WISE AIR 4.0®
MEASURE TO MANAGE

User Manual for WA-EUS-750 Acoustic Leak Imager

Compressed Air Energy Saving Solutions

Smart Measurement Technology That You Can Trust

About Us

At WiseAir Technologies, our mission is to empower industries with innovative and advanced measurement solutions for compressed air and gases. With over 20 years of expertise in the field of compressed air management, we have developed smart, reliable, and state-of-the-art products that are both accurate and easy to use. Our focus is on incorporating cutting-edge technologies like M2M communication and the Industrial Internet of Things (IIoT) to bring increased automation, improved communication, and self-monitoring to industrial processes.

Our WA range of smart IIoT sensors can be easily integrated into existing manufacturing and energy management software to enhance data collection, exchange, and analysis for improved productivity and efficiency.

Our Network

Our Smart Sensors are Developed with Design and Technology Support from Our Partners Across North America, Europe and Asia. With Our Strong Network of Partners, we offer Seamless and Best-in-Class Service to Our Customers.

Artificial Intelligence and Machine Learning Software
Our software are programmed to analysis and self Diagnose the Measured Datas

Smart IIOT Sensors
For measurement of Flow, Power, Dew Point and Pressure

Product Experts
Product Specialists with Decades of Experience in Compressed Air Measurement and Management

Simplify Your Compressed Air Management With Our Smart Technology

Compressed Air Systems are Dynamic and Highly In-Efficient. Hence they Require Continuous Monitoring for Sustained Benefits. With Our WiseAir 4.0 Smart Sensors and M2M / AI Softwares Your Compressed Air System is Measured, Analysed and Improved Over Time.

With Our Seamless and Detailed Analytical Reports You Can Keep Track Of Your Compressed Air Systems Efficiency with Minimal Human Intervention.

Our Services

We Offer Free Assessment Services to Identify the HotSpots For Improvements and Develop Road Maps for Sustainable Results. Our Product Specialists Can Also Offer You Customised Plans for Monitoring the Key Performance Factors Of Your Compressed Air System.

Connect with Our Expert Product Specialists to Learn How Your Factory Can Begin to Realize Energy and Cost Savings with Our Advanced Solutions.

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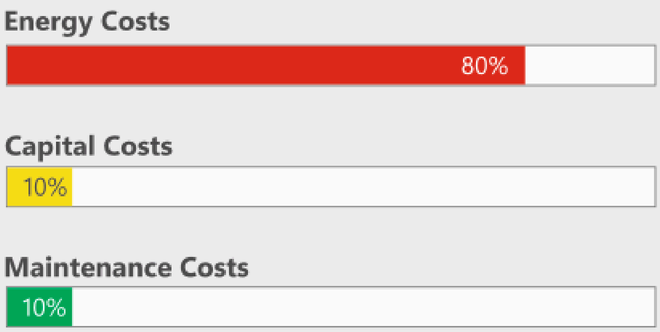
Understand The True Costs Of Compressed Air

In a Compressor's Life Cycle More than 80 % of its Operating Costs is Spent Towards its Energy. Hence Monitoring and Managing Compressors at their Peak Energy Efficiency will give Significant Energy Savings.

Our Smart Sensors Can Provide Vital Informations Like Flow, Power, Dew Point and Pressure. When Our Sensors are Networked with Our AI Software Programs, All the Measured Datas are Analysed and Reported To You With Suggested Action Plans in Real Time.

Manage Your Compressed Air System Efficiently and Effortlessly With Our WiseAir Smart Sensors and AI Softwares.



WA-EUS-750

Acoustic Imager

User's Manual v 1.0.3

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Contents

1. INTRODUCTION TO ACOUSTIC IMAGERS

Acoustic imagers—also referred to as **acoustic cameras** or **sound cameras**—are advanced diagnostic tools used to **visualize sound** by detecting and precisely locating **audible and ultrasonic acoustic emissions** in real time.

In power systems, defects such as **cracks in high-voltage insulators** can lead to **partial discharges**, which generate characteristic ultrasonic signals. Similarly, **leaks in high-pressure gas pipelines or tanks** release high-velocity airflow, producing distinct ultrasonic or audible noise. These phenomena excite the surrounding air and emit sound waves that can be captured by acoustic imaging systems.

The **WA-EUS-750 Acoustic Imager**, for instance, is equipped with a **microphone array**, **visible light camera**, **signal processor**, and **display screen**. The **microphone array**, arranged in a calibrated geometric pattern, captures spatial sound data. The imager processes these signals and overlays the detected sound sources onto real-time video, enabling accurate **visual localization of fault points** such as gas leaks or electrical discharges.

Figure 1 illustrates typical acoustic imaging outputs for **partial discharge detection** and **high-pressure leak localization** applications.

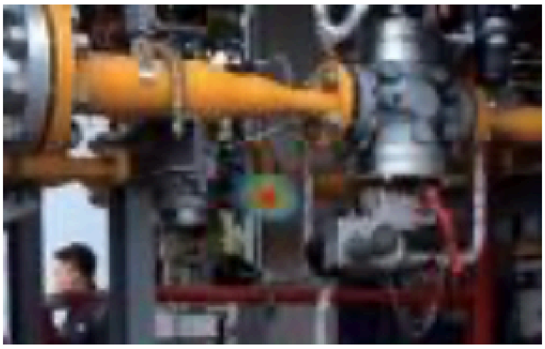



Figure 1. Examples of acoustic imaging pictures

The images generated by **acoustic imaging technology** are **synthetic overlays** that visualize **sound pressure levels** across a visible light image. This is achieved by **semi-transparently layering color maps** onto the video or photo feed. The **color gradient—from red to purple—indicates high to low sound pressure levels**, with **red typically marking the most intense sound source**, often corresponding to the exact location of a defect.

By capturing both **images and video**, acoustic imagers enable precise localization of **partial discharges** and **gas leaks**. Additionally, based on the **waveform characteristics** of the detected acoustic signals, these systems can classify **different types of electrical discharges**, such as:

- **Tip discharge**
- **Surface discharge**
- **Suspended discharge**

Furthermore, by analyzing the **sound pressure level**, along with other key parameters, the imager can **estimate the severity or volume of high-pressure gas leakage**.

Document Overview

This manual provides a **comprehensive and structured guide** for the use of the **WiseAir WA-EUS-750 Acoustic Imager**. It covers all critical aspects, including **equipment operation, maintenance procedures, software upgrades, data management**, and **troubleshooting**. The content is organized to help users access essential information quickly and **fully leverage the advanced capabilities** of the WA-EUS-750 system.

Chapter 2: Getting Started

This chapter introduces users to the **basic operation workflow** of the **WA-EUS-750**, serving as a quick-start guide for first-time users. It walks through:

- The layout and functions of the main user interface
- Steps to **capture acoustic images and videos**
- How to **browse, manage, and export recorded data**

We strongly recommend new users review this section carefully and follow the outlined procedures in practical sessions to **gain familiarity and confidence in using the system**.

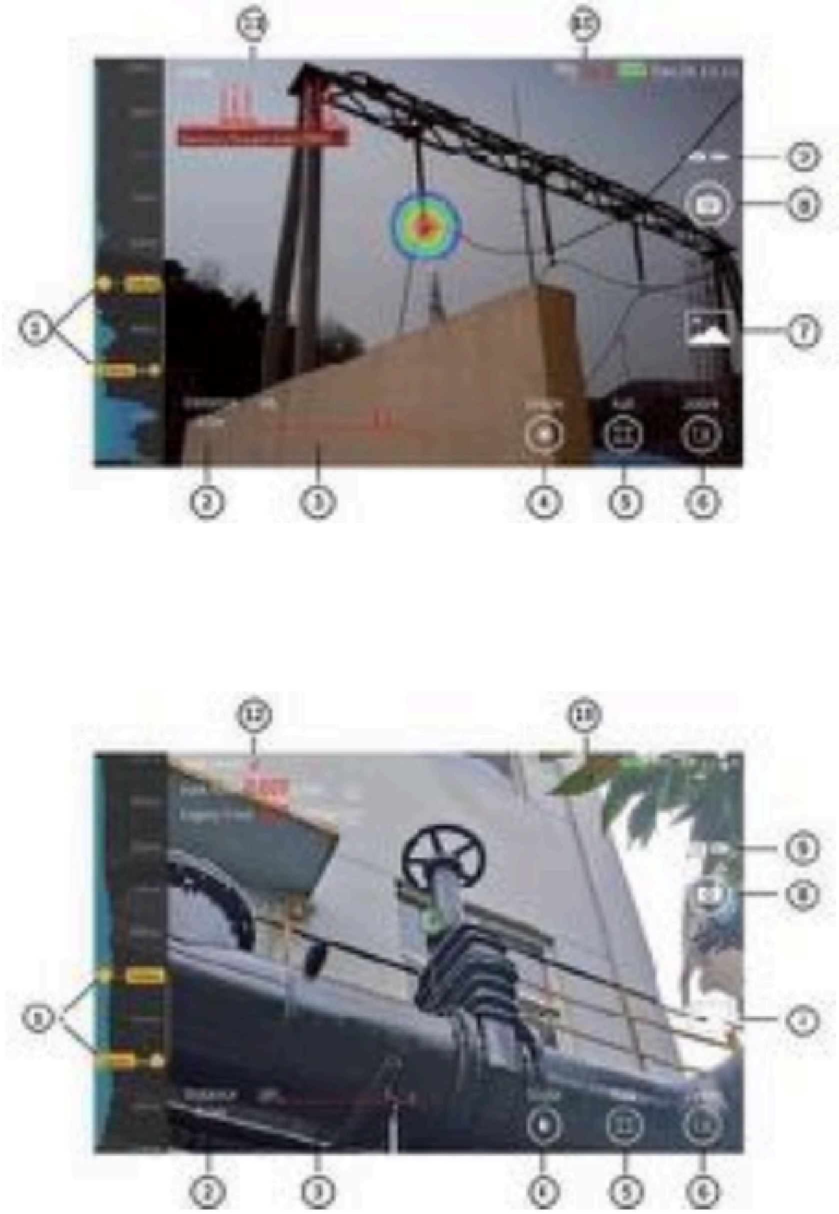
Chapter 3: Detailed Instructions

Chapter 3 offers in-depth guidance on the **advanced functions and configurable settings** of the WA-EUS-750. This includes:

- Detailed explanations of all interface elements and buttons
- Instructions for **switching detection and imaging modes**
- **Frequency range configuration**
- **Sound pressure level measurement**
- **PRPD (Phase Resolved Partial Discharge) diagram analysis**

1. Main User Interface

Figure 2 illustrates the **primary user interface** of the acoustic imager. This interface displays **real-time acoustic imaging video**, the **power spectrum** of captured sound signals, the **sound pressure level (SPL) curve**, the **PRPD (Phase Resolved Partial Discharge) plot**, and **leak rate estimates**, along with various control



1	Power Spectrum
2	Distance
3	Sound Pressure Level Curve
4	Acoustic Imaging Mode
5	Acoustic Imaging Area
6	Digital Zoom Factor
7	Data Management
8	Take Photo/Video
9	Photo/Video Mode Switch
10	Maximum SPL
11	PRPD Plot
12	Leak Rate Estimation

Figure 2. Main user interface of "Partial Discharge" (upper) and "Leak" (lower) detection mode

Table1lists the functions of the buttons and controls on the main user interface.

Index	Button/Control	Function
1	Power Spectrum	Displays the real-time power spectrum of the sound from the reference microphone.
2	Distance	Sets the distance between the sound source and the microphone array plane. This affects the accuracy of leak rate estimation.
3	Sound Pressure Level Curve	Displays the real-time sound pressure level as a dynamic curve.
4	Acoustic Imaging Mode	Selects the acoustic imaging mode, including 'Single Source', 'Multiple Sources', and 'Holographic'.
5	Acoustic Imaging Area	Selects the imaging area: either 'Focusing' or 'Full Screen'.
6	Digital Zoom Factor	Applies digital zoom at 2x, 4x, or 8x magnification.
7	Data Management	Opens the Data Management interface to browse, export, or delete captured images and videos.
8	Take Photo/Video	Captures and saves an acoustic image or video. Icon changes based on the selected recording mode.
9	Photo/Video Mode Switch	Switches between photo and video recording modes for acoustic imaging.
10	Maximum SPL	Displays the maximum sound pressure level within the current imaging area.
11	PRPD Plot	Displays the PRPD (Phase Resolved Partial Discharge) diagram.
12	Leak Rate Estimation	Shows the estimated leak level, calculated leak rate, and associated cost.

2. CAPTURING ACOUSTIC IMAGING PICTURES – STEP-BY-STEP INSTRUCTIONS

1. **Generate a Test Sound**
   Hold your hand approximately **0.5 meters** in front of the acoustic imager and **rub your fingers gently** to produce a slight sound. The imager will display a corresponding **acoustic image** in real time on the screen.

2. **Set to Photo Mode** 
   Tap the **"Photo/Video Mode Switch"** button and confirm that the device is set to **Photo Mode**. The appropriate icon will appear on the right side of the screen.

3. **Capture the Image** 
   While continuing to rub your fingers in front of the device, tap the **"Take Photo"** button on the display to capture the acoustic imaging picture.

4. **Save the Image**
   A **save dialog box** will appear (as shown in Figure 3). Tap the **"Save"** button to confirm.

   - You may optionally **rename the file** and **add remarks** in the input fields before saving.
   - Tapping **"Cancel"** will discard the capture.
     After either action, the imager will return to the **main user interface**.

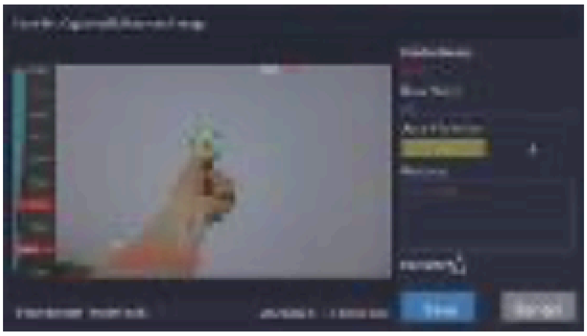


Figure 3. Dialog box to save data

Note: To evaluate the **positioning accuracy** of an acoustic imager, it is necessary to use a **sound-generating device** with a **precisely defined and small sound-emitting area**—such as an **igniter or similar point-source emitter**—to simulate a localized sound source.

2. RECORDING ACOUSTIC IMAGING VIDEOS – STEP-BY-STEP INSTRUCTIONS

1. **Switch to Video Mode**

   Tap the **"Photo/Video Mode Switch"** button to toggle the device to **Video Mode.** The corresponding icon will appear on the right side of the screen to confirm the mode selection.

2. **Start Recording**

   Generate a test sound by **rubbing your fingers approximately 0.5 meters** in front of the acoustic imager. Then, tap the **"Record Video"** button to begin capturing the acoustic imaging video.

3. **Stop and Save**

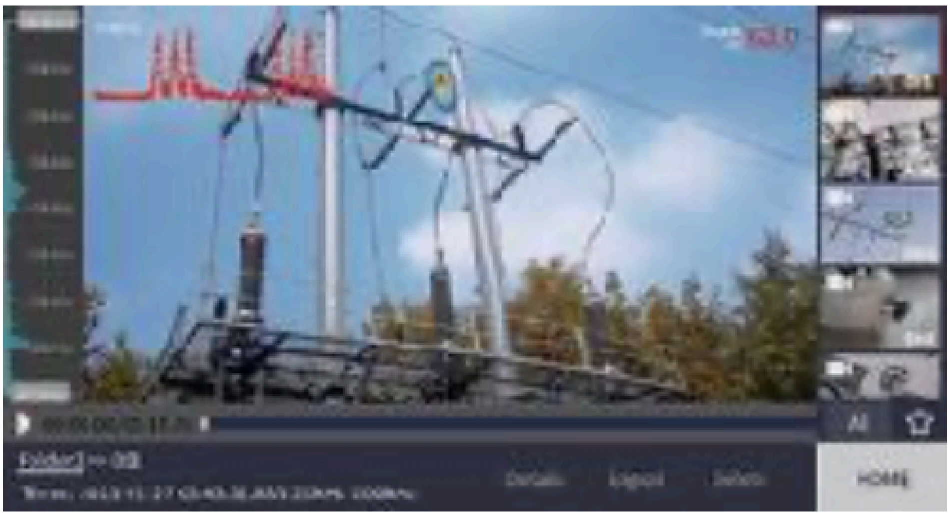
   When the desired recording is complete, tap the **"Stop"** button. A **save dialog box** will appear. Tap the **"Save"** button to store the recorded video. You may also rename the file and add remarks before saving, if required.

4. Browsing Saved Pictures and Videos

To access saved media, tap the **"Data Management"** button on the main user interface. This will open the **Data Management screen**, as illustrated in **Figure 4**.

Figure 4. Data Management Interface

The Data Management interface displays a list of all **acoustic image and video files** stored in the current directory of the acoustic imager. Users can **browse, review, and manage** these files directly from this screen.To return to the main interface, tap the **"HOME"** button



5. Exporting Data

The **acoustic images and videos** saved on the WA-EUS-750 acoustic imager can be **exported to a USB drive** for further analysis. Once exported, the files can be opened on a personal computer using the **WA-EUS-750DM post-processing software**, where users can perform tasks such as **browsing, adding annotations**, and **generating reports**.

Figure 5. Exporting data

To export data:

1. **Insert a USB drive** into the imager.
2. On the **"Data Management"** interface, tap the **"Export"** button (see **Figure 5**).

Note: The WA-EUS-750 features a **USB-C port**. If your USB flash drive has a **USB-A interface**, use the **USB-C adapter cable** provided with the device to ensure compatibility.

For optimal performance and compatibility, it is recommended to use the **USB flash drive and adapter included** with the acoustic imager.

