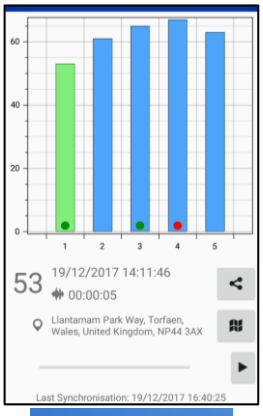
User Guide: DXmic / DXmic Pro.
(Includes using the DXmic Pro App).



DXmic App

DXmic unit and a selection of accessories

Warning: Please read, understand and follow the instructions in the manuals. Additionally, carefully read and follow the information in the "Safety Warnings and Approvals Information" document.

TABLE OF CONTENTS

1 INTRODUCTION, SAFETY AND SUPPORT OF PRODUCT

Thank you for choosing a HWM device. We trust it will provide you with many years of service.

This user-guide covers the following models:

Model Number	Description
DXMIC*	DXmic unit (and accessory options).
DXPRO*	DXmic Pro unit (and accessory options).

In addition, the user-guide covers use of the "DXmic Pro App" mobile-phone app (optional) which can extend the functionality of the DXmic Pro unit.

The DXmic is an advanced, electronic ground microphone amplifier designed to amplify the noise generated by water escaping from buried supply pipes under pressure. Identifying the location of the loudest leak noise usually indicates the location of the actual leak itself.

The DXmic / DXmic Pro is normally sold with a selection of accessories. The system comprises:

- A lightweight portable amplifier module, complete with battery charger,
- Options of various wired headphones or wireless (Bluetooth) headphones (with charger),
- Option of an acoustically shielded ground microphone foot,
- Option of a hand-held listening probe with a tripod foot, plus probe rod attachments for sounding in soft ground.
- Carrying strap and case.

The DXmic has a touch screen colour LCD display. The advanced, easy-to-use, features of the DXmic enable the operator to pinpoint leaks faster and with more confidence than ever before.

1.1 SAFETY AND APPROVALS INFORMATION

Before continuing, please read the "Safety Warnings and Approvals Information" document supplied with the product (MAN-150-0007).

Lithium ion batteries

The batteries supplied and fitted to the DXmic units are rechargeable lithium ion. Do not short circuit or overcharge these batteries. Any misuse of these batteries may result in explosion or fire. They must not be used in any other application or used with any

other equipment. Only batteries supplied by HWM Water must be used. Refer to the "Safety Warnings and Approvals Information" document.

1.2 Support of Product

HWM provides support of the product by means of webpage:

https://www.hwmglobal.com/dxmic-support/

Should you have any questions that are not covered by a manual, or Frequently Asked Questions (FAQs) provided online, please contact the HWM Technical Support team on +44 (0) 1633 489479, or email cservice@hwm-water.com

2 Overview

The DXmic unit is built to be robust, suitable for field conditions. It is portable and can be carried by either hand or shoulder-strap. Its injection-moulded housing is purpose-designed to provide long-term field durability and effective protection under realistic site conditions. It is environmentally rated to IP65.

The control unit has a single button membrane switch, used for power On / Off.
The colour multifunction touchscreen LCD display is backlit to give good visibility.
The interface to the headphones, charger and USB port are environmentally protected to IP65 by connector covers. Connection to a microphone (sound sensor) is via a military-specification connector.

Note: To prevent damage, whenever connectors are not in use, they should be covered by the protective covers provided.

2.1 Preparation for use

2.1.1 Battery charging

The rechargeable battery pack for the DXmic is supplied within the control unit.

A mains-powered charger is supplied with the unit. Alternatively use the car charger option (powered by a 12V cigarette lighter adapter).

To recharge the batteries, lift the rubber cover to gain access to the battery charging connector (see section 2.2). Connect the charging lead from the charger to the battery charging connector on the top of the DXmic.

Plug the mains-charger unit into the mains supply. (Or plug the car charger into the 12v outlet of the car).

Note: You can only charge the DXmic between 0 °C – 40 °C.

While the batteries are charging with the device in standby, the charging LED on the front of the DXmic will flash red. The LED will flash green when the batteries are fully charged. The time required to charge the batteries from flat is approximately 8 hours.

Note: The battery **will not charge** through the USB port.

The On/Off switch can be pressed while the unit is on charge to see how much charge is in the batteries at any time. When fully charged, the battery icon (located in the top right corner of the screen) will appear completely dark.

When charging is complete, remove the charger lead. Firmly push the rubber connector cover back into position to protect the connectors when not in use.

2.1.2 Battery charging - within the carrycase

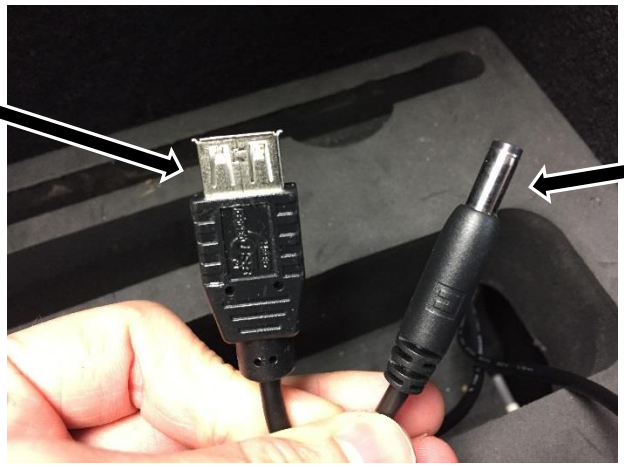
It is possible to charge both DXmic and (optional) Bluetooth headphones, whilst safely stored in the case, using the internal cable system.

The DXmic case comes equipped with an internal USB socket and DC power plug.

- The USB socket can be used to connect the USB charging cable for Bluetooth headphones.
- The DC power plug can be directly connected to DXmic battery recharging connector.

In order for the devices to charge, a power adapter (either the plug-top power supply or the 12V cigarette lighter adapter) has to be connected to the power input barrel connector on the side of the storage case.

USB socket for (optional) Bluetooth headphone charging. (Use cable supplied with headphones).



DC plug for DXmic charging.

2.2 LOCATION OF CONNECTORS AND CONTROLS

Number	Description
1	Battery compartment.
2	Connector cover - charger connector and USB connector.
3	Connector cover - headphone socket.
4	Headphone socket.
5	Battery Charging connector.
6	USB port *** **NOT FOR CHARGING** *** (USB micro; no cable supplied). For factory use and software upgrade only.
7	Sensor connector.
8	LED (Power / Charge indicator).
9	On / Off button; Mute control #2.
10	Carry Strap.
11	LCD screen (touch sensitive).

2.3 SWITCHING DXMIC ON / OFF

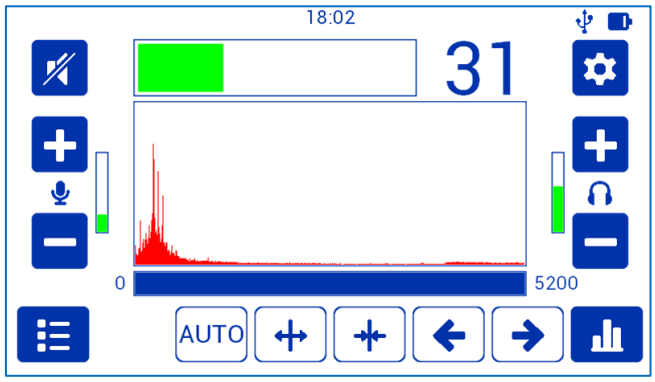
To switch DXmic **ON**, press and hold the On / Off button for 2 seconds.
The LED will illuminate green when the DXmic is on.
The DXmic LCD screen will illuminate and the unit will power-up.

To switch DXmic **OFF**, press and hold the On / Off button for 1 second.
The LED will switch off when the DXmic is off.
The DXmic LCD screen will be blank and the unit will power-down.

2.4 DXMIC LCD SCREEN

On power-up, the LCD screen typically looks like the picture opposite. It is touch sensitive, so the screen has a dual purpose:

- Display of information.
- Button controls (activated by tapping once).



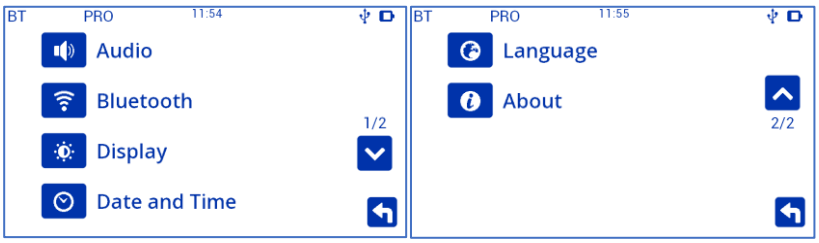
2.5 DXMIC - LANGUAGE SELECTION (USING THE SETTINGS PAGE)

The DXmic supports several languages. To select the required language:

Tap the settings icon,

Tap the next page icon,

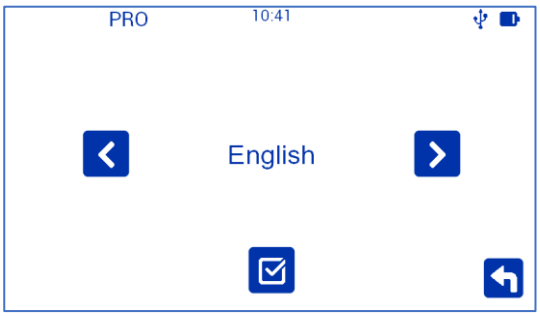
Tap the Language icon,



Tap the change selection icons to navigate between the available languages.

When you have selected your preference, tap on the Set icon.

Tap the Exit Page icon to exit the current page and return to the previous page.



2.6 DXmic - Model variants and availability of an App

2.6.1 DXmic functionality levels.

DXmic is the entry-level model.

DXmic PRO has all of the features of the DXmic, plus additional memory, plus sound recording ability and option to use with the "DXmic Pro App".

Note: Both models require accessories (e.g. microphone, cables, headset) to complete the system and are therefore usually ordered as a kit.

The "**DXmic Pro App**" is an optional app for a mobile phone that extends the capability of the DXmic Pro module. It brings the ability to provide location details for measurements and to be able to share results via email.

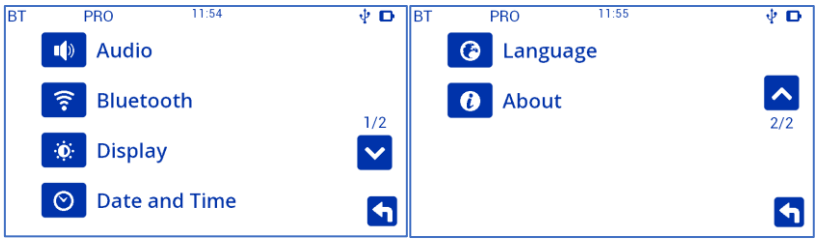
2.6.2 Compatibility of DXmic PRO with Phone models (for DXmic Pro App)

The "PRO" version of DXmic is required for use of the DXmic Pro App. Check for the word "PRO" at the top of the LCD display.

Both Android and iOS (e.g. Apple iPhone) versions of the DXmic App are available, however early versions of DXmic PRO hardware are not compatible with iOS devices.

To tell which version of DXmic Pro hardware you have, you need to display the DXmic Information page ...

Tap on the settings icon,
Tap the next page icon,
Tap the "About" icon.



Check the letter at the end of the top line of text.

"A" version supports only Bluetooth Classic protocol, limiting installation of the DXmic App to only Android-based devices.

"B" version supports Bluetooth Low Energy protocol and allows installation of the DXmic App on either an Android or iOS device.

Phones using the Android operating system require: **Android 6.0** or later.

Phones using the iOS operating system require: **iOS 12.2** or later.
(Compatible with iPhone, iPad and iPod touch).

Ensure any device used for the DXmic Pro App has **GPS** and **internet** available.

2.7 CONNECTING THE MICROPHONE

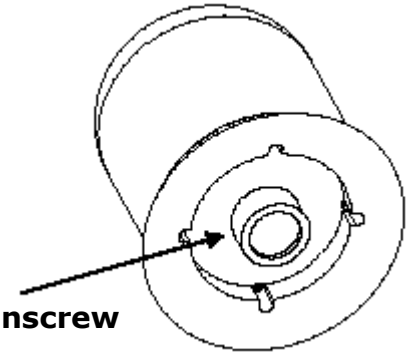
Select the sensor required, either:

- The acoustically shielded ground microphone foot, or
- The handheld microphone unit with tripod, or
- The handheld microphone unit with probe rods.

Note: When using the handheld microphone unit, the tripod or probe-rods must be screwed into the bottom of the microphone housing.

