store

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

Note

On the mobile device, make sure that Bluetooth and geolocalization (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 symbol.

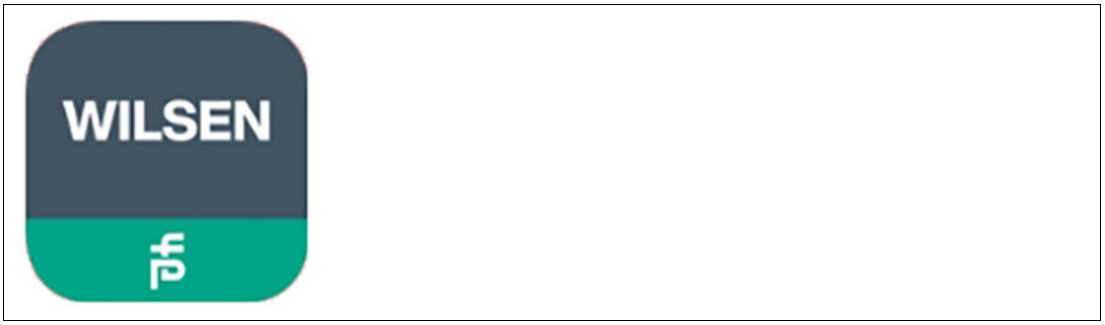


Figure 5.3

↳ The WILSEN app Device Discovery will appear. Available devices within detection range will be displayed after a short time.

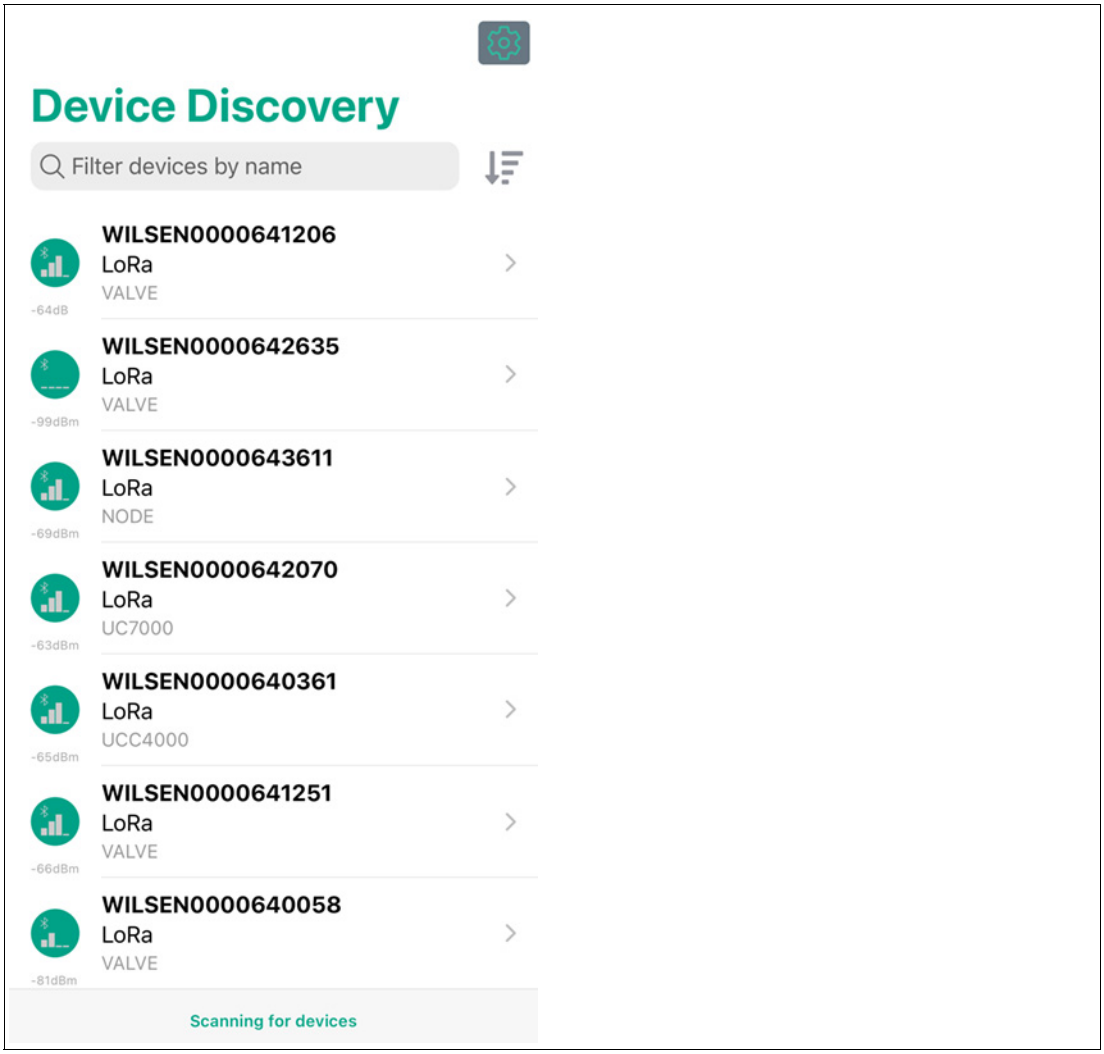


Figure 5.4

Tip

Enter the desired device name or part of it to reduce the number of devices in the list in accordance with the search.

The "Sort" symbol to the right of the input field allows you to sort the displayed devices according to various criteria. You can also use this to completely disable a specific sort order. In this case, newly found devices are simply added to the end of the list.

4. Tap on the desired device to connect it to the app.

Tip

During the setup connection process, the system generates a pairing request, which must be confirmed by the user.

5. Enter the default password `00000000` when setting up a new device or the valid password for an already known device within 30 seconds and confirm with `OK`.

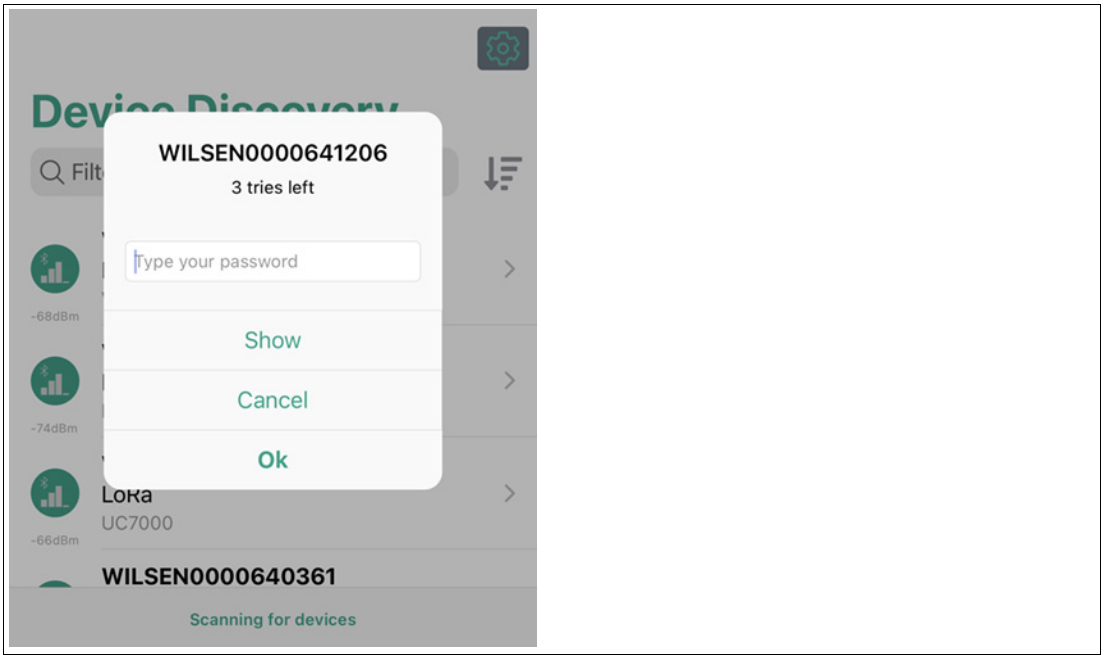


Figure 5.5

↳ The app will switch to the **Sensor Status & Configuration** menu, which displays current sensor values and provides access to sensor settings.

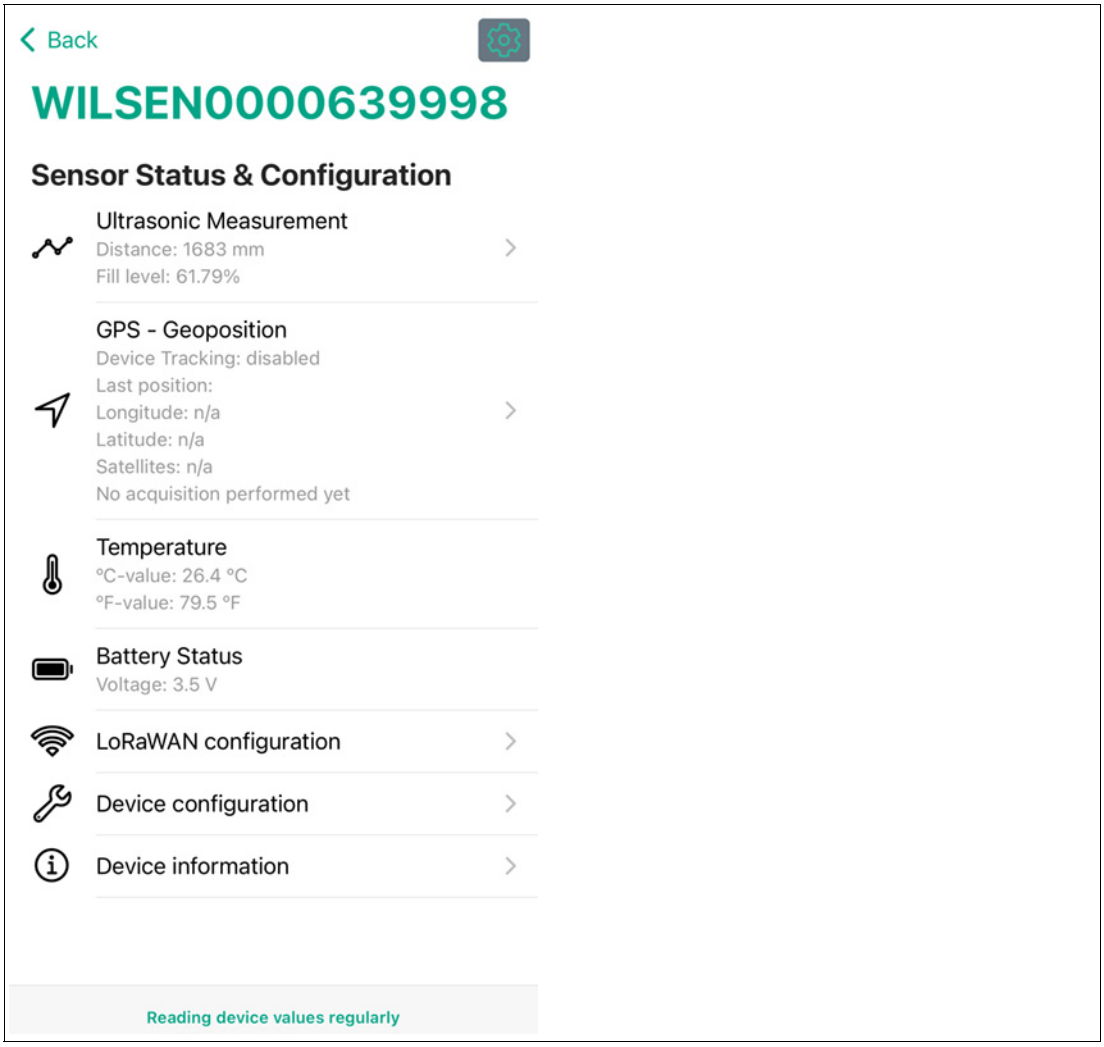


Figure 5.6

Caution!

High Power Consumption During Bluetooth Connection

To ensure the longest possible battery life, keep the connection time between the mobile device and the wireless ultrasonic sensor via Bluetooth and the app as short as possible.

The Bluetooth connection between the sensor and the app is automatically severed if there is no further user activity for five minutes.

Note

Temporary Block After Three Incorrect Password Entries

If the password is incorrectly entered three times in a row, the device is blocked from reconnecting via Bluetooth for a specific period of time.

This is indicated by the "Blocked" sign in the device list. There is also a note indicating when the device will be accessible via Bluetooth again. If an incorrect password continues to be entered multiple times once access is restored, the blocking period becomes increasingly longer after every three attempts.

6 Mounting

6.1 Installation Conditions

To ensure proper functioning, you must observe the following installation conditions when mounting the wireless ultrasonic sensor in a container, tank, or silo:

- Installing the wireless ultrasonic sensor in shielded environments made of metal or other conductive components usually has a significant effect on the wireless connection and wireless range. These effects must be taken into account accordingly in such installation situations.
- The ultrasonic transducer must be aligned in the direction of the filling material to be measured.
- There must be no interfering elements in the sensing range of the ultrasonic sensor. Depending on the contour, the adjustable sensor configuration may be used to exclude interfering struts in the container. For more information, contact the application specialists at Pepperl+Fuchs.

6.2 Mounting Instructions

The wireless ultrasonic sensor is delivered pre-mounted on a mounting base for easy and quick mounting in a container, tank, silo, etc. The mounting base enables various mounting points.

The following drawings show the dimensions and mounting points of the wireless ultrasonic sensor versions.