After the export is complete, the data will be available in the **"data share" folder** on your USB drive. You can browse the exported files via your computer's file explorer or directly import them into the **WA-EUS-750-DM** software for detailed post-analysis.

6. Generating Reports

WiseAir Technologies provides dedicated **post-processing software – WA-EUS-750DM** – to manage acoustic imaging data and generate detailed reports on a personal computer.

To install **WA-EUS-750DM**, please refer to the software's installation guide in the user manual. Once installed, locate the **WA-EUS-750DM shortcut** on the Windows desktop and double-click to launch the application. If the shortcut is not visible, you can search for **"WA-EUS-750DM"** using the Windows **Start Menu**.

Figure 6 displays the initial user interface of the WA-EUS-750DM software.

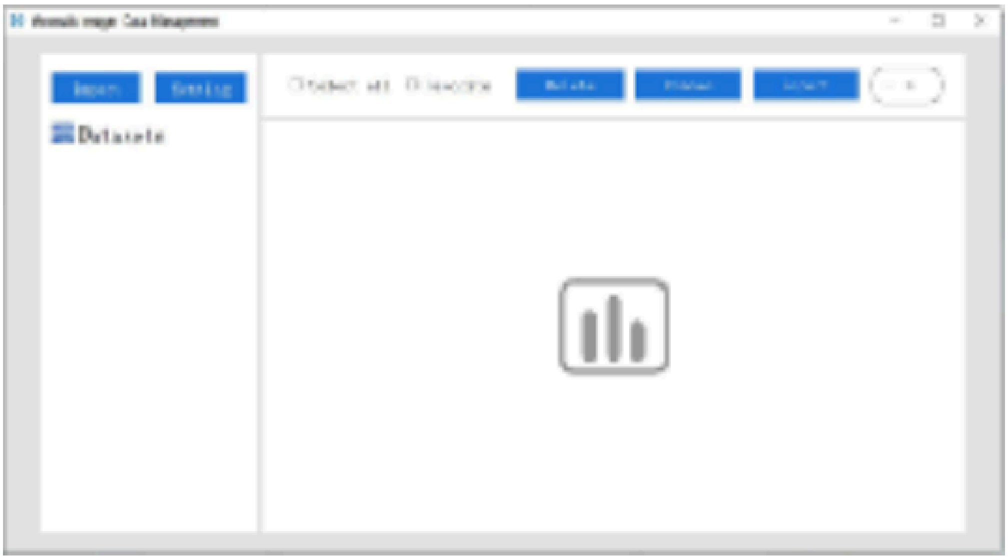


Figure 6. Initial Interface of the WA-EUS-750DM Software

To begin, click the **"Import"** button to load acoustic imaging files (photos and videos) from a connected USB drive. The interface allows you to:

- **Select specific files** for inclusion in a report
- **Generate structured reports** in .docx format with just a few clicks

If **infrared (IR) data** is available, the software also supports **adding or modifying measurement areas** and **integrating temperature readings** into the report.

For further guidance on data import and report generation, refer to the **WA-EUS-750DM User Manual**.

Overview of the User Interfaces

The **WA-EUS-750 Acoustic Imager** features three primary user interfaces:

- The **Main User Interface**
- The **Data Management Interface**
- The **Parameter Configuration Interface**

During data operations and parameter adjustments, the system may also display **context-sensitive dialog boxes** as required.

Upon powering on the acoustic imager, the device **automatically launches into the Main User Interface**, as shown in **Figure 7**. This interface serves as the **central workspace**, providing real-time acoustic imaging output and access to key functions, including:

- Modifying acoustic imaging parameters
- Capturing and recording data
- Navigating to the **Data Management** interface
- Accessing the **Parameter Configuration** interface

From the Main Interface, tapping the **"Data Management"** button opens the **Data Management Interface**, where users can:

- Browse saved images and videos
- Playback recordings
- Add or edit annotations
- Export or delete files
- Perform general data management operations

Figure 7. Tap the "**Data Management**" button to open the "**Data Management**" interface

To access the **Parameter Configuration** interface, **swipe downward** from the **top of the main user interface** to the bottom of the screen. This action will expand the configuration panel, as illustrated in **Figure 8.**

Figure 8. Swipe down from the top of the screen to open the "**Parameter Configuration**" interface

The **Parameter Configuration** interface consists of **three separate pages**, which can be navigated by tapping the **left or right arrow buttons** to switch between them

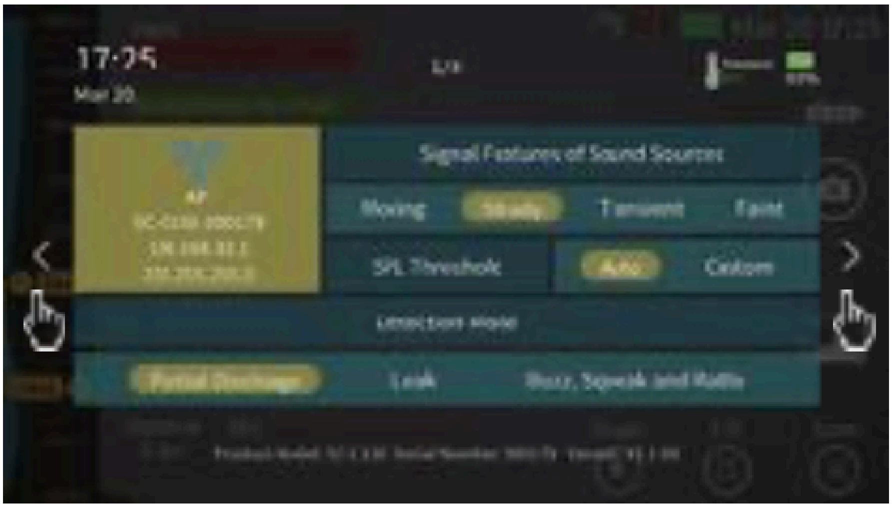


Figure 9. First page of the "**Parameter Configuration**" interface

As illustrated in **Figure 9**, the **first page** of the *Parameter Configuration* interface includes settings related to **detection mode** and **signal characteristics** of sound sources.

The **second page**, shown in **Figure 10**, primarily contains system-related options such as **adjusting screen brightness**, **restoring factory settings**, and toggling the **display of sound pressure level (SPL) measurement points**.

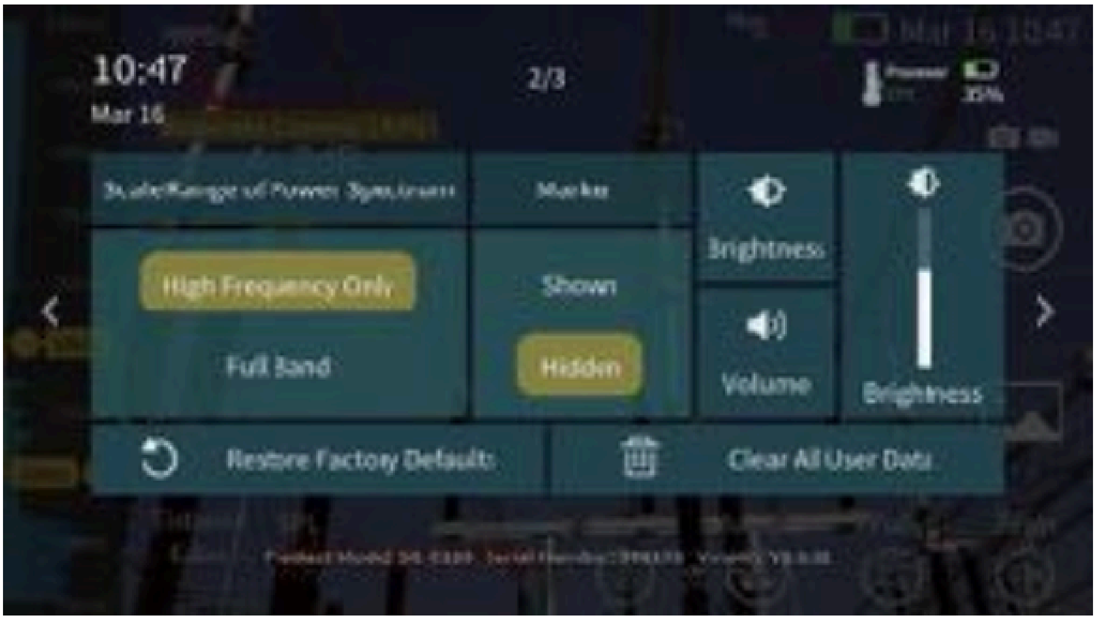


Figure 10. Second page of the "**Parameter Configuration**" interface

The **third page** of the *Parameter Configuration* interface, as shown in **Figure 11**, provides additional settings including **grid frequency**, **dynamic range**, **default frequency band**, and **power management options**.

Figure 11. Third page of the "**Parameter Configuration**" interface

Selecting the Detection Mode

On the **first page** of the *Parameter Configuration* interface, you can select the desired **Detection Mode** for the acoustic imager, as shown in **Figure 12**. The available modes include:

- **Partial Discharge (PD)**
- **Leak**
- **Buzz, Squeak, and Rattle (BSR)**

Each mode is optimized to enhance the detection and visualization of specific types of sound sources relevant to different application scenarios.

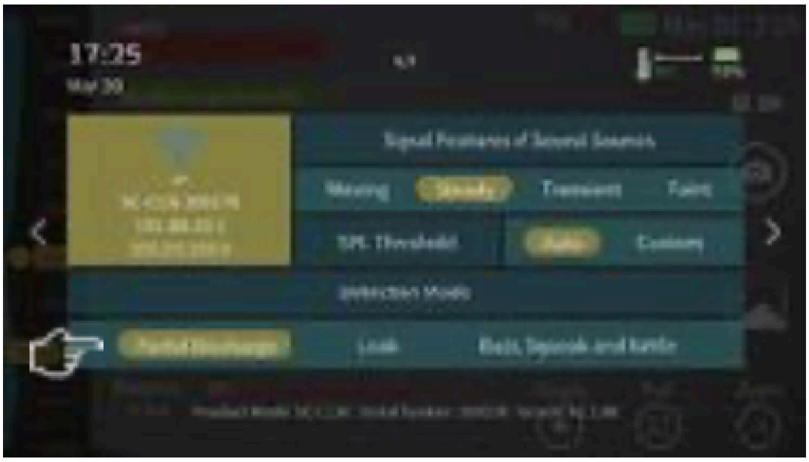


Figure 12. Select detection mode

Table 2 outlines the key differences between the available **detection modes** of the WA-EUS-750 acoustic imager.

- The **Partial Discharge** mode is specifically designed for detecting **electrical discharge phenomena** in high-voltage equipment.

- The **Leak** mode is optimized for the **detection and localization of gas leaks** in pressurized systems.

- The **BSR (Buzz, Squeak, and Rattle)** mode is intended to identify and isolate **mechanical noises** generated during the operation of machines or components.

The **main user interface dynamically adjusts its displayed content** based on the selected detection mode to provide the most relevant information and tools for the specific application.

Table 2. Comparison of detection moWA-EUS-750

Mode	Main user interface behavior	Frequency range	Default frequency band*
Partial Discharge	Display PRPD diagram.	2k~100kHz	30~50kHz
Leak	Displaytheestimated leakrateandenergycost.	2k~100kHz	15~40kHz
BSR	/	2k~100kHz	10~30kHz

The **default frequency bands** used for acoustic imaging in various detection modes can be **customized or adjusted** as needed.

Partial Discharge Detection Mode

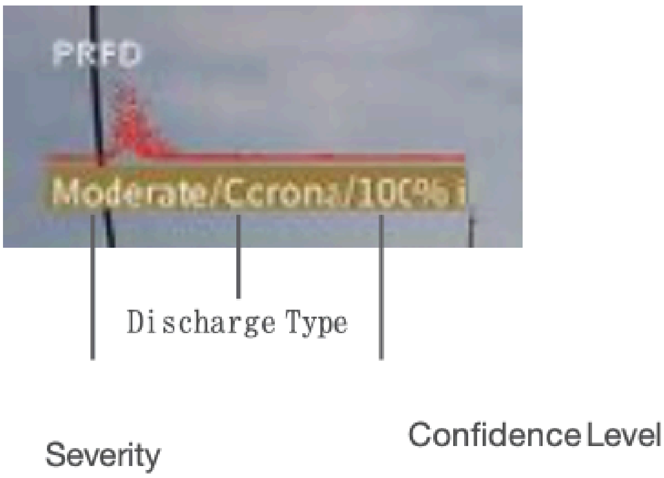
When operating in **Partial Discharge** detection mode, the acoustic imager performs **real-time acoustic imaging** and calculates the **PRPD (Phase Resolved Partial Discharge)** pattern of the detected sound signals. The system also **automatically identifies the type of discharge**, such as tip, surface, or suspended discharge.

Once this mode is activated, the **upper-left corner** of the main user interface will display both the **PRPD plot** and the **classification results** of the detected discharge type. An example of this interface is shown in **Figure 13**, providing users with clear and immediate visual feedback to assess the **partial discharge condition** of the electrical equipment under inspection.

Figure 13. Main User Interface Display in **Partial Discharge Detection Mode**

As shown in **Figure 14**, an **information bar** appears beneath the **PRPD plot** when the acoustic imager detects characteristics indicative of a potential partial discharge. This bar displays key diagnostic information, including the **severity level**, **discharge type**, and the **confidence level** of the detection results.

Figure 14. Automatic identification information of partial discharge



The **severity** of partial discharge is classified into three levels:

- **Normal** – No discharge signal detected
- **Moderate** – Signs of discharge activity present
- **Serious** – Significant discharge detected

The **discharge types** identified include **Corona (Tip)**, **Surface**, and **Suspended** discharges. The **background color** of the information bar changes according to the severity level:

- **Green** for Normal
- **Yellow-brown** for Moderate
- **Red** for Serious

Tapping the **"i" icon** on the right side of the information bar opens a detailed **information box**, as shown in **Figure 15**. The contents of this box mirror the information displayed in the bar, providing a clear summary of the detection results.

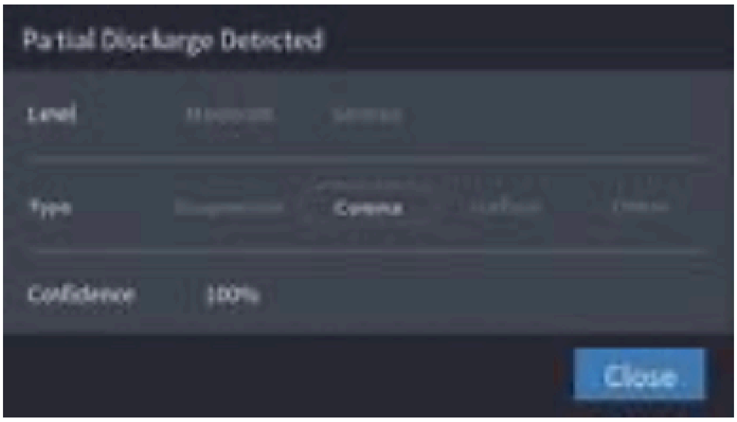


Figure 15. Partial Discharge Detection – Information Box Display

1. The acoustic imager provides an **advisory assessment** of partial discharge severity based on parameters such as **signal amplitude**. This assessment is intended **for reference purposes only** and should not be the sole basis for deciding whether maintenance is required for power equipment.
   Accurate evaluation should involve a **comprehensive assessment**, taking into account the **specific condition of the equipment**, site context, and **professional judgment**. Appropriate corrective actions should be implemented based on a full diagnostic understanding of the detected discharge points.

2. For **monitoring the progression** of a known partial discharge point, users can compare **sound pressure level (SPL) readings** recorded over time (e.g., monthly intervals) to assess any worsening.
   However, the SPL value is influenced by variables such as the **acoustic imaging frequency band** and the **distance between the sensor and the discharge point**. Therefore, when using SPL trends to evaluate deterioration, it is critical to ensure that **test conditions and settings—particularly the frequency band—remain consistent** across measurements.

The **acoustic imager** utilizes a **deep learning-based algorithm** to analyze the **PRPD (Phase Resolved Partial Discharge) patterns** and accurately identify the **type of discharge**. The identified discharge type, along with its **feature matching confidence**, is displayed on the user interface. This functionality helps users assess the **reliability of the classification** provided by the device.

The imager is capable of recognizing the following **discharge types**:

- **Corona Discharge**
- **Surface Discharge**
- **Suspended Discharge**

If the signal characteristics do not match any known discharge patterns, the event is classified as **"Noise"**.

Corona discharge, also known as **tip discharge**, commonly occurs near electrode tips with **small curvature radii** where the **local electric field intensity** becomes extremely high. This strong field causes **ionization of surrounding gas**, initiating the discharge process. Due to **polarity effects**, the phase distribution of corona discharge tends to be **asymmetric and scattered.**

On a PRPD diagram, this appears as a dense cluster of data points with **higher amplitudes in one half-cycle**, while the **opposite half-cycle exhibits significantly lower amplitudes.**

Figure 16 illustrates a typical PRPD diagram associated with **corona discharge**

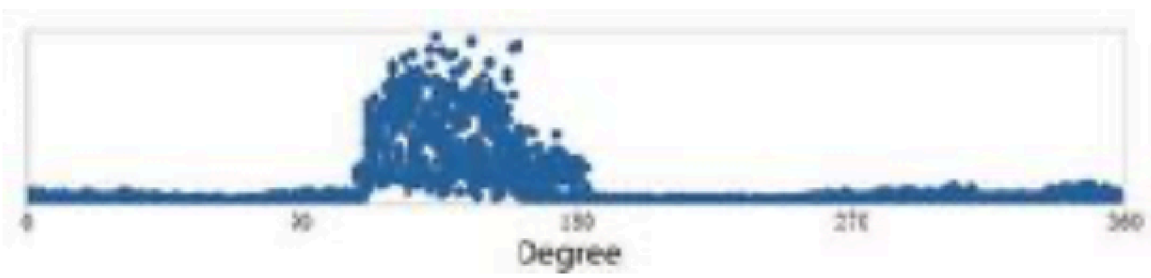


Figure 16. Example of PRPD diagram of corona discharge

Surface discharge occurs when **gas discharge develops along the surface of an insulator**, often caused by **surface irregularities, contamination, or moisture**. These conditions weaken the insulating properties and lead to the initiation of discharge activity.