2.7.1 Ground Microphone foot

Warning: The Ground Microphone foot has a sensor attached that can be seen from the bottom of the unit. Users must not attempt to unscrew this sensor as this will break internal components of the microphone resulting in irreparable internal damage. Sensor replacement is then the only option. Any necessary repair or dismantling of the foot must be carried out by HWM Water or by an authorised distributor.
If the sensor does become loose it should be tightened manually so that it is “finger tight". Excessive force will cause damage.



Sensor: Do NOT attempt to unscrew

When using the ground microphone foot, the handle should be attached to it for ease of use.

Connect the ground microphone to the DXmic unit using the supplied cable.
Ensure the cables are fastened securely to the connectors to ensure the connections are water-tight.

2.7.2 Hand probe Microphone

The hand probe microphone has a threaded connection to the sensor. Various adaptors can be attached to the screw thread.

These include a tripod for ground surface sound measurements. (Suitable for use on irregular surfaces).

A set of rods is also available for listening to the sound within fittings inside a chamber, or to probe a pipe buried in soft ground.

When attaching the adaptor fittings, do not over-tighten the screw thread.

For normal soft ground surfaces, the single pointed extension rod should be connected. For direct contact with underground fittings via access covers it may be necessary to use the second extension rod. To do this, remove the single rod and connect the extension rod - replacing the pointed rod again.

If the rods have been over-tightened, spanner slots allow easy removal.

Connect the hand-probe microphone to the DXmic unit using the supplied cable. Ensure the cables are fastened securely to the connectors to ensure the connections are water-tight.

2.8 HEADPHONES

DXmic has various high-quality headphone options including both wired and Bluetooth headphones.

Where Bluetooth headphones are supplied with the unit, a USB adaptor cable is also supplied for headphone charging purposes.

2.8.1 Wired headphones

Remove the protective cover from the headphone connector.

Plug the wired headphones into the headphone jack.

When not using the headphones, replace the protective cover.

Ensure the headphones are stored where they cannot be damaged when they are not in use.

2.8.2 Bluetooth wireless headphones - Charging

The DXmic is compatible with wireless Bluetooth headphones.

Prior to using Bluetooth headphones, ensure they are charged.

Use a powered USB port to provide power to the charging cable.

The other side of the cable should be plugged into the charging socket of the headphones.

Unplug the cable when charging is completed.

2.8.3 Bluetooth wireless headphones - Pairing

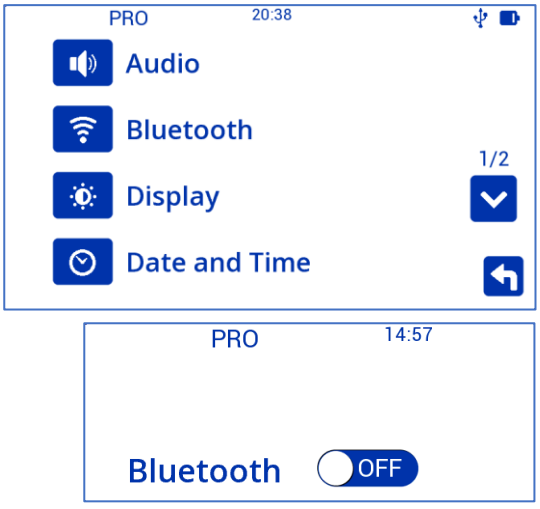
The Bluetooth headset has to be paired with the DXmic unit before it can be used.

Tap on the settings icon.

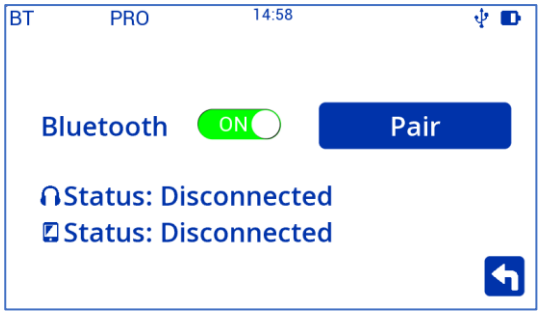
Tap the “Bluetooth” icon.

Bluetooth is initially OFF, to reduce power use.

Tap the control to switch Bluetooth ON.



The Bluetooth control now indicates the Bluetooth functions within the DXmic are ON; a “BT” symbol also appears at the top left of the display.



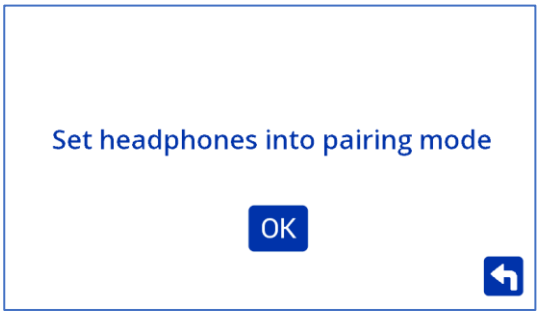
The status indicates both

- headphones and
- mobile phone device

are in a disconnected (non-paired) state.

The DXmic is required to initiate the pairing process with the headset; Tap the “Pair” button.

Put the headphones into pairing mode (see later). Then tap OK to confirm the Bluetooth headphones have just been put into pairing mode.



Follow the instructions of the headset for putting it into pairing mode.

Typically, this will be done from a non-powered state and holding down the power button until the LED of the headphones flashes a specific pattern (e.g. alternating green and red)

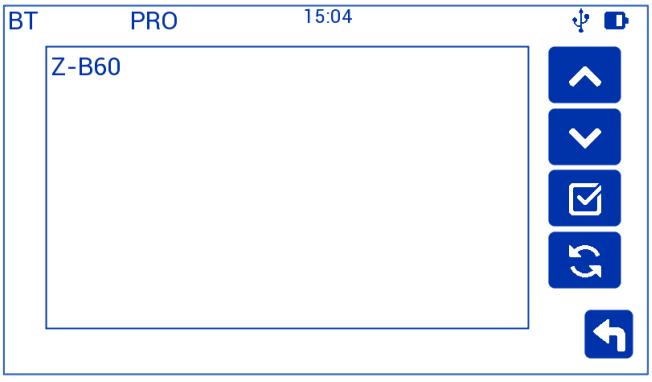
Tap the OK button on DXmic.

The DXmic will search (scan) for available devices.

If your headset is not found, press the refresh button to re-scan.

Select your headphones from the displayed list (tap on the line).

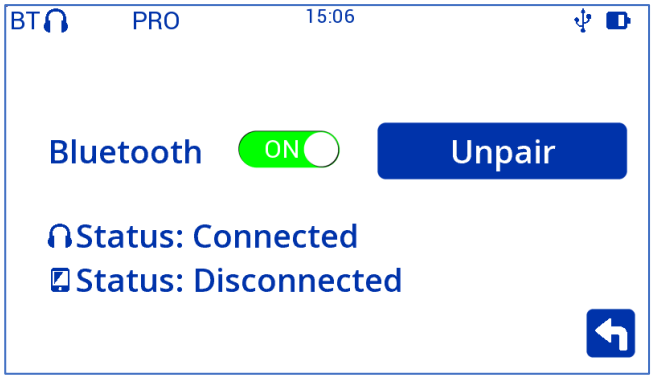
Then tap the selection confirm box (tick).



The Bluetooth display will now read 'Status: Connected'. A "headphone" image will be shown next to the "BT".

Tap the page exit icon when finished.

Note: Both Bluetooth and wired headphones can be used simultaneously if required, for product training.



Increase the volume of your headphones so that they are near maximum. This ensures the DXmic headphone signal level is not degraded by being reduced to a low volume by the headphones themselves.

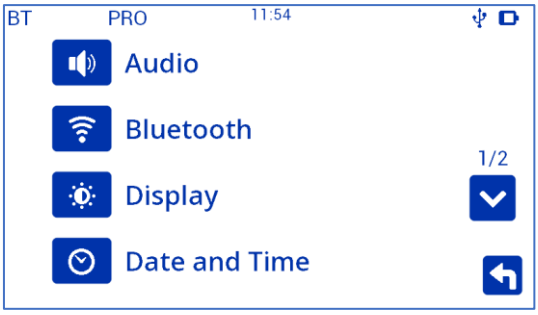
2.9 SETTING THE DATE AND TIME

It is advisable to set the date and time in the DXmic as it can time-stamp certain activities.

To set the time …

Tap on the settings icon,

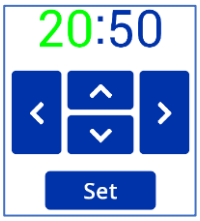
Tap the "Date and time" icon.



The Time and Date formats can be adjusted.

Tapping on the relevant "Set" button and then adjust the value.
Tap "Set" when the local adjustment has been made.

To conclude the time / date settings, tap the exit page icon.



Note: The DXmic Pro app can also adjust the time on a DXmic Pro unit (see section 5.2).

2.10 CHECKING THE BATTERY LEVEL

A battery icon at the top-right of the screen gives a coarse indication of the battery level. Blue indicates available charge.

2.11 ADJUSTING THE DXMIC DISPLAY

The display of the DXmic can be adjusted to best suit ambient light conditions. This improves the comfort of use and also reduces the possibility of eyestrain for the user.

Note: The display is best used in the shade or angled by the user to avoid reflections of strong light sources. Always take regular breaks from use of the DXmic and stop use if you are showing signs of eyestrain, headaches, or feel unwell.

2.11.1 Adjusting Brightness of LCD back-light.

The DXmic LCD is backlit.
To adjust the background light level:

Tap on the settings icon. 

Tap the “Display” icon. 

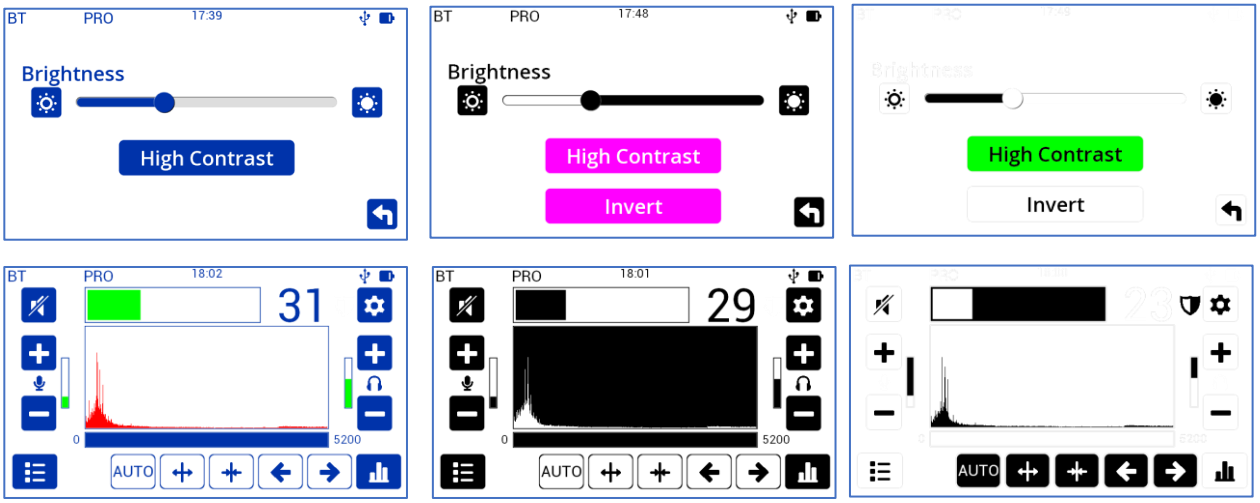
The slider-control allows the user to increase or decrease the light level.

A brighter display increases battery use, but the user should prioritise the setting for comfort of viewing.

2.11.2 Setting to a high-contrast colour-scheme

There is, in addition to backlight adjustments, there is a “High Contrast” button (see above).

This changes from the default colour scheme into a high-contrast scheme.

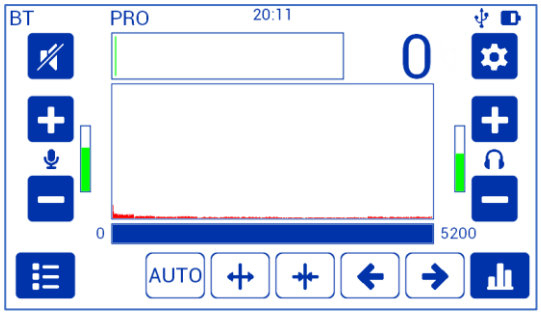


Tap on “Invert” to change to the alternative High Contrast colour scheme.

Select the scheme that is easiest to read in the light conditions existing at the time of the DXmic being used.

Tap on the screen exit icon when adjustments are completed.

The DXmic resumes normal operation with your choice of colour-scheme setting.



