NL CAMERA

nL ACOUSTICS

NOISELESS ACOUSTICS LTD

Pasilanraitio 9 B
00240 Helsinki
Finland

+358 (0)10 583 3240
info@nlacoustics.com
www.nlacoustics.com

FI26650896

Document version: **17.05.2021**

This User Manual supports the following NL Camera version:
S/N: **AC13xxxx**   SW: **21H1**

TABLE OF CONTENTS

1. 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.

1.1 Legal

For warranty terms contact your distributor.

©2021, Noiseless Acoustics Ltd. All rights reserved worldwide. Names and marks appearing on the products herein are either registered trademarks or trademarks of Noiseless Acoustics and/or its subsidiaries.

All other trademarks, trade names or company names referenced herein are used for identification only and are the property of their respective owners.

Noiseless Acoustics Ltd is committed to a policy of continuous development; therefore, we reserve the right to make changes and improvements to any of the products without prior notice.

1.2 Compliance

We caution 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.

1.3 Markings

The physical device ID label, the CE and the WEEE markings are situated on the top left side of the NL Camera (see *Image 1 right*).

The ID label contains the following info: Product name, Serial number, Country of origin, Company name and Approval markings.

The electronic ID-label or e-label containing all the regulatory information is the primary ID-plate of the NL Camera AC13. The e-label is available from the NL Camera user interface. To open the e-label, press the *Settings* icon and choose *Device info*.

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

ID Label position

CE & WEEE Markings

	Serial number	
Model number	**AC13**xxxx	Device ID
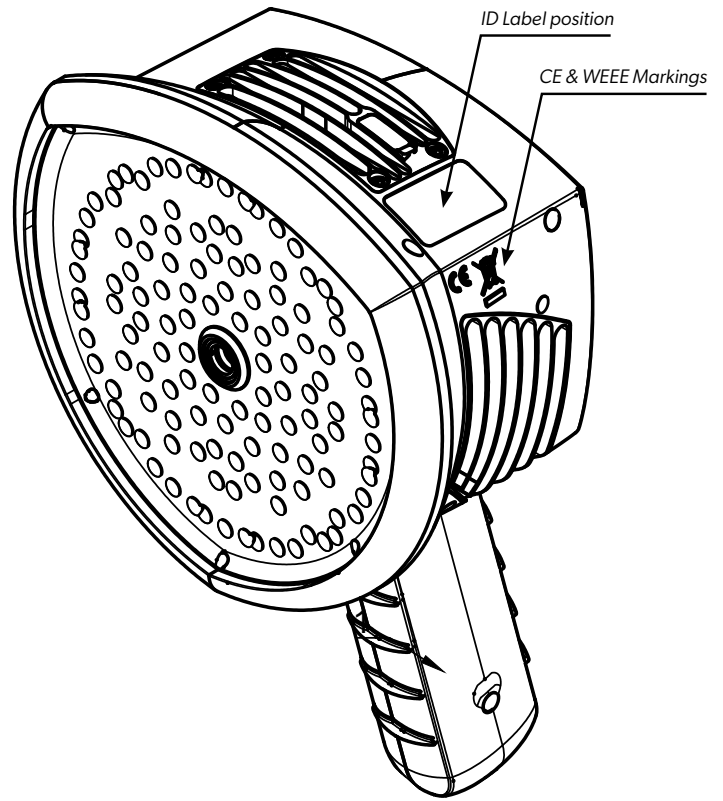
Image 1. Different markings on the NL Camera.

1.4 Customer help

Do not hesitate to contact our Customer Support Center if you experience problems or have any questions about your product.

For customer help, go to **support.nlacoustics.com**.

1.5 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 crossed-out wheeled bin (*see right*) 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.
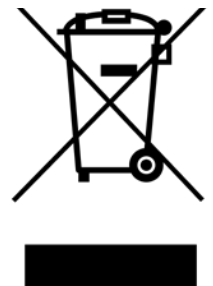
For this purpose, all local authorities have established collection schemes under which residents can dispose of waste electrical and electronic equipment at a recycling center or other collection points, or WEEE will be collected directly from households. More detailed information is available from the technical administration of the relevant local authority.

2. 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 much 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.

2.1 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 to absolute sound pressure levels.

2.2 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 NL 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 any USB peripherals are connected 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 used 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.

2.3 Specifications

DEVICE

Manufacturer: NL Acoustics Ltd.
Name: NL Camera

MECHANICAL & ENVIRONMENTAL

Size: 273 x 170 x 125 mm (10.7 x 6.7 x 4.9 in)
Battery cord length: 0.9 m (3.0 ft), extended 2 m (6.6 ft)
Weight: Bare unit 980 g (2.2 lb),
Total (incl. all accessories) 2.9 kg (6.4 lb)
Protection class: IP51
Operation & storage temperatures: -10 °C–+50 °C (14 °F–122 °F)
Operation & storage humidity: 0–90 %RH
Charging temperature: 0 °C–+40 °C (32 °F–104 °F)

