



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

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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:

<u>Model Number</u>	<u>Description</u>
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.

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

1.3 INTRODUCTION

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.

Two versions (feature sets) of the DXmic unit are available (refer to section 2.6), the DXmic and the DXmic Pro. The DXmic Pro also can be used in conjunction with an app (called DXmic Pro App). (Refer to section 5.1 for DXmic Pro App installation details).

The DXmic can be used:

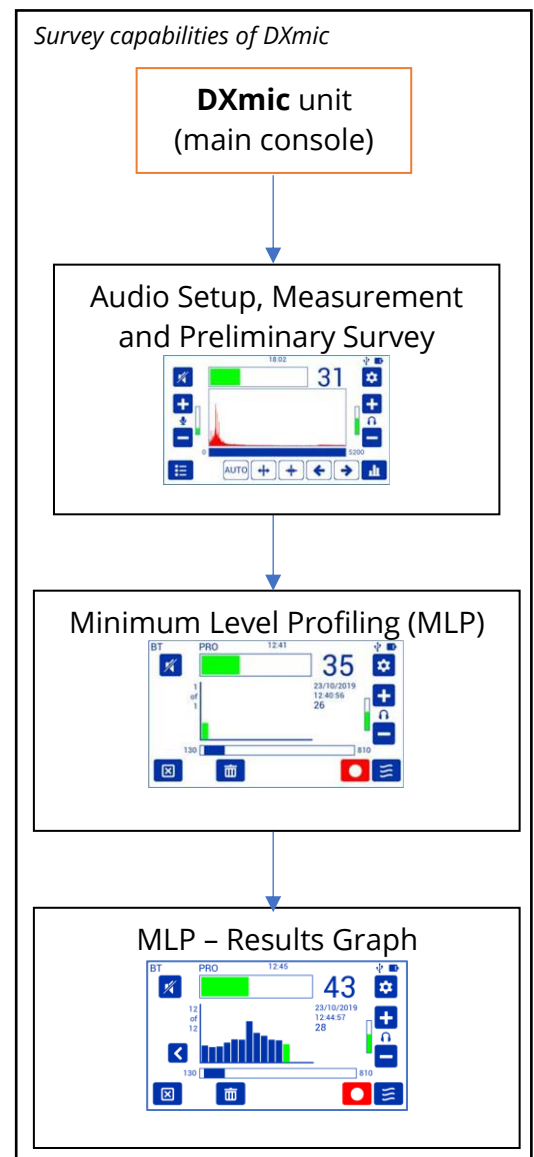
- As a listening tool for a user who is listening for the sound of a leaking pressurised water pipe.
- To undertake surveys of an area to try to detect and locate a leak.

There are various ways the two versions of the instrument can be used to undertake a survey.

A summary of the **DXmic** unit survey capabilities is shown opposite.

A summary of the **DXmic Pro** unit survey capabilities is shown below.

Full capabilities require the use of the unit in conjunction with the DXmic Pro App.



Survey capabilities
of DXmic Pro

DXmic Pro unit (main console)

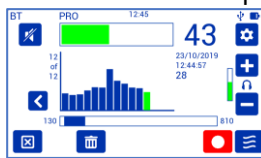
Audio Setup, Measurement
and Preliminary Survey



Minimum Level Profiling (MLP)



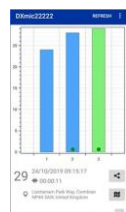
MLP – Results Graph



DX Mic Pro App

Manual Survey
(Select 'Measurements')

Manual Survey
(Obtain GPS, sound levels,
audio recordings)

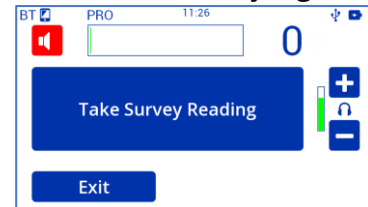


Group and send survey data
via e-mail or to 'the cloud'

DX Mic Pro App

Auto Survey
(Select 'Survey Mode')

Main console used to measure and
make leak / no-leak judgement.



(App automatically records
GPS, sound levels, recordings,
leak judgements)

App automatically groups and
sends survey data to 'the cloud'

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.

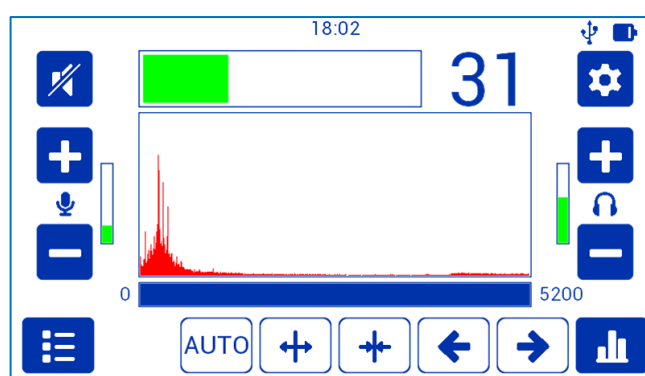
The DXmic LCD screen will be blank and the unit will power-down.

2.4 DXMIC LCD SCREEN

The DXmic screen is touch sensitive, so it has a dual purpose:

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

On power-up, the LCD screen will show the “live measurements” screen (as shown opposite). This displays measurements in a choice of graph or gauge formats. It is also used to ensure the DXmic audio circuits are suitably set.



2.5 DXMIC - LANGUAGE SELECTION (USING THE SETTINGS PAGE)

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

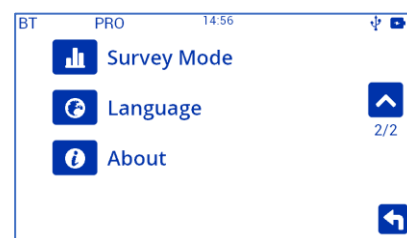
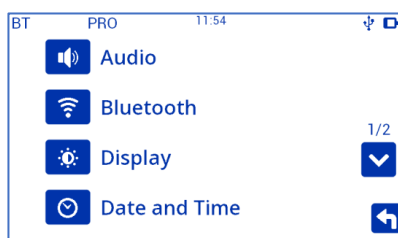
Tap the settings icon,



Tap the next page icon,



Tap the Language icon,



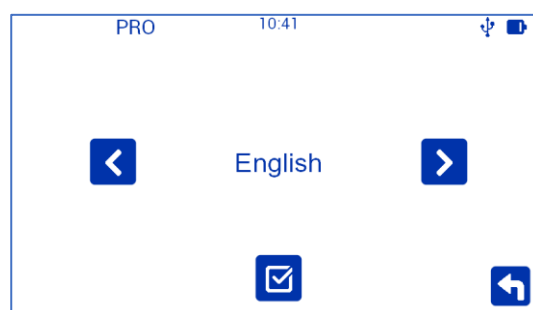
Tap the change selection icons to navigate between the available languages.



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 or by upload to DataGate. (See also section 1.3).

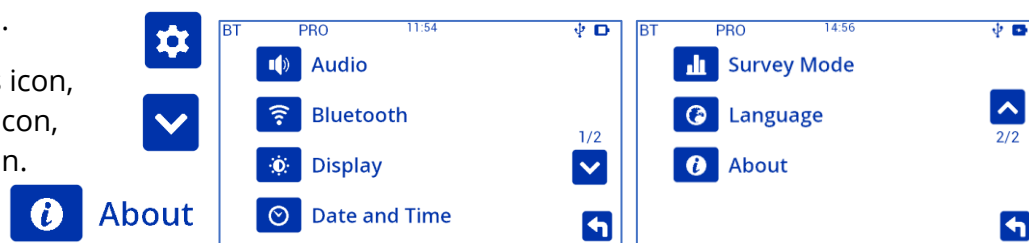
2.6.2 Compatibility of DXmic Pro with Phone models (for DXmic Pro App)

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 Pro 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 Pro App to only Android-based devices.

“B” version supports Bluetooth Low Energy protocol and allows installation of the DXmic Pro 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:

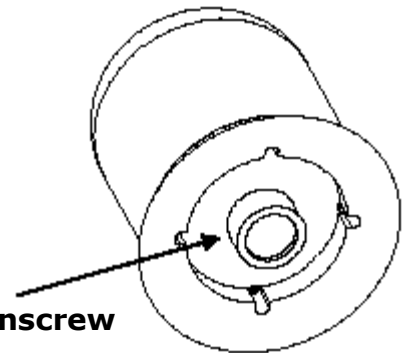
- The acoustically shielded ground microphone foot, or
- The handheld microphone unit with tripod, or
- The handheld microphone unit with probe rods.

