Pyxis®

PRL-100 Personal Radar Level Sensor

Near-Field Communication Tank Scanner with LoRa Capability

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USER MANUAL

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Limited Warranty

Pyxis Lab warrants its products for defects in materials and workmanship. Pyxis Lab will, at its option, repair or replace instrument components that prove to be defective with new or remanufactured components (i.e., equivalent to new). The warranty set forth is exclusive and no other warranty, whether written or oral, is expressed or implied.

Warranty Term

The Pyxis warranty term is thirteen (13) months ex-works. In no event shall the standard limited warranty coverage extend beyond thirteen (13) months from the original shipment date.

Warranty Service

Damaged or dysfunctional instruments may be returned to Pyxis for repair or replacement. In some instances, replacement instruments may be available for short duration loans or lease.

Pyxis warrants that any labor services provided shall conform to the reasonable standards of technical competency and performance effective at the time of delivery. All service interventions are to be reviewed and authorized as correct and complete at the completion of the service by a customer representative or personnel. Pyxis warrants these services for 30 days after the authorization and will correct any qualifying deficiency in labor provided that the labor service deficiency is exactly related to the originating event. No other remedy, other than the provision of labor services, may be applicable.

Repair components (parts and materials), but not consumables, provided during a repair, or purchased individually, are warranted for 90 days ex-works for materials and workmanship. In no event will the incorporation of a warranted repair component into an instrument extend the whole instrument's warranty beyond its original term.

Warranty Shipping

A Repair Material Authorization Number (RMA) must be obtained from Pyxis Technical Support before any product can be returned to the factory. Pyxis will pay freight charges to ship replacement or repaired products back to the customer. The customer shall pay freight charges for returning products to Pyxis. To receive an RMA you can generate a request on our website at https://www.pyxis-lab.com/request-return-or-repair/

Pyxis Technical Support

You can contact Pyxis Technical Support at 1-866-203-8397 or service@pyxis-lab.com

Table of Contents

1. Introduction

The Pyxis PRL-100 sensor is W-band FMCW continuous frequency modulation radar level transmitter designed for personal use in the field. The device provides continuous liquid level measurements up to 591 inches (49.2 ft. or 15 m) and is integrated with LoRa (Long Range Radio) output, BlueTooth 5.0® and NFC (Near Field Communication) for container tag scan identification. The PRL-100 radar level sensor is ideal for your chemical inventory tracking applications by servicing facilities with multiple container locations. It allows easy identification of each labeled container with an NFC Tag scanning feature, take a liquid level measurement (through plastic) within 10 seconds and show important statistical data such chemical usage rate and remaining inventory.

The PRL-100 Series has a 2.8" LCD display and 3 buttons for rapid configuration and can be wirelessly configured via the Pyxis **uPyxis®** app for Mobile or Desktop devices enabling rapid integration and deployment in the field. The sensors are powered by a 3.7V rechargeable lithium battery. This non-contact liquid level sensor platform is well suited for corrosive liquids and can be used for industrial, municipal and process liquid storage as well as chemical feed applications.

2. Specifications

Specification	PRL-100
Part Number (P/N)	60388
Power Supply	3.7V 10200mAh Li-Ion Battery / Rechargeable
BlueTooth® Connectivity	BlueTooth 5.0® 4.1, 32 ft. (10 Meters) Line of Sight for use with uPy xis
Radio Output	Long Range Radio (LoRa)
Interface	Type-C for charging and data transfer
Range	3.94 – 591 inches (0.1 – 15 meters)
Resolution	0.02-inch (0.5 mm)
Accuracy	±2mm
Dead Zone	3.94 inch (10 cm)
Wireless Module Operating Frequency	BlueTooth: 2402MHZ-2480MHZ Radar: 76GHz - 81GHzLoRa: 803-930MHz LoRa: 803-930MHz
Tag Scan Feature	NFC (Near Field Communication) Scanner
Installation	2-inch NPT Thread
Weight	1.10 lb(500 g)
Dimension	Height: 7.09 inch (180 mm); Diameter: 2.64 inch (67 mm)
Enclosure Material	PBT
Ambient Temperature	5 - 122 °F (-15 - 50 °C)
Storage Temperature	-4 - 140 °F (-20 - 60 °C)
Pressure	-29 – 58 PSI (-0.2 – 0.4 MPa)
Enclosure Rating	IP66
Display	2.8" LCD display
Regulation	CE / RoHS / UKCA

**With Pyxis' continuous improvement policy, this specification is subject to change without notice.*

3. Unpacking Instrument

Remove the instrument and find the standard accessories from the shipping container as listed below. Inspect each item for any damage that may have occurred during shipping. Verify that all accessory items are included. If any item is missing or damaged, please contact Pyxis Lab Customer Service at service@pyxis-lab.com or by phone at 1-866-203-8397.

3.1 Standard Provided Accessories

The PRL-100 Series level sensors as delivered are provided with the items outlined below.

- PRL-100 Radar Level Sensor (P/N 60388)
- Charging Plug (P/N 27367)
- Type-C Charging Cable (P/N 25102)
- NFC Tag Kit (5x Tags Included No Charge)
- Belt Clip (P/N 27510)
- User Manual Can Be Downloaded at Support Documents - Pyxis Lab, Inc. (pyxis-lab.com)

3.2 Optional/Replacement Accessories

Pease refer to the table below for all spare parts and optional / replacement accessories to support the PRL-100.

Optional / Replacement Accessories Information	P/N
PRL-100 Radar Level Sensor – Complete Replacement	60388
PRL-100 Replacement Charging Plug	27367
PRL-100 Replacement Type-C Charging Cable	25102
NFC Container Tag Kit (25 each)	28121
PRL-100 Replacement Belt Clip	27510
Pyxis Factory Lithium Ion Battery Replacement Service	60388-Battery

