

EN

ORIGINAL INSTRUCTIONS
CORRELATOR



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Notes regarding the instructions

Symbols

 **Warning of electrical voltage**
This symbol indicates dangers to the life and health of persons due to electrical voltage.

 **Warning**
This signal word indicates a hazard with an average risk level which, if not avoided, can result in serious injury or death.

 **Caution**
This signal word indicates a hazard with a low risk level which, if not avoided, can result in minor or moderate injury.

Note
This signal word indicates important information (e.g. material damage), but does not indicate hazards.

 **Info**
Information marked with this symbol helps you to carry out your tasks quickly and safely.

 **Follow the manual**
Information marked with this symbol indicates that the instructions must be observed.

You can download the current version of the instructions and the EU declaration of conformity via the following link:



LD20HC



<https://hub.trotec.com/?id=40995>

Safety

Read this manual carefully before starting or using the device. Always store the manual in the immediate vicinity of the device or its site of use.



Warning

Read all safety warnings and all instructions. Failure to follow the warnings and instructions may result in electric shock, fire and/or serious injury. **Save all warnings and instructions for future reference.**

- Do not use the device in potentially explosive rooms or areas and do not install it there.
- Do not use the device in aggressive atmosphere.
- Do not immerse the device in water. Do not allow liquids to penetrate into the device.
- The device may only be used in dry surroundings and must not be used in the rain or at a relative humidity exceeding the operating conditions.
- Protect the device from permanent direct sunlight.
- Do not remove any safety signs, stickers or labels from the device. Keep all safety signs, stickers and labels in legible condition.
- Do not open the device.
- Only use the device, if sufficient safety precautions were taken at the surveyed location (e.g. when performing measurements along public roads, on building sites etc.). Otherwise do not use the device.
- Observe the storage and operating conditions (see Technical data).
- Never insert non-rechargeable batteries into the charger. A charger that is suitable for one type of battery pack may create a risk of fire and explosion, when used with another battery pack or non-rechargeable batteries.
- Do not expose the charger to rain or wet conditions. Water entering an electrical appliance increases the risk of electric shock.
- Keep the charger clean. Contamination entails a risk of electric shock.

- Check the charger, cable and plug before each use. Do not use the charger if you detect any damages to the device. Do not open the charger and have it repaired only by qualified personnel and only with original spare parts. Damaged chargers, cables and plugs increase the risk of electric shock.
- Do not operate the charger on highly combustible ground (e.g. textiles, paper etc.) or in an inflammable environment. The heat generated by the charger during charging entails a risk of fire.
- In case of damage and improper use of batteries, vapours may be emitted. Provide for fresh air and seek medical help in case of complaints. The vapours can irritate the respiratory system.
- Under abusive conditions, liquid may be ejected from a battery. Avoid contact with liquid ejected from the battery as it may cause skin irritation or burns. If contact accidentally occurs, flush with water. Seek medical help if this liquid contacts eyes.

Intended use

The device LD20HC is a combined detector for electro-acoustic leak detection using correlation, for electro-acoustic listening to surfaces / fittings and for acoustic pipe location. The device may only be used for the given intended use while complying with the specified technical data.

To use the device for its intended use, only use accessories and spare parts which have been approved by Trotec.

Foreseeable misuse

Do not use the device in potentially explosive atmospheres or at live parts. Trotec accepts no liability for damages resulting from improper use. In such a case, any warranty claims will be voided. Any unauthorised modifications, alterations or structural changes to the device are forbidden.

Personnel qualifications

Only trained or instructed personnel who know and understand the operating instructions and the possible dangers may work with the device.

Personnel to be trained, instructed or undergoing training may only work on the equipment under the constant supervision of an experienced person.

People who use this device must:

- have read and understood the instructions, especially the Safety chapter.

Residual risks



Warning of electrical voltage

There is a risk of a short-circuit due to liquids penetrating the housing!

Do not immerse the device and the accessories in water. Make sure that no water or other liquids can enter the housing.



Warning of electrical voltage

Work on the electrical components must only be carried out by an authorised specialist company!



Warning of explosive substances

Do not expose the batteries to temperatures above 60 °C! Do not let the batteries come into contact with water or fire! Avoid direct sunlight and moisture. There is a risk of explosion!



Warning

Risk of suffocation!

Do not leave the packaging lying around. Children may use it as a dangerous toy.



Warning

The device is not a toy and does not belong in the hands of children.



Warning

Dangers can occur at the device when it is used by untrained people in an unprofessional or improper way! Observe the personnel qualifications!



Caution

Keep a sufficient distance from heat sources.

Note

To prevent damages to the device, do not expose it to extreme temperatures, extreme humidity or moisture.

Note

Do not use abrasive cleaners or solvents to clean the device.

Information about the device

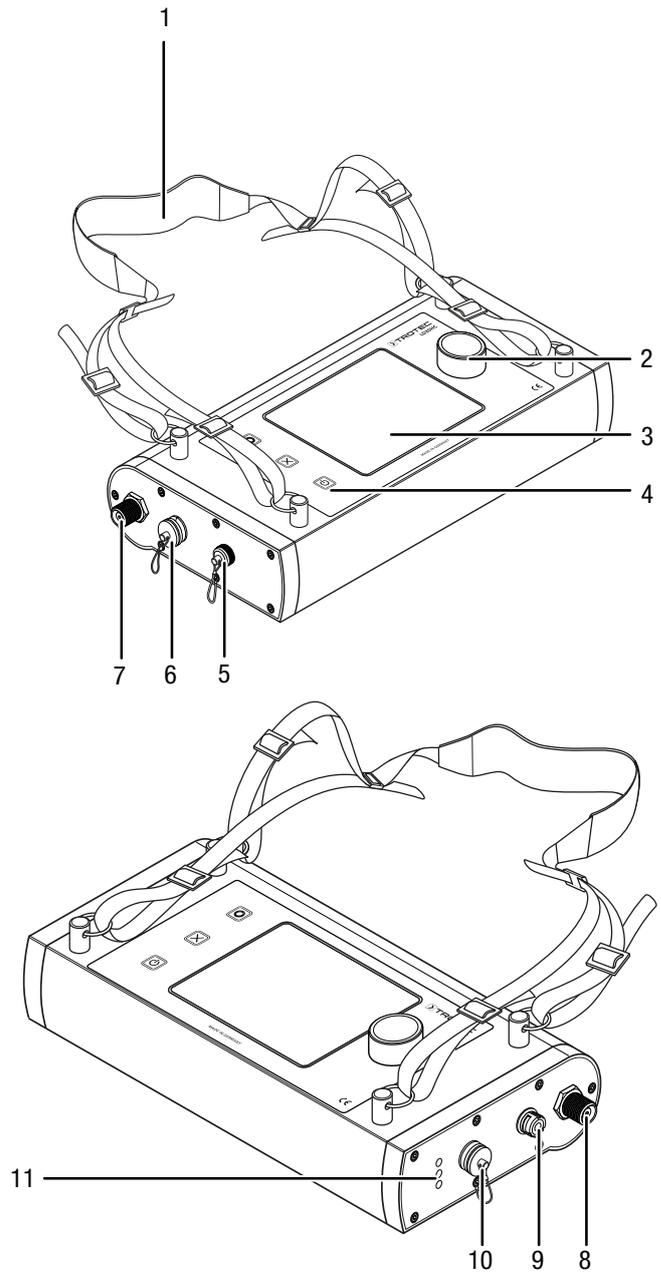
Device description

The combination device LD20HC enables pinpoint leak detection in pressurized pipeline systems. It can be used for both performing correlations and for direct electro-acoustic listening.

The device is suited for leak detection in pipelines and drinking water systems where a leakage noise is produced at the leak point due to pressure. This noise travels through the pipeline in both directions with parameters (volume, frequency) varying in intensity and is detected by highly sensitive sensors installed at accessible locations such as hydrants, valves etc.

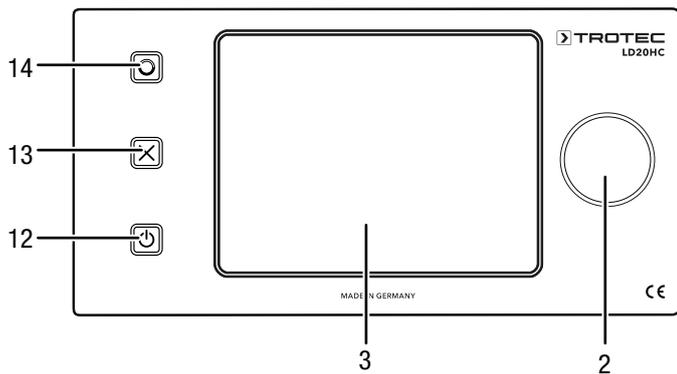
Moreover, the device is able to detect leaks in pipes with up to 20 different pipe materials and diameters in one measurement (correlation). The amplified sensor signal is transmitted to the central unit by radio. The device allows to amplify the signal received more than 60,000 times using the geophone. It contains 256 freely selectable filters to be used for the signal received.

Device depiction



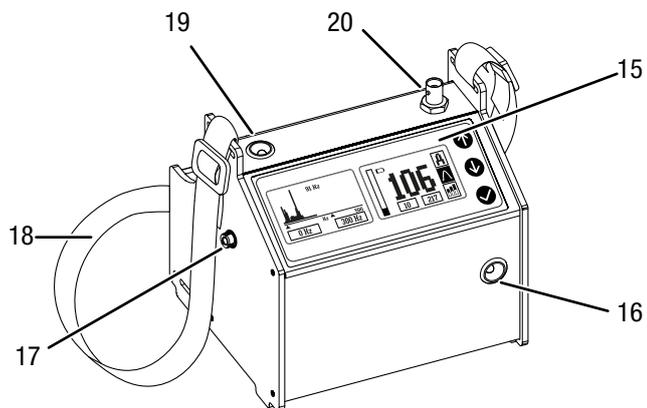
| No. | Designation |
|-----|---|
| 1 | Shoulder strap |
| 2 | Rotary button |
| 3 | Touchscreen |
| 4 | Control panel |
| 5 | Port with cover for PC connection cable |
| 6 | Headphone connection with cover |
| 7 | Left antenna connection |
| 8 | Right antenna connection |
| 9 | Microphone connection |
| 10 | Charging socket |
| 11 | LEDs battery status |

Central unit control panel



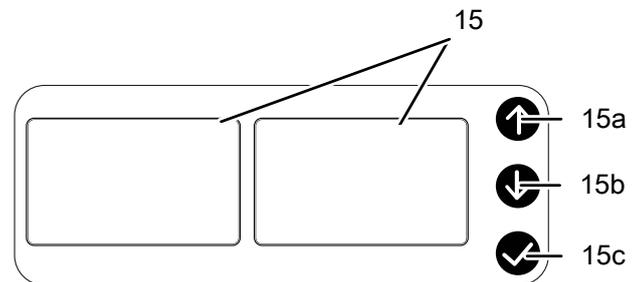
| No. | Designation |
|-----|---------------|
| 2 | Rotary button |
| 3 | Touchscreen |
| 12 | Power button |
| 13 | Cancel button |
| 14 | Record button |

Transmitter device depiction



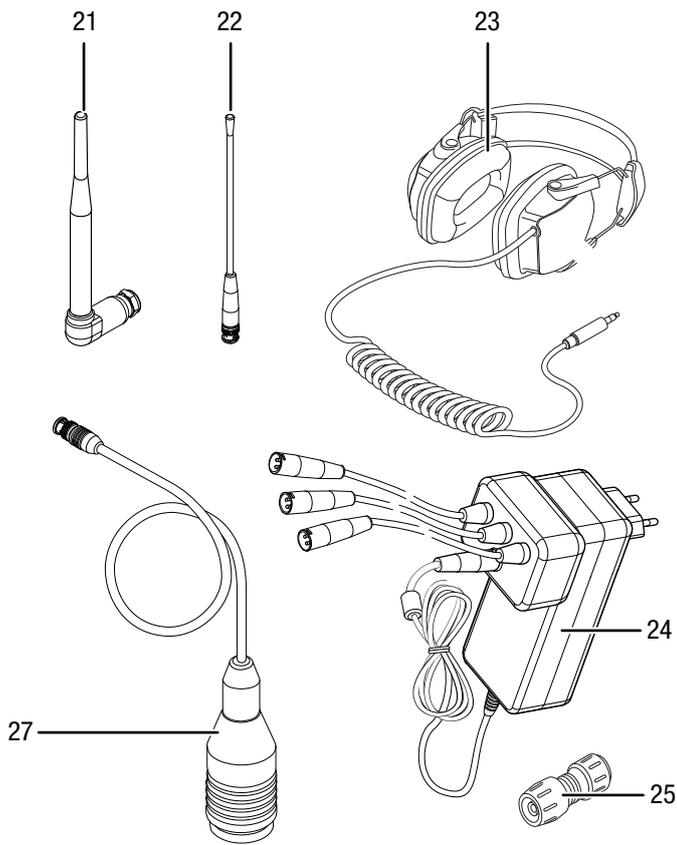
| No. | Designation |
|-----|---|
| 15 | Displays |
| 16 | Jack socket for headphones |
| 17 | Connection for structure-borne sound receiver |
| 18 | Shoulder strap |
| 19 | Charging connection |
| 20 | Transmitter antenna connection |

Transmitter control panel



| No. | Designation |
|------|--------------------------|
| 15 | Displays |
| 15 a | Arrow button <i>up</i> |
| 15b | Arrow button <i>down</i> |
| 15c | Confirm or On/Off button |