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

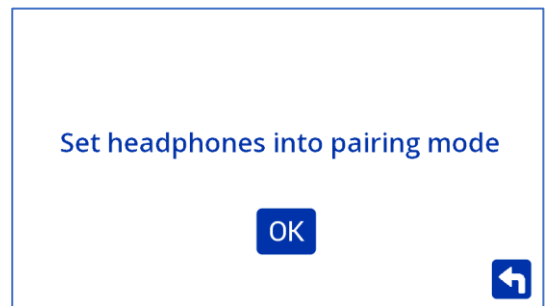
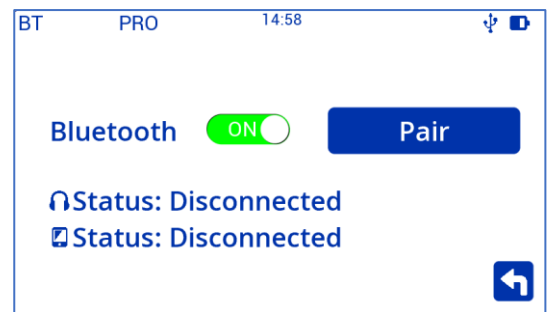
- headphones and
- mobile phone device



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.



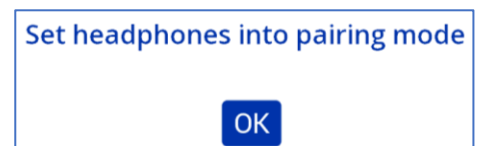
Follow the instructions of the headset for putting it into pairing mode.

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.

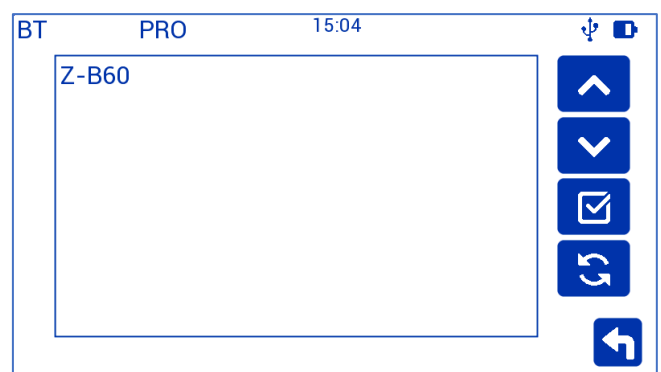


If your headset is not found, press the refresh button to re-scan.



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

Then tap the selection confirm box (tick).

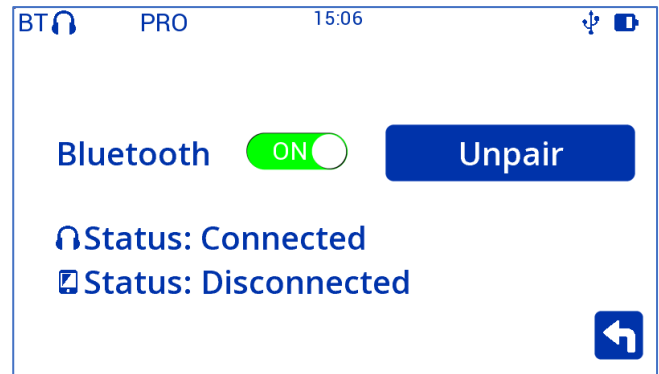


The Bluetooth display will now read 'Status: Connected'. A "headphone" image will be shown next to the "BT".



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

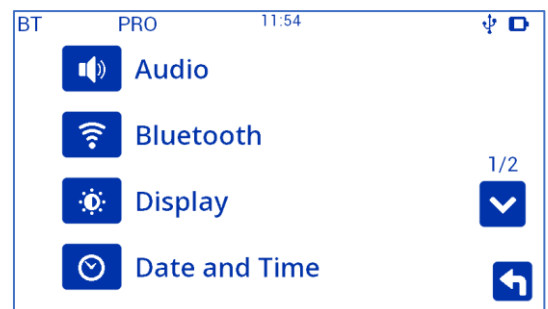
It is advisable to set the date and time in the DXmic as it can time-stamp certain activities.

To set the time ...

Tap on the settings icon,



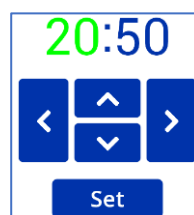
Tap the "Date and time" icon.



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 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.

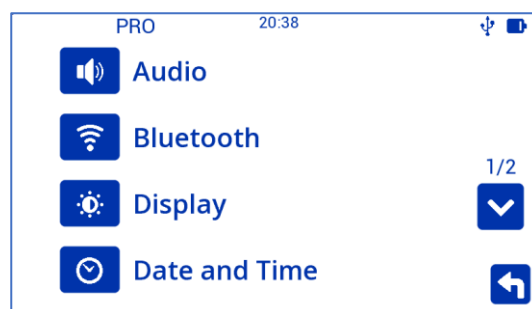
2.11.1 Adjusting Brightness of LCD back-light.

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.

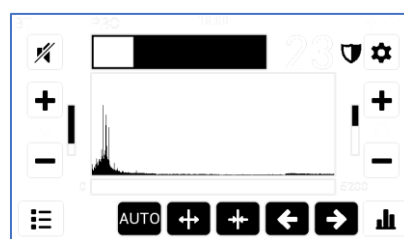
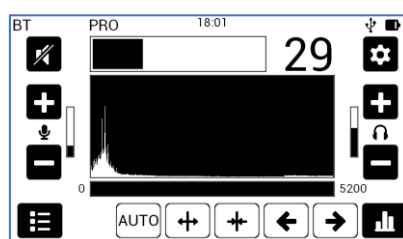
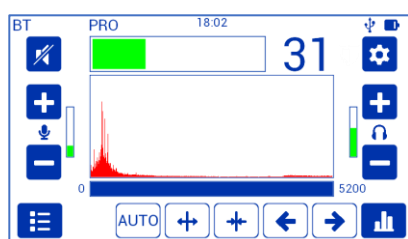
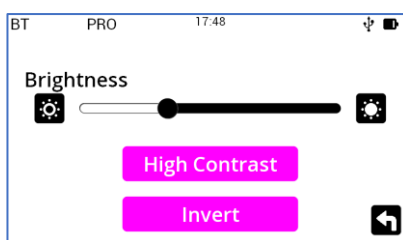
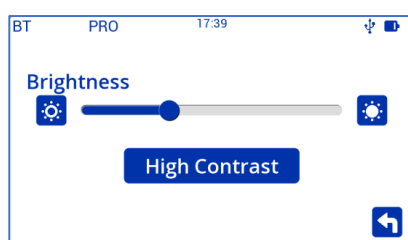
A brighter display increases battery use, but the user should prioritise the setting for comfort of viewing.



2.11.2 Setting to a high-contrast colour-scheme

In addition to backlight adjustments, there is a "High Contrast" button (see above). This changes the display from the default colour scheme into a high-contrast scheme.

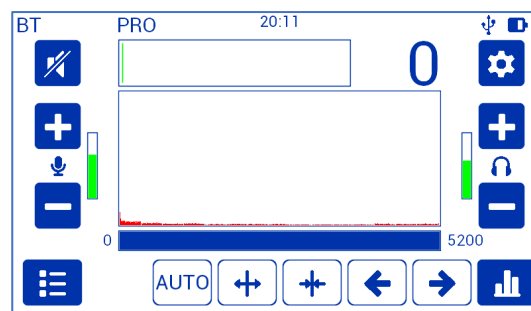
Tap on "Invert" to change to the alternative High Contrast colour scheme.



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.

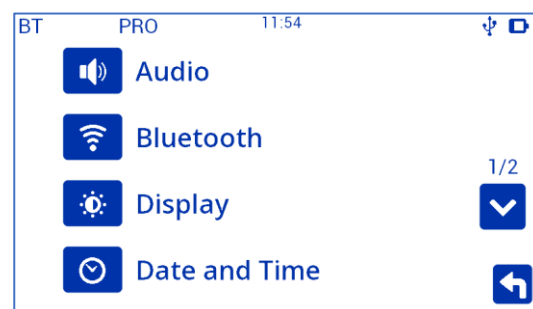
Tap on the settings icon,



Tap on the "Audio" icon.