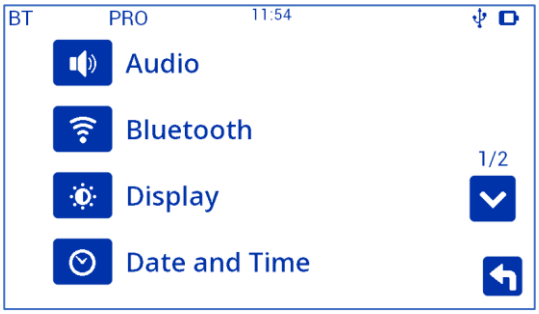
2.12 Setting the Hearing Protection feature

Placing a ground microphone near the ground can leave a user exposed to sudden loud noises, which could damage the user's hearing if not limited. The DXmic deals with this by providing a hearing protection filter. The filter function analyses the noise level in the incoming signal and limits any loud sound levels from reaching the headphones.

It is advisable to set the DXmic hearing protection to ON.

Tap on the settings icon, 

Tap on the "Audio" icon. 

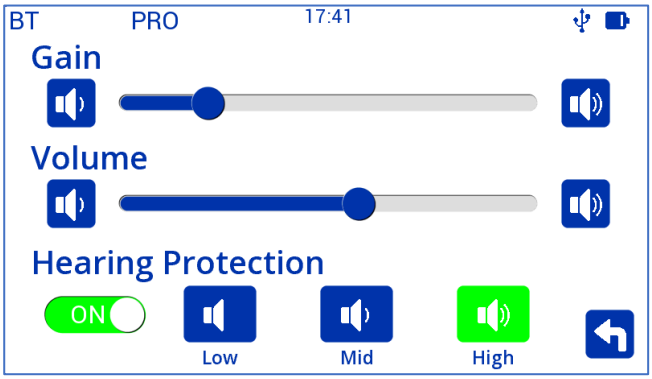


Activate the Hearing Protection filter. 

Select the required protection level from one of the 3 available threshold options (LOW has greatest protection):

1. LOW – cuts the output at level 70
2. MID - cuts the output at level 80
3. HIGH - cuts the output at level 90

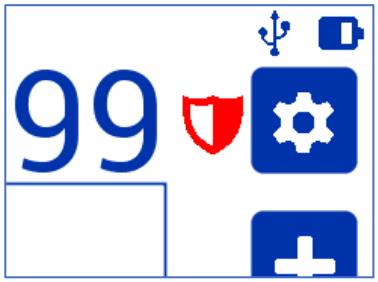
Tap on the screen exit icon when adjustments are completed.



The figures shown are approximate for the DXmic headset volume control being set to mid-level. Any other control setting is adjusted for by the DXmic moving the thresholds to compensate. (i.e. if the headset volume control is increased, the DXmic decreases the threshold of the sound level that activates the hearing protection).

Note: Consider that some headsets have adjustable volume level when making this setting. Ensure that when Bluetooth Headset is used it is still a comfortable limit even with headset set to maximum volume.

Note: A small audio delay is introduced in the signal path to the headphones when the filter is active. It is required to allow the DXmic to react to loud noises. The delay does not compromise measurement quality or any other DXmic function.



When the Hearing Protection filter is triggered, the sound is temporarily muted, and a shield icon is visible on the display (see opposite). After the excessive sound level has passed, normal operation is resumed, with sound returning to the headphones.

The feature can be set to a level whereby it activates whenever the ground microphone is being lifted and re-positioned at its next location on the ground. When so set, the user does not have to remember to mute and unmute the headset manually.

3 USING THE DXMIC

The DXmic is used to listen to noises at or below ground level, trying to find the most likely location of a leak. A leak is usually a very persistent sound level, so locating the point on the ground where the leak can be heard at the loudest level can help in locating the leak. The DXmic has many features to assist the user.

3.1 KEY FEATURES

DXmic unit:

- Lightweight, easily portable system.
- IP65 enclosure
- On / off button (Weatherproof).
- Versatile – ground microphone and hand probe configurations.
- Military specification connectors.
- Robust construction for field use.
- Options for settings and operation mode.
- Rechargeable batteries (up to 25 hours use)
- Audio filter selection (flexible adjustment of frequency range).
  (Filter out background noise and listen to frequencies relevant to the leak noise).
- Backlit multi-function LCD touchscreen showing:
  - Graphical and digital noise levels
  - Option of bar-graph view (frequency vs sound level) OR
    Gauge view
- Ear protection filter for loud and sudden noises to protect the users hearing.
- Wired headphones or wireless (Bluetooth) headphones with volume control.

- Minimum Level profiling.
  (Records levels of leak noise at various locations for comparison as a histogram profile).

DXmic PRO unit:

- All features of DXmic supported.
- Recording and playback of sound samples.
- Option to use with the DXmic Pro App (mobile phone required).

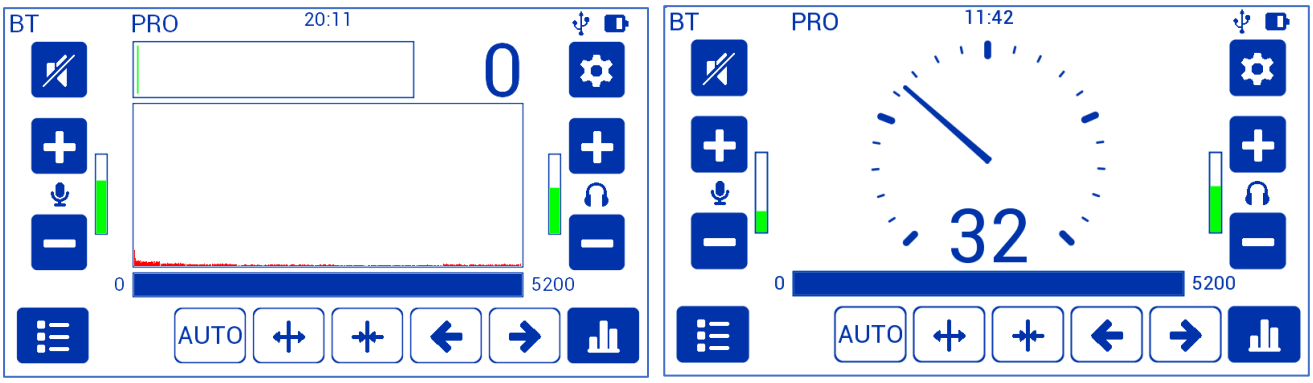
DXmic PRO unit used with DXmic App:

- Provides location information for each measurement.
- Provides ability to share results via e-mail.

3.2 DXmic Display – Common controls and indicators

3.2.1 Switching views (graph ←→ gauge)

Tapping the center of the screen will cause the view to switch between graph view and gauge view.



Graph view

Gauge view

3.2.2 Display auto-dim and stand-by functions

The LCD screen and backlight behave as follows:

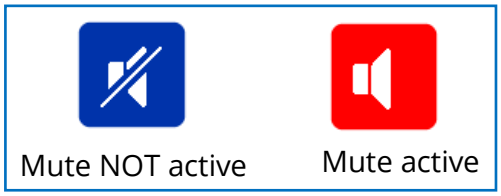
- When the touch-screen has been recently tapped, the backlight is on and LCD graphics are updated.
- After 60s of the touch-screen not being tapped, the backlight is dimmed and LCD graphics remain being updated.
- After 300s of the touch-screen not being tapped, the backlight is switched off and all LCD graphics are erased.
- Once the screen is tapped, the backlight is switched back on. LCD graphics are updated once more.

Note: Pressing the DXmic on/off button has equivalent behaviour as a screen tap.

3.2.3 Headset mute

The user may wish to mute the headset in order to partake in other tasks that require hearing.

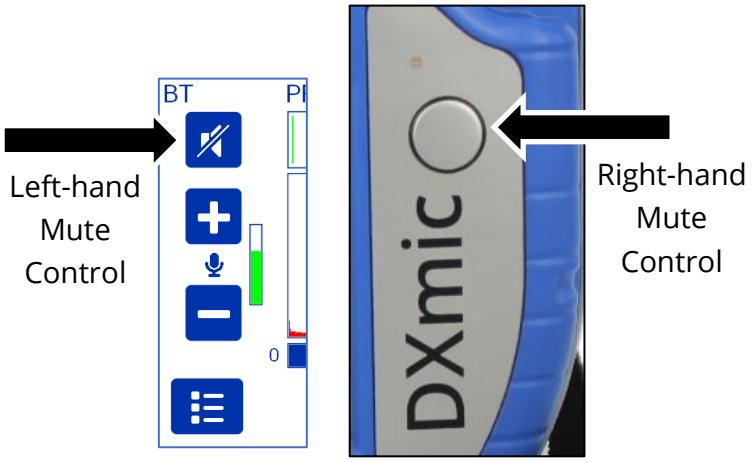
The LCD display has an icon at the top left of the display showing the current mute status of the headset.



The DXmic provides two controls to mute (and unmute) the headset.

Left hand: Tap on the “mute” icon

Right hand: Click the on/off button.



3.2.4 Headset volume control

The headset volume can be adjusted using the + / - buttons above and below the headset icon. A green bar indicates the current volume level adjustment.

3.2.5 Microphone volume control (Sensor gain)

The microphone (sensor) passes through a circuit that can adjust its level prior to any mathematical evaluation by the DXmic.

The DXmic has controls on the display to allow the user to adjust this level.

The sensor signal level can be adjusted using the + / - buttons above and below the microphone icon. A green bar indicates the current volume level adjustment.

Note: Setting the sensor level is an important task (see section3.3).

3.2.6 The filter range indicator

The DXmic processes the incoming signal in order to produce both graphical displays, measurements and the outgoing audio for the headphones.

The signal processing ability includes applying frequency filters to the incoming signal. The filters have an effect on the headphone audio. They also have an effect on the overall power level digitally displayed.

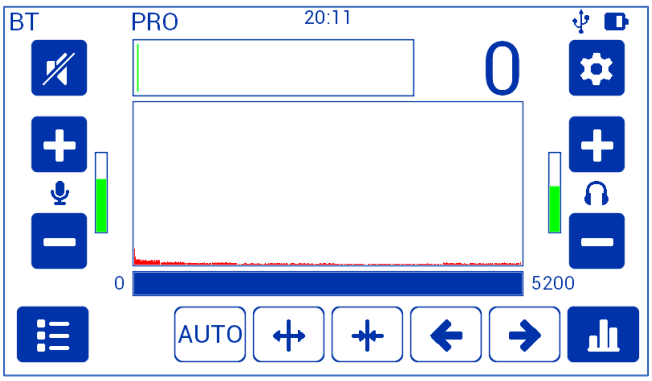
Below the gauge or graph display there is a blue bar (shown) which indicates the frequency range affected by the filter.

The DXmic is designed to handle frequencies from 0Hz to 5200Hz.

The filled blue areas of the bar indicates the range of frequencies that pass through the filter stages; Conversely un-filled areas of the bar shows the region of frequencies that are blocked (significantly reduced).

The ends of the filter range bar have numeric indicators that show the change-over frequency of the filter (stop ←→ pass ; pass ←→ stop).

3.2.7 Digital Power Level indicator



Graph view

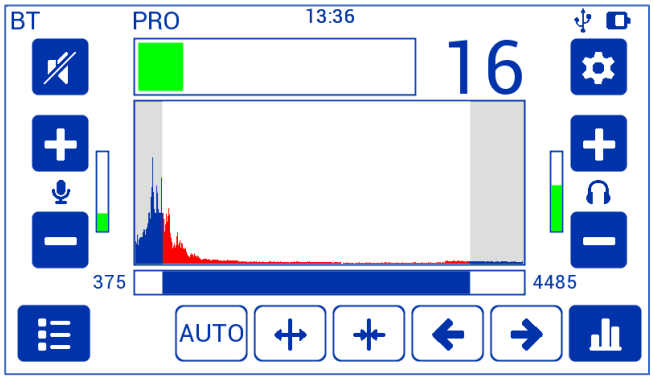
Gauge view

A numeric display of the current sound level is displayed on the graph view (top-right corner) and gauge view (bottom of the dial). This displays the current power-level of the input signal after it has been through both the input gain stage (input volume level control) plus any selected filtering. The volume level of the headset has no effect on this indication. The digital level is prevented from changing too quickly by smoothing out the rate of change (by an averaging function).

3.3 ADJUSTING THE INPUT GAIN (BEFORE MEASUREMENTS AT A NEW SITE)

The noise within a pipe with water flowing smoothly is minimal. Pipes do however pick up noise from the environment (near-by mechanical equipment), various assets that form part of the pipe network, and of course leaks. The microphone is very sensitive and is followed by a gain stage that is adjustable. It is important that the sound level being picked up is brought within the usable range of the sound signal processor of DXmic and does not to saturate it. The user should therefore set the input volume level according to the specific conditions on the site being investigated.