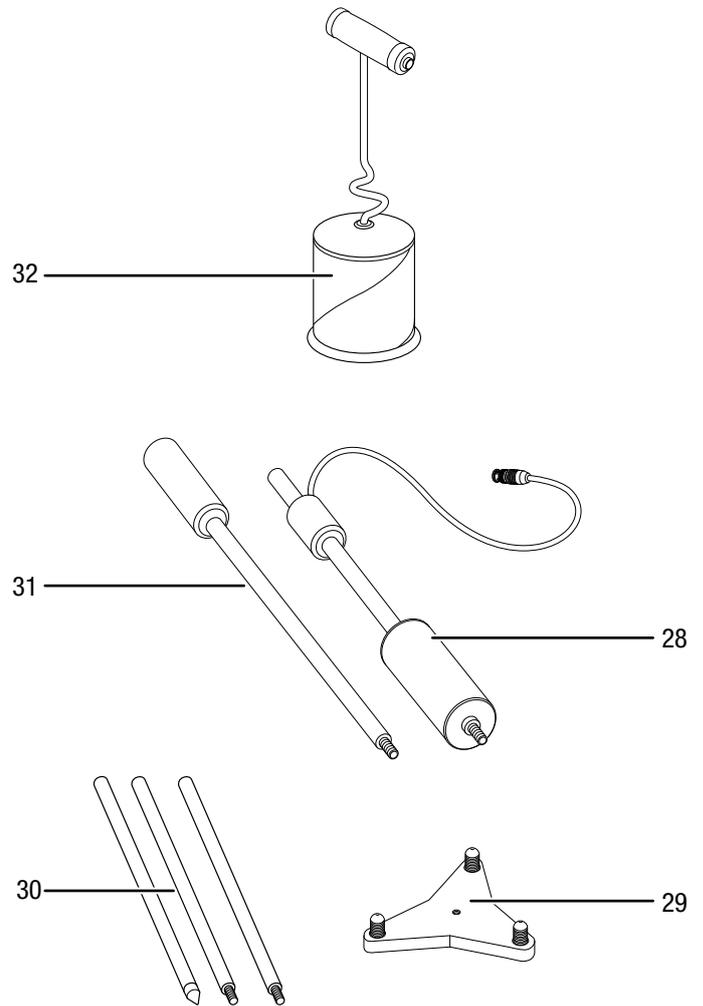
Accessories



| No. | Designation |
|-----|--|
| 21 | Central unit antenna (2x) |
| 22 | Transmitter antenna (2x) |
| 23 | Headphones |
| 24 | Charger with distributor and connection cables |
| 25 | Reset dongle |
| 27 | Structure-borne sound receiver |

Optional accessories

Microphones and sensors



| No. | Designation |
|-----|----------------------|
| 28 | Probe rod upper part |
| 29 | Tripod magnet |
| 30 | Probe rod extensions |
| 31 | Probe rod lower part |
| 32 | Ground microphone |

Technical data

| Parameter | Value |
|--------------------------------------|--|
| Receiver | |
| Operating modes | Leak detection via correlation (automatic, manual) acoustic leak detection (volume, smart) |
| Measuring and device functions | automatic filter adjustment, automatic amplification, preference memory function for manual filter settings, sound level override protection |
| Measurement resolution correlation | 5 cm for a measuring distance of 100 m |
| Measurement resolution geophone | 0–99 digits (equivalent to dB) |
| Control | optionally via touchscreen or buttons and control dial |
| Amplification | 120 dB with low noise figure |
| Input impedance | 1 M Ω |
| Filter | 256 high-pass and low-pass filters |
| Display | 5.7" touch colour LCD with background illumination |
| battery check | via micro controller |
| Output impedance | < 10 Ω |
| Power supply | integrated NiMH battery, 8500 mAh |
| Operating time | approx. 10 h in continuous operation with fully charged battery |
| Memory | up to 100 measurements per operating mode |
| Connections | 2 x SMA antenna sockets bayonet sensor connection 4-pin charging socket with cover 3-pin headphone connection with cover USB cable connection with cover |
| Type of protection | IP65 |
| Housing | aluminium, powder-coated |
| Temperature conditions | Operation: -20 °C to +60 °C Storage: -25 °C to +65 °C |
| Dimensions (length x width x height) | approx. 380 x 155 x 67 mm |
| Weight | approx. 2,300 g |

| Parameter | Value |
|--------------------------------------|---|
| Transmitter | |
| Display | numeric and graphic sound level |
| Amplifier stages | The device comes with 3 amplifier stages: <ul style="list-style-type: none"> • No. 1: pre-preamplifier • No. 2: preamplifier • No. 3: post-amplifier |
| Filter function | The device comes with 5 filter functions: <ul style="list-style-type: none"> • open = 0–5000 Hz • low = 0–300 Hz • medium = 200–800 Hz • high = 600–1400 Hz • very high = 1000–4000 Hz |
| Amplification | Automatic pre- and post-amplification, -10 to +10 steps manually adjustable for pre-amplification |
| | 5 preset filter ranges |
| Transmission power | 500 mW maximum |
| Frequency bands | Channel A: 433.7 MHz Channel B: 434.7 MHz Channel C: 434.0 MHz |
| Background illumination | Automatic |
| Temperature conditions | Operation: -20 °C to +60 °C Storage: -25 °C to +65 °C |
| Power supply | integrated NiMH battery |
| Dimensions (length x width x height) | approx. 175 x 165 x 155 mm |
| Structure-borne sound sensors | |
| Sound receiver | Piezoceramic |
| Connections | TNC antenna connection bayonet sensor connection 4-pin charging socket with cover 3-pin headphone connection with cover |
| Type of protection | IP68 |
| Housing | aluminium, powder-coated |
| Operating time | approx. 7 h in continuous operation with fully charged battery |
| Weight | approx. 2,900 g |

Scope of delivery

- 1 x Central unit with two antennas and a shoulder strap
- 1 x Transmitter 1 incl. sound receiver, coloured yellow
- 1 x Transmitter 2 incl. sound receiver, coloured red
- 1 x Headphones with sound protection
- 1 x Charger
- 1 x Reset dongle
- 1 x Transport case
- 1 x Manual

Transport and storage

Note

If you store or transport the device improperly, the device may be damaged.
 Note the information regarding transport and storage of the device.

Transport

For transporting the device, use the transport case included in the scope of delivery in order to protect the device from external influences.

Storage

When the device is not being used, observe the following storage conditions:

- dry and protected from frost and heat
- protected from dust and direct sunlight
- the storage temperature complies with the values specified in the Technical data

Start-up

Charging the battery of the central unit

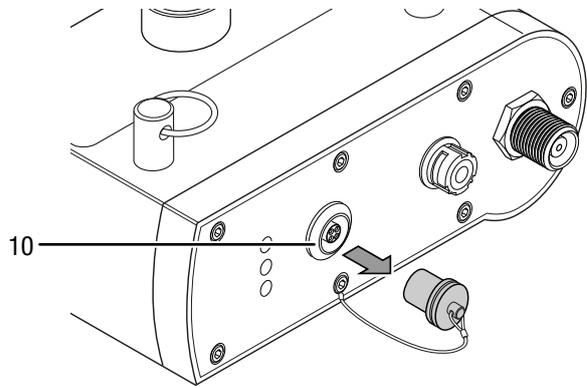
Before use make sure that the battery of the central unit is charged.

A full charging cycle (completely empty until completely charged) takes approx. 8–10 h.

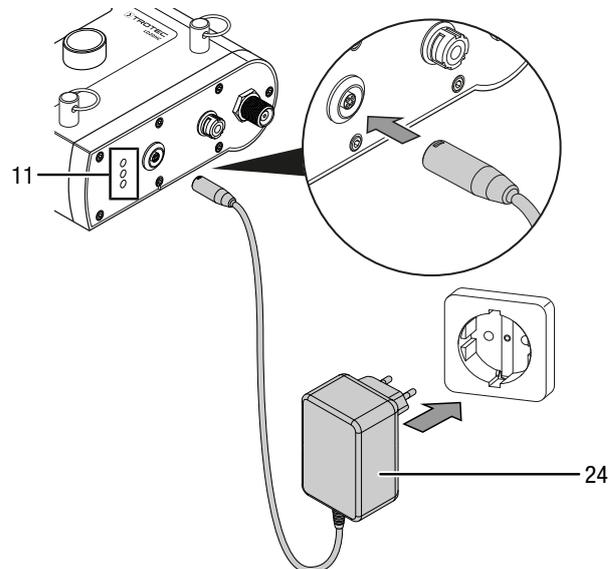
Please note the LEDs (11) on the right-hand side of the central unit. They indicate the following:

| | |
|------------|---|
| Blue LED | illuminated = battery charging |
| Green LED | illuminated = battery fully charged |
| Orange LED | illuminated = power adapter connected and supplied with voltage |

1. Remove the cover from the charging socket (10) of the central unit.



2. Insert the mains plug of the charger (24) into a properly fused mains socket.
3. Plug the charging cable into the charging socket (10) of the central unit. Make sure that the red marks on the charging socket and on the charging cable connector are aligned.



⇒ The orange and blue LEDs (11) light up.

4. Wait until the battery is fully charged.
⇒ The green LED (11) lights up.
5. Remove the cable from the charging socket and reattach the cover to the charging socket.

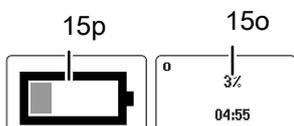
Charging the battery of the transmitter

Before use make sure that the battery of the transmitter is charged.

A full charging cycle (completely empty until completely charged) takes approx. 5–6 h.

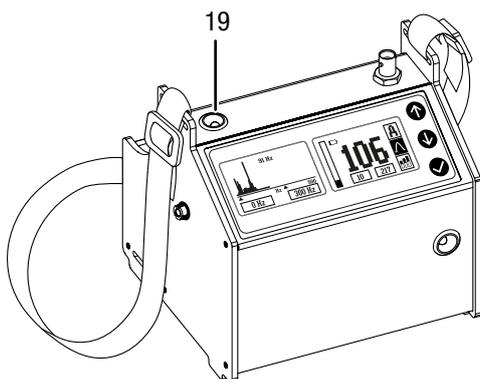
The left and right displays (15) show the following information during the charging process:

- The left display shows the battery status with a flashing battery level indication (15p).
- The right display shows the percentage of the battery status (15o).



The battery is fully charged when the battery status (15o) shows 100 % and the battery level indication (15p) stops flashing.

1. Insert the mains plug of the charger (24) into a properly fused mains socket.
2. Plug the charging cable into the charging socket (19) of the transmitter. Make sure that the red marks at the charging socket and at the charging cable connector are aligned.



Connecting the antennas to the central unit and transmitters



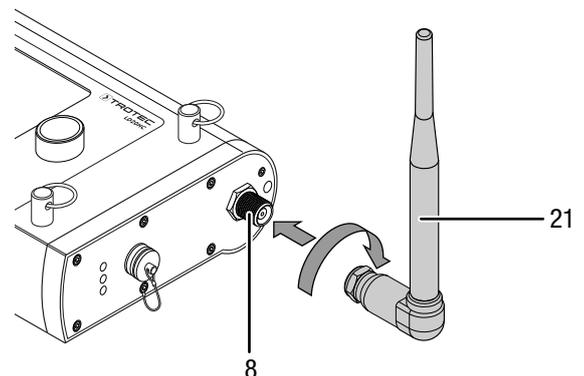
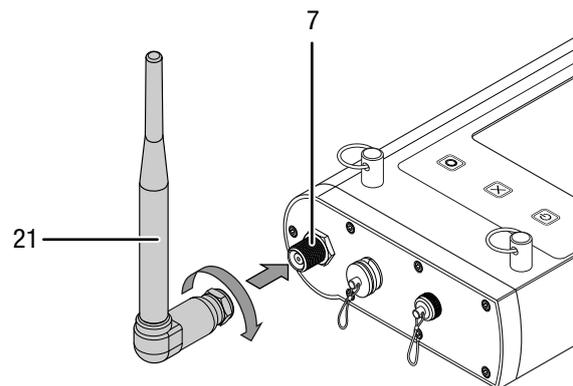
Info

If the antenna is not connected, the radio module may overheat and get damaged.

Risk of overheating of the radio module

To enable communication between the transmitters and the central unit, the antennas must be connected.

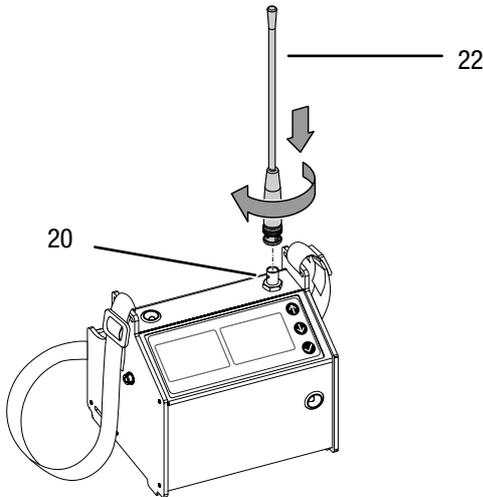
1. Screw the two antennas of the central unit (21) to the left (7) and right (8) antenna connection of the central unit.



2. Orient the two antennas (21) towards the top.

3. Wait until the battery is fully charged.
4. Remove the cable from the charging socket and reattach the cover to the charging socket.

3. Connect the antennas for the transmitters (22) to the antenna connection (20) of the red and yellow transmitter.

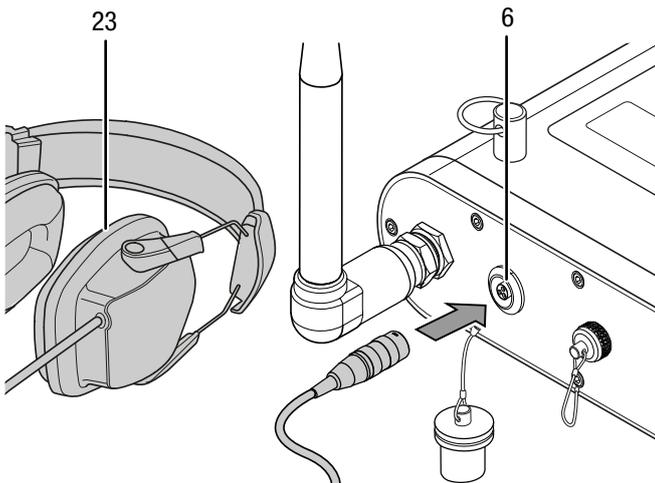


Connecting the headphones

The headphones can be connected to the central unit if required.

Only use the original headphones for your measurements. The headphones are used to listen to the noise transmitted by transmitters A/B/C, ground microphone or other sensors and to make filter and amplification settings on that basis.

1. Remove the cover from the headphone connection (6).
2. Connect the headphones (23) to the headphone connection (6) of the central unit. Make sure that the red marks on the headphone connection and on the device connector are aligned.



Connecting the transmitters

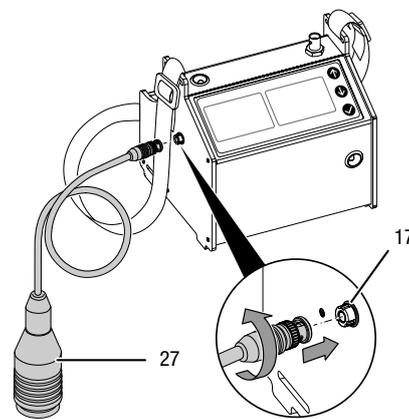


Info

If, after the sensors have been installed and the transmitters switched on, no noise can be heard and the display on the transmitter indicates a value near **0**, reduce the distance from the leak or select another sensor type.