WS-UCC2500-F406-*

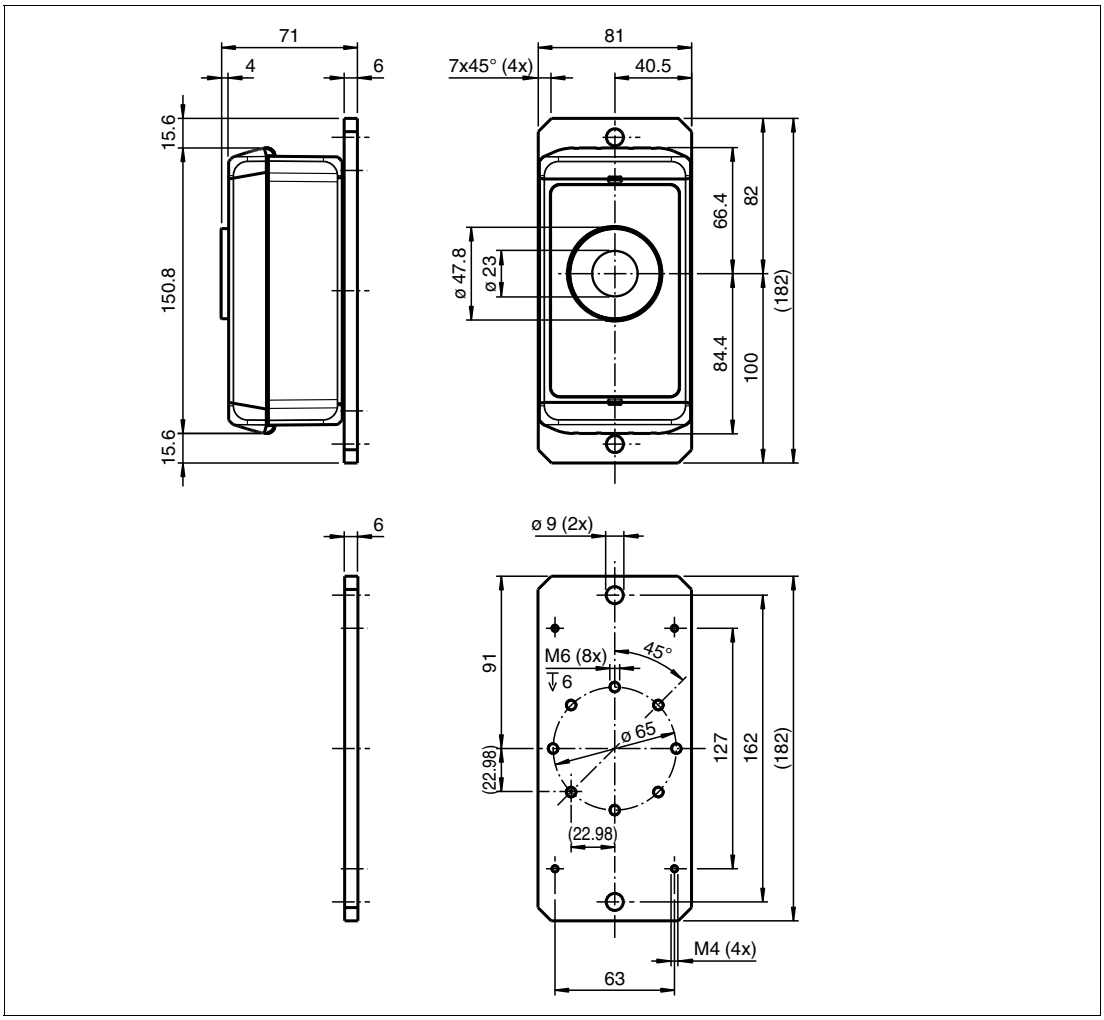


Figure 6.1

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WS-UCC4000-F406-*

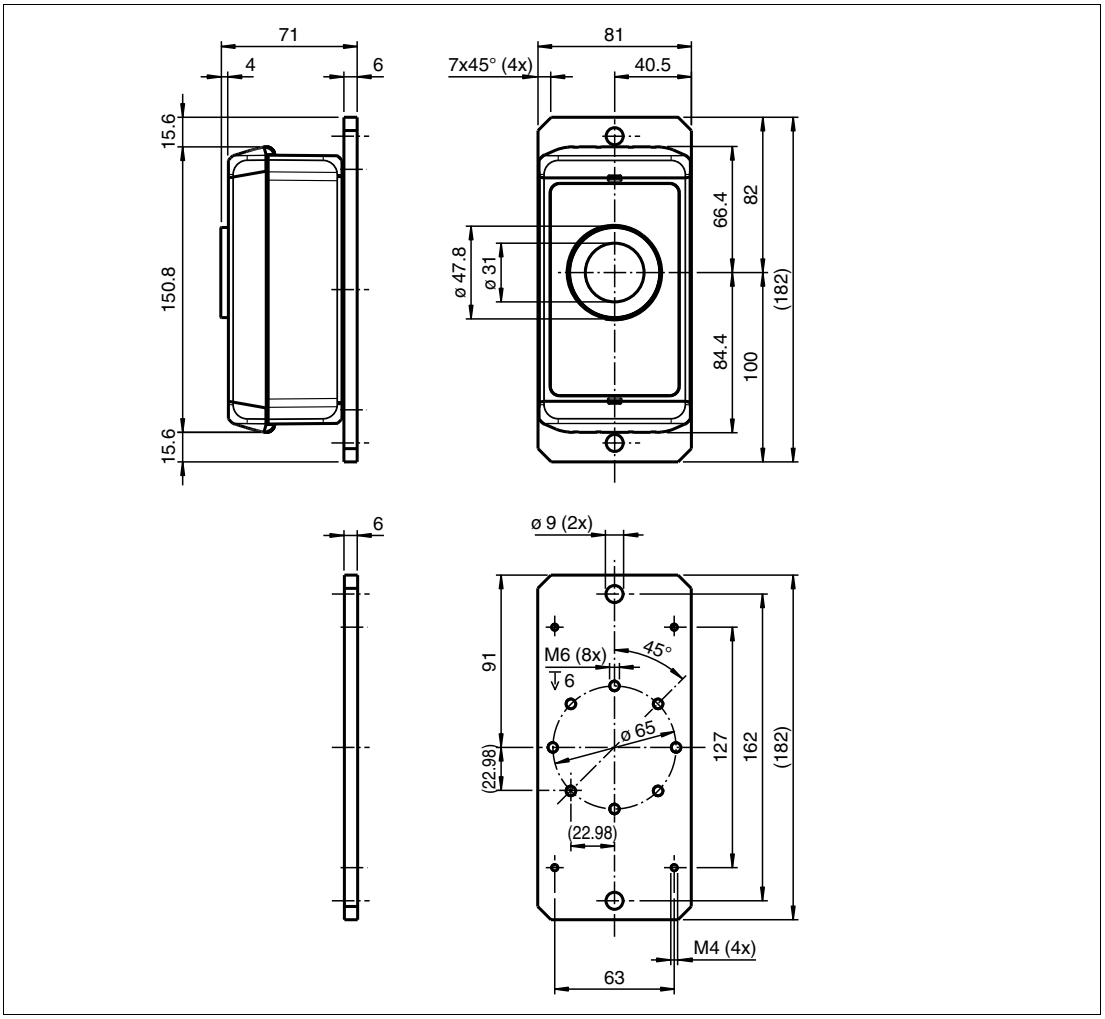


Figure 6.2

WS-UC7000-F406-*

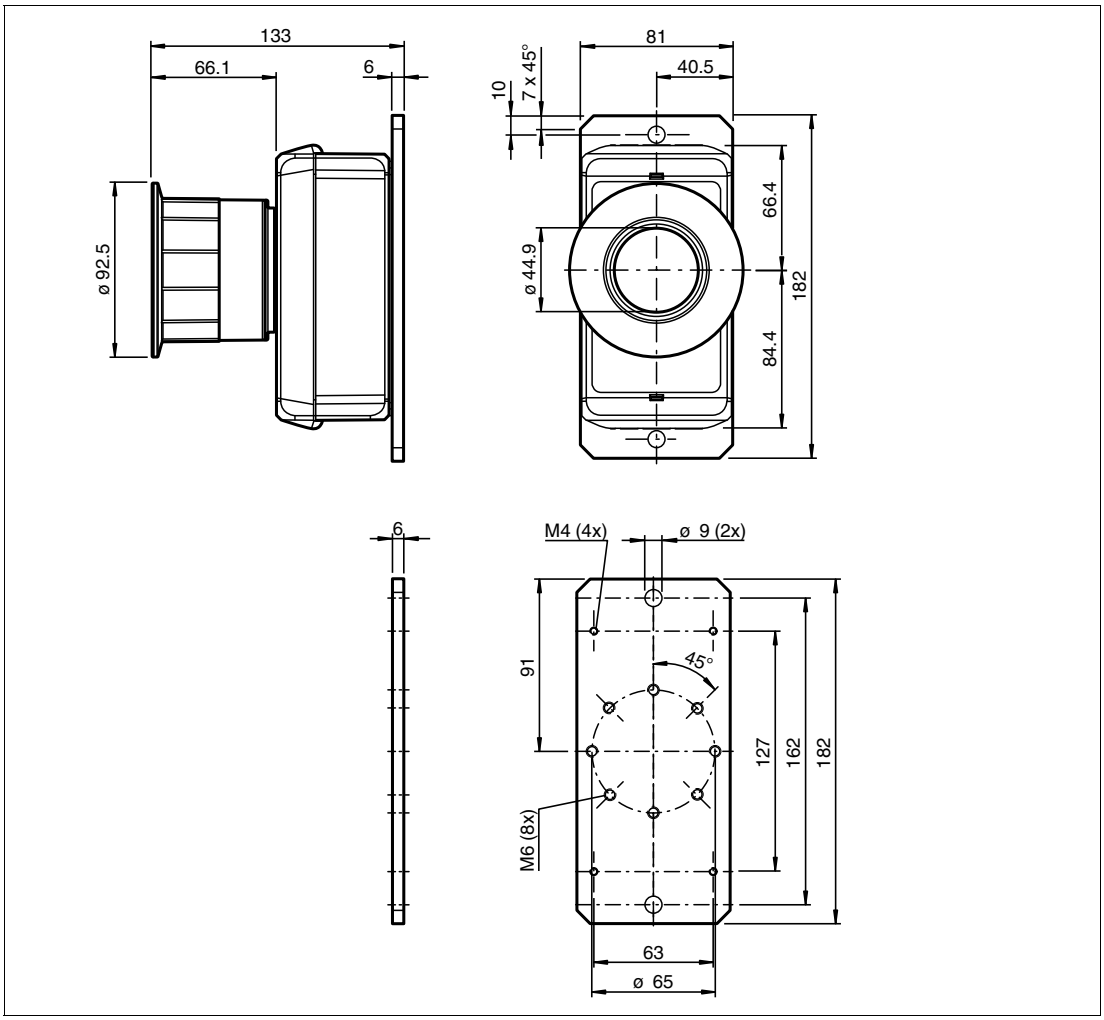


Figure 6.3

You can attach the mounting plate to a mounting location via the following points:

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

WS-UCC2500-F406-*IBC

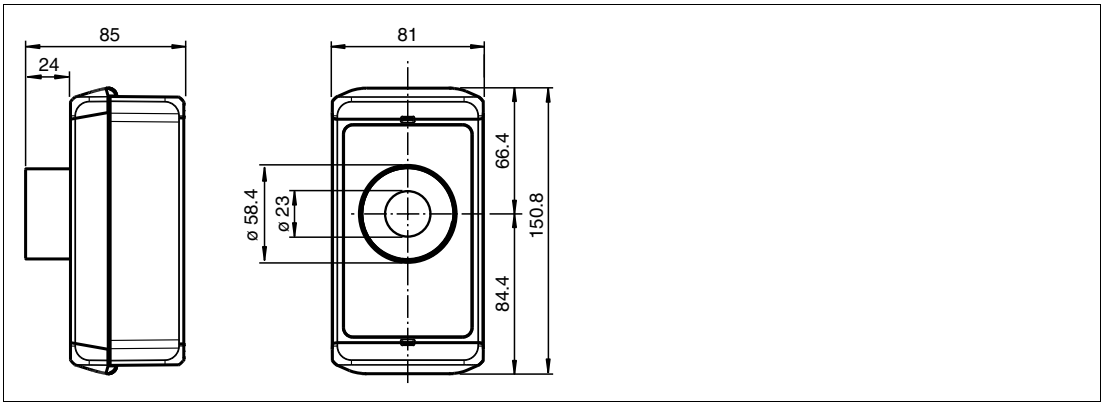


Figure 6.4

The WILSEN version for level measurement in an intermediate bulk container (IBC) does not have a mounting plate. The device is screwed directly into a suitable opening in the IBC lid using the 2-inch thread on the ultrasonic module and then tightened hand-tight.

7 Measurement Data Acquisition and Data Transfer of the WILSEN.sonic.level

The figure below illustrates the sequence of measurement data acquisition and data evaluation of the WILSEN.sonic.level in conjunction with the triggers that trigger them.

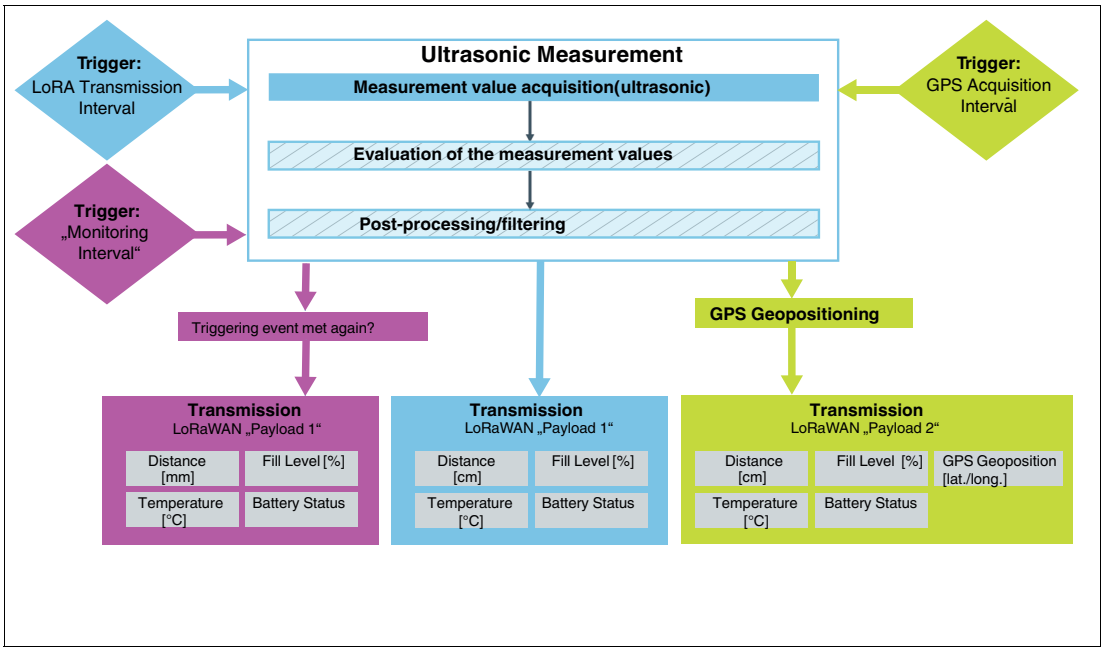


Figure 7.1 Flowchart: Measurement data acquisition and analysis

Triggers for Measurement-Data Acquisition and Transmission

Measurement-data acquisition with the WILSEN.sonic.level is initiated by one of three different triggers.