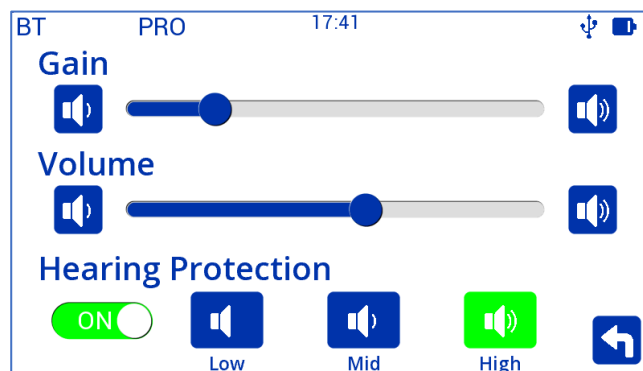
Activate the Hearing Protection filter.



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

- LOW - cuts the output at level 70
- MID - cuts the output at level 80
- HIGH - cuts the output at level 90

Tap on the screen exit icon when adjustments are completed.



The figures shown above 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).

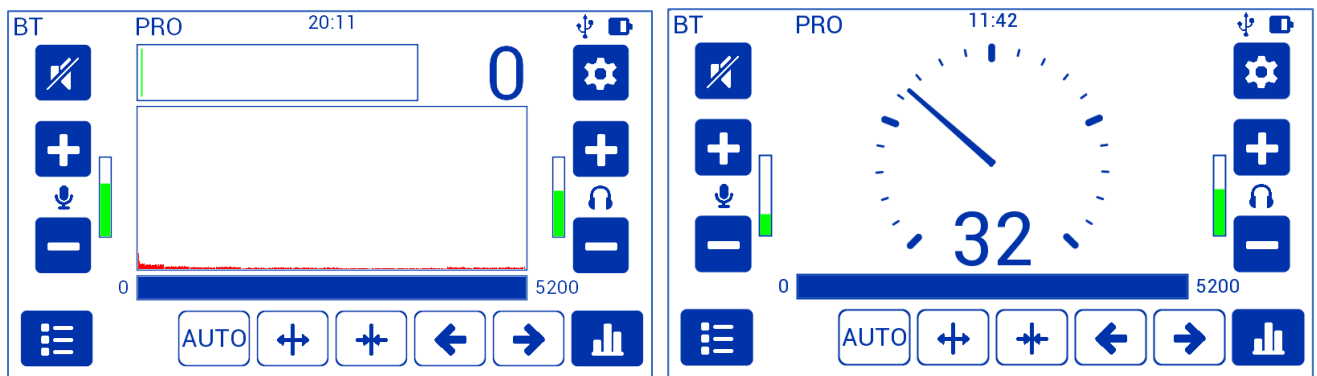
DXmic Pro unit used with DXmic Pro App:

- Provides location information for each measurement.
- Provides ability to share results via e-mail or upload an entire survey to DataGate.

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:

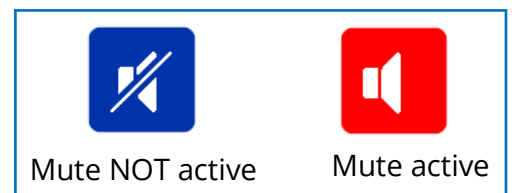
- When the touch-screen has been recently tapped, the backlight is on and LCD graphics are updated.
- After 60s of the touch-screen not being tapped, the backlight is dimmed, and LCD graphics remain being updated.
- After 300s of the touch-screen not being tapped, the backlight is switched off and all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

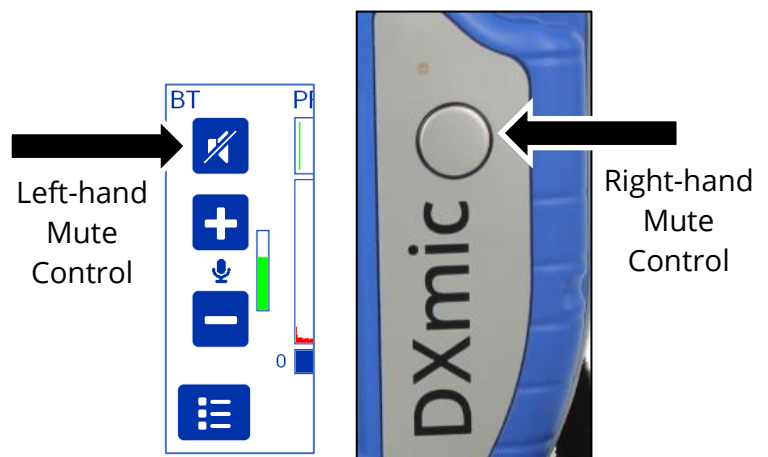
The LCD display has an icon at the top left of the display showing the current mute status of the headset.



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 gain (amplification 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.

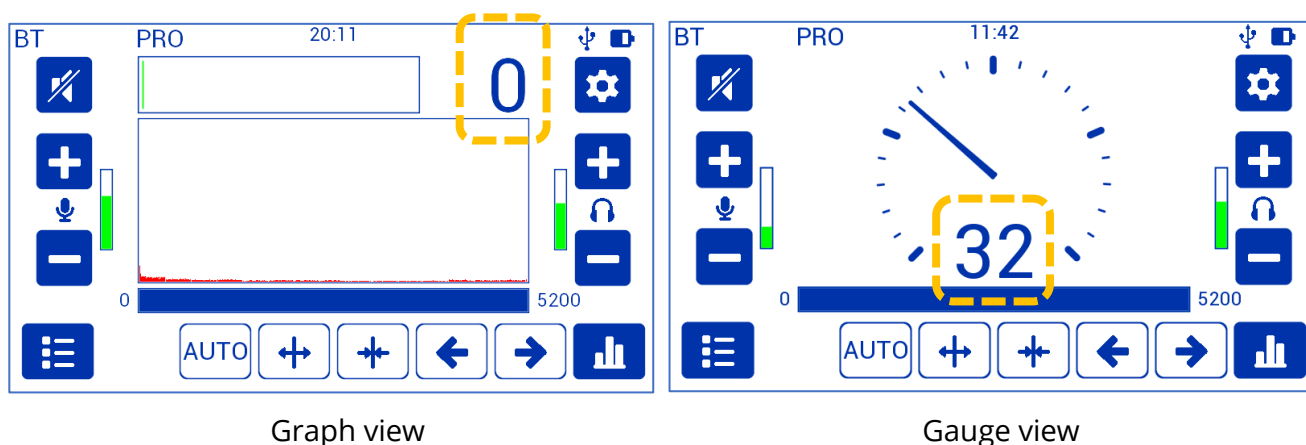


The DXmic is designed to handle frequencies from 0Hz to 5200Hz.

The filled blue area(s) 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 \leftrightarrow pass ; pass \leftrightarrow stop).

3.2.7 Digital Power Level indicator



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 (in dB) 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).

Note: The numeric display indicates power in dB. This is relative to the signal level at which the DXmic electronics can first detect sound; its 'hearing threshold', so to speak. This can vary with the type of microphone being used and also the gain of the microphone input (which is user-adjustable via the microphone volume control).

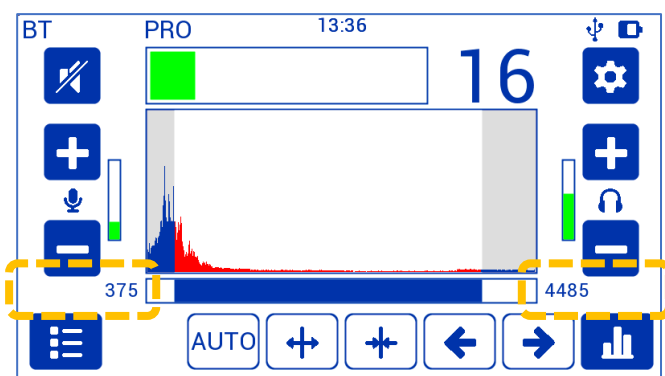
3.3 ADJUSTING THE INPUT GAIN (BEFORE MEASUREMENTS AT A NEW SITE)

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 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 graph shows frequencies in the range 0Hz to 5200Hz.

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 (shown in red) 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.

