

NL Camera  
User Manual

# Table of contents

<b>Notice to user</b>	5
Legal	5
Compliance	5
Markings	6
Disposal of electronic waste	6
<b>Introduction</b>	7
Intended use of the device	7
User safety	7
Specifications	8
Package contents	10
Camera parts	11
Battery parts	13
Charger	13
<b>Getting started</b>	13
Charging	14
Startup	15
Shutdown	16
<b>User interface</b>	17
Heatmap	17
Take snapshot	18
Snapshot browser	18
Filter	19
Zoom	19
Single-source / multi-source mode	19
Screen brightness	20
Wifi status [option]	20
Settings	20
Network settings [option]	20
Upload snapshots	20
Enable/disable wifi	21
Select wifi	21
Change mode [option]	21
Record settings [option]	21
Advanced settings	21
Timezone	21
Show threshold	21
Calibration mode [option]	22
Cloud upload [option]	22
Remote update [option]	22

USB export	22
USB update	23
<b>Application-specific features</b>	25
Leak detection [option]	25
Filter	25
Distance	25
Advanced settings	25
Leak unit	25
Currency	26
Unit cost	26
Env. temp.	26
Rel. humidity	26
Leak corr.	26
Partial discharge detection [option]	26
Filter	27
Manual AC frequency adjustment [option]	27
<b>Usage techniques</b>	28
General usage	28
Locating sound sources and taking snapshots	28
<b>Cloud [option]</b>	31
Browse through snapshots	31
Snapshot view	32
Color mode	33
Offline file upload [option]	33
Report generation	34
Camera selection	34
<b>Offline snapshot viewer [option]</b>	34
<b>Maintenance</b>	34
Storage	35
Cleaning	35
Visual and/or permanent damage	35

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# Notice to user

This manual is the current printed version of the NL Camera User Manual. For updated versions of the manual, please contact your distributor.

## Legal

For warranty terms contact your distributor.

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## Compliance

Caution to the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device. It may cause interference with radio frequency receivers in residential areas and the user should correct the interference by themselves. The EMC conformity of the equipment is indicated by the CE marking which the equipment bears.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

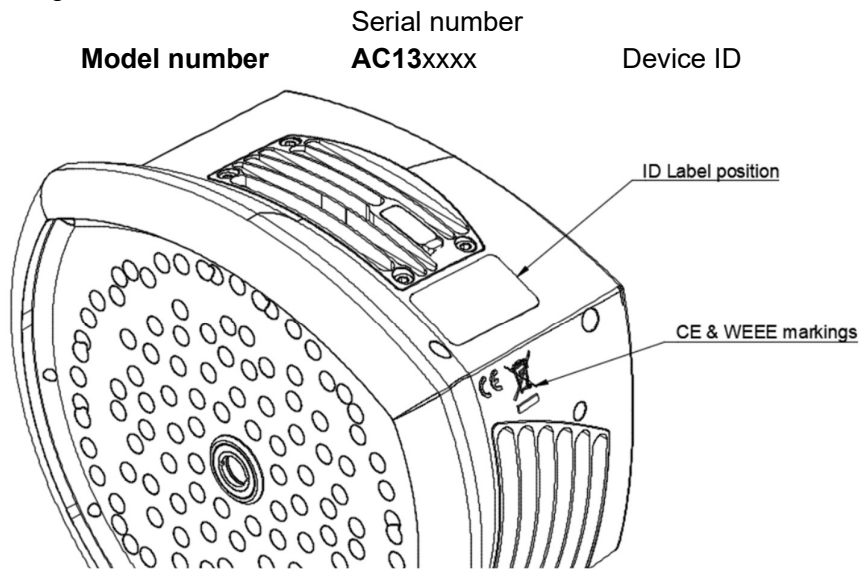
Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

## Markings

The physical device ID label consisting of identification data, CE and WEEE markings is on the top left side of the NL Camera. The ID label consists of the product name, the serial number, the country of origin, the company name and approval markings.

The e-label where all the regulatory information is displayed is the primary ID-plate of the NL Camera AC13. E-label is available in the NL Camera user interface. To open e-label press Settings -icon, choose Device info.

The four first letters of the serial number are the model number of the equipment and the last four is the running identification number:



## Disposal of electronic waste

Electrical and electronic equipment (EEE) contains materials, components and substances that may be hazardous and present a risk to human health and the environment when waste electrical and electronic equipment (WEEE) is not handled correctly.

Equipment marked with the below crossed-out wheeled bin is electrical and electronic equipment. The crossed-out wheeled bin symbol indicates that waste electrical and electronic equipment should not be discarded together with unseparated household waste, but must be collected separately.



For this purpose all local authorities have established collection schemes under which residents can dispose waste electrical and electronic equipment at a recycling centre or other collection points, or WEEE will be collected directly from households. More detailed information is available from the technical administration of the relevant local authority.

# Introduction

Thank you for choosing the NL Camera. The NL Camera is a standalone system for acoustic image measurements and signal analysis. As a standalone system, no additional equipment is needed for basic usage of the device.

The NL Camera uses 124 microphones to form a very precise acoustic image in the desired direction. This acoustic image is transposed in real-time on top of a digital camera picture, which allows the user to accurately see from which directions sound is arriving to the camera. Interesting sound sources can then be separated from background noise and saved for deeper analysis and problem classification, using the NL Cloud service.

The NL Camera is a lot more sensitive and accurate than the human ear, which means that it can locate both sound sources that are inaudible to the human ear, as well as sound sources that the human ear cannot reliably locate. The NL Camera has a frequency range that extends to ultrasonic frequencies, which is a huge benefit since many interesting problems and phenomena can be located precisely using ultrasound.

## Intended use of the device

The NL Camera is a tool for localizing sound sources and analyzing acoustic phenomena.

The NL Camera is not a measurement instrument for precise acoustic or other measurements. The dB readings produced by the device are not guaranteed to correspond with absolute sound pressure levels.

## User safety

Follow all instructions. Please note that by using the device you agree to the terms of use. Misuse might cause device damage or false sensor readings.

Use only the accessories that are provided with the NL Camera. Use only spare parts provided by Noiseless Acoustics.

The heat sinks (8, 9 & 10) will become hot when the device is on or has been on. Beware of touching them. Long term contact may cause burns.

Protect the camera lens and the microphone array from any kind of foreign objects, dust or liquids.

The NL Camera is not intended to be used while the battery is being charged. Charge the battery only when disconnected from the NL Camera.

Charge the battery at temperatures between 0 °C and +40 °C (+32°F to +104°F)

Do not leave the charging battery unattended.

Hold the NL Camera firmly by the handle.

Do not pull by the cord or use any kind of pliers or tools to disconnect the cable.

The top heatsink will get hot when using the NL camera. It is recommended that USB export is done directly after starting the device, as attempting to export the results after prolonged use might be problematic due to the hot heatsink.

Consult your safety officer about using the NL Camera and the carrying bag with the strap in your facility or working environment. The strap is rigid and does not have a separate safety release mechanism, so special care should be applied around heavy machinery.

Do not try to repair or open the enclosure of the NL Camera and the battery. Do not use any damaged device, battery or cords.

Protect the device and accessories from dirt, dust, impacts and liquids.