POWER SUPPLY

Max input rating: 15 V, 2.5 A
Internal system backup battery: Li-Ion, 6 Wh

EXTERNAL BATTERY OPTIONS

External battery Tracer: LiFePO4, 12 V, 7 Ah, 84 Wh, 985 g (2.2 lb), 90 x 145 x 65 mm (3.5 x 5.7 x 2.6 in), IP64, Usage 6 h (depending on ambient conditions), charging time 4–6 h.
Battery charger Tracer: Input 100–240 V ~ 50/60Hz, 1.3–1.5 A; Max output 13.8–14.6V, 4.0 A depends on the charger provided, see the documentation or the ID-plate of the charger.
External battery RRC2040: Li-Ion, 10.80 V, 3.35 Ah, 36.20 Wh, 170 g, 84.87 x 58.76 x 21.89 mm, IP40, Usage time > 2h (depending on conditions), charging time 2-3h.
Battery charger RRC2040: Input 19-26Vdc, 2.8 A max, Output: 17.4 Vdc/4A max, 120 x 64 x 43 mm, 110g, Operating temperature: 0 °C–+40 °C (32 °F–104 °F)
Charger power supply RRC2040: Input 100-240VAC / 50-60 Hz, Output 19VDC ± 5% / 3.4 A, Maximum power 65 W, 95 x 51 x 25.4 mm, Operating temperature 0 °C–+40 °C (32 °F–104 °F), 270g.

USER INTERFACE

Display: Size: 5″, 800x480; Color: 24-bit RGB; Brightness: 1000 cd/m2 (adjustable)
Input device: Resistive touchscreen
Power on indicator: Red LED
Image resolution: 800x480
Video frame rate: 25 fps (max)
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 -15 dB
Dynamic range, high limit: More than 120 dB
Bandwidth: 2 kHz to 35 kHz, depending on mode and filter setting.
Bandwidth Air leak mode: 20 kHz to 35 kHz
Bandwidth Power mode: 10 kHz to 35 kHz
Distance: From 0.3 m (1.0 ft) up to and above 130 m (430 ft)

COMMUNICATION & STORAGE

Wireless data transfer: 2.4 GHz and 5 GHz IEEE 802.11b/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 62368-1:2014, IEC 61010-1, EN 62311:2008 (RF Exposure)

$C\,E$

2.4 Camera Software options and part numbers

Option list	90019000-L001	90019000-P001	90019000-PL001
WiFi status*	x	x	x
Network settings*	x	x	x
Change mode			x
Cloud upload*	x	x	x
Remote update*	x	x	x
Leak detection	x		x
Partial discharge		x	x
Cloud*	x	x	x
NL Camera Viewer	x	x	x
NL Camera Viewer Pro	Offline software sold separately (99019000, 99019001)		
Direct Data Transfer	Available with NL Camera Viewer Pro (99019000, 99019001)		
Calibration mode	Available with NL Sonic Tester (95020002)		

*Network functionality not available in all regions.

2.5 Package contents

If you choose the NL Camera with the **Tracer** external battery, the product packaging consists 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 NL Acoustics. !!

If you choose the NL Camera with the **RRC2040** external battery, the product packaging consists of:

1. NL Camera
2. Two batteries
3. Cordless battery housing
4. Charger
5. Charger power supply and a country-specific power cord
6. Carrying bag
7. Mass storage
8. Lanyard
9. Documentation

2.6 Camera parts

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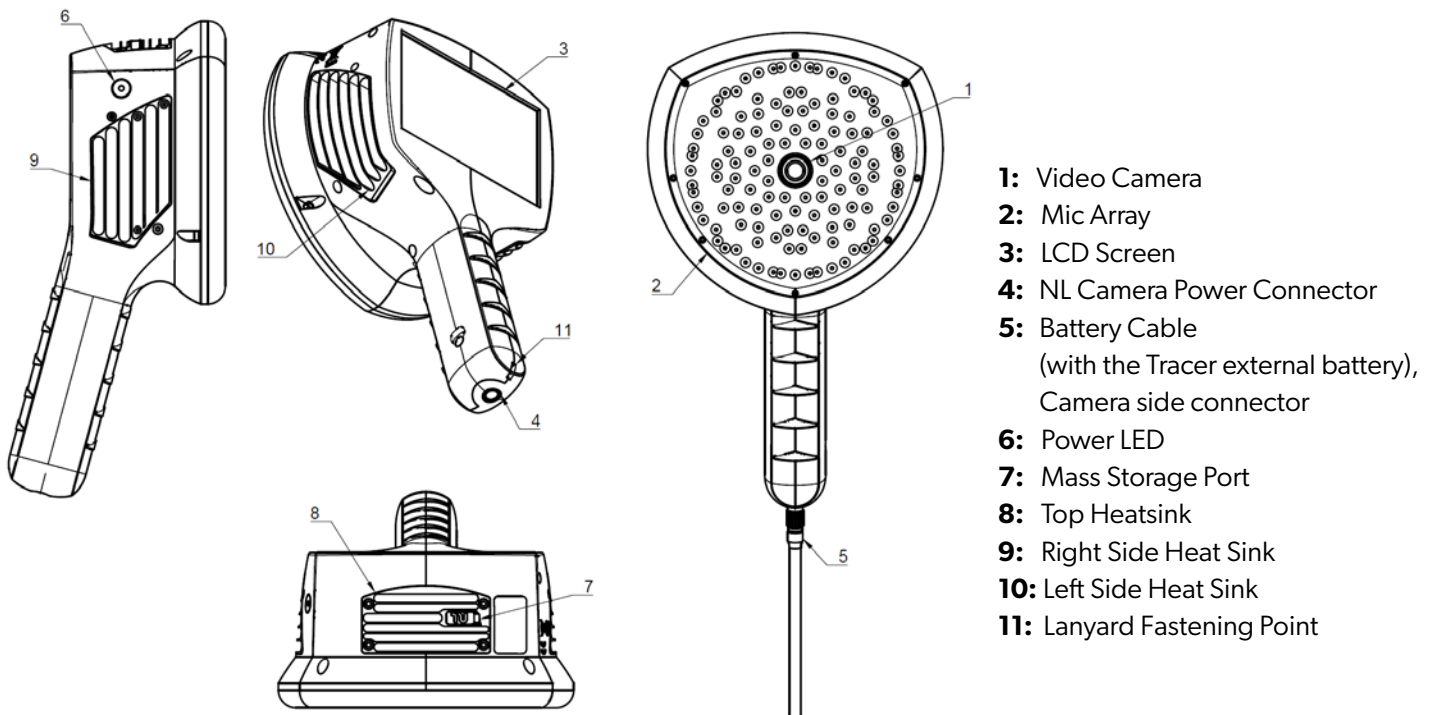**10:** Left Side Heat Sink
11: Lanyard Fastening Point