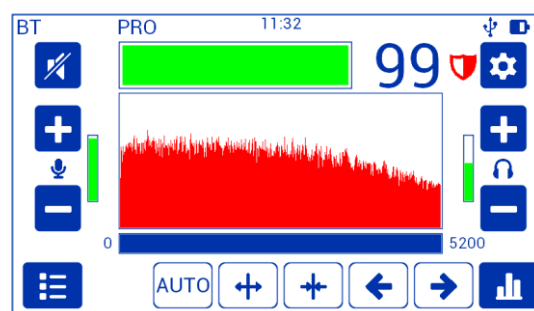
(Saturating is when the display indicates “99” or somewhere close to it, even occasionally).

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.



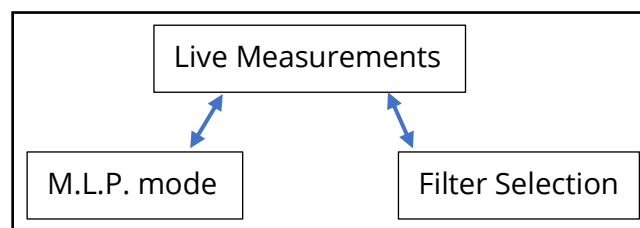
Note: Since the ambient noise and pipe sound level will vary from one site to another, this check / adjustment **should be re-done** each time a new site is visited.

(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 SCREEN NAMES / NAVIGATING BETWEEN THE VARIOUS SCREENS

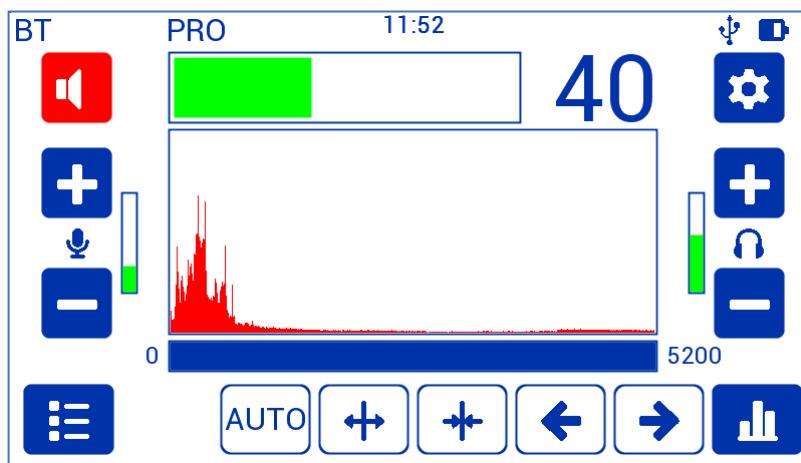
This section introduces the various screens that exist on the DXmic, and also how to navigate between the various screens. This is summarised in the diagram opposite.



3.4.1 Live Measurements screen

The “Live Measurements” screen (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. (Refer to the diagram below).



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

The DXmic in “M.L.P. mode” uses the Minimum Level Profile screen (see diagram below).

To navigate to this screen, from the “Live Measurements” screen:

Tap the “Minimum Level Profile” button. (Refer to the diagram above).

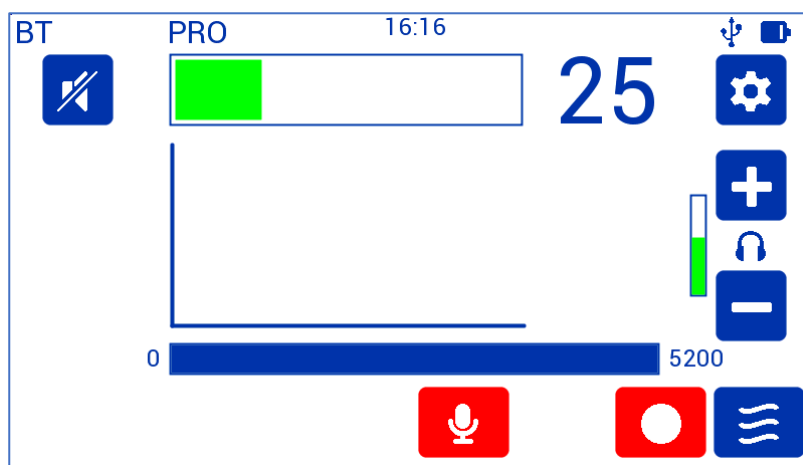


The view will change to the “Minimum Level Profile” screen, shown opposite.

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).

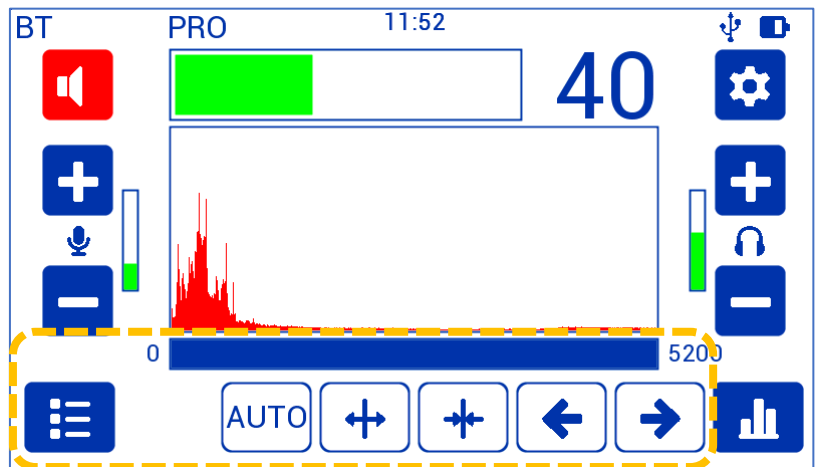
To access filter settings, the user must first switch back to the “Live Measurements” screen (see section 3.4.1).



3.4.3 Filter Selection screen

Filter selection takes place on the lowest part of the “Live Measurements” screen.

The chosen filter settings remain in effect for most screens. Check the filter settings bar present on the screen to confirm this.

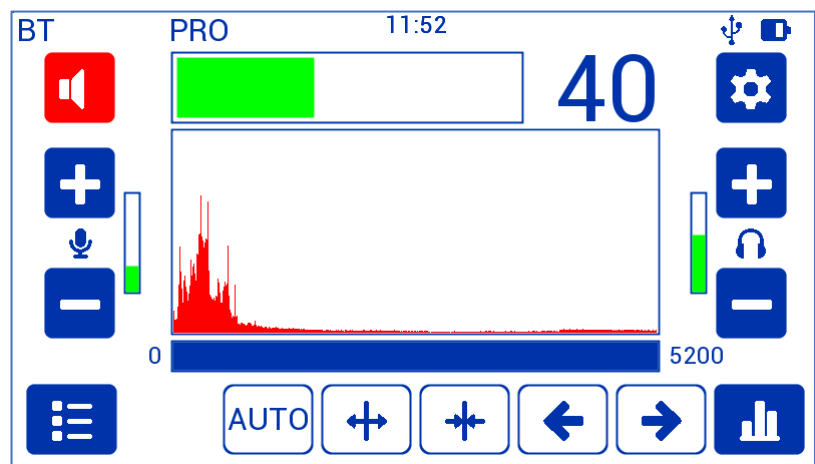


3.5 USING THE LIVE MEASUREMENTS SCREEN / PRELIMINARY SURVEY

The “Live Measurements” screen is initially used for setup of the DXmic sensor gain.

The screen also provides visual feedback of the measured sound level and its frequency content. This can help the user isolate the sound of a water leak from a pressurised pipe.

It also gives the user access to many of the DXmic controls.



Setup the microphone gain as described in section 3.3 before making any evaluation of the sound.

During an investigation the user can conduct a Preliminary Survey:

- Use the DXmic to listen to the sound at ground level.
- Try to identify the sound of a leak.
- Repeat the listening process at various locations.
- If the microphone input level is found to be saturating, repeat the setup process at the louder location.

The DXmic instrumentation (sound level and audio frequency spectrum indications) can then be used to make the final comparisons (with the input level no longer needing adjustment). The location of the leak is likely to correspond to the loudest volume of the leak-sound. Refer to section 9.

The task of identifying a leak sound can often be made easier by applying a filter to the audio (see 3.6) to remove some of the irrelevant background noise.