- LoRa Transmission Interval
  First, there is regular measurement-data acquisition, which is initiated via the "LoRa Transmission Interval" trigger. This interval is used to obtain measurement data at regular intervals to ensure an overview of the system and the availability of the WILSEN.sonic.level.
- Monitoring Interval
  There is also the option of event-driven reporting of measurement data using the "Monitoring Interval" trigger. In this case, measurement-data acquisition is usually triggered at much shorter time intervals. However, the measurement data is only transferred when a newly detected crossing of the "Limit Distance" threshold occurs.
- GPS Acquisition Interval
  The geoposition of the WILSEN.sonic.level unit can also be determined as an option together with measurement-data acquisition. This is done via the "GPS Acquisition Interval" trigger, which is the third trigger option for measurement-data acquisition.

Measurement-Data Acquisition Process

To acquire measurement data, the integrated ultrasonic sensor of the WILSEN.sonic.level is briefly powered up. By transmitting an ultrasonic packet and measuring the echo delay, the distance to the object in the detection range is determined and the corresponding fill level is calculated in percent.

Optionally, you can set a measurement sequence instead of a single measurement, i.e., a sequence of several individual measurements at defined time intervals. These measurements are then evaluated, e.g., on the basis of the determined average and optionally further parameters, and calculated to provide a result.

Alternatively, or in addition, the collected distance values can optionally be filtered using post-processing filters. This can be to further stabilize or optimize the measured value output for a specific application.

When measurement data acquisition is triggered via one of the three triggers mentioned, the battery voltage and temperature are recorded alongside the distance measured by the ultrasonic sensor and the calculation of the fill level as a percentage. With the "GPS Acquisition Interval" trigger, the geoposition of the WILSEN.sonic.level is additionally determined.

Data Transmission

Following measurement-data acquisition initiated by the "LoRa Transmission Interval" trigger, the recorded data is transmitted directly in the form of "Payload 1". In addition to the measured distance value in millimeters and the calculated fill level in percent, "Payload 1" also includes the battery status and the temperature of the WILSEN.sonic.level.

If measurement-data acquisition was initiated by the "GPS Acquisition Interval" trigger, data transmission takes place immediately after geolocation is completed in the form of "Payload 2". "Payload 2" contains the same measured variables as "Payload 1" and the recorded geoposition.

If measurement data acquisition is initiated by the "Monitoring Interval" trigger, data is only transferred if the measured distance value crosses the set threshold (>> Limit Distance) in the configured direction, either exceeding or falling below it. In this case, the data is transmitted once in the form of "Payload 1".

8 Parameterization

You can query and set the WILSEN device parameters in the following two ways:

- WILSEN app
- LoRaWAN downlink channel

With the exception of the app-specific parameters, all WILSEN device parameters described below can also be queried and set via the LoRaWAN downlink channel.

For logical reasons, the details of the device parameters are described in this chapter based on the structure and clustering in the WILSEN app.

Note

The hexadecimal codes and specific information required for access via the LoRaWAN downlink channel are in a separate document entitled "Downlink Description".

You can find this at www.pepperl-fuchs.com on the product details page for the WILSEN device.

8.1 Menu Structures

The **Sensor Status & Configuration** 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:

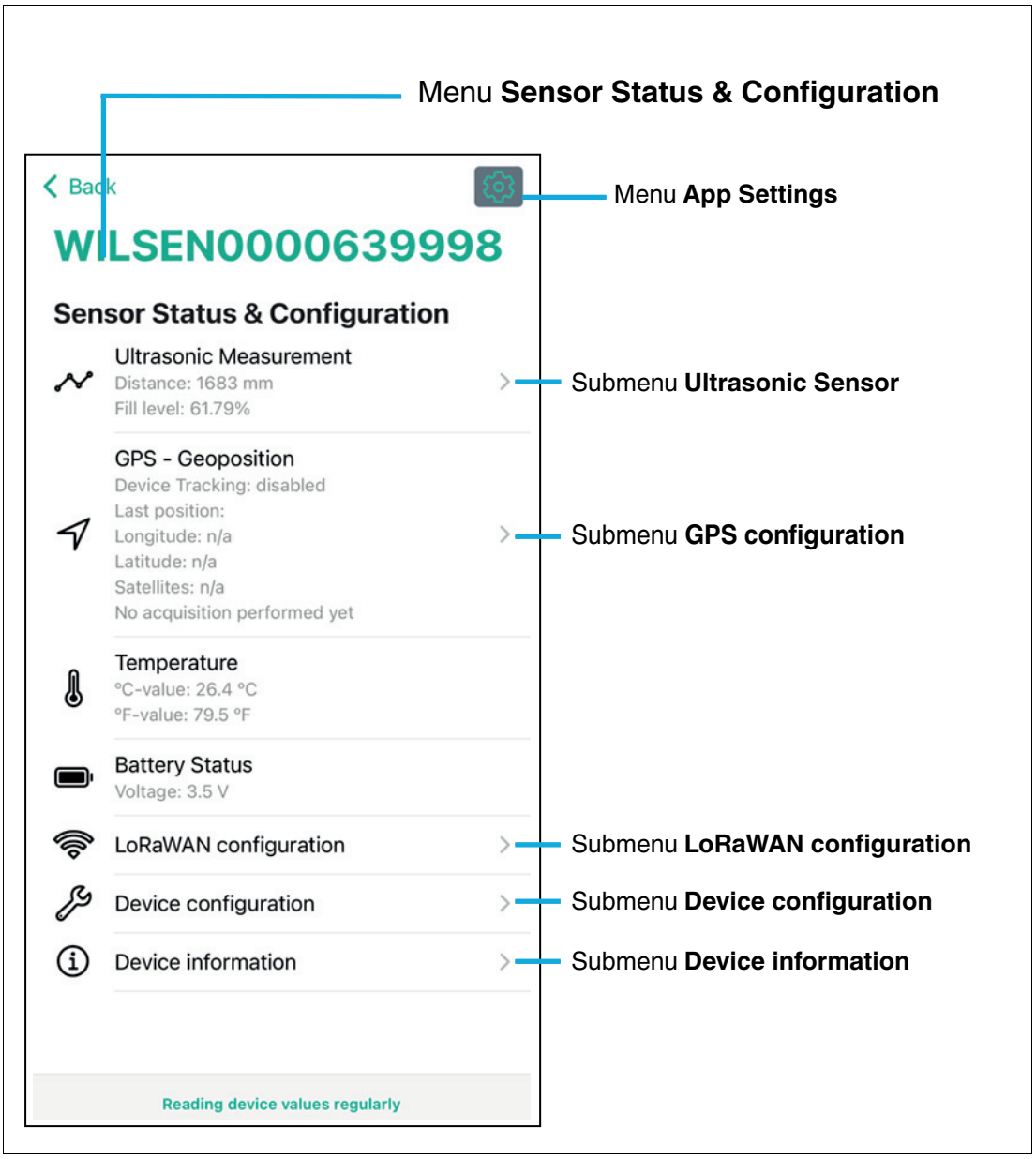


Figure 8.1

Menu/Submenu	Task/Content
Sensor Status & Configuration	Main menu with submenus and displays for the device
App settings	Changing the language and information about the app version used
Ultrasonic Sensor	Setting the parameters for the ultrasonic measurement, such as the sound beam width, limits for fill-level determination, and additional settings in expert mode
GPS Configuration	Setting the parameters for GPS position determination and its transmission interval
LoRaWAN Configuration	Setting the LoRaWAN-specific parameters and the transmission interval
Device Configuration	Setting the displayed device name, changing the device password, various reset options, and deactivating the Bluetooth interface
Device Information	Information about the device (device data and counter readings) and the option to update the firmware

Table 8.1

8.2 App Settings Menu

In the **App Settings** menu, you can select the language and color scheme used in the app. In addition, this menu shows legal notices along with the version number of the app installed on your device.

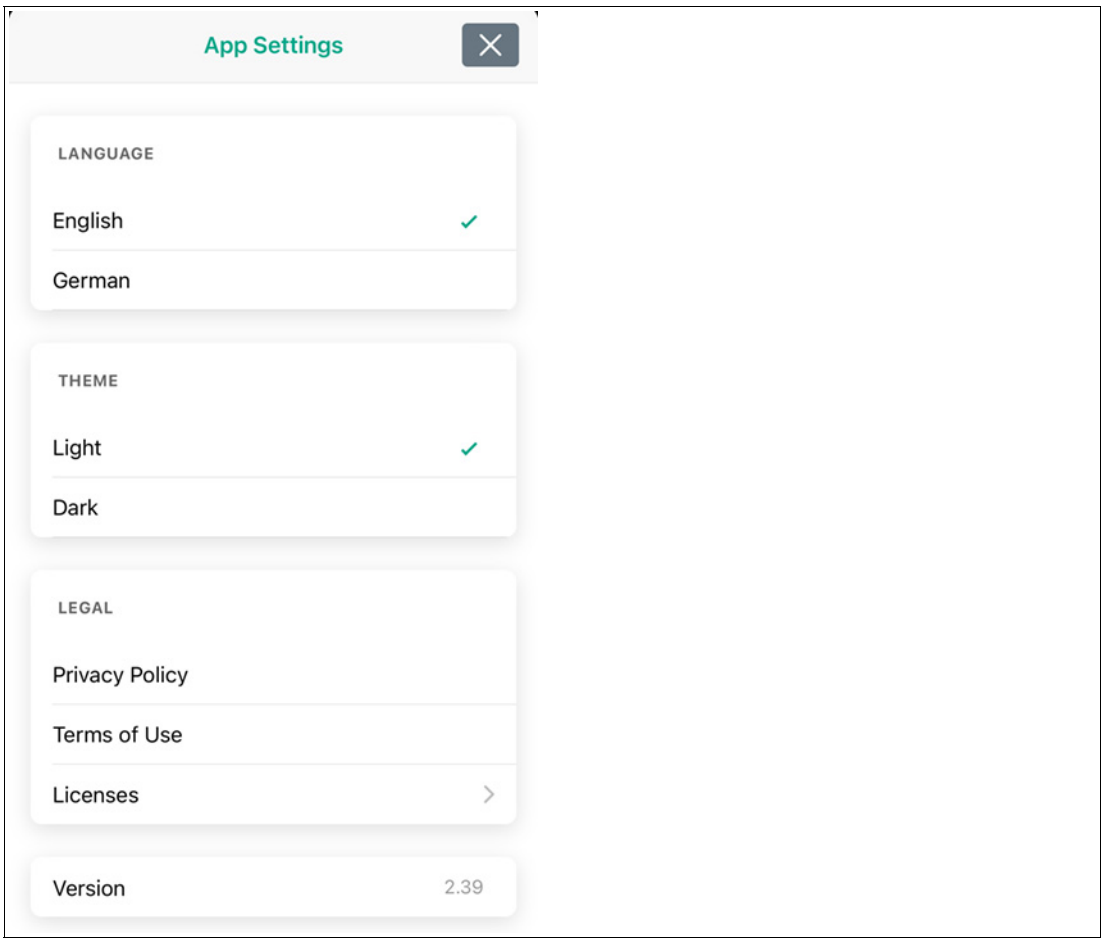


Figure 8.2

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8.3 Ultrasonic Sensor Submenu

In the **Ultrasonic Sensor** submenu, you can set parameters for ultrasonic distance measurement.

Depending on the application, a simple normal mode and an expert mode are available.

Normal mode

In normal mode, only the most important parameters are displayed in a streamlined view.

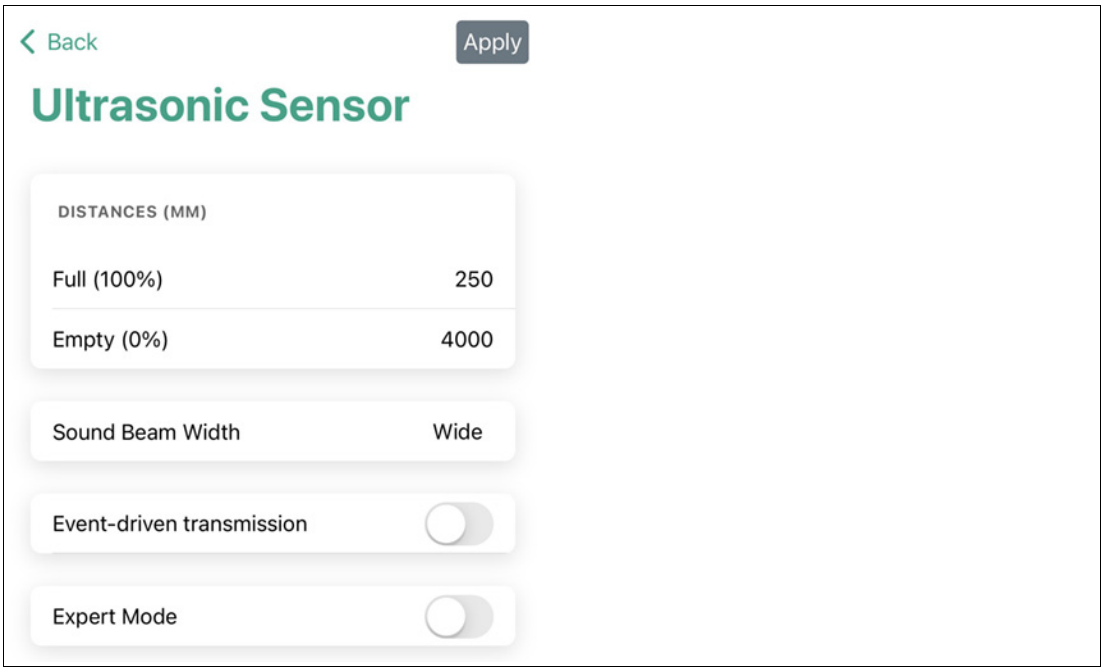


Figure 8.3

Expert Mode

For more detailed settings, you can set expert mode.