The picture opposite shows the graph view.



The filter bar shows that a band-pass filter is being applied; there are lower and upper cut-off frequencies which means only the power of the center signals are being considered to produce the over-all digital power-level indication.

Tap on the “widen filter” button until the filter bar is completely blue. This ensures the digital power level indication is for the whole frequency range of the input signal.

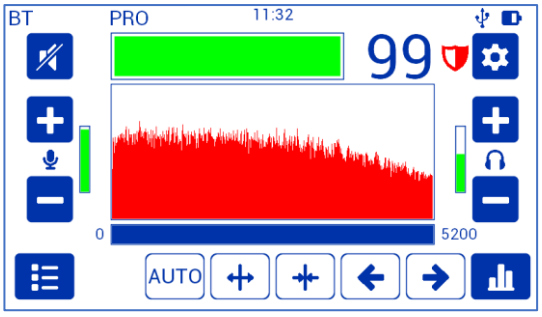
Next adjust the input volume control until the signal is not saturating.

(Saturating is when the display indicates “99” or somewhere close to it, even occasionally).

e.g. A level reaching “60” occasionally (but usually lower) is probably a good starting point. This level may need to be re-adjusted if you move to a point closer to the leak, where the noise may be louder.

Note: Since the ambient noise and pipe sound level will vary from one site to another, this check / adjustment **should be re-done** each time a new site is visited.

(Shown opposite: A very bad setting of microphone gain (volume), with the input level so high it is totally saturating the input to the sound processing of DXmic. A substantial reduction of the microphone sensor gain is required).



3.4 NAVIGATING BETWEEN THE VARIOUS SCREENS

This section introduces the various screens that exist on the DXmic, and also how to navigate between the various screens.

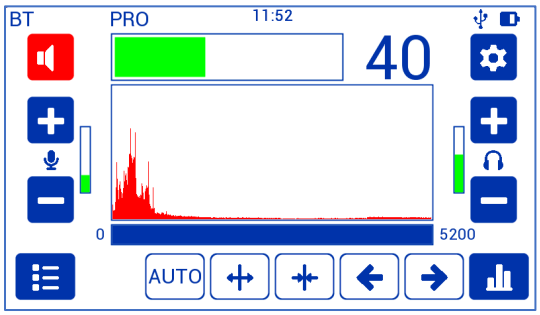
3.4.1 Settings screen

The “settings” icon is visible from every view. Refer to the start of section 2.5.

3.4.2 M.L.P. mode (Minimum Level Profile) screen

From the “Survey Mode” screen (usually shown at start-up):

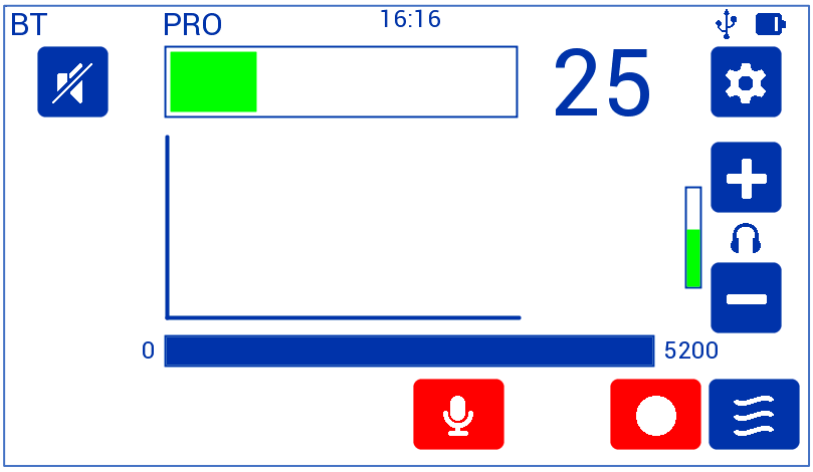
Tap the “Minimum Level Profile” button.



The view will change to the “Minimum Level Profile” screen, shown opposite.

Its function will be described later in section 3.7.

Note: There is no access to filter controls from this screen, although the filter settings are actually in use (as indicated by the filter range display bar).

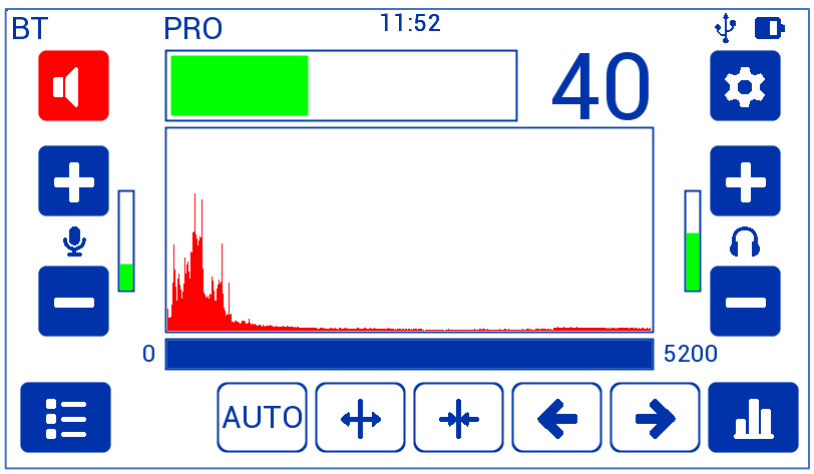


To access filter settings, the user must first switch back to the survey mode view (see section 3.4.3).

3.4.3 Survey Mode screen

The Survey Mode (see opposite) is the default screen after switching the DXmic on.

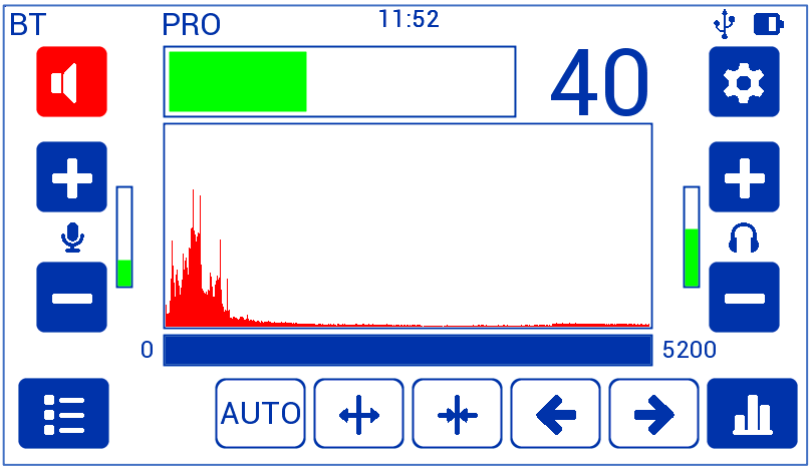
If in the M.L.P. mode, tap the “filter” icon to reach this screen.



3.4.4 Filter selection screens

Filter selection takes place on the lowest part of the Survey Mode screen.

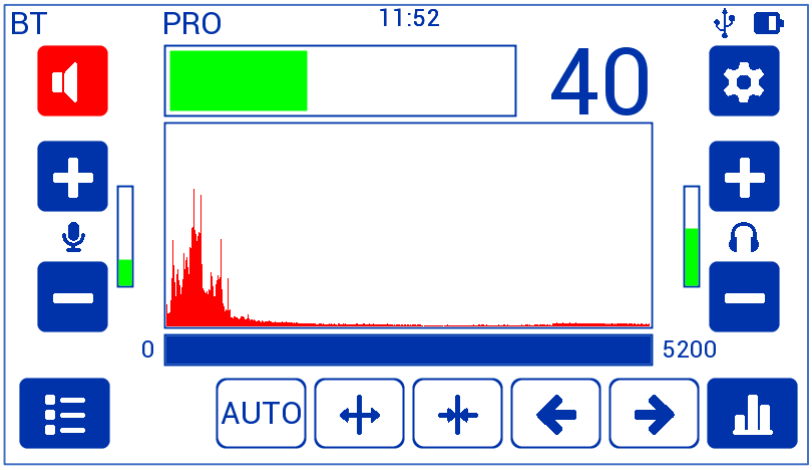
Although this is where the filter selections take place, the chosen filter settings remain in effect for most screens. Check the filter settings bar present on the screen to confirm this.



3.5 SURVEY MODE

Survey mode uses the default screen after power-up.

Setup the microphone gain as described in section 3.3 before making an initial survey. Repeat the setup if required during the initial survey (if the microphone input level is saturating). Then make the final comparisons (with the input level no longer needing adjustment).



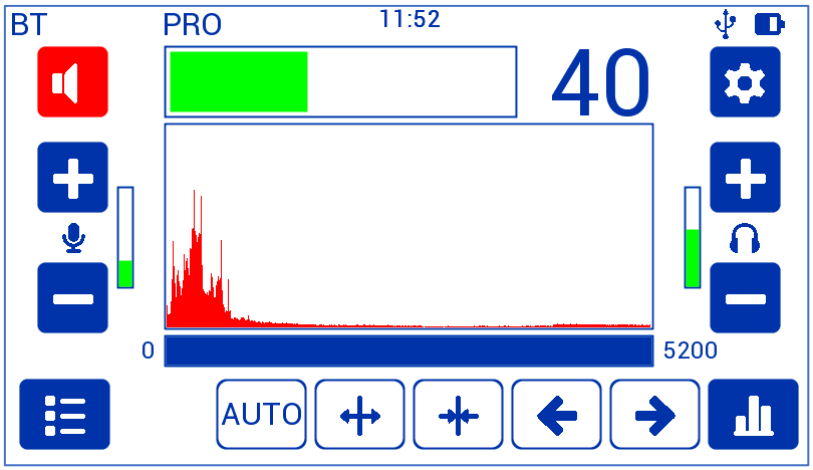
During an investigation the user uses the DXmic to listen to the sound at ground level, at various locations, to try to identify the location of the leak; The location of the leak corresponds to the loudest volume of the leak-sound. Refer to section 7.

The DXmic has level and audio frequency spectrum indications to assist with this task. The task can often be made easier by applying a filter to the sound (see 3.6) to remove some of the irrelevant background noise.

3.6 USING A SOUND FILTER

Applying frequency filters to the audio can eliminate some of the distracting background noise and help to focus on the sound and noise-level of the pipe leak.

The controls for the sound filter are located on the Survey mode screen.



The frequency filter settings are applied to:

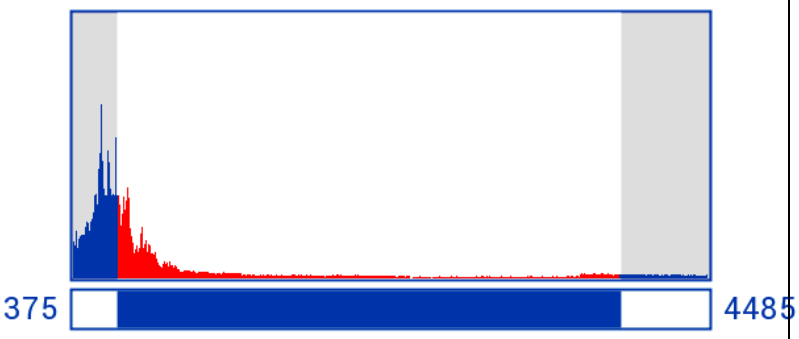
- The sound-path to the headphones.
- The sound path to the digital sound level calculator.

The heard audio level and displayed digital power level should fall slightly if a significant amount of background noise can be rejected.

The filter parameters can be manually controlled by using the four buttons below the graph / filter indication bar.

The current filter settings are shown in both the displayed filter indication bar (see 3.2.6) and also the graph itself.

The graph shows the frequency spectrum of the signal and which frequencies / levels are rejected.



Tap the “widen filter bandwidth” icon to widen the filter pass-band.

Tap the “narrow filter bandwidth” icon to reduce the filter pass-band.

Tap the “lower filter frequency” icon to reduce the frequency of the filter pass-band.

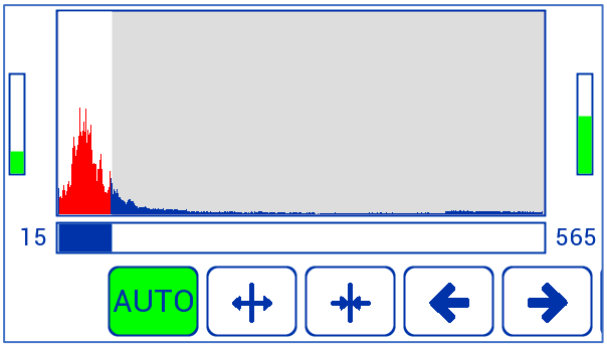
Tap the “raise filter frequency” icon to increase the frequency of the filter pass-band.