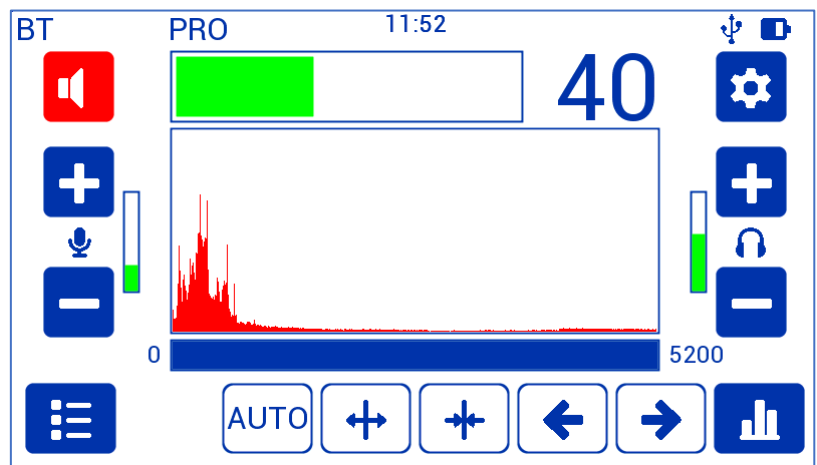
3.6 USING A SOUND FILTER

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 “[Live Measurements](#)” screen.

The frequency filter settings are applied to:

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



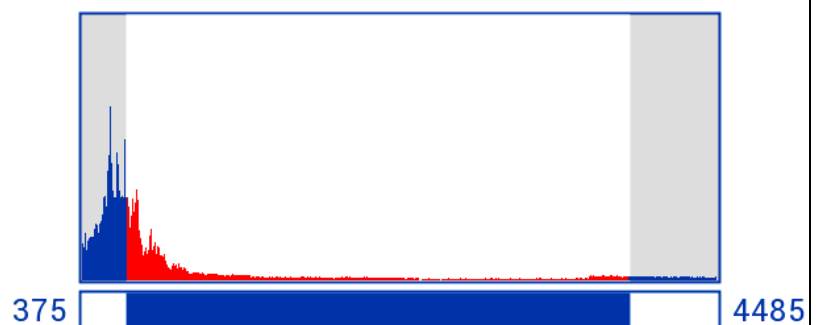
The heard audio level and the displayed digital power level should fall slightly if a significant amount of background noise can be rejected.

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 (those in the greyed out area).



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.

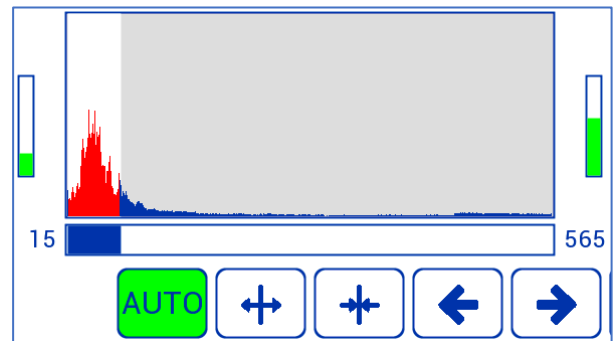


When “Auto” button is tapped, it changes to green in colour; Auto is active.



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.

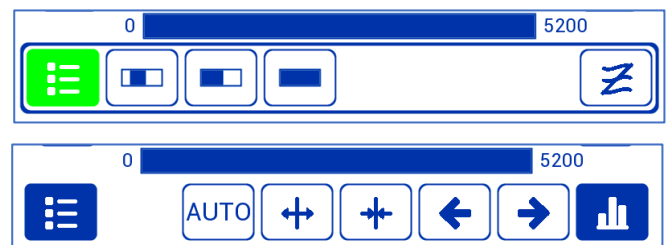
There is a “Pre-set Filters” button on the screen.

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.

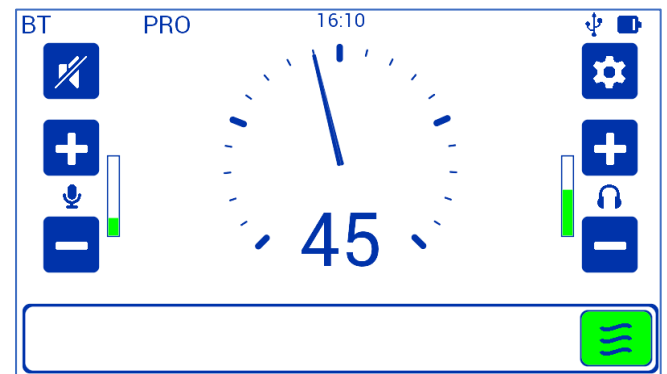
A green button remains that will de-activate the mode and return the user to the regular filtered mode.



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 MANUAL SURVEY / M.L.P. MODE (MINIMUM LEVEL PROFILING)

The DXmic product range offers two types of “survey mode”:

- “Manual Survey”: This is available on all DXmic models.
(It is described in this section).

Note: The DXmic Pro unit (& App) can additionally share the survey results.

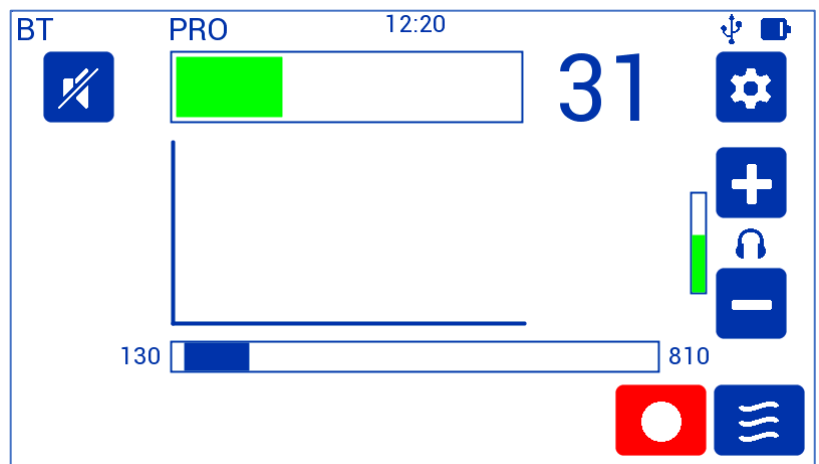
- “Auto Survey”: This is available only on ‘DXmic Pro’ models.
(It is described in section 6).

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 “Live Measurements” screen to setup the microphone sensor level and filters. The general area for closer examination should also have been found whilst listening to the DXmic audio and evaluating the area around the site using the “Live Measurements” screen.

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 (as in the preliminary survey), the M.L.P. mode uses the sound power level meter within the DXmic to produce a numeric value which is then stored in the memory of the DXmic. Multiple locations are measured, thus forming a **survey** of the area with the corresponding set of results). The results can be compared to assist in locating the leak. The result for each location is displayed using a bar graph (known as the M.L.P. 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 can 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.

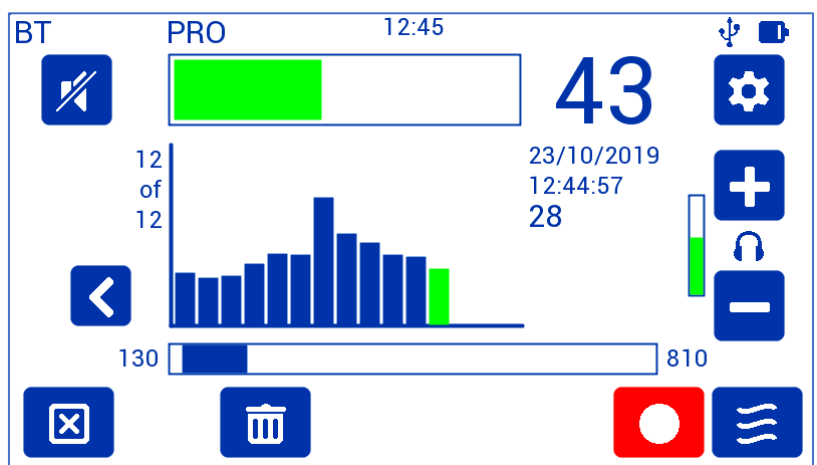
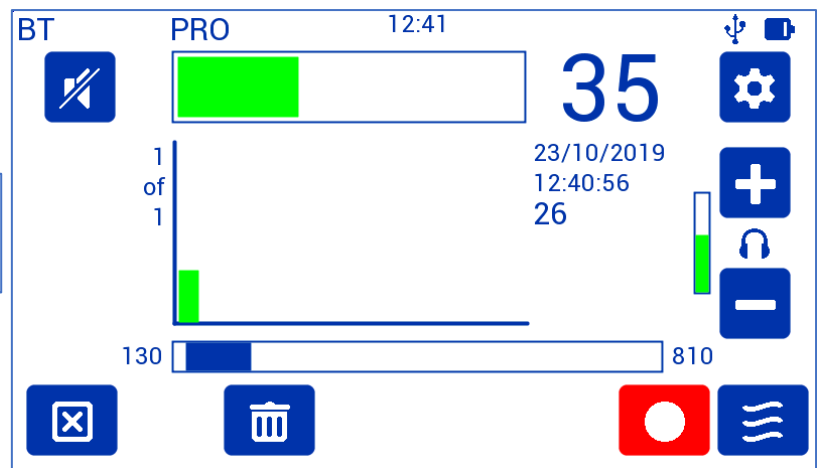
23/10/2019
12:40:56
26

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

The DXmic stores 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.