## Specifications

### Device

**Manufacturer:** Noiseless Acoustics Ltd.

**Name:** NL Camera

### Mechanical & Environmental

**Size:** 273 x 170 x 125 mm

**Battery cord length:** 0.9 m, extended 2 m

**Weight:** bare unit 980 g, total (incl. all accessories) 2.9 kg

**Protection class:** IP51

**Operation & storage temperatures:** -10°C – +50°C

**Operation & storage humidity:** 0 – 90 %RH

### Power supply

**Max input rating:** 15 V, 2.4 A

**External battery:** LiFePO<sub>4</sub>, 12 V, 7 Ah, 84 Wh, 985 g, 90 x 145 x 65 mm, IP64, usage 7 h (depending on ambient conditions), charging time 4 – 6 h

**Battery charger:** input 100 – 240 V ~ 50/60Hz, 1.5 A; max output 13.8 - 14.5V, 4.0 A depends on the charger which is provided, see the documentation or the ID-plate of the charger)

**Internal system backup battery:** Li-Ion, 6 Wh



### **User interface**

**Display:** size: 5", 800x480; color: 24 bit RGB; brightness: 1000 cd/m<sup>2</sup> (adjustable)

**Input device:** resistive touchscreen

**Power on indicator:** red LED

**Video image resolution:** 1640x1234

**Video frame rate:** 25 fps

**Acoustic image framerate:** 30 fps

**Zoom:** 2x digital zoom

### **Acoustic specifications**

**Acoustic measurement:** 124 low-noise MEMS microphones, real-time sound visualization

**Dynamic range, low limit:** less than 0 dB

**Dynamic range, high limit:** more than 120 dB

**Bandwidth:** 2 kHz to 31 kHz, depending on filter settings

**Distance:** from 0.3 m up to 100 m

### **Communication & storage**

**Wireless data transfer:** 2.4 GHz and 5 GHz IEEE 802.11.b/g/n/ac secured wireless LAN

**Storage, internal:** 32 GB SD card, non-removable

**Storage, external:** 8 GB USB mass storage, provided with device

### **Features**

**Handheld:** lightweight unit with a carrying bag for the battery and auxiliary parts

**Cloud:** upload the measurements for storage and analysis

**Environment:** for outdoor and indoor industrial use

### **Standards & Compliance**

**RED:** ETSI EN 300 328, ETSI EN 301 893

**EMC:** ETSI EN 301 489-1/17, EN55032: Class A,

FCC CFR 47 Part 15 Subpart B: Class A, ICES 003 : Class A

**RoHS:** EN 50581:2012

**LVD:** IEC 61010-1, EN 62311:2008 (RF Exposure)



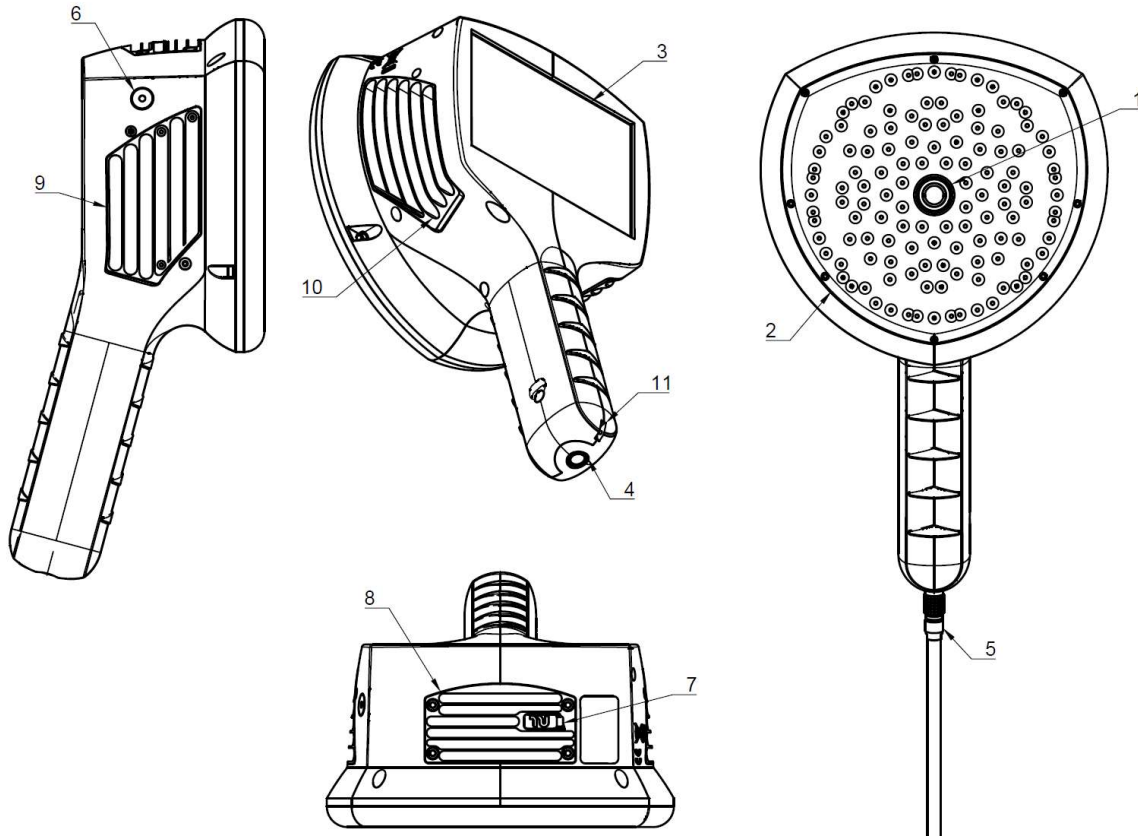
## **Package contents**

The NL Camera product packaging consist of:

1. NL Camera
2. Battery
3. Battery Cable
4. Charger with a detachable mains cord
5. Carrying bag
6. Mass storage
7. Lanyard
8. Documentation

**!! NOTE: Use only the accessories that are provided with the NL Camera. Use only spare parts provided by Noiseless Acoustics. !!**

## Camera parts



- 1: Video Camera    2: Mic Array    3: LCD Screen    4: NL Camera Power Connector  
5: Battery Cable, Camera side connector    6: Power LED    7: Mass Storage Port  
8: Top Heatsink    9: Right Side Heat Sink    10: Left Side Heat Sink    11: Lanyard Fastening Point



**!! NOTE: The heat sinks (8, 9 & 10) will become hot while using. Beware of touching them. Long term contact may cause burns. !!**

The front side of the NL Camera consists of a video image sensor (1) and the microphone array (2). The video shown on the display is monochromatic (black and white) and the acoustic image is colored.

The NL Camera has a resistive touch screen (3). The screen can also be used with gloves. Only touch the screen using your finger - do not use the touch screen with anything sharp or with hard objects, which may damage the surface. Do not exert excessive force when pressing the screen as it will affect the durability of the touch screen.

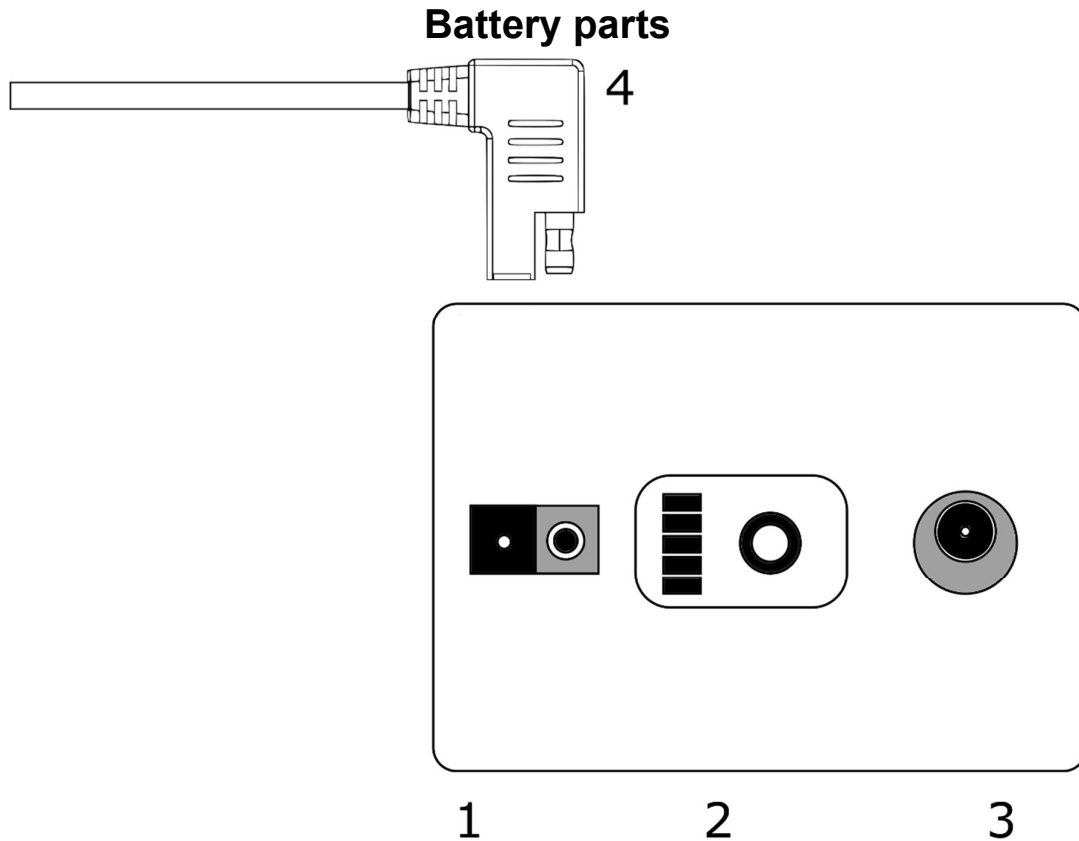
The main power source is an external battery which is connected to the bottom of the handle (4). The NL Camera comes with a cable (5) which can be attached to the camera. Only use batteries and cables provided with the NL Camera or otherwise approved for use with the NL Camera.