There is an “Auto” button on the screen.

When “Auto” button is tapped, it changes to green in colour; Auto is active.

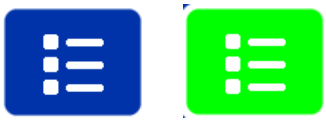
When “Auto” button is tapped again, it returns to its normal colour; Auto is inactive.

The Auto function attempts to dynamically adjust the filter to pass only sound frequencies close to whatever is currently the loudest frequency. The filter’s pass-band will be constantly changing according to whatever sounds appear. When you are close to the leak, this will usually be the sound of the water leak.

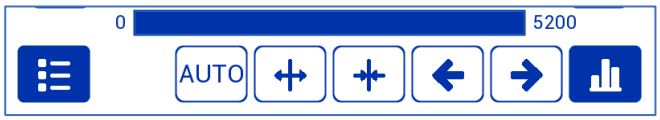


The Auto function should only be used for a short period to try to lock onto the leak sound. Once this has been found, deactivate the Auto function. This will freeze the current filter parameters, which is essential to be able to make good comparisons of loudness levels of the leak sound at different locations on the ground.

There is a “Pre-set Filters” button on the screen.
When the button is tapped, it changes to green in colour;
The pre-set filter sub-menu is active.



Hint: The sub-menu can be recognised by the buttons being enclosed by a rectangle with rounded corners.



When “Pre-set Filters” button is tapped again, it returns to its normal colour; the sub-menu is no longer active.

The “Pre-set Filters” sub-menu currently has three filters defined.

A band-pass filter, often used for metal pipes.

A low-pass filter, often used for plastic pipes,

An option to remove any filtering of the signal.

For each of the above, the microphone sensor signal is used by the DXmic signal processing circuit. The signal processing limits the bandwidth to a maximum of 5.2KHz (usually more than sufficient to find pipe leaks).

It is also possible to widen the bandwidth to the full range of human hearing, approximately 20Hz to 22KHz. This gives CD-quality sound from the DX mic headset.

To enable this feature, tap the “Filter by-pass” button; The sensor sound now travels to the headset without modification, except where necessary to implement the hearing protection function (if active).

Whilst the Filter by-pass mode is operating, several changes occur:

The sub-menu box clears, as it is not possible to select filters.
A green button remains that will de-activate the mode and return the user to the regular filtered mode.

There is no filter bar on the display, as the filter circuits are disabled.

Only the gauge-view is available, since the signal processing circuitry (which computes the values for graph displays) is disabled.

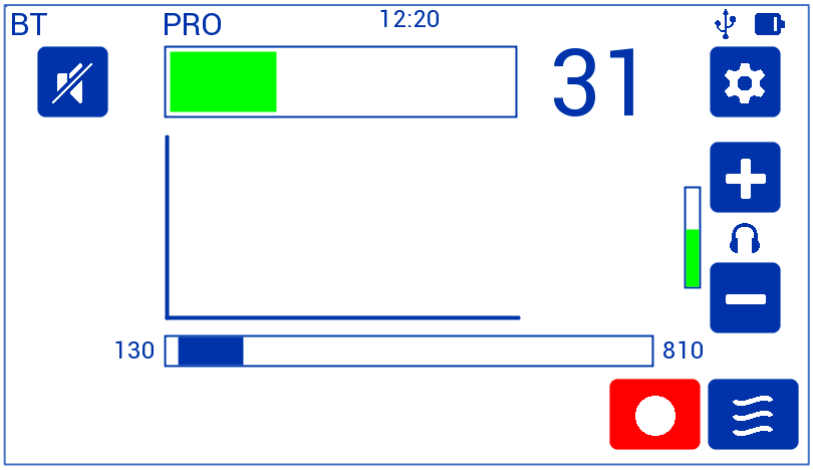
A digital sound level is still produced, and any hearing protection is still active.

Tap the filter by-pass button again to de-activate the mode.

3.7 M.L.P. MODE (MINIMUM LEVEL PROFILING)

3.7.1 Obtaining measurements

The process of locating a leak using a ground microphone is to listen at various points in the area and judge where the sound seems to be the loudest. This process can be assisted using M.L.P. mode.



First use the survey mode to setup the microphone sensor level and filters. The general area for closer examination should also have been found using the survey mode.

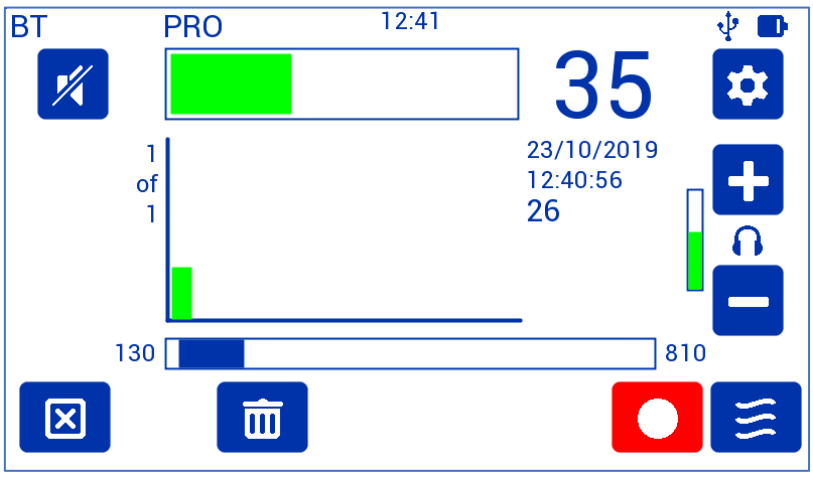
Select the M.L.P. mode of the DXmic (see section 3.4.2).

Rather than the user having to "remember" the sound level at various locations, the M.L.P. mode uses the sound power level meter within the DXmic to produce a numeric value which can then be stored in the memory of the DXmic. Multiple locations are measured and then these can be compared to assist in locating the leak. The locations will be displayed as a bar graph. It is the responsibility of the user to remember where the microphone was placed each time (e.g. by using a marker on the ground).

The method the DXmic uses to obtain the measurement is to listen for 3 seconds, sampling the sound level many times. The lowest sound level measured during this time is recorded as the final numeric value. The method is able to reject short ambient noises that may be present; Generally, the recorded value will be less than the value displayed on the power meter.

First locate the microphone at the measurement point.
Then to make the measurement, tap the "measure" button.

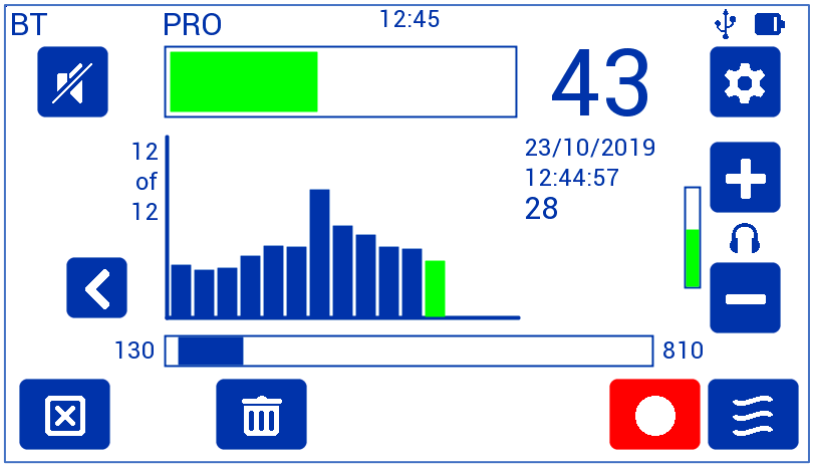
A green vertical bar will appear on the M.L.P. graph (representing the last measurement location), along with details of the date and time of the measurement, and the measured level.



Move to the next measurement location and make the next M.L.P. sound level sample.
(Repeat until finished).

The DXmic stored the set of measurements for each location (represented by a set of bars).

The display has one bar selected (in green) which has the corresponding measurement details listed.



Change which bar is selected using the arrow icons.

The location with the highest bar is likely to correspond to the leak position.

3.7.2 Deleting measurements

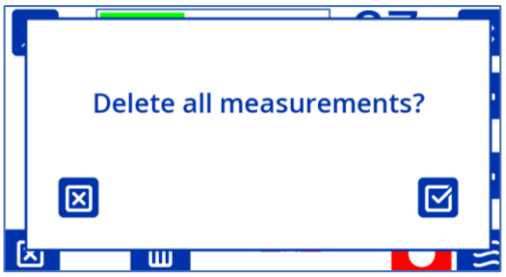
DXmic can store up to 100 measurements.

To delete a specific measurement, select it using the arrow icons, then tap the “delete selected measurement” icon.

Note: No confirmation is required when deleting the selected measurement.

To delete ALL measurements, tap the “delete ALL measurements” icon.

The user must confirm the action before ALL measurements are deleted.



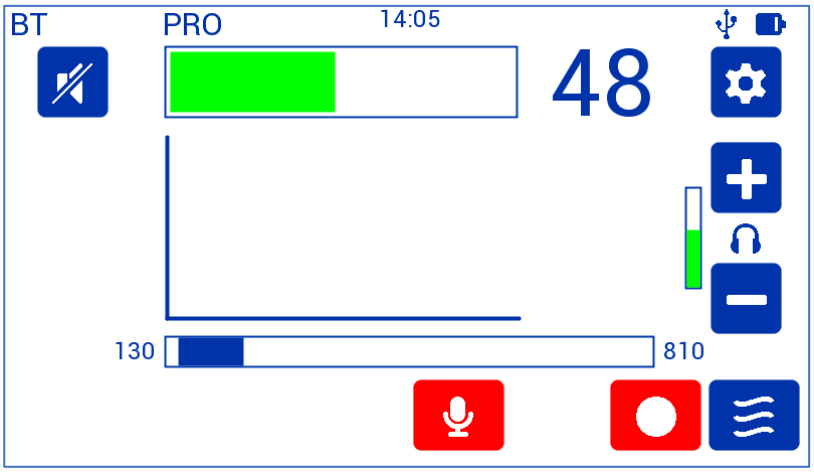
4 USING THE DXMIC PRO

The DXmic PRO supports all of the features of the DXmic (see sections 2 and 3), plus some additional features:

- Sound recording and playback
- Option to use DXmic PRO with the “DXmic App” mobile phone app.

4.1 SOUND RECORDING AND PLAYBACK IN M.L.P. MODE

In the M.L.P. mode, the option exists to simultaneously make a measurement and make a sound recording from the microphone sensor.

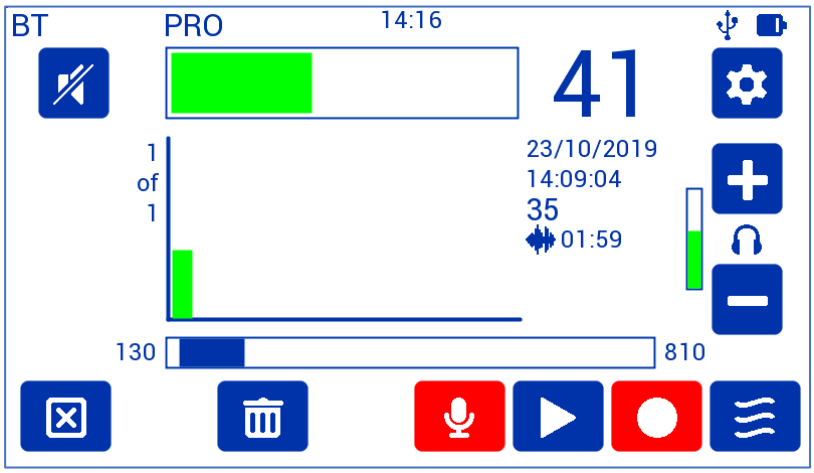


Tap on the microphone button  to make the measurement and begin the recording.

Tap on the “recording stop” button to stop the recording. 

Recordings can last up to 2 minutes. Recordings are made without any filtering being applied. Muting the headphones has no effect on the sound recording.

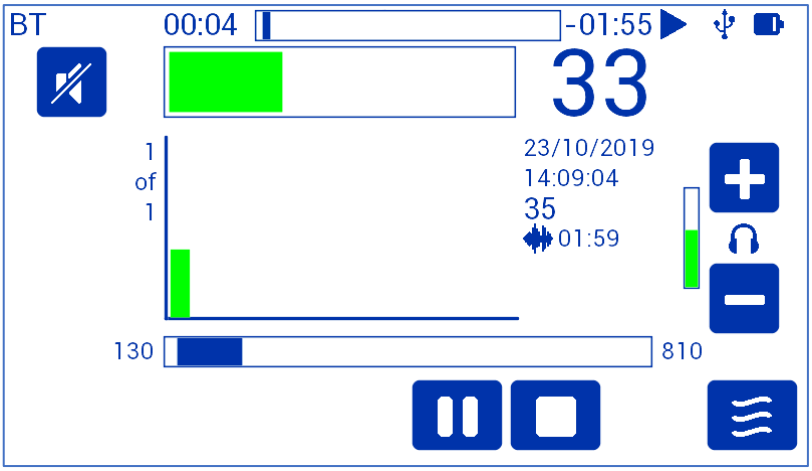
When a location is selected which has a sound recording saved, the measurement information area of the screen is appended with a “recording exists” icon, along with the length of the recording.



