

# SPOT + SV600 PAYLOAD INTEGRATION

SPOT + Sonic Viewer



## Users Manual

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## **Warranty**

The manufacturer warrants this instrument to be free from defects in material and workmanship under normal use and service for the period of two years from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, batteries or any product which has been subject to misuse, neglect, accident, or abnormal conditions of operation.

In the event of failure of a product covered by this warranty, the manufacturer will repair the instrument when it is returned by the purchaser, freight prepaid, to an authorized Service Facility within the applicable warranty period, provided manufacturer's examination discloses to its satisfaction that the product was defective. The manufacturer may, at its option, replace the product in lieu of repair. With regard to any covered product returned within the applicable warranty period, repairs or replacement will be made without charge and with return freight paid by the manufacturer, unless the failure was caused by misuse, neglect, accident, or abnormal conditions of operation or storage, in which case repairs will be billed at a reasonable cost. In such a case, an estimate will be submitted before work is started, if requested.

The foregoing warranty is in lieu of all other warranties, expressed or implied, including but not limited to any implied warranty of merchantability, fitness, or adequacy for any particular purpose or use. The manufacturer shall not be liable for any special, incidental or consequential damages, whether in contract, tort, or otherwise.

This manual is available in different languages. In case of differences between the language versions, the English manual is binding.

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## Compliance Statement



The device complies with the requirements of the European Directives:

EC – Directive 2014/30/EU – for Electromagnetic compatibility directive (EMC)

- EN 61000-6-3:2007+A1:2011
- EN 61000-6-2:2005 + AC:2005

EC – Directive 2011/65/EU – RoHS3 Restriction of Hazardous Substances

- EU2011/65/EU RoHS2
- EU2015/863

## **Safety Information**

This document contains important information, which should be kept at all times with the instrument during its operational life. Other users of this instrument should be given these instructions with the instrument. Eventual updates to this information must be added to the original document. The instrument can only be operated by trained personnel in accordance with these instructions and local safety regulations.

### **Acceptable Operation**

This instrument is intended only for the measurement of acoustic signals. The instrument is appropriate for continuous use. The instrument operates reliably in demanding conditions as long as the documented technical specifications for all instrument components are adhered to. Compliance with the operating instructions is necessary to ensure the expected results.

### **Unacceptable Operation**

The instrument should not be used for medical diagnosis.

### **Replacement Parts and Accessories**

Use only original parts and accessories approved by the manufacturer. The use of other products can compromise the operation safety and functionality of the instrument.

Safety Symbol	Description
	Read all safety information before in the handbook
	Hazardous voltage. Risk of electrical shock.
	Warning. Risk of danger. Important information. See manual.
	Earth (ground) terminal
	Protective conductor terminal
	Switch or relay contact
	DC power supply
	Conforms to European Union directive.
	Disposal of old instruments should be handled according to professional and environmental regulations as electronic waste.
	International Ingress Protection Marking



**To prevent possible electrical shock, fire, or personal injury follow these guidelines:**

- Read all safety information before you use the product.
- Use the product only as specified, or the protection supplied by the product can be compromised.
- Do not use the product around explosive gases, vapor, or in damp or wet environments.
- Carefully read all instructions.
- Do not use and disable the product if it is damaged.
- Do not use the product if it operates incorrectly.
- Do not apply more than the rated voltage between the terminals or each terminal and earth ground.
- Incorrect wiring can damage the sensor and void the warranty. Before applying power, make sure all connections are correct and secure!
- To prevent possible electrical shock, fire, or personal injury make sure that metallic components are grounded before use.
- Have an approved technician repair the product.

## Contacts

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## 1 Description

The SV600 sonic viewer is the evolution in acoustic monitoring solutions. It combines the powerful use of acoustic imaging, detection of sound levels and accurate localization. The SV600 sonic viewer supports edge computing, all powered and connected with one single network cable.

The SV600 sonic viewer can be used in a variety of application fields: safety & security, mobility, environmental and machine maintenance. The acoustic monitors can be easily connected to cover larger areas with secure and GDPR proof data handling.

- All in one acoustic monitoring
- Environmental noise monitoring
- Visual light camera integrated
- Sound intensity mapping

**Figure 1-1: SV600 Sonic Viewer**



## 2 Technical Data of SV600

### 2.1 Physical Properties

#### SV600:

Size (LxWxD)	170 x 170 x 65 mm (6.7 x 6.7 x 2.5 in)
Weight	0.85 kg (1.8 lb)
Power	PoE+ port 100 – 240V AC, max 37 W, IEEE 802.3
Status LED	red, green

#### Mounted with a cage and a rail adapter:

Frame Size (LxWxD)	208.1 x 302.2 x 106.9 mm (8.19 x 11.90 x 4.07 in)
Weight	3.70 kg (8.17 lb)

#### Mounted with a cage and a Spot Core I/O adapter plate:

Frame BSize (LxWxD)	208.1 x 204.2 x 210.5 mm (8.19 x 8.04 x 8.29 in)
Weight	3.86 kg (8.5 lb)

### 2.2 System Integration

API	HTTP REST, Modbus
Event Triggers	dB SPL or SoundMap threshold
Event Actions	Acoustic SoundMap overlay

### 2.3 Camera

Type	Integrated visible light
Resolution video	720 x 1280
Aspect ratio	4:3
Camera Resolution	720p at 30 fps

### 2.4 Microphones

Type	MEMS, Digital Bottom Port
SNR	64 dB for 94 dB SPL, @ 1kHz, (A-weighted, at 1 kHz)
Sensitivity	-26 dBFS ± 1.5 dB, at 1 kHz, 94 dB SPL
Acoustic Overload Point	120 dB SPL, at 1 kHz, <10% THD

### 2.5 General

Ingress Protection	IP54
Operating Temperatures	-20 to 50°C (4 to 122°F)

## 3 Payload Installation and Registration

### 3.1 Network

Spot has two different wi-fi modes – access point and client mode, which is useful to know for connecting to Spot through tablet and accessing SV600 dashboard.

#### 3.1.1 SV600 Network Setting

Network of SV600 for Spot must be set to static IP address.

- Default gateway - **192.168.50.3**
- Subnet mask – **255.255.255.0**

Depends on the port, SV600 must have the corresponding static IP address:

Port Range	Static IP address – SV600
21000	192.168.50.5
31000	192.168.50.6
23000	192.168.50.7
24000	192.168.50.8
25000	192.168.50.9

*Please refer to the ‘Payload device network configuration’ in Boston dynamics documentation for more details*

*Please refer to the ‘Payload Port Forwarding table’ in Boston Dynamics documentation and*

*‘3 2 Payload Information’ in this manual for more details*

#### 3.1.2 Spot Network Setting

##### 3.1.2.1 Access point

‘Access point’ mode uses Spot’s wi-fi network. Users need to connect the spot tablet or PC to Spot’s wi-fi.

By default, Spot’s IP address is **192.168.80.3**

##### 3.1.2.2 Client

When ‘Client’ mode is selected, Spot is connected to the other network as a client. Users need to connect the spot tablet or PC to the same network where Spot is connected to.

If DHCP option is chosen, robot will have a IP address assigned by the network automatically,

Enable DHCP   
 Use DHCP to configure IPv4 Address, Route Prefix, and Default Route.

IPv4 Address  
 192.168.1.226

Route Prefix  
 24

Gateway  
 192.168.1.1

### 3.2 Port information

IP address – SV600	Port range	Auth	SSDS	SSDS Socket	Device Management	License Client
192.168.50.5	21000	21910	21911	21912	21913	21914
192.168.50.6	31000	31910	31911	31912	31913	31914
192.168.50.7	23000	23110	23111	23112	23113	23114
192.168.50.8	24000	24110	24111	24112	24113	24114
192.168.50.9	25000	25110	25111	25112	25113	25114

### 3.3 Payload Layouts

In 'Payloads' setting, once the payload – SV600 is connected to Spot's port, a message will appear for users to authorize the payload. A correct payload layout must be chosen based on the actual layout how SV600 is mounted on Spot.