Image 2. Different NL Camera parts.

!! 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**) (*see Image 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**) (*see Image 2*). 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**) (*see Image 2*). If you bought the NL Camera with the Tracer external battery, the device comes with a cable (**5**) that can be attached to the camera (*see Image 2*). 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**) (*see Image 2*), 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 (*see Image 2*). 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**) (*see Image 2*). 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**) (*see Image 2*). 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. !!

2.7 External battery parts

The battery parts depend on whether you have purchased the NL Camera with the **Tracer** external battery or with the **RRC2040** external battery. See the battery parts below.

2.7.1 Tracer external battery parts
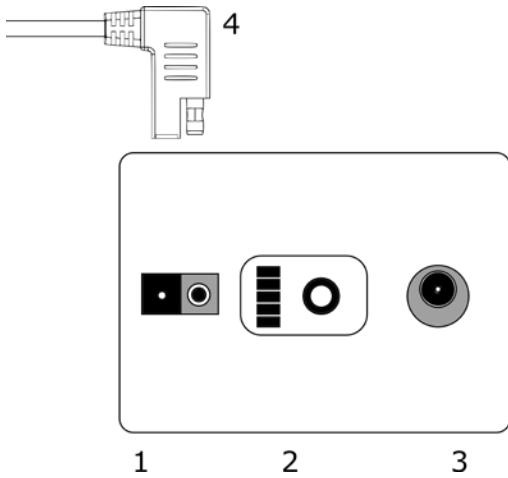
Top: The battery end of the Battery Cable (**4**)
Bottom: The main battery of the NL Camera
1: Output connector for the Battery Cable
2: Charge Gauge
3: Battery Charger connector

Image 3. Tracer external battery parts.

2.7.2 Tracer external battery charger

The Charger for the battery is an AC/DC converter with an output capable of charging LiFePO4 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 chargers other than NL Acoustics approved chargers.

2.7.3 RRC2040 external battery parts

The main parts of the RRC2040 set are the battery housing and the RRC2040 batteries.

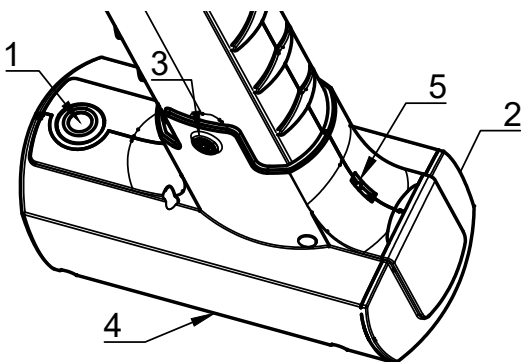*Image 4. RRC2040 battery housing.*

Image 5. RRC2040 battery.

1: Power button
2: Magnetic lid
3: Fixing screw
4: Battery housing
5: Lanyard pin

1: Battery connectors
2: Charge cauge button
3: Battery charge display

2.7.4 RRC2040 external battery charger

The RRC2040 charger has two parts: the charger unit and the power supply. The charger unit has connectors for the battery in the charging bay and a DC barrel input for power supply. The power supply has universal mains input where the power cord can be chosen depending on the region.

2.8 Spare parts and accessories

Description	Part Number	Included in default shipment
Transport case (Hardcase)	71019003	N/A
Camera pouch	71019006	1x
Camera lanyard	72519001	1x
Memory stick	72019002	2x
NL Sonic Tester (Acoustic camera calibrator + stand)	95020002	N/A

External battery option: Tracer

Description	Part Number	Included in default shipment
Tracer Battery cable	70019002	1x
Tracer Battery	21019001	1x
Tracer Battery rubber plug	42019012	1x
LiFePO4 Battery charger	70019007	1x

External battery option: RRC2040

Description	Part Number	Included in default shipment
RRC2040 battery	21119000	2x
Battery housing	61019004	1x
RRC Charger	70019009	1x
Charger power supply	70019014	1x

3. 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 is low. To ensure a long lifetime of the batteries charge the batteries fully before the first use.