When surface discharge is detected, it should be addressed **without delay**, and the insulator surface should be **inspected, cleaned, or maintained** as necessary to prevent further degradation or failure.

On a **PRPD diagram**, surface discharge typically exhibits a **symmetrical distribution** across both the **positive and negative half-cycles**, with **scattered amplitude points**. The amplitudes of the two cycles may be **comparable**, although one side may occasionally dominate.

Figure 17 presents a representative **PRPD pattern of typical surface discharge**.

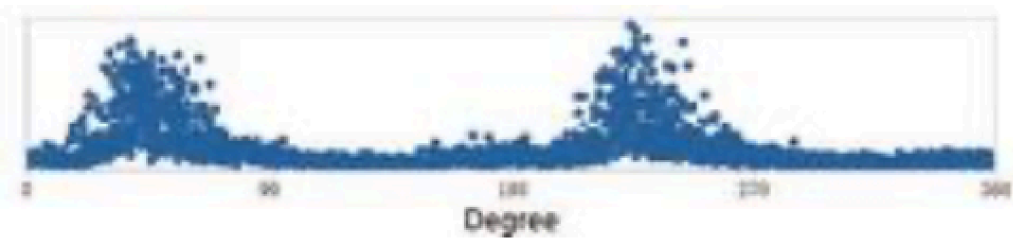


Figure 17. Example of PRPD diagram of surface discharge

Suspended discharge occurs when an **electric field causes current to pass through an air gap** or a **non-uniform dielectric medium**. In high-voltage equipment, this phenomenon may result from **structural design defects**, or when components become **loose, misaligned, or detached**, leading to the formation of **floating conductive elements**.

On a **PRPD diagram**, suspended discharge typically appears as a **symmetrical pattern** across the **positive and negative half-cycles**, characterized by **large amplitudes** and a **"floating" or detached discharge behavior**. The **amplitude difference** between the two half-cycles is minimal, and the **discharge intervals** remain relatively consistent.

Figure 18 illustrates a representative **PRPD pattern of a typical suspended discharge**.

Figure 18. Example of PRPD diagram of suspended discharge

Leak Detection Mode

In **Leak** detection mode, the acoustic imager provides **real-time acoustic imaging** of leak-related sound sources and calculates the **estimated gas leak rate** and associated **energy cost** at each identified point.

When this mode is active, the **upper left corner** of the main user interface displays the **total estimated leak rate** and **cumulative energy loss** from all detected sources, as shown in **Figure 19**. This information helps users **quantify the severity of leakage** and make informed decisions regarding maintenance and corrective actions.

Figure 19. Main user interface of "**Leak**" detection mode

Acoustic imagers estimate the **leak rate in high-pressure gas systems** using **empirical calculation models** based on acoustic signal characteristics. **Figure 20** presents a **schematic diagram** of a typical high-pressure gas system used for such analysis.

Figure 20. Ty[illegible]e calculation model

When **high-pressure gas or air escapes** through an orifice in a pipeline wall, the resulting **pressure differential** and the **orifice diameter** primarily determine the **volumetric leak rate**. While the **pressure difference** is typically known or can be provided by the pipeline operator, the **orifice diameter** is generally **not directly measurable** in the field.

As gas escapes, it undergoes **rapid expansion**, generating **turbulence** and emitting both **audible** and **ultrasonic sound waves**. By analyzing the **sound pressure level (SPL)** produced by this escaping gas, the acoustic imager estimates the **orifice diameter**, which is then used to calculate the **volumetric leak flow rate**.

Once the **leak flow rate** is estimated, additional parameters such as **gas temperature** and **density** are applied to determine the **actual leak rate**.

To configure these calculations, tap the **Settings** icon located on the **right side** of the **Leak Rate and Energy Cost** display area on the main interface (see **Figure 21**). This will open:

- The **"Leak Rate Calculation Parameters"** dialog box (Figure 22)
- The **"Energy Cost and Compressor System Settings"** dialog box (Figure 23)

These tools allow for **customization of calculation parameters** based on your specific gas type

Figure 21. Tap the Settings Button to Modify the Parameters for for leak rate and energy cost calculation

Figure 22. "Leak Rate Calculation Parameters" dialog box

Figure 23. "Energy Cost and Compressor System Settings" dialog box

Table 3 outlines the **key parameters** used by acoustic imagers to calculate **gas leak rates** and evaluate their **associated energy costs**. By measuring the **sound pressure level (SPL)** and factoring in variables such as the **type of leakage orifice**, the system estimates the **equivalent orifice size**, which is then used to determine the **volumetric leak rate**.

Furthermore, by combining this leak rate with user-defined inputs—such as **gas cost**, **electricity cost**, and the **specific power consumption** of the compressor—the acoustic imager is able to **quantify the financial impact** of energy losses due to leakage.

Table 3. Parameter setting instructions

Category	**Parameter**	**Description**
Leak Rate Calculation Parameters	Crack Geometry	Select the type of leak location, including: circular hole, quick connector, gap, and threaded joint. The acoustic imager estimates the correction factor for the size of the equivalent orifice model based on the type.
	SPL Comp.	The acoustic imager estimates the leak rate based on the sound pressure level measured at the leakage point. However, this estimation is based on an empirical model of orifice leakage and may significantly differ from the actual leak rate. By setting this parameter, the correspondence between sound pressure level and leakage can be manually intervened. At a certain measured sound pressure level, the larger the value of this parameter, the higher the calculated leak rate, with a logarithmic relationship between them.
	Distance	The distance from the acoustic imager to the leakage point. In the main user interface, tap on the "Distance" control to set the distance. The distance setting affects the estimation of the orifice diameter based on the sound pressure level. If the distance is not accurate, the estimated leak rate might be biased.
	System Pressure	The internal gas pressure of the pipeline or tank.

Table 3. Parameter setting instructions

Category	Parameter	Description
Leak Rate Calculation Parameters	Gas Type	Set the gas type inside the pipeline or tank, including: air, carbon dioxide, carbon monoxide, helium, hydrogen, methane, nitrogen, and oxygen. Acoustic imagers associate gas density with the selected gas type and use density as one of the parameters for calculating leak rate. If the gas type is not listed, select 'Other' and manually enter the gas molecular weight and specific heat ratio.
	Gas Temperature	The internal gas temperature of the pipeline or tank.
Energy Cost and Compressor System Settings	Cost of Gas	The unit price of gas. If compressed air is used, input 0.
	Cost of Electricity	The electricity price per kilowatt hour.
	Currency Unit	The currency units used for gas and electricity pricing.
	Compressor Specific Power	The ratio of input power to compressed air flow rate for the compressor system. This value can typically be obtained from the compressor nameplate.
	Operation Hours	The annual operating hours of the system. For example, continuous operation throughout the year is set to 8760 (24×365).

Note:
The **leak rate and energy cost estimates** provided by the acoustic imager are **for reference purposes only**. The accuracy of these estimates may vary due to several influencing factors, including:

- Uncertainty in the **actual shape and geometry of the leak orifice**
- **Open pipe length effects**, which can alter acoustic behavior
- Variations in the **distance and angle** from which the **sound pressure level** is measured
- **Environmental conditions**, such as temperature, humidity, and ambient noise

Due to these variables, the calculated values should be interpreted as **approximate indicators**, and critical decisions should be supported by additional analysis or measurements where necessary.

BSR Detection Mode

When set to BSR (Buzz, Squeak, and Rattle) detection mode, the acoustic imager provides real-time acoustic imaging and precise localization of abnormal sound sources. This mode is primarily used to detect undesirable noises originating from mechanical components during operation.

Typical components that can be monitored include:

- **Bearings**
- **Gearboxes**
- **Motors and engines**
- **Fans**
- **Chains**
- **Speakers**, and other moving parts

The BSR mode is effective in identifying **common mechanical noise anomalies**, such as:

- **Knocking**
- **Friction**
- **Whistling**
- **Blasting sounds**

This mode aids in early fault detection and **predictive maintenance** by isolating and visualizing noise sources that may indicate mechanical wear, misalignment, or impending failure

Figure 24. Main user interface of "**BSR**" detection mode

Abnormal mechanical sounds typically exhibit **transient signal characteristics** and may span a **wide frequency range**, from **low to high frequencies**. For improved localization and high-resolution imaging of these signals, the **acoustic imaging frequency band** can be set to a **higher range**, such as **15 kHz to 30 kHz**. This setting enhances the imager's ability to detect and visualize **short-duration, high-frequency noise events.**

However, if the abnormal sound primarily exists in the **low-frequency range** (especially **below 2 kHz**), the **positioning accuracy** of the acoustic imager may degrade. In such cases, a **microphone array with a larger aperture** is required for accurate localization, making **compact handheld imagers less suitable** for low-frequency detection.

When operating in **BSR detection mode**, the imager does **not generate PRPD diagrams** or **calculate leak rates**. The **core acoustic imaging algorithm and display logic** remain consistent across **PD, Leak, and BSR modes**, but BSR signals often exhibit **distinct peaks and harmonics** within the **power spectrum**.

In some scenarios, selecting a **narrower frequency band** may be advantageous, particularly when the **power spectrum reveals specific peaks** associated with BSR events. These spectral peaks may originate from **different mechanical components or locations**, making it necessary to **experiment with multiple frequency band settings** to comprehensively identify all contributing sound sources.

Selecting Acoustic Imaging Mode

Acoustic imagers utilize a **microphone array** to capture sound signals and a **visible light camera** to record the visual scene. The system then calculates the **spatial distribution of sound pressure levels (SPL)** across the captured area. These SPL values are translated into **color-coded overlays**, which are **semi-transparently superimposed** on the visible image to indicate the **intensity and location of sound sources**.

Users can choose from the following **acoustic imaging modes** based on the application scenario:

- **Single Sound Source Mode**
- **Multiple Sound Sources Mode**
- **Holographic Mode**

Each mode offers distinct capabilities in terms of visualization and localization accuracy. **Table 4** provides a detailed comparison of the differences between these imaging modes.

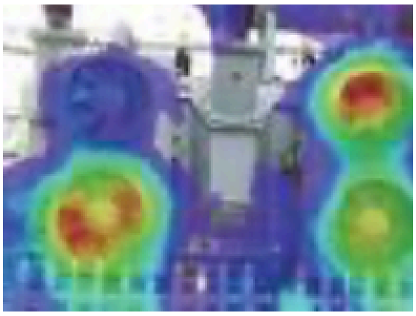
Mode	Function	Example
Single Sound Source	In **Single Sound Source** mode, the acoustic imager **displays only the sound source with the highest sound pressure level**. This mode is ideal for isolating the most dominant acoustic signal in the environment. By default, when the device is **powered on or restarted**, the **acoustic imaging mode automatically defaults to Single Sound Source.**	
Multiple Sound Sources	In Multiple Sound Sources mode, the acoustic imager displays all sound sources with relatively high sound pressure levels, allowing users to identify and analyze multiple active sources simultaneously within the acoustic scene.	
Holographic*	In **Holographic Mode**, the visible area is divided into a **uniform grid**, and the **sound pressure level (SPL)** is calculated at each grid point. The resulting SPL values are then represented using a **color-coded scale**, indicating the relative intensity of sound across the entire scene. These data points are **semi-transparently overlaid** on the visible light image, producing a composite visualization that displays the **spatial distribution of acoustic energy** throughout the field of view.	

Table 4. Acoustic imaging moWA-EUS-750

Note : While the term **“Holographic”** is used in the acoustic imager to **describe its wide-area acoustic imaging mode**, it should not be confused with **true “Acoustic Holography” technology**.
In reality, **Acoustic Holography** refers to a fundamentally different and more complex imaging algorithm, which is **not implemented** in this device. The term is used here for **intuitive description purposes only**.

To change the acoustic imaging mode, **tap the “Acoustic Imaging Mode” option** on the **main user interface**, as shown in **Figure 25**. This allows you to switch between the three available modes: **Single Sound Source**, **Multiple Sound Sources**, and **Holographic**.

Figure 25. Tap to switch acoustic imaging mode

Single Sound Source Mode - In **Single Sound Source** acoustic imaging mode, the imager displays **only the point with the highest sound pressure level**. This mode is typically used when the **target sound source is strong and clearly distinguishable**, as it **filters out weaker signals**, resulting in a **cleaner and more focused acoustic image**.

However, if the **target signal is weak**, comparable to **background noise**, or if **stronger sound sources exist outside the imaging area**, the display may become **unstable**. The acoustic spot may **frequently shift between fixed positions**, indicating the possible presence of **multiple sources**. In such cases, switching to **Multiple Sound Sources mode** is recommended for improved stability and clarity.

The **size of the acoustic spot** in Single Sound Source mode is determined by the **"Range of Color Map"** setting, which can be adjusted on the **third page** of the **Parameter Configuration** interface.

- **Larger values** produce a **larger spot**, offering more **stable visualization**
- **Smaller values** result in **sharper localization**, with **higher sensitivity** to signal fluctuation

For general use, a **dynamic range between 0.5 to 1.0 dB** is recommended. For **precise localization**, a **narrower range (e.g., 0.1 dB)** can be used. However, smaller spot sizes may cause display instability in **low signal-to-noise ratio environments**.

Figure 26 shows acoustic imaging results of the **same sound source** under four different **color map dynamic range settings**:
0.1 dB, **0.5 dB**, **3 dB**, and **10 dB** (from left to right, top to bottom).

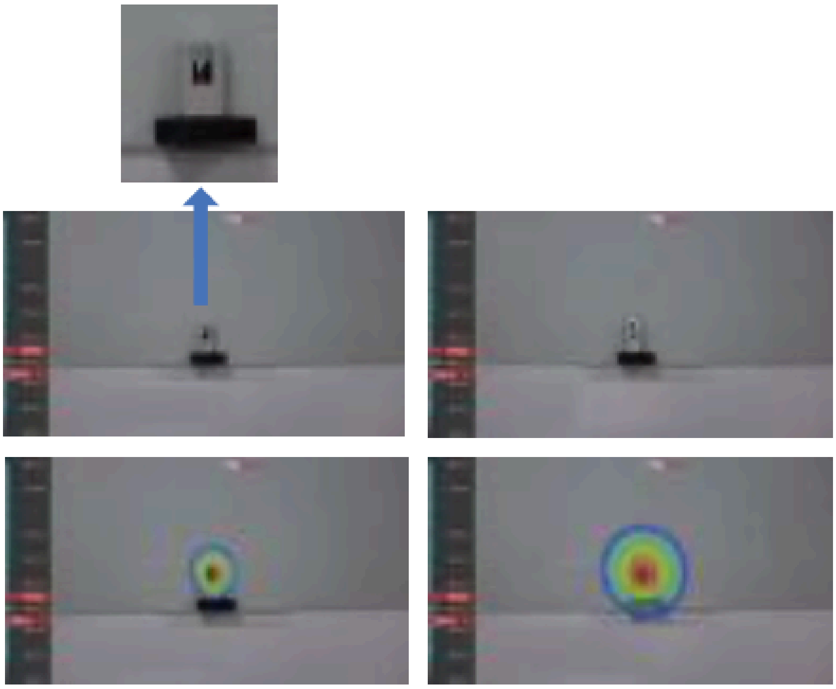


Figure 26. The influence of dynamic range setting on acoustic imaging results

In **Single Sound Source** acoustic imaging mode, the imager can be configured to **effectively suppress external sound sources or ambient noise** originating **outside the field of view (FOV)**. This functionality is controlled via the **"Exclude Sound Sources Outside FOV"** option, which can be enabled on the **third page** of the **Parameter Configuration** interface, as shown in **Figure 27**.

When this feature is activated, the acoustic imager uses a **filtering algorithm** to evaluate whether detected sound sources are the result of **ghosting or false imaging** from sources **outside the visible area**. If such sources are identified, they are **automatically excluded from display**, helping to **minimize false positives** and avoid misleading results during diagnostics.

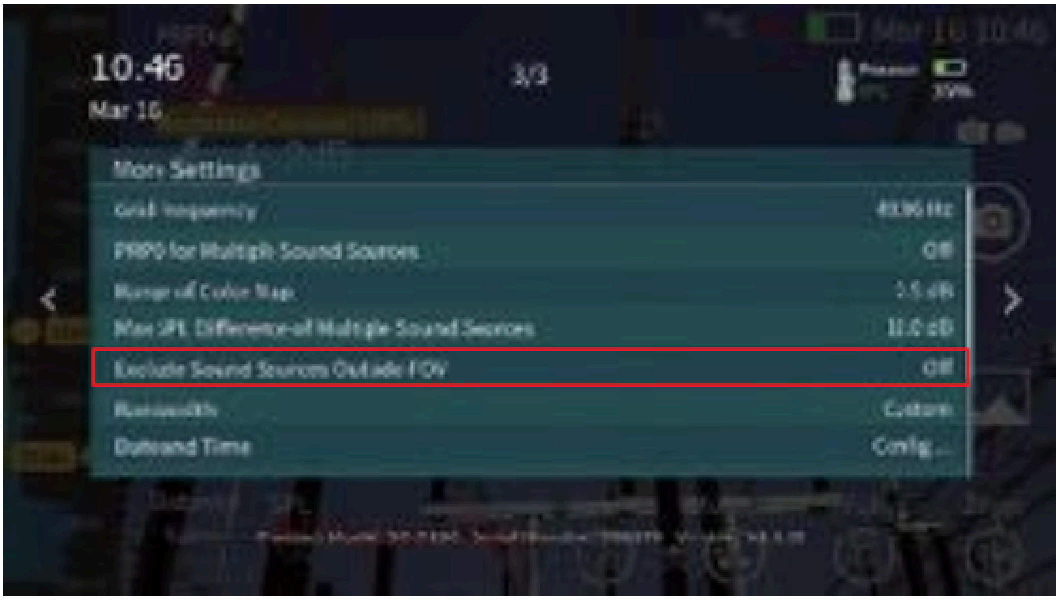


Figure 27. Setting of "**Exclude Sound Sources Outside FOV**"

Note: When the **sound source signal is weak** or the **signal-to-noise ratio (SNR) is low**, enabling the **"Exclude Sound Sources Outside FOV"** function may lead to the **failure to detect valid sound sources**. To avoid this issue, the acoustic imager is designed to **automatically disable** the "Exclude Sound Sources Outside FOV" feature **each time the device is powered on**, ensuring that all potential sources are initially visible during setup and scanning.