4 Installation

4.1 Device Overview

① 2.8” LCD Screen

② Buttons * 3

③ 2-inch NPT thread

④ Belt Clip

⑤ NFC Antenna

⑥ Type-C Connector

⑦ Radar Lens

Figure 1

4.2 Dimensions

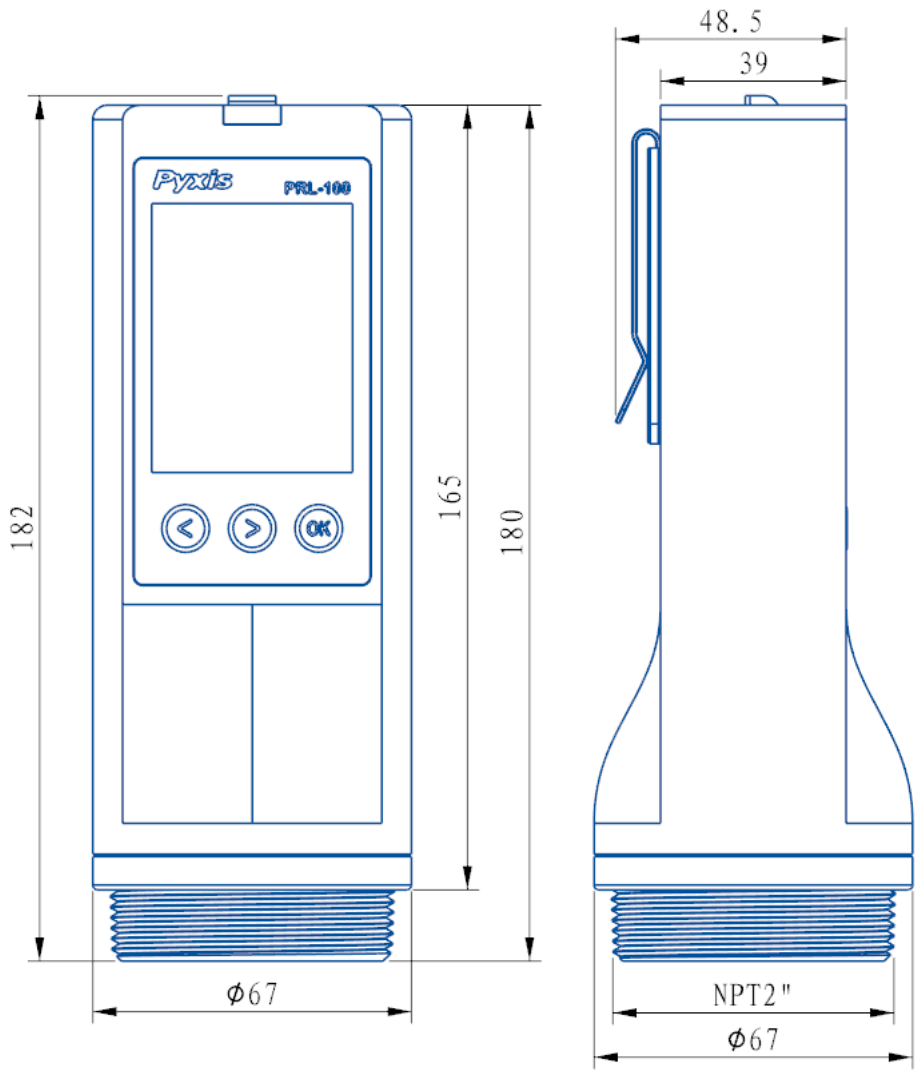

Figure 2

4.3 Installation and Precautions

The PRL-100 is capable of measuring liquid level through plastic or fiberglass with a thickness ideally below ¼-inch. It is not capable, however, of measuring through any metal container and would require installation into the container bulkhead fitting for liquid measurement. Should the sensor be installed in a 2-inch bulkhead fitting on the top of the tank/container, the following installation guideline should be maintained.

The dimensions of the PRL-100 sensor are shown in Figure 2. If a flat horizontal surface is not available on the top of the tank, please use a self-aligning bulkhead fitting so that the sensor can be adjusted to be perpendicular (90°) to the liquid surface. The PRL-100 series sensors are also embedded with a 3-axis accelerometer which allows the user to use the Display Mode Switch Button to get the Z-axis angle (the angle at which the sensor deflects the line of gravity) measurement result as shown in Figure 3 below. In other words, Z angle represents the inclination of the horizontal plane of the sensor. For the sensor to work properly, the Z angle should be measured **within 3 degrees of 0.00 horizontal baseline.**

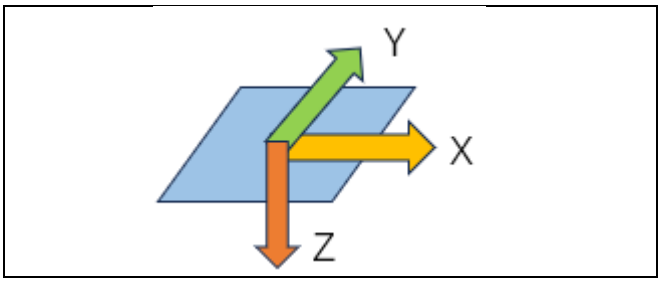

Figure 3

- Install and adjust the sensor to be perpendicular to liquid surface.
- Installation location should not be too close to the container wall to avoid interference. Ideally >8inches.
- The sensor has a 1.97 inch (5 cm) dead zone (DZ). Raise the probe to avoid the DZ as needed.
- Do not install in a location which will cause the microwave to be obstructed.

5 Instrument Overview

PRL-100 adopts FMCW principle to measure liquid level. FMCW (Frequency-Modulated Continuous Wave) is a radar technology that uses continuous wave signals with frequency modulation to measure the range. The radar transmits a continuous wave with a frequency that changes over time (e.g., increasing linearly). The signal reflects off a target and returns to the radar receiver. The received signal is mixed with the currently transmitted signal to produce the beat frequency. Based on the time delay between the transmitted and received signals, the beat frequency is analyzed to determine range.

PRL-100 should be kept vertically to the surface of the liquid to be measured, when the angle becomes larger the radar signal will become weaker, which may lead to failure of normal measurement. ***IMPORTANT NOTE*** *When the angle is greater than 30 degrees, PRL-100 will turn off the radar, stop measuring, and prompt:* ***'Place the device vertically.'***

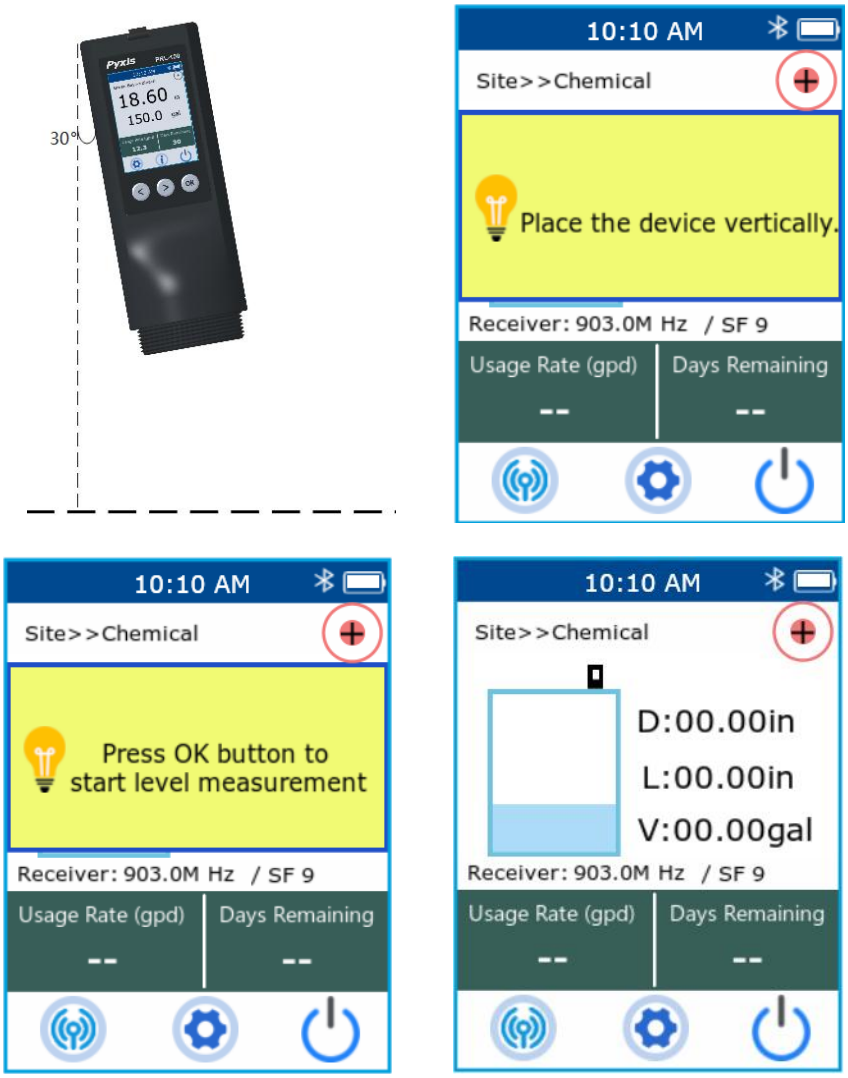

Figure 4

5.1 Inventory Tracking with PRL-100

The PRL-100 portable radar level sensor is ideal for your chemical inventory tracking applications. It allows you to easily identify each different tank/container with an NFC (Near Field Communication) Tag, take a level measurement in just about 10 seconds and show important statistical data such chemical usage rate and how many days left before emptying the tank. Pyxis offers the NFC Tag Kit (P/N 28121) containing a quantity of 25 NFC tags for programming and container use. The following chapters describe a typical procedure to start tracking your chemical inventories.