3.1 Charging

The main power source of the NL Camera is either the Tracer external battery or the RRC2040 external battery. The batteries should be charged fully before operating the device. Also make sure that the batteries are charged before storing them.

!! NOTE: The NL Camera is not intended to be used while the batteries are charging. Charge the batteries only when disconnected. !!

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

3.1.1 Charging Tracer external battery

To fully charge an empty Tracer battery 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 Tracer battery used in optimal environment conditions yields up to 7 hours of usage.

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

1. Disconnect the battery cable from the battery output connector (**1**) first.
2. Plug the mains cable of the charger into the wall socket.
3. 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

Charge gauge: Press the charge 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.

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

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 % (nearing self switch-off)
No lights	Empty (recharge within 12 hours)

Nominally the battery yields 6 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.

3.1.2 Charging the RRC2040 external battery

Before using the batteries, remember to charge them first. To fully charge an empty RRC2040 battery usually takes about 2 hours. Please note that the battery should be charged at temperatures between 0 °C and +40 °C (+32 °F to +104 °F). A new RRC2040 battery used in optimal environmental conditions yields over 2 hours of usage. By swapping the battery in between, you can extend the working time on the field and use the NL Camera for up to 6 hours.

The RRC2040 batteries and the charger are delivered with the NL Camera. Only use the provided battery charger.

1. Plug the DC barrel connector of the power supply to the RRC Charger.
2. Plug the mains cable of the charger into the wall socket.
3. Ensure that the connectors of the battery and the charger bay are aligned when inserting the battery. When inserted correctly, the battery stands firmly and straight. The charger light starts blinking when the battery is connected properly.

When the battery starts charging, the charger light turns orange. When the battery is full, the light turns green. You can see how much the battery has charge by pressing the charge gauge.

Color of the charging status LED	Explanation
Off	Not powered or no battery
Green	Ready
Yellow	Charging
Red	Malfunction / temperature limits exceeded
Flashing/Changing	Setting up

Charge gauge: The front side of the RRC2040 battery has the battery connectors and the top side of the battery has the charge gauge button and the battery charge display. To check the state of charge of the battery, press the charge gauge button and the battery charge display will show the charge percentage through the 4 LEDs.

Amount of LEDs on	State of charge [%]
4	100-76
3	51-75
2	26-50
1	10-25
1 (flashing)	<10

3.2 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.

3.2.1 Startup with Tracer external battery

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 to the following instructions, with the orientation markings facing the same way:
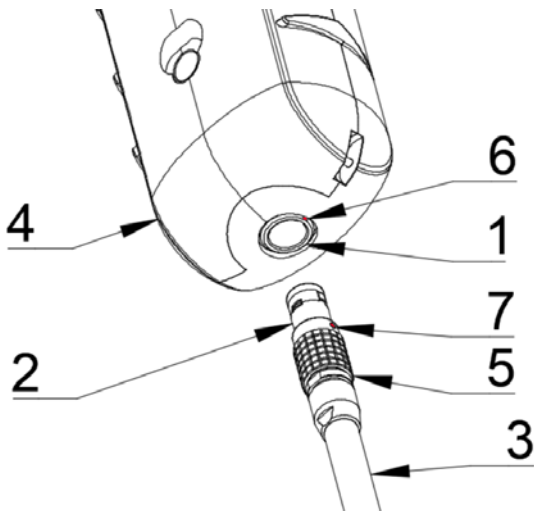

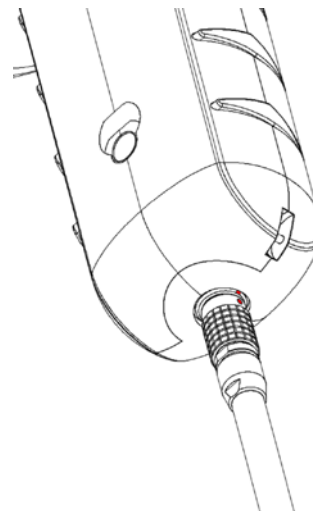*Image 6. Different parts to consider when starting the NL Camera.*

Image 7. Battery cable inserted in the NL Camera.

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 marking**s (*see Image 6*). 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** (*see Image 6*) and make sure that the orientation markings of both connectors are aligned before inserting the battery cable. **Then carefully insert the battery cable connector into 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 NL Acoustics logo will appear on the screen. **When the system setup is complete the NL Camera GUI will start automatically, and you are 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.

3.2.2 Startup with RRC2040 external battery

The RRC2040 battery set for the NL Camera includes two batteries, a cordless battery housing, a charger, a charger power supply, and a country-specific power cord.