Multiple Sound Sources Mode - In **Multiple Sound Sources** acoustic imaging mode, the imager displays **several sound source points** with the **highest sound pressure levels** within the imaging area. The system **ranks all detected sound sources** based on their SPL and **visualizes those with the highest intensities**, limited by a predefined **maximum count parameter**.

When this mode is selected, users can control the **maximum number of sound sources** displayed by adjusting the **“Count” control** on the **main user interface**, as shown in **Figure 28**. This allows for more flexible visualization, especially in environments where **multiple concurrent noise sources** are present or suspected.

Figure 28. Tap to switch the maximum number of sound sources

The acoustic imager will display **no more than the number of sound sources specified** by the **“Count” control**. For example, if the count is set to **3**, but only **2 valid sound sources** are present within the imaging area, the system will display only those **2 sources.**

When the **“Count” control** is set to **N**, the imager will display **up to N sound sources**, based on their **sound pressure levels** and other **configured detection criteria**. Only the sources that meet the set conditions will be visualized, ensuring a focused and relevant acoustic imaging result.

The imaging performance in **Multiple Sound Sources** mode is governed by two key parameters:

1. **Range of Color Map**

2. **Max SPL Difference of Multiple Sound Sources**

As shown in **Figure 29**, both parameters can be adjusted on the **third page** of the *Parameter Configuration* interface.

- The **Range of Color Map** influences the **display size of the acoustic spots**. A **larger value** will cause the spots to appear **more prominent**, enhancing visibility but potentially reducing pinpoint accuracy.

- The **Max SPL Difference of Multiple Sound Sources** defines the **minimum sound pressure level (SPL)** a source must have (relative to the peak SPL) to be included in the display.
  Specifically, sources with SPLs **below the threshold**, which is calculated as:
  Maximum SPL – Max SPL Difference,
  will be **excluded** from the imaging results.

This setting is useful for **filtering out low-intensity or insignificant sources**, thereby improving image **clarity** and **stability**.

For optimal performance in practical applications, it is recommended to set the **Max SPL Difference** between **10 and 15 dB**. This range typically offers a good balance between **detection sensitivity** and **image quality**.

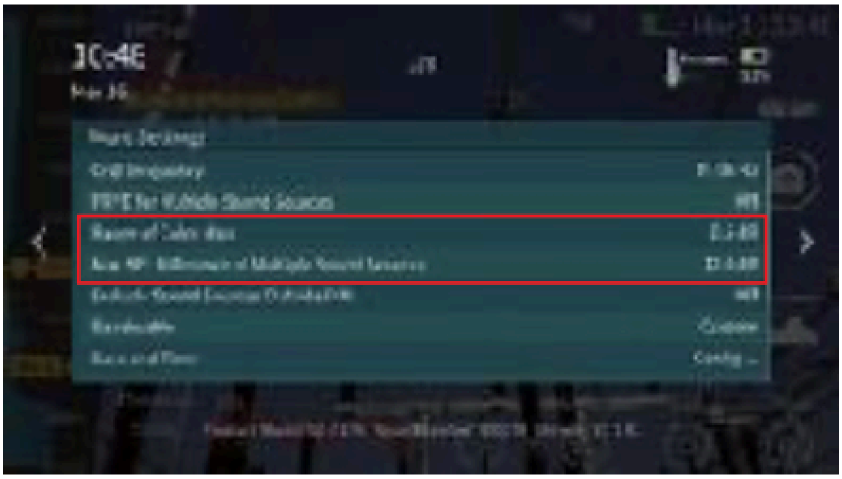


Figure 29. Settings related to multiple sound sources imaging

In **Multiple Sound Sources** acoustic imaging mode, when the imager identifies and locks onto **stable sound source points**, it displays the **individual sound pressure levels** for each corresponding acoustic spot, as shown in **Figure 28**.

If the **detection mode** is set to **“Leak”**, the imager will also display the **estimated leak rate** for each detected sound source point simultaneously, as illustrated in **Figure 30**. The value shown in the **upper left corner** of the screen represents the **total estimated leak rate**, calculated as the **sum of all individual leak rates** from the currently displayed sound sources (i.e., leakage points).

Figure 30. Display of leak rate from multiple sound sources

Holographic Mode

In **Holographic** acoustic imaging mode, the **area of interest** is divided into a grid of **uniform points**, and the **sound pressure level (SPL)** at each grid point is calculated. These SPL values are then visualized using a **color-coded overlay**, which is applied **semi-transparently** on top of the visible light image. This creates a detailed representation of the **relative acoustic energy distribution** across the entire imaging area.

In this mode, the **“Scale” setting** appears on the **main user interface** and can be adjusted to control the imaging dynamic range. Tapping the **Scale control** cycles through different options, as shown in **Figure 31**.

The available scale settings and their corresponding dynamic ranges are:

- **Small** – 0.1 dB
- **Medium** – 1 dB
- **Large** – 3 dB
- **Ultra** – 20 dB

These settings allow users to tailor the visualization based on the **signal strength** and **detection requirements**, offering flexibility between **high-resolution pinpointing** and **broad-range imaging.**

Figure 31. Dynamic range setting for "**Holographic**" mode

When to Use Holographic Acoustic Imaging Mode

The **"Holographic" acoustic imaging mode** can offer distinct advantages in the following scenarios:

☀ **Low-Noise Environments**

In settings such as **anechoic chambers** or **quiet laboratories**, background noise is minimal. The **Holographic mode** is capable of visualizing **sound sources with very low sound pressure levels**, even those approaching the noise floor—enabling detection of subtle acoustic signals that might otherwise go unnoticed.

☀ **Wide-Area Leak Detection**

In environments like **industrial workshops**, where **numerous pipelines, joints, and valves** are present, leaks may occur at multiple and unpredictable locations.
Using the Holographic mode, operators can perform **broad-area scanning** to observe zones with **elevated sound pressure levels**, helping identify **potential leak zones**.
After isolating these zones, switching to **"Single Sound Source"** or **"Multiple Sound Sources"** mode allows for **precise localization** and **quantitative measurement.**

Closely Spaced Sound Sources

When **multiple sound sources** are located in **close physical proximity**, the acoustic imager may **struggle to distinguish them individually** in *Multiple Sound Sources* mode. This can lead to the display of a **single, merged acoustic spot** positioned between the actual source locations—potentially misleading the operator into interpreting it as a **single source**.

In such cases, switching to **Holographic mode**, particularly with **"Large" (3 dB)** or **"Ultra" (20 dB)** scale settings, can significantly improve **separation and visualization** of the clustered sources. For example:

- In *Holographic* mode, two closely spaced sound sources may appear as a **broadened or elliptical acoustic spot** covering both positions.
- In contrast, *Multiple Sound Sources* mode might show a **round spot at the midpoint**, inaccurately suggesting a single source.

Other Use Cases for Holographic Mode

☀ Surface Sound Sources

When detecting sound originating from **surfaces** (e.g., machine shell resonance or vibrating panels), *Holographic* mode is particularly effective in identifying **areas of high sound radiation**.
The *Single* and *Multiple Sound Source* modes are better suited for **point sources**, whereas *Holographic* mode excels at visualizing **distributed surface sources**.

☀ Reflected Sound in Confined Spaces

In **small or enclosed environments**, acoustic signals may come not only from **direct sound sources**, but also from **reflections** off nearby surfaces.
Holographic mode enables users to observe both **direct** and **reflected** sources, providing a more comprehensive assessment of the acoustic field.

Configure the Frequency Band for Acoustic Imaging

The acoustic imager applies a **bandpass filter** to incoming sound signals from all channels, based on the selected **acoustic imaging frequency band**. This filtering removes unwanted signal components **outside the defined range** and enables accurate computation of the **sound pressure level (SPL)** distribution.

Adjusting the imaging frequency band allows users to **suppress environmental noise** and **focus on target signal ranges.** For example:

- **Partial discharge** or **gas leak signals** typically have acoustic energy concentrated in the **20 kHz to 50 kHz** range.
- **Human speech**, by contrast, mostly lies **below 10 kHz**.

By setting the frequency band to **20–50 kHz**, the acoustic imager can **filter out speech and other low-frequency noise**, ensuring reliable detection of discharges or leaks.

The **main user interface** displays a **real-time power spectrum** (Figure 32), where users can adjust the **upper and lower frequency limits** of the imaging band via an interactive selection box.
This feature enables precise tuning of the frequency range, helping isolate meaningful acoustic events and **reduce false positives** caused by irrelevant background noise.

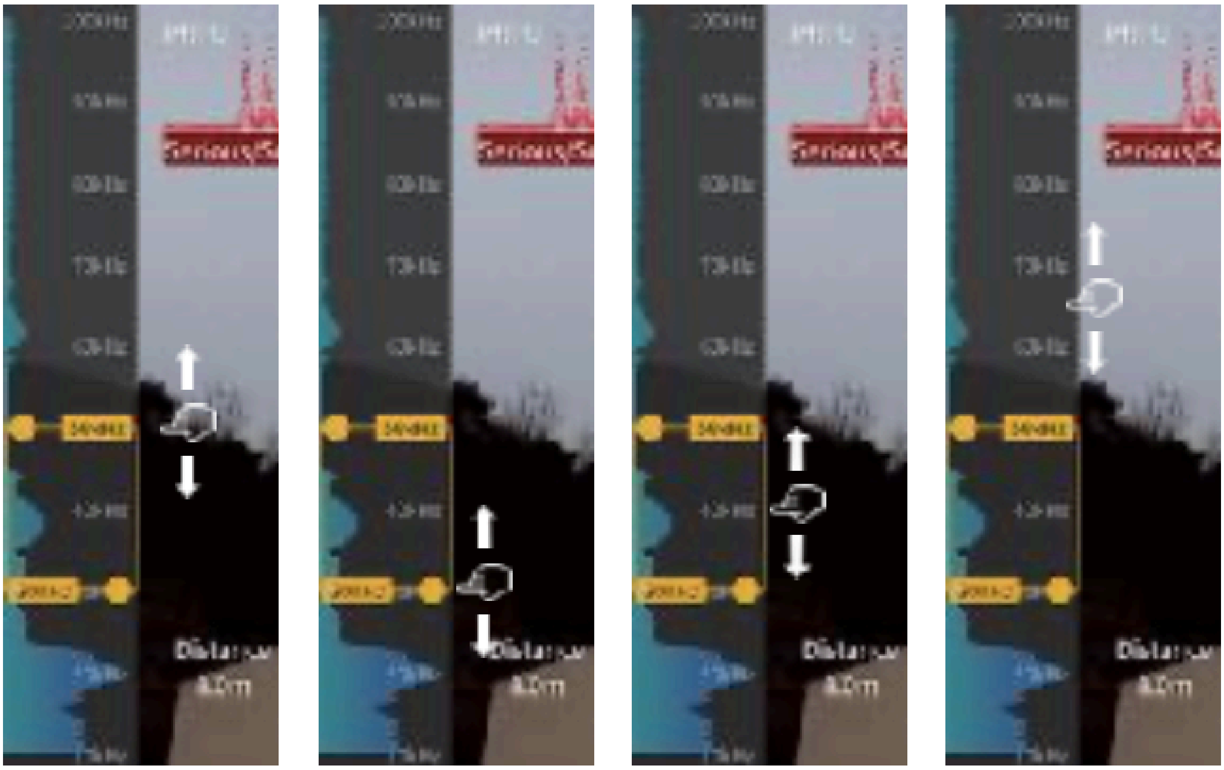
Figure 32. Setting the frequency band for acoustic imaging

As shown in **Figure 33**, you can adjust the **acoustic imaging frequency band** using intuitive touch gestures:

- **To adjust the upper or lower limit independently**, press and hold the corresponding **limit marker**, then **slide upward or downward** to increase or decrease its value.

- **To shift the entire frequency band range simultaneously**, press and hold **the area between the upper and lower limits** (or any space outside the markers) and **slide vertically**. This will move both limits up or down together, maintaining the same bandwidth.

These controls allow for **precise tuning** of the acoustic imaging frequency range based on specific detection requirements.



(a) (b) (c) (d)

(a)Sliding upper limit (b)Sliding lower limit

(c) Both upperand lower limits change simultaneously

Figure 33. Methods for setting the upper and lower limits of the frequency band

When the **acoustic imaging frequency band** is adjusted, the **frequency band selection box** turns **red**, and the **current frequency range** is prominently displayed at the center of the screen. Additionally, a **"Restore Default Frequency Band Settings"** button becomes visible, allowing users to quickly revert to the default configuration, as illustrated in **Figure 34**.

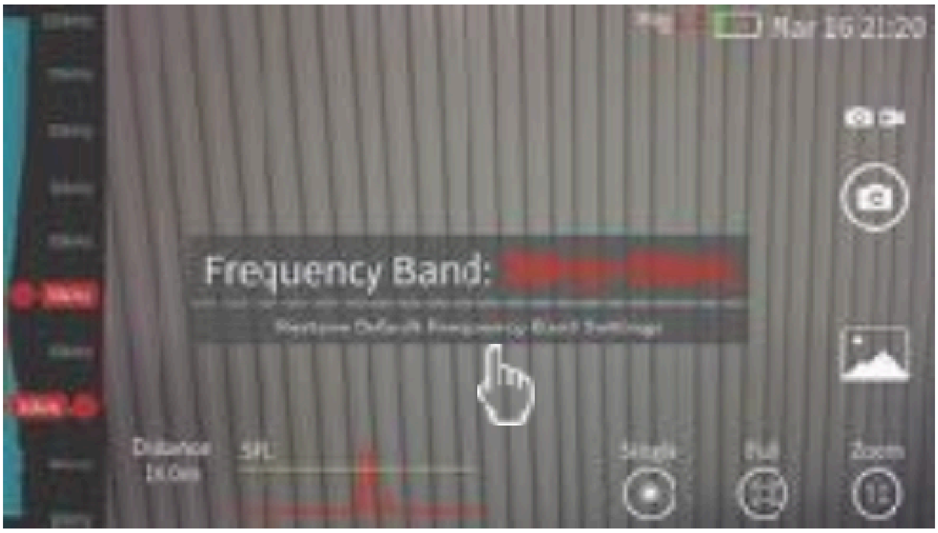


Figure 34. Restoring default frequency band settings

To restore the **acoustic imaging frequency range** to its factory defaults, simply **tap the "Restore Default Frequency Band Settings"** button.

Set Default Frequency Band

The acoustic imager allows users to configure a **custom default frequency band** based on specific application needs. Once set, the selected frequency band will be **retained and automatically applied** each time the device is powered on.

To configure this setting:

1. Navigate to the **third page** of the **"Parameter Configuration"** interface.
2. Scroll to the bottom under the **"More Settings"** section.
3. Tap the **"Config..."** button located beside the **"Default Frequency Band"** option, as shown in **Figure 35**.

This enables the customization of a preferred frequency band, ensuring consistent performance tailored to your use case.

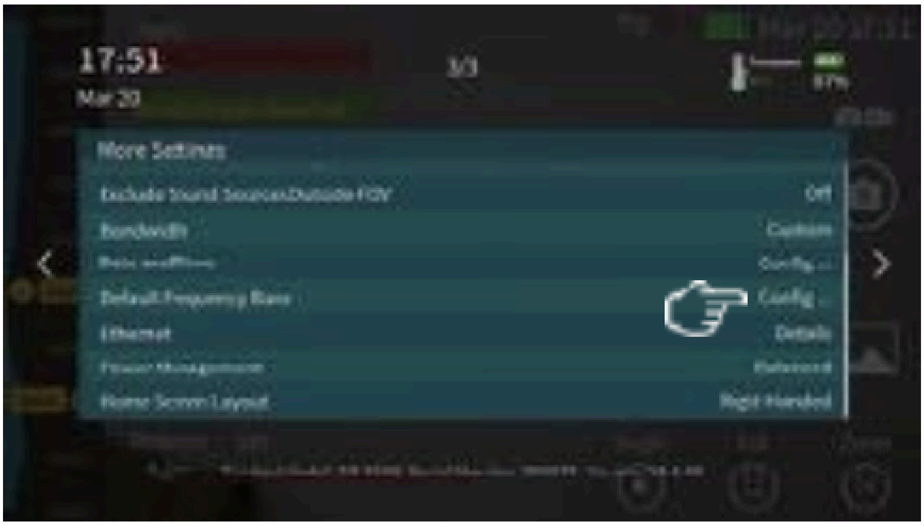


Figure 35. "**Default Frequency Band**" setting item

The acoustic imager presents a **"Default Frequency Band"** dialog box, as shown in **Figure 36**. Within this dialog, users can configure **individual default frequency bands** for each detection mode—**Partial Discharge (PD)**, **Leak**, and **BSR**. This allows the device to automatically apply the most appropriate acoustic imaging frequency band based on the selected mode, ensuring optimized performance across different use cases.