Prepare NFC Tag

An NFC tag is a small device based on Near Field Communication (NFC) technology that can exchange data with compatible devices over short distances. It usually consists of a chip and an antenna and has the function of data storage. Its working principle is based on electromagnetic induction.

Pyxis offers customized NFC tags to be compatible with uPyxis 2.0 App and the PRL-100. The tank/container information can be programmed into NFC tag via uPyxis 2.0 App prior to taking a level measurement.

The user launches the uPyxis 2.0 App on the smart phone and clicks the icon in the upper-right corner and further click NFC in the Tool screen to start communicating with an NFC tag.

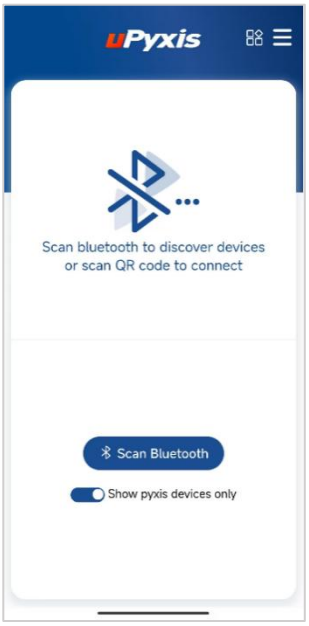

Figure 5. uPyxis Startup

Figure 6. uPyxis Tool

Users place the NFC tag on the back of the phone, the App will automatically read content from the tag. **NOTE** - *Please put the tag closer to the phone if the App does not read properly. Please note that if you use a case for your mobile device, you may be required to remove this for easier NFC card reading.* The App will display NFC Card is Empty at the bottom if this is a new NFC tag, otherwise data already saved to the tag will be read out and displayed in the App.

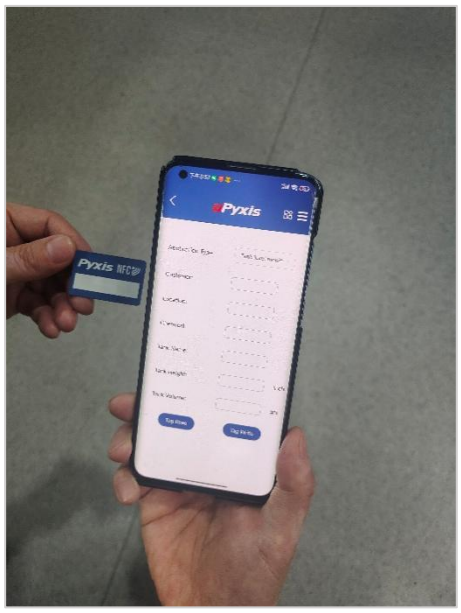

Figure 7 Prepare NFC Tag

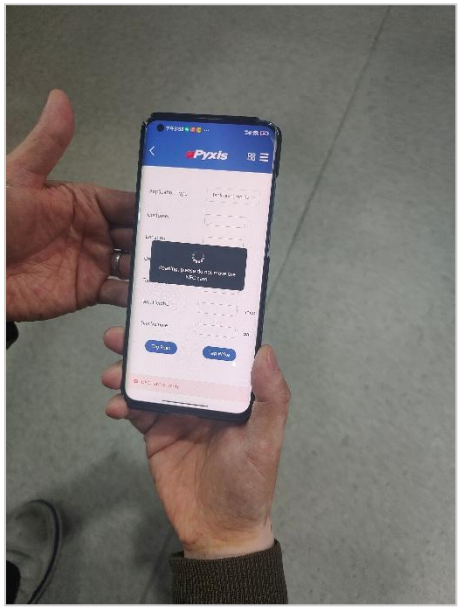

Figure 8 uPyxis Scans Tag

NFC Tag Information Reading Writing:

Edit the NFC tag using uPyxis 2.0 to record the following information:

- Application Type
- Customer Name
- Location Name
- Chemical Name
- Tank Name
- Tank Height
- Tank Volume

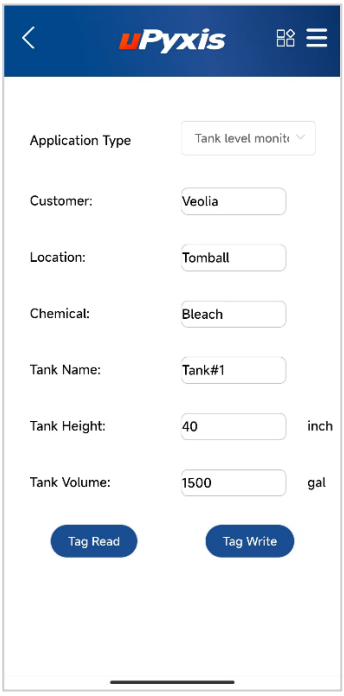

Figure 9 uPyxis Programs Tag

Stick the NFC Tag to Your Tank

There is a layer of adhesive backing on the back of the tag, peel off the protective layer and stick the NFC tag to the tank/container where you can easily access with PRL-100.

Figure 10 - A Tank with Tag

Scan the NFC Tag

Please scan the NFC tag every time before making a level measurement. Simply hold the head of the PRL-100 close to the tag and the PRL-100 will automatically read the tank/container information as shown in Figure 11. Click the OK button to confirm to use this tank settings for the following measurement.

Figure 11 – Scan Tag and PRL-100 Automatically Reads Tank Information

Taking A Measurement & Unit Calculations

Hold the PRL-100 with one hand and place it vertically against the top surface of tank if the tank is made of plastic such as PVC, PP or HDPE. The PRL-100 will display an indication [1] of radar signal strength and an icon [2] to tell whether the signal is vertical as shown in Fig 9. ***NOTE*** *Vertical hold of the sensor closest to center of the circle in image [2], will ensure an accurate sensor measurement.*

Make sure you have a strong radar signal, and the signal is pointed vertically downwards. The PRL-100 will start measuring distance, level and remaining volume of the tank, it also calculates the usage rate and remaining days by referencing previous measurements to this same tank as shown in Fig 10. The PRL-100 will lock the measurement (background color changes to blue) and save the result to the SD card once the reading has stabilized.

Figure 12. Level Measurement

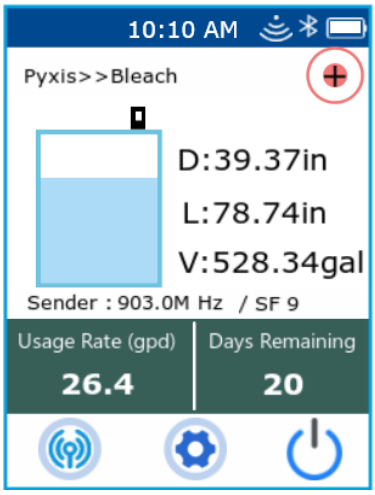

Figure 13. Measurement Results

[1] - The more the number of waves, the stronger the radar signal.

[2] - The closer the cross is to the center, the more vertical the radar signal is.

IMPORTANT NOTE *As shown in Figure 14, there is a 2-inch thread on the bottom of the PRL-100. If the tank is made of a metal such as stainless steel, screw the PRL-100 to the top of the tank for proper measurements, as radar waves, being electromagnetic,* ***do not penetrate metal.***

Figure 14. NPT 2" Threads

Data Logging & Export

After each measurement is completed, the device will record a log. The log information includes the test data/time, on-site test information (read through NFC tag), measurement readings, and so on.

Logs can be displayed on the PRL-100 itself or read and shared through uPyxis.

For details on how to read logs using uPyxis, please refer to Section 6.4 of this user manual.