To start using the battery, you first need to attach the battery housing to the NL Camera. To do so, unscrew the lowest screw in the camera handle counterclockwise, and then insert the handle in the battery housing. The battery housing has a protruding screw hole that should align with the screw hole of the camera handle. Now you can secure the battery housing with the 30 millimeter screw that comes with the battery set.
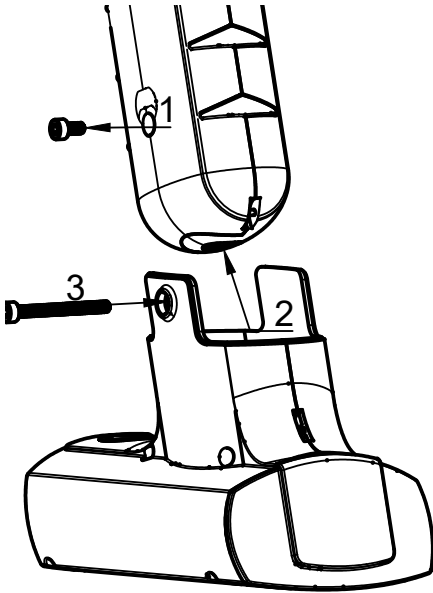

Image 8. Attaching the RRC2040 battery housing.
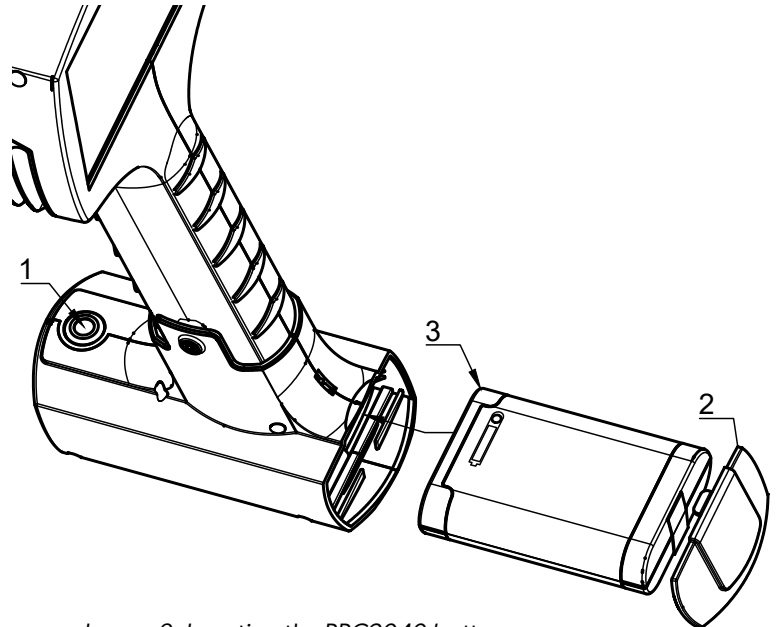
Image 9. Inserting the RRC2040 battery.

1: Unscrew and remove the lowest screw of the camera handle. (tool: 2.5 mm Hex socket screwdriver)
2: Insert the battery housing into the camera handle. The housing is in its correct place when the screw hole of the battery housing is aligned with the lowest screw hole of the camera handle.
3: Screw the 30 mm hex screw through the housing into the handle. Tighten firmly.

1: Power switch button
2: Magnetic lid
3: RRC2040 Battery in the correct position when inserting in the housing.

After you have attached the battery housing to the NL Camera, open the housing's lid and insert the battery connectors first and the charge gauge upwards. Ensure the battery is all the way inside the housing. Close the lid. The portable battery is now ready to use. Press the on/off button at the front of the battery housing to turn on the camera. If the power LED of the NL Camera blinks, your battery has depleted its charge before startup.

If you wish to attach the NL Acoustics wrist lanyard that comes with the camera to the battery housing, you can find a place for it on top of the battery housing lid.

3.3 Shutdown

The NL Camera turns off automatically when the external battery power is disconnected.

3.3.1 Shutdown with Tracer external battery

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, you can perform a hard shutdown by disconnecting the battery power and waiting until the power LED turns off. If the shutdown takes more than 5-10 minutes after disconnecting the battery, contact NL Acoustics for service.

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

3.3.2 Shutdown with RRC2040 external battery

To turn off the NL Camera, **simply press the on/off button. While in off state, the button is in the up position**.

1. Press down the on/off button until it clicks and rises up. The power is now switched off. Alternatively, you can pull the battery out of the battery housing.
2. The NL logo will appear and the system will safely perform a shutdown.
3. The camera's red Power LED will turn off when the shutdown is complete.

If you encounter a problem with the system, you can perform a hard shutdown by disconnecting the battery power and waiting until the camera's power LED turns off. If the shutdown takes more than 5-10 minutes after disconnecting the battery, contact NL Acoustics for service.

.

3.4 Device setup wizard

The first time the NL Camera is powered up, the device setup wizard is shown. The wizard will help you set up the most important settings needed for using the device. These settings can be changed later through the settings menu. Please see the appropriate section of *4.7: Settings* for details

4. USER INTERFACE

The camera supports the following application modes:

- **Air mode** is used for localization of compressed-air leaks.
- **Power mode** is used for localization and classification of high-voltage and medium-voltage partial discharges.

The available functions, settings, and real-time analysis information in the user interface (*see an example in Image 10 right*) depend on the selected application mode.

Image 10. An example of the graphical user interface of the NL Camera.

4.1 Heatmap

The main view of the user interface shows the camera image with a heatmap overlay. 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:

1. The location color mode.
2. The strength color mode.

The location color mode (*see Image 11*) 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 location color mode is active in the Power application mode.

The strength color mode (*see Image 12*) shows each sound source with a single color according to the intensity of the sound source. The strength color mode is active in the Air application mode.

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.

IMAGE 11: The Location color mode.