The transmitters can be positioned at a distance of up to 1500 m from the central unit. Please note the following information for positioning the transmitters:

- The maximum distance of up to 1500 m applies for a free area. Obstacles such as houses or trees may affect the transmission capacity. The distance must be reduced in this case.
 - The minimum distance from the central unit is approx. 10 m. In this context, please note that measurements performed in indoor areas such as blocks of flats are prone to error due to a considerable amount of interfering noise.
 - The pipe section to be measured should be as straight as possible and have as few pipe bends as possible to guarantee an accurate measurement with preferably little interfering noise.
1. Connect the required sensor to the connection (17) of the corresponding transmitter (example: structure-borne sound receiver (27)).



2. Position the transmitters with the sensor on the leaking pipeline.
3. Press the Power button (12) to switch the transmitters on.
 - ⇒ The current level is displayed as a bar.
 - ⇒ Amplification takes place automatically.
4. Make any further settings at the central unit if necessary.

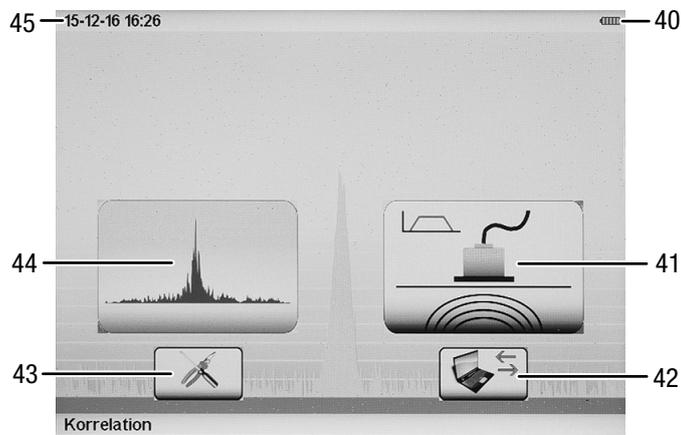


Info

If, after the sensors have been installed and the transmitters switched on, no noise can be heard and the display on the transmitter indicates a value near **0**, reduce the distance from the leak or select another sensor type.

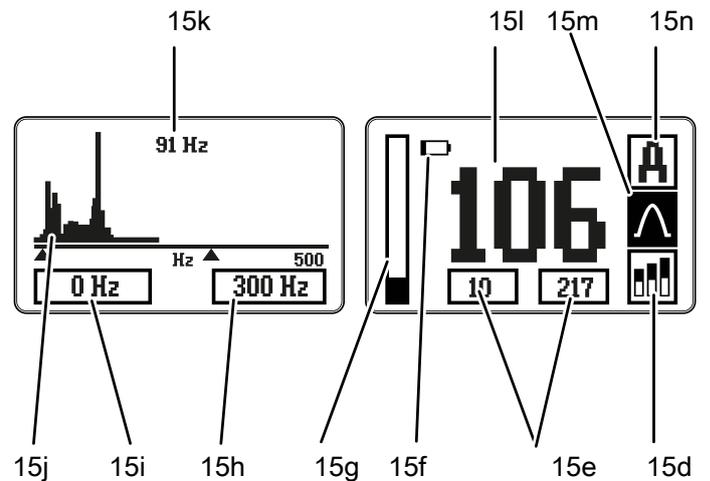
Operation

Central unit main menu



| No. | Designation |
|-----|--|
| 40 | Battery indication |
| 41 | Acoustic leak detection (geophone measurement) |
| 42 | Data exchange with a PC |
| 43 | Settings |
| 44 | Correlation measurement |
| 45 | Date and time indication |

Transmitter main menu



| No. | Designation |
|------|--|
| 15d | Retuning indication |
| 15e | Numerical value for pre-/post-amplifier (optional) |
| 15f | Battery status |
| 15g | Graphic noise level bar |
| 15h | Low-pass filter indication |
| 15i | High-pass filter indication |
| 15j | Frequency response line |
| 15k | Main frequency of the present noise (highest amplitude) |
| 15 l | Numeric noise level |
| 15m | Filter menu |
| 15n | Amplifier menu for preamplifier (A=automatic / M=manual) |

Automatic adjustment of the transmitter



Info

The sound receiver must be placed on the pipeline before switching on.

After switching on the transmitter, the amplification is adjusted automatically. The amplification is selected on the basis of the available useful signal. The automatic amplification usually also corresponds to the optimal measurement setting. If the automatic amplification is too strong or too weak, the amplification must be changed manually.

Manual adjustment of the transmitter



Info

If the automatic amplification does not correspond to the optimum, it can be adjusted manually. To assess whether the useful signal (leak noise) is correctly amplified, listen to the signal via the headphones directly at the measurement box. The sound should be clearly audible, but not overdriven or "tinny". Another indication of an incorrect amplification is the noise level bar (15g). If it is constantly at full scale, the amplification should be reduced. If the noise level bar is permanently at a very low level, i.e. there is hardly any deflection, the amplification should be increased.

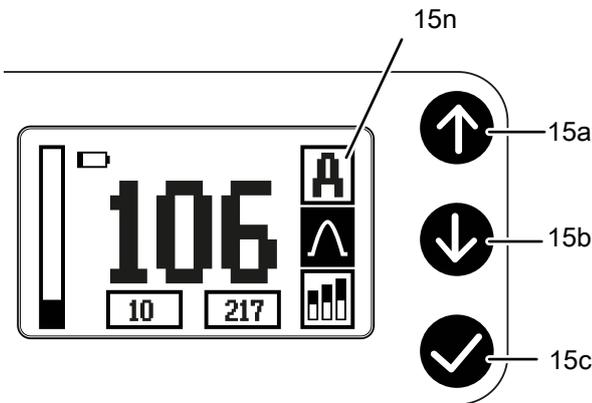
In the standard version, the transmitters have two amplifier stages:

1. Fixed amplifier on the receiver (pre-preamplifier)
2. Adjustable preamplifier (before filtering the signal)

The following equipment is reserved for the professional version only: Optional amplifier stage no. 3 (post-amplifier, after filtering the signal).

To change the amplifier no. 2 (preamplifier), please proceed as follows:

1. Place the cursor on the *amplifier menu* (15n).



2. Press the confirmation button (15c).
3. Use the *Up/Down* arrow buttons (15a/15b) to set the pre-amplification between -10 and +10.

There are a total of 18 levels (1–18) for amplifier no. 2. If, for example, the automatic amplification has been set to numerical value 5, the maximum level that can be reached during manual adjustment is 15 [5+10]. In the other direction, only the lowest amplification level [1] can be reached. The negative range cannot be selected.

The following step is reserved for the professional version only: To change the amplifier no. 3 (optional post-amplifier), please proceed as follows:

1. Place the cursor on the right field of the numerical value *pre-/post-amplifier* (15e).
2. Press the confirmation button (15c).
3. Use the arrow buttons (15a/15b) to set the post-amplification between 1 and 254.
4. The numerical value always starts at the value that has been automatically determined beforehand. You can adjust this value in steps of 3.

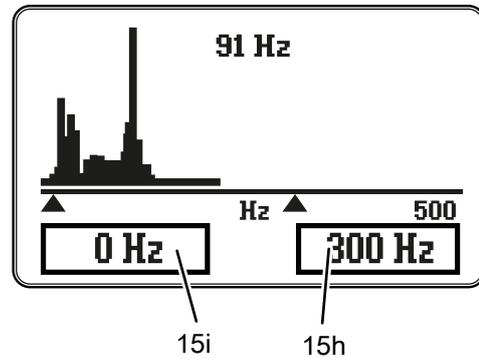
⇒ To prevent making accidental and incorrect settings, manual settings are deleted as soon as another filter is selected, the device is retuned or switched off/on.

Selecting the filter range of the transmitter

The transmitter has 5 preset filter functions.

In the **professional version**, the two filters "high-pass" and "low-pass" can also be changed in 50 Hz steps in order to achieve an extremely fine tuning of the useful signal and to eliminate noise as well as possible. This function can significantly improve measurement results or even make a measurement possible in the first place. However, using this function requires experience and knowledge, without which measurements may lead to no result (correlation) in extreme cases!

The numerical values are indicated on the left display below the frequency indication.



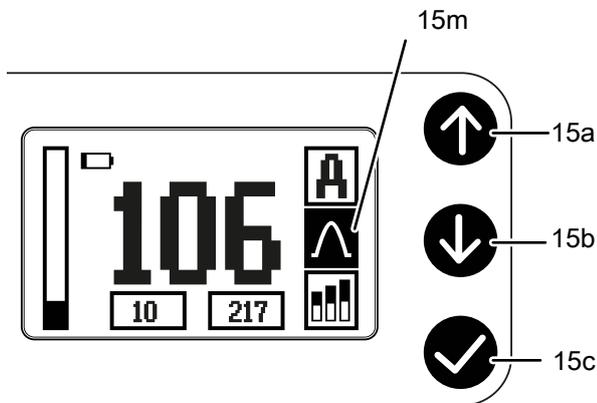
| No. | Designation |
|-----|--|
| 15h | Low pass (frequencies above this numerical value are clipped) |
| 15i | High pass (frequencies below this numerical value are clipped) |

This means that only frequencies within the two displayed numerical values are sent to the central unit (correlator) via radio.

Selection of the prefilter

Please proceed as follows to select the prefilter:

1. Use the *Up/Down* arrow buttons (15a/15b) to select the prefilter menu (15m).



Retuning the transmitters



Info

If the transmitters are repositioned or the leak noise changes during the measurement, the transmitters should be retuned.

1. Press the Power button (15c) to switch the device off.
2. Press the Power button (15c) to switch the device back on.

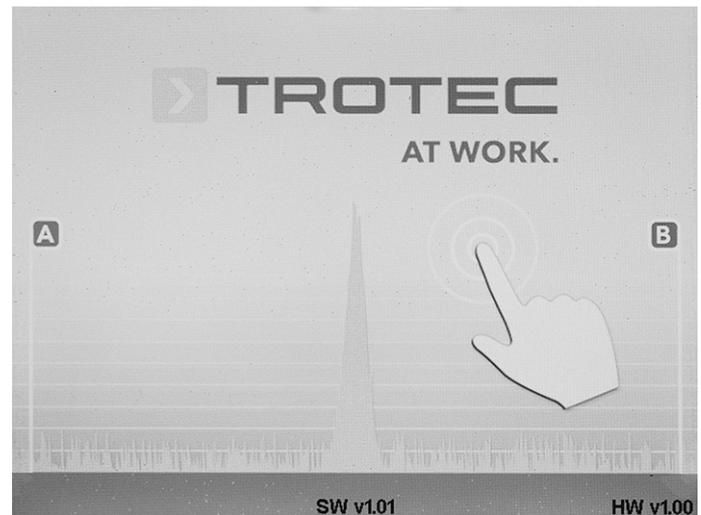
You can also perform retuning via the menu item. To do so, please proceed as follows:

1. Use the *Up/Down* arrow buttons (15a/15b) to select the *Retuning* (15d) indication.
2. Press the *Confirmation* button (15c) to confirm.
 - ⇒ The amplifier is readjusted and the noise level is recalculated.

Switching the central unit on

Please proceed as follows to switch on the central unit:

1. Press the Power button (12) at the central unit.
 - ⇒ The central unit starts up.
 - ⇒ The start screen is displayed.



2. Press the *Confirm* button (15c) until you have selected the desired symbol (see filter area symbols).

| Symbol | Filter range no. | Name and filter range (Hz) |
|--------|------------------|--|
| | 1 | Entire frequency range, (0 – 5000 Hz) <i>no filter active</i> |
| | 2 | Low frequency range, (approx. 0 – 300 Hz) |
| | 3 | Medium frequency range (200 – 800 Hz) |
| | 4 | High frequency range (600 – 1,400 Hz) |
| | 5 | Very high frequency range (1,000 – 4,000 Hz) |

Freely selectable filter range

The following step is reserved for the professional version only!

1. To manually limit a frequency range, move the cursor to one of the numerical values (15 i /15 h) on the left display.
2. Select the preset frequency range 1 for the maximum possible selection.
3. If a different resolution is desired, it is also possible to filter in one of the 4 other preset frequency ranges.
4. The filter levels can be adjusted for both the high pass (only frequencies above this numerical value are considered) and the low pass (only frequencies below this numerical value are considered) in steps of 50 Hz.

Control and menu structure

Control

After switching the central unit on, the main menu opens. Here you have the following options:

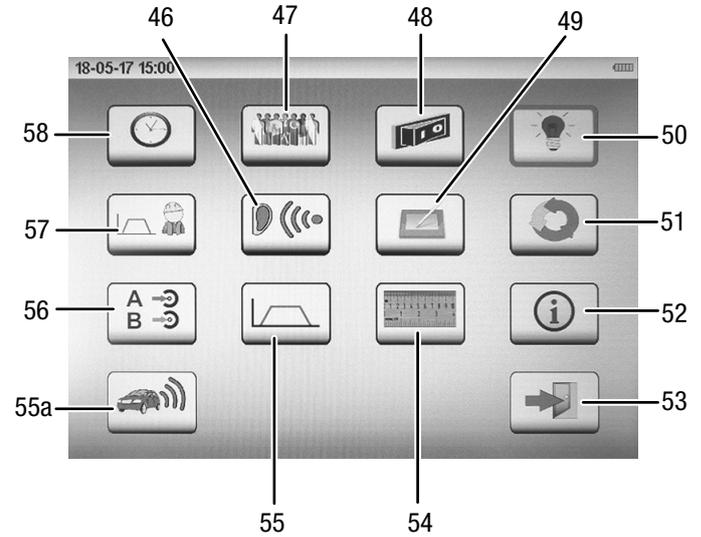
The central unit comprises menu and selection fields, which can be selected either directly via the touchscreen (4) or using the rotary button (2).

- When using the touchscreen, simply press on the desired menu or selection field with your finger.
- Alternatively, you can turn the rotary button to the right or left to navigate through all menu and setting fields available. **Active menu items or selection fields are highlighted in yellow with a red frame.**
 - To confirm your selection, press the rotary button (2). The desired menu or selection window is now displayed.
- By pressing the Cancel button (13) you can exit the current menu or selection window.

To return to the main menu from any submenu, press the Exit menu symbol (53, door symbol) or the red X (Cancel button, 13).

Central unit settings

The *Settings* menu can be opened by pressing the settings symbol (43) in the main menu.