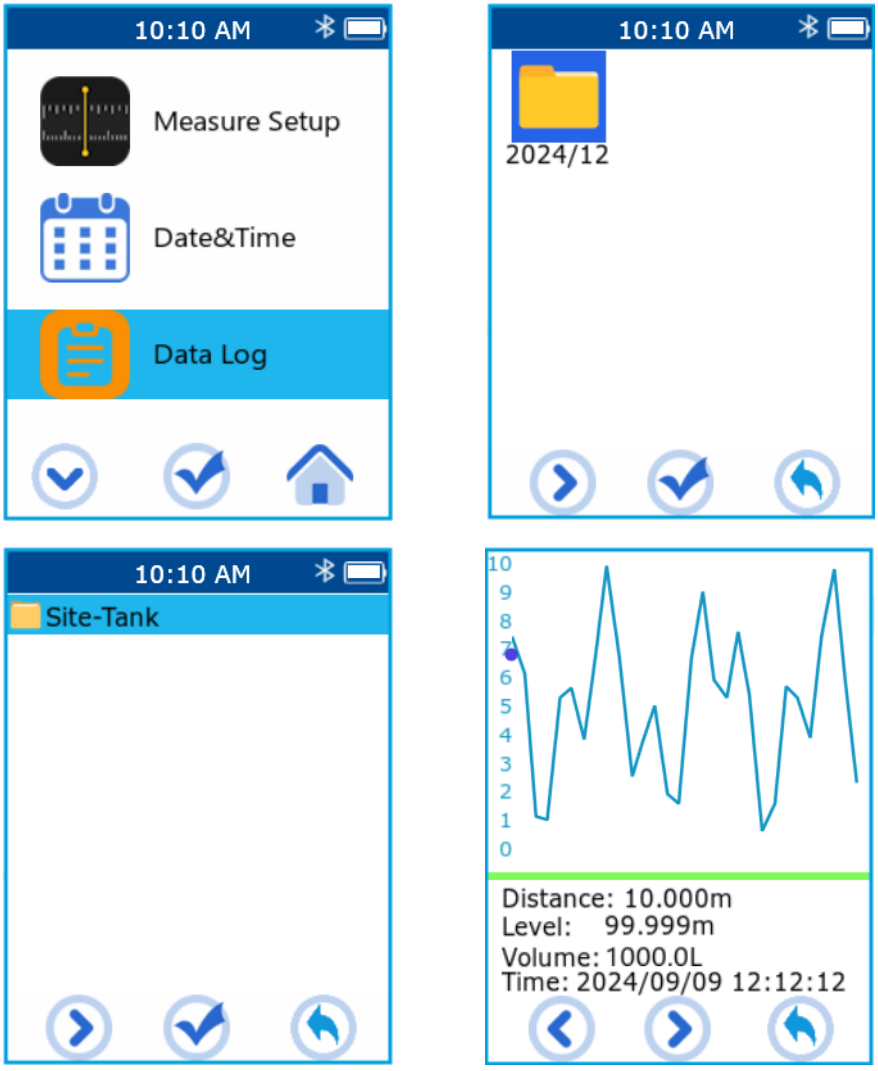

Figure 15. – PRL Screen Interface for Data Access and Graphing View

5.2 Remote Monitoring with LoRa (Long Range Radio)

The PRL-100 has a built-in LoRa communication module, which can be used in pairs or in a network. For example, at the dosing location, one PRL-100 can be used to measure the level of chemicals in the storage container, while another PRL-100 receives the measurement data via LoRa, which is convenient for the user to monitor the level of storage container when controlling the dosing equipment.

LoRa Setup

PRL-100 supports the LoRa function and there are two (2) working modes, consisting of **Receiving** and **Transmitting**. This allows two PRL-100 devices to be paired, one as transmitter and one as receiver, allowing users to remotely monitor storage container level data. See programming details in the next section.

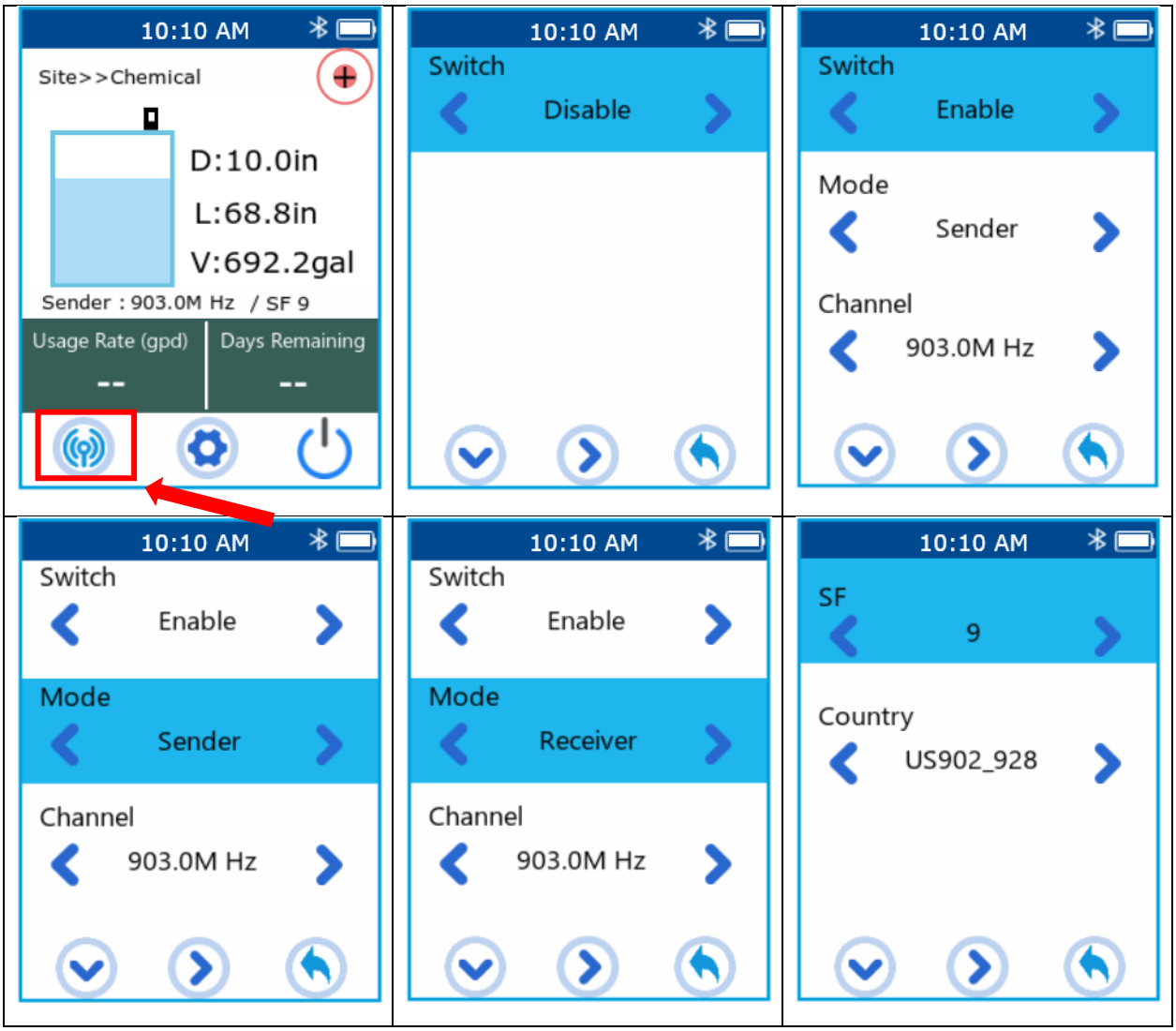

Figure 16. – Programming As LoRa Receiver or Transmitter

As shown in the figure, clicking the **left button** on the main interface will enter the LoRa settings interface.

Setup within the LoRa Interface

Switch: Control the LORA switch by pressing the middle button to toggle the LoRa state.

Mode: Press the left button to select an item, then press the middle button to switch the LoRa work mode. There are **two mo**des to choose from: In **Sender** mode, the device will send data to other devices, while in **Receiver** mode, the PRL-100 will receive data from other devices.