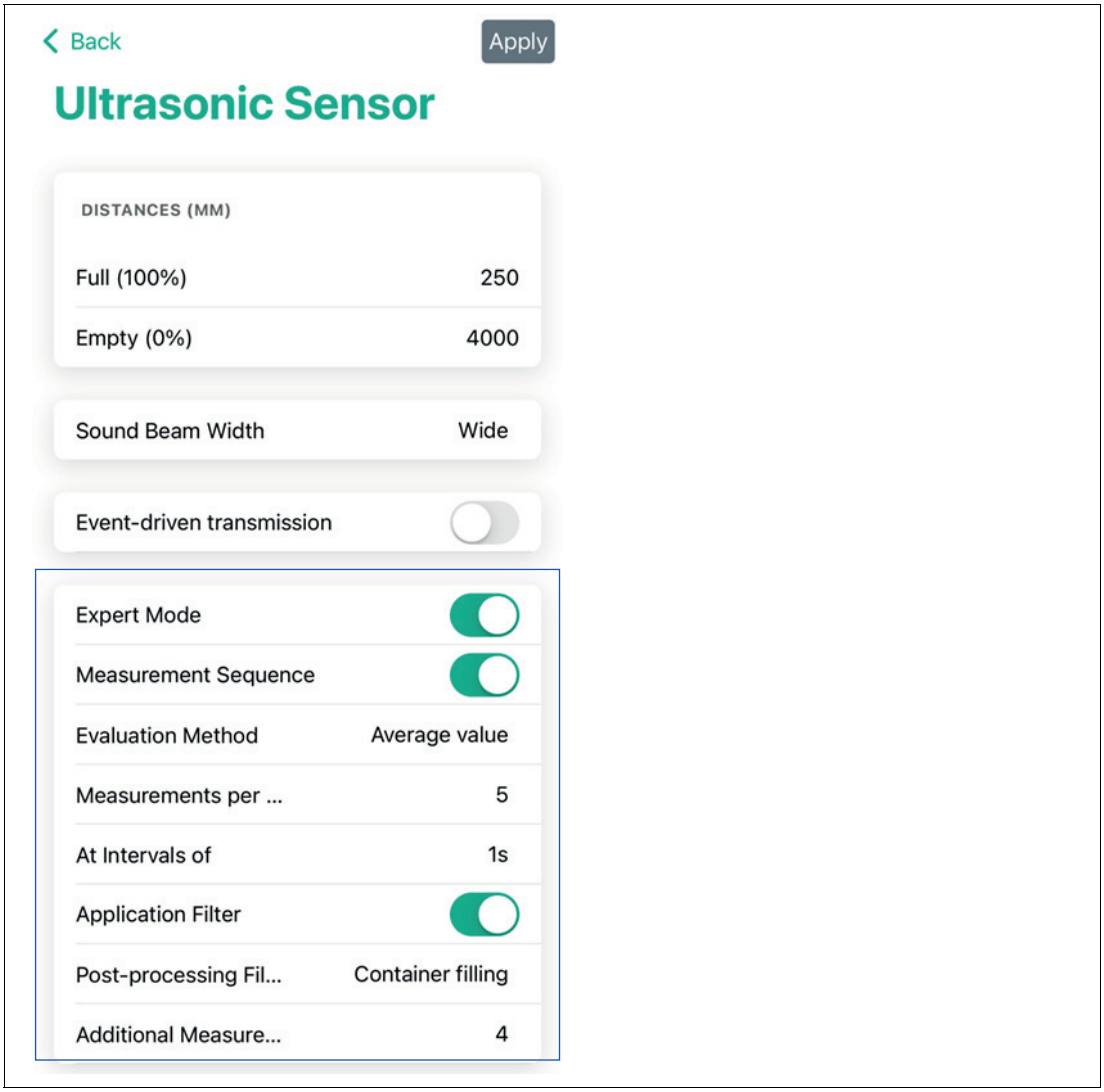


Figure 8.4

8.3.1 Distance Values (mm) with Full (100 %) / Empty (0 %)

When these two values are set, the fill level of your container is displayed in the form of a corresponding percentage value. You must specify the appropriate distance values in mm.

8.3.2 Sound Beam Width

This parameter allows you to adjust the sound beam width of the ultrasonic sensor.

By default, you can choose between the following sound beam widths:

- Wide
- Medium
- Small
- User defined

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 three default 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 relevant WS-UC*-F406-B41-* wireless ultrasonic sensor at www.pepperl-fuchs.com.

If none of the pre-selectable sound beam widths are suitable for your application, you can select **User-defined** settings for the sound beam. In this case, you must select the "User defined" option in the "Sound Beam Width" parameter. The following three parameters appear, allowing for a more specific adjustment of the sound beam.

- Sensitivity
- Burst Length
- Transmitting Power

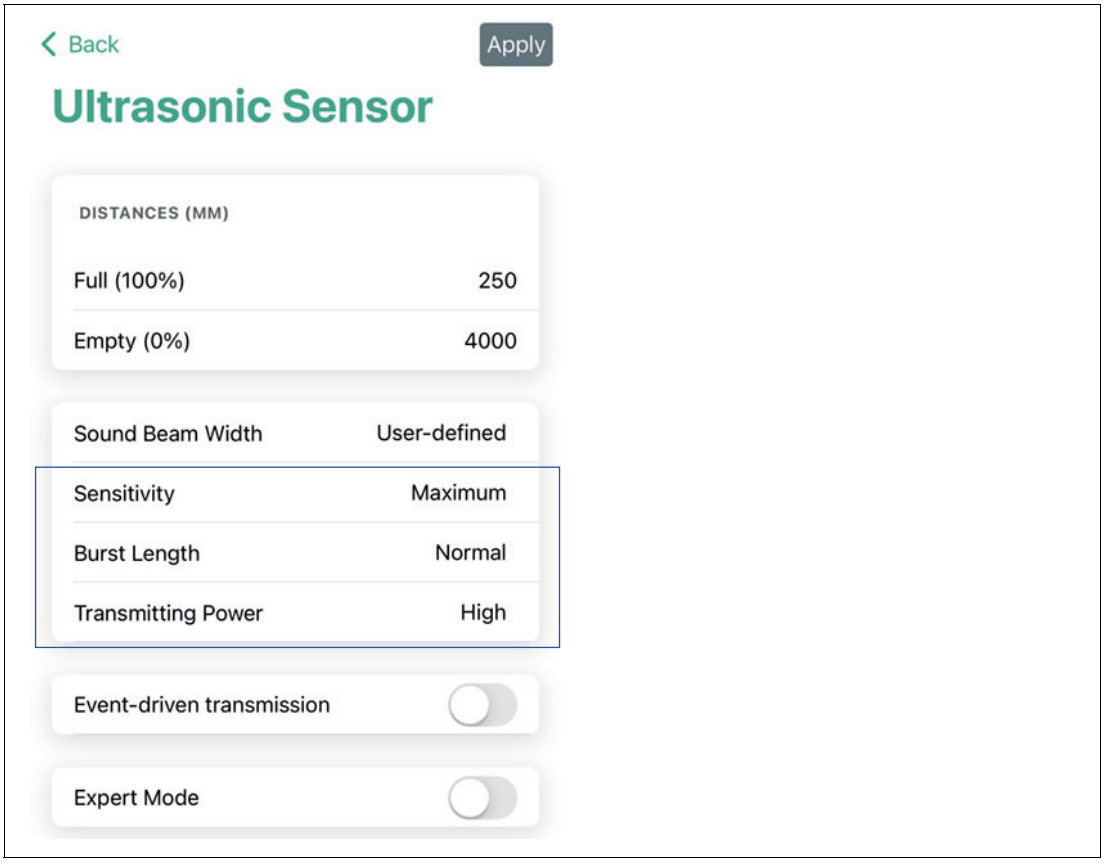


Figure 8.5

Caution!

Improper user-defined settings may result in malfunctions!

Improper setting of the Sensitivity, Burst Length, and Transmitting Power parameters may cause the sensor to stop functioning in the application. Specific properties of the sensor such as detection range, dead band, object detection reliability, etc. can change significantly.

We strongly recommend that these parameters only be set after consulting our application specialists.

8.3.3 Sensitivity

This parameter sets the sensitivity of the ultrasonic amplifier.

You may select from the following six adjustment options:

- Maximum
- Very High
- High
- Medium
- Low
- Minimum

The resulting sound beam geometry, including possible influence on the dead band and detection range, depends on the settings of the "Sensitivity", "Transmitting Power", and "Burst Length" parameters. These three parameters together define the shape of the sound beam.

Note

Note that the "Maximum" setting results in a wider sound beam and the "Minimum" setting results in a very narrow sound beam.

Take note that if the sensitivity is not set to "Maximum", the sensing range of the ultrasonic sensor is reduced. Depending on the reflection properties of the object to be detected, the nominal range of the ultrasonic sensor may not be reached.

We therefore recommend that the "Sensitivity" parameter may only be set after consulting our application specialists.

8.3.4 Burst Length

This parameter determines the length of the ultrasonic pulse emitted.

You may select from the following adjustment options:

- Normal
- Short
- Very short

By shortening the burst length, the dead band of the ultrasonic sensor can be shortened. However, this automatically reduces the sensing range of the ultrasonic sensor significantly and the nominal range is no longer reached.

The amplitude of the pulse is not affected by this parameter (see "Transmitting Power" parameter). Nevertheless, the effect of a change in the burst length is directly related to the "Transmitting Power" parameter. Both of these parameters together determine how much and for how long the ultrasonic transducer is excited and what acoustic energy the resulting sound package ultimately has. This results in the necessary dead band and also the maximum detection range of the ultrasonic sensor.

The resulting sound beam geometry, including possible influence on the dead band and detection range, depends on the settings of the "Sensitivity", "Transmitting Power", and "Burst Length" parameters. These three parameters together define the shape of the sound beam.

Note

Note that if the burst length is not set to "Normal," the sensing range of the sensor is drastically reduced.

We recommend that you only set this parameter after consulting our application specialists.

8.3.5 Transmitting Power

Selecting one of the available options sets the amplitude of the emitted ultrasonic pulse.

You may select from the following adjustment options:

- High
- Medium
- Low

By reducing the transmitter radiated power, you can shorten the dead band of the sensor. However, this automatically reduces the sensing range of the sensor significantly, and the nominal range is no longer reached.

The burst length is not affected by this parameter. Nevertheless, the effect of a change in the transmitter radiated power is directly related to the "Burst Length" parameter. Both of these parameters together determine how much and for how long the ultrasonic transducer is excited as well as the eventual acoustic energy of the resulting sound package. This in turn results in the necessary dead band and also the maximum detection range of the sensor.

The resulting sound beam geometry, including possible influence on the dead band and detection range, depends on the settings of the "Sensitivity", "Transmitting Power", and "Burst Length" parameters. These three parameters together define the shape of the sound beam.

Note

Note that if the transmitter radiated power is not set to "High", the sensing range of the sensor is drastically reduced.

We recommend that you only set this parameter after consulting our application specialists.

8.3.6 Event-Driven Transmission

Enabling this parameter activates event-driven monitoring of the distance value measured by the ultrasonic sensor

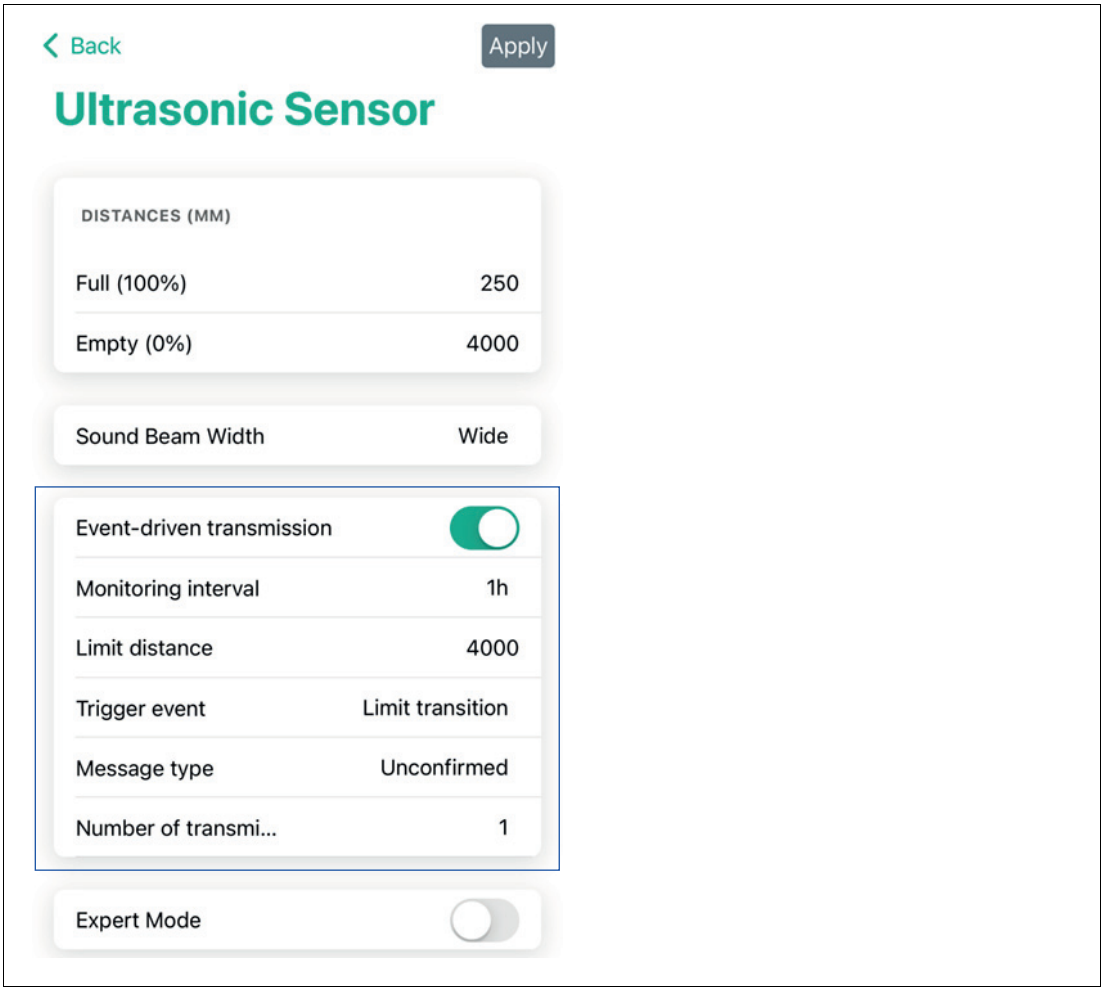


Figure 8.6

Event-driven monitoring means that in addition to the regular interval (>> "LoRa Transmission Interval") the distance recorded by the ultrasonic sensor is also measured at the monitoring interval configured here and checked for changes relative to the set limit distance. If this monitoring detects that the set limit distance has been exceeded or fallen below, in accordance with the configured notification settings (>> "Trigger Event"), a message is sent once using the transmission settings configured here.