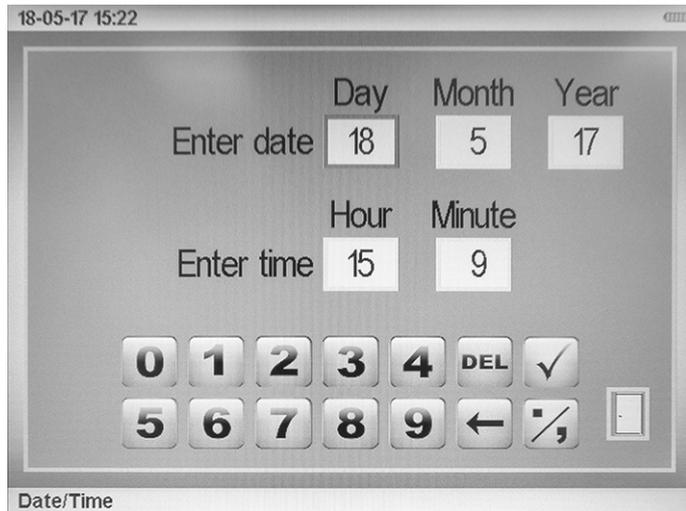
| No. | Designation |
|------|----------------------------------|
| 46 | Ear protection |
| 47 | Language |
| 48 | Operating time |
| 49 | Touchscreen |
| 50 | Illumination |
| 51 | Factory settings |
| 52 | Device information |
| 53 | Exit menu |
| 54 | Units |
| 55 | Frequency settings / correlation |
| 55 a | Trans Auto |
| 56 | Correlator inputs |
| 57 | Frequency range / geophones |
| 58 | Date and time |

Navigate to the desired settings item and select it in order to make the following configurations:

Date and time

In this submenu you can make settings regarding date and time.

1. Use the rotary button (2) to navigate to the *Date and time* submenu (58).
⇒ The selected settings field is highlighted in yellow with a red frame.
2. Confirm your selection by pressing the rotary button.
⇒ The *Date and time* submenu (58) will be displayed.



Language

In this submenu you can set the display language.

1. Use the rotary button (2) to navigate to the *Language* submenu (47).
⇒ The selected settings field is highlighted in yellow with a red frame.
2. Confirm your selection by pressing the rotary button.
⇒ The *Language* submenu (47) will be displayed.



3. You can change the settings (1 to 31 for the day; 1 to 12 for the month; 10 to 99 for the year) by turning the rotary button.
⇒ If you want to enter the values directly via the touchscreen, use the number field at the bottom.
4. You can confirm your entry by pressing *OK* and delete it by pressing *DEL*.
5. To confirm the selection, press the rotary button again. To abort the changes, press the Cancel button (13).
6. To confirm the newly set values and leave the menu, press the *door symbol*. To discard all settings and leave the settings menu, press the Cancel button (13).

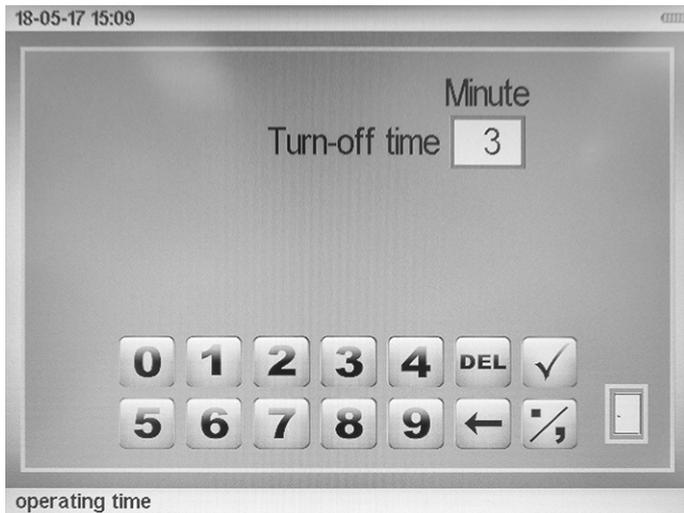
3. Navigate to the desired language.
⇒ The selected settings field is highlighted in yellow with a red frame.
4. Confirm your selection by pressing the rotary button.
5. To leave the submenu, press the Cancel button (13) or the *door symbol* on the screen.

Operating time

In this submenu you can flexibly set the time of non-use after which the measuring device will switch off automatically within a range from 1 to 60 minutes. This setting can increase the battery life.

The turn-off time is preset to 3 min by default.

1. Use the rotary button (2) to navigate to the *Operating time* submenu (48).
⇒ The selected settings field is highlighted in yellow with a red frame.
2. Confirm your selection by pressing the rotary button.
⇒ The *Operating time* submenu (48) will be displayed.



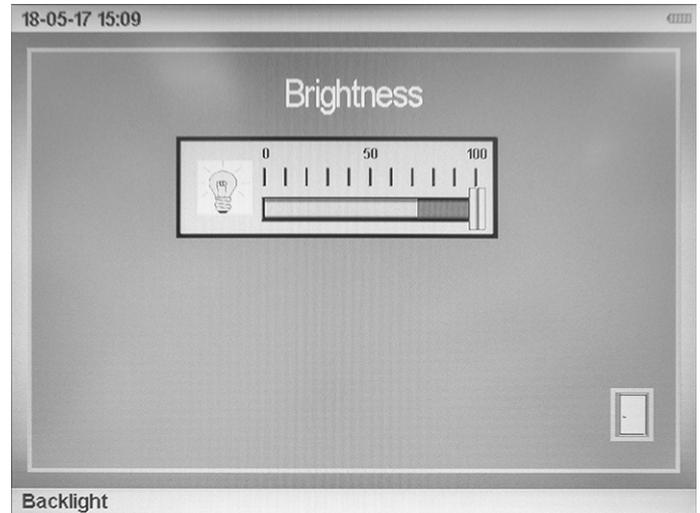
3. You can change the settings (1–60 minutes) by turning the rotary button.
⇒ If you want to enter the values directly via the touchscreen, use the number field at the bottom.
4. You can confirm your entry by pressing *OK* and delete it by pressing *DEL*.
5. To confirm the selection, press the rotary button again. To abort the changes, press the Cancel button (13).
6. To confirm the newly set values and leave the menu, press the *door symbol*. To discard all settings and leave the settings menu, press the Cancel button (13).

Illumination

In this submenu you can adapt the brightness of the display illumination to your individual requirements on a scale from 0 to 100 %.

The scale is additionally divided into two colour ranges indicating the influence of the brightness setting on the power consumption and battery life. Selecting a brightness level within the green range ensures a maximum battery life; values within the red range result in a low battery life.

1. Use the rotary button (2) to navigate to the *Backlight* submenu (50).
⇒ The selected settings field is highlighted in yellow with a red frame.
2. Confirm your selection by pressing the rotary button.
⇒ The *Backlight* submenu (50) will be displayed.



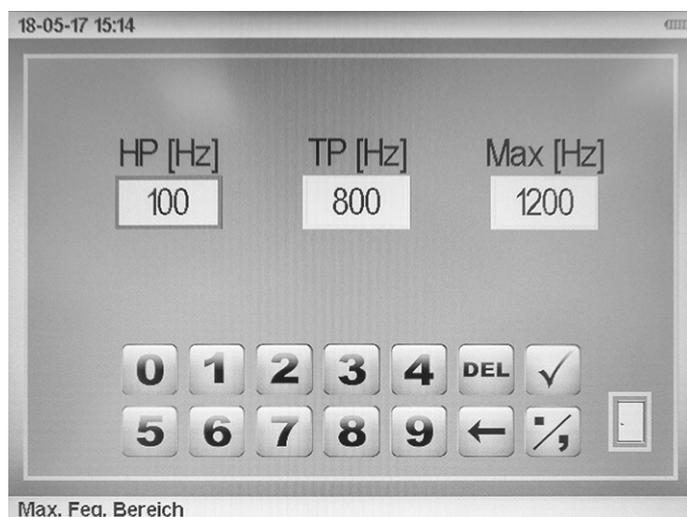
3. Increase or reduce the brightness by turning the rotary button.
4. Confirm your selection by pressing the rotary button.
5. To leave the submenu, press the Cancel button (13) or the *door symbol* on the screen.

Frequency range / geophones

In this submenu you can specify the values for a user-defined filter. This user-defined filter is available in the measuring modes for acoustic leak detection in addition to the two predefined filters (ground microphone and probe rod).

You can adjust the high-pass filter (HP) and low-pass filter (TP) as well as the maximum width of the frequency spectrum. The maximum frequency range available in geophone mode is 4,000 Hz.

1. Use the rotary button (2) to navigate to the *Frequency range* submenu (57).
 - ⇒ The selected settings field is highlighted in yellow with a red frame.
2. Confirm your selection by pressing the rotary button.
 - ⇒ The *Frequency range* submenu (57) will be displayed.



Ear protection

The device is equipped with an automatic sound level reducer ensuring that the hearing protection requirements laid down in BGV B 3 (German national regulation) are complied with at all times when using the headphones included in the scope of delivery. For an individual adjustment, you can set the device's hearing protection intensity on a scale from 0 (relatively low) to 3 (maximum). The requirements of BGV B 3 will be met in any case.

1. Use the rotary button (2) to navigate to the *Ear protection* submenu (46).
 - ⇒ The selected settings field is highlighted in yellow with a red frame.
2. Confirm your selection by pressing the rotary button.
 - ⇒ The *Ear protection* submenu (46) will be displayed.



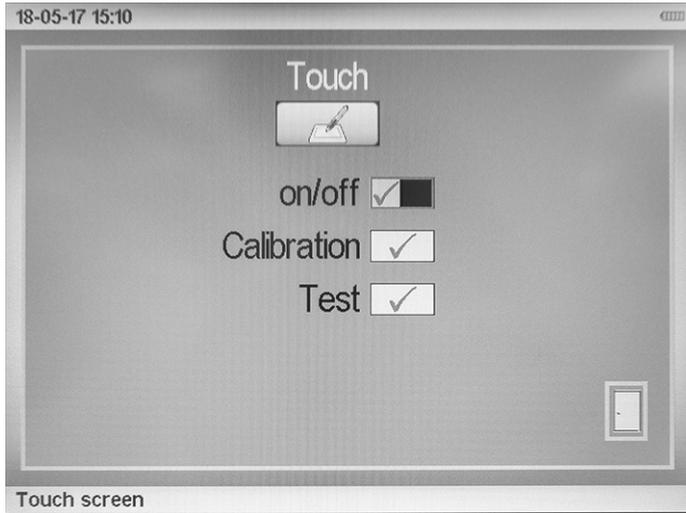
3. You can change the settings (1 to 4000 Hz) by turning the rotary button.
 - ⇒ If you want to enter the values directly via the touchscreen, use the number field at the bottom.
4. You can confirm your entry by pressing *OK* and delete it by pressing *DEL*.
5. To confirm the selection, press the rotary button again. To abort the changes, press the Cancel button (13).
6. To confirm the newly set values and leave the menu, press the *door symbol*. To discard all settings and leave the settings menu, press the Cancel button (13).

3. You can change the settings (0 to 3) by turning the rotary button.
 - ⇒ If you want to enter the values directly via the touchscreen, use the number field at the bottom.
4. You can confirm your entry by pressing *OK* and delete it by pressing *DEL*.
5. To confirm the selection, press the rotary button again. To abort the changes, press the Cancel button (13).
6. To confirm the newly set values and leave the menu, press the *door symbol*. To discard all settings and leave the settings menu, press the Cancel button (13).

Touchscreen

In this submenu you can globally deactivate or calibrate the touch function of the display or carry out a function test.

1. Use the rotary button (2) to navigate to the *Touchscreen* submenu (49).
 - ⇒ The selected settings field is highlighted in yellow with a red frame.
2. Confirm your selection by pressing the rotary button.
 - ⇒ The *Touchscreen* submenu (49) will be displayed.



3. You can switch the touch function of the display off or on by pressing the rotary button.
 - ⇒ Note that if the touch function is switched off, entries can only be made using the rotary button!



Info

If you find that the touch function of the display is working incorrectly (e.g. a menu item can only be selected by tapping next to the symbol), it may be necessary to recalibrate the touchscreen. In this case, follow the instructions on the screen. Afterwards, the touch function should function normally again.

Factory settings

In this submenu you can reset the following settings:

By pressing *Clear measurement data* you can delete all measured values stored in the device.

By pressing *Reset parameter* you can delete the user-defined filters specified in the *Frequency range* settings window.

1. Use the rotary button (2) to navigate to the *Factory settings* submenu (51).
 - ⇒ The selected settings field is highlighted in yellow with a red frame.
2. Confirm your selection by pressing the rotary button.
 - ⇒ The *Factory settings* submenu (51) will be displayed.



3. Clear the memory directly via the touchscreen or use the rotary button to navigate to the desired option and confirm your selection by pressing the rotary button.
4. Memory clearing is acknowledged by way of a confirmation tick symbol.
5. To leave the submenu, press the Cancel button (13) or the *door symbol* on the screen.

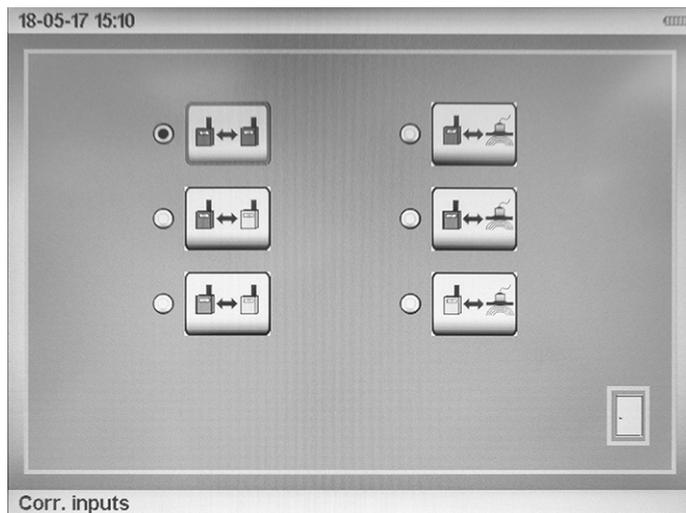
Correlator inputs

In this submenu you can select the signal inputs to be used for calculating a correlation. There are the following input combinations:

- A-B
- A-C
- B-C
- A-sensor input
- B-sensor input
- C-sensor input

A, B and C are the respective channels of the transmitters (A = yellow; B = red; C = without colour assignment) and *sensor input* refers to the direct connection of any microphone to the central unit. These settings can also be made in the main correlation window. The factory setting is A-B (yellow-red).

1. Use the rotary button (2) to navigate to the *Correlator inputs* submenu (56).
⇒ The selected settings field is highlighted in yellow with a red frame.
2. Confirm your selection by pressing the rotary button.
⇒ The *Correlator inputs* submenu (56) will be displayed.