Channel: Channel is the frequency at which LoRa operates. When communicating within the same group of devices, ensure that they use the same channel. When there are multiple groups of LoRa devices in the environment, different groups can set different Channels to avoid data confusion.

SF: The SF (Spreading Factor) option is from 9 to 12. Selecting 9 results in the fastest data transmission and is more stable. Selecting 12 results in the longest transmission distance but with a slower rate. Please choose based on the environment and application.

Country: The Country option is to select a different country or region, as regulations in different countries require LoRa to work at different frequencies.

NOTE *PRL-100 when set as a LoRa receiver can also receive data from other Pyxis radar level sensors, such as LSR-801L, LSR-803L, etc., and can be used to remotely view the data or troubleshooting.*

IMPORTANT NOTE *When pairing, you need to make sure that* ***Channal, SF, Country*** *of LoRa devices are configured the same, or else they can't communicate with each other.*

5.3 Open Level Measurement

Another working mode of PRL-100 is the Open Level Measurement, which is used in the same way as tank mode, but the volume parameter is not displayed during the open level measurement.

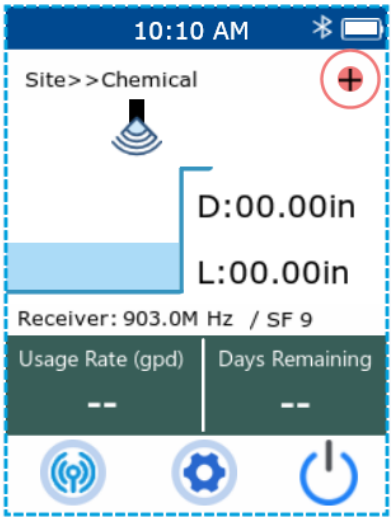

Figure 17. – Programming As Open Channel Level Measurement

5.4 Configuration Menu

5.4.1 Measurement and Settings Function Overview

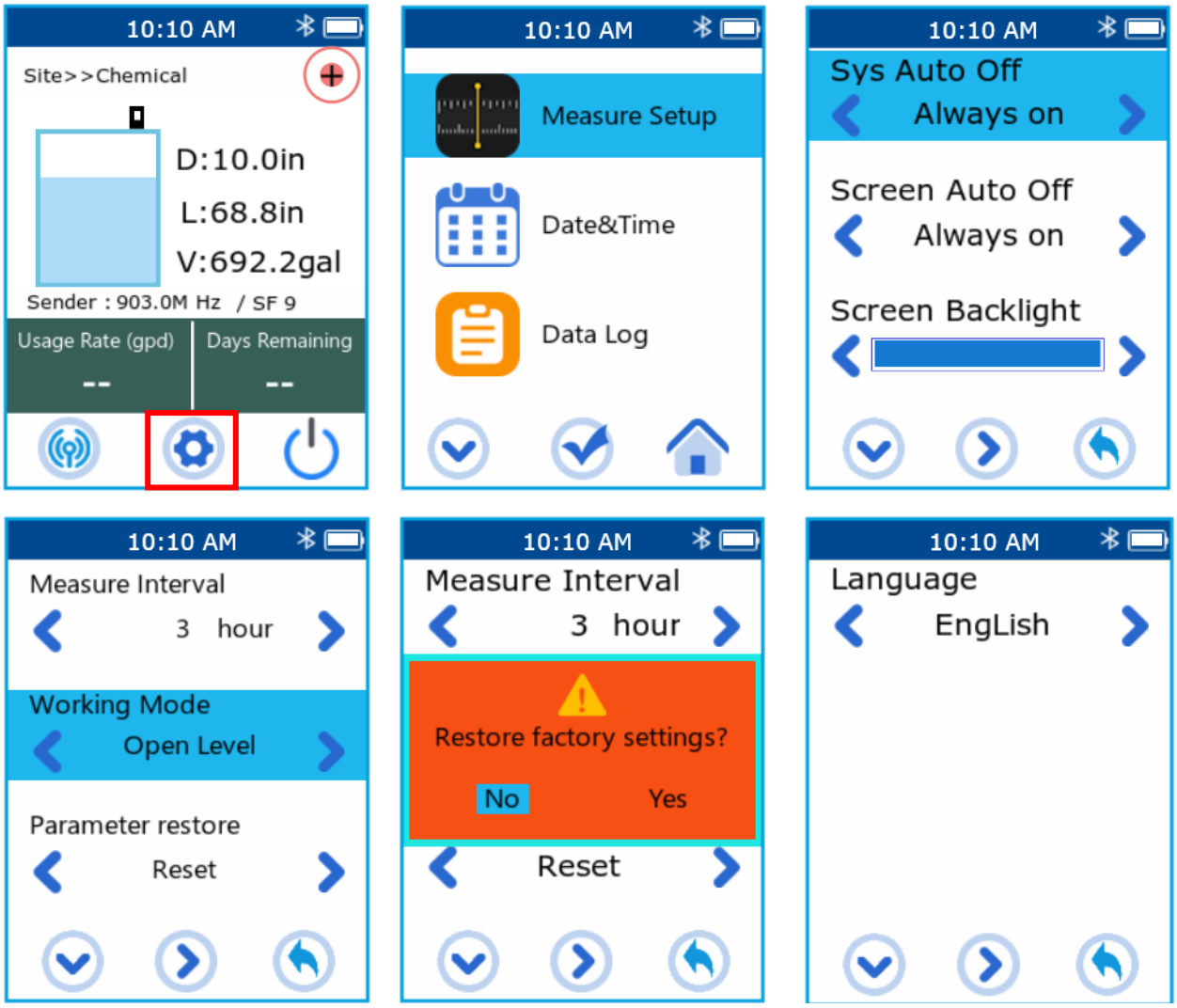

Figure 18. – Measure Setup Parameters

Click the middle button on the main interface to enter the settings interface.

(1) Sys Auto Off

This feature determines the timing of auto-shutdown (power down) of the PRL-100. After setting, select the corresponding shutdown time. When the no-key operation time reaches the set time, the PRL-100 will automatically turn off.

(2) Screen Auto Off

This feature determines when the screen goes into sleep mode. After setting, select the corresponding screen off time. When the no-key operation time reaches the set time, the screen will go to sleep. Press any button to wake up the screen.

(3) Screen Backlight setting

Select the corresponding backlight brightness, there are 10 levels of brightness available. When you select the corresponding backlight brightness, the screen will change to your setpoint.

(4) Measure Interval

This feature determines the frequency at which a level measurement is conducted and logged. ***NOTE*** *The device defaults to continuous measurement mode.* Users can adjust the interval measurement to their desired frequency. For example if set to 5 minutes, the PRL-100 will measure level in accordance with the set time (5-min) for a single measurement. After the completion of the measurement, the device enters the sleep state until the next measurement time, or if the user presses any key to wake up. This mode is designed to significantly save battery power.

(5) Working Mode

There are two (2) options for working modes. **Tank Mode** and **Open Level** Mode.

- Tank Mode for level monitoring of liquid tanks or other containers.
- Open Level Mode for open channel liquid monitoring.

(6) Parameter Reset

Users may restore all PRL-100 parameters to the factory settings with this feature.

(7) Language Settings

The PRL-100 offers multiple user interface languages. The current optional languages are: English, Chinese and Spanish. Coming soon will be German and French.

5.4.2 Date & Time Setting Function

The system time is set by keys, or the time can be automatically synchronized by connecting to uPyxis.

The log records contain time information, so please set the correct time before using it for the first time.