The status of the internal power supply unit is indicated by the power LED (6), which is red when the power is on. While the power is on the NL Camera dissipates heat through the three heatsinks (8, 9, 10) which are located on both sides and the top. While using the NL Camera the heat sinks must be uncovered to ensure that the heat dissipation works properly. Do not bag the device while the Power LED is on. Please note that the heatsinks sometimes get hot after prolonged usage, so be careful when touching the heatsinks. The warning sign about hot surfaces is located next to the top heatsink.

There are two ways to export the results from the NL Camera - using the included cloud service which requires a secure wifi connection, or through USB export (if available on your unit). The USB port is located under the cover on top of the device (7). Please use the included USB memory stick for result export.

To protect your NL Camera from falling you can attach a lanyard to the NL Camera (11). Do not carry the NL Camera by the lanyard only.

**!! NOTE: Protect the camera lens and the microphone array from any kind of foreign objects, dust or liquids. !!**



TOP: The battery end of the Battery Cable (4)      Bottom: The main battery of the NL Camera  
 1: Output connector for the Battery Cable    2: Fuel gauge 3: Battery Charger connector

## Charger

The Charger for the battery is an AC/DC converter with an output capable of charging LiFePO<sub>4</sub> chemistry batteries. The charger has a universal single phase mains input, a status led and a charging output. The charger is provided with a mains power cable including a plug compatible for your regional mains output. For charging the battery, the charger has a DC barrel plug at the end of the output cord. Do not use any other chargers than Noiseless Acoustics approved chargers.

## Getting started

Before every use make sure that all the parts are in good condition. Make sure that the contacts of all the connectors are clean and dry. Due to supplier storage time and transportation regulations the charge of the batteries are low. To ensure long life time of the batteries charge the batteries fully before the first use.

## Charging

The main power source of the NL Camera is the Battery. It should be charged fully before usage - also make sure the battery is charged before prolonged storage. To charge an empty battery fully usually takes 4-6 hours. Please note that the battery should be charged at temperatures between 0 °C and +40 °C (+32°F to +104°F). A new battery used in optimal environment conditions yields over 7 hours of usage.

**!! NOTE: The NL Camera is not intended to be used while the battery is being charged.**

**Charge the battery only when disconnected. !!**

**!! NOTE: Charge the battery at temperatures between 0 °C and +40 °C (+32°F to +104°F). !!**

The battery and the charger is delivered with the NL Camera. Only use the provided battery charger.

- Disconnect the battery cable from the battery output connector(1) first.
- Plug the mains cable of the charger into the wall socket
- Plug the DC barrel connector to the charging connector of the battery (3).

When the status LED of the charger is red/yellow the battery is being charged. When the status LED of the charger is green while the DC barrel connector is connected to the Battery the charge is complete. The status LED is also green when the DC barrel connector is disconnected.

Mains cable connected	Charge cable connected	Status LED on battery
No	No	Off
Yes	No	Green
Yes	Yes	Red or yellow, Charging
Yes	Yes	Green, Fully Charged

**!! NOTE: Do not leave the battery charging unattended. !!**

## Fuel gauge

Press the fuel gauge button (2) to test the state of the battery charge (SoC). This is approximate only and the most accurate results are after 2 minutes of no load.

LEDS	SoC
3 greens, 2 red	Full
2 greens, 2 red	Over 50 %

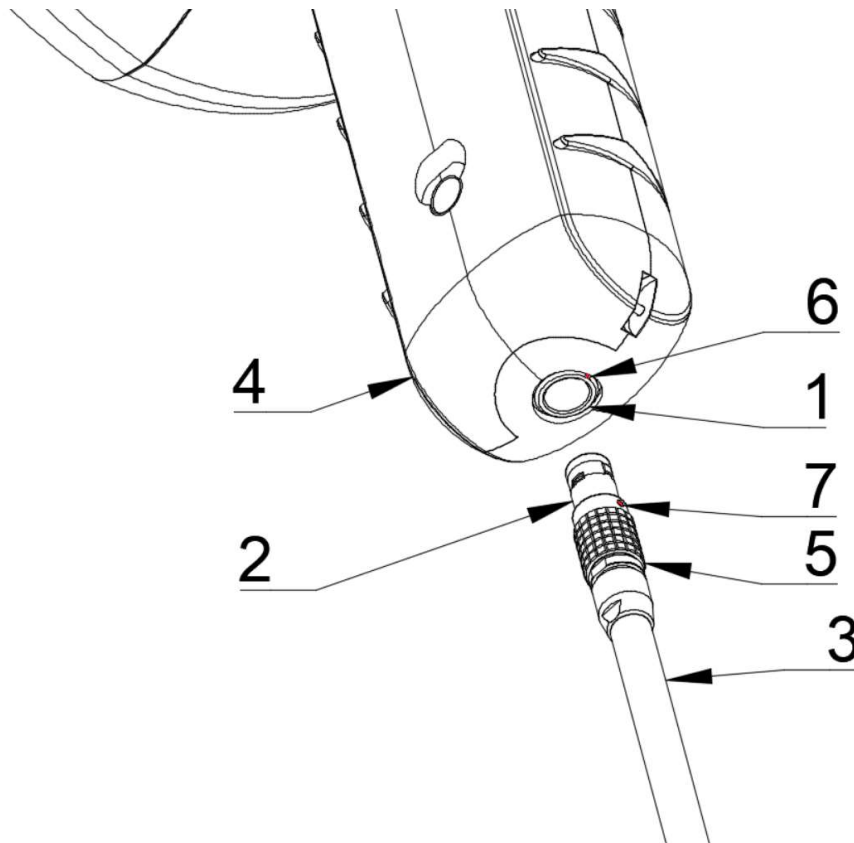
1 greens, 2 red	Over 20 %
2 red	Less than 20 % (recharge soon)
1 red	Less than 10 % (near self switch off)
No lights	Empty (recharge within 12 hours)

Nominally the battery yields 7-8 hours of usage. Though the battery usage depends on multiple variables which may decrease the usage time. These are the cell temperatures, the load and the age (cycles) of the battery.

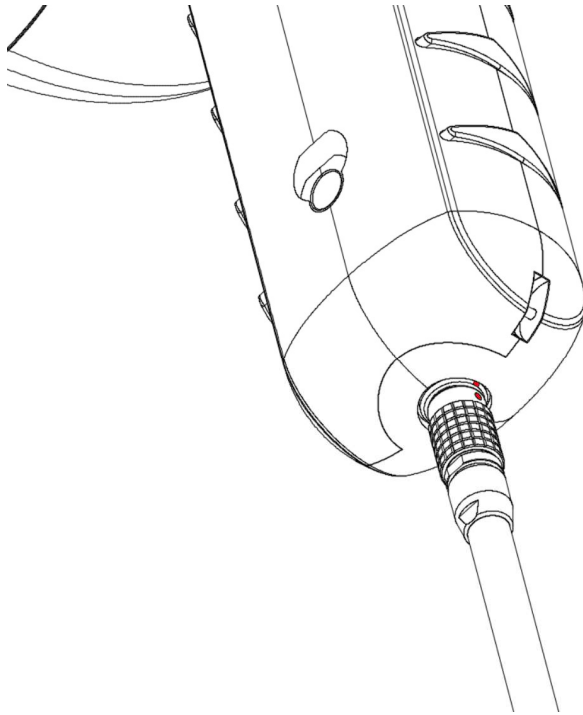
## Startup

The NL Camera will start automatically when the power supply is connected. The NL Camera will shut down automatically when the battery is disconnected. If the battery is disconnected accidentally and immediately reconnected to the NL Camera the unit will reboot. When shutting the device down, it is recommended to wait until the power LED is off before connecting the battery power supply again.