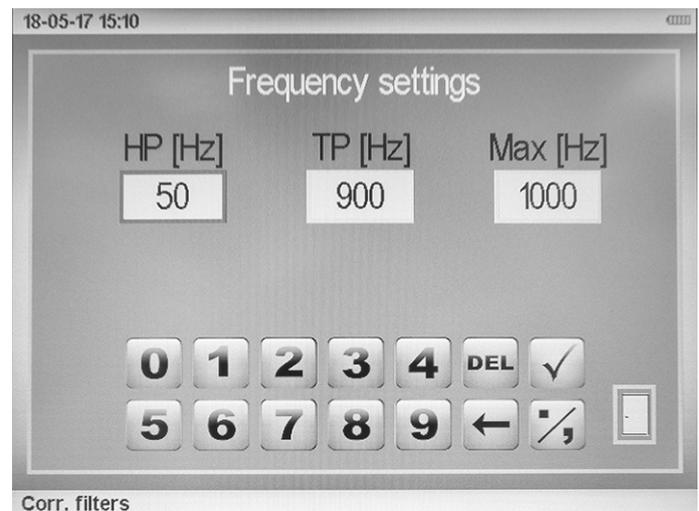


3. You can select the desired combination by turning the rotary button or using the touchscreen.
4. To leave the submenu, press the Cancel button (13) or the *door symbol* on the screen.

Frequency settings / correlation

In this submenu you can select the high-pass filter (HP [Hz]) and the low-pass filter (TP [Hz]) as well as the maximum frequency range available for manual correlation measurement. The maximum frequency range available is 5000 Hz.

1. Use the rotary button (2) to navigate to the *Frequency settings / correlation* submenu (55).
⇒ The selected settings field is highlighted in yellow with a red frame.
2. Confirm your selection by pressing the rotary button.
⇒ The *Frequency settings / correlation* submenu (55) will be displayed.



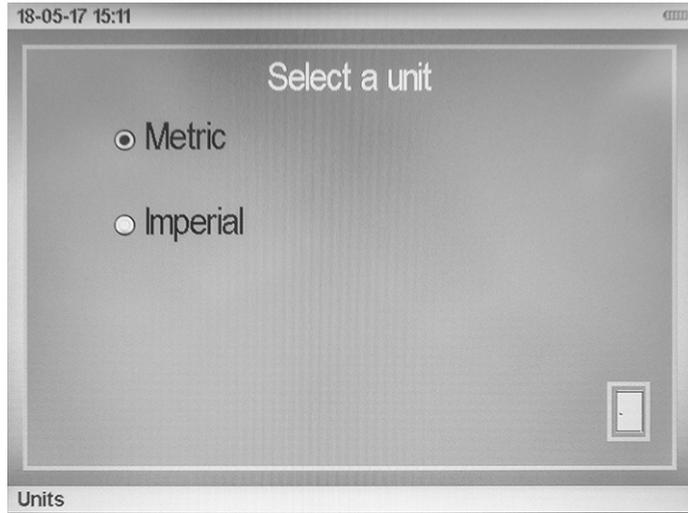
3. You can change the settings (0–5000 Hz) by turning the rotary button.
⇒ If you want to enter the values directly via the touchscreen, use the number field at the bottom.
4. You can confirm your entry by pressing *OK* and delete it by pressing *DEL*.
5. To confirm the selection, press the rotary button again. To abort the changes, press the Cancel button (13).
6. To confirm the newly set values and leave the menu, press the *door symbol*. To discard all settings and leave the settings menu, press the Cancel button (13).

These settings can also be made in the submenu for manual correlation.

Units

In this submenu you can set the unit to be used. You can choose between *Metric* and *Imperial*.

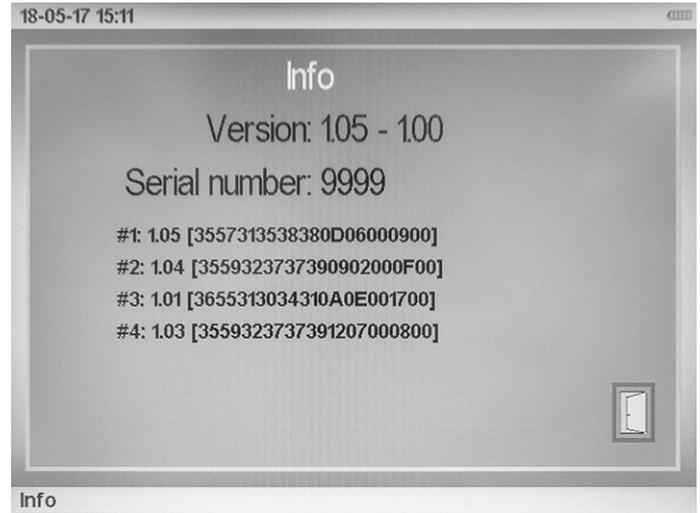
1. Use the rotary button (2) to navigate to the *Units* submenu (54).
⇒ The selected settings field is highlighted in yellow with a red frame.
2. Confirm your selection by pressing the rotary button.
⇒ The *Units* submenu (54) will be displayed.



Device information

In this submenu you can call up device-specific parameters such as the firmware version and serial number.

1. Use the rotary button (2) to navigate to the *Device information* submenu (52).
⇒ The selected settings field is highlighted in yellow with a red frame.
2. Confirm your selection by pressing the rotary button.
⇒ The *Device information* submenu (52) will be displayed.



3. You can select the desired setting by turning the rotary button or using the touchscreen.
4. To leave the submenu, press the Cancel button (13) or the *door symbol* on the screen.

3. To leave the submenu, press the Cancel button (13) or the *door symbol* on the screen.

Trans Auto

In this submenu you can adjust the level for an automatic measurement interruption in case of high interfering noise.

- Use the rotary button (2) to navigate to the *Trans Auto* submenu (55a).
⇒ The selected settings field is highlighted in yellow with a red frame.
- Confirm your selection by pressing the rotary button.
⇒ The *Trans Auto* submenu (55a) will be displayed.



- You can change the settings (Level 0–3) by turning the rotary button.
⇒ If you want to enter the values directly via the touchscreen, use the number field at the bottom.
- You can confirm your entry by pressing *OK* and delete it by pressing *DEL*.
- To confirm the selection, press the rotary button again. To abort the changes, press the Cancel button (13).
- To confirm the newly set values and leave the menu, press the *door symbol*. To discard all settings and leave the settings menu, press the Cancel button (13).

Shutdown



Info

The central unit may switch off automatically after the specified period of time (see *Operating time* submenu).

- Switch off the central unit by pressing the Power button (12) for approx. 5 s.
Should the device firmware have frozen making it impossible to switch the device off, please connect the reset dongle (25) to the microphone socket (9). The device should switch off automatically.
- Switch off the transmitter by pressing the Power button (15c) of the corresponding transmitter.
- Remove the sensors from the transmitters.
- Remove the antennas from the central unit and from the transmitters.
- Stow the device and the accessories away in the transport case.
- Store the device according to the Storage chapter.

Correlation

Sensors for correlation

Generally, there are two types of sensors:

- Structure-borne sound receivers
- Hydrophone receivers

The structure-borne sound receivers have been specifically designed for metallic pipes and can be attached to ferromagnetic pipelines at accessible locations (valves, hydrants, manholes) e.g. using a magnet. They receive the sound transmitted via the pipe material.

Hydrophone receivers have been specifically designed for non-metallic (plastic) pipes and must be directly connected to the water column at hydrants or other accessible connections by means of special adapters. They receive the sound that propagates through the medium (water).

Check what material the pipeline to be measured is made of and select the corresponding type of sensor.

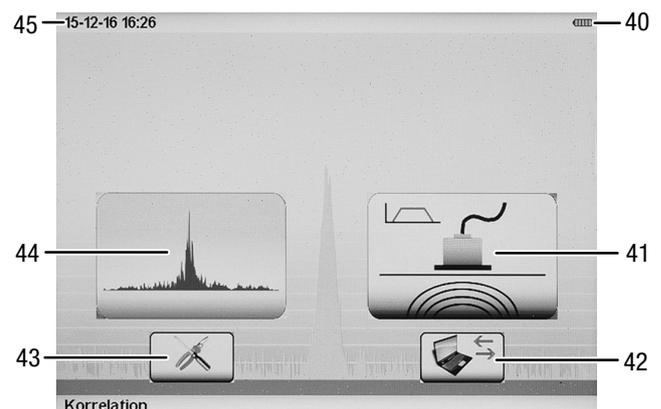


Info

Besides correlating a noise via the transmitters A/B/C, the device also offers the option of recording a source of noise by connecting a corresponding sensor directly to the central unit and using it for a measurement. Use the sensor connection to connect a sensor to the central unit. Refer to *Optionally available accessories* for a selection of available transmitters.

Performing correlation at the central unit

The correlation menu can be opened by pressing the >>Correlation<< button (44) on the start screen.

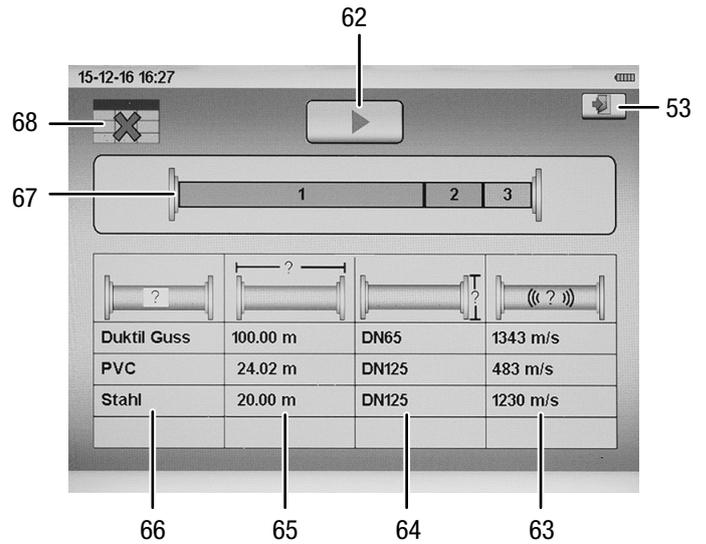


| No. | Designation |
|-----|--|
| 40 | Battery indicator |
| 41 | Acoustic leak detection (geophone measurement) |
| 42 | Data exchange with a PC |
| 43 | Settings |
| 44 | Correlation measurement |
| 45 | Date and time indication |

The device can be used to calculate the accurate position of a leak (correlation). Proceed according to the start-up procedure for correlation (see Operation chapter) and note the information regarding sensor types, transmitters and signal inputs.

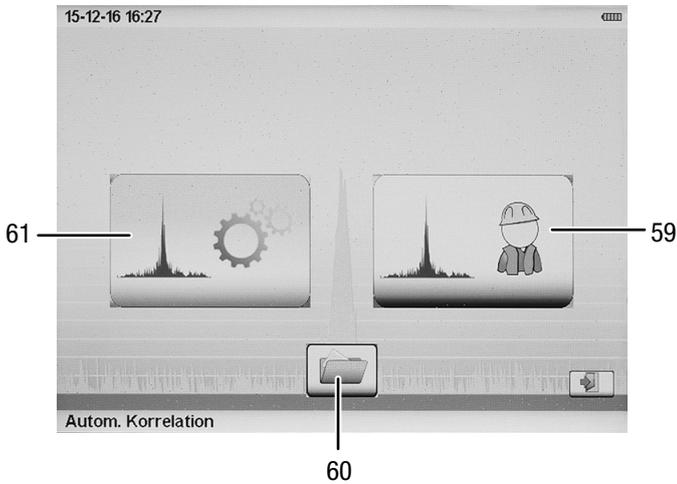
As a rule, you can either carry out correlation manually or perform an automatic measurement. In manual mode, settings for analogue filters and signal amplification, amongst other things, must be defined by the user. In automatic mode, the device selects these settings automatically based on certain algorithms. In the main correlation window, however, you can change all signal amplification and filter settings manually in every measuring mode. This means that manual adjustment after a measurement is also possible in automatic mode.

Entering the pipe parameters



| No. | Designation |
|-----|---------------------------|
| 53 | Exit menu |
| 62 | Start measurement / Next |
| 63 | Speed of sound |
| 64 | Pipe diameter |
| 65 | Pipe length |
| 66 | Pipe material |
| 67 | Overview of pipe sections |
| 68 | Delete line |

If you select automatic measurement, a window will open showing a table where you can enter the pipe parameters, i.e. pipe material, length and diameter. Once all information has been entered in one line, the corresponding speed of sound stored for this pipe section will be displayed in the corresponding column.



| No. | Designation |
|-----|-----------------------------------|
| 59 | Manual correlation measurement |
| 60 | Load measurement data |
| 61 | Automatic correlation measurement |

Automatic measurement

1. Start an automatic measurement by using the rotary button (2) or by pressing the button for automatic correlation measurement (61) on the display.
⇒ The submenu for entering the pipe parameters opens.

The values in the table are permanently stored in the device, but they can be manually adjusted for each section afterwards. This should, however, only be done by highly experienced users. If the speed of sound was modified accidentally, simply change one of the pipe parameters and then enter the correct value again. The permanently stored speed of sound will be rewritten into the column.

Up to 20 different pipe sections can be entered in the device. If the pipe consists of mixed materials or has various diameters, enter the materials in the correct order starting at transmitter A (yellow). To delete an entry, either press the *Delete line* button (68) or select the pipe material - - .

1. Enter the pipe parameters.
2. Once all pipe sections have been registered correctly, you can access the main correlation screen by pressing the *Start measurement* button (62). Pressing the *door symbol* returns you to the main menu.
3. If you press the Cancel button (13), you will return to the screen for selecting automatic or manual measurement.

Starting correlation

After pressing the *Start measurement* button (62), the device starts to automatically adjust the amplification of the two channels (A and B) so that the ideal noise level is available for measuring. This can be seen from the fact that the amplification level (75 and 82) at the bottom of the main correlation window has changed.

Afterwards, the device performs several test measurements with various filter settings to determine the optimal noise quality of the two signals or of the coherence. This can be seen from the fact that the number of averagings (79) increases for a short time, is stopped and then starts increasing again with a new filter setting.

After a short time, the device starts the actual measurement and determines the exact position of the source of noise. When the measurement has been completed, the number of averagings stops increasing (in automatic mode, the number of averagings is preset to 50). The current measurement can be interrupted at any time by pressing *Stop measurement* (70). The localised source of noise, which generally corresponds to the location of the leak, is shown symbolically (69) in the upper image (85), and the distance from the respective transmitters is indicated.