Five default layouts suggested for SV600 payload :

**1. Looking Forward**



**2. Looking Backward**



**3. Looking Sideways (left and right)**

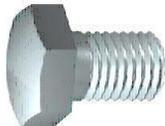


**4. Looking Backwards on top of SPOT I/O**



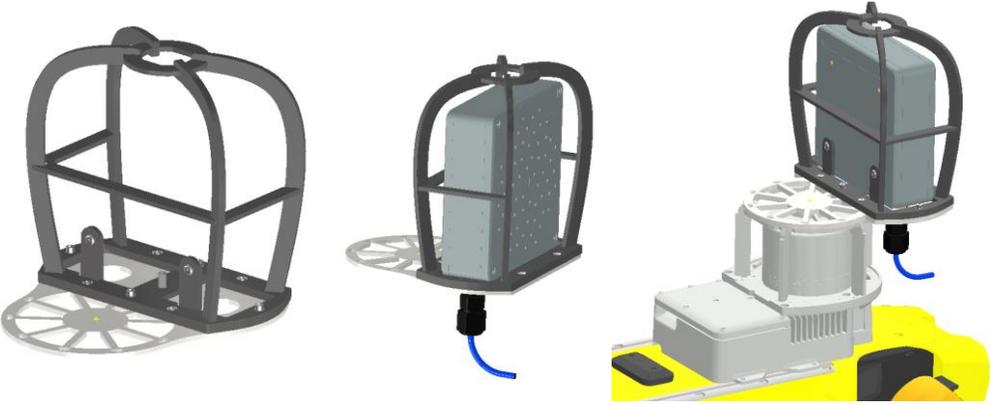
### 3.4 SV600 Payload Cage

Cage Components:

Name	Image	Quantity
Base Plate		1
Rail adapter		1
M5x8		2
M4 washer		8
M5x10		4
M5 Washer		4
M4x8		8
1/4"-20 UNC		1

<p><b>Lidar plate</b></p>		<p><b>1</b></p>
<p><b>Rail mount</b></p>		<p><b>4</b></p>
<p><b>Cage assy</b></p>		<p><b>1</b></p>

The cage must be assembled as follows, depending on the layout :

<p><b>1. Looking forward and backward</b></p> 	<p><b>2. Looking to left and right</b></p> 
<p><b>3. Looking backward on top of SPOT I/O</b></p> 	

Please refer to the '**Spot + SV600 Step-by-step instruction**' for some practical information

### **3.5 Cables for payload connection**

Between Spot and SV600 – male DB25 to Ethernet cable

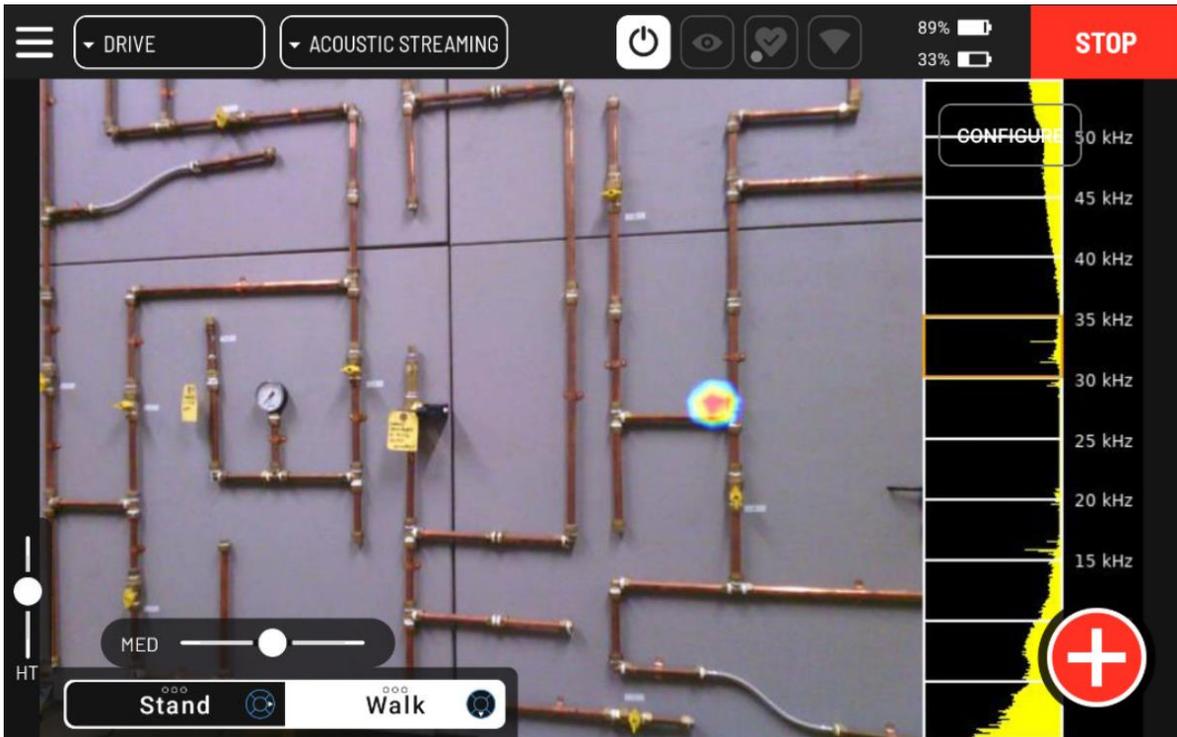
Between Spot Core I/O and SV600 – A splitter cable - ethernet cable to ethernet and male socket connect

## 4 Acoustic Streaming Service

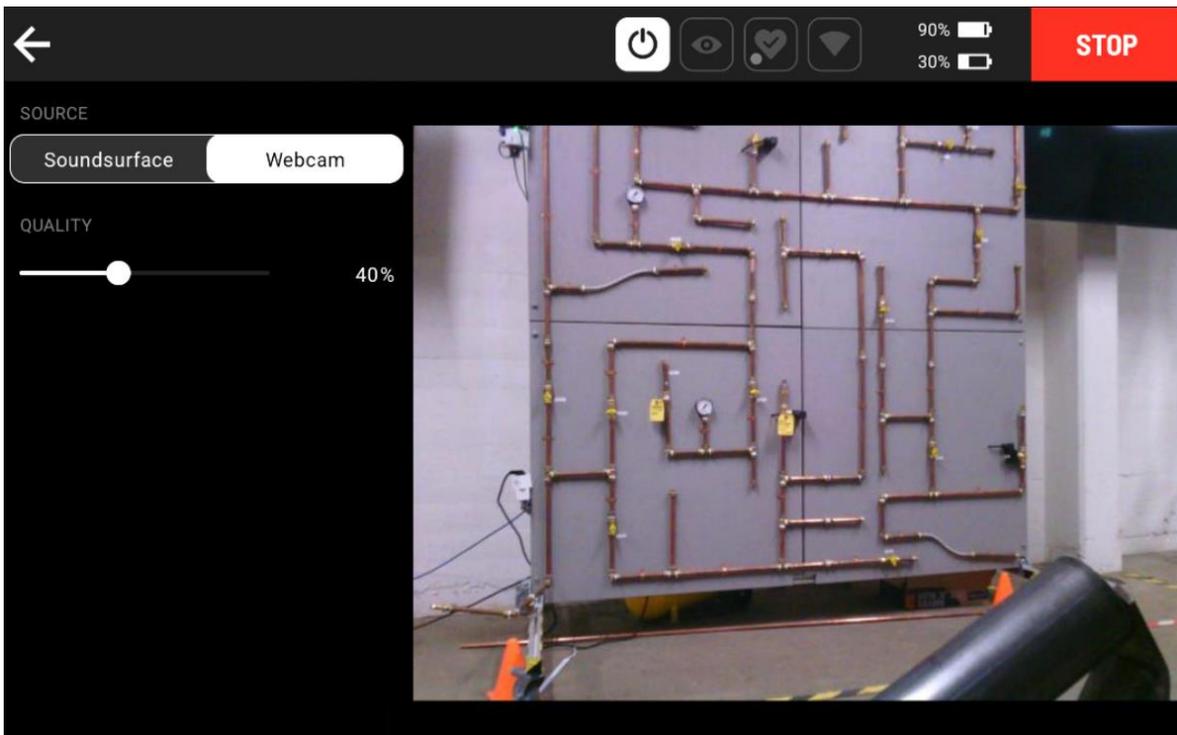
Acoustic Streaming service allows user to monitor and control the Soundmap on the tablet.