1. Attach the Battery Cable to the battery. The connector of the Battery Cable can be attached to the battery output connector only one way. Push the connector downwards all the way.
2. Attach the connector to the NL Camera according the following instructions, with the orientation markings facing the same way:



- 1: Input connector    2: Battery cable connector    3: Battery cable    4: NL Camera Handle    5:  
**Connector Lock Ring**    6: **Input Orientation Marking**  
7: **Cable Orientation marking**



Both the NL Camera and the Battery Cable have **red orientation markings**. They indicate the position of the key and the slot of the connectors which ensures the proper connection orientation. **Hold the battery cable connector by the locking ring** and make sure that the orientation markings of both connectors are aligned before inserting the Battery Cable. **Then carefully insert the Battery Cable connector to the NL Camera.** The connectors should lock audibly.

When the power is on, the red Power LED is lit. The system starts in approximately 10-15 seconds. The Noiseless Acoustics logo will appear on the screen. **When the system setup is complete the NL Camera GUI will start automatically and you're ready to make sound visible!**

**!! NOTE: Hold the NL Camera firmly by the handle. !!**

The NL Camera has internal system backup batteries which are charged by the main battery while in use. **At the first system start up**, it is recommended that the NL Camera stays powered by the main battery at least 45 minutes so the internal backup batteries are charged fully.

## Shutdown

To turn off the NL Camera, **simply disconnect the battery connector from the NL Camera.**

1. Hold the battery cable connector by the lock ring and pull it outwards. The lock ring will slide until it releases the connection. Alternatively disconnect the cable from the battery.
2. The NL logo will appear and the system will safely perform a shutdown.
3. The red Power LED will turn off when the shutdown is complete.

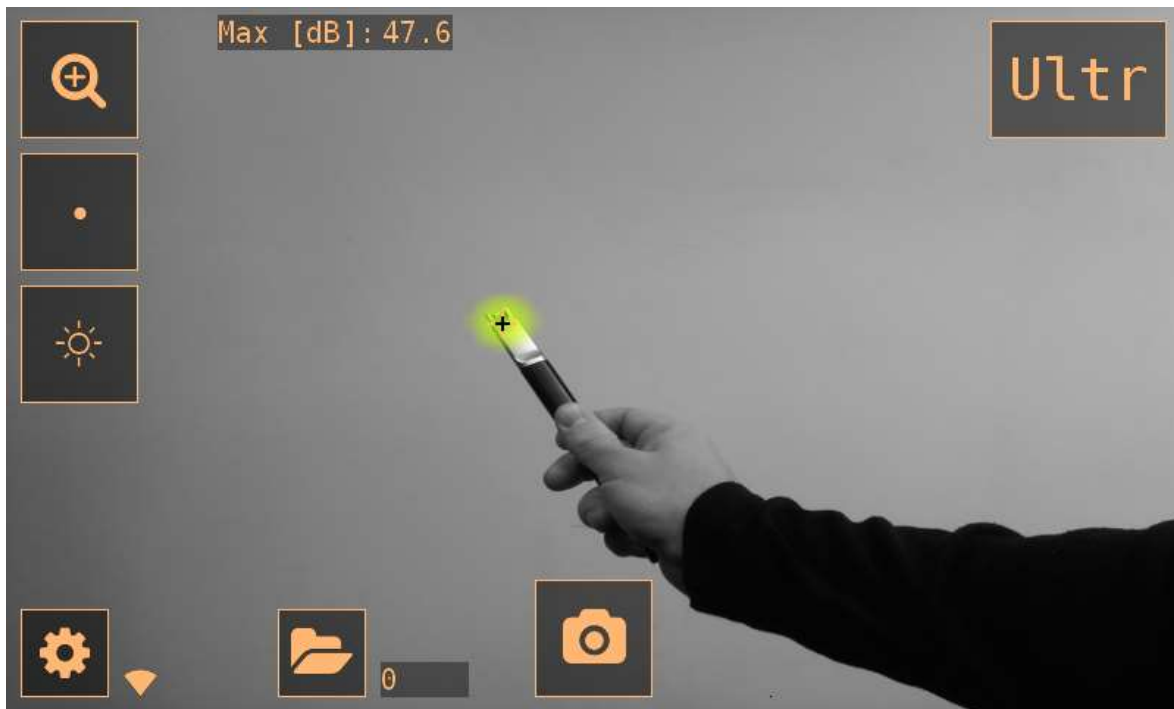
If you encounter a problem with the system, a hard shutdown is performed by disconnecting the battery power and waiting longer until the power led will turn off. If the shutdown takes more than 5-10 minutes after disconnecting the battery, contact Noiseless Acoustics for service.

**!! NOTE: Do not pull by the cord or use any kind of pliers or tools to disconnect the cable. !!**



## User interface

An example of the graphical user interface of the NL Camera is shown below. Note that the exact layout of the user interface might be different on your unit, since different versions of the NL Camera have different optional features.



## Heatmap

The main view of the user interface shows the camera image with a heatmap overlaid on top. The heatmap shows the location of the strongest sound source (single-source mode) or multiple sound sources (multi-source mode). There are two different types of color modes for displaying the heatmap. The available color modes depend on the version of NL Camera.



The *location* color mode shows each sound source with several different colors, ranging from blue to red. The center of the sound sources is shown with red color, while the color gradually changes via yellow, green, and cyan to blue outwards from the center of the sound source.



The *strength* color mode shows each sound source with a single color according to the intensity of the sound source.

In addition to the heatmap, the location of the strongest sound source is shown with a small crosshair. When taking a snapshot, the sound arriving from the direction of the crosshair will be recorded. Application-specific analysis available on some versions of the NL Camera will also use the sound arriving from the direction of the crosshair. By default, the level of the sound from this direction is shown at the top of the main view.

## Take a snapshot



Press the *snapshot* button to take a snapshot containing the current camera image and heatmap as well as a short recording of the strongest sound source. The direction of the strongest sound source is shown with a crosshair.

The record time is by default 2 seconds and can be selected by the user on some versions of the NL Camera. When pressing the *snapshot* button, the previous 2 seconds of the sound from the strongest source will be saved. This means, that if you are observing a sporadic event, you can press the *snapshot* button immediately after you have observed it. This also means that it is recommended to keep the camera stable for a few seconds before taking a snapshot in order to get a clear signal from the source of interest.

When taking a snapshot, a keyboard will be displayed, which you can use to enter optional comments about the snapshot. After entering comments, press the button in the upper right corner to save the comments and the snapshot. If you at this stage choose not to save the snapshot, press the *garbage bin* button in the upper left corner instead.

## Snapshot browser



The number of snapshots currently saved on the NL Camera is shown to the right of the *snapshot browser* button. If there are two dots visible next to the number, snapshots are currently being uploaded to the NL Cloud.

Press the button to browse through the snapshots. On the bottom of the screen, thumbnails of the snapshots are shown, and you can scroll through these horizontally. When you press a thumbnail, the snapshot will be shown together with additional information.

Note that snapshots are not available in the snapshot browser after they have been uploaded to the cloud service or exported to a USB memory stick.

## Filter



Press the *filter* button to switch between different filters. The available filters are application-specific, and typically change the frequency range that the NL Camera uses for showing sound sources. The same frequency range is also used when taking a snapshot and the sound is recorded.

Try the different available filter settings to see which filter serves your application best. Remember that the most appropriate filter might vary from case to case, and depend not only on the sound source of interest, but also on the background noise, and the distance to the sound source. See the *Usage techniques* section for more information on choosing filters. The NL Camera will typically be configured with some of the following filters:

**Norm:** Frequencies from 10 kHz upwards. Useful at larger distances in the absence of strong background noise.

**High:** Frequencies from 20 kHz upwards. Useful in the presence of strong background noise.

**Ultr:** Frequencies from 25 kHz upwards. Useful in the presence of strong background noise.

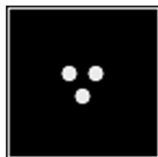
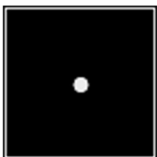
**SLM:** Filter optimized for finding small leaks in the presence of background noise.