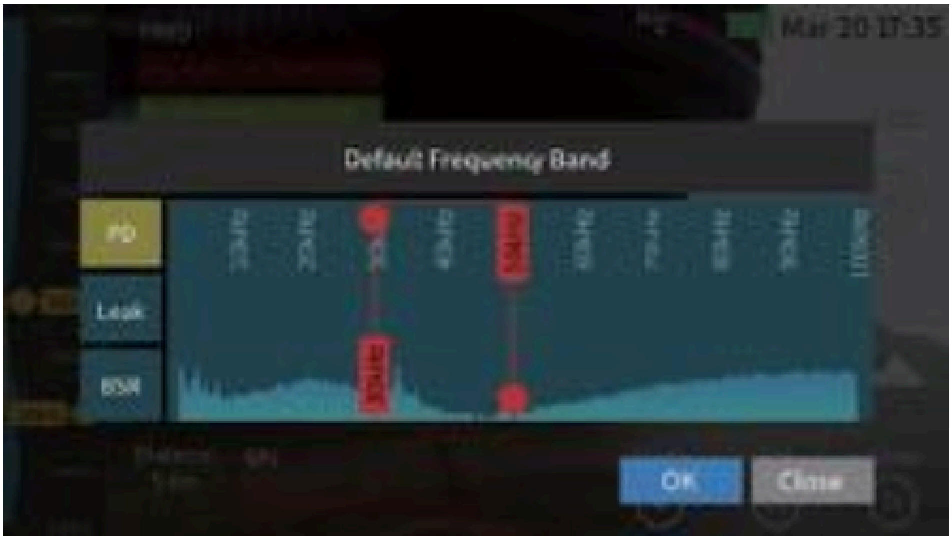


Figure 36. "**Default Frequency Band**" setting dialog box

To adjust the **default frequency band setting**, **swipe your finger** across the **upper or lower limit** of the frequency band range displayed in the dialog.

Before the changes are saved and confirmed, the **frequency band selection box** appears in **gray**, indicating that the current settings are provisional. This is illustrated in **Figure 37**.

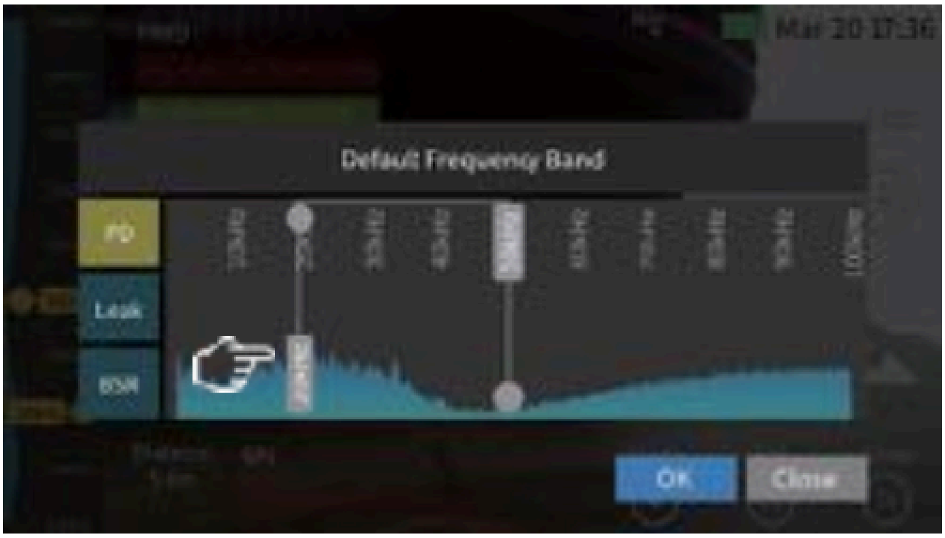


Figure 37. When the default frequency band setting is changed, the selection box is displayed in gray

Tap the **"OK"** button to confirm and save the current frequency band as the **default setting**. When accepted, the **frequency band selection box** will be highlighted in **red**, indicating the saved state. To exit without saving, tap the **"Close"** button to leave the **Default Frequency Band** dialog box.

You must configure the default frequency bands **individually** for the **PD**, **Leak**, and **BSR** detection modes. Within the dialog box, tap on the **"PD"**, **"Leak"**, or **"BSR"** buttons to access the frequency band setting interface for each specific mode. After configuring each one, ensure you tap **"OK"** to save the settings **before** switching to another mode.

Note:

1. If you tap the **"Close"** button or switch detection modes **before confirming and saving**, the current frequency band settings will be **discarded** and **will not overwrite** the previously saved default settings.

2. Each time the acoustic imager is **powered on or restarted**, the frequency band the main user interface will automatically **revert to the default frequency nd** assigned to the currently selected detection mode.

Set Acoustic Imaging Area

To configure the imaging area of the acoustic imager, tap the **"Acoustic Imaging Area"** button located on the main user interface. This allows you to toggle between different imaging area settings based on your application needs.

Set Acoustic Imaging Area

When the **"Acoustic Imaging Area"** is set to **"Full"**, the acoustic imager computes acoustic imaging results across the **entire field of view (FOV)** of the camera, as shown in *Figure 38*.

Conversely, if the **"Acoustic Imaging Area"** is set to **"Focus"**, the device will restrict calculations to the **highlighted circular region** displayed on the main user interface, as illustrated in *Figure 39*.

This feature allows users to concentrate on specific areas of interest for enhanced accuracy and noise suppression in localized inspections.

Figure 38. "**Full**" acoustic imaging area

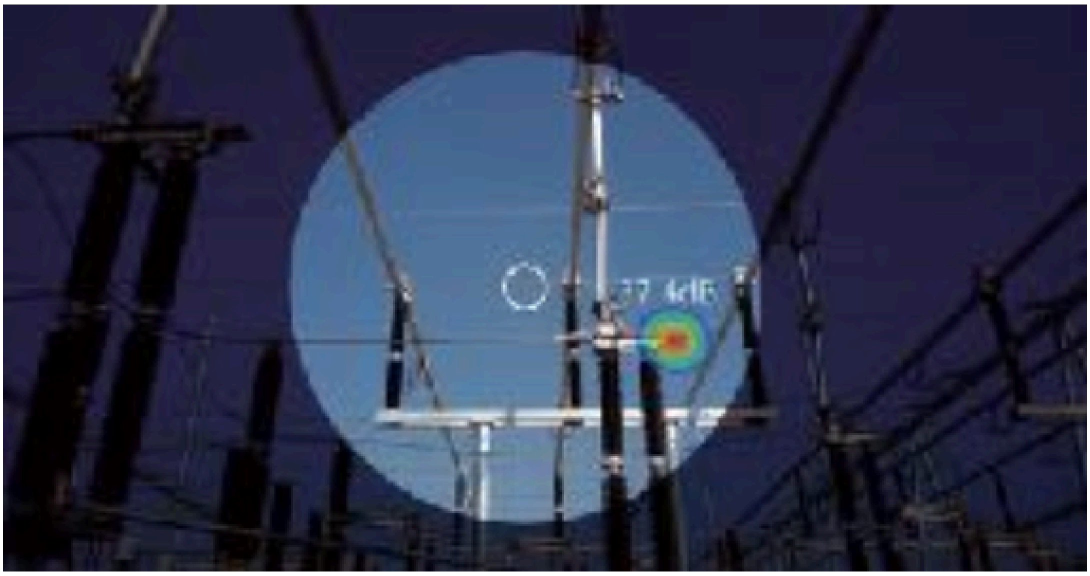


Figure 39. "**Focus**" acoustic imaging area

Using "Focus" Mode for Acoustic Imaging Area
Setting the **acoustic imaging area** to **"Focus" mode** helps suppress signal interference from outside the selected circular region, thereby enhancing the **detection sensitivity** for weak signals within the area of interest.

For instance, as illustrated in *Figure 38*, when the imaging area is set to **"Full"**, the acoustic imager detects and displays two sound sources—**Source #1** with a sound pressure level (SPL) of **41.5 dB**, and **Source #2** at **37.4 dB**. However, in *Figure 39*, after switching to **"Focus" mode**, only **Source #2**, which lies within the circular region, is visualized—resulting in a **sharper and clearer image** of the weaker source.

This mode is particularly useful when isolating specific sound sources in complex acoustic environments.

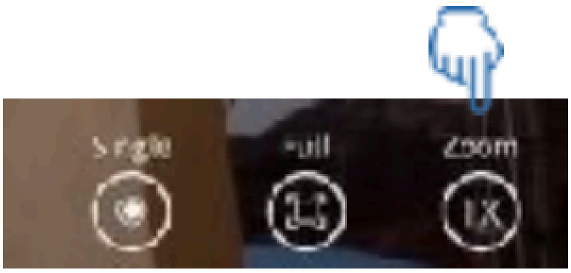
Set Digital Zoom Factor

The acoustic imager is equipped with a **digital zoom feature** that enhances focus on specific regions by narrowing both the **visible light camera's field of view** and the **acoustic imaging area**. This zoomed view is displayed in **full-screen mode**, providing clearer and more detailed visualization of target sound sources.

The device offers three zoom levels:

- **2X**: Reduces the viewing area to 1/2 of the original size
- **4X**: Reduces to 1/4
- **8X**: Reduces to 1/8
  All zoom levels are centered on the original image's midpoint.

To adjust the zoom, **tap the "Zoom" button** on the main user interface. The system defaults to **1X (no zoom)** on startup.



As shown in Figure 40, a voltage of 10,000V was applied between a metal needle and a metal plate using a partial discharge simulation device, leading to a discharge occurrence at the tip of the needle.

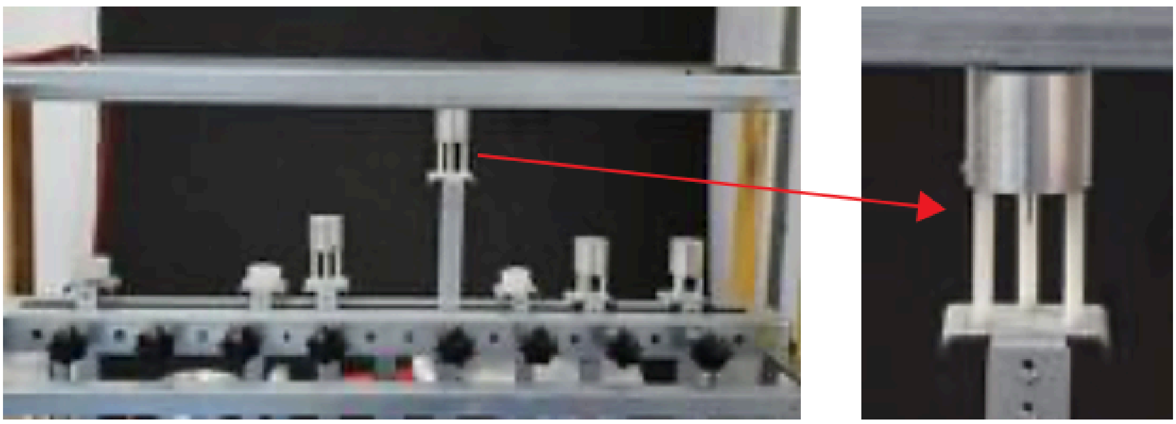


Figure 40. Tip discharge simulation device

We performed acoustic imaging on the partial discharge simulation device using the acoustic imager. The device successfully identified the precise location of the partial discharge and provided critical diagnostic information, including the PRPD diagram and classification of discharge types. This comprehensive visual and data output significantly supports accurate analysis and condition assessment. As illustrated in Figure 41, the captured images and data clearly present the characteristics of the partial discharge phenomena.

Figure 41. Acoustic imaging of tip discharge

To systematically evaluate the impact of different digital zoom levels on acoustic imaging performance, we adjusted the acoustic imager's digital zoom factor incrementally to 2X, 4X, and 8X. The corresponding imaging results are shown in Figures 42, 43, and 44. These results clearly illustrate that increasing the zoom factor significantly enhances the level of detail captured and improves the precision of sound source localization.

As the zoom factor increases, the visible light image area narrows, allowing for a more focused acoustic analysis and improved positioning accuracy. This facilitates the precise identification of sound source locations. In this demonstration, a partial discharge simulation device was used to generate the sound source, effectively highlighting the acoustic imager's zooming capabilities.

It is important to note that the digital zoom function of the acoustic imager is not limited to the "Partial Discharge" detection mode; it is equally applicable in both "Leak" and "BSR" detection modes, enabling enhanced focus and precision across all diagnostic applications.

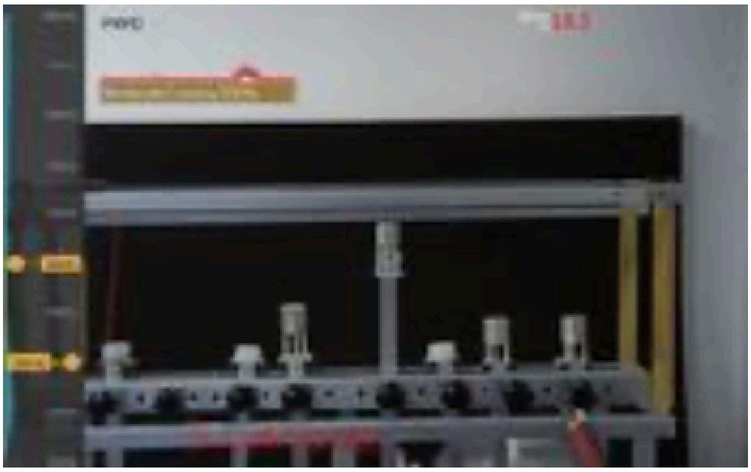


Figure 42. 2X digital zoom imaging result

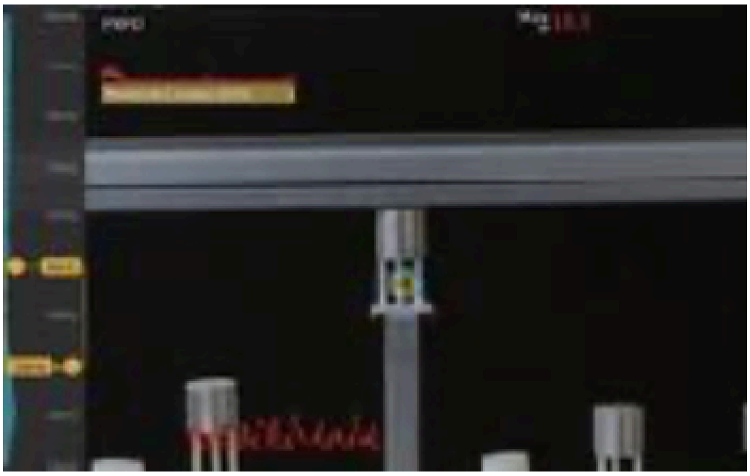
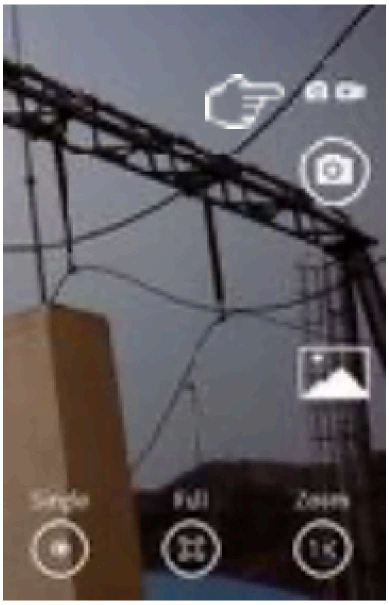


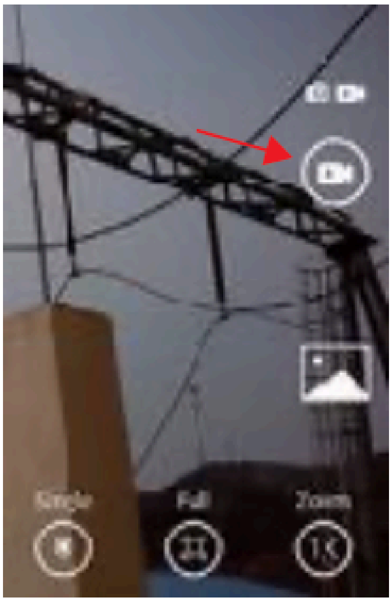
Figure 43. 4X digital zoom imaging result

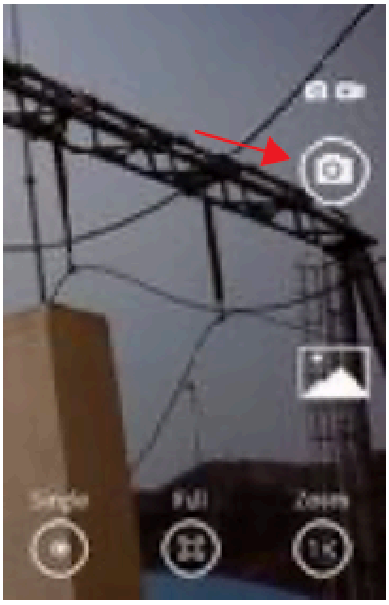
Capture Images and Record Videos:

Switching Between Photo and Video Modes

Tap the **"Photo/Video Mode"** button to switch between image capture and video recording modes on the acoustic imager. This allows you to choose the appropriate mode based on your inspection requirements.







Toggle Data Recording Mode

When the data recording mode is set to **"Photo"**, the acoustic imager captures a snapshot that includes the visible light image, acoustic imaging overlay, PRPD diagram, leak estimation results, frequency band settings, and other relevant parameters at the moment of capture.

When switched to **"Video"** mode, the acoustic imager continuously records visible light video along with the corresponding acoustic imaging data during the entire recording session.