### 4.1 Image Streaming

Users can monitor the streaming page on the tablet with the Soundmap and spectrum data

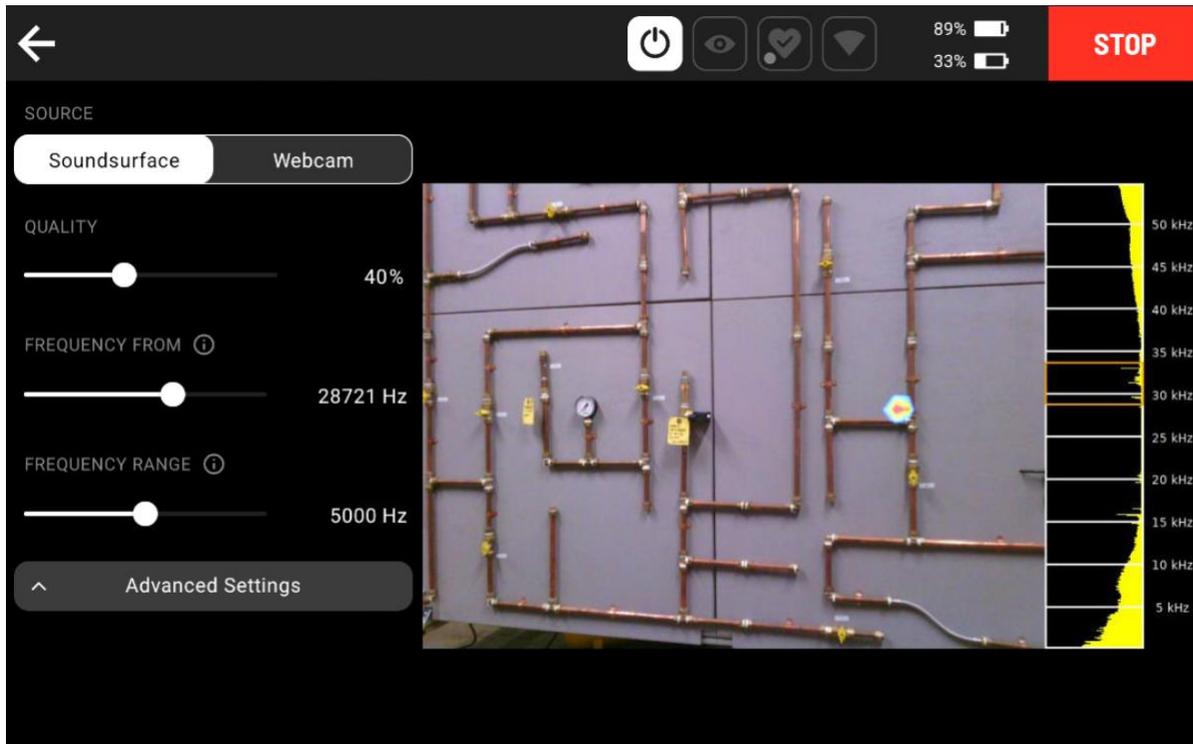


Users can choose to monitor the webcam image without Soundmap



## 4.2 Frequency Range

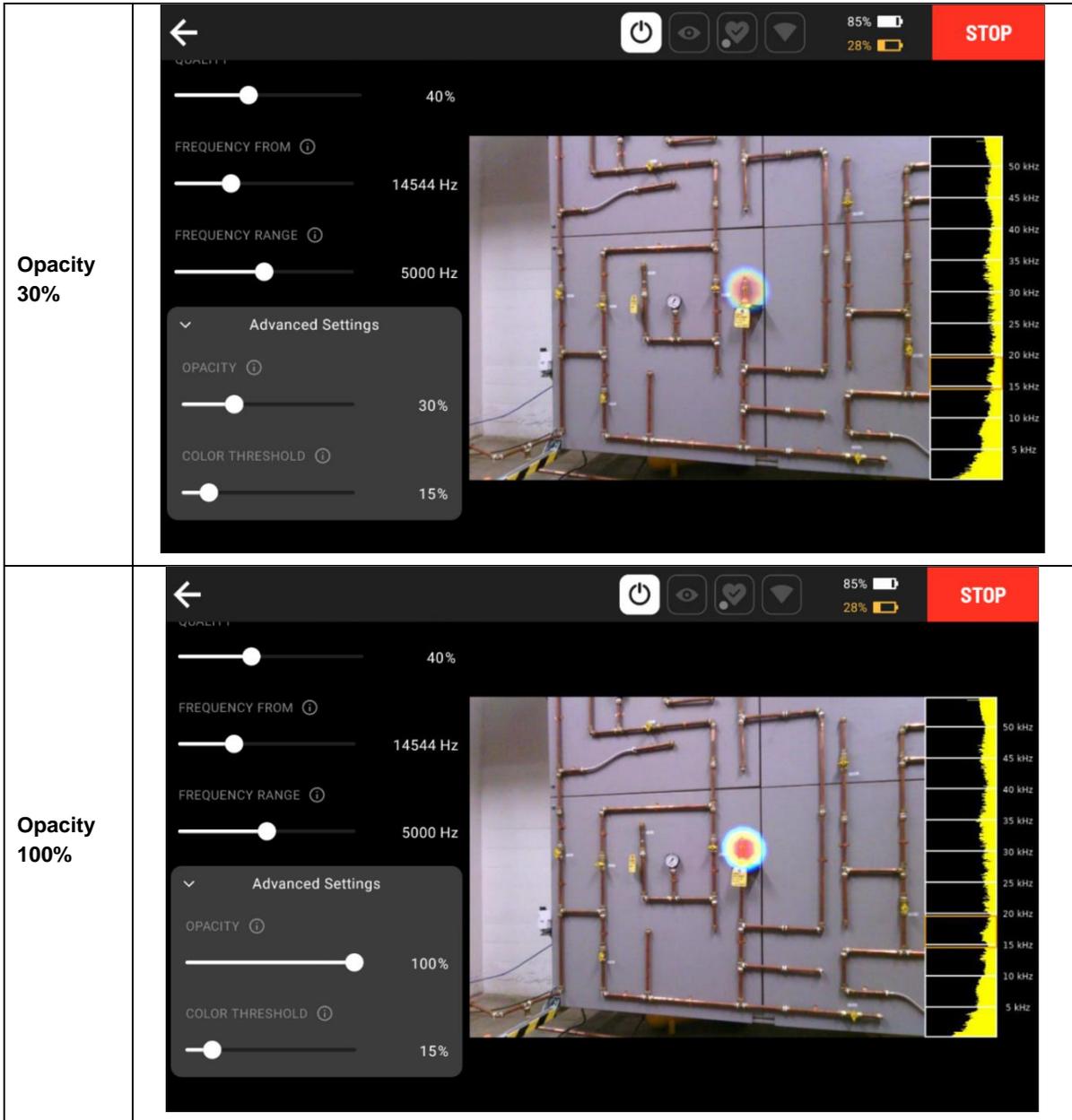
Users can control the starting point of frequency range ('Frequency From') and frequency range ('Frequency Range'), 'Frequency From' can be chosen from 0 Hz to 42000 Hz. The minimum frequency range selection is 2000 Hz wide and the maximum frequency selection is 8000 Hz wide.