Tap the “Play” icon to playback the recording. 

A “playback progress bar” is shown at the top of the display.

Note that the filter bar is present in its usual position.



The recording is made without any filtering being applied to the sound. The headphone audio does have the filtering applied to the “live sound” whilst recording. During playback of the sound within DXmic, the “live sound” is muted and the headphones have the recording played into them. During playback any filter selection the user chooses will be applied to the sound received by the headphones.

Tap the filter icon to change the filter settings applied to the playback if so desired.

The sound playback will play in a continuous loop until the user taps on the “Pause” icon or “Stop” icon; These work as expected. After stopping the playback, you are returned to the previous M.L.P. screen.

If the user chooses to delete a selected measurement (or ALL measurements), the sound recording will also be deleted at the same time.

5 USING THE DXMIC PRO WITH THE DXMIC PRO APP

The DXmic PRO can be used together with a mobile phone app, “DXmic Pro App” (sometimes known as “DXmic App”). Use of the DXmic and the app together supports all of the features of the DXmic (see sections 2, 3 and 4), plus some additional features:

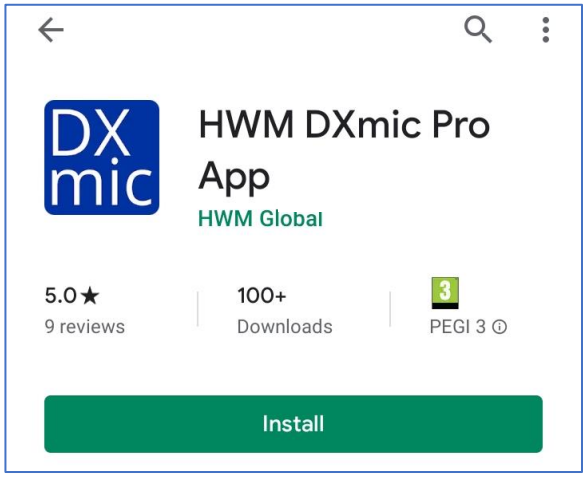
- The app provides an estimate of Geographic location to the DXmic Pro.
  The user can adjust the position manually if required.
- The app uses the phone services to provide a means of generating an e-mail report of measurement results and audio files.
  It is thus possible to store the results off-line and obtain a second opinion on the investigation from office staff, include in any reports required, etc.
- The app provides another user interface to manage the DXmic storage (e.g. to delete sound files).
- Before sending an email, the user may use other phone apps to obtain pictures for inclusion in the email.

5.1 INSTALLING THE DXMIC PRO APP / FIRST USE

Note: Screen-shot pictures used within this manual were created on an Android device. If using on an Apple iPhone or similar device, the screens may be different to those shown.

Locate the app on the Apple Appstore or Google Play.

Tap the Install button.

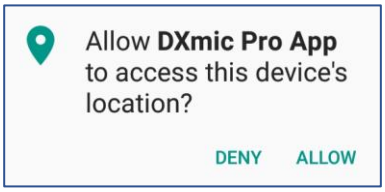


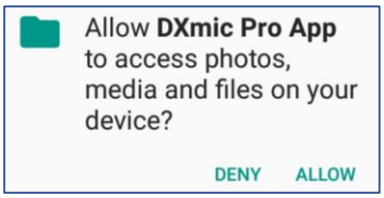
The app will install and an icon for the app will appear on the mobile phone.

Tap on the DXmic icon to launch the DXmic Pro App.

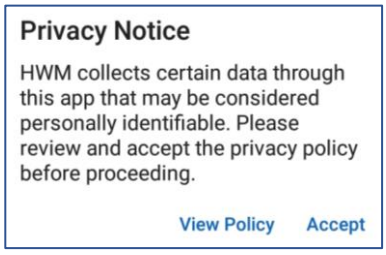
The app will launch and request permission to access various facilities within the phone.

Tap “ALLOW” to give the app the permissions it requires, otherwise it cannot correctly function.





View and accept the HWM privacy policy to continue.



Initially a “Select device” screen is shown, with the app software version also displayed.

(The app has no DXmic selected for use).

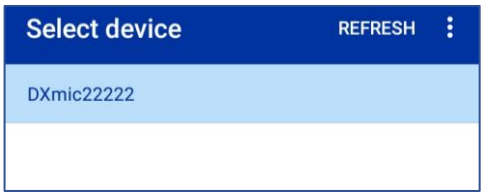
5.2 CONNECTING TO THE DXMIC PRO WITH THE MOBILE PHONE

Connection between the DXmic Pro and the app is initiated from the app.

Each time the app is launched it will ask for a DXmic to be selected. Tap on “Refresh” to scan for Bluetooth-compatible devices.

DXmic Pro devices will be listed as “DXmic” followed by “xxxxx” (5 digits).

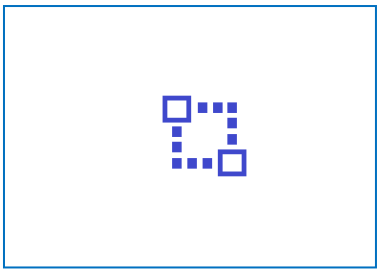
Select your DXmic Pro from the list.



Tap on the “Connect” button.

The app will connect to the DX mic.

Note: During any communication over the Bluetooth-compatible link, DXmic temporarily stops normal display update and displays only a “synchronisation” icon.



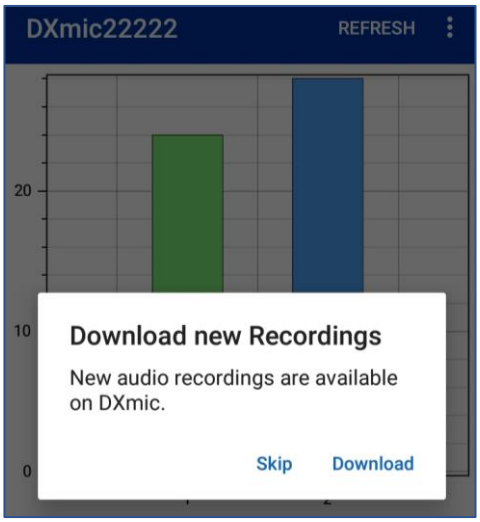
If the app considers the DXmic Pro has the wrong time (e.g. a change to or from British Summer Time), the app will suggest that the time is changed.

Tap on “Yes”; The app updates the DXmic Pro unit.

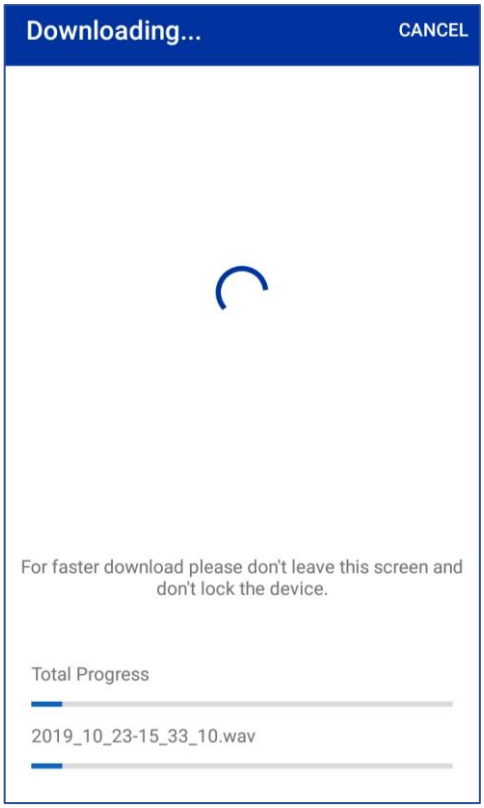
Depending on what the DXmic Pro contains, the app will either state “No measurements available” or (if the DXmic Pro already has measurements) it will download the measurements into the phone.

If sound recordings are also stored in the DXmic, the app will ask the user if these should also be downloaded.

Tap on “Download”.



Note: Usual operation is to start the DXmic Pro app when first going to a site, before any measurements are made.

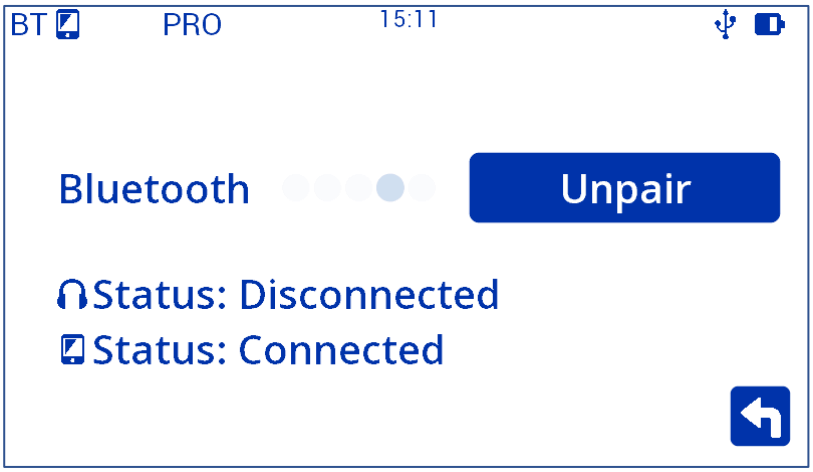


The sound file download progress is shown in the form of 2 bars. One bar represents the current file. The other bar represents the total progress of the download.

The DXmic Pro screen will show the “synchronisation icon” whilst the files are being downloaded to the phone.

When finished it will display a “phone” icon in the top left of the display.

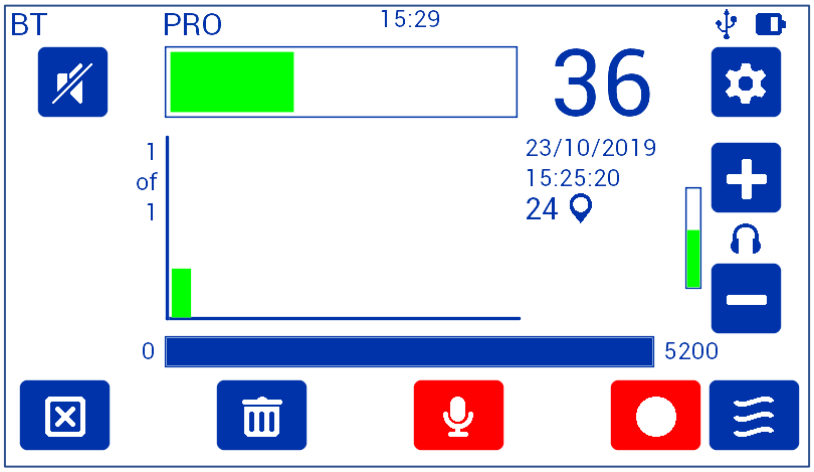
Within the Settings → Bluetooth screen, it shows a “connected” status.



5.3 Obtaining Location Data for a Measurement

When the DXmic Pro is used in conjunction with the DXmic Pro App, the app provides location information to the DXmic Pro, which gets stored with the measurement data.

When the location of a measurement is known, a geo-indicator icon is also displayed.



The location is provided by the phone, using its GPS capability. The accuracy of GPS depends on how many satellites are picked up and will be sufficient to be able to identify the general area of the site being investigated. There is a facility within the app for the user to refine the position of the measurement locations later.

5.4 DXmic Pro App Main Screen

The main screen is shown opposite.

The "graph" area displays measurement data that was downloaded from the DXmic. The download is not automated but must be requested by the user. Tap on "Refresh" to begin the synchronisation.

The user can select a single measurement by tapping on the relevant bar. A selected measurement shows the bar in green; all other bars display as blue, indicating they are not selected.

A dot near the base of the bar indicates a recording exists. The dot is green if the sound recording has been downloaded, but red if it has not been downloaded.

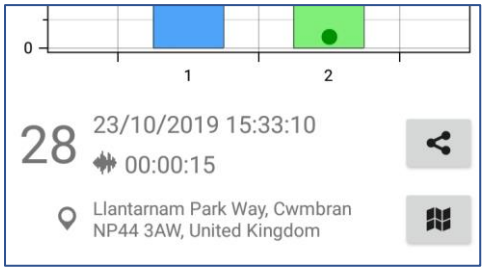
The phone graph display is of limited width, typically being able to display around 6 measurement bars. Bars "off-screen" can be accessed by dragging the graph display left or right with your finger.