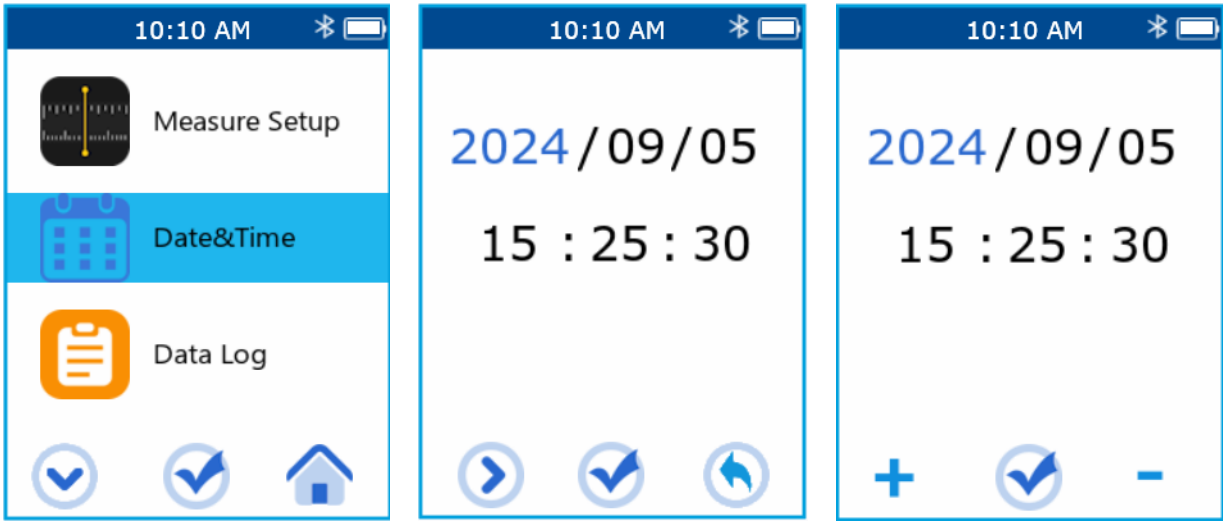

Figure 19. – Setting the PRL-100 Device Time & Date

5.4.3 System Diagnosis Screen

Users can view the measurement readings and signal strength in the diagnosis interface and analyze current radar measurements through the radar signal waveform.

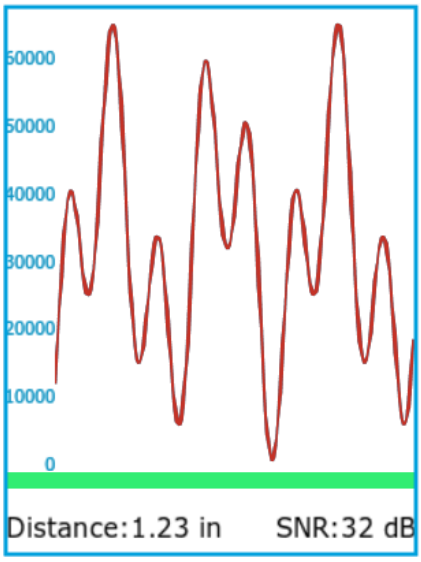

Figure 20. – Diagnosis Screen

5.4.4 Device Information

The device information screen displays the basic information of the device, PN, SN, software version, battery level, time, error code and other information.

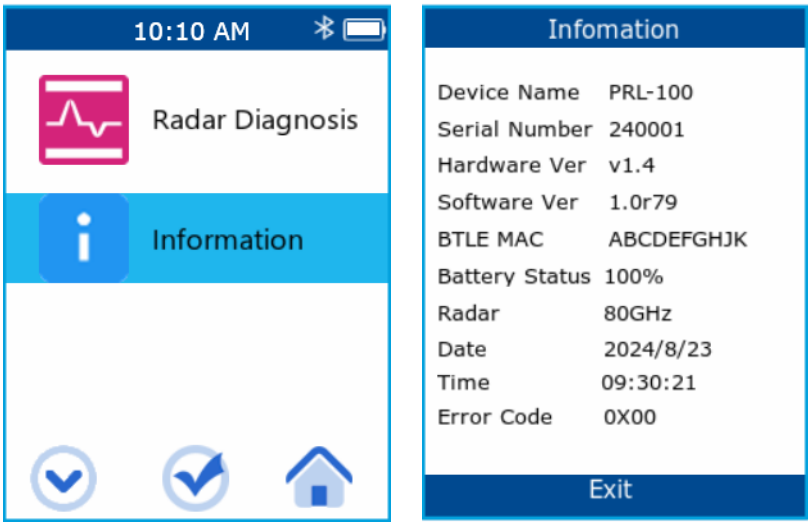

Figure 21. – Device information Screen

5.5 Charging Function

The PRL-100 is powered by a 3.7V rechargeable lithium battery. The battery can be charged via Type-C connector. When the battery power is lower than 20%, the screen will indicate that the power is low, please charge. When the battery power is lower than 5%, the device will automatically shut down. When the device is charging in the OFF state, the screen will show the battery level and when the device is turned ON the battery icon will show the charging status.

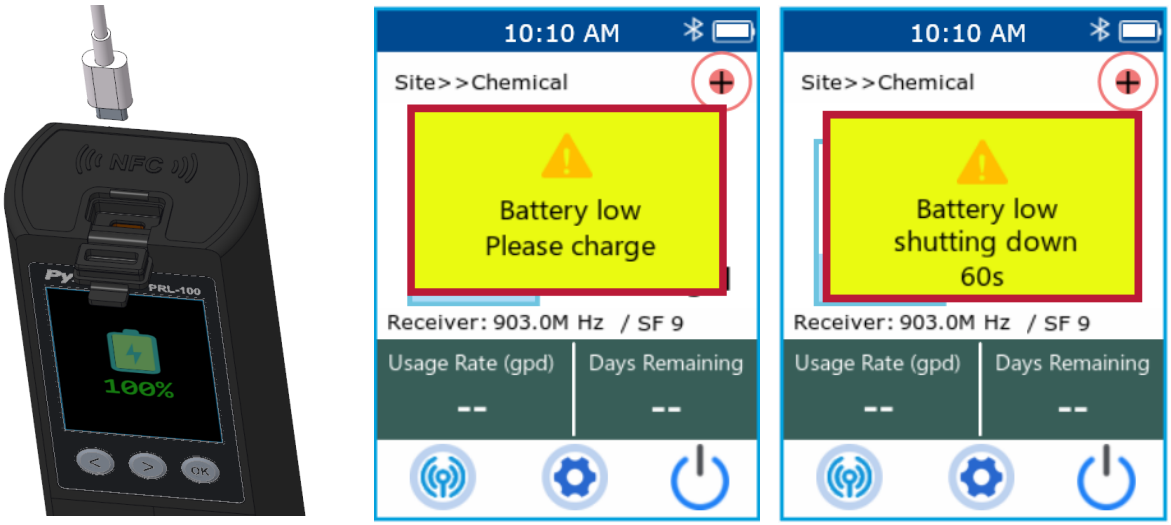

Figure 22. – Battery Charging Interface

6 Setup with uPyxis 2.0 Mobile

6.1 Download the uPyxis 2.0 Mobile App

Download **uPyxis 2.0** Mobile APP from Apple App Store or Google Play.

6.2 Connecting to uPyxis 2.0 Mobile App

Turn on the BlueTooth 5.0® on in your mobile device. ***NOTE*** *Do not pair the phone's BlueTooth 5.0® to the PRL-100 sensor, the uPyxis 2.0 APP will do the pairing.*

Open uPyxis 2.0 Mobile App. Click "Scan Bluetooth" button and the App will start to search for Pyxis sensors. Click on the PRL-100 Sensor Picture to connect to the Pyxis Radar sensor.