### 4.3 Advanced Settings

#### 4.3.1 Opacity

Users can control the transparency of the sound blob in the Soundmap. The range is between 0 to 100 %



**4.3.2 Color Threshold**

Users can control the threshold value that controls the visibility of color in the jet scale. The range is between 0 to 100 %

<p><b>Color Threshold</b> <b>0%</b></p>	
<p><b>Color Threshold</b> <b>100%</b></p>	

## 5 Data Acquisition Plugin – SV600 Acoustic Measurement

Data Acquisition (DAQ) Plugin service allows users to utilize the data acquisition service on-robot to communicate with payload, gather the data and save the result. SV600 Acoustic Measurement DAQ plugin provides following features:

- Monitoring the Soundmap of the target point using Acoustic Streaming service
- Choosing the frequency range or other parameters in advanced settings
- Posing the spot toward the area of interest during the acoustic streaming monitoring
- 3 Measurement types : LeakQ, Image and Video
- Configure metadata

### 5.1 DAQ plugin – SV600 acoustic measurements

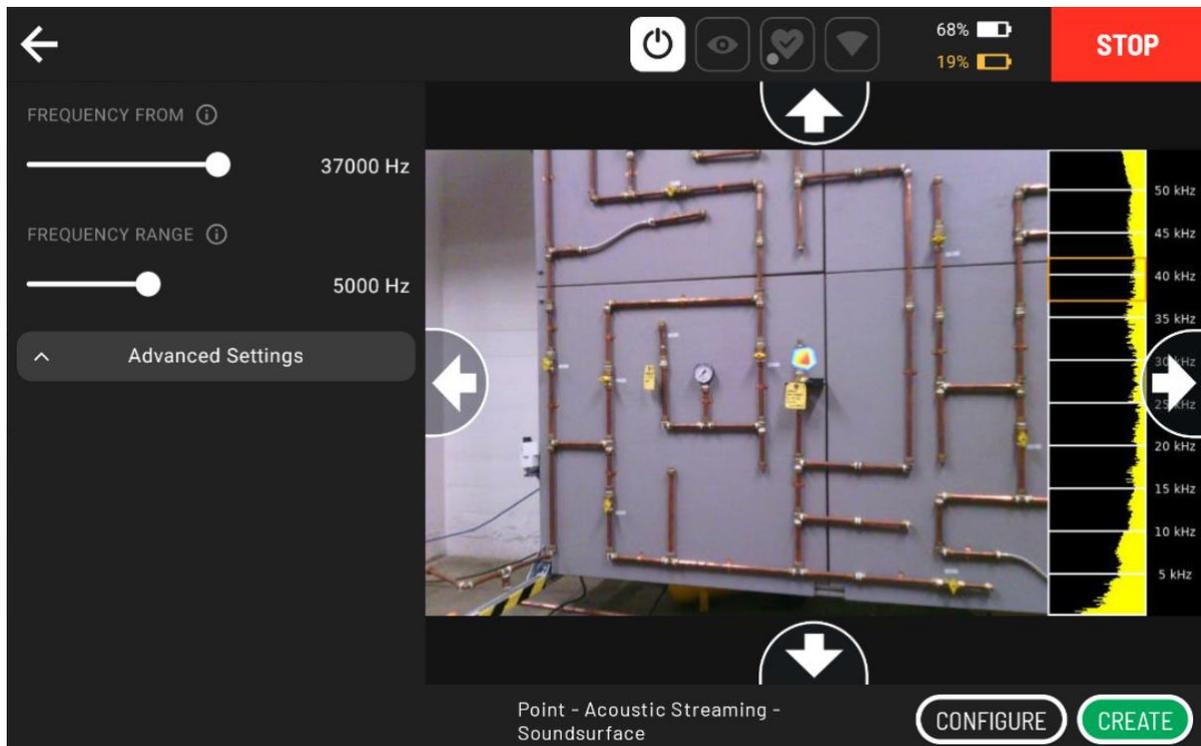
Acoustic Measurement DAQ plugin should proceed through three main pages

1. Acoustic Streaming
2. DAQ Plugin Configuration
3. Metadata Configuration

#### 5.1.1 Acoustic Streaming Page

Point the device to the area of interest using “Pose” feature, press arrows on the screen to control the spot. Adjust the frequency range for inspection.

Please refer to the **‘How to choose frequency range’** in Appendix A. for more details



#### 5.1.2 DAQ Plugin configuration

Choose the measurement types among : LeakQ, Image and Video

Adjust the frequency range for inspection. Frequency range parameters are available in all types of measurement.

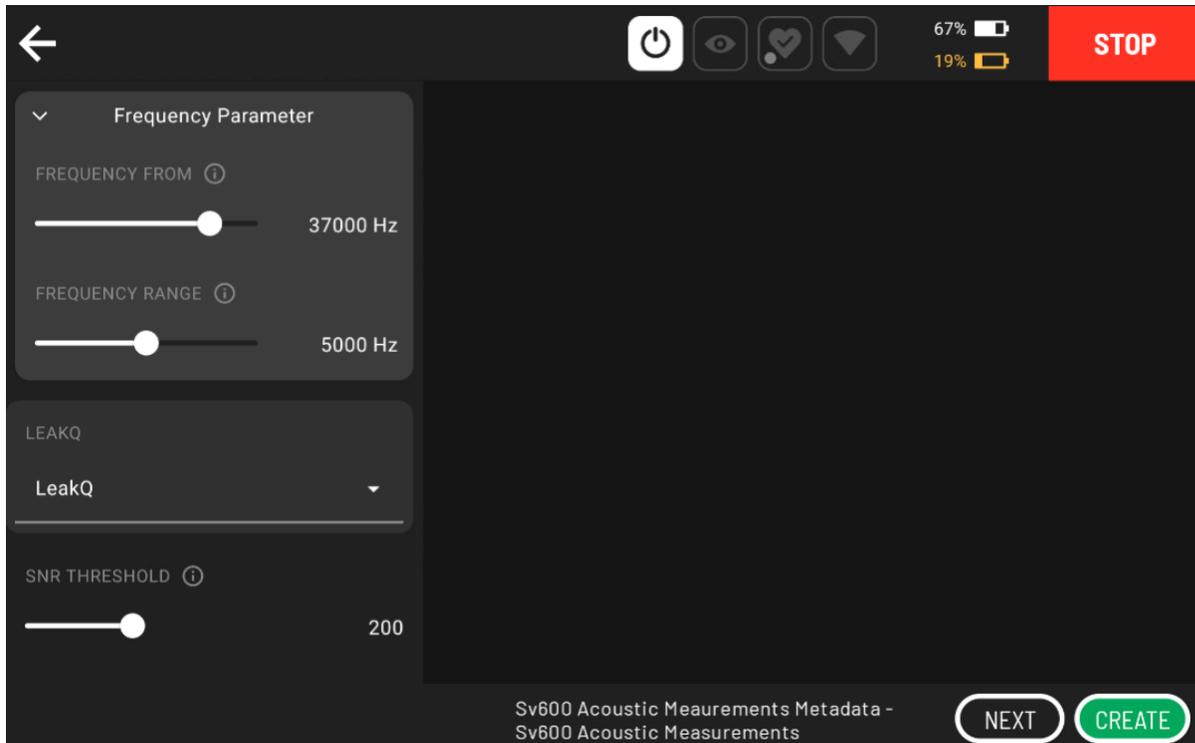
### LeakQ:

LeakQ is a measurement for leak inspection. It creates an as2 file format and a video file for classifying the leak. For Leak classification, upload the saved .as2 files to the [online LeakQ generator](#).