The lower part of the display shows the measurement, the time and date of the measurement. If an audio file exists, it shows an icon for this along with length of recording. If geodata data is stored it does not show the co-ordinates, but an approximate address of the measurements.

5.5 POSITION DISPLAY AND REFINEMENT (MAP VIEW)

The location where a selected measurement was made can be shown on a map.

Tap the “map” button.



A map will be displayed.

A blue dot shows the estimate of the current position of the phone. The accuracy (uncertainty) of the position is shown by a shaded disc that reduces in size as more satellites are picked up.

The stored geodata of the selected measurement is indicated by a green geolocation symbol. An address bubble is on top of the geolocation symbol. If any non-selected measurements fall within the map area they would similarly be located, but with a blue geolocation icon.

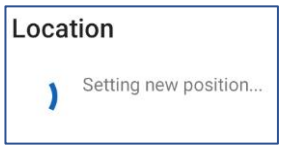
To refine the location of the measurement, tap on “Modify”.

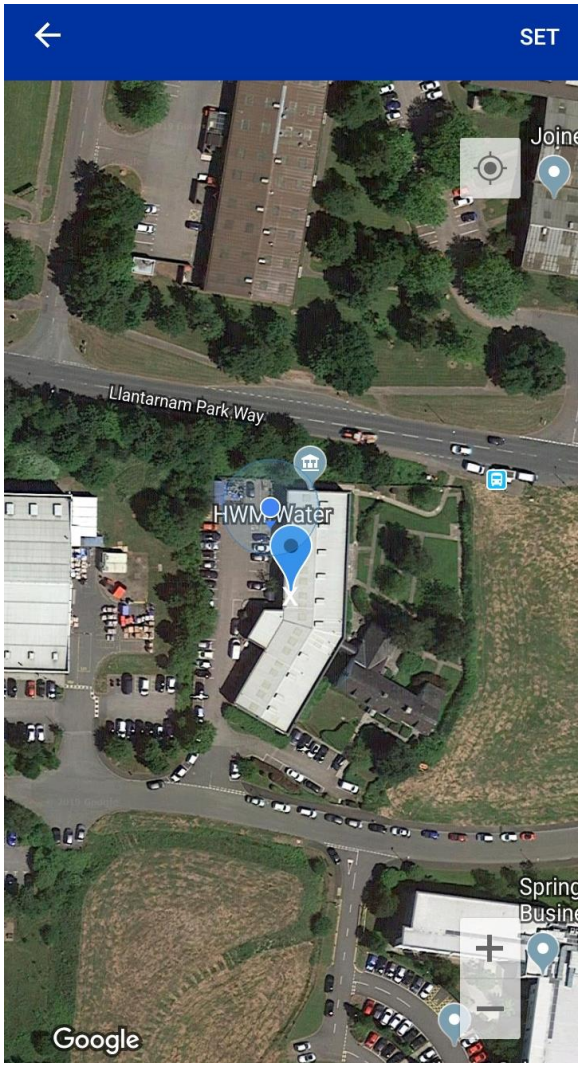
A white “X” will appear under the geolocation symbol.

Zoom into the map and drag it with your finger in order to the position the “X” at the exact location of the measurement.

The tap “Set”.

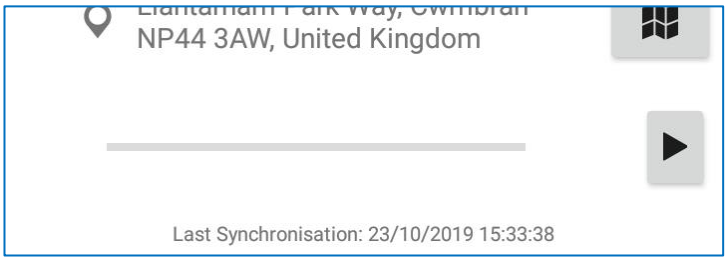
The new GPS coordinates will be stored within the DXmic Pro unit.





5.6 AUDIO PLAYBACK

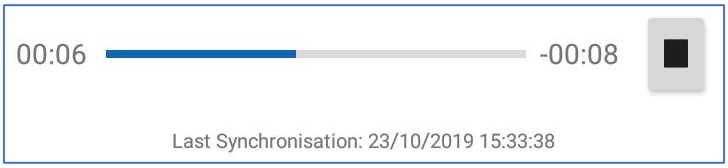
Tap on the “play” icon to play the sound recording through the phone speaker or headphone socket.



A progress bar is displayed during playback.

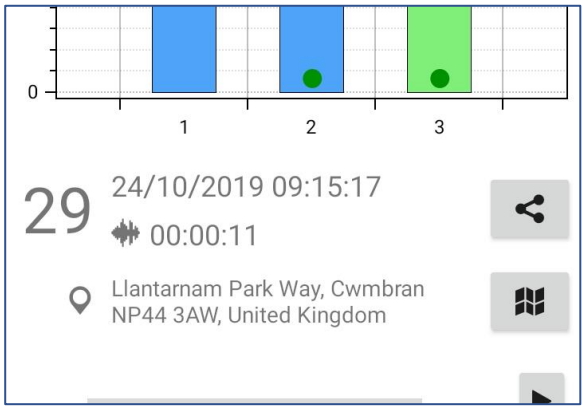
Playback has no frequency filters applied.

Playback is a continuous loop until the user cancels it by tapping the “stop” icon.



5.7 SHARING MEASUREMENTS AND SOUND RECORDINGS WITH OTHERS

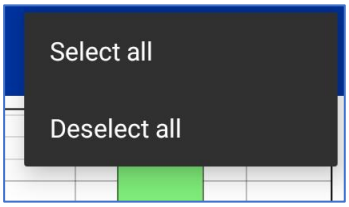
After ensuring the positions of measurements you wish to share are accurately set, tap on the “share” icon (on the main screen).



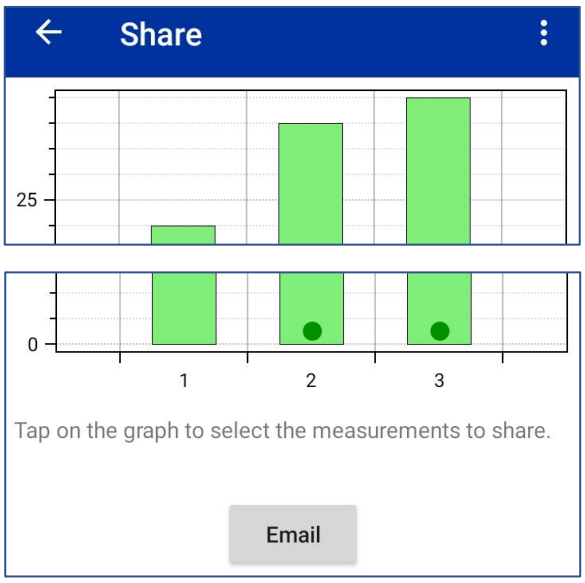
The “Share” screen is launched.

Multiple measurement locations can be selected to be shared. A selected item changes from blue to green.

Tap on the menu (3 vertical dots) to select or deselect all.



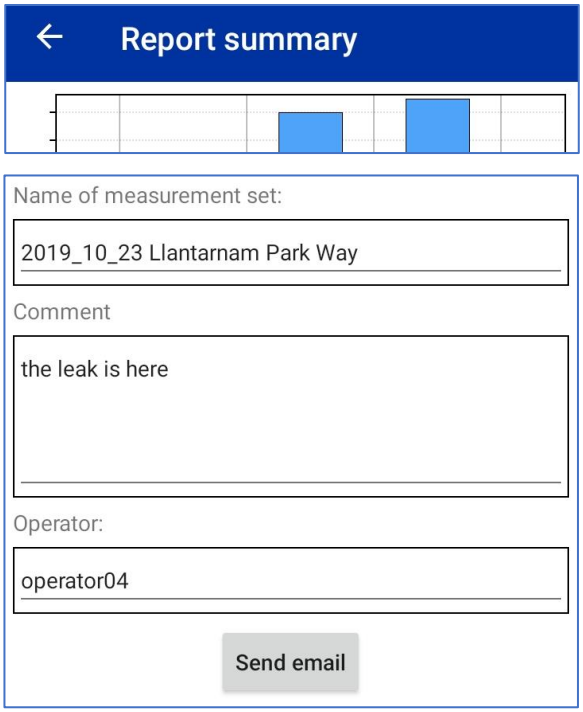
When finished, tap on the “Email” button.



The “Report Summary” page is displayed.

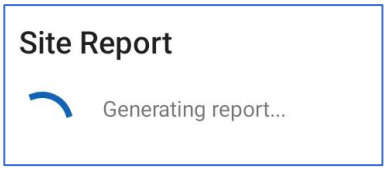
Complete the information on the form.

Modify the address if required.



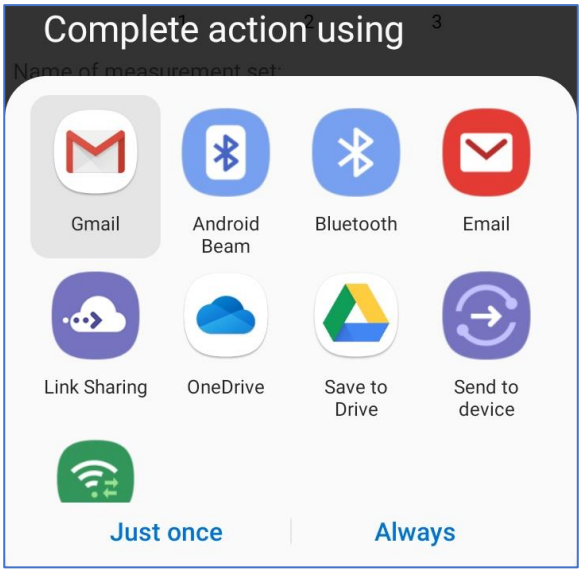
Then tap the “Send email” button.

The app will generate a report for emailing.



Select your usual e-mail application from the listed phone apps.

Then tap “Just once” or “Always”.



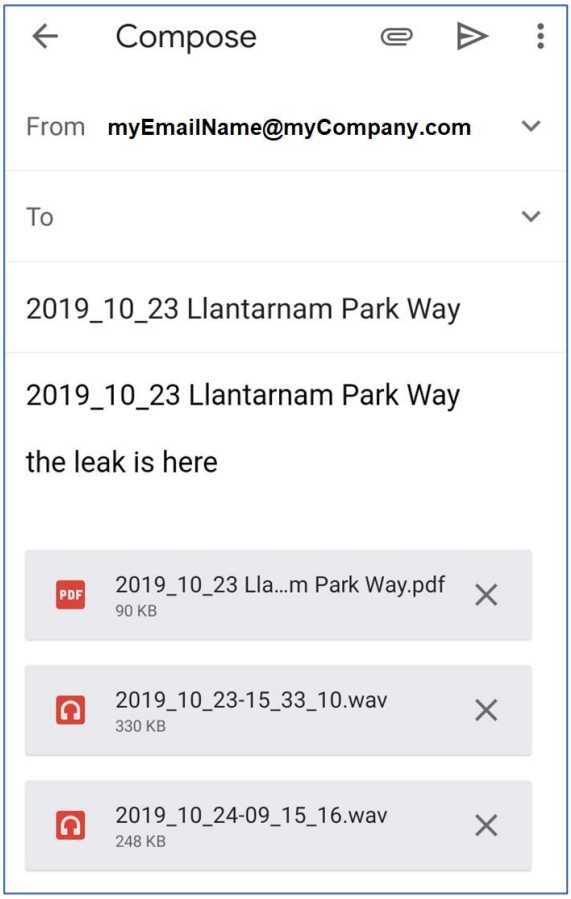
The report is generated as a *.pdf file.

The pdf file and any sound recordings are added to the email as attachments.

(The recordings are in the *.wav file format).