23/10/2019
12:44:57
28



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.



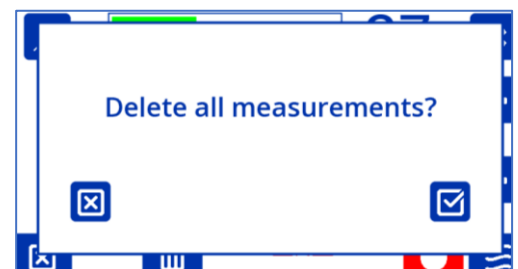
Note: No confirmation is required when deleting the selected measurement.

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



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

Deletion of the results of a survey, when they are finished with, can simplify evaluation of the next survey; you start with a “blank canvas”.



4 USING THE DXMIC PRO

The DXmic Pro models support all the features of the DXmic (see sections 2 and 3), plus some additional features:

- Sound recording and playback is added to M.L.P. mode.
- Option to use DXmic Pro with the “DXmic Pro App” mobile phone app.

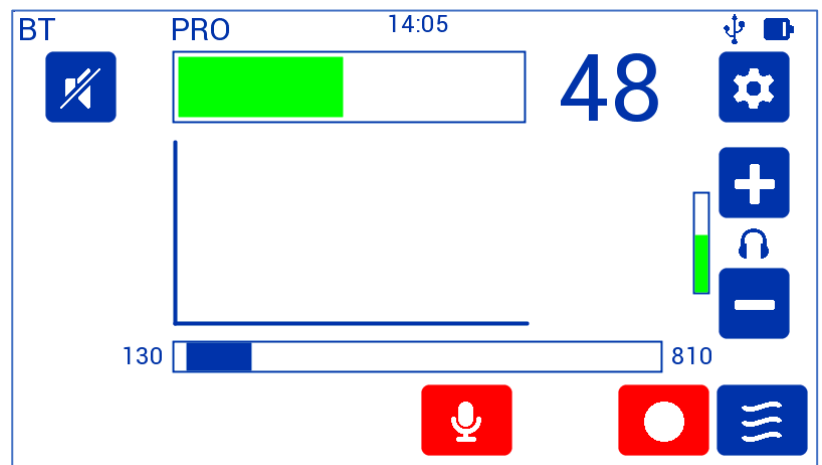
4.1 SOUND RECORDING AND PLAYBACK IN M.L.P. MODE

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.



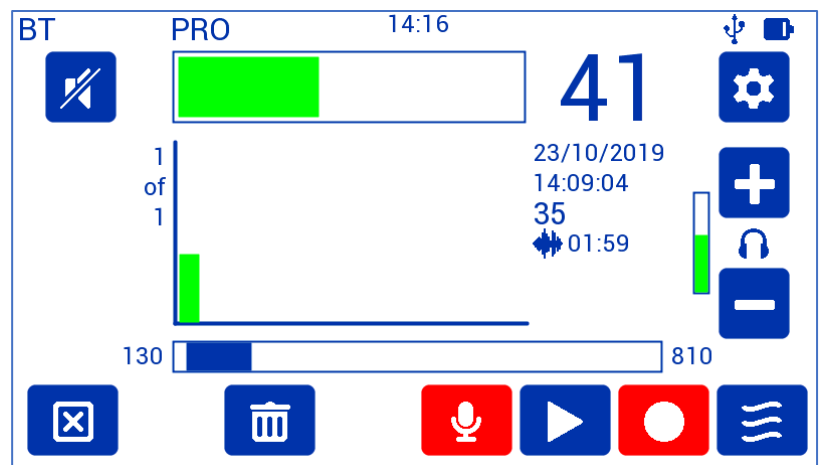
Tap on the “recording stop” button to stop the recording.



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.

23/10/2019
14:09:04
35
01:59



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.

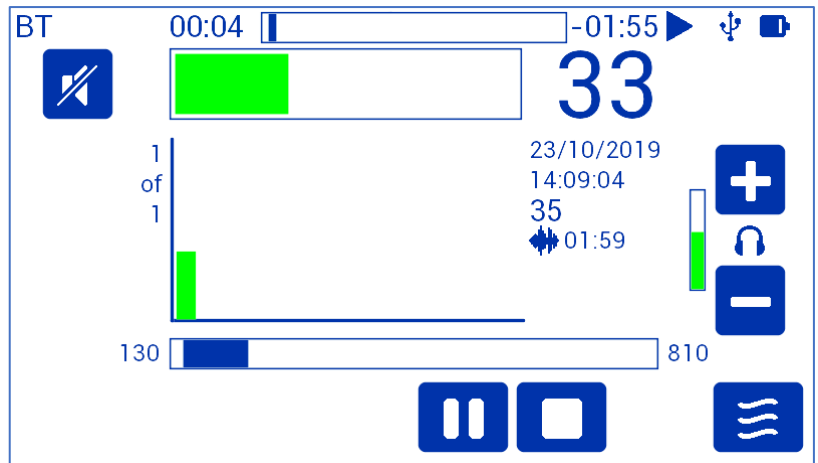
The recording is made without any filtering being applied to the sound. The headphone audio does have the filtering applied to the “live sound” whilst recording.

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”. Use of the DXmic Pro 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.
- Before sending an email, the user may use other phone apps to obtain pictures for inclusion in the email.
- DXMic Pro App has a facility to integrate with the HWM Datagate server, being able to upload measurement results and audio to the server for storage. The data is then available for other employees to inspect or evaluate any actions required. The uploaded data is grouped on the server as a “survey”, which details the exact location where each of the measurements was made.
- The DXmic can make a judgement and confidence indication of the presence (or absence) of a near-by leak.

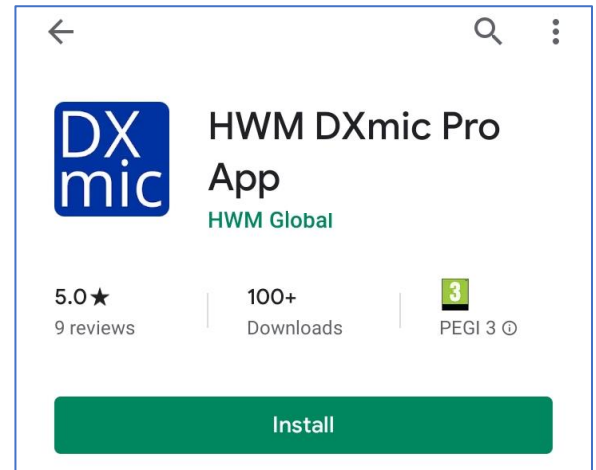
5.1 INSTALLING THE DXMIC PRO APP / FIRST USE

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 Store.

Tap the Install button.

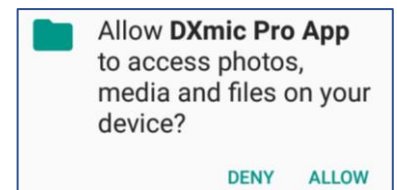
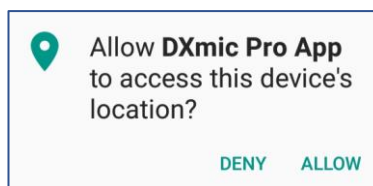
The app will install and an icon for the app will appear on the mobile phone.



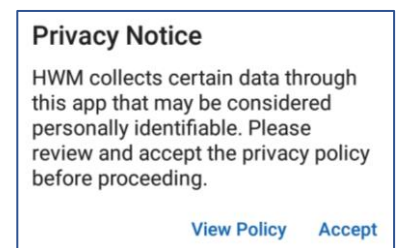
Tap on the DXmic icon to launch the DXmic Pro App.