In **"Photo"** mode, tap the **"Take Photo"** button on the main user interface to freeze the current acoustic imaging frame and open the **save dialog box**.

In **"Video"** mode, tap the **"Take Video"** button to start recording. The button icon will immediately change to a flashing **"Stop"** button. Tap the **"Stop"** button to end the recording, and the **save dialog box** will appear to confirm and store the video file.

Figure 45 illustrates the dialog box that appears when saving an image or video. Tap the "Data Name" and "Remarks" fields to edit the file name and add relevant notes, respectively.

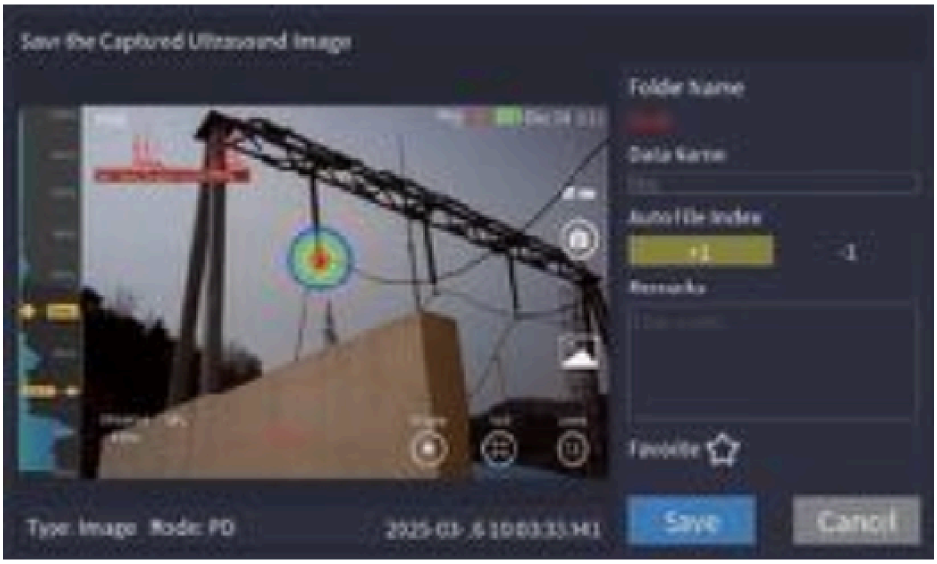


Figure 45. Dialog box for saving image or video

Set Folder for Saving Data

To specify a storage location, tap the **"Folder Name"** field in the save dialog box. This opens the **"Folder Management"** dialog box, where you can select or create a folder to save acoustic imaging pictures and videos.

Figure 46 shows the interface of the **"Folder Management"** dialog box.

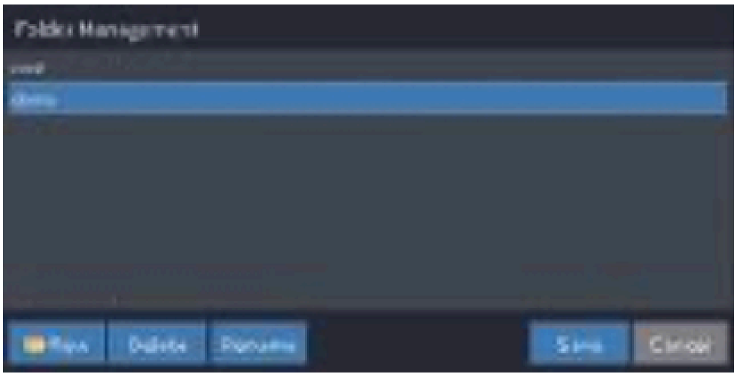


Figure 46. "**Folder Management**" dialog box

Tap on the desired folder to set it as the storage location for images and videos, then select the **"Save"** button to confirm and close the dialog box. The acoustic imager will store the captured data in the selected folder. You can also use the **"New"**, **"Delete"**, or **"Rename"** buttons to create a new folder, remove an existing one, or rename the selected folder accordingly.

Figure 44. 8X digital zoom imaging result

Note: Folder names must not contain spaces or special characters.

Automatic Data Naming

Tap the **"Auto File Index"** button in the save dialog box (as shown in Figure 47) to configure automatic file naming rules for subsequent image or video recordings. This setting allows the acoustic imager to generate file names automatically based on predefined indexing logic, ensuring consistency and preventing duplication.

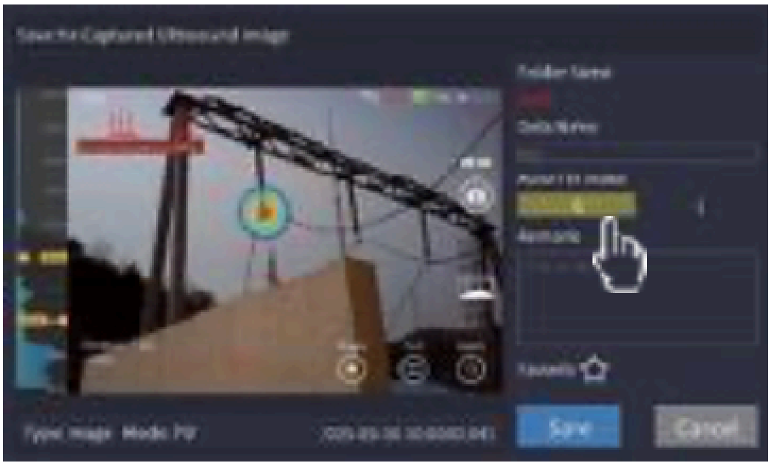


Figure 47. Selecting automatic naming rules for data

Automatic Naming Logic

When **"+1"** is selected, the new data name will increment by 1 from the previous data's name. If the previous name does not end with a numerical sequence, the imager will append **"001"** to the new data name.

When **"-1"** is selected, the new data name will decrement by 1 from the previous data's name. If the previous name does not include a numerical suffix, or ends with **"001"**, the name of the new data will remain unchanged.

Note:

Files with identical names can coexist and will not overwrite each other. However, it is strongly recommended to assign unique names to each data entry to ensure proper identification and management.

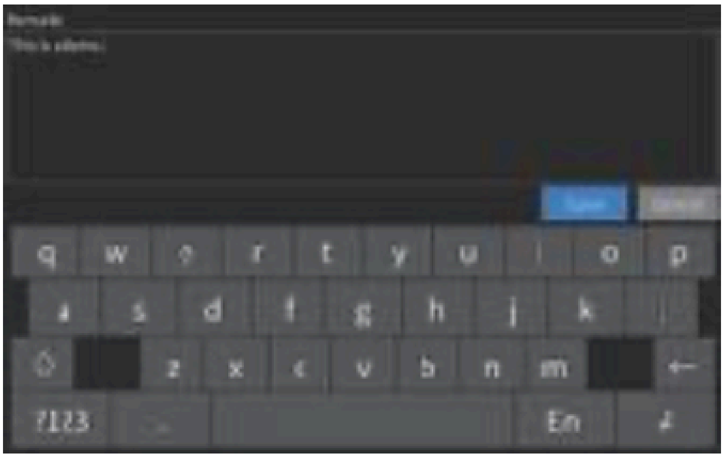
Add Notes

To add remarks to your data:

1. Tap the **"Remarks"** field in the **Save** dialog box.

2. Use the on-screen keyboard to enter your notes, as shown in **Figure 48**.

Figure 48: Editing remark content



The entered remark is saved along with the corresponding acoustic image or video file. You can view or edit this remark later in the **"Data Management"** interface.

Mark as Favorite

For data requiring special attention or easier access in the future, tap the **"Favorite"** control to assign a favorite tag, as illustrated in **Figure 49**.

Within the **"Data Management"** interface, you can apply filters to display only those files marked as favorites, simplifying the process of locating, analyzing, and managing key data sets efficiently.

Figure 49. Setting favorite tags

Sound Pressure Level Measurement

In the **upper right corner** of the main user interface, the **“Maximum SPL”** and **“Set Point SPL”** controls display the **maximum sound pressure level (SPL)** detected within the camera’s field of view and the **SPL at the current cursor position**, respectively, as shown in **Figure 50**.

Figure 50. Maximum SPL and set point SPL

On the main user interface, you can **drag the "Set Point SPL" measurement cursor** to any desired location, as shown in **Figure 51**, to accurately measure the sound pressure level at that specific point of interest.

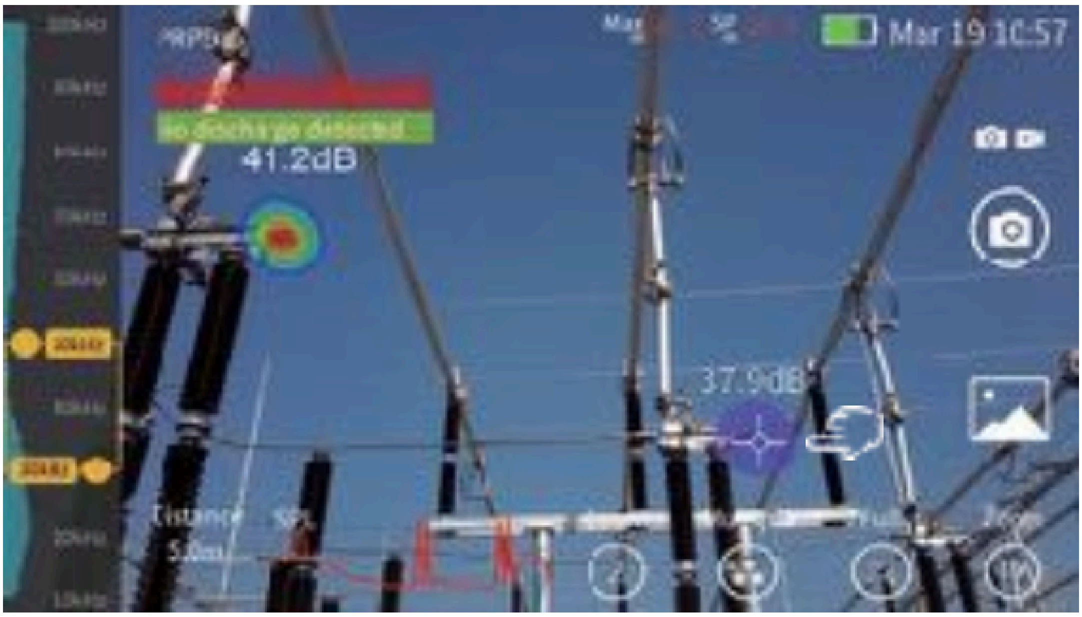


Figure 51. "**Set Point SPL**" measurement cursor

If the **"Set Point SPL" measurement cursor** is not visible on the main user interface, you can enable it by setting the **"Marker"** option to **"Shown"** on the **second page** of the **Parameter Configuration** interface, as illustrated in **Figure 52**. Note that this setting defaults to **"Hidden"** each time the acoustic imager is powered on or restarted.

Figure 52. Displaying "**Set Point SPL**" measurement cursor on the main user interface

Power Spectrum and Frequency Range Setting

The **power spectrum plot** displayed on the main user interface visualizes the **energy distribution of real-time acoustic signals across different frequencies**, enabling users to select an appropriate frequency band for acoustic imaging.

The **frequency axis** of the plot represents the range over which the acoustic imager can perform imaging, typically specified in the device's technical specifications—for example, **2 kHz to 100 kHz**.

Figures 53 and 54 illustrate the power spectrum and corresponding acoustic imaging results of a gas leakage simulation device in its **off** and **on** states, respectively.

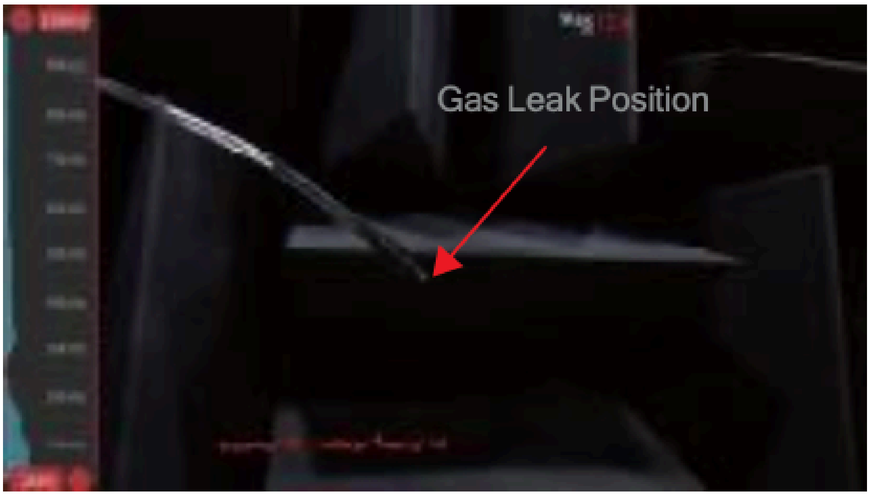


Figure 53. Gas leak simulation device not turned on

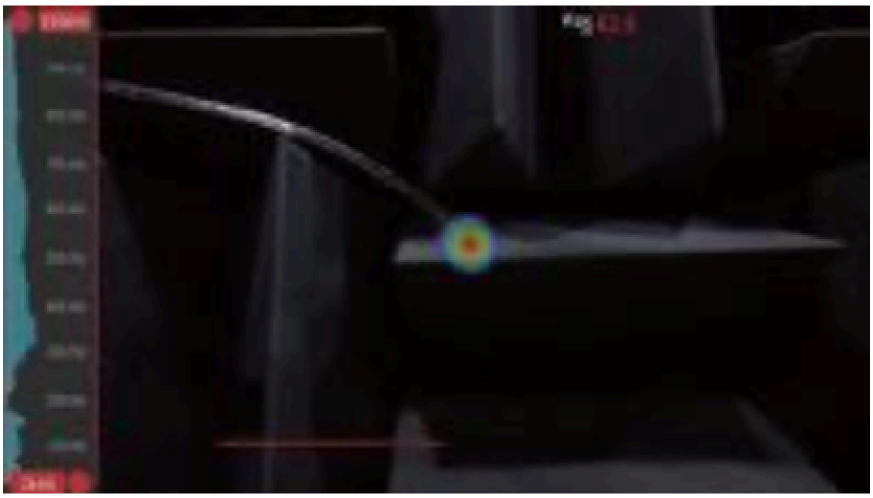


Figure 54. Gas leak simulation device turned on

Comparing the power spectra shown in **Figures 53 and 54**, it is evident that during a gas leak, the emitted sound comprises **multiple frequency components** spanning a broad range. However, in cases of **very weak leaks** or **low signal-to-noise ratio (SNR)** partial discharges, the power spectrum may exhibit **no distinct or discernible features.**

The acoustic imaging performance is heavily influenced by the **frequency band selected for imaging**. Higher frequency bands typically provide:

- **Greater positioning accuracy**
- **Reduced overlap of acoustic spots**
- **Improved resolution when imaging multiple sound sources**

As shown in **Figure 54**, the power spectrum of the leaking sound spans from a few **thousand hertz** to several **tens of thousands of hertz.**

Figures 55 and 56 display acoustic imaging results when the imaging frequency bands are set to **2 kHz–20 kHz** and **30 kHz–50 kHz**, respectively. Comparing these images reveals that as the imaging frequency band increases, the acoustic spot of the leakage point becomes **more focused and concentrated**, enabling **more precise localization.**

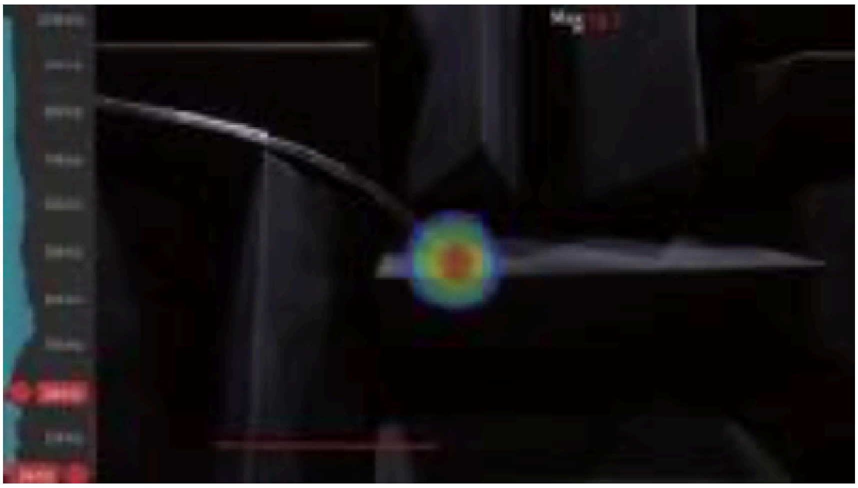


Figure 55. Leakage acoustic imaging, frequency band set at 2k-20kHz

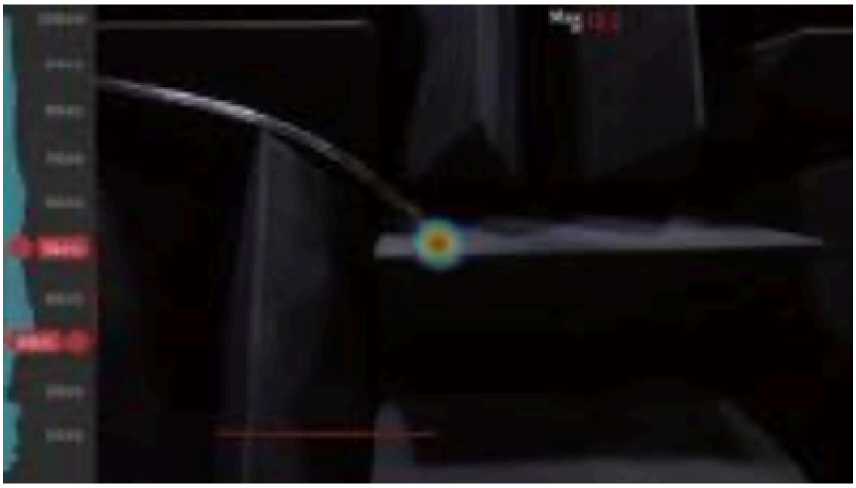


Figure 56. Leakage acoustic imaging, frequency band set at 30k~50kHz

In applications involving **partial discharge, leak detection, and BSR**, the dominant frequency of the sound source may not always be high, but these phenomena typically generate **higher-frequency components** as well. For example, partial discharges and high-voltage gas leaks produce sounds within the **audible range** alongside **ultrasonic components** beyond human hearing. Similarly, bearings and other rotating machinery emit acoustic signals corresponding to their **rotational speed** and associated **harmonics** —frequencies that can be several to tens of times the fundamental rotational frequency.