IMAGE 12: The Strength color mode.

4.2 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.

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.

4.3 Record a video
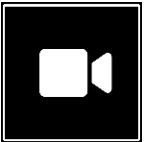
Press the *video recording* button on the right side of the snapshot button to start recording. Please note that the video length is limited to 5 minutes. To stop recording, tap the button again. After you have finished recording, you will see the same comments screen that is shown after you take a snapshot. You are also given the choice to save or erase the recorded video clip. You can erase the clip by tapping the garbage bin button.

You can view the saved videos later in the NL Cloud, NL Camera Viewer, or NL Camera Viewer Pro. However, you cannot view the recorded videos in the camera itself, or by using any other video player software on your computer.

4.4 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, exported to a USB memory stick (*see section 4.6: USB export*), or exported with direct export functionality to a PC.

To access automatic cloud upload settings, trigger manual cloud upload or direct data transfer, press the *upload* button.

Enable/disable the cloud upload:
Upload to cloud

With this functionality, you can enable or disable automatic data upload to the NL Cloud. See section *4.9: Cloud upload* for more information.

Manually triggered cloud upload:
Upload to cloud now

If you have disabled the automatic data upload, you can manually trigger data upload to the NL Cloud. See section 4.9 Cloud upload for more information.

Transfer snapshots directly to a PC without USB sticks:
Direct data transfer

You can directly transfer the data to NL Camera Viewer Pro with this functionality without using the USB export functionality. See section 4.11 Direct data transfer for more information.

4.5 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.

4.6 Quick settings

Press the *quick settings* button to show the available quick settings. The possible settings are listed below.

4.6.1 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).

4.6.2 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 dominant sound source, 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.

4.7 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
• Time settings
• Change mode
• Air mode settings
• Power mode settings
• Advanced settings

4.7.1 Network settings

Press the Enable WiFi button to show the available WiFi settings.

To be able to scan for and select a WiFi network, you must first select the correct WiFi country. If the selected WiFi country is incorrect, you may not be able to connect to WiFi networks or the WiFi connection might not work properly.

When pressing the Select WiFi button, the camera will scan for nearby WiFi networks. After the scan, a list of the found networks will be shown. In case the WiFi network you wish to connect to does not 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 WiFi networks are supported. The camera accepts WiFi networks that require password input (not networks that require both username and password).

An icon representing the WiFi connection status and strength is shown to the right of the settings button:

Excellent wifi connection strength.

Good wifi connection strength.

Satisfactory wifi connection strength.

Poor wifi connection strength.

No wifi connection.

Device registration:

To be able to upload snapshots to the cloud and browse them with the NL Cloud, the device must first be registered with the cloud service. Please follow the on-screen instructions in order to register the device. Once the device has been registered, this option will no longer be available.

4.7.2 Time settings

The current time and date are shown under the time settings. Choose the correct timezone in order to show the correct local time. The time and date are automatically synchronized when connected to WiFi.

4.7.3 Change mode

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.

4.7.4 Advanced settings

Language

This option allows you to choose the desired user interface language. The following languages are supported:

- Czech
- Danish
- Dutch
- English
- Estonian
- Finnish
- French
- German
- Greek
- Hungarian
- Italian
- Japanese
- Korean
- Norwegian
- Polish
- Brazilian Portuguese
- Russian
- Simplified Chinese
- Spanish
- Swedish
- Thai
- Traditional Chinese
- Turkish
- Vietnamese

Distance unit

The distance unit can be changed here to either meters (m) or feet (ft).

Reset settings

All settings can be reset to their default value by pressing *Reset settings*. Note that doing a settings reset will not remove any snapshots, revert to any previous software version or remove the device registration.

Remove all data

All user data and settings can be removed from the device by pressing *Remove all data*. The snapshots and device registration will be removed, and the camera can be registered with a new user afterwards. The software is not reverted to any previous version.

Calibration mode

For periodically checking the accuracy of the NL Camera, a separate tester (**NL Sonic Tester**) is available from NL Acoustics. For details, please contact your local distributor. For details about the calibration mode, please see the documentation provided with the NL Sonic Tester.

4.7.5 Air mode settings

Please see *section 5: Application-specific features* for the Air mode specific settings.

4.7.6 Power mode settings

Please see *section 5: Application-specific features* for the Power mode specific settings.

4.8 Filter

Press the *filter* button to switch between different filters. The available filters depend on the selected application mode. The filters typically change the frequency range that the 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. For more information on choosing filters, see *section 6.2: Locating sound sources* and taking snapshots.

4.9 Real-time analysis

Real-time analysis results are shown at the top of the graphical user interface. The level in decibels of sound arriving from the strongest source (shown with a crosshair) is presented. The real-time analysis also provides additional information about problems related to the specific application. For details, see *section 5: Application-specific features*.

4.10 Cloud upload

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 *snapshot browser* (*see section 4.3: Snapshot browser*). Snapshot upload can also be triggered manually, if the automatic snapshot upload is turned off. 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.

4.11 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 (*see Image 13 below*) 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.