Manual measurement

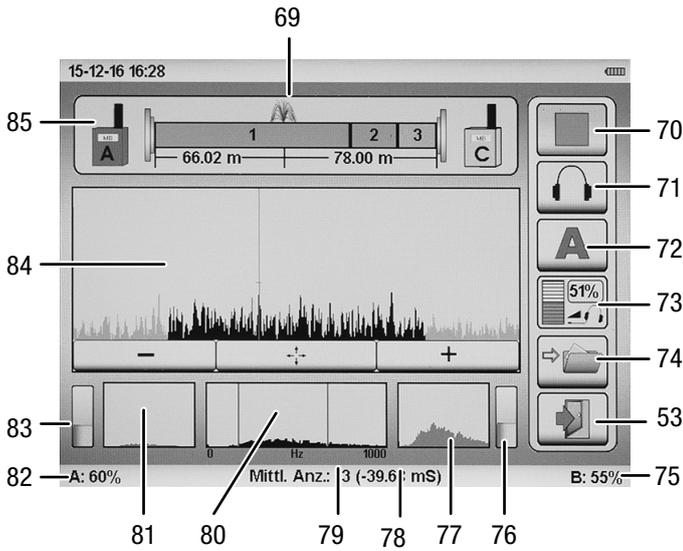
Manual measurement can be accessed by clicking the *Manual measurement* button (59). In the window that opens you have to enter information regarding the pipe material, length and diameter. Proceed as described for automatic measurement. Once all pipe sections have been entered correctly, you can access the window for the filter settings by clicking the *Next* button (62). The coherence of the last measurement is shown in the main screen. Set the high-pass and low-pass filters according to the frequency distribution. In addition, you can listen to the respective noises from channel A and channel B by activating the headphone output. This way you can determine which filter setting provides the best sound quality by ear.

Click the *Next* button (62) again to open the main correlation window. Unlike in automatic mode, the measurement will not start automatically in manual mode. First of all, the noise amplification of channel A (83) and channel B (76) must be adapted in the main window. The same applies to all other signal inputs. By tapping the level, another window opens where you can adjust the amplification on a scale from 0 to 100 %. By pressing the rotary button or tapping outside of the window, this submenu closes and the set amplification is displayed below the level. Select the amplification in a way that the average noise level fills about half of the level indication. The noise can be listened to via the headphones. This way you can check whether the signal is too quiet or overmodulated.

After all settings have been made, start the correlation by tapping the *Start / Stop measurement* button (70). The number of averagings increases and a correlation peak should form.

The measurement can be interrupted at any time by tapping the *Start / Stop measurement* button (70) in the upper right corner. In manual mode, the measurement continues until 250 averagings have been made, provided that the measurement is not interrupted beforehand. As a rule, 40 to 50 averagings should be sufficient to yield a good result. If this is not the case, the filter setting, amplification or measuring setup should be checked and, if necessary, adjusted.

Setting options for correlation (main correlation window)

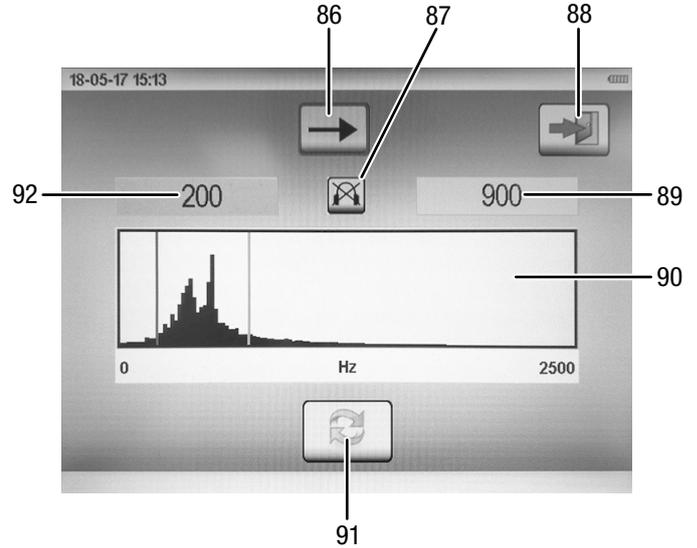


The following operating elements and displays are available in the main correlation window:

| No. | Designation |
|-----|---|
| 53 | Exit menu |
| 69 | Symbolic and numeric pipe burst indication & active button for material input |
| 70 | Start / Stop measurement |
| 71 | Headphone output for the different signal inputs |
| 72 | Switching between different signal inputs |
| 73 | Headphone volume |
| 74 | Save measurement |
| 75 | Numeric value (0–100 %) for amplification of channel B |
| 76 | Amplification of channel B |
| 77 | Frequency image (FFT) of channel B |
| 78 | ΔT of averagings in milliseconds |
| 79 | Number of averagings completed |
| 80 | Coherence (FFT) of A and B |
| 81 | Frequency image (FFT) of channel A |
| 82 | Numeric value (0–100 %) for amplification of channel A |
| 83 | Amplification of channel A |
| 84 | Correlation result |
| 85 | Overview of measuring path |

Filter settings

You can access the screen for filter setting by selecting manual measurement in the second setting step. Alternatively, you can select the filter settings by tapping on the coherence (80) via the touchscreen or using the rotary button (2) at any time from the main correlation window. A new window opens offering the following functions:



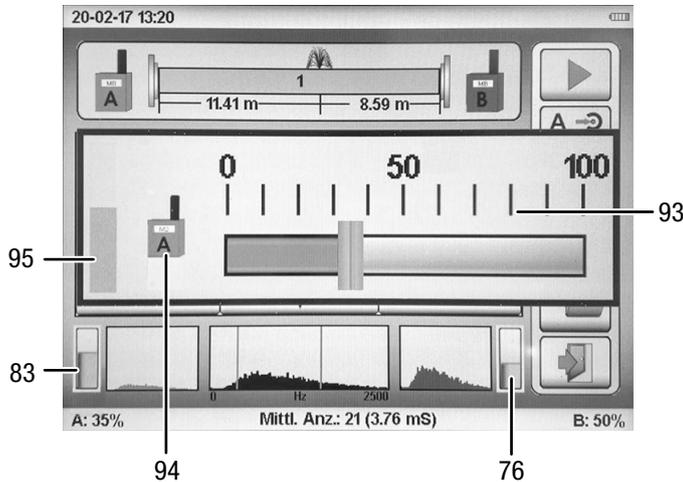
| No. | Designation |
|-----|--|
| 86 | >>Next<< button |
| 87 | Activating the headphone output or switching between channel A and B for the headphone input |
| 88 | >>Back<< button |
| 89 | Low-pass (LP) filter settings |
| 90 | Coherence image of the two signals from A and B |
| 91 | >>Refresh<< button (recalculate frequency image) |
| 92 | High-pass (HP) filter settings |

If you select the fields for the high-pass (92) and low-pass filter (89), you can adjust the filter levels. They are displayed in the coherence image (90) as additional red lines. If the high-pass or low-pass filter is selected, the line in the image turns blue and the box is highlighted in red. Now you can change the selected filter by using the rotary button (2) or tapping into the image.

Click the *Next* button (86) to open the main correlation window. The effect of clicking the *Back* button (88) depends on whether you have accessed the *Filter settings* window via the second setting step for manual measurement or via the main correlation window. In the former case, you will return to the start screen; in the latter case, you will return to the main correlation window.

Signal amplification

To adjust the amplification of channel A or B, tap on the corresponding *Amplification of channel A* (83) or *Amplification of channel B* button (76) in the main correlation window. The following dialogue box (93) opens:



| No. | Designation |
|-----|---------------------------------------|
| 76 | Amplification of channel B |
| 83 | Amplification of channel A |
| 93 | Dialogue box for signal amplification |
| 94 | Transmitter |
| 95 | Level indication |

You can set the desired amplification using the rotary button (2) or the touch function. Adjust the amplification in a way that the bars for amplification of channel A (83) and B (76) are both roughly half-filled.

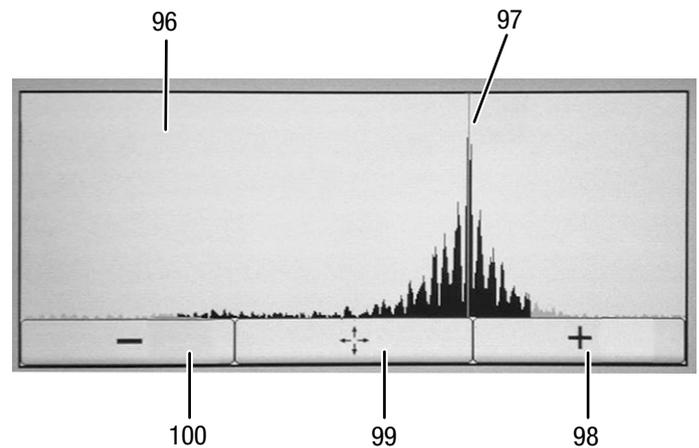


Info

If you press the Record button (14) or the *Transmitter* button (94) while this dialogue box is displayed, the device will adjust the amplification automatically.

Correlation result

If a measurement has finished after reaching the maximum number of averagings (50 in automatic mode or 250 in manual mode) or has been terminated manually by pressing the *Stop* button during a measurement, you can navigate through the result. To do so, select the correlation result by using the rotary button or tapping the button. You can select the following items in this window:



| No. | Designation |
|-----|--|
| 96 | Correlation image from signal A and signal B |
| 97 | Correlation peak (red line in the display) |
| 98 | Zoom in on image |
| 99 | Show full image |
| 100 | Zoom out of image |

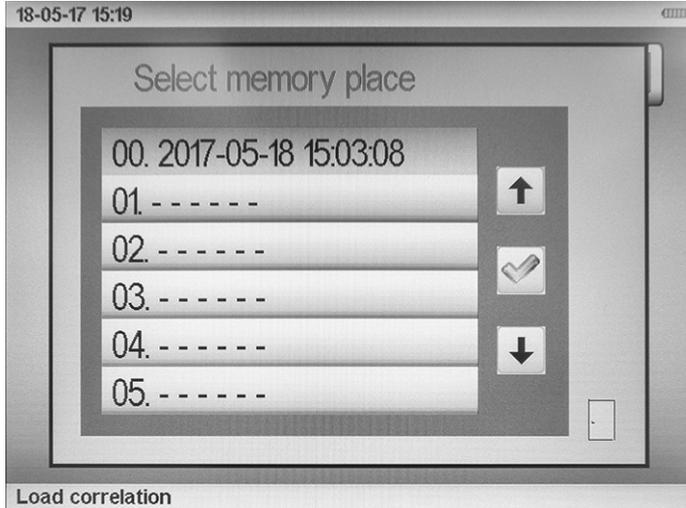
If you select the correlation image (96), you can adjust the correlation peak (97) at the rotary button or using the touch function.

After a measurement has been completed, the correlation peak is always automatically set to the maximum. However, if the user wants to find a potential second peak, this can be done using this function. If the line is moved via the rotary button, the position must be confirmed by pressing the rotary button once again. The new distances will then be displayed on the *Pipe burst indication* (69 in the main correlation window).

Saving and loading measurements and measurement series

To save a measurement, please proceed as follows:

1. Press the *Save measurement* button (74) in the main correlation window.
 - ⇒ The submenu for the memory spaces will be opened.



2. Select a memory space to save the measurement. The memory space will be overwritten.
 - ⇒ The file is stored in the memory with the current date and time.
 - ⇒ A total of 100 correlations can be stored on the device.
 - ⇒ When the device memory is full, we recommend saving the files on a PC.

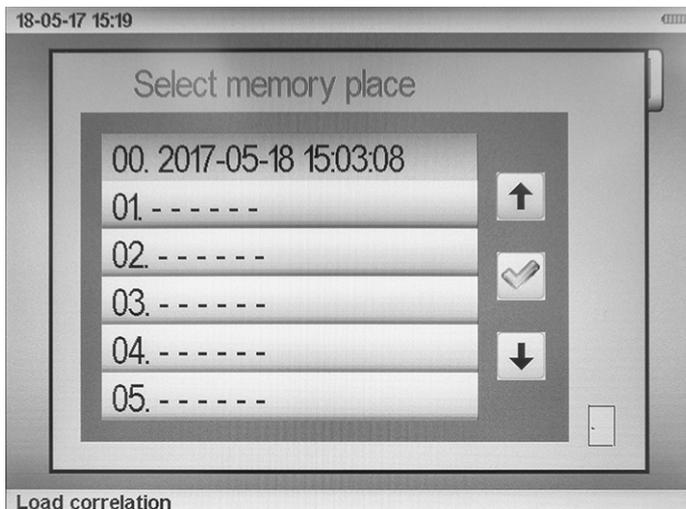


Info

The entire memory can be deleted by pressing the *Clear memory* button (51) in the settings menu.

To load a measurement, please proceed as follows:

1. Return to the start screen.
2. Select correlation measurement (44).
3. In the correlation screen, select the *Load measurement data* button (60).
 - ⇒ A new window opens showing a list of all stored correlations.



4. Select a line and confirm your selection using the rotary button (2).
 - ⇒ You will return to the main correlation window, where you can view the stored result and change the pipe parameters (length, material, diameter) if required.

Acoustic leak detection

Sensors for acoustic leak detection

When using the device for acoustic leak detection (geophone), only use one of the microphones below:

- **Ground microphone**

The ground microphone (32) is sheltered from the wind and serves to precisely locate leaks on firm ground. For measurements on unpaved ground (gravel, meadow), the ground microphone can be combined with the tripod magnet (29).

- **Probe rod**

The probe rod (28, 31) is used to listen to fittings in the course of leak pre-location. Thanks to the extensions (30) it is even possible to access fittings in deeper manholes without having to enter the manhole.

- **Universal microphone / Universal microphone with handle (not shown)**

The universal microphone can be used as a **probe rod** in combination with the extensions or as a **contact microphone** in combination with the magnet for the purpose of leak pre-location. When using the tripod (29), the universal microphone can be used as a ground microphone for pinpoint location of leaks and for checking a correlation result.

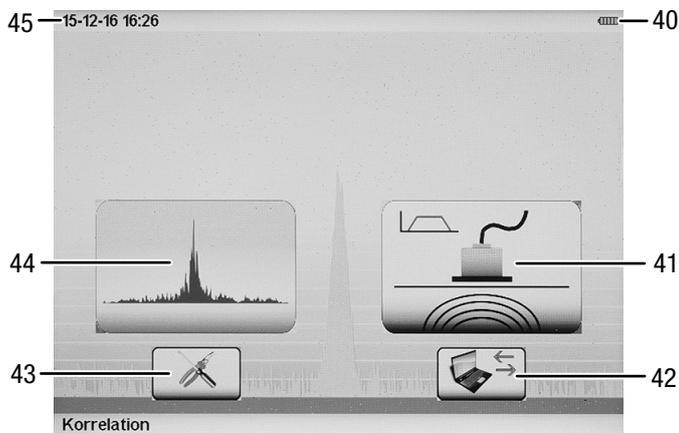


Info

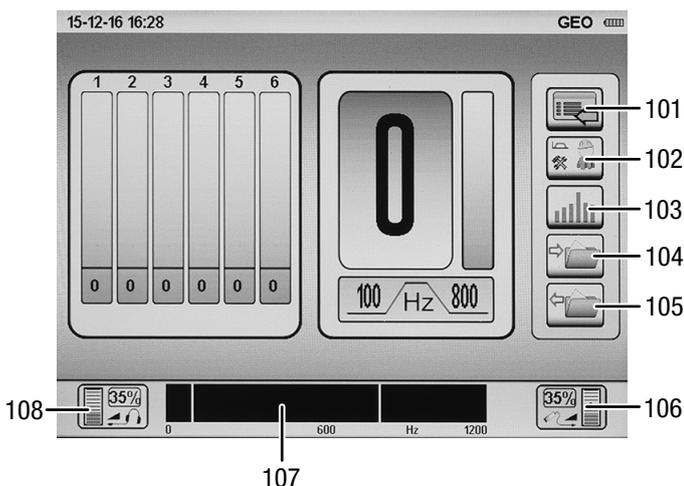
Besides correlating a noise via the transmitters A/B/C, the device also offers the option of recording a source of noise by connecting a corresponding sensor directly to the central unit and using it for a measurement. Use the sensor connection to connect a sensor to the central unit. Refer to Optionally available accessories for a selection of available transmitters.