## Zoom



The NL Camera is equipped with a 2x digital zoom, which can be used for close-up snapshots. Press the *zoom* button to zoom in or zoom out.

## Single-source / multi-source mode



Press the *single-source / multi-source* button to toggle between the two modes. In single-source mode, the NL Camera shows only the sound source with the highest intensity (with a crosshair on top). If there are multiple sound sources with the same or almost the same intensity, they will all be shown.

In multi-source mode, the NL Camera shows multiple sound sources with different intensities. The sound source with the highest intensity will be shown with a crosshair on top. Not all sound sources will be shown. For example, if there is a very strong sound source shown, very weak sound sources will not be visible at the same time.

To see weaker sound sources (in either single-source or multi-source mode), position and rotate the camera so that stronger sound sources are outside the field of view. You can also use the *zoom* button to limit the field of view.

## Screen brightness

The brightness of the display can be adjusted by pressing the *brightness* button. This is useful to make the display readable under different lighting conditions (indoors/outdoors).



## Wifi status [option]

An icon representing the wifi connection status and strength is shown next to the *settings* button:



Excellent wifi connection strength.



Good wifi connection strength.



Satisfactory wifi connection strength.



Poor wifi connection strength.



No wifi connection.

## Settings



Press the *settings* button to show the available settings. Possible settings are listed below, but the available settings depend on the version of the NL Camera.

### Network settings [option]

The following options are found under *Network settings*:

#### Upload snapshots

This option turns on or off upload of snapshots to the NL Cloud. When on, all snapshots available on the device are automatically uploaded to the cloud whenever the device is connected to a wifi network with Internet connection. Once a snapshot has been uploaded to the cloud, it will no longer be available on the device.

## Enable/disable wifi

Use this option to enable or disable the wifi connection. After enabling wifi, connect to the desired wifi network by pressing *Select wifi*.

## Select wifi

When pressing *Select wifi*, the NL Camera will scan for nearby wifi networks. After the scan, a list of the detected networks will be shown. In case the wifi network you wish to connect to doesn't show up, try moving closer to the wifi access point. Once you find and select the desired network, you will be asked to enter the wifi password. Please note that public wifi networks are not supported, only secure password-protected wifi networks are supported. Wifi networks with a separate login page are not supported.

While wifi is enabled, the NL Camera will remember the last wifi network connected to and reconnect to this network if it is within range.

## Change mode [option]

Some versions of the NL Camera have several different modes available. These modes might either change different parameters or they might be used for entirely different applications.

## Record settings [option]

Some versions of the NL Camera have the option to change the duration that sound is recorded when taking a snapshot. Press the *Change* button to switch between the available record times.

## Advanced settings

General advanced settings are described here. Some advanced settings are application-specific. Information about the application-specific features is found below.

### Timezone

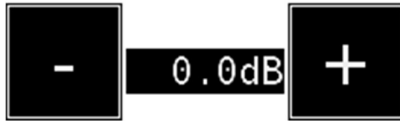
This option allows the user to select the current timezone. The default timezone is UTC. Timezones are ordered according to their current offset to UTC. Scroll up and down to find and select the appropriate timezone.

The clock on the NL Camera is automatically synchronized over the Internet when connected to wifi.

### Show threshold

This option allows the user to temporarily adjust the threshold of the NL Camera. The threshold determines how low sound levels the device will show. By lowering the threshold, quieter sound sources can be shown, as long as the background noise is not too strong. If the threshold is set too low in a silent environment, the camera may not focus on a single sound source, but instead show randomly varying noise across the display. If the threshold is set too high, the device will not show the most quiet sound sources.

## Threshold:



When enabling *Show threshold* under *Advanced settings*, the threshold adjustment will only be temporarily shown. If the filter or mode is changed, or the device restarted, the threshold adjustment will be hidden and the threshold set to its default value.

Some versions of the NL Camera always have the threshold adjustment enabled and shown on the main view.

### Calibration mode [option]

For periodically checking the accuracy of the NL Camera, a separate tester (NL Sonic Tester) is available from Noiseless Acoustics.. For details, please contact your distributor. The calibration mode is available under *Advanced settings* on devices sold with the NL Sonic Tester or later upgraded to support it. For details about the calibration mode, please see the documentation provided with the NL Sonic Tester.

### Cloud upload [option]

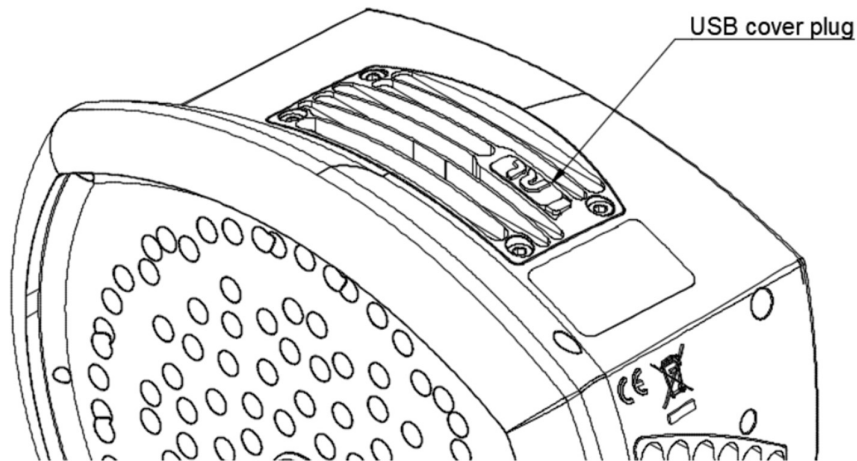
When connected to the Internet via wifi, the NL Camera will automatically upload any snapshots on the device to the NL Cloud, as long as *Upload snapshots* is turned on under *Network settings*. Next to the *snapshot browser* button, the number of snapshots currently on the device is shown. Two dots next to the number indicate that snapshots are currently being uploaded to the cloud.

### Remote update [option]

When connected to the Internet via wifi, the NL Camera will automatically download software updates available in the NL Cloud. If an update has been downloaded, it will be applied the next time the NL Camera is started. The current software version is visible when pressing the *settings* button.

### USB export

Snapshots on the NL Camera can be exported to a USB memory stick. Open the orange cover on top of the NL Camera and insert the memory stick in the USB port. Check that the orientation of the memory stick and the port is correct before inserting the stick.



The NL Camera will recognize the inserted memory stick and ask if you want to transfer snapshots to the USB device. If you press **Yes**, the transfer will begin. During the transfer, the progress will be displayed, and the transfer can be aborted by pressing the **Stop** button. Snapshots already transferred to the memory stick will remain on the stick and snapshots not transferred will remain on the NL Camera. Do not remove the memory stick from the USB port while the transfer is in progress, as this may corrupt the file system on the memory stick. Once the transfer has been successfully completed (or aborted if the **Stop** button was pressed), the main view of the graphical user interface is shown, and the memory stick can be removed from the USB port. Remember to put the orange USB port cover back in place.

The snapshots transferred to the memory stick can be browsed on a computer. On the USB stick, the snapshots are organized into subfolders which can be browsed.

Snapshots transferred to a memory stick will not be uploaded to the NL Cloud. Devices with the offline viewer option export *.n/z* files that can be uploaded at a later point in time from the memory stick or other storage location using the *Offline files* upload feature in the NL Cloud.

**!! NOTE: The top heatsink will get hot when using the NL camera. It is recommended that USB export is done directly after starting the device, as attempting to export the results after prolonged use might be problematic due to the hot heatsink. !!**

## USB update

In case the remote update feature cannot be used, the NL Camera can also be updated using a USB memory stick. Place the software update file provided by NL Acoustics in the root directory of the the memory stick (i.e., not in any folder). Do not rename the file. Open the orange cover on top of the NL Camera and insert the memory stick in the USB port. Check that the orientation of the memory stick and the port is correct before inserting the stick.