!! NOTE: Use only the USB memory sticks provided with the NL Camera. Other memory sticks are not guaranteed to work and may lead to loss of data. !!
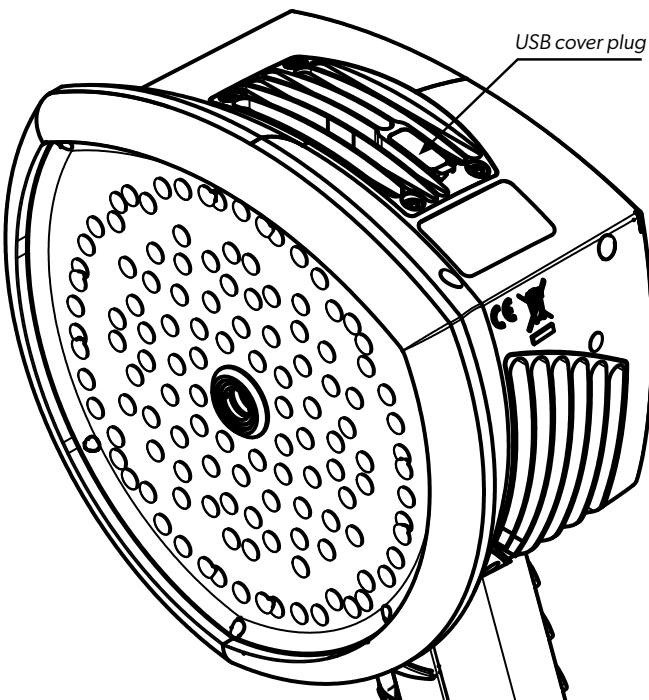

USB cover plug

Image 13. The location of the USB cover plug.

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 USB port cover back in place.
The snapshots transferred to the memory stick can be browsed on a computer with the NL Camera Viewer software. On the USB stick, the snapshots are organized into subfolders.

Snapshots transferred to a memory stick will not be uploaded to the NL Cloud. The snapshot *.nlz* files 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. !!

4.12 Direct data transfer

In case USB export cannot be used for exporting the data to a PC, direct data transfer is an alternative way to transfer snapshots directly from the NL Camera to the NL Camera Viewer Pro software (*see section 8: NL Camera Viewer and NL Camera Viewer Pro offline software*). The NL Camera Viewer basic version does not support this feature.

This feature uses a direct WiFi connection between a PC and the NL Camera. The feature can be accessed in the snapshot browser (*see section 4.3: Snapshot browser*).

See the NL Camera Viewer Pro documentation for instructions how to access the functionality in the offline software (*see section 8: NL Camera Viewer and NL Camera Viewer Pro offline software*).

4.13 Remote update

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.

4.14 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 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 to 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 down the NL Camera by unplugging the power cable and start it again by connecting the power cable. The update will now be applied.

5. 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.

5.1 Compressed air leak detection

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 *section 5.1.2 Distance*), as well as setting the environment temperature and relative humidity (see section 5.1.3 Air mode-specific settings).

The NL Camera will also display an estimate of how much the detected leak costs annually. The estimate relies on the user setting the distance to the leak correctly (see section 5.1.2 Distance), as well as setting leak-related settings correctly (see section 5.1.3 Air mode-specific settings).

5.1.1 Filter

The High and Ultra filters both filter out audible background noise, 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.

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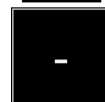
The NL Camera has buttons for setting the distance to the detected leak. Use the + and - buttons to select the distance that you think is closest to the real distance of the leak. The distance is used to compensate for the fact that the intensity of sound is reduced over distance. This information is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

5.1.3 Air mode specific settings

The following 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.

Energy cost

To estimate the cost of compressed air leaks, the energy cost must be known. Typically, this means the local price (per kWh) of electricity. Note that if the currency is changed, the energy cost must be updated accordingly.

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 number 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.

Specific power

The specific power is a measure of how much energy is needed to produce a certain amount of compressed air. The unit is either $kW/m^3/min$ or kW/100 CFM. This option is for advanced users; leave it at the default value if you do not know the specific power of your compressed air system.

5.2 Partial discharge detection

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 concentrate 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.

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. Press on the window to enlarge it. Press once more to make it small again. The severity assessment in the NL Cloud and NL Camera Viewer Pro relies on the user setting the distance to the leak correctly (*see section 5.2.2: Distance*).

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

5.2.1 Filter

The Norm filter filters out low frequency background noise, while the High and Ultra filters both filter out all audible background noise, concentrating on ultrasonic frequencies where the sound of partial discharges often is prominent. If there is only a little background noise, try the Norm filter. In the presence of strong background noise, the High or Ultra 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.

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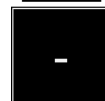
The NL Camera has buttons for setting the distance to the detected partial discharge. Use the + and - buttons to select the distance that you think is closest to the real distance of the partial discharge. The distance is used to compensate for the fact that the intensity of sound is reduced over distance.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

6. USAGE TECHNIQUES

6.1 General usage

Keep the Tracer battery inside the carrying bag and carry the bag with the strap over your shoulder to free your hands for using the NL Camera (*see Image 14*).

!! 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 used 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.

Image 14. Using the NL Camera.

6.2 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 (*see Image 15 below*).