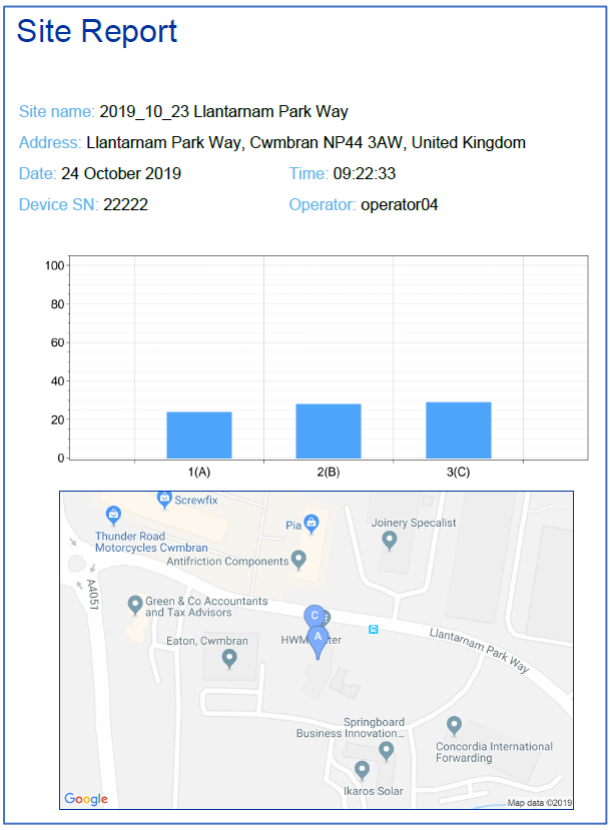
Complete the “To” section (the email address that you want to send the data to).

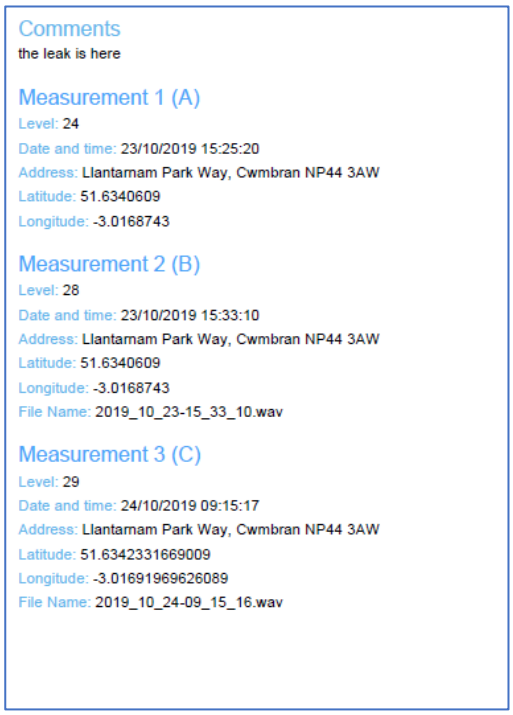
Send the e-mail
(e.g. press the send icon).



The recipient of the e-mail will receive the attached files.

The report content will be similar to that shown below.





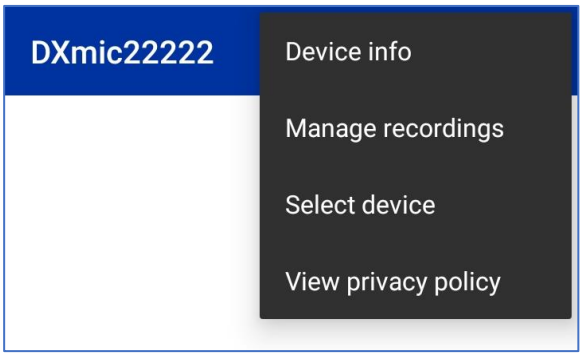
Any sent audio files have had no frequency filters applied.

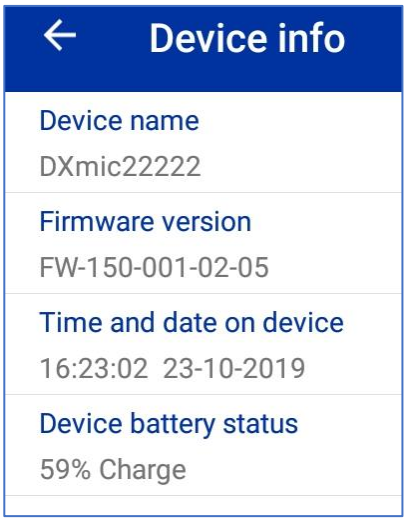
5.8 DISPLAYING DXMIC PRO UNIT INFORMATION

From the main screen:

Tap on the menu (3 vertical dots) to display the menu items.

Tap on “Device Info”.





A list of the DXmic Pro device information is displayed, including the battery charge status.

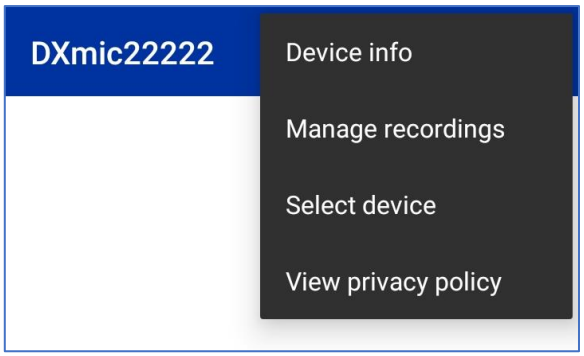
5.9 Listing, Playing and Deleting Sound recording data

Sound recordings can be removed from the phone memory as follows:

From the main screen:

Tap on the menu control (3 vertical dots) to display the menu items.

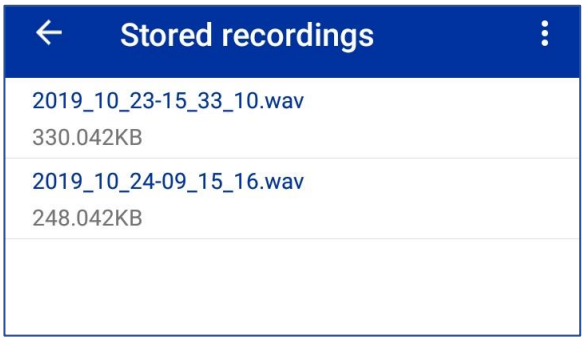
Tap on “Manage recordings”.



A list of stored recordings is displayed.

If you wish to play a recording, tap on it to select it.

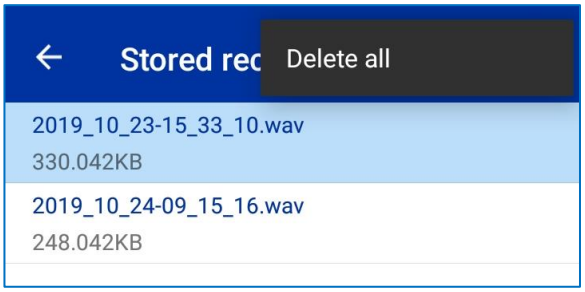
Then use the play control at the bottom of the screen.



(The sound will play in a continuous loop until the user cancels the operation by tapping the stop icon).

To delete ALL audio files, use the menu and select “Delete all”.

This does not affect anything stored in the DXmic Pro.



Note: Audio recordings and measurement data are also deleted from the app if the user does so from the DXmic Pro unit (see 3.7.2) and then synchronises the app to the DXmic Pro using the “Refresh” button.

6 TROUBLESHOOTING AND MAINTENANCE

6.1 CLEANING

Do not attempt to clean the mains powered chargers.

The DXmic unit and its accessories can be cleaned with a damp cloth and a mild cleaning solution. Do not allow any water to enter the connectors. Dry the unit after cleaning.

6.2 TOUCH SCREEN CALIBRATION

If the screen does not correctly react to being tapped, it may require calibration.

To calibrate the touch screen, turn off the DXmic by pressing the push button for three seconds. Push the button again to turn on the device. Keep the button pressed until after the splash screen disappears, the calibration screen will appear. Tap the small flashing dots as accurately as possible to complete the calibration process. Once completed, the DXmic automatically begins normal operation.

6.3 SOFTWARE UPDATE

The DXmic has a facility to upgrade the firmware.

You can obtain the latest firmware for DXmic by downloading the latest version of the Installation and Diagnostic Tool (IDT) (for a Personal Computer) from the HWM website www.hwmglobal.com.

To perform a firmware update:

- Install the latest version of IDT on your PC.
- Connect the DXmic to the PC using a USB micro cable (not included).
- Launch IDT and click on “Read Device”.
- If a newer firmware is available a message will appear asking you if you want to update the software; Click on “OK” to perform the update.
  Note: The update might take several minutes to complete.
  During the update do not disconnect the USB cable and do not quit IDT.

WARNING: All measurements data (and audio recordings DXmic Pro) will be lost after a software update.

6.4 BATTERY REPLACEMENT

Although the batteries are rechargeable, they may eventually need to be replaced. Only batteries configured to the correct specification and type must be used, these are available from HWM Water.

To replace the batteries, switch the unit off and unscrew the six screws of the battery compartment cover on the underside of the unit (see 2.2), using a 2mm hex socket (Allen Key). Unplug the battery connector by depressing the connector locking mechanism and remove the battery pack. Connect the new battery pack, then replace the cover using the six screws and lightly tighten to 0.3Nm. Ensure any seals are correctly seated before tightening.

6.5 Service and Repair

Failed units or those with suspected faults can be returned to the HWM service center for investigation upon completing an on-line RMA (Return Materials Authorisation) form.

https://www.hwmglobal.com/hwm-rma/

Ensure the unit is cleaned with a mild cleaning solution and dried prior to shipment.

7 Guidance to Effective Acoustic Leak Detection

7.1 Introduction

All acoustic leak detection methods are based on the premise that normal water passage through pipelines takes place noiselessly. When the water passage is disturbed a noise is created. Causes can include partial pipe blockages, sudden changes in pipe diameter, abrupt changes in pipe direction, pumps or meters installed in the pipeline, consumer usage or pipeline damage. Pipeline damage can include holes, cracks or splits, complete pipeline rupture, leaking joints or leaking valves.

Careful application of leak detection techniques will enable the operator to eliminate detected noises generated by poor pipeline design or consumer usage and to identify leakage due to pipe system damage.

The strength and clarity of noise generated by leaks will be affected by the water pressure, the size and shape of the orifice allowing leakage, the type of ground material around the pipeline, the type of ground cover over the pipe, the diameter, wall thickness and material of the pipeline and the quantity of water leaking.

A small orifice or hole and a high water pressure generally produces a higher frequency noise. Often the noise level increases around valves, pipe elbows, T-connections and pipe ends, etc... since the partial obstruction increases pressure and creates some further disturbance in the water path.

Leak noise is transmitted along the pipeline both through the water and the pipe wall, as well as into the ground around the pipe. The noise travels much better through "hard" materials: further along metallic pipes than asbestos cement pipes which themselves are better than plastic pipes. Ground material generally provides a poorer travel path than the pipeline itself. Soft sandy ground provides a worse travel path than well compacted ground with a hard-paved surface covering.

The leak noise can change in strength and pitch as it travels along the pipe or through the ground. The deeper the pipe is buried and the softer the ground the more the noise will be dampened.

When a leak is produced in a metallic pipe the leak noise will transmit well through the pipe. It does not travel so well through a plastic pipe. This means that a leak noise can be heard further away on metal than on plastic. Also bear in mind that the further you go from a leak noise source the more difficult it is to pinpoint that leak noise accurately.

Background noise can interfere with leak detection. Traffic and machinery noises can travel for considerable distances through both air and ground material and often occur in the same frequency bands as leak noise. Sometimes it is necessary to use leak detection techniques at night when interfering noises are less.

It is very important to adopt a methodical approach when using any instrument for acoustic leak detection. It is necessary to practice the technique in order to distinguish between different sounds, recognising background or interfering noises, so that they can be eliminated. It is also essential that other (non-leakage) system noise sources such as consumer draw-off or partially closed valves be eliminated by logical site inspection practices prior to any excavation taking place.

7.2 SURVEYING

The leak location can be narrowed down by listening at accessible contact points such as meters, hydrants, valves and stop-taps. These provide good points of sound pick-up, particularly if the pipe is metallic. Use the hand-probe/extension rod to listen at these points.

If there are no accessible contact points or if the pipe is of non-metallic material, use the microphone foot for listening, placing the foot over the pipe route in the area of the suspected leak. Move along the pipe route listening at each accessible pipefitting

Or at regular positions on the ground until you have identified the area of maximum noise level.

Note: When you are listening on pipe-fittings the location of the point of maximum noise will probably not indicate the leak position, only the fitting closest to the leak. The

noise level will also appear stronger where there is less thickness of ground or other material for it to pass through. The leak noise will follow the path of least resistance.

7.3 PINPOINTING THE LEAK POSITION

Pinpointing the leak position involves a process of comparing a number of leak noises. Select the most suitable sensor device; the microphone foot for hard ground surfaces or the hand probe for soft ground.

Operate the ground microphone and adjust the headphone volume control to a comfortable listening level. Once you have listened to the noise through the headphones, mute the headphones and move the microphone foot or hand probe to the next test position.

Repeat the sequence to listen to each of the test locations moving along the pipe route in the direction where signal strength is increasing. If the leak noise level falls you have passed the leak and should go back and reduce the distance that you move between measurements. The loudest leak noise will then indicate the location of the leak bearing in mind the ground conditions already mentioned.

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