By appropriately setting the acoustic imaging frequency band to a **higher range**, users can obtain imaging results with **improved resolution and clarity**.

When the **"Scale Range of Power Spectrum"** option on the **second page** of the **Parameter Configuration** interface is set to **"High Frequency Only"**, the power spectrum displayed on the main user interface will show **only frequency components above 10 kHz**.

Typical frequency band settings for different applications include:

- **Partial discharge and leak detection:** frequency band above **30 kHz**
- **Mechanical noise detection:** frequency band above **15 kHz**

Therefore, the acoustic imager is designed to **automatically default** to the **"High Frequency Only"** power spectrum frequency band setting upon startup or restart, optimizing it for these common use cases.

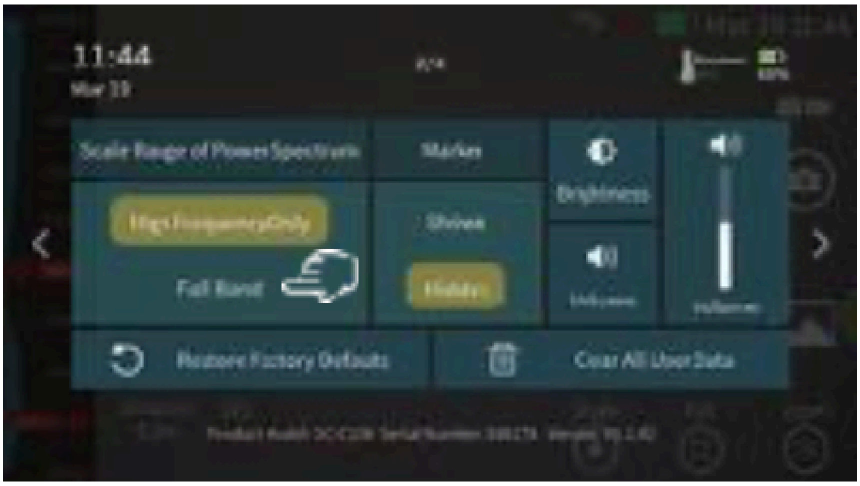


Figure 57. Setting the "**Scale Range of Power Spectrum**"

IIf you need to locate **sound sources below 10 kHz**, adjust the **"Scale Range of Power Spectrum"** setting to **"Full Band"**, as shown in **Figure 57**. This change expands the power spectrum plot on the main user interface to display the **entire imaging frequency range** of the acoustic imager, spanning from **2 kHz to 100 kHz**.

Fixed Bandwidth

Bandwidth refers to the range between the **upper and lower limits** of the acoustic imaging frequency band. The acoustic imager does **not impose fixed restrictions** on bandwidth, allowing users to freely adjust these limits according to the signal characteristics.

- For **single-frequency** or **narrowband signals**, it is advisable to use a **smaller bandwidth**, setting the upper and lower frequency limits as close as possible for improved signal focus.

- However, manually adjusting to a very **narrow bandwidth** can be challenging due to the limited display size and interface constraints on the device.

To facilitate this adjustment, the **"Bandwidth"** setting is available on the **third page** of the **Parameter Configuration** interface, allowing users to modify the relationship between the upper and lower frequency limits of the imaging band, as illustrated in **Figure 58**.

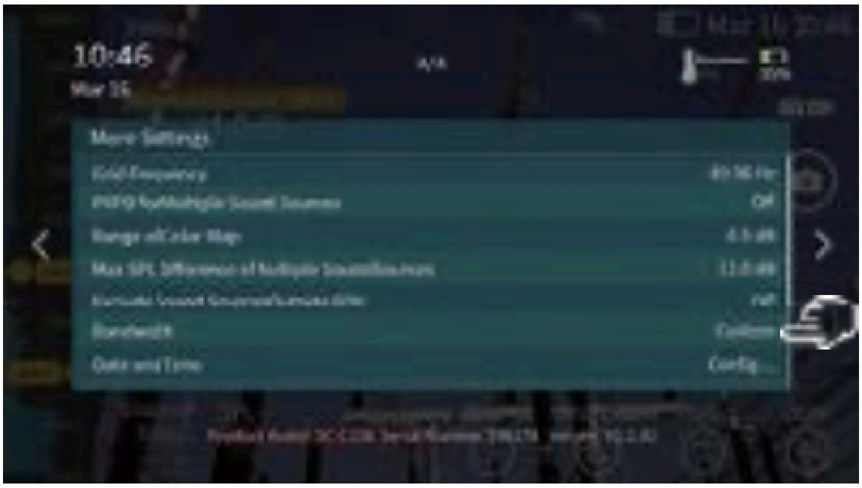


Figure 58. Setting the acoustic imaging bandwidth mode

The **“Bandwidth”** configuration options include:

- **Custom**
- **Fixed 2 kHz**
- **Fixed 10 kHz**
- **Fixed 30 kHz**

The **“Custom”** option allows users to freely adjust the **upper and lower frequency limits** on the power spectrum plot independently.

The **fixed bandwidth options—2 kHz**, **10 kHz**, and **30 kHz**—constrain the acoustic imaging frequency band to a **constant bandwidth** of the specified size. When a fixed bandwidth mode is selected, the **upper and lower frequency limits move synchronously** during adjustments, maintaining the set bandwidth width.

By default, the acoustic imager sets the **“Bandwidth”** option to **“Custom”** each time the device is powered on or restarted, allowing for flexible frequency range configuration.

Select Sound Source Signal Feature Type

Acoustic imagers typically produce **25 or more frames per second** when generating acoustic imaging pictures. To ensure **stable and smooth localization** of sound sources, the imager performs **inter-frame averaging** by combining multiple recent frames. This process often utilizes **exponential averaging**, which smooths the time series data by assigning **higher weights to more recent frames** and gradually reducing the influence of earlier frames.

Different **weighting strategies** are applied depending on the characteristics of the sound signal.

Based on the nature of the sound source, the acoustic imager provides **pre-set optimized inter-frame averaging parameters** for four signal feature types:

- **Mobile**
- **Steady**
- **Transient**
- **Faint**

Users can select the appropriate **"Signal Feature of Sound Sources"** option on the **first page** of the **Parameter Configuration** interface, as illustrated in **Figure 59**, to optimize acoustic imaging performance.

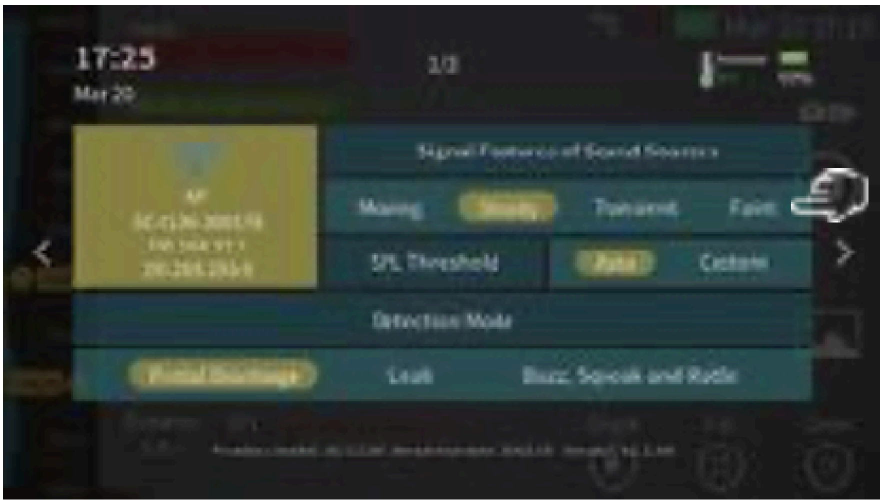


Figure 59. Selecting signal feature of sound sources

The **"Mobile"** mode is specifically designed to locate sound sources emitted by **moving objects**, such as **drones in flight** or **trains in motion**. In this mode, the **inter-frame averaging parameter** is set lower, placing greater emphasis on the most recent data frames. As a result, the acoustic imaging output provides a **more accurate and real-time representation** of the moving target's current position.

Signal Feature Modes

Steady Mode

The **"Steady"** mode is optimized for sound sources with **fixed locations** and **continuous emissions**, such as ongoing leakage points or persistent partial discharges. In this mode, the inter-frame averaging parameter is set to a **moderate value**, balancing the influence of recent frames with data collected over the previous **0.5 to 1 second**. This ensures **stable imaging**, even if the imager is moved slightly or used while walking, maintaining a consistent lock on the sound source. For **high-intensity signals** from partial discharge, leaks, or mechanical noise, the *Steady* mode is generally the **preferred setting**.

Transient Mode

The **"Transient"** mode is designed to capture **brief, short-duration sounds** such as **finger snaps, clicks, crackling from structural stress releases, and other explosive noises**. This mode uses a **higher inter-frame averaging parameter**, combining the latest data with frames from the preceding **1 to 3 seconds**. As a result, the imaging of transient sounds is **sustained for 1 to 2 seconds after the sound ceases**, making them easier to observe and analyze. Without this averaging, transient events might appear only briefly or flicker on the display, making them difficult to detect with the naked eye.

Faint Mode

The **"Faint"** mode targets **weak or low signal-to-noise ratio (SNR)** sounds, such as distant partial discharges in power facilities or subtle leaks in noisy industrial environments. It maximizes the inter-frame averaging parameter by integrating the most recent data with signals from the previous **3 to 5 seconds**. This extended averaging allows faint signals to become visible in the acoustic imaging results.

In **industrial applications**, the **"Steady"** mode is the most commonly used setting. The acoustic imager **automatically defaults** to this mode on startup or restart. However, users are encouraged to experiment with different modes to best suit their specific detection scenarios.

Set Sound Pressure Level Threshold

To enhance the stability of acoustic imaging, a **sound pressure level (SPL) threshold** can be set as a trigger condition for displaying imaging results. The acoustic imager will begin processing and displaying acoustic images **only when the detected sound power exceeds this preset threshold**.

For example, in a **noisy environment** such as an exhibition hall, the imager may capture sounds from multiple directions, causing frequent shifts in imaging focus. By setting an SPL threshold, the imager filters out **background noise** from distant sources whose sound pressure levels fall below the threshold. Consequently, only sound sources that are **closer and stronger** than the threshold will be visualized, resulting in **more stable and relevant imaging**.

This setting can be selected and adjusted on the **first page** of the **Parameter Configuration** interface, as shown in **Figure 60**.

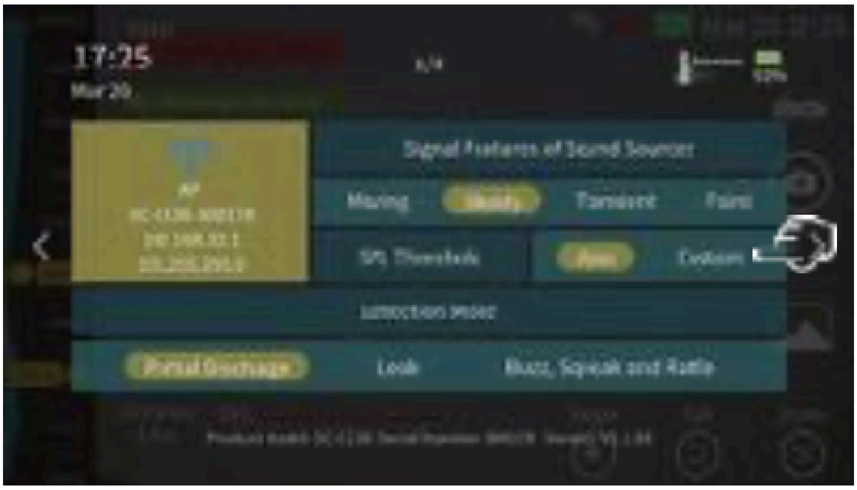


Figure 60. Setting the "**SPL Threshold**" mode

Select the **"SPL Threshold"** setting to **"Auto"** for the acoustic imager to automatically determine an optimal threshold based on signal characteristics, maximizing the number of sound sources displayed.

Alternatively, if the **"SPL Threshold"** is set to **"Custom"**, you can manually adjust the threshold using the **Sound Pressure Level Curve** graph on the main user interface. Simply slide the **yellow dashed line** within the graph to set the desired sound pressure level threshold for acoustic imaging, as shown in **Figure 61**.

When the sound pressure level falls **below the configured threshold**, no acoustic imaging spot will be displayed on the visible light image, effectively filtering out weaker signals.

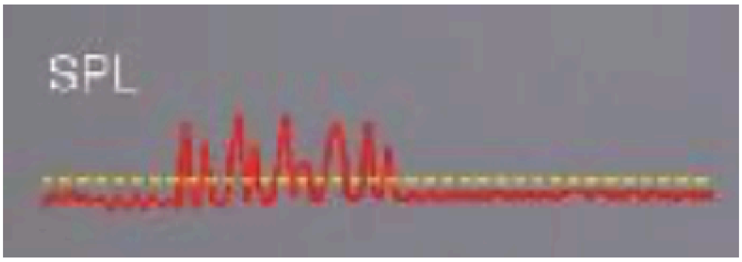


Figure 61. Setting sound pressure level threshold

Note:
Double-tapping the **Sound Pressure Level Curve** graph expands the vertical height of the curve display area, facilitating easier adjustment of the threshold setting. After approximately **5 seconds** of inactivity, the graph will automatically revert to its original size.

PRPD Diagram and Its Parameter Settings

The **PRPD (Phase Resolved Partial Discharge) diagram** illustrates the phase distribution of partial discharge activity relative to the **AC power grid voltage**. In this diagram, the **horizontal axis** represents the **phase angle** of the power frequency voltage, while the **vertical axis** corresponds to the **amplitude** of the discharge.

While the PRPD diagram generated by an acoustic imager is visually similar to that produced by a conventional partial discharge tester, it differs in its underlying physical meaning. The acoustic imager's PRPD diagram is derived from **acoustic (sound) signals**, with the vertical axis normalized to arbitrary units, which **do not directly correlate to absolute discharge quantities**. Instead, this PRPD diagram is primarily used to **identify discharge characteristics** and classify discharge types—such as **corona**, **surface**, and **suspended discharges**—rather than for precise quantitative analysis or fault severity assessment.

Each point on the acoustic imager's PRPD diagram represents a **feature point** of the sound signal, where:

- The **X-coordinate** corresponds to the **power grid phase angle** at the time the sound occurred
- The **Y-coordinate** represents the **energy intensity** of the sound segment

By aggregating these feature points over a time period (e.g., 10 seconds), the imager constructs the PRPD diagram with a dense distribution of points.

To ensure the PRPD diagram accurately reflects the partial discharge characteristics, it is essential to correctly configure the **power grid frequency**. An incorrect setting will distort the phase alignment, causing the PRPD diagram to fail in displaying critical phenomena such as **phase clustering** or **floating patterns** at specific phases, thus compromising its interpretative value.

Setting Power Grid Frequency

On the **third page** of the **Parameter Configuration** interface, you can set the **power grid frequency**, as shown in **Figure 62**. In most countries, the grid frequency is typically set to either **50 Hz** or **60 Hz**.

Figure 62: PRPD Diagram Parameter Settings

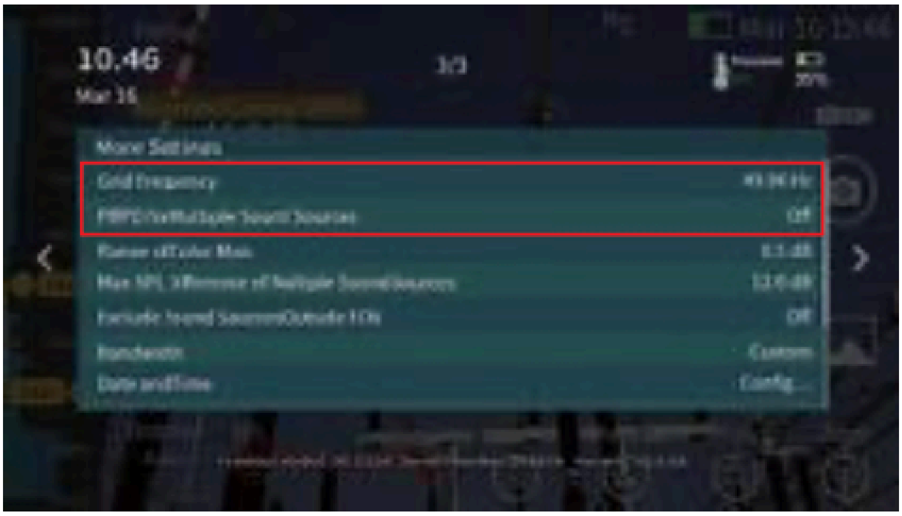


Figure 62. PRPD diagram parameter settings

Note:
If the PRPD diagram exhibits a **cyclic movement pattern**, it may indicate a slight discrepancy in the grid frequency setting. The actual frequency might deviate from the nominal value—for example, being **49.95 Hz** instead of **50 Hz**. In such cases, the **"Grid Frequency"** parameter should be **fine-tuned** until the PRPD pattern stabilizes for accurate phase alignment.