When this function is activated, the following additional parameters are displayed:

- Monitoring Interval
- Limit Distance
- Trigger Event
- Message Type
- Number of transmissions

Practical uses of this function include parking space monitoring, for example, where it enables very rapid detection of changes (parking space occupied or vacant). It can also be used in fill level monitoring applications, for example to provide immediate notification when a warning level is reached, as well as similar applications.

Note

Event-driven transmission is disabled by default because this function is not relevant for all fill level and distance measurement applications. This also promotes the longest possible battery life.

Only enable this function if your application actually requires this type of monitoring.

8.3.7 Monitoring Interval

When event-driven transmission is enabled, the "Monitoring Interval" parameter determines the time intervals in which the object distance is measured by the ultrasonic sensor.

Note

Select this monitoring interval carefully and set it only as short as is actually required for your application. The shorter the selected interval and therefore the more frequently the ultrasonic sensor measures the object distance, the shorter the battery life will be.

It is very easy to estimate the effects of activated event-driven monitoring with corresponding monitoring intervals on battery life with the help of our Battery Lifetime Calculator for your application.

You can find this at https://wilsen-services.pepperl-fuchs.com.

8.3.8 Limit Distance

For event-driven transmission, the limit distance is the threshold value used to evaluate the measured distance and determine whether or not a new event has been triggered. Depending on the setting of the "Trigger Event" parameter (see chapter 8.3.9), a message is sent once via LoRaWAN when the measured distance exceeds or falls below the limit distance.

8.3.9 Trigger Event

This parameter is used for event-driven transmission to specify which events lead to the transmission of a LoRa message. The limit distance serves as the threshold value.

If "Limit transition" is selected as the trigger event, a LoRa message is sent once whenever the measured distance either falls below or exceeds the limit distance.

For the trigger events "Below Limit" or "Above Limit", a notification is only generated for one transition direction:

- For "Below limit", only if the measured distance falls below the limit distance (measured distance value < limit distance),
- For "Above Limit", only when the limit distance is exceeded (measured distance value > limit distance).

Note

The evaluation of whether the condition for a trigger event is met takes place exclusively on the basis of distance measurements during event-based monitoring (>> "Monitoring Interval").

Only changes detected within the set monitoring interval can trigger the sending of an event-driven message.

For example:

The monitoring interval for event-driven monitoring is set to 1 hour.

During event-driven measurement, the distance to the water surface in a 1000 mm high rainwater collection tank is measured at 220 mm (corresponding to a fill level of 78 % in this example).

The limit distance is set to 200 mm (which corresponds to a pre-warning threshold of 80 % fill level). A message is to be sent for each "Limit transition".

Five minutes after the event-driven measurement, it begins to rain heavily and the fill level in the tank rises to 85 % within 10 minutes (distance between water surface and sensor: 150 mm).

It then stops raining and water is drawn from the tank. The fill level drops to 60 % over the next 30 minutes (distance between water surface and sensor: 400 mm).

Another 15 minutes later, a new distance measurement is triggered by the monitoring interval. A distance of 400 mm to the water surface is measured.

Based on the previous, event-triggered measurement with a measured distance of 220 mm and the current measurement of 400 mm, the WILSEN device does not detect a transition below the set limit distance of 200 mm, which means no event-driven notification is sent.

8.3.10 Message Type

LoRaWAN offers two possible message types for the transmission of a device payload:

- "Unconfirmed" transmission:
  When you select the message type "Unconfirmed", the WILSEN device sends its message to the gateway according to the set "Number of transmissions" (see following parameter). However, it does not expect a receipt confirmation from the gateway.
- "Confirmed" transmission:
  When you select the message type "Confirmed", the WILSEN device sends its message to the gateway and expects a receipt confirmation. If this is not received within a specified time frame, the sensor sends its message to the gateway a maximum of two more times. The WILSEN device performs a total of three transmission attempts. After the 3rd attempt, if no confirmation is received from the LoRa network server, the WILSEN device discards the current message.

Usually, with LoRaWAN, measurement data from devices is sent to the gateway "unconfirmed". This minimizes the load on the LoRaWAN network and allows receipt of multiple messages simultaneously on different gateway channels. Receipt of messages is therefore possible in most events. Of course, especially with this type of transmission, messages from one or more devices may not be received by the gateway.

If it is necessary to ensure that a message is received at the gateway, the message type should be "Confirmed". This is especially useful for alarm messages and often for event-driven messages.

Note

The message type selected here applies only to event-triggered messages. It does not affect regularly transmitted messages triggered by the "LoRa Transmission Interval" or "GPS Acquisition Interval".

Only select a "Confirmed" transmission if it is absolutely necessary for your application. In addition, make sure that the measured distance does not change constantly, especially when the query intervals are set very short, to prevent overloading the LoRa network due to the large number of confirmed transmissions generated as a result.

8.3.11 Number of Transmissions

Note

This parameter is only available if the message type is set to "Unconfirmed".

You can choose between the values "1" and "3" as the number of message transmissions (payload).

- With "1", the WILSEN device sends each message (payload) toward the gateway only once.
- With "3", each message is sent a total of three times at short intervals.

Multiple transmissions of the same message increase the probability that each message will actually arrive at the gateway and therefore in the IoT system if the message transmission is "Unconfirmed".

At the same time, however, this also increases the utilization of the LoRa wireless network. In a LoRaWAN network operating near the network capacity limit or with high utilization, there may be an increased likelihood of telegram collisions between different transmitting devices. Messages sent simultaneously from different devices overlap on the wireless transmission path. On the receiving side, this can cause these messages to become inconsistent and therefore be discarded. Multiple transmissions of the same message in LoRaWAN networks with high utilization can therefore counteract the original intention of increasing the probability of receiving the message on the gateway side.

Note

The number of transmissions selected here applies exclusively to event-triggered messages. It does not affect regularly transmitted messages triggered by the "LoRa Transmission Interval" or "GPS Acquisition Interval".

8.3.12 Expert Mode

Activation of expert mode enables further adjustment options of the ultrasonic sensor.

This includes the optional execution of a measurement sequence including the corresponding evaluation instead of the execution of only one single measurement.

Another function is optional post-processing of the measured value by appropriate filters.

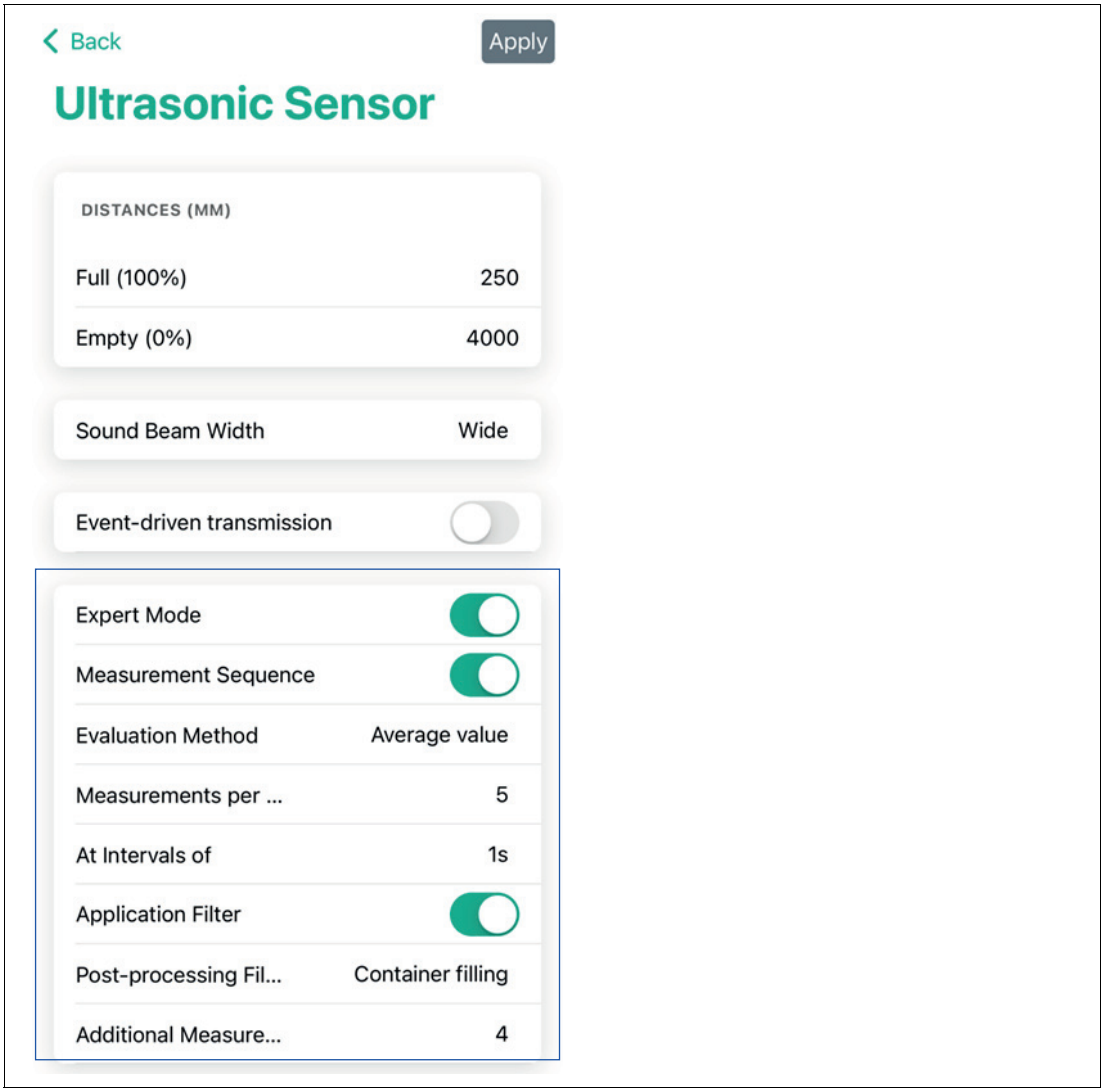


Figure 8.7

8.3.13 Measurement Sequence

Enabling this parameter allows you to perform a sequence of multiple ultrasonic distance measurements at defined time intervals instead of the normal single measurement and to smooth the data recorded in this way using an evaluation method.

By enabling this parameter in the app, the following three additional parameters are displayed:

- Evaluation Method
- Measurements per Seq
- At Intervals of

8.3.14 Evaluation Method

This parameter allows you to define the method used to process the data recorded in the measurement sequence. Currently, the only available option is "Average Determination." The outliers of the data recorded in the measurement sequence are first determined and excluded from further processing. The arithmetic average is then calculated using the remaining data.

The number of outliers N depends on the number of measurements per sequence M. The following assignment applies.

M	N
1	0
2	0
3	1
4	1
5	2
6	2
7	3
8	3
9	4
10	4

Table 8.2

8.3.15 Measurements per Seq & At Intervals of

These two parameters allow you to define the number of measurements that make up the measurement sequence and the time interval at which they are performed.

Note

Note that the total time required to execute the measurement sequence may consist of up to several minutes, depending on the setting selected.

In extreme cases, for ten measurements at intervals of one min., it will take ten minutes until the next new measured value is available and can be transmitted.

The measured values of the ultrasonic measurement displayed in the WILSEN app in the "Sensor Status & Configuration" view are also only updated after the total time required for executing a set measurement sequence.

Note

To ensure the longest possible battery service life, activate a measurement sequence instead of an individual measurement only if this is required in your application to obtain stable data. Keep the number of "Measurements per Sequence" as low as necessary. By contrast, the parameter "At Intervals of," has no effect on the energy consumption required for the execution of a measurement sequence.

8.3.16 Application Filter

Enabling this parameter allows the new measured value determined from the individual measurement / measurement sequence to be post-processed or further smoothed by means of a filter before being transferred. Depending on the application, this may improve the stability of the data even further.

8.3.17 Post-processing Filter

Depending on the selected filter, the measured value taken from the measurement sequence or recorded as an individual measurement is considered and evaluated in combination with historical data.

Currently, only the "Container filling" option is available as a post-processing filter.

The "Container filling" filter is intended for sensor applications in collection containers (old clothes, recycling, raw materials, etc.). In these applications, a container is continuously filled with content for a prolonged period of time. When a certain fill level is reached, the container is emptied.

The container filling filter always remembers the latest maximum value of the percentage fill level during the current filling phase. If the new measured value is below this value, the last maximum value is still transmitted. If the new measured value is higher than the last maximum value, the maximum value is adjusted and the new maximum value of the percentage fill level is transmitted.

If the percentage fill level is abruptly reduced by more than 50 %, the filter assesses this to be the emptying process of the container. It adjusts the stored maximum value to the newly acquired lower level.

If the container is emptied at a fill level of less than 50 %, the filter likewise assesses a subsequently measured fill level value in the range of 0 .. 3 % as an "emptied container." The filter likewise adjusts the stored maximum value to the newly acquired lower level.

Note

This filter only affects the percentage fill-level value, not the distance value in mm. The distance value always corresponds to the last determined distance value, even if the container filling filter is enabled.

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8.3.18 Additional Measurements

The application filter can be supplied with additional intermediate values by additional measurements / measurement sequences. Depending on the application, this may result in an even more stable or better smoothed fill level value.

The number of additionally set measurements / measurement sequences is carried out by the sensor, evenly distributed over time, within the set LoRa transmission interval.

For example:

- set LoRa transmission interval = six hours
- additional measurements = five

A measurement / measurement sequence is carried out every hour. Every six hours, the measured value determined within this six hour interval and evaluated via the filter is transmitted via LoRaWAN.