Performing acoustic leak detection via the central unit

The acoustic leak detection menu can be opened by pressing the *Acoustic leak detection* button (41) on the start screen.



Regardless of the measuring mode selected, the following parameter settings can be made in both measuring modes available for acoustic leak detection with an identical operating scheme:



| No. | Designation |
|-----|--|
| 101 | Return to the start screen |
| 102 | Sensor selection (default filter settings) |
| 103 | Measuring mode |
| 104 | Save measurement |
| 105 | Load measurement |
| 106 | Adjustment of sensor sensitivity |
| 107 | Selection of filter setting |
| 108 | Adjustment of volume (headphones) |

Setting of acoustic parameters

Adjustment of sensor sensitivity

To adjust the sensitivity of the microphone connected to the measuring device, please proceed as follows:

1. Navigate to the *Adjustment of sensor sensitivity* button (106) in the measurement display window and confirm your selection.
 - ⇒ The window for adjusting the sensor sensitivity opens.
 - ⇒ The current amplification factor of your microphone is displayed on a scale from 0 to 100 %.
2. Set the desired sensitivity value using the rotary button or the touchscreen.
 - ⇒ You have reached the optimal sensitivity value when the control bar displayed on the left side of the window is in the centre position.
3. The set amplification is activated by pressing the rotary button or by pressing the *Adjustment of sensor sensitivity* button (106) once again.



Info

If the amplification menu is open and the Record button (14) is pressed and held a bit longer, the device will automatically select the ideal amplification. While you are holding the Record button (14), a repeated beep is emitted. Once you let go of the Record button (14), the device selects the optimal level of amplification. For this purpose, the sensor should be positioned at the location where you want to record the noise.

Please note that the current measurement series will be deleted every time you change the sensitivity setting.

Sensor selection setting (default filter settings)

There are three predefined filter settings that can be selected for acoustic leak detection. Beyond that, each filter range can be individually adjusted during the measurement:

To select one of the three predefined filter settings, proceed as follows:

1. Navigate to the *Sensor selection* button (102) in the measurement display window and confirm your selection.
 - ⇒ The window for selecting the default filter setting opens.

Three default settings are available:

| | |
|--|---|
|  | <p>The predefined frequency range is 0 to 2,000 Hz with a high-pass filter of 200 Hz and a low-pass filter of 800 Hz, which is ideal for listening to fittings and hydrants.</p> |
|  | <p>The predefined frequency range is 0 to 1,000 Hz with a high-pass filter of 50 Hz and a low-pass filter of 400 Hz, which is ideal for listening to surfaces.</p> |
|  | <p>This default setting uses the filter range that you have predefined in the settings menu under <i>Frequency range / geophone</i> according to your personal filter preferences. In the default state, the predefined frequency range is 0 to 1,200 Hz with a high-pass filter of 100 Hz and a low-pass filter of 800 Hz.</p> |



Info

In addition to the preset filters, you can manually adjust the filter frequencies at any time between two individual measurements in every measuring mode for acoustic leak detection.

Please note that the current measurement series will be deleted every time you change the filter setting.

Adjustment of volume

You can adjust the headphone volume depending on the preset hearing protection intensity. The currently set volume is displayed both numerically and in the form of a bar on the button for *Adjustment of the headphone volume* (108) in the measurement display window.

To adjust the headphone volume **before** or **after** a measurement, please proceed as follows:

1. Navigate to the *Adjustment of headphone volume* button (108) in the measurement display window and confirm your selection.
 - ⇒ The window for adjusting the headphone volume opens.
 - ⇒ The current volume of your headphones is displayed on a scale from 0 to 100 %.
2. Set the desired volume using the rotary button (2) or the touchscreen.
3. If you want to exit the window without changing the volume, press the Cancel button (13).
4. To confirm the selected setting, press the rotary button or press the volume symbol once again.



Info

Modifying the volume neither has any influence on the measurement curve nor does it delete the current measurement series.

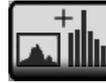
To adjust the headphone volume **during** a measurement, please proceed as follows:

1. You can adjust the volume at any time during a measurement by turning the rotary button to the left (volume down) or right (volume up).

Setting the measuring mode

The *Measuring mode* button (103) in the measurement display window indicates the currently set mode. By pressing the rotary button (2) the desired measuring mode is selected.

- Smart mode



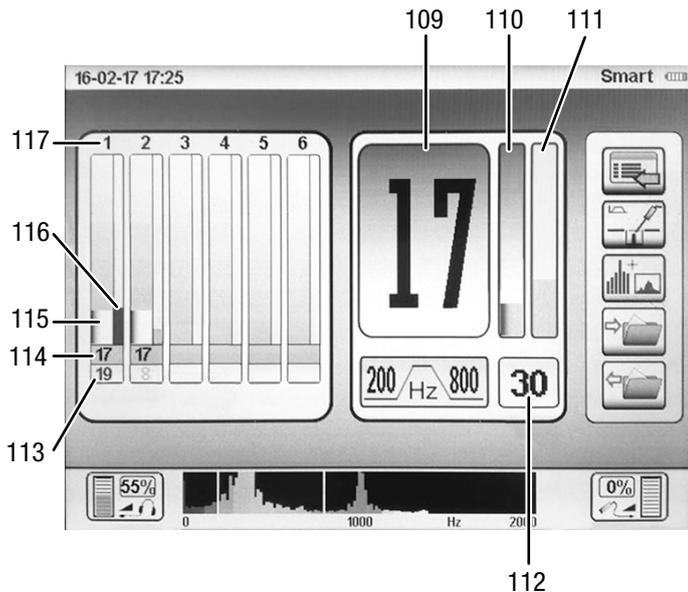
- Volume mode



Smart mode

In smart mode, a dual bar display consisting of noise level and smart indicator ensures an unambiguous indication of the leak location. The smart indicator is based on an elaborate calculation and analysis method using the factors frequency, level and weighing.

This algorithm has proved itself in practice particularly in combination with loud environmental noises and very quiet leakages.



| No. | Designation |
|-----|--|
| 109 | Lowest noise numeric |
| 110 | Lowest noise graphic |
| 111 | Smart indicator graphic |
| 112 | Smart indicator numeric |
| 113 | Smart indicator numeric (measurement series history) |
| 114 | Noise amplitude numeric |
| 115 | Noise amplitude graphic |
| 116 | Smart indicator graphic (measurement series history) |
| 117 | Measurement series history |

Please proceed as follows to perform a measurement in smart mode:

1. If you press the Record button (14) or the push button at the microphone handle, the measurement will be started and carried out for as long as you hold the respective button.
2. Once you let go of the button, the measurement will be terminated and saved.

The measurement display window can display a measurement series consisting of the six previously performed individual measurements as well as the current measurement. The current measurement is composed of the items *Lowest noise numeric* (109), *Lowest noise graphic* (110), *Smart indicator numeric* (112) and *Smart indicator graphic* (111).

In the history, the previously recorded noise levels are shown on positions 1–6. The first measurement saved is displayed on position 1; every new measurement shifts the previous one to the right. When the sixth position has been reached, the oldest measurement will be deleted with every new measurement, and the most recent measurement is displayed on position 1.

In smart mode, the following information is shown on the dual bar display for each measurement:

The left, wide bargraph (115) represents the noise amplitude on a level scale from 0 to 100. The grey bargraph represents the measured minimum value, i.e. the lowest noise, which is relevant for leak detection. This value is also displayed numerically under the bar display (114).

The right, narrow bargraph (116) represents the smart indicator. The higher the smart indicator value, the more reliable is the statement that can be made with regard to the leak. In addition, the colour of the smart indicator bar indicates the frequency used for indicator calculation. The following rule of thumb can be applied: The nearer the leak, the higher the smart indicator bar and the lighter its colour.

In addition to the bar display, the smart indicator value is also displayed numerically (112).



Info

During individual measurements, you can change the measuring mode at any time and analyse or continue the previous measurements in another mode. The measurement series is retained when the mode is changed and is not deleted.

Each measurement should be performed for at least 5 seconds. As long as the level (bar) is still moving strongly, the measurement should be continued until the value stops changing or has become relatively stable.

Volume mode

The leak noise is displayed as a volume level (amplitude). The location with the highest level corresponds to the location of the leak.

In volume mode, only the noise amplitude of the measured minimum value is displayed as a single bargraph. If you press the Record button (14) or the push button at the microphone handle, the measurement will be started and carried out for as long as you hold the respective button. Once you let go of the button, the measurement will be terminated and saved.

The height of the bar indicates the noise amplitude on a level scale from 0 to 100. The possibility of a leak is the highest at the location with the highest amplitude value.



Info

Each measurement should be performed for at least 5 seconds. As long as the level (bar) is still moving strongly, the measurement should be continued until the value stops changing or has become relatively stable.

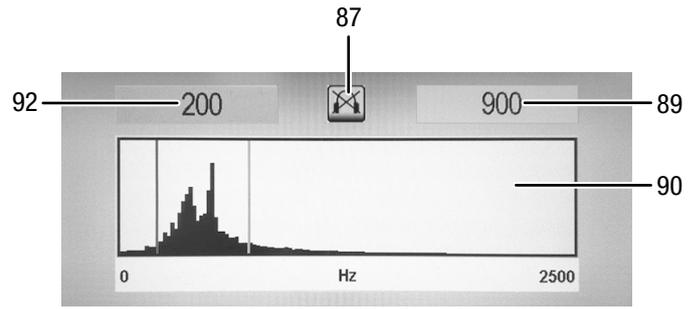
Deleting the current measurement series

The device allows you to carry out up to seven individual measurements as a measurement series and to display them in the measurement display window. If no parameter settings are changed, this measurement series is retained in the memory even if the device is switched off in the meantime.

This feature is of particular advantage for practical use since it allows you to continue a measurement series at another measuring point while the last measured value is still available. However, the measurement series will be deleted immediately if the sensor sensitivity or preselected filter setting is changed.

To delete individual measured values or measurement series displayed in the measurement display window, press the rotary button (2), hold it for 3 seconds and let go of it again. All seven measured value positions in the measurement display window will be deleted.

Filter setting



| No. | Designation |
|-----|--|
| 87 | Activating the headphone output or switching between channel A and B for the headphone input |
| 89 | Low-pass (TP) filter settings |
| 90 | Coherence image of the two signals from A and B |
| 92 | High-pass (HP) filter settings |

Manual:

In both measuring modes for acoustic leak detection you can modify the preset filter frequencies at any time between the individual measurements. To do so, navigate to the selection of filter setting item (107) in the measurement display window, activate it and confirm your selection. The window for acoustic filter adjustment opens.

It shows the preset high-pass and low-pass filter, the frequency spectrum as well as the symbol for activating the headphones. The frequency spectrum is additionally displayed as a colour gradient. Dark colours indicate low-frequency noise while lighter colours indicate high-frequency noise.

The respective filter that is currently being adjusted is highlighted in yellow with a red frame.

To change the frequency value of the filter, turn the rotary button or directly slide the high-pass filter bar to the desired position using the touchscreen.

To change the frequency value of the low-pass filter, press the rotary button once.



Info

In practice, you should adjust the low-pass filter in a way that all high-frequency portions are within the selection; the high-pass filter, however, should be set so that the lower left part of the selection frame is positioned on the left trailing edge of the largest spectrum portion.

Every time the filter setting is changed, the current measurement series will be deleted!

To exit the window, press the Cancel button (13) or tap on the frequency display at the bottom (107).

Automatic:

The device is able to optimize the filter settings automatically. To do so, open the window for frequency range display, press the Record button (14) and hold it for a while. A repeated beep is emitted. If you let go of the button now, the device will automatically select the ideal filter setting for the noise recorded.

The device comes with a function for activating the headphones during filter setting.

This function can be switched on and off by briefly pressing the Record button (14) while the filter settings window is displayed.

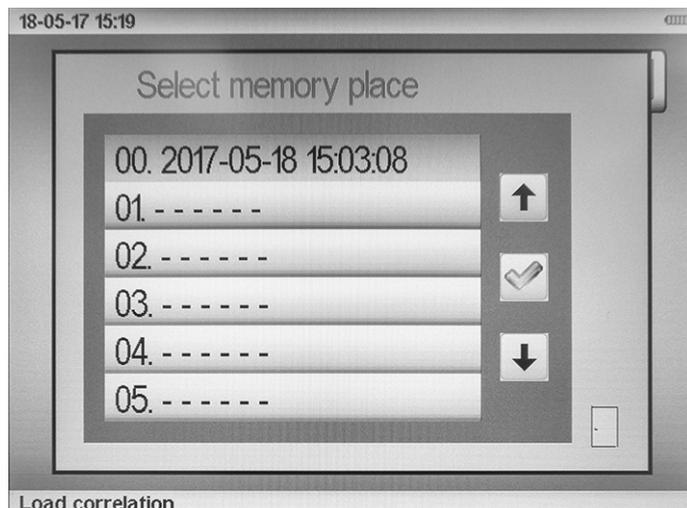
If the function is enabled, the current noise will be transmitted even during filter adjustment. This way, you cannot only narrow down the frequency ranges of interest numerically but also by ear.

Saving and loading measurements and measurement series

All measurements and measurement series created with the device can be permanently transferred to the device's measured value memory so that they can be called up again at a later point in time. The *Save* (104) and *Load* buttons (105) can be directly selected in the window for acoustic pipe burst detection.

To save or load measurements or measurement series, please proceed as follows:

1. Use the rotary button (2) to navigate to the *Save* (104) or *Load* button (105).
2. Press the rotary button (2) to confirm your selection.
 - ⇒ The submenu for the memory spaces will be opened.