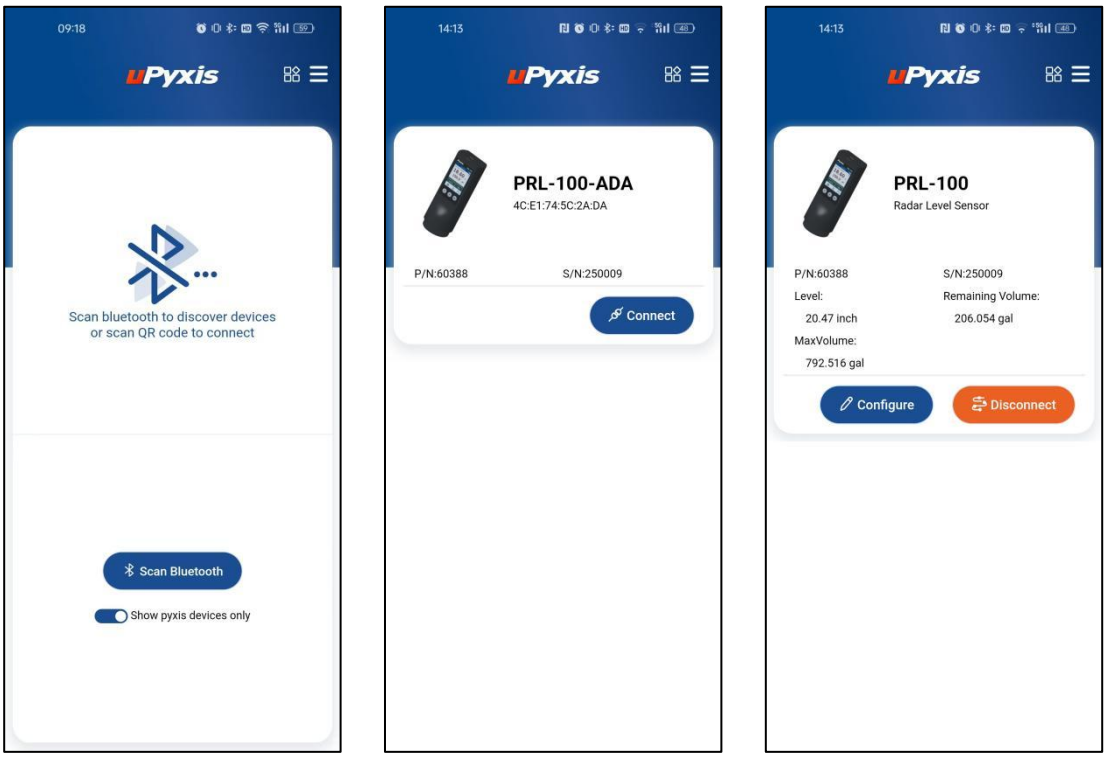

Figure 23. – Connecting to PRL-100 via uPyxis 2.0 Mobile App

6.3 Parameter Setting via uPyxis Mobile App

There are four-tab pages on the main screen of the uPyxis 2.0 as shown below. Once connected, the mobile app will display the Trend Chart screen. Users can click on Overview tab to see tank schematic with measurement information. The Configuration Tab is for user to change the settings of the sensor if needed.

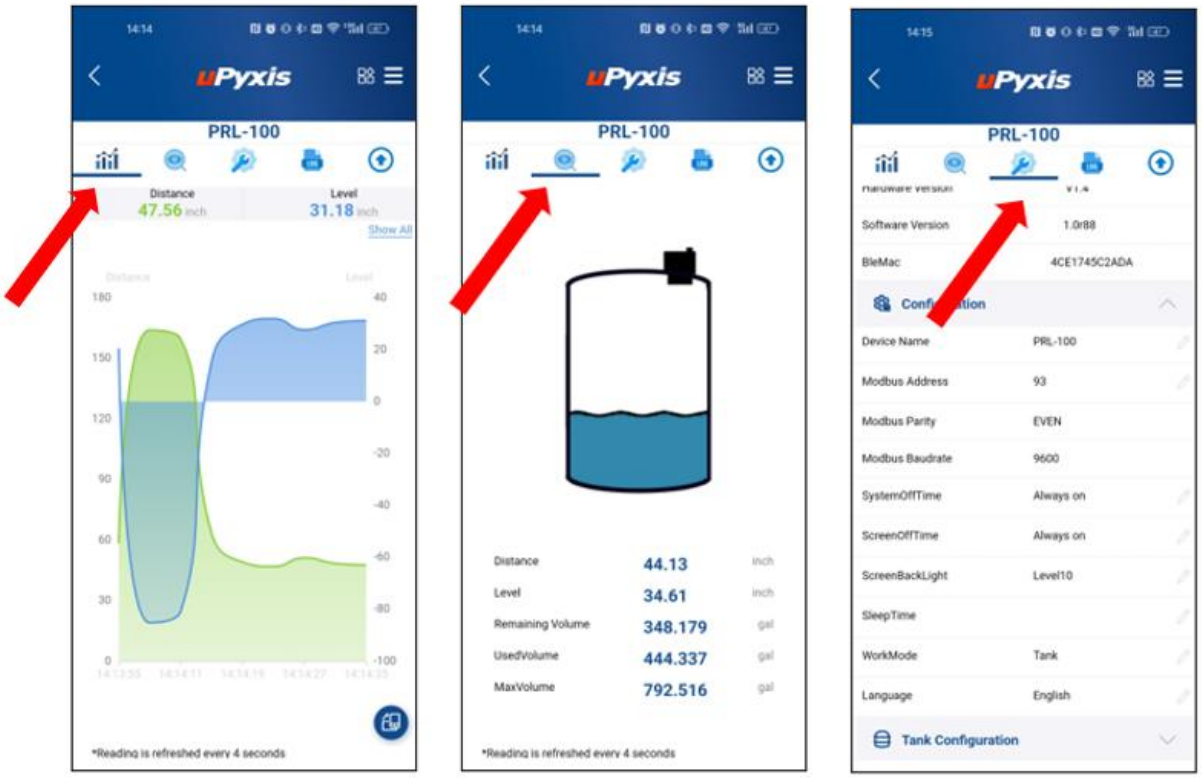

Figure 24. – uPyxis 2.0 Screen Interfaces – Live Data / Tank Schematic Level / Configuration

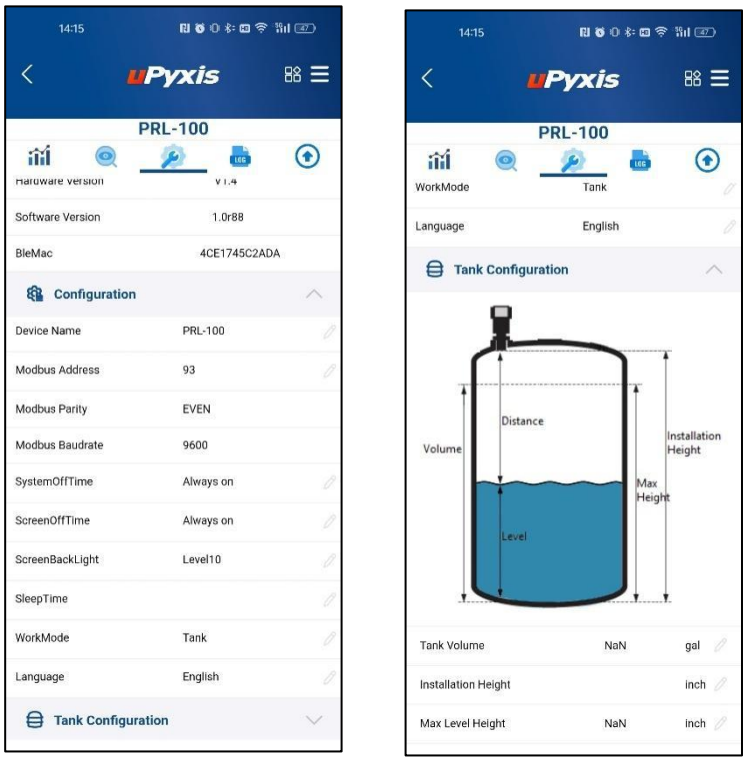

Figure 24. – PRL-100 & Tank Configuration Tab Continued

In the Configuration Tab on the top of the page, the user can check the basic information of the sensor when clicking on Information sub menu.