LeakQ measurement has “SNR threshold” parameter to configure how the sound blob is drawn in SoundMap™. “SNR threshold” is a threshold for SNR value, which is an arbitrary value indicating the energy at peak location in relation to the energy in the all location. It has no direction relationship with acoustic energy or pressure value.

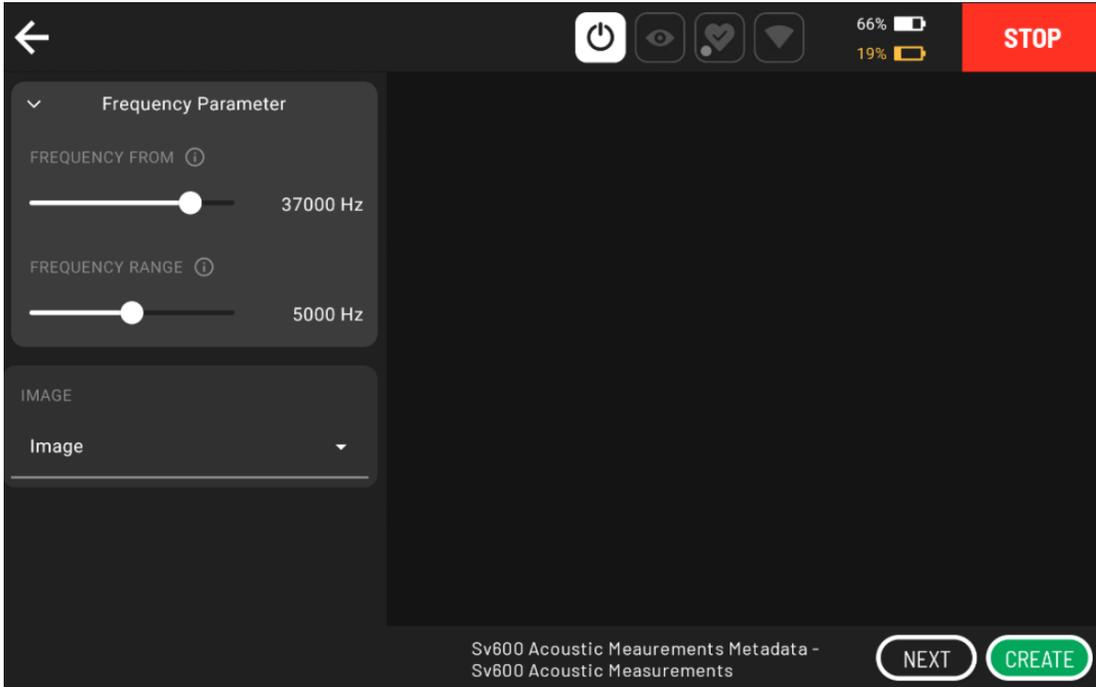
If the SNR value is smaller than the threshold, the sound blob will not be drawn, even if there is a leak detected. If the SNR value is higher than the threshold, the sound blob will be indicated in the image.

Please refer to the ‘**How to choose SNR threshold**’ in Appendix B. for more details



**Image:**

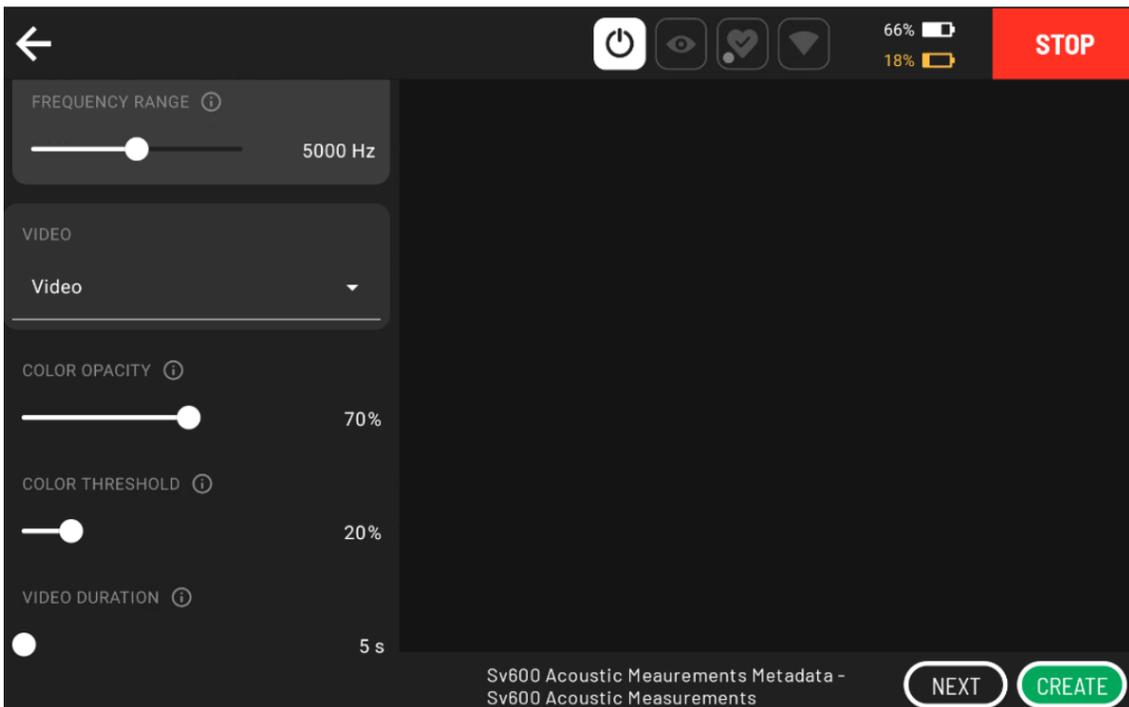
Image measurement will capture an image of the current SoundMap™ including min/max values and spectrogram.



**Video:**

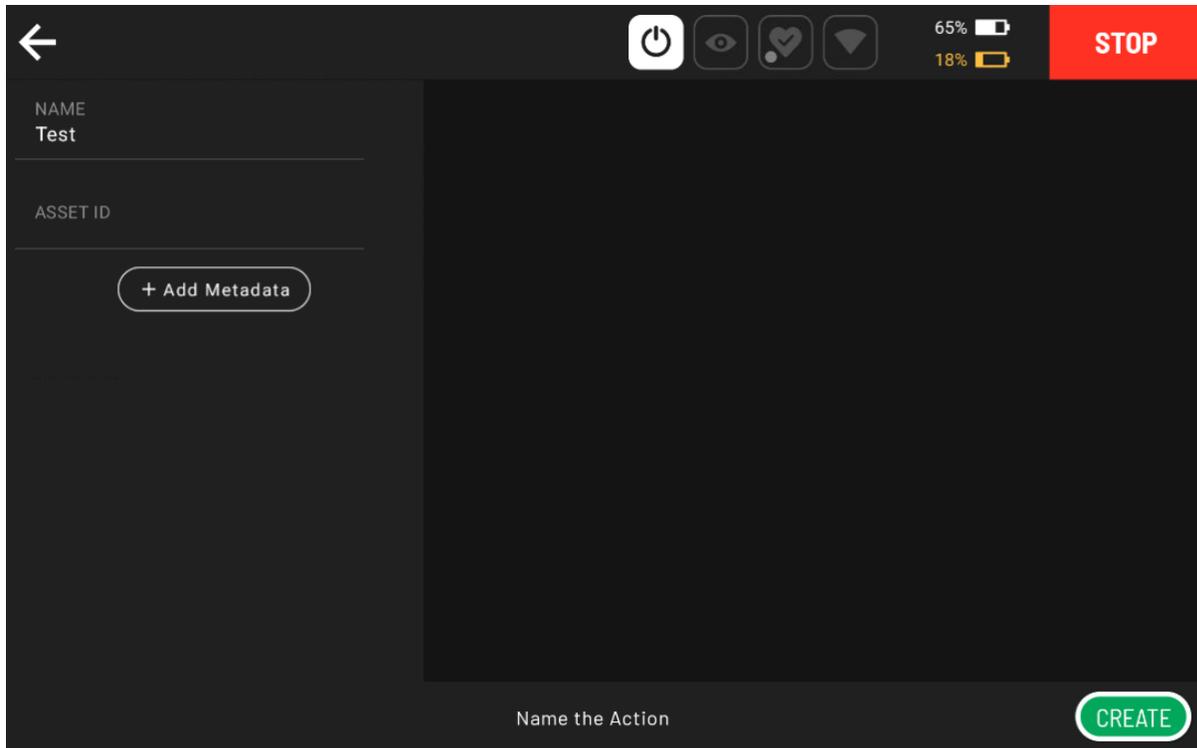
Video measurement will start recording a video from the video stream with a SoundMap™ overlay. The video will stop when the specified duration is over.