The NL Camera will detect the software update present on the memory stick and ask if you want to apply the update. Press **Yes** to copy the update to the NL Camera. **Do not remove the memory stick while the update is being copied.** Once the update is on the NL Camera, you will be asked

to restart the device to apply the update. Remove the memory stick and put the orange USB port cover back in place. Shut the NL Camera down by unplugging the power cable and start it again by connecting the power cable. The update will now be applied.



# Application-specific features

Each NL Camera is configured according to the customer's use case. The typical applications are leak detection (locating and estimating the size of compressed air leaks) and partial discharge detection (locating and analyzing partial discharges in power grids). The features specific to these two applications are described below.

## Leak detection [option]

The NL Camera detects compressed air leaks based on the sound emitted by the leak. The different filters available on the NL Camera filter out background noise and concentrate on the ultrasonic frequencies where the sound of a leak typically is much stronger than the background noise.

Based on the sound from a detected sound source, the NL Camera will determine if the source is likely to be a leak. When a leak is detected, the NL Camera will estimate the size of the leak. The estimate relies on the user setting the distance to the leak correctly (see *Distance* below), as well as setting the environment temperature and relative humidity (see *Advanced settings* below).

The NL Camera will also display an estimate of how much the detected leak costs annually. The unit cost associated with leaks should in this case be specified under *Advanced settings*.

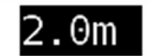
### Filter

The *High* and *Ultr* filters both filter out audible background noise (below 20 kHz and 25 kHz, respectively), concentrating on ultrasonic frequencies where the sound of leaks often is prominent. The *SLM* filter emphasizes the sound from leaks by further filtering out the sound of many typical industrial noise sources. The most appropriate filter might vary from case to case, test the different available filters to see which filter gives the best results.

### Distance



The NL Camera has buttons for setting the distance to the detected leak. Use the + and - buttons to select the distance that you think is closest to the real distance of the leak. The distance is used to compensate for the fact that the intensity of sound is reduced over distance. This information is used when estimating the size of the leak.



### Advanced settings

The following advanced settings specific to leak detection are available:

#### Leak unit

The unit used to display the leak size estimate can be adjusted. Available options are: l/min (liters per minute) and CFM (cubic feet per minute). Other options can be available upon request.

### Currency

The currency in which to display the leak cost estimate can be selected from the available options.

### Unit cost

This determines the cost associated with the leak size for leak cost estimation. Depending on the selected leak unit, this determines how much a leak of size 1 l/min or 1 CFM costs in the selected currency.

### Env. temp.

The environmental temperature affects how the sound from a leak propagates through the air. Specify the temperature in order to get as accurate a leak estimate as possible. The temperature can be entered either in °C or °F.

### Rel. humidity

The relative humidity of the environment affects how the sound from a leak propagates through the air. Specify the relative humidity in order to get as accurate a leak estimate as possible.

### Leak corr.

The leak size estimation in the NL Camera has been developed based on a large set of different measured leaks. It might, however, in some cases underestimate the leak size, or in other cases overestimate the leak size, since the leak size depends on a large amount of different variables. If the leak size estimate systematically differs from your own observations, you can adjust it by setting the leak correction (leak corr.) factor. A leak correction less than 1.0 will produce smaller estimates, while a leak correction larger than 1.0 will produce larger estimates.

## Partial discharge detection [option]

The NL Camera detects partial discharges based on the sound they emit. The different filters available on the NL Camera filter out background noise and concentrates on the high and ultrasonic frequencies where the sound of partial discharges typically is much stronger than the background noise.

The NL Camera will automatically determine when a detected sound source is likely to be a partial discharge. This autodetection works for AC frequencies of 50 and 60 Hz. Manual AC frequency adjustment is available as an option (see below).

When a possible partial discharge has been detected, its so called PRPD (phase-resolved partial discharge) pattern will be shown on the top of the screen. By default, the pattern is shown in a small window. Click on the window to enlarge it. Click once more to make it small again.

For more details on the PRPD pattern and how to interpret it, please see the separate application note on partial discharge analysis.

## Filter

The *Norm* filter filters out low frequency background noise (below 10 kHz), while the *High* and *Ultr* filters both filter out all audible background noise (below 20 kHz and 25 kHz, respectively), concentrating on ultrasonic frequencies where the sound of partial discharges often is prominent. If there is only little background noise, try the *Norm* filter. In the presence of strong background noise, the *High* or *Ultr* filter will most likely work better. The most appropriate filter might vary from case to case, test the different available filters to see which filter gives the best results.

## Manual AC frequency adjustment [option]

As an option, the AC frequency can be manually set. This is useful when performing tests with AC frequencies other than 50 or 60 Hz. In this case, a button will be available in the bottom right corner. In *50/60* mode, the NL Camera will autodetect partial discharges at AC frequencies of 50 or 60 Hz. Press the button to switch to *Man* (manual) mode, where the AC frequency can be manually specified.

# Usage techniques

## General usage



Keep the battery inside the carrying bag and carry the bag with the strap over your shoulder to free your hands for using the NL Camera.

**!! NOTE: Consult your safety officer about using the NL Camera and the carrying bag with the strap in your facility or working environment. The strap is rigid and does not have a separate safety release mechanism, so special care should be applied around heavy machinery. !!**

When you are not carrying the NL Camera in your hand, always put it securely inside the carrying bag to prevent it from falling. Always put the NL Camera inside the carrying bag when you need both hands for other tasks, such as climbing ladders. Ensure that the camera is placed in such a way inside the bag that it does not fall out.

Use the lanyard to ensure that you do not accidentally drop the NL Camera. Do not carry or lift the NL Camera by the lanyard. Always carry it by the handle or the chassis. Always keep the USB port covered. Water must not enter the NL Camera, as this will damage the electronics inside. Protect the microphone array at all times. Do not touch the video camera lens or the conical microphone holes.

## Locating sound sources and taking snapshots

The NL Camera has different filters that are useful for finding different types of sound sources. These filters limit the frequency range of the sound sources that are displayed. The higher the frequency range is, the more local the sources of interest are - even in the presence of a lot of

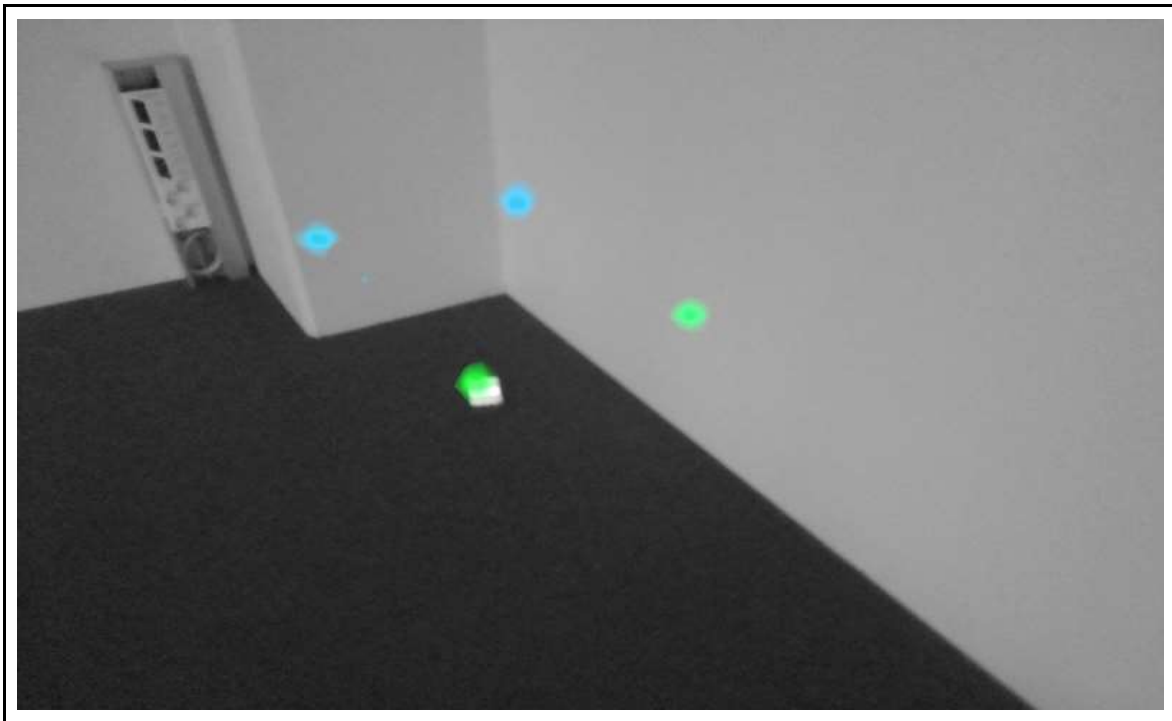
background noise. Background noise (for example traffic or factory noise) is often dominant at low frequencies, while many interesting phenomena have a lot of energy at high frequencies. More in-depth analysis is always done on the **location of the crosshair** on the screen.