If the user wants to rename the device name, change the communication parameters or display unit, please click on the Configuration sub menu.

If NFC tags are not used at the customer site, the parameters of the tank can still be configured via uPyxis. To configure the tank, click on the Tank Configuration sub menu and set Tank Volume, Installation Height and Max Level Height if needed. Please click on parameter data or the "PEN" image to the right of the related parameter to modify the parameter and then click on the "Apply" button to finish the setting.

IMPORTANT NOTE *The installation height is the height at which the PRL-100 is positioned to take a level measurement, typically on top of the container itself if it's plastic, or in the 2-inch container port if its metal.* ***The difference between the installation height and the maximum level height MUST BE GREATER THAN 1.97 inches.*** *This represents the sensor dead zone.*

6.4 Read Datalog via uPyxis Mobile App

PRL-100 saves measurement results internally in SD card, it stores data by month. Each month has a separate folder named after YYYY-MM. Within the folder, PRL-100 creates multiple datalog files and each file is associated with a different tank. All saved datalog files can be exported via uPyxis 2.0 App and share with your customers.

Connect PRL-100 with uPyxis 2.0 App first, and navigate to LOG function, click **Read File List** button to read all saved folders as shown in Fig 13, select the month folder you want to read and click **Get Log List** button to read tank file info.

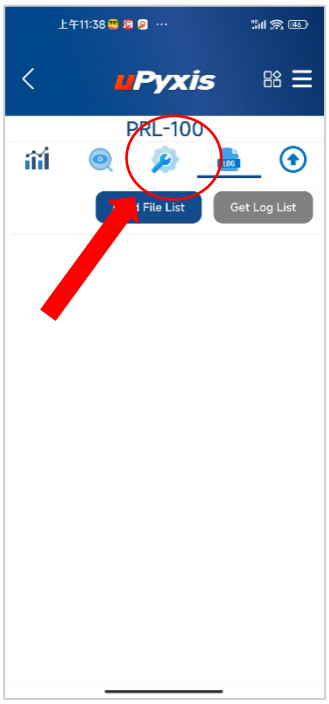

Figure 25. Datalog Page

Figure 26. Read File List

Figure 27. Read Log List

Select the tank name you want to read data log.

- Click **Get log file status** button to retrieve data log file information
- Click **Read all data records** button to read all saved measurement results or **Read last 100 data records** button to only read the last 100 data points.
- Click **Export** button to share the readout data as CSV file through email or any other apps.

Click **Export** button to share the readout data as CSV file through email or any other apps.

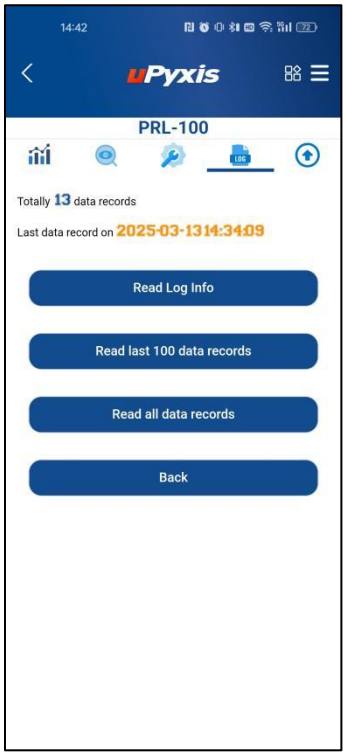

Figure 28. Read Log Info

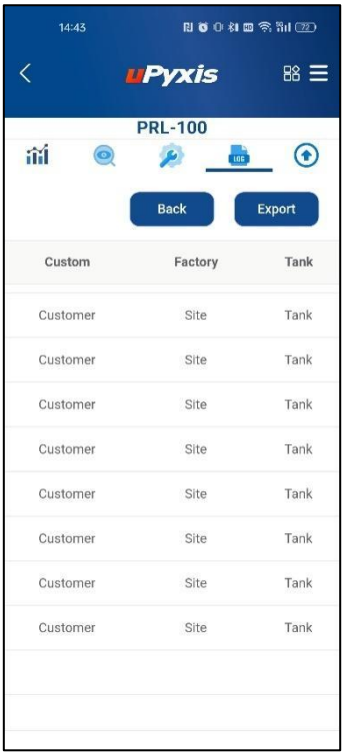

Figure 29. Read Log Data

6.5 Update firmware via uPyxis Mobile App

When connecting uPyxis to PRL-100 and clicking the **Upgrade Menu:**

- Click the Check **Update** button to view the latest version information.
- Then, click the **Download** button to download the latest version.
- After the download is successful, click the **Upgrade** button to start the upgrade process.
- During the upgrade, ensure that PRL-100 remains powered on and do not perform any operations.
- Keep uPyxis connected and do not exit the application.

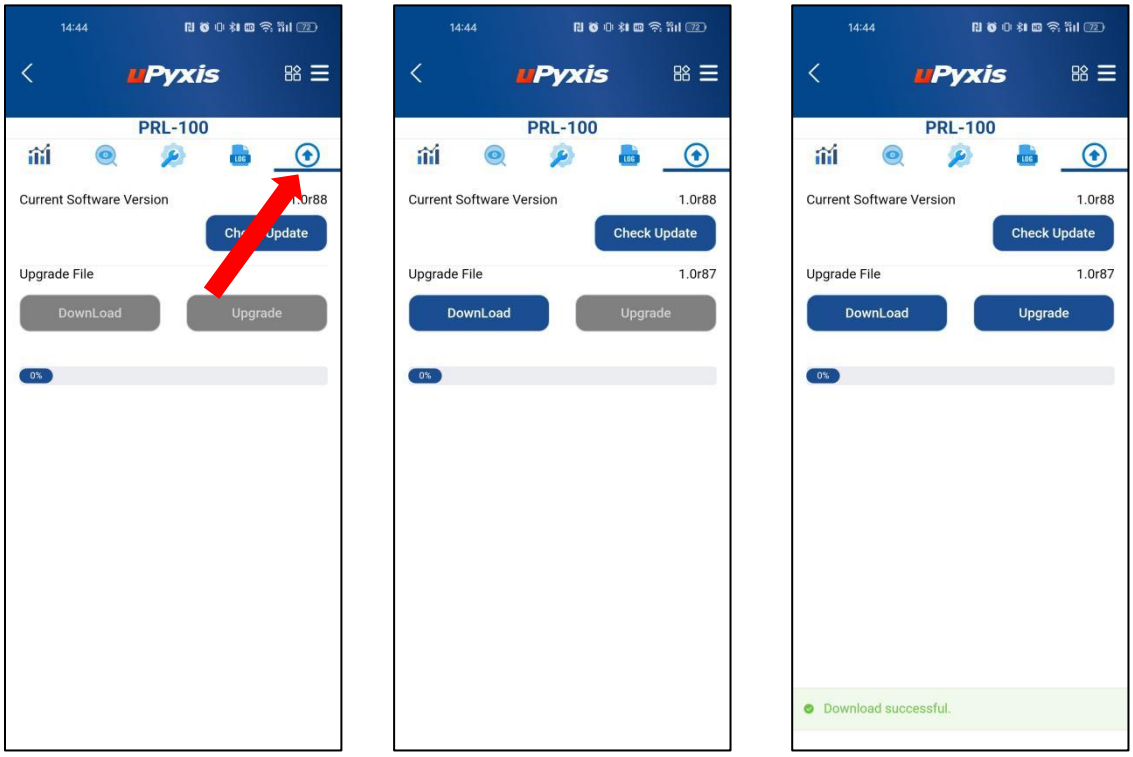

Figure 30. – Upgrading PRL-100 Firmware via uPyxis App

7. Regulatory Approval

United States

The PRL-100 sensor 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 an 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

Canada

This device complies with Industry Canada license exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie 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, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible

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