Video measurement has “Duration” parameter to control the total duration of the video. Minimum duration is 5 seconds and maximum duration is 30 seconds.



### 5.1.3 Metadata Configuration

Metadata section allows user to record any additional data related to the measurement



### 5.2 Measurement Results

Measurement result can be downloaded on 'File Management' page of SV600 dashboard

Depends on the measurement type, SV600 will generate results below:

#### LeakQ:

- an .as2 file
  - As2 file contains files below :
    - Thumbnail.jpg - image measurement as a thumbnail image
    - Metadata.json – data containing key results for leak inspection
    - BeamformedData.bin – a bin file (int32) with a single stream of beamformed audio data
    - Image.jpg – image measurement of the current SoundMap™
- a .webm video file

#### Image:

- a .jpg image file - image measurement of the current SoundMap™

#### Video:

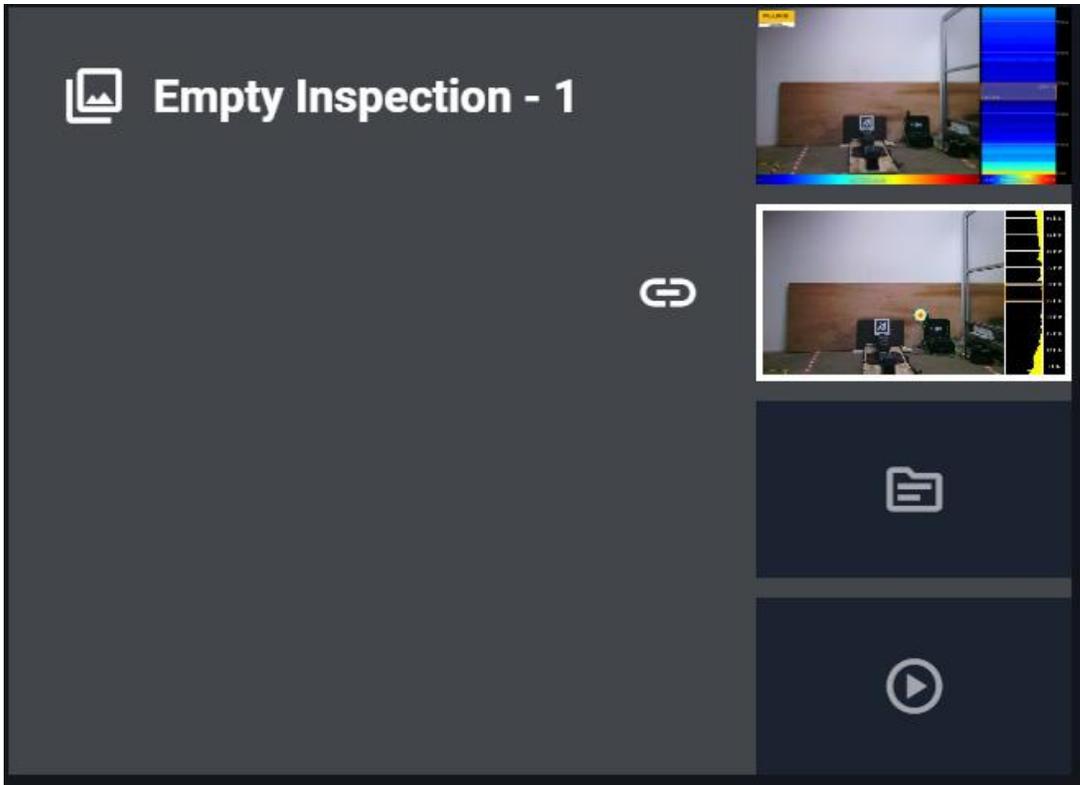
- a .webm video file – video measurement with SoundMap™ overlay

## 6 Utilizing Scout

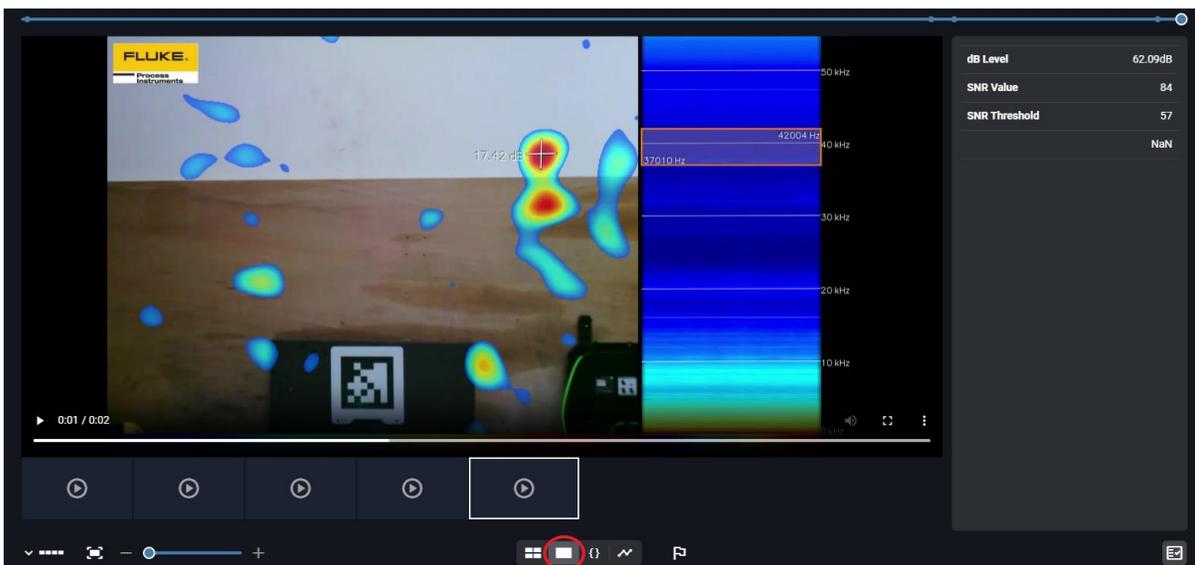
### 6.1 Monitoring the Result from Autowalk Mission

After the autowalk mission containing SV600 Acoustic Measurement is run, results will be saved in Scout as well. It can be found in "Mission History"