In the *single-source* mode, the NL Camera will always show the strongest sound source in the field of view. The strongest source will depend on the currently selected filter; different filters might display different sound sources. In order to see weaker sound sources in the presence of a strong sound source, move or rotate the camera so that the strong sound source is clearly outside the field of view. You can also use the *zoom* button to limit the field of view.

In the *multi-source* mode, the NL Camera will show not only the strongest sound source, but also weaker sound sources. Note that sound sources considerably weaker than the strongest source will not be shown. The *multi-source* mode is useful for locating weaker sound sources. If you want to examine these sources closer, you can move and rotate the camera as well as use the *zoom* button. Always keep in mind that any analysis is done in the direction of the crosshair on the display.

The NL Camera will not only show actual physical sound sources, but also reflections from these sound sources. In order to verify that a source shown on the display is an actual sound source and not a reflection, move around to look at the source from different directions. If the location of the source remains the same from all different directions, the source is an actual sound source. If the location of the source moves along a surface (or completely disappears) when you move around, the source is probably a reflection.

The *multi-source* mode might also be useful when determining whether a source shown on the display is an actual sound source or a reflection. With the multi-source mode, you might be able to see both the actual sound source and one or several reflections, and by moving the NL Camera around you might be able to tell which of the sources are reflections.



An example of one actual sound source and three reflections shown by the NL Camera in *multi-source* mode. The actual sound source lies on the floor, while there are three reflections shown on the walls. When the camera is moved around, the location of the actual sound source remains the same, while the reflections move around on the walls, and are not seen from all angles.

Note, that if an actual sound source is large (for example a large vibrating surface), the source shown on the display might be smaller than the actual source. The source might in this case also move around as you move around the surface, depending on which point of the surface is closest to the NL Camera. In this case, taking a snapshot and viewing it in the NL Cloud might help. In the NL Cloud, it is possible to adjust the dynamic range of the heatmap with the slider below the image. By increasing the dynamic range, you might be able to tell how large the sound source actually is.

It is often useful to take snapshots of interesting sound sources from several different directions. The exact location of the source is easier to determine when viewed from different angles. Sound sources can also be directional, meaning that the sound level will differ depending on the direction.

When pressing the *snapshot* button, the sound coming from the direction of the crosshair will be saved. The default is to save 2 seconds of sound, from the moment that the *snapshot* button is pressed backwards. This means that you should keep the camera steady for a few seconds before taking a snapshot, in order to get a clear signal from the source of interest. If you observe a sporadic event, take a snapshot directly when or after you observe the event in order to record the signal of the event.

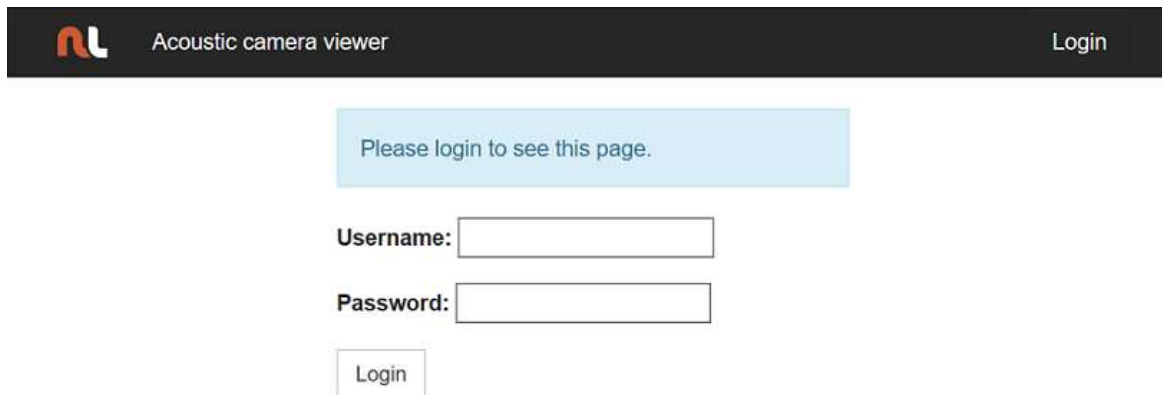
The minimum recommended sound source distance for the NL Camera is approximately 0.3 meters. If the distance is shorter than this, the location of sound sources will not be accurately displayed. In addition, the optical camera will not be focused at such short distances.

There is no specific upper limit for the distance at which the NL Camera can be used. In practical cases, the distance is often limited to approximately 100 meters, but strong sound sources in an otherwise quiet environment can be detected at even larger distances. Respectively, weak sound sources usually require closer proximity.

# Cloud [option]

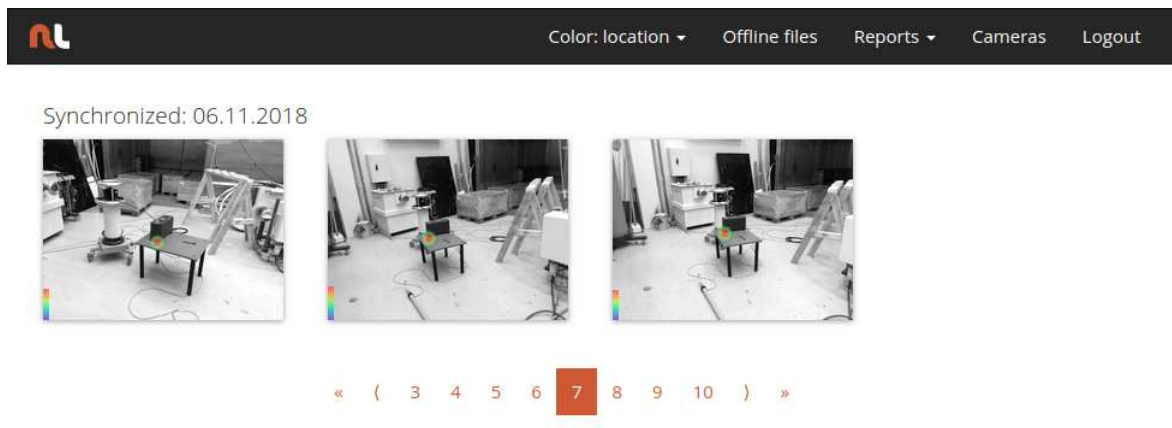
The NL Cloud expands your sound imaging experience by offering various analysis methods for the sound image and the signal. It also serves as a storage for snapshots taken, and can be used for generating reports.

Use a modern web browser and enter the following address: <https://view.nlacoustics.com/> . To access cloud services use the username and the password provided with the NL Camera and type them in the respective Username and Password fields. If you have lost your login information, please contact your distributor for support.



The screenshot shows the login interface for the NL Acoustic camera viewer. At the top, there is a dark header with the NL logo on the left, the text "Acoustic camera viewer" in the center, and a "Login" button on the right. Below the header, a light blue message box contains the text "Please login to see this page." Underneath this, there are two input fields: "Username:" followed by a text box, and "Password:" followed by a text box. Below the password field is a "Login" button.

## Browse through snapshots




The screenshot displays the snapshot gallery in the NL Cloud. At the top, a dark header contains the NL logo on the left and navigation links: "Color: location", "Offline files", "Reports", "Cameras", and "Logout". Below the header, the text "Synchronized: 06.11.2018" is shown. Three thumbnail images of a room interior are displayed in a row. Below the thumbnails is a pagination control consisting of a series of numbers from 3 to 10, with the number 7 highlighted in a red box. The pagination is flanked by left and right arrow symbols.