Note

The additional data is only collected and fed into the filter, but is not transferred individually.

8.3.19 "Apply" Button

The changes made to parameters are only transferred to the device and permanently stored there when the "Apply" button is tapped.

8.4 GPS Configuration Submenu

In this submenu, you can switch on the GPS function of the WILSEN device and set the GPS accuracy, the position determination frequency, and the transmission settings for the associated messages ("Payload 2").

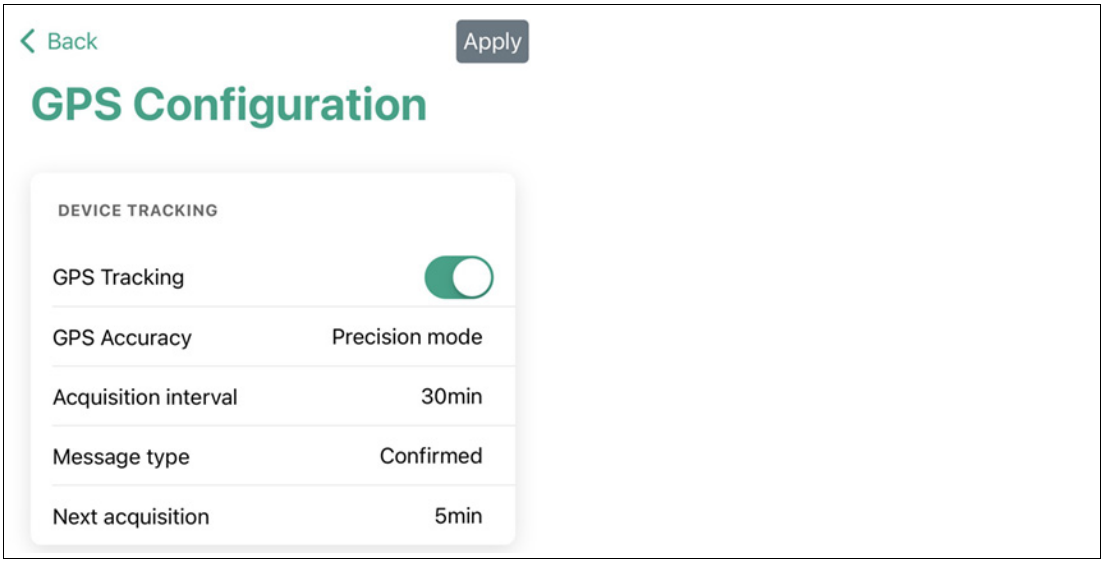


Figure 8.8

Note

An initial or newly initiated acquisition of the GPS position will only take place after the time set in the "Next acquisition" parameter has elapsed. Unless another setting has been made for this parameter, the default setting is five minutes. When you tap the "Apply" button, a corresponding countdown timer is displayed at the bottom of the GPS configuration menu. After the 1st successful acquisition of the sensor, this countdown timer in the app will disappear.

8.4.1 GPS Tracking

This switch activates the GPS function of the WILSEN device. The following additional parameters will then be displayed in the app.

- GPS Accuracy
- Acquisition interval
- Message type
- Number of transmissions
- Next acquisition

8.4.2 GPS Accuracy

WILSEN.sonic devices with firmware version 2.5.11 or later offer the option of defining the positioning accuracy for GPS localization.

Each position acquisition generally requires a relatively large amount of energy and therefore always has a negative impact on the battery life. However, the accuracy of position acquisition is also crucial for the amount of energy required. The more precise the position needs to be, the longer the GPS module has to be in operation to locate it and the higher the energy requirement.

The two selection options for the "GPS Accuracy" parameter are:

- "Eco mode"
  "Eco mode" is suitable for all applications where locating the WILSEN device with an accuracy of approx. 75–100 meters from the actual position is sufficient. A medium level of energy consumption is sufficient for this accuracy.
- "Precision mode"
  "Precision mode" achieves positioning accuracies of around five to ten meters from the actual position. The energy requirement in "Precision mode" is disproportionately higher and has a greater impact on the battery life than "Eco mode".

Note

Select the GPS accuracy that is appropriate for your application and locate the device only as often as necessary to achieve the longest possible battery life.

If the position of the WILSEN device does not have to be tracked permanently, it is possible to switch its GPS localization on and off as required via the LoRaWAN downlink channel using the "GPS Tracking (ON/OFF)" parameter and, if necessary, the additional "Acquisition Interval" and "Next Acquisition" parameters. Despite the need for temporary device localization, this significantly extends the battery life.

You can easily estimate the impact of GPS localizations of the WILSEN device on the settings required for your application using our battery runtime calculator. You can find this at https://wilsen-services.pepperl-fuchs.com.

8.4.3 Acquisition Interval

The "Acquisition Interval" parameter determines the frequency of the GPS position determination. At each of these points in time, an ultrasonic distance measurement or distance measurement sequence is performed in parallel with the acquisition according to the settings in the ultrasonic sensor. The data collected in this way is transmitted together in "Payload 2".

Note

More information on the structure and content of "Payload 2" can be found in the additional document entitled "Payload Description (Uplink)" on the product details page at www.pepperl-fuchs.com.

The payload decoders (uplink and downlink) suitable for the WILSEN device can be found at the same location in the "Software" section.

Note

The collection of GPS data requires relatively high power consumption. To ensure the longest possible battery service life, select the appropriate GPS acquisition interval for your application. However, avoid "unnecessarily frequent" acquisition.

If the position of the WILSEN device does not have to be tracked permanently, it is possible to switch its GPS localization on and off as required via the LoRaWAN downlink channel using the "GPS Tracking (ON/OFF)" parameter and, if necessary, the additional "Acquisition Interval" and "Next Acquisition" parameters. Despite the need for temporary device localization, this significantly extends the battery life.

You can easily estimate the impact of GPS localizations of the WILSEN device on the settings required for your application using our battery runtime calculator. You can find this at https://wilsen-services.pepperl-fuchs.com.

Note

The "GPS Acquisition Interval" works independently of a "LoRa Transmission Interval" that may be activated in parallel in the sensor (see chapter 8.5)

and of activated event-driven monitoring and transmission (see chapter 8.3.6).

8.4.4 Message Type

This parameter can be used to select one of the two typical LoRaWAN message types for transmitting the "Payload 2" sent in connection with GPS localization:

- "Unconfirmed" transmission:
  When you select the message type "Unconfirmed", the WILSEN device sends its message to the gateway according to the set "Number of transmissions" (see following parameter). However, it does not expect a receipt confirmation from the gateway.
- "Confirmed" transmission:
  When you select the message type "Confirmed", the WILSEN device sends its message to the gateway and expects a receipt confirmation. If this is not received within a specified time frame, the device sends its message to the gateway a maximum of two more times. The WILSEN device performs a total of three transmission attempts. After the 3rd attempt, if no confirmation is received from the LoRa network server, the WILSEN device discards the current message.

Note

The message type selected here applies exclusively to "Payload 2" transmissions triggered by the "GPS Acquisition Interval". The message type does not affect regularly transmitted messages triggered by the "LoRa Transmission Interval". The transmission of messages due to event-driven monitoring also remains unaffected by this.

8.4.5 Number of Transmissions

Note

This parameter is only available if the message type is set to "Unconfirmed".

You can choose between the values "1" and "3" as the number of message transmissions (payload).

- With "1", the WILSEN device sends each message (payload) toward the gateway only once.
- With "3", each message is sent a total of three times at short intervals.

Multiple transmissions of the same message increase the probability that each message will actually arrive at the gateway and therefore the IoT system if the message transmission is "Unconfirmed". This also increases the utilization of the LoRa wireless network.

In a LoRaWAN network operating near the network capacity limit or with high utilization, there may be an increased likelihood of telegram collisions between different transmitting devices. Messages sent simultaneously from different devices overlap on the wireless transmission path. On the receiving side, this can cause these messages to become inconsistent and therefore be discarded. Multiple transmissions of the same message in LoRaWAN networks with high utilization can therefore counteract the original intention of increasing the probability of receiving the message on the gateway side.

Note

The message type selected here applies exclusively to "Payload 2" transmissions triggered by the "GPS Acquisition Interval". The message type does not affect regularly transmitted messages triggered by the "LoRa Transmission Interval". The transmission of messages due to event-driven monitoring also remains unaffected by this.

8.4.6 Next Acquisition

This parameter is used to define when the next GPS acquisition and therefore also when the next transmission of the relevant payload is to take place. In this way, acquisitions and transmissions can also be defined by multiple WILSEN devices at specific times of the day, depending on the application.

This parameter can also be very helpful if the localization function is only activated as required via the LoRaWAN downlink channel, since this can be used to initiate the very timely start of a new localization after the downlink communication.

8.4.7 "Apply" Button

The changes made to parameters are only transferred to the device and permanently stored there when the "Apply" button is tapped.

Note

An initial or newly initiated acquisition of the GPS position will only take place after the time set in the "Next acquisition" parameter has elapsed. Unless another setting has been made for this parameter, the default setting is five minutes. When you tap the "Apply" button, a corresponding countdown timer is displayed at the bottom of the GPS configuration menu. After the 1st successful acquisition of the sensor, this countdown timer in the app will disappear.

8.5 LoRaWAN Configuration Submenu

The **LoRaWAN Configuration** submenu is used to set the wireless connection parameters specific to LoRaWAN and to set the transmission interval.

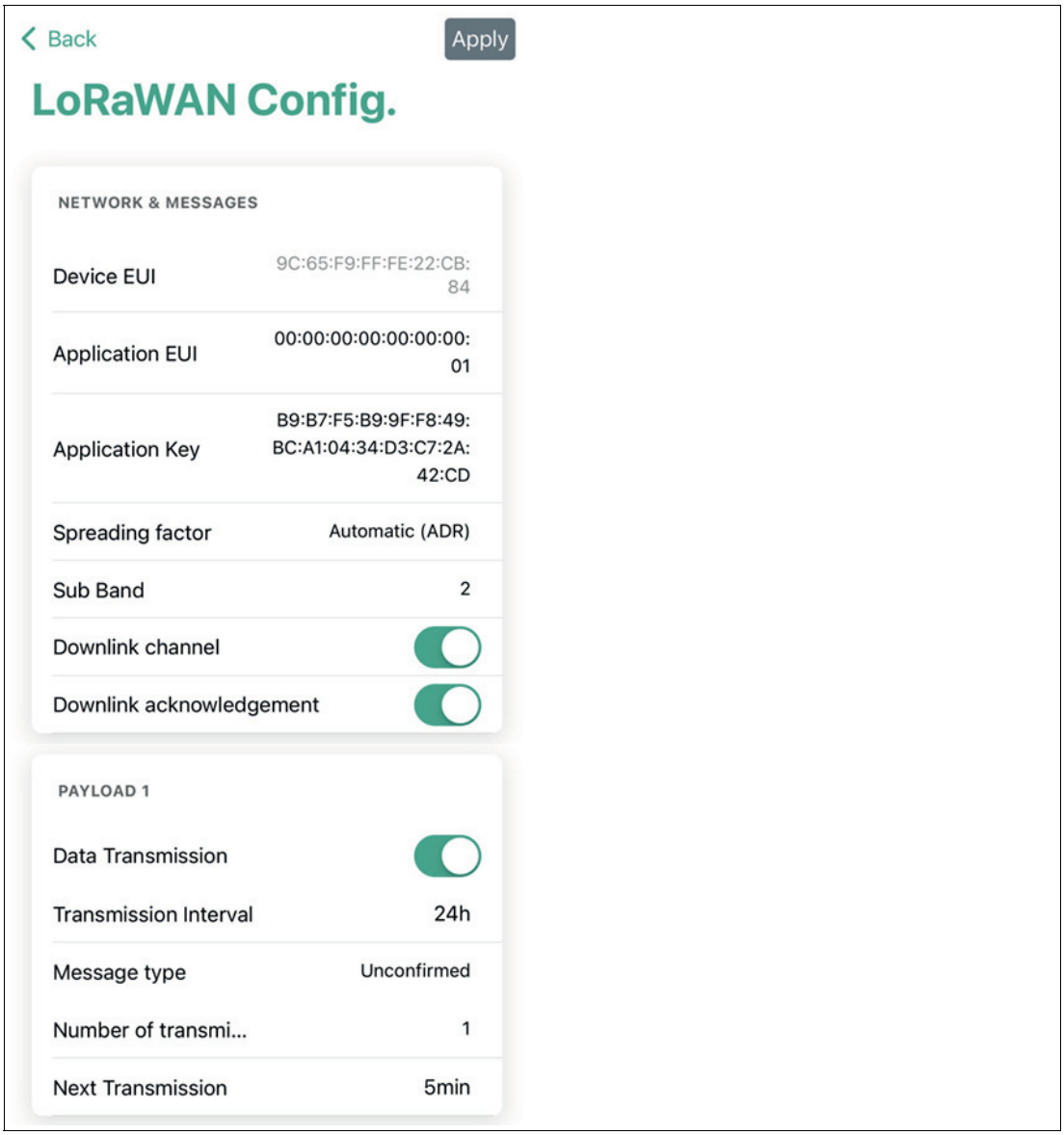


Figure 8.9

8.5.1 Device EUI

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

The device EUI is assigned to every device as a globally unique number according to IEEE rules. For this reason, it is not possible to change the device EUI of your sensor.

8.5.2 Application EUI/Join EUI

Application EUI/Join EUI is an identifier optionally assigned by the LoRa network server (LNS) or by you for the relevant application.

The application EUI is preset with a uniform value and is identical for each sensor in the delivery state. This value can be used to establish a connection to a LoRa network. However, it is recommended that this value be adjusted to suit the particular LoRa environment when the sensor is commissioned.

8.5.3 Application Key

The application key is used to encrypt the sensor measurement data before it is transmitted.

A random number is assigned at the factory as the application key and this is unique for each sensor unit. This default value only needs to be changed if the LoRa network provider or an existing LoRa environment defines a specific value for the application key. If it is not defined in this way, the application key provided by the sensor unit can be transferred to the intended LoRa environment.

8.5.4 Spreading Factor

The spreading factor is a LoRaWAN parameter that is used to set the transmission strength and data rate of the device. These values depend on the individual influences and conditions on the wireless link between the device and the gateway.