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

Tap "ALLOW" to give the app all the permissions it requires, otherwise it cannot correctly function.

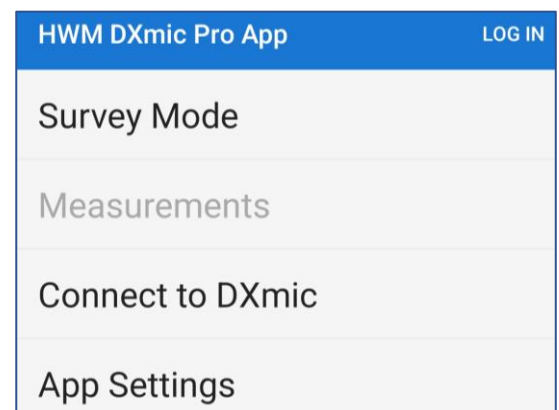


View and accept the HWM privacy policy to continue.



Initially a home screen is shown, which takes the form of a menu.

This screen gives options to open other screens in order to use the app. (These will be discussed in subsequent sections).



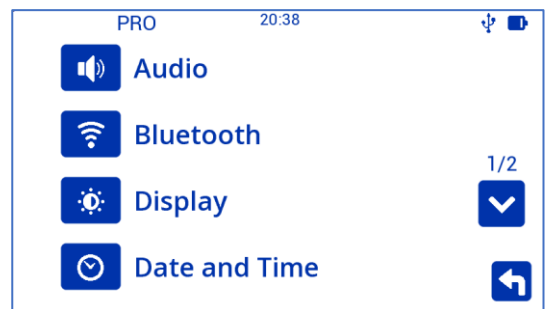
5.1.1 Bluetooth wireless – Enabling

To connect with the DXmic Pro App, the DXmic Pro unit must have the Bluetooth functions switched on.

First tap on the settings icon.



Then tap the “Bluetooth” icon.



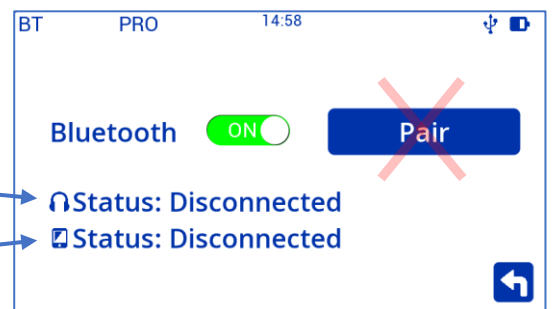
Bluetooth is initially OFF, to reduce power use.

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 the headphones and the mobile phone device are in a disconnected (non-paired) state.

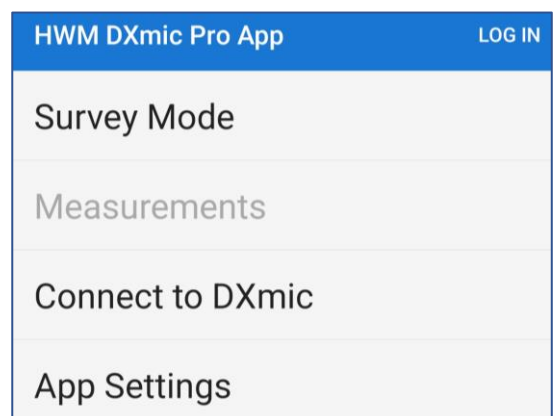
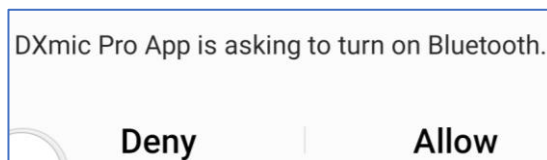


The DXmic Pro App is required to initiate pairing between the phone and the DXmic Pro unit. The pair button on the unit should not be used; it is for headphone pairing only.

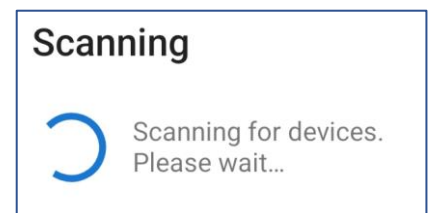
To pair the two together, proceed as follows:

Tap the “Connect to DXmic” line.

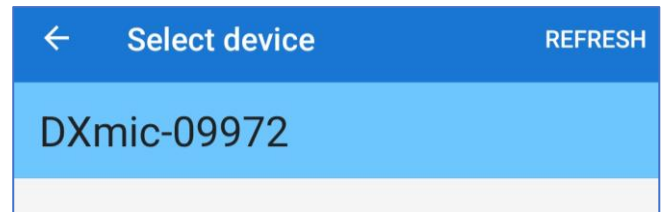
(If not already enabled, allow Bluetooth).



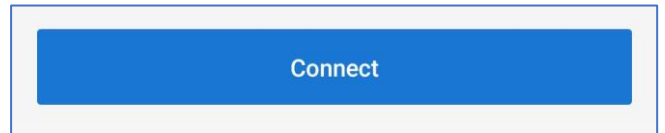
Scanning for the DXmic Pro will start.



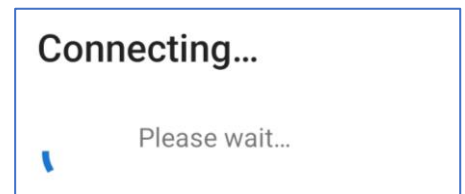
The DXmic Pro should be shown (if there is a problem, refer to section 8.1).



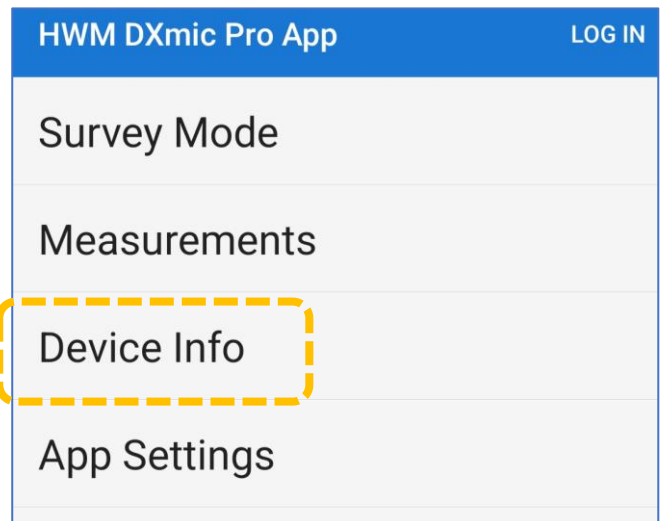
Tap on the Connect button.



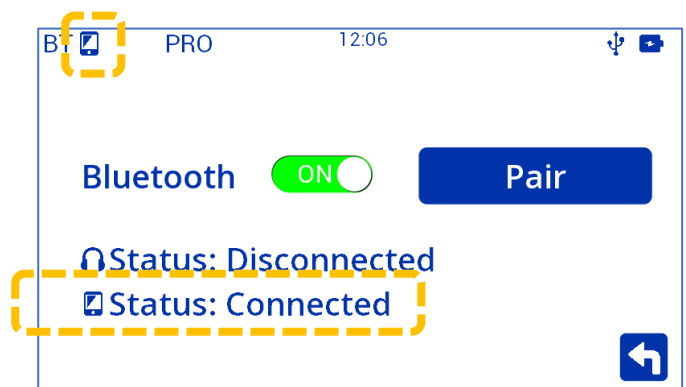
Wait a few seconds for the connection to be established.



Connection with a DXmic Pro device can be confirmed by the "Device Info" line now being displayed in the menu.