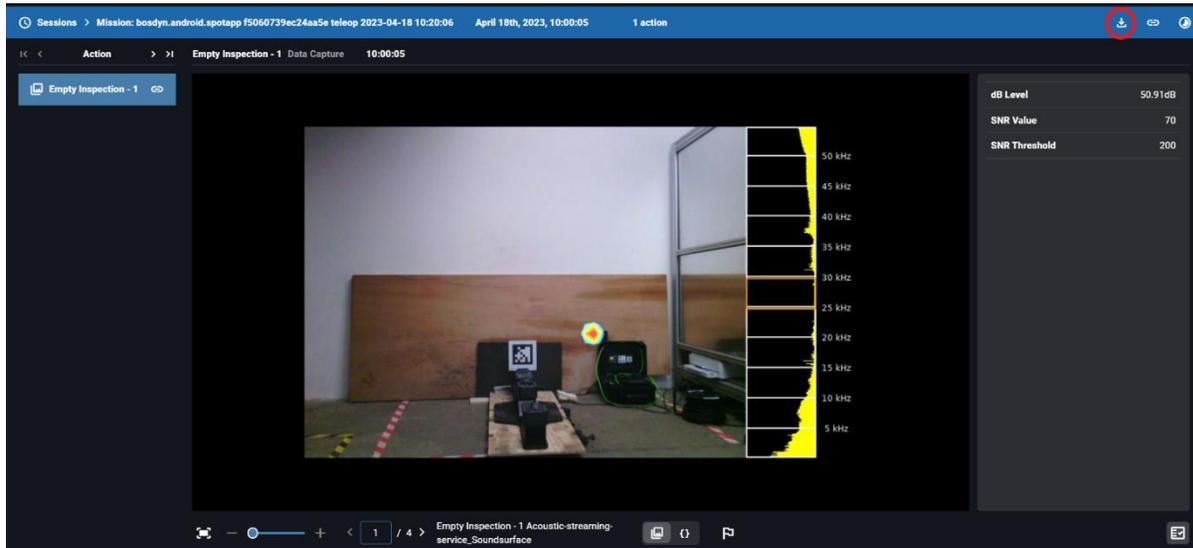
- Scout saves the same result as SV600 does (5.2) but with an extra image capture from acoustic streaming page of Spot tablet



- Video measurement can be previewed in Scout

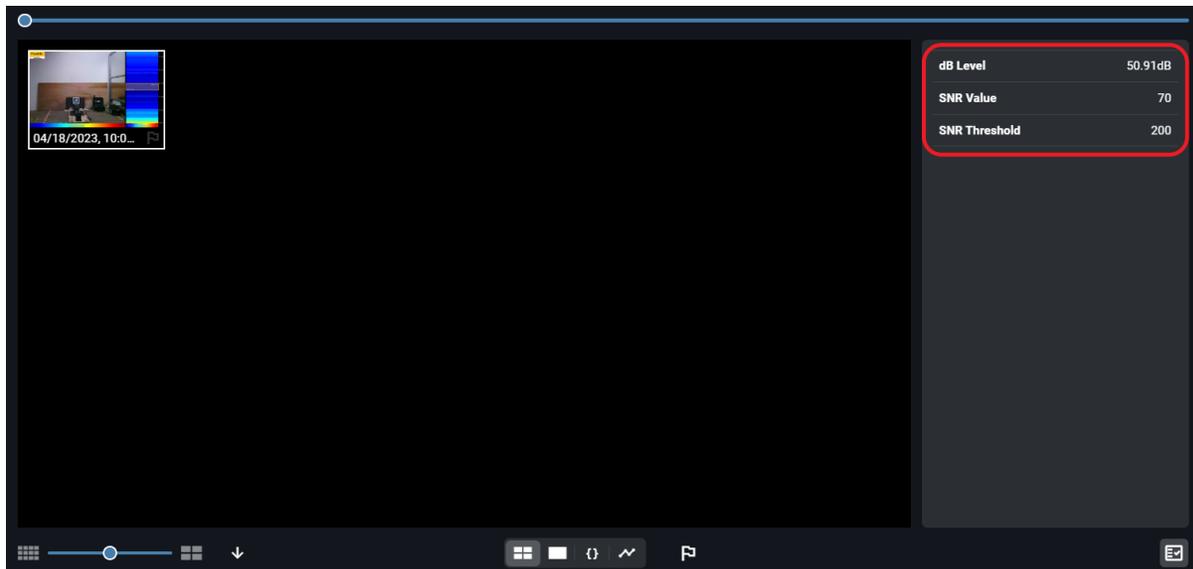


- Video measurement and as2 file can be downloaded from “Session Detail” in Scout

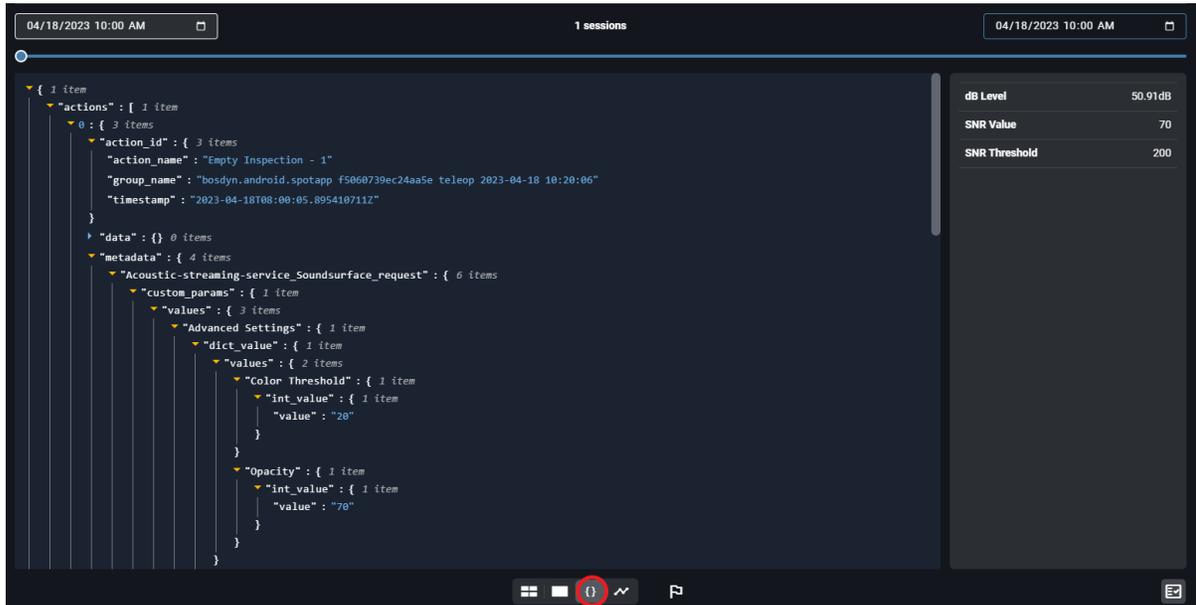


## 6.2 Key Result – LeakQ Measurement

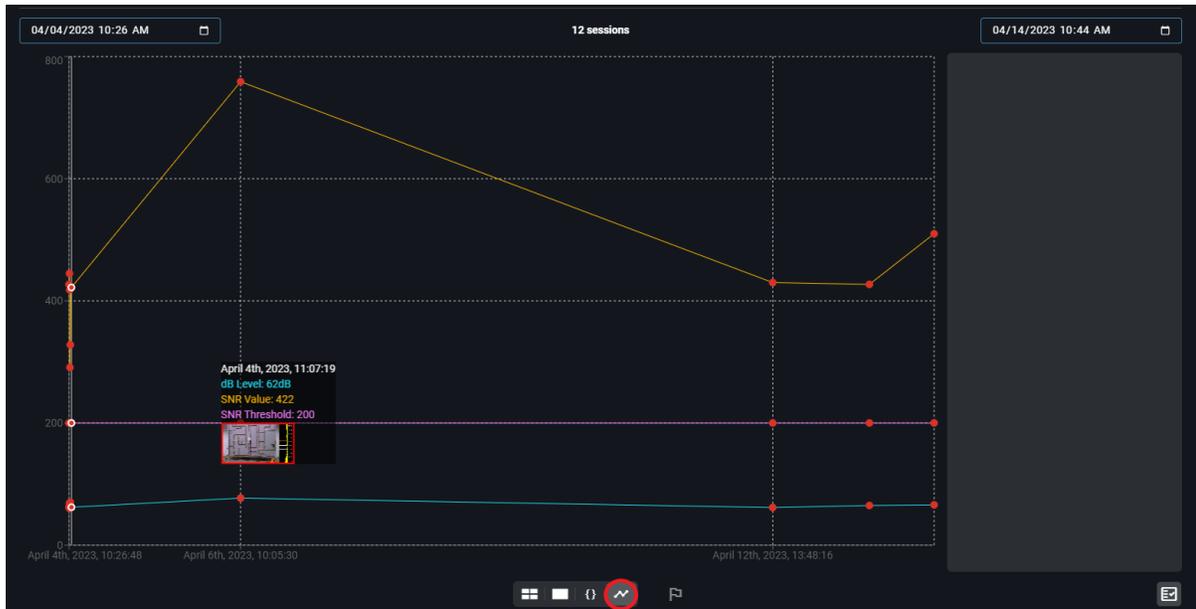
- Scout will also generate the key results at the right side of history page, which are the part of action metadata as well