The following two relationships apply:

- Device: The higher the spreading factor, the higher the transmitting power and longer the transmission duration and therefore the higher the energy consumption in the transmitting device.
- LoRaWAN network: The higher the spreading factor, the longer the data transmission and therefore the higher the load/occupancy of the LoRaWAN network.

Further details can be found at https://lora-alliance.org/about-lorawan/.

In most applications, "Automatic (ADR)" (adaptive data rate) is the appropriate setting. In this case, the LoRa network server regulates the sensor spreading factor to a degree that is appropriate to the actual conditions of the wireless link. First, the wireless transmission begins after the sensor rejoins/joins (Join / Rejoin) the LoRa network with a high spreading factor. This ensures that the first transmissions are successful even under poor conditions. The spreading factor is gradually reduced depending on the signal strength received and the signal-to-noise ratio. The LoRaWAN network server performs this task.

The "Automatic (ADR)" setting usually represents the optimal compromise between energy consumption for wireless transmission, low load on the LoRaWAN wireless network due to short transmission time, and good reliability of data reception on the server side.

In some applications, there are no stable conditions on the wireless link. Changes in the environmental influences or EMC influences occur. Both can lead to unreliable transmission of the data.

There are also applications in which there is essentially only poor LoRaWAN wireless coverage. For example, this could be in an urban environment with only a few gateways that may be positioned very far away and/or with sensor operating locations that are heavily shielded in terms of wireless technology.

In such circumstances, the "Automatic (ADR)" setting may not work reliably. Either no data can arrive at the gateway or only sporadically, i.e., with dropouts. For these applications, a fixed setting of the spreading factor is usually advantageous—usually a high setting such as SF11 or SF12.

Conversely, there are also applications in which consistently very good LoRa network coverage is ensured. In such a case it can also be advantageous to set the spreading factor to a fixed value. We recommend low settings such as SF7 and SF8. Therefore, even when the sensor joins/rejoins, the spreading factor is directly adapted to the very good conditions, which means a lower energy consumption than with "ADR."

Note

The selected spreading factor applies to the transmission of all payloads of the device.

To ensure the longest possible battery life, select a spreading factor appropriate for your application. Avoid unnecessarily high settings.

8.5.5 Sub Band

Note

The "Sub Band" parameter is only available on WILSEN devices that use LoRaWAN frequency plan US915 (type designations WS*-B41-02-*) or AU915 (type designations WS*-B41-03-*).

In LoRaWAN frequency plans US915 and AU915, the available frequency range is divided into eight fixed blocks, known as sub-bands. Each block contains eight narrowband 125 kHz channels and a wider 500 kHz channel.

The WILSEN and the gateway must be configured to use the same sub-band for the join process and data transmission to function correctly.

For most LoRa networks, "Sub Band 2" has become the standard, which is why WILSEN devices are factory-set to use "Sub Band 2" by default. If you are using a LoRa network that requires a different setting, you can configure it using this parameter.

After the WILSEN has successfully joined the LoRa network, the gateway may expand or adapt the sub-bands used by the WILSEN during normal operation. This depends on the number of gateway channels and its configuration. It does not require any further user intervention at the WILSEN device level. If a new join process is required for the WILSEN device in the LoRa network, it is automatically performed again using the sub-band configured in the WILSEN via this parameter.

Note

This parameter can only be set using the WILSEN app. There is no corresponding downlink command for it.

8.5.6 Downlink Channel

Note

The downlink channel in the device is switched on at the factory in the delivery state.

A detailed description of how the downlink channel works and how to use it can be found in the separate document "Downlink Description." You can download this online from the product detail page relating to your WS*F406-B41 WILSEN device at www.pepperl-fuchs.com.

This parameter is used to activate the downlink channel in the WILSEN device. When the downlink channel is switched on, the WILSEN device is able to receive and process messages via the LoRa network. This allows you to query or change parameter settings in the WILSEN device via the LoRa network.

8.5.7 Downlink Acknowledgement

Note

This parameter is only available if the downlink channel is activated.

If this parameter is activated, the WILSEN device sends a confirmation to the LoRa network server in response to incoming downlink messages after they have been processed. In this way, it is possible to check the correctness of a command and its proper processing in the WILSEN device.

If the downlink acknowledgement is not activated, the device will process incoming downlink messages with changed parameter values, but no acknowledgement will be sent to the LoRa network server.

It is always possible to query the currently set parameter values in the WILSEN device via the downlink channel, regardless of the downlink acknowledgement, even if the acknowledgement is deactivated.

8.5.8 Data Transmission

As long as the "Data Transmission" parameter is enabled in the "LoRaWAN Configuration" menu, the sensor sends the data contained in "Payload 1;" see separate document entitled "Payload Description." The frequency of this transmission and the time schedule are defined using the additional parameters "Transmission Interval" and "Next Transmission".

8.5.9 Transmission Interval

This parameter determines the time intervals at which data transmission takes place. If "6h" is selected, the sensor sends its data every six hours. The start time of the interval can be controlled using the "Next Transmission" parameter.

Note

The transmission interval selected here applies exclusively to regular "Payload 1" transmissions.

It has no effect on Payload 2 transmissions triggered by the set "GPS interval".

The transmission of messages due to event-driven monitoring also remains unaffected by this.

Caution!

Observe the maximum permissible transmission time per device!

Legal regulations in Europe allow a maximum permissible transmission time (air time/duty cycle) of 1 % per hour for the use of the 868 MHz band per device. The configured transmission intervals (>> LoRa transmission interval, >> GPS interval and >> monitoring interval) and the resulting message transmissions may not collectively exceed the maximum permitted transmission time. The spreading factor used for transmission must also be taken into account, because it also has a significant effect on the duration of the message transmission. If event-driven monitoring is not enabled in the WILSEN device and the LoRa transmission interval is at least 30 minutes, it can be assumed that the permitted transmission time will not be exceeded under any LoRa transmission conditions, even when a GPS interval is additionally configured. Compliance is also ensured when only a LoRa transmission interval of 5 minutes or 10 minutes is active in the device (i.e., there is no event-driven monitoring or GPS interval). For all other configurations, and especially when event-driven monitoring is activated, compliance with this requirement must be carefully verified, taking into account the specific conditions of the application. A LoRa transmission interval of less than five minutes may only be set for a very short time. If such a setting is configured in the app, a corresponding message is displayed and the parameter is reset to the last non-critical value as soon as the app connection to the sensor is terminated.

The WILSEN device does not accept transmission intervals of less than 5 minutes when configured via the LoRaWAN downlink channel.

The user is responsible for complying with the 1 % requirement. Failure to comply with this requirement may result in criminal penalties.

Please note that in other countries, based on legal requirements or requirements issued by LoRa network operators and other institutions, additional, possibly stricter restrictions may apply and must be observed.

Note

To ensure the longest possible battery life, select a transmission interval appropriate for your application. However, avoid setting an "unnecessarily short" interval and therefore "too frequent" measurement and transmission.

8.5.10 Message Type

LoRaWAN offers two possible message types for the transmission of a device payload:

- "Unconfirmed" transmission:
  When you select the message type "Unconfirmed", the sensor sends its message to the gateway according to the set "Number of transmissions" (see following parameter). However, it does not expect a receipt confirmation from the gateway.
- "Confirmed" transmission:
  When you select the message type "Confirmed", the sensor sends its message to the gateway and expects a receipt confirmation. If this is not received within a specified time frame, the sensor sends its message to the gateway a maximum of two more times. The sensor performs a total of three transmission attempts.
  If no confirmation is received from the LoRa network server after the 3rd attempt, the sensor discards the current message. After the set LoRa transmission interval has expired, the sensor rejoins the LoRa network. It then records new data, which is then transmitted again with a request for a receipt confirmation.

Usually, LoRaWAN sends the measurement data from devices to the gateway "Unconfirmed". This minimizes the load on the LoRaWAN network and allows receipt of multiple messages simultaneously on different gateway channels. Receipt of messages is therefore possible in most events. Of course, especially with this type of transmission, messages from one or more devices may not be received by the gateway.

If it is necessary to ensure that a message is received at the gateway, the message type should be "Confirmed". Examples include the alarm message from a smoke detector or when using the WILSEN products as overfill protection or similar. However, it should be noted in this case that for each message from each device set up in this way, a receipt confirmation is requested/required by the gateway. While the gateway is sending this receipt confirmation, the high signal strength means that it is not possible to receive other messages on the gateway at the same time. This quickly overloads the LoRa network, especially in the case of a high number of communications with requested confirmation. It may also be the case that no other messages can be received.

For this reason, there is a general time limit for the downlink transmission capacity for LoRaWAN gateways. This relates to the transmission of data from the gateway toward the devices. LoRaWAN gateways may only use a maximum of 10 % of their total operating time to send downlink messages. In other words: 90 % of the time, the gateway must be available to receive messages.

Note

The message type selected here applies exclusively to transmissions of "Payload 1" triggered by the "LoRa Transmission Interval" and to the transmission of "Payload 3" (status payload). It does not affect regularly transmitted messages triggered by the "GPS Acquisition Interval". The transmission of messages due to event-driven monitoring also remains unaffected by this.

Only select a "Confirmed" transmission of the data if it is absolutely necessary for your application. In this case, the setting for the measurement / transmission interval must also be as long as possible.

8.5.11 Number of Transmissions

Note

This parameter is only available if the message type is set to "Unconfirmed".

You can choose between the values "1" and "3" as the number of message transmissions (payload).

- With "1", the sensor sends each message (payload) toward the gateway only once.
- With "3", each message is sent a total of three times at short intervals.

Multiple transmissions of the same message increase the probability that each message will actually arrive at the gateway and therefore the IoT system if the message transmission is "Unconfirmed". At the same time, however, this also increases the utilization of the LoRa wireless network. In a LoRaWAN network operating near the network capacity limit or with high utilization, there may be an increased likelihood of telegram collisions between different transmitting devices. Messages sent simultaneously from different devices overlap on the wireless transmission path. On the receiving side, this can cause these messages to become inconsistent and therefore be discarded. Multiple transmissions of the same message in LoRaWAN networks with high utilization can therefore counteract the original intention of increasing the probability of receiving the message on the gateway side.

Note

The number of transmissions configured here applies exclusively to transmissions of "Payload 1" triggered by the "LoRa Transmission Interval" and to the transmission of "Payload 3" (status payload). It does not affect regularly transmitted messages triggered by the "GPS Acquisition Interval". The transmission of messages due to event-driven monitoring also remains unaffected by this.

Decide on the number of transmissions for a message carefully and according to the requirements of your application.

8.5.12 Next Transmission

This parameter determines the start time of the transmission interval. Depending on whether you set the parameter via the WILSEN app or via the LoRaWAN downlink channel, the 1st data transmission takes place at different times.

- Via the WILSEN app:
  For example, if the "Next Transmission" parameter is set to "5 min", the 1st data transmission of the set interval takes place five minutes after the changed settings have been transmitted to the sensor by tapping the "Apply" button.
- Via the LoRaWAN downlink channel:
  With this parameterization, the 1st data transmission of the set interval takes place five minutes after the corresponding LoRaWAN downlink message is received by the WILSEN device.

By configuring this parameter, it is also possible to define a transmission time within a specific time frame for a number of sensors, e.g., "always in the first quarter of an hour".

8.5.13 "Apply" Button

The changes made to parameters are only transferred to the device and permanently stored there when the "Apply" button is tapped.

A payload transmission according to adjusted LoRaWAN settings first takes place after the time set in the "Next Transmission" parameter has expired. Therefore, when you tap the "Apply" button, a corresponding countdown timer is displayed at the bottom of the LoRaWAN configuration menu. After the first transmission and therefore also during normal operation of the sensor, this countdown counter in the app is hidden again.

8.6 Device Configuration Submenu

The **Device Configuration** submenu displays the device name and allows you to disable the Bluetooth interface of the sensor, change the device password, reset the device to factory settings, and reset the counters.

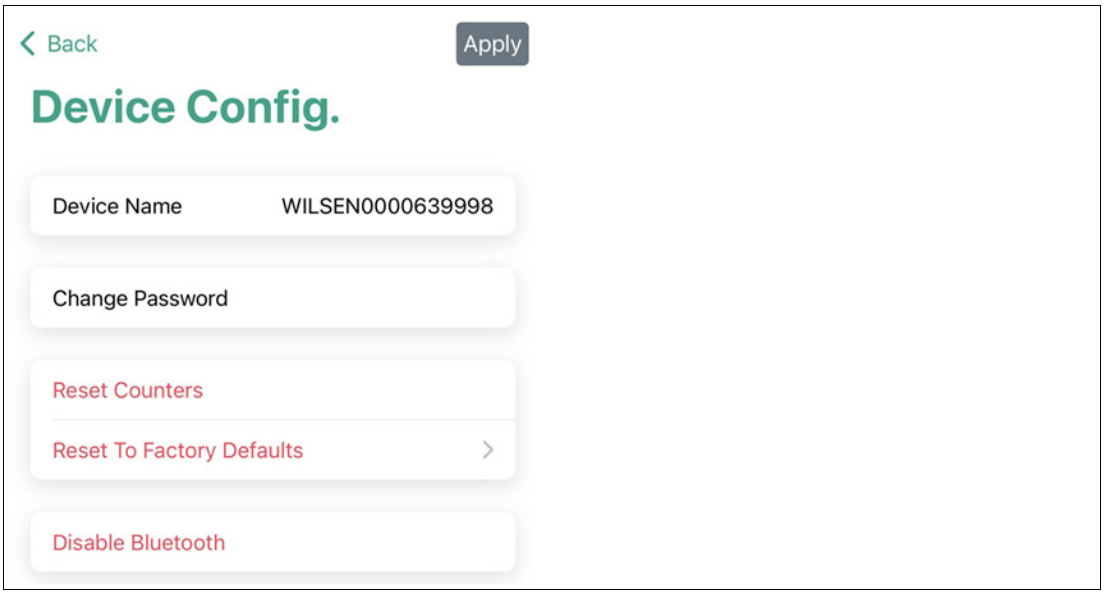


Figure 8.10

8.6.1 Device Name

The device name that is currently assigned to the device is displayed here. You can change this by tapping the name and customizing it using the keyboard that appears.

8.6.2 Change Password

Here you can change the password for accessing the sensor via the Bluetooth interface. The default value for the password is "00000000".