PRPD Diagram of Multiple Sound Sources

By default, the acoustic imager calculates and displays the PRPD diagram for the **strongest sound source** detected within the imaging area, shown in the upper left corner of the screen. This includes the corresponding **discharge type** for that dominant source.

When multiple sound sources are present, you can enable the **"Multiple Sound Sources PRPD"** function, as illustrated in **Figure 62**, to view PRPD diagrams and discharge types for additional sound sources.

After activating this feature, switch the acoustic imaging mode to **"Multiple Sound Sources"** on the main user interface to access and analyze the PRPD data for multiple concurrent sources.

Figure 63. PRPD diagram of the left sound source

On the acoustic imager, as shown in **Figure 63**, users can select the desired sound source by tapping on it. The main user interface will then highlight the selected source with a **red circle labeled "PRPD Sound Source"**. When this indicator appears, the acoustic imager calculates the PRPD diagram for the sound signal within the circled area and identifies its corresponding discharge type.

Figure 63 depicts two simulation devices with different discharge types: **suspended discharge** on the left and **corona discharge** on the right. Selecting the discharge point on the left causes the PRPD diagram to display the calculation results and discharge type for the left source. Similarly, tapping the discharge point on the right updates the PRPD diagram to show the results for the right source, as illustrated in **Figure 64**.

Figure 64. PRPD diagram of the right sound source

If the area within the **"PRPD Sound Source"** circle does not correspond to any detected sound source, the acoustic imager will display a prompt stating **"No sound source found inside the PRPD ROI"**, as shown in **Figure 65**.

Figure 65. "**PRPD Sound Source**" circle not aligned with any sound source

Please note that the **PRPD diagram** is displayed only when the **"PRPD Sound Source"** circle is properly aligned with an actual sound source. If multiple sound sources are visible in the acoustic image, you can reposition the **"PRPD Sound Source"** circle by tapping on each sound source point individually. Alternatively, you may fix the circle at a desired location (e.g., near the center of the screen) and then physically adjust the position or angle of the acoustic imager to align the target sound source with the center of the circle.

Other Settings and Operations

The acoustic imager provides additional configuration options, including **system time setup** and **factory reset**. To access these features, navigate to the **third page** of the **Parameter Configuration** interface, scroll through the **“More Settings”** list, and adjust options such as **Date and Time**, **Power Management**, and **Home Screen Layout**, as shown in **Figure 66**.

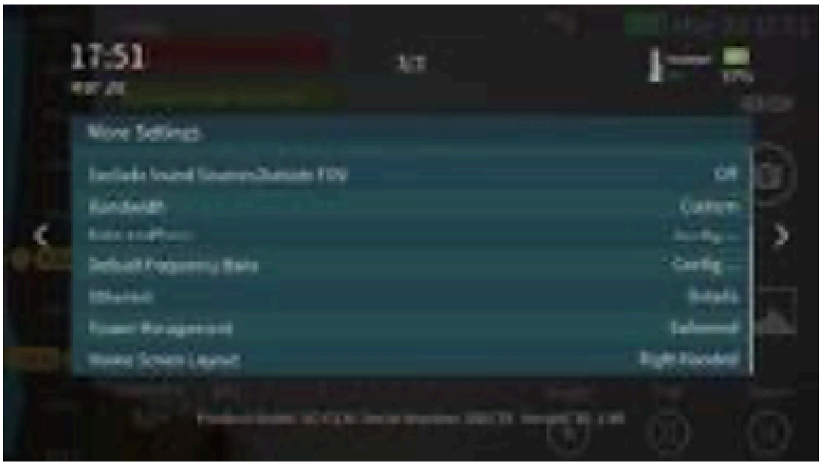


Figure 66. More setting options

System Time

Tap the **"Config..."** button next to the **"Date and Time"** setting to open a dialog box where you can adjust the system’s date and time, as shown in **Figure 67**. Press **"OK"** to save your changes or **"Cancel"** to discard them and revert to the previous settings.

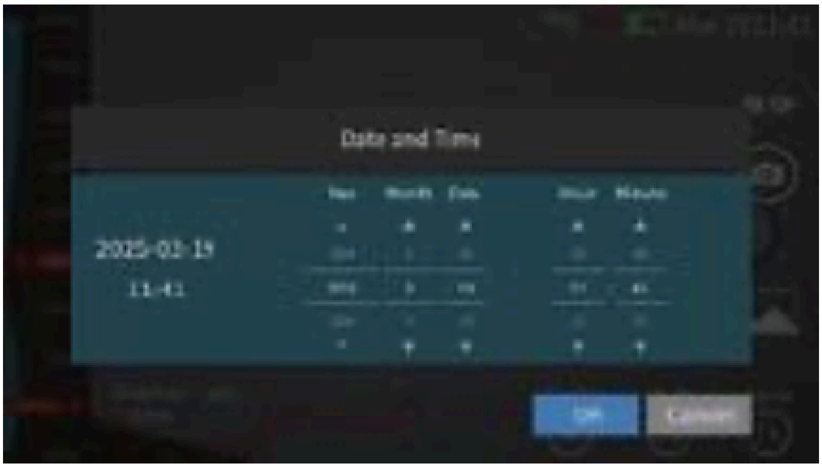


Figure 67. Setting system time

Power Management

Tap the option next to **"Power Management"** to switch among three modes:

- **Power Saver**
- **Balanced**
- **High Performance**
- **Power Saver** mode extends battery life but reduces the acoustic imaging update rate.
- **High Performance** mode maximizes the update rate but decreases battery life.
- **Balanced** mode optimizes the trade-off between update rate and power consumption.

For most use cases, **"Balanced"** mode is recommended and is set as the default each time the acoustic imager powers on.

Layout of the Main User Interface

Tap the option next to **"Home Screen Layout"** to toggle between **"Left-Handed"** and **"Right-Handed"** layouts.

- In **Left-Handed** mode, the photo and video buttons are positioned on the **left** side of the screen, with the power spectrum on the **right**.
- In **Right-Handed** mode, these elements are mirrored.

Select the layout according to your personal preference. This setting is saved permanently and remains consistent across device restarts.

Restore Factory Settings

Press the **"Restore Factory Defaults"** button on the **second page** of the **Parameter Configuration** interface to reset all device settings to factory defaults.

Note that this action **does not delete any saved data or directories**. After restoring, the acoustic imager will **automatically restart** to apply the default settings.

Delete All User Data

Tap the **"Clear All User Data"** button on the **second page** of the **Parameter Configuration** interface to delete all data stored within the imager's data folder. Note that this action **does not remove the data folder itself**. If you wish to delete entire folders, this must be done via the **"Folder Management"** dialog box.

Screen Brightness

Tap the **"Brightness"** button on the **second page** of the **Parameter Configuration** interface to reveal a **slider control** for adjusting screen brightness, as shown in **Figure 68**. Slide the control up or down to increase or decrease the brightness level.

By default, the screen brightness is set to a **medium level** upon powering on or restarting the acoustic imager. Please note that increasing screen brightness will **reduce battery life.**

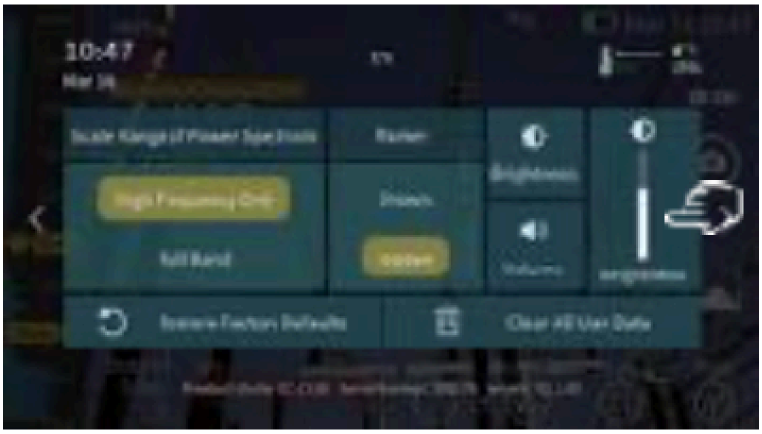


Figure 68. Adjusting screen brightness

Headphone Volume

Tap the **"Volume"** button on the **second page** of the **Parameter Configuration** interface to activate the **volume adjustment slider**, as shown in **Figure 69.** Slide the control up or down to adjust the playback volume of connected Bluetooth headphones.

By default, the volume is set to a **medium level** each time the acoustic imager is powered on or restarted.

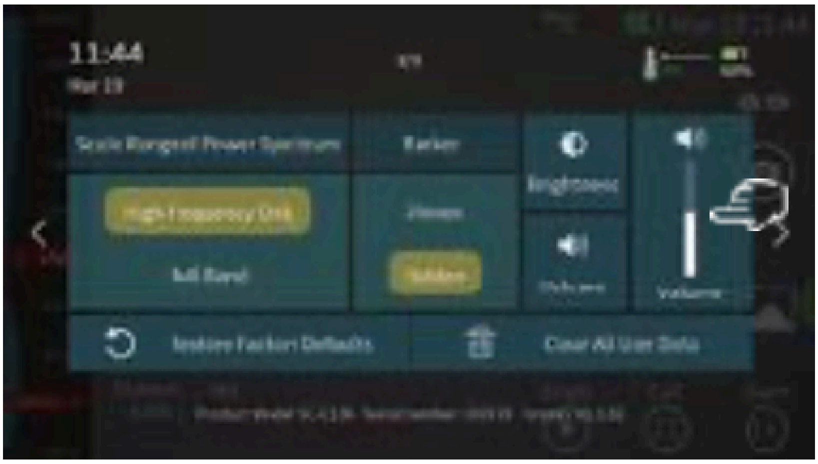
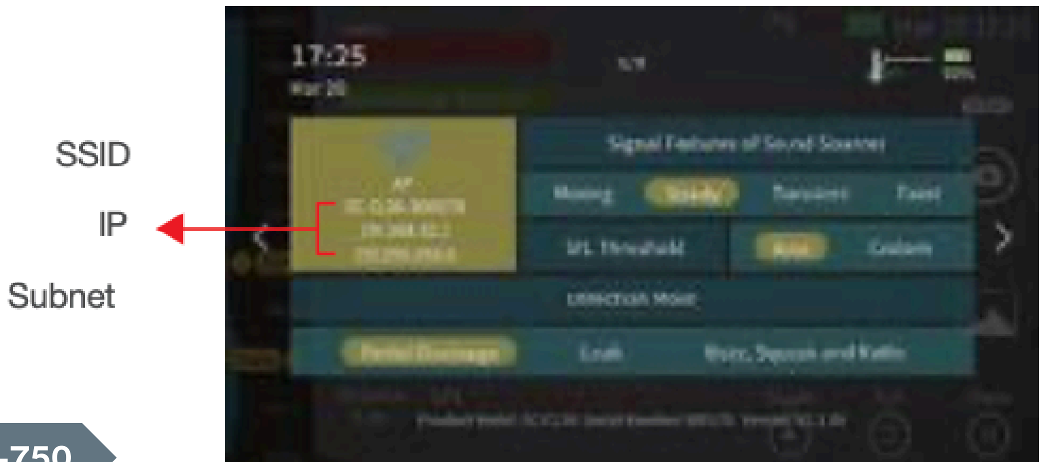


Figure 69. Adjusting earphones volume

Wi-Fi Hotspot

Tap the **"AP"** button on the **first page** of the **Parameter Configuration** interface to enable or disable the acoustic imager's Wi-Fi hotspot function. Once activated, the imager will display the **wireless network name (SSID)**, **IP address**, and **subnet mask**, as



After enabling the Wi-Fi hotspot, your personal computer can connect to the acoustic imager via Wi-Fi and access its **web-based interface** for system upgrades and configuration tasks. The default Wi-Fi access password for the acoustic imager is **1**

Ethernet Connection

Use a **USB-C to RJ45 Ethernet adapter** to connect the acoustic imager to a local area network or router that supports **DHCP**. The imager will automatically obtain an **IP address** and **subnet mask** from the DHCP server.

This IP address can then be used to access the acoustic imager's **service webpage** for system upgrades, configuration, and other operations.

To view the current network details, tap the **"Details"** button next to the **"Ethernet"** setting on the **third page** of the **Parameter Configuration** interface. This will display the assigned IP address and subnet mask in a pop-up dialog.

Firmware Update

Upgrading the acoustic imager's firmware helps resolve software issues and enhances device functionality.

The firmware upgrade process involves replacing specific binary files within the device and **does not erase** any saved data such as images, videos, or settings. However, it is recommended to **export your data to a USB drive** before upgrading as a precautionary measure.

Preparation for Firmware Upgrade

Before beginning the firmware upgrade, ensure the following:

- A **personal computer** and **USB drive** are ready
- The acoustic imager's **battery level is at least 5%** or higher

Firmware Upgrade Steps

Please follow the steps below to upgrade the firmware on your acoustic imager:

1. Power on the acoustic imager.

2. Ensure the battery level is at least **5%**.

3. If necessary, export all important data to a USB drive for backup via the **Data Management** interface.

4. Swipe down from the top of the screen to open the **Parameter Configuration** interface.

5. On the **first page** of the Parameter Configuration interface, locate the acoustic imager's **Wi-Fi SSID**, **IP address**, and **subnet mask**, as shown in **Figure 70**.

6. If the Wi-Fi hotspot is not enabled, activate it.

7. On your personal computer, search for and connect to the acoustic imager's Wi-Fi network using the password **12345678**.

8. Open a web browser and enter the imager's IP address and port number in the address bar—for example:
   http://192.168.32.1:45600/

9. The acoustic imager's operation webpage will load, as illustrated in **Figure 71**, where you can proceed with the firmware upgrade process.

Figure 71. Acoustic imager operation webpage

Tap the **"Upgrade"** button on the operation webpage, then select the **.dat** firmware file provided by the acoustic imager supplier. The .dat file typically includes the firmware version number in its filename.

Wait approximately one minute while the acoustic imager completes the upgrade and automatically restarts.

After reboot, verify the firmware version on the **first page** of the **Parameter Configuration** interface, as shown in **Figure 72**. Ensure the displayed firmware version matches the version number indicated in the .dat file name.

Figure 72. Firmware version number

Note:

If your personal computer lacks Wi-Fi capability or the wireless connection fails, you can use an **Ethernet connection** to link both the acoustic imager and the computer to the same LAN or router. Obtain the acoustic imager's IP address, substitute **192.168.32.1** with this IP in step 6, and proceed with the remaining steps to complete the firmware upgrade.

Data Management

Tap the **"Data Management"** button on the acoustic imager's main user interface to open the **Data Management** interface, as shown in **Figure 73**. Within this interface, users can view and replay saved acoustic imaging pictures and videos, edit associated notes, and perform data filtering, deletion, and export operations.

Figure 73. "**Data Management**" interface

①	Explorer control	⑥	Data Details button
②	Favorite button	⑦	Data Properties display area
③	Return button	Ⓑ	Data Display indicator
④	Delete button	⑥	Progress bar
⑤	Export button	⑩	Play button

Data Management Interface Overview

The **"Explorer"** control displays data captured by the acoustic imager as thumbnails.

- Thumbnails marked with a **camera icon** in the upper left corner indicate **acoustic imaging videos**.
- Other thumbnails represent **acoustic imaging pictures**.

Tapping any thumbnail opens the corresponding picture or video in the **"Data Display"** area. Users can scroll vertically within the Explorer to browse additional data entries.

By tapping the **"Favorite"** button, the Explorer filters and displays only the data tagged as favorites.

Data Properties and Editing

The **"Data Properties"** section shows detailed information about the currently selected data, including:

- Storage folder
- Data name
- Save timestamp
- Acoustic imaging frequency band

Tapping the **"Details"** button opens a pop-up window where users can:

- Modify the data name
- Edit notes
- Add or remove favorite tags

Video Playback

When viewing acoustic imaging videos, press the **"Play"** button to activate frame-by-frame playback. The **"Data Display"** area will show each video frame sequentially, and the **"Play"** button changes to a **"Pause"** button. Users can pause playback at any time by tapping the **"Pause"** button.

Data Deletion and Export

- Tap the **"Delete"** button to permanently remove the currently selected data from the acoustic imager.
- Tap the **"Export"** button to transfer all data from the current storage folder to a connected USB drive.
- To export all data from **all folders**, check the **"Export data in ALL folders"** option in the export dialog box, as shown in **Figure 74**.

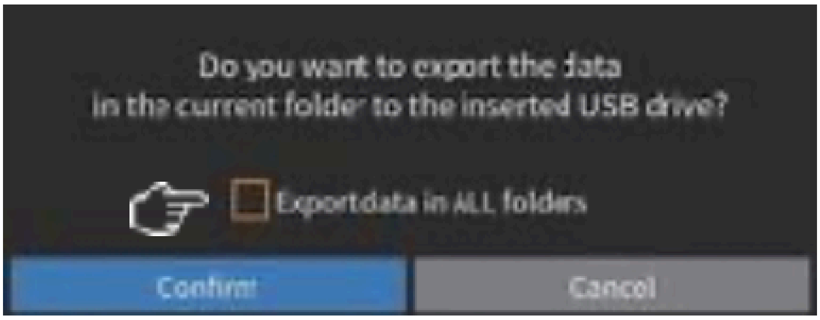


Figure 74. Data export dialog Box

Note:
The **"Data Management"** interface displays data entries from the **currently selected storage folder**. The acoustic imager may contain multiple storage folders. To view data from other folders, you must change the active folder using the **"Folder Management"** dialog box.

Within the **Data Management** interface, you can tap the folder name (displayed with an underscore) in the **"Data Properties"** area to access the folder selection options.

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