Once logged into the NL Cloud, the main view lists the snapshots taken with the currently selected camera or cameras. The snapshots are ordered by date, from newest to oldest. Each page shows

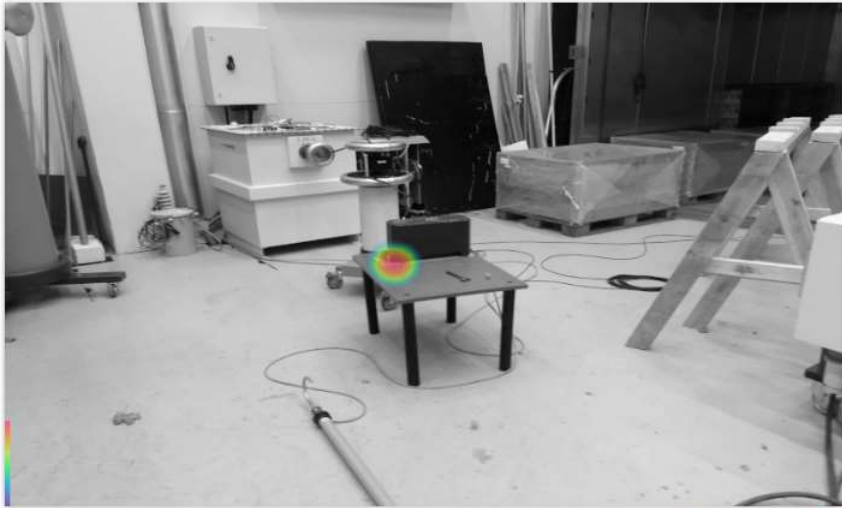
a limited number of snapshots, and you can navigate back and forth through pages using the number and arrow links at the bottom of the page. When moving the cursor on top of a snapshot, you will see the comments that were entered when the snapshot was taken. If no comments were entered when the snapshot was taken, the device-generated label will be shown instead. Symbols that might be displayed on top of the snapshots are related to application-specific analysis. On the left side of each snapshot a colorbar is shown. The height of the colorbar represents the sound level.

## Snapshot view

Color: location ▾ Offline files Reports ▾ Cameras Logout

List / Snapshot

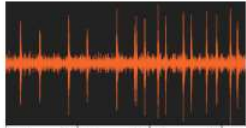
### AC110000\_00008\_181106\_0932\_0008



**Measured dB(Z):**  
-0.7 dB


**Signal last 100ms:**

Time ▾



0 ms 30 ms 60 ms 90 ms

$\Delta f$ : 21000Hz — 31250Hz

Range: 

**Comments**

**Properties:**

**Creation date:**  
2018-11-06 11:32:12 GMT+0200

**Synchronisation date:**  
2018-11-06 11:47:24 GMT+0200

**ID:**  
1803

**Device-generated label:**  
AC110000\_00008\_181106\_0932\_0008

**Camera:**  
AC110000



When clicking on a snapshot in the main view of the NL Cloud, a view of that snapshot will be opened. On the upper left you can see the camera image and the acoustic heatmap overlaid on top of it. Above the image, the comments entered when taking the snapshot are shown. If no comments were entered, the device-generated label is shown instead. On the left side of the image a colorbar is shown. The height of the colorbar represents the sound level, which also is shown to the right of the image (*Measured dB(Z)*).

Underneath the image, there is a range slider that can be used to adjust the dynamic range of the acoustic heatmap. Increase the range to the left to view the extent of large sound sources, or to see weaker sound sources when there are stronger sound sources present. More exact estimates of the sound source location are shown when the range is adjusted to the right.

Below the image, there is a field for entering and updating comments. Click on *Save comments* to save the new or updated comments.

Below the field for comments, additional properties of the snapshot are listed. Below these, there is a button for deleting the snapshot.

To the right of the image, below the sound level, there is a view of the last 100 ms of the sound signal from the dominant source in the image (i.e. the location of the crosshair when taking the picture). At the moment of writing this document, you can choose between five different ways to visualize the signal:

- Time: amplitude of the signal as a function of time
- FFT: magnitude spectrum of the signal
- Spectrogram: magnitude spectrum of the signal as a function of time
- Cepstrum: cepstrum of the signal
- Autocorrelation: autocorrelation of the signal

Below the signal view, application-specific analysis results are shown, if available.

## Color mode

On top of the screen, there is the possibility to choose between two different color modes for displaying the snapshot heatmap: *location* and *strength*.

The *location* color mode shows each sound source with several different colors, ranging from blue to red. The center of the sound sources is shown with red color, while the color gradually changes via yellow, green, and cyan to blue outwards from the center of the sound source.

The *strength* color mode shows each sound source with a single color according to the intensity of the sound source.

## Offline file upload [option]

To upload snapshots from a USB memory stick to the NL Cloud for storage and further analysis, click on the *Offline files* button on top of the screen. Either drag and drop the files into the

designated area or select the files to upload by first clicking the link. The snapshot files that should be uploaded have the *n/z* extension on the USB memory stick. Note that these *n/z* files are not exported on all versions of the NL Camera.

Once you have selected the files you want to upload, click on the *Upload Files* button to start the upload. Once the upload is done, it might take a few minutes until the new snapshots are visible in the snapshot list.

## Report generation

To generate a PDF report of a group of snapshots, first select the snapshots by clicking on the checkbox in the lower right corner of each snapshot shown in the list. By clicking on the *Reports* menu on top of the screen, you also have the possibility to select all snapshots taken with the currently selected cameras, or to deselect all snapshots.

Once you have selected the snapshots you want to include in the report, click on the *Reports* menu and then choose *Generate...* A list of the selected snapshots will be shown, and you can choose how the snapshots should be ordered and which date format should be used. Click on *Generate Report* to create the PDF report. The report generation will take some time, depending on the number of snapshots, and the progress will be shown. Once the report has been generated, click on the *Save* button to download the report.

## Camera selection

At the top of the screen, click on the *Cameras* menu to show a dialog where you can select the cameras all or some of the cameras available for you. Select one or several cameras to browser through the snapshots taken with these cameras.

## Offline snapshot viewer [option]

An offline viewer for browsing snapshots taken with the NL Camera is available as an option. The installation file for the offline viewer will in this case be copied to the USB memory stick when exporting snapshots. To install the offline viewer, open the installation file from the root folder on the USB stick. Further documentation for the offline viewer is available in the software itself.

## Maintenance

**!! NOTE: Do not try to repair or open the enclosure of the NL Camera or the battery. Do not use any damaged devices, batteries or cords. Protect the device and accessories from dirt, dust, impacts and liquids. !!**

The intended usage conditions and instructions are described in this user manual. Please read and follow the instructions carefully in order to avoid damage to the device and accessories. If problems occur, contact your distributor for support.

## Storage

Store the equipment in a dry location at room temperature. Store the batteries fully charged and recharge once every three months. Also start up the NL Camera at least once every three months. These actions ensure reliability.

## Cleaning

Do not use any strong cleaning solutions. Do not use any running or dripping water or liquid. Do not immerse any of the equipment.

Before cleaning the NL Camera, disconnect all the cords and make sure that no equipment is powered. For surface cleaning of **the chassis, the screen and cables** use damp cloth (w/ water or mild soap water), dry the cloth until it doesn't drip water.

Cleaning of **the microphone array** is not suggested to be performed by the user, as this may damage the device. Contact your distributor for support. However, if you decide to clean the microphone array yourself: Indirect **low**-pressure air from a distance can be used to blow particles away from the conical holes of the microphones. No direct and/or highly compressed air should be applied to the microphone array. If the suggested method doesn't work and the microphone array is still badly soiled, contact your distributor for support. Noiseless Acoustics is not responsible for any damage caused by the user in an attempt to clean the microphone array.

For **the battery and the charger** use dry cleaning cloth only.

**Bags and cases** can be vacuum cleaned. Make sure that the bag or case is completely empty first.

## Visual and/or permanent damage

**Broken accessories:** Replace using Noiseless Acoustics official spare parts. Dispose and/or recycle broken equipment.

**NL Camera unit:** Contact your distributor for repairs.

Recycle and dispose all broken devices and packaging material. Contact your local authorities for instructions for proper disposal.