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 right when or right 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 (1.0 ft). 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 130 meters (430 ft), but strong sound sources in an otherwise quiet environment can be detected at even larger distances. Respectively, weak sound sources usually require closer proximity.
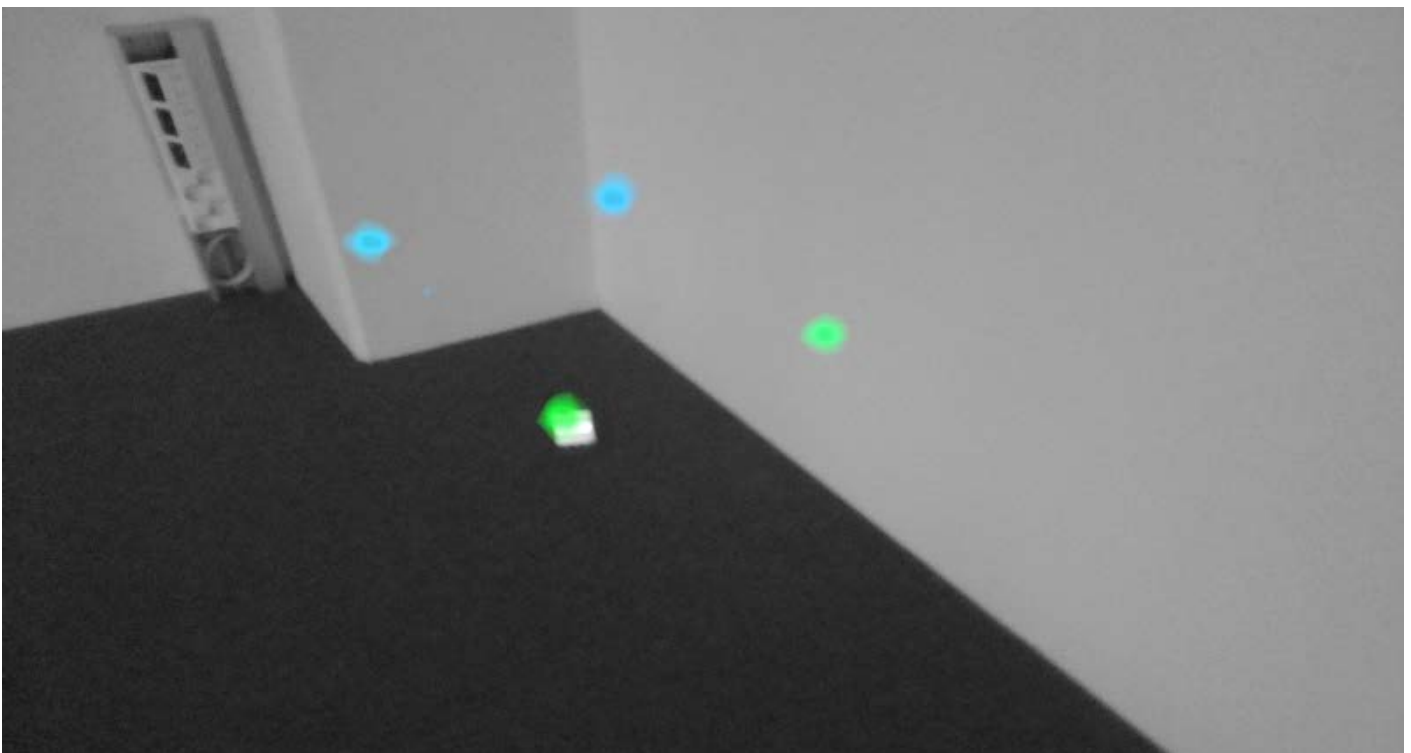

Image 15. An example of one actual sound source and three reflections shown by the NL Camera in multi-source mode. The actual sound source lies on the floor, while there are three reflections shown on the walls. When the camera is moved around, the location of the actual sound source remains the same, while the reflections move around on the walls, and are not seen from all angles.

7. CLOUD

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 (e.g. Google Chrome, Microsoft Edge, Mozilla Firefox) and enter the following address: **view.nlacoustics.com**.

To use the cloud service, you must first register as user and register the device to the cloud service (see *Device registration* under *4.6.1: Network settings*).

Please see the NL Cloud interface for further documentation.

8. NL CAMERA VIEWER AND NL CAMERA VIEWER PRO OFFLINE SOFTWARE

NL Camera Viewer is an offline computer software for Microsoft Windows 10 operating systems, and it is used for viewing and analyzing snapshots taken with the NL Camera. The installation file for the offline viewer will 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 NL Camera Viewer is available in the software itself.

NL Camera Viewer Pro is an optional offline computer software for Microsoft Windows 10 operating systems, and it is used for viewing, analyzing, and reporting snapshots taken with the NL Camera. The Viewer Pro offers additional advanced features for analysis and automatic reporting. For details, please contact your local distributor. Further documentation for the NL Camera Viewer Pro is available in the software itself.

.

9. 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.

9.1 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.

9.2 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 a damp cloth (with water or mild soap water), squeeze the cloth until it does not 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 does not work and the microphone array is still badly soiled, contact your distributor for support. NL Acoustics is not responsible for any damage caused by the user in an attempt to clean the microphone array.

For **the batteries and the chargers** use a dry cleaning cloth only.

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

9.3 Visual and/or permanent damage

Broken accessories: Replace using NL Acoustics official spare parts. Properly dispose of and/or recycle broken equipment.

NL Camera unit: Contact your distributor for repairs.

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