3. Select a memory space and confirm your selection using the rotary button.
 - ⇒ The measurement is saved or loaded.



Info

When saving a measurement, please note that any existing measurement on the selected memory space will be overwritten.

Practical information

Acoustic leak detection

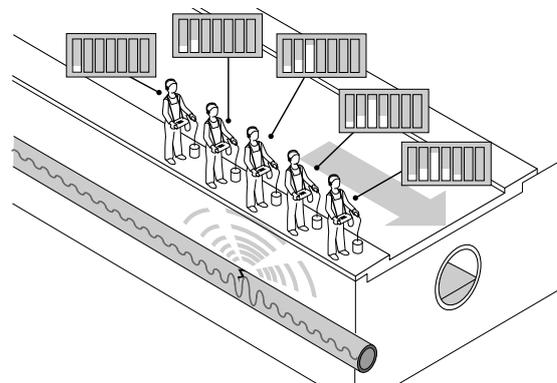
Formation of sound

When there is a leak in a pressure pipeline, water escaping at high speed produces sound due to friction. On the one hand, this causes the pipeline itself to vibrate. The sound is transmitted by the pipe and can be rendered audible at remote contact points (valves, hydrants, fittings) using structure-borne sound microphones. On the other hand, the water escaping directly at the leak also creates noises, which are transported through the ground up to the surface.

Ground-borne sound

If water escaping from the leak under pressure comes up against parts of the ground, these parts start to vibrate due to the escaping water. The sound propagates spherically and can be received near the leak using a ground microphone. The frequency components of these signals range from 30 to 700 Hz.

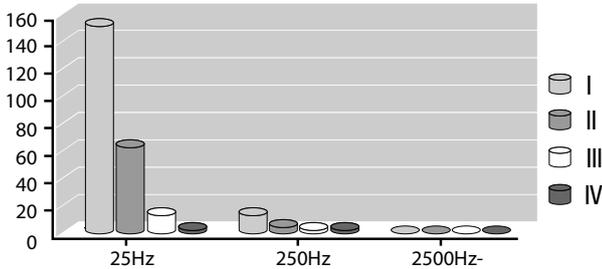
Frequencies the wavelength of which is smaller than the pipe's installation depth are heavily attenuated by the low-pass effect of the soil so that primarily only the low frequencies can reach the surface.



If a water bubble has built around a leak that has already existed for some time and if water continues to escape into this bubble, the ground-borne sound produced will hardly be audible. In this case, locating the leak with a ground microphone is nearly impossible.

If the pipe to be examined can be supplied with compressed air, this can help to render the leak noise audible again. For this purpose, compressed air is fed into the pipe via a hydrant or house connection with a slight overpressure. The air/water mixture thus produced will then generate a clearly audible sound at the point of leakage.

The diagram below illustrates the influence of the soil conditions on the reach of the ground-borne sound waves – in relation to the leak's frequency – in metres. Low-frequency noises propagate further than high-frequency noises, and heavily compacted ground conducts the sound to the surface better than less compacted ground.



| | | | |
|----|----------|----|------|
| I | Concrete | II | Clay |
| II | Soil | IV | Sand |

Structure-borne sound

Structure-borne sound vibration is created when water (the medium) escapes from a leak under pressure at a certain speed and makes the pipe start to vibrate.

The noise created at the leakage point travels in both directions of the pipe. Particularly in the case of low-dimensioned steel pipes, the material starts vibrating heavily and the leak noise can even be perceived at remote listening points. In contrast, the sound propagation in a thick-walled pipe vibrating only little, particularly in a plastic pipe, is very limited.

The extent of propagation of structure-borne sound strongly depends on the frequency and material. Similarly as with ground-borne sound, the low-frequency noises propagate further, and soft materials such as PVC or PE pipes absorb the energy generated by the leak to a greater extent than metallic pipes.

Aerodynamic sound

Aerodynamic sound occurs at narrow parts of a pipe, e.g. at a partly closed valve, due to a change in the pipe dimension (house connection) or a constriction of the pipe due to heavy incrustation (corrosion). This can lead to turbulent flows in the medium, which sometimes generate unusually high frequencies of up to 4,000 Hz.

Interference factors

After being heavily attenuated and filtered by the soil, environmental sounds have a similar frequency spectrum as leak sounds. In this context, the disruptive influence of the typical stop-and-go traffic in a city centre is by far not as strong as the interference caused by traffic on a busy main road.

The higher the operating pressure of the pipe to be examined, the higher the energy produced at the leak. As a result, the audibility of a leak decreases drastically at pressures below 3 bar. When falling below 1.5 bar, leak noises cannot even be perceived from a short distance.

Schematic leak detection

Economic leak detection – e.g. at a water pipe – requires a systematic approach. First of all, the course of the pipeline to be inspected must be known. Moreover, it is necessary to draw a clear distinction between the phases of pre-location and pinpoint location, since without the time-saving pre-location for tracking down the leak it would be necessary to examine the entire pipe length up to the leak.

Narrowing down the leakage point using a probe rod microphone

To narrow down and predetermine a leakage point, the tip of the probe rod microphone is used first of all to listen at accessible contact points of the pipe network section to be examined. In doing so, it is necessary to determine whether the noise received is generated by a leak (dull sound) or by a constriction at the valve itself (bright sound). Both types of sound are useful for narrowing down the leak. However, it should be noted that flow noises can also be caused by normal withdrawal.

When narrowing down a leakage point, it must be ensured that no measured value exceeds the display range in order to detect the actual maximum value. During these measurements, the measured value storage is of particular advantage since the last measured value can be saved and called up again at the next measuring point.

As long as no device settings are changed, this allows you to identify the pipe section with the highest noise intensity. This is the pipe section which must be examined by above-ground pinpointing afterwards.

Pinpoint location using a ground microphone

After the faulty pipeline section has been identified using the probe rod microphone, ground microphone measurements must be performed for the purpose of pinpoint location. When positioning the ground microphone, the distance between two positioning points must be as small as possible to avoid missing the leak. As a rule, the distances should be less than one metre.

Errors and faults

The device has been checked for proper functioning several times during production. If malfunctions occur nonetheless, check the device according to the following list.

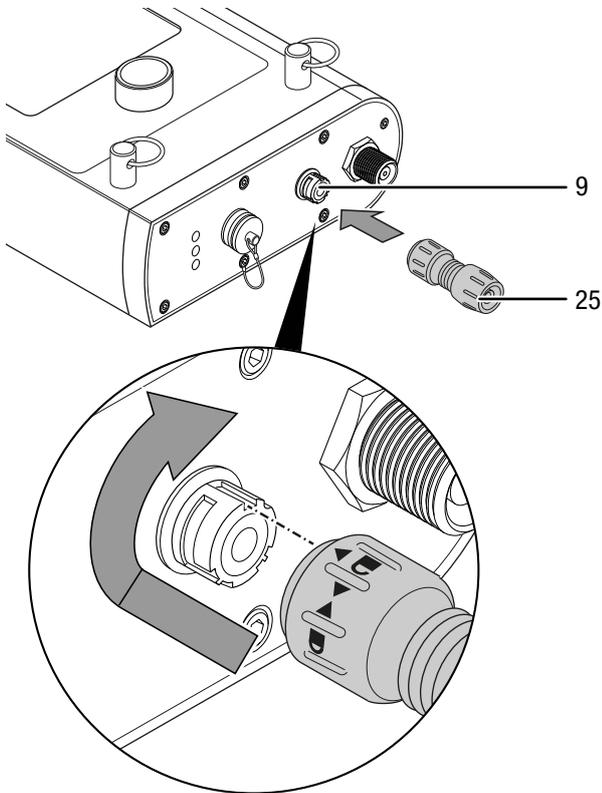
| Fault description | Cause | Remedy |
|--|---|---|
| Correlation leak detection | | |
| Signal from transmitters is not received | The transmitters are not switched on or have switched off themselves due to low battery voltage. | Check the transmitters for proper functioning and recharge the batteries if necessary. |
| | The antennas are not attached to the central unit. | Use the supplied antennas for the central unit. |
| | The antennas are not attached to the transmitters. | Use the supplied antennas for the transmitters. |
| | The distance between the transmitters and the central unit is too large. | Reduce the distance from the transmitter that is not received. |
| Incorrect correlation result | The parameter input for the pipe section is wrong. | Check the inputs for pipe material, length and diameter. |
| | The leak noise was cut due to improper filtering. | Check the filter settings and repeat the measurement if necessary. |
| | The signal received was amplified too little / too much. | Check the amplification settings and repeat the measurement if necessary. |
| | The signal of the transmitters is not received and the central unit only correlates background noise. | See description of the error Signal from transmitters is not received. |
| No correlation despite optimal settings and signal reception | The correlation is outside the section to be measured. | Check the inputs for pipe material, length and diameter. |
| Leak noise is not audible / cannot be perceived | Incorrect sensor type for the pipe section to be measured. | See Correlation chapter and the explanation of the different sensor types. |
| | The sensor has come off the fitting / pipe. | Always attach the sensor so that it cannot slip off. |
| | The pipe in the ground is made of another material (plastic) than indicated on the plan. | Plastic pipes conduct sound only very poorly. We recommend to always use so-called hydrophones for measuring in such cases. |

| Fault description | Cause | Remedy |
|--|--|--|
| Acoustic leak detection | | |
| No sound perceived in the headphones | The sound receiver or headphones are not properly connected. | Check the plug connections between the connected sound receiver or headphones and the central unit. |
| | Incorrect filter settings. | Select a large frequency range, e.g. 50 to 2,000 Hz, and generate a clearly audible noise, e.g. by scratching or switching on a radio. If the numeric indications and bargraphs on the display change and sounds can be perceived clearly in the headphones, the headphones and microphone are functioning properly. In this case, repeat your original measurement and adapt the frequency range to your measuring situation. |
| | The cable between the sound receiver and the central unit is defective. | Check the plug connections between the connected sound receiver and the central unit. Replace the cable with a spare cable, if any, or with the cable of a second device and check if for functioning again. |
| | The cable between the headphones and the central unit is defective (in this case the level indication on the display is working!). | Check the plug connections between the connected headphones and the central unit. Connect other headphones or the headphones of a second device for test purposes and check for functioning again. |
| | Memory settings. | Should the previously described steps for troubleshooting not lead to the desired result, clear the parameter memory by selecting <i>Clear memory</i> in the <i>Settings</i> menu. If there is still no sound audible in the headphones afterwards, please contact our customer service. |
| Display remains black after switch-on | The battery is empty. | Recharge the battery of the central unit. |
| | Defective sound receiver. | Please contact our customer service. |
| Display: insufficient brightness | The brightness setting is incorrect. | Increase the display illumination in the <i>Settings</i> menu. |
| | The battery is almost empty. | Recharge the battery of the central unit. |
| The central unit can no longer be operated or switched off | The software has crashed. | Use the supplied reset dongle to restart the device. |
| The transmitter can no longer be operated or switched off | The software has crashed. | Press and hold the Confirm or On/Off button (15c) to restart the device. |
| The signals from the measurement boxes are not received | The measurement boxes are not switched on or have switched off because the battery voltage is too low. | Check the measurement boxes for proper functioning and recharge the batteries if necessary. |
| | The antennas are not attached to the central unit. | Mount the supplied antennas to the central unit. |
| | The antennas are not attached to the measurement boxes. | Mount the supplied antennas to the measurement boxes. |
| | The distance between the measurement boxes and the central unit is too large. | Reduce the distance between the measurement boxes and the central unit. |
| The display remains black/dark after switch-on | The battery voltage is too low. | Charge the batteries of the central unit. |
| | The measurement box is defective. | Contact the Trotec customer service. |
| The measurement box can no longer be operated | The measuring box freezes due to the software. | Contact the Trotec customer service. |
| | | Press and hold the On/Off button to restart the device. |

Using the reset dongle

The reset dongle contained in the scope of delivery allows you to switch off the device in case the software has crashed. To do so, please proceed as follows:

1. Connect the reset dongle (25) to the microphone connection (9) of the central unit.



⇒ The device switches off.

2. Remove the reset dongle.
3. You can switch the device on again using the Power button (12).

Maintenance and repair

Charging the battery

The battery of the central unit should be charged when the battery indicator in the upper right-hand corner of the central unit display is empty or when the central unit can no longer be switched on (see Charging the battery of the central unit).

The battery of the transmitters should be charged when the charging indicator (15f) on the right display for the transmitter is empty or when the transmitter can no longer be switched on (see Charging the battery of the transmitter).

Performing a software reset

Should it be impossible to switch the device off after a software crash, you will have to use the reset dongle to restart the device (see chapter Errors and faults).

Cleaning

Clean the device with a soft, damp and lint-free cloth. Make sure that no moisture enters the housing. Do not use any sprays, solvents, alcohol-based cleaning agents or abrasive cleaners, but only clean water to moisten the cloth.

Repair

Do not modify the device or install any spare parts. For repairs or device testing, contact the manufacturer.

Disposal

Always dispose of packing materials in an environmentally friendly manner and in accordance with the applicable local disposal regulations.



The icon with the crossed-out waste bin on waste electrical or electronic equipment is taken from Directive 2012/19/EU. It states that this device must not be disposed of with the household waste at the end of its life. You will find collection points for free return of waste electrical and electronic equipment in your vicinity. The addresses can be obtained from your municipality or local administration. You can also find out about other return options that apply for many EU countries on the website <https://hub.trotec.com/?id=45090>. Otherwise, please contact an official recycling centre for electronic and electrical equipment authorised for your country.

The separate collection of waste electrical and electronic equipment aims to enable the re-use, recycling and other forms of recovery of waste equipment as well as to prevent negative effects for the environment and human health caused by the disposal of hazardous substances potentially contained in the equipment.

In the European Union, batteries and accumulators must not be treated as domestic waste, but must be disposed of professionally in accordance with Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators. Please dispose of batteries and accumulators according to the relevant legal requirements.

Declaration of conformity

We – Trotec GmbH – declare in sole responsibility that the product designated below was developed, constructed and produced in compliance with the requirements of the EU Radio Equipment Directive in the version 2014/53/EU.

Product model / Product: LD20HC

Product type: correlator

Year of manufacture as of: 2018

Relevant EU directives:

- 2011/65/EU
- 2012/19/EU

Applied harmonised standards:

- ETSI EN 300 113 V2.2.1

Applied national standards and technical specifications:

- EN 62311:2008
- EN 62368-1:2014/AC:2015
- ETSI EN 301 489-1 V2.2.3
- ETSI EN 301 489-3 V2.2.0 (Final draft)
- IEC 62368-1 2014 + Corr.1 2015

Manufacturer and name of the authorised representative of the technical documentation:

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Place and date of issue:

Heinsberg, 17.02.2023

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