As a password, you can enter an unlimited number of alphanumeric characters and special characters from the UTF-8 character range.

To ensure a sufficient level of security, we strongly recommend that the sensor password is changed when the device is commissioned so that it differs from the default password. The new password must consist of at least eight characters and must also be changed at regular intervals in the future.



Caution!

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

Make a note of the new password in a secure location. Neither the user nor the manufacturer can reset or retrieve a forgotten or lost password.

8.6.3 Reset Counters

Use this button to reset the counters that are running in the sensor to monitor the frequency of front-end sensor queries, GPS position acquisition, and LoRa transmissions. This may be useful after a battery change.



Note

The current counter readings can be found in the "Sensor Information" menu and are cyclically transmitted in a trimmed-down form with the sensor heartbeat ("Payload 3") via LoRaWAN.

Only the counter readings since last reset can be reset. The total counter readings are continuously incremented from the production of the sensor and cannot be reset.

8.6.4 Reset to Factory Settings

This button takes you to another submenu where three reset options are available.



Figure 8.11

Include password

If you select this option, all device parameters, including the password, are reset to the factory settings. The LoRa credentials will remain unchanged.

Include LoRa credentials

If you select this option, all device parameters, including the LoRa credentials, are reset to the factory settings. The password will not be reset.

Everything

If you select this option, all device parameters, including the password and LoRa credentials, are reset to the factory settings. The sensor will completely revert to its delivery state.

8.6.5 Disable Bluetooth

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 even more difficult.

You can reactivate the Bluetooth interface by disconnecting the battery for approximately ten seconds and reconnecting it. Alternatively, you can use the LoRaWAN downlink channel to switch Bluetooth on again on the respective device using the corresponding command. This requires an activated downlink channel in the device; see chapter 8.5.6.

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. The sensor can then no longer be found in the device search list of the app.

8.7 Device Information Submenu

The **Device Information** submenu contains a variety of information about the device, such as device data and counter readings. It also includes the function for over-the-air firmware updates.

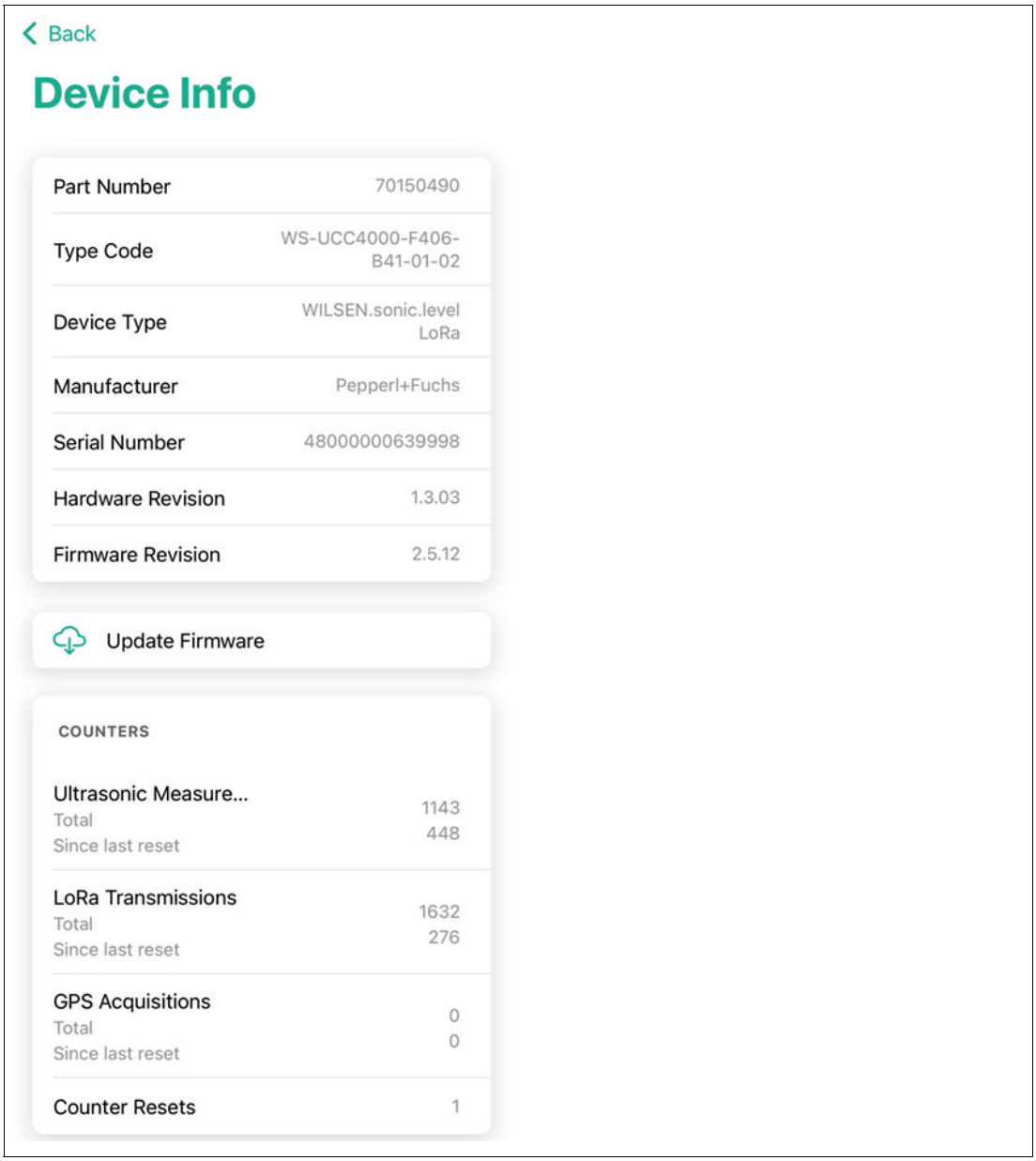


Figure 8.12

8.7.1 Firmware Update

Note

You can only update the device firmware using the WILSEN app and via the device's Bluetooth interface, not via LoRaWAN.

Pressing this button initiates an over-the-air update of the device firmware after a confirmation prompt. A newer version of the firmware is downloaded and installed on the device via the internet connection of the mobile device you are using.

Note

If a more up-to-date version is available, executing this function will overwrite the existing firmware on the device without any further prompt. Some device parameters may be reset to their factory settings.

After updating to a newer firmware version, it is no longer possible to revert to an earlier firmware version.

8.7.2 Counters

The device logs the execution frequency of some functions. The collected data is displayed under the heading "Counters". In each case, the frequency since the device was manufactured (= "Total counter readings") and the frequency since the last reset of the counter readings are displayed.

"Counter Resets" also shows how many times the user has reset the counter readings on the current device. This data also provides information about the life status and the history of the device.

Note

The full range of counter readings only appears in the WILSEN app.

However, all counter readings since the last reset are also transmitted once a day via LoRaWAN as part of the status payload (payload 3), therefore providing information about the device life status.

9 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.

10 Exchanging the Battery

The device battery is exchangeable. Spare 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.

Safety Notes for Exchanging the Battery

Warning!

Risk of injury if the battery is faulty!

This device uses a high-energy cell for its voltage supply. This battery contains lithium and thionyl chloride. If these substances escape, the appropriate protective measures must be observed. Refer to the safety datasheet.

In the event of leakage, contact with the skin or eyes may cause severe irritation and burns. Inhalation of electrolyte vapors may affect the upper respiratory tract and lungs.

Note

You can find the safety datasheet for lithium thionyl chloride batteries online at www.pepperl-fuchs.com, on the product detail page for the respective WILSEN device.

Warning!

Non-genuine batteries jeopardize operational safety!

Use only genuine spare 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. Unapproved batteries may become discharged earlier than genuine batteries.

Note

Observe the following rules when exchanging the battery

- Before opening the device, make sure that moisture cannot penetrate the device and, if necessary, rub the device dry.
- Before and while opening the device, check that the battery to be exchanged is intact and that no chemicals have leaked out. If they have, stop exchanging the battery immediately and close the enclosure. Observe the information in the safety datasheet for the battery.
- Ensure that the new battery is well-secured in the device by the hook-and-loop tape and ensure that no part of the hook-and-loop tape will be trapped by the closing edge of the enclosure.
- Make sure that the battery connection cable is only routed inside the device and cannot be trapped when the enclosure cover is closed.

Exchanging the Battery

Note

The following steps use a WILSEN.sonic.level device as an example. The procedure is the same for all WILSEN device versions.



Figure 10.1

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

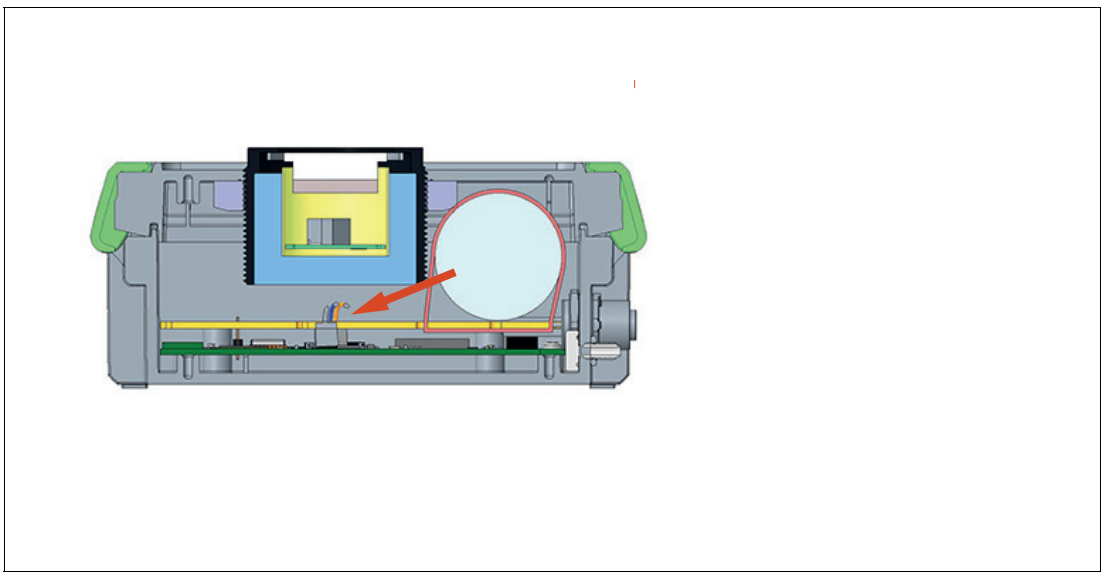


Figure 10.2

3. Carefully pull the plug of the battery connection cable out of the connector.
4. Detach the hook-and-loop tape securing the battery and remove the old battery.
5. Dispose of the battery in accordance with regulations.

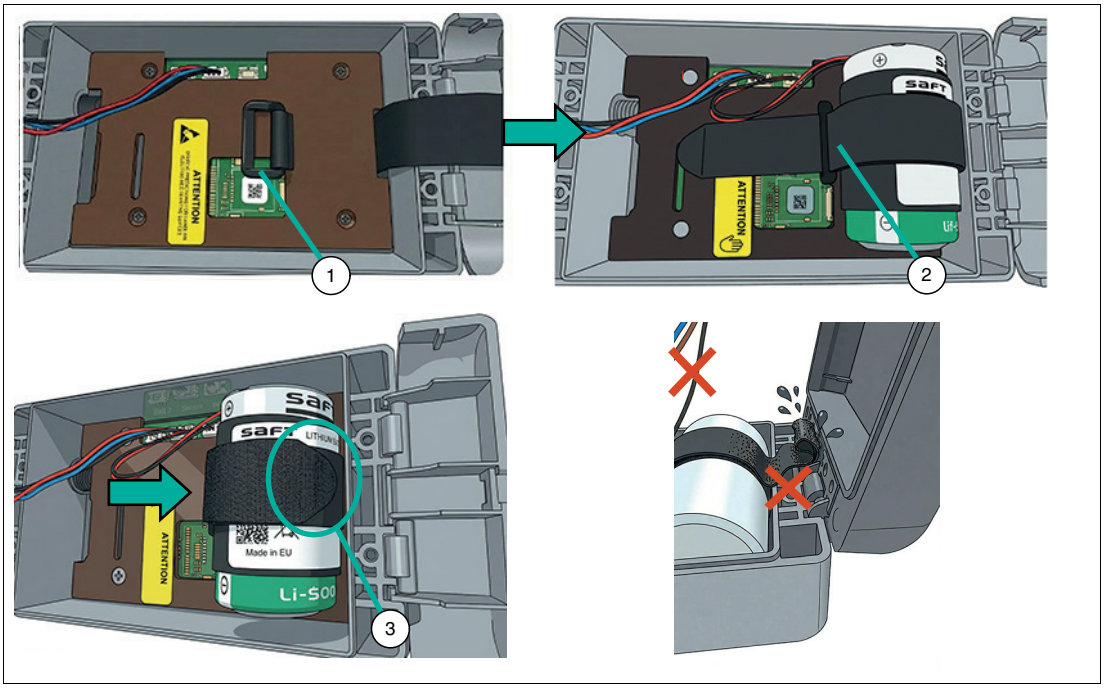


Figure 10.3

6. Before inserting the new battery, make sure that the clasp (1) for the hook-and-loop tape is close to the base plate. If this is not the case, correct the position of the hook-and-loop tape and insert the battery in the intended installation position.
7. Place the hook-and-loop tape around the battery and guide it through the clasp (2).
8. Tighten and secure the hook-and-loop tape so that it fits tightly around the battery and ends near the closing edge of the enclosure (3). No part of the hook-and-loop tape may be outside the enclosure or on the closing edge of the enclosure cover.
9. 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.
10. Check that the LED briefly lights up. This indicates that the device is ready for operation.

Caution!

Do not trap the battery cable and hook-and-loop tape.

When closing the enclosure cover, take care to ensure that the battery connection cable and hook-and-loop tape are completely in the enclosure and are not trapped by the closing edge. Otherwise, the device may malfunction and the degree of protection can no longer be guaranteed.

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

Note

After exchanging the battery, it may be useful to reset the sensor operating counters. If you want to do this, launch the WILSEN app on your mobile device and switch to the "Device configuration" menu. Select the "Reset counters" function.

It is also possible to reset the operation counters by sending the corresponding command via the LoRaWAN downlink channel.

11 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

12 Repair

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

13 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.

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