- To look into the detail of the measurement, press “View action metadata”,

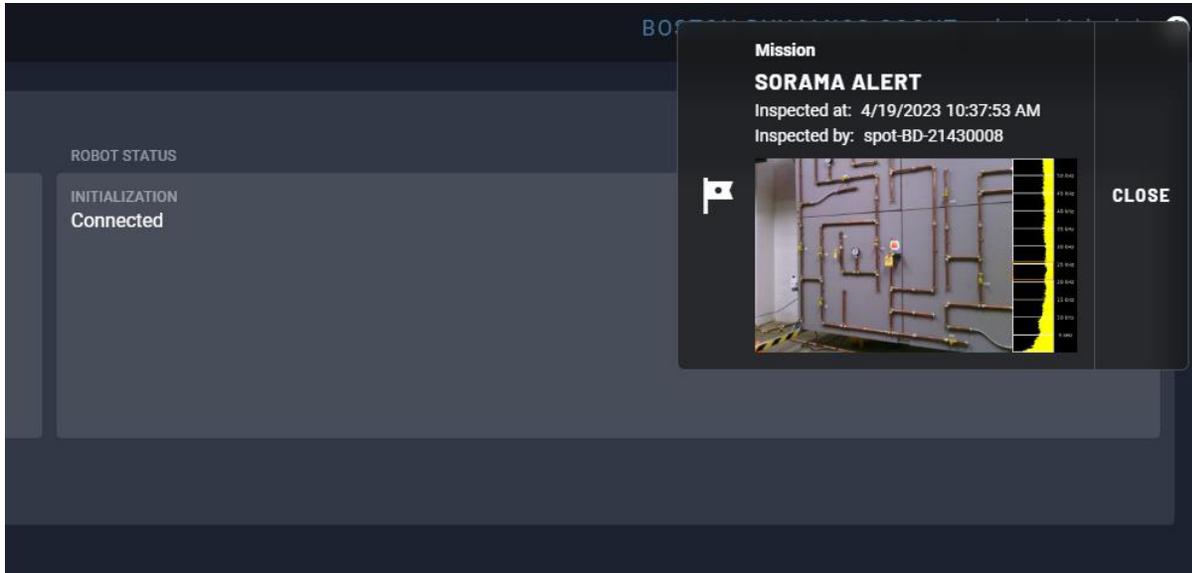


- To inspect the trend of leak characteristics throughout multiple LeakQ measurements, press “View line chart” to see the graph generated based on the key result.



### 6.3 Alert

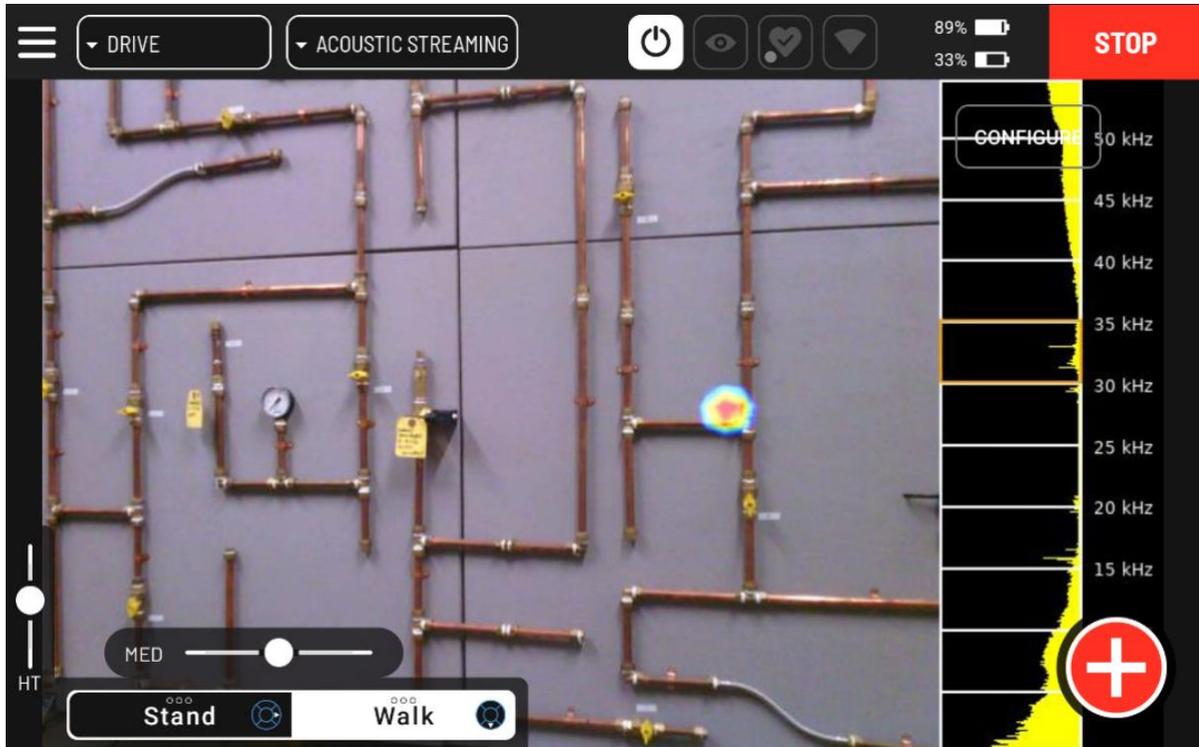
Alert feature of Scout can be setup using SNR threshold of LeakQ measurement. When the SNR value of LeakQ measurement exceeds the threshold value, alert will be on.



## Appendix

### A. How to choose frequency range

In order to conduct any measurement through DAQ plugin SV600 acoustic measurement, it is essential to select an appropriate frequency range to localize the sound source. Using spectrum UI information, try to find a constant noise with a peak on the spectrum.. There might be multiple peaks indicated on the spectrum. Try to find the harmonics of this sound source where forms the smaller sound blob, especially in the ultrasonic range or above hearing range 20 - 50 kHz.



### B. How to choose SNR threshold

SNR value of LeakQ measurement is an arbitrary value, which is not directly correlated with any acoustic pressure value. Moreover, it varies with the measurement environment and sound sources. Therefore, in order to conduct any LeakQ measurement and to inspect the trend of air leak correctly, it is important to find an appropriate snr threshold value. Try running a few test LeakQ measurements in the inspected area before starting the actual measurements. Check what snr value prevents drawing the sound blob. Check the approximate value where it starts to draw the sound blob. Use this value as a reference point – snr threshold.



e.g. when there was a leak, the snr value appeared to be approximately around 300-500. When there is no leak, but with background noise, the snr value was around 0-150. Therefore, 'SNR threshold' parameter can be set to around **200**