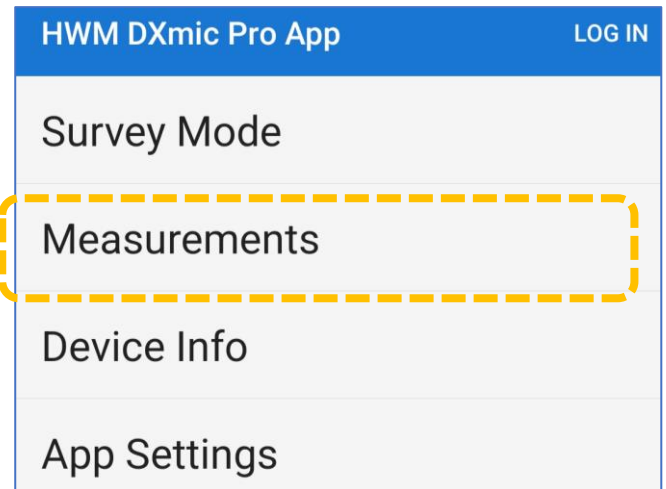


The DXmic Pro unit will similarly confirm the connection by showing a phone status of "connected" (in 2 places).



5.2 DOWNLOADING MANUAL SURVEY DATA FROM THE DXMIC PRO TO THE APP

To initiate a download of data from the DXmic Pro, tap on the “Measurements” line.



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.

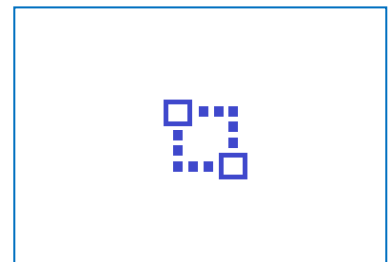
Set date and time

Do you want to set date and time on DXmic?

No

Yes

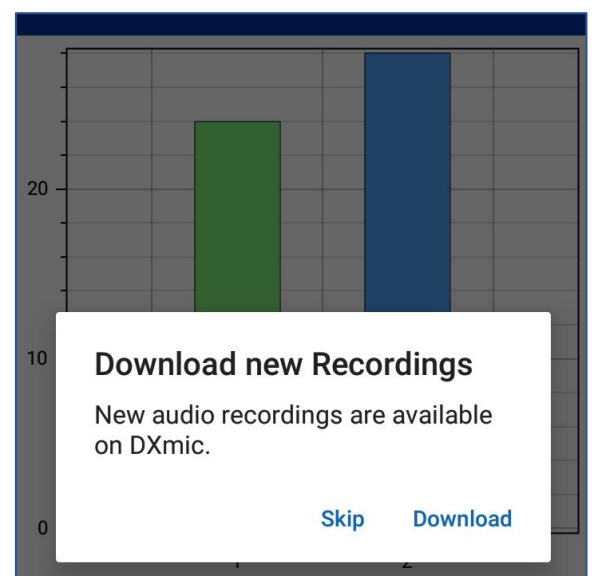
Note: During any communication over the Bluetooth link, the DXmic Pro unit temporarily stops normal display update and displays only a “synchronisation” icon.



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.

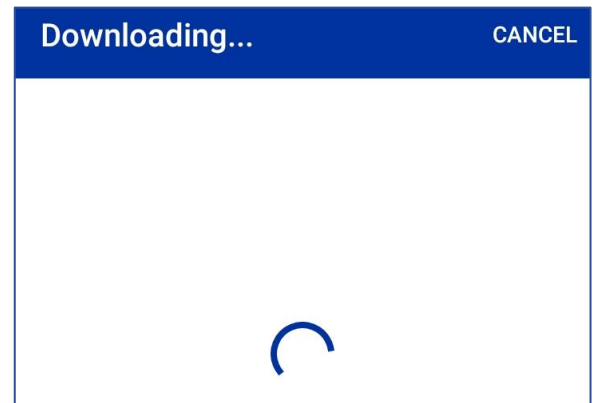
If sound recordings are also stored in the DXmic Pro, the app will ask the user if these should also be downloaded.

Tap on “Download”.



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

Download will commence.



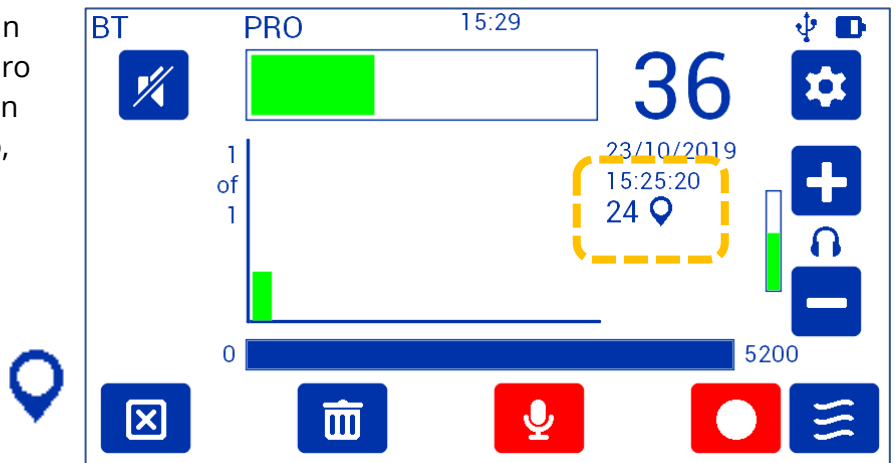
The sound file download progress is shown in the form of 2 bars. One bar represents the current file. The other bar represents the total progress of the download.



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 – MANUAL SURVEY RESULTS SCREEN

The Manual Survey results screen is shown opposite.

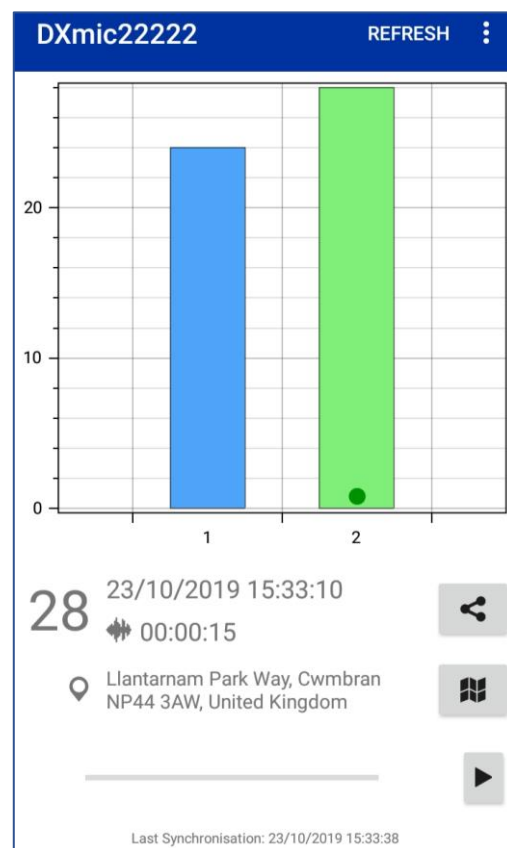
The “graph” area displays measurement data that was downloaded from the DXmic Pro. The download is not automated but must be requested by the user. Tap on “Refresh” to begin the synchronisation.

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.

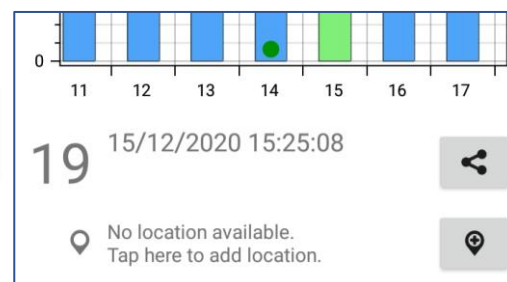
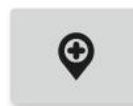
The lower part of the display shows the measurement, the time and date of the measurement. If an audio file exists, it shows an icon for this along with length of recording. If geodata data is stored it does not show the co-ordinates, but an approximate address of the measurements.



5.5 POSITION DISPLAY AND REFINEMENT (MAP VIEW)

Note: The geographical location of the DXmic Pro when a measurement or audio recording was made *is required* for integration with the DataGate system.

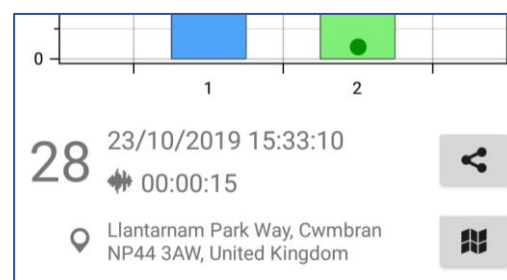
When the DXmic Pro App has no location data available for a measurement, a button exists that prompts you to set a location (it looks like a geo-position symbol with “+” inside). The method is very similar to modifying the location (described below).



When the DXmic Pro App has location details, for a measurement, a “map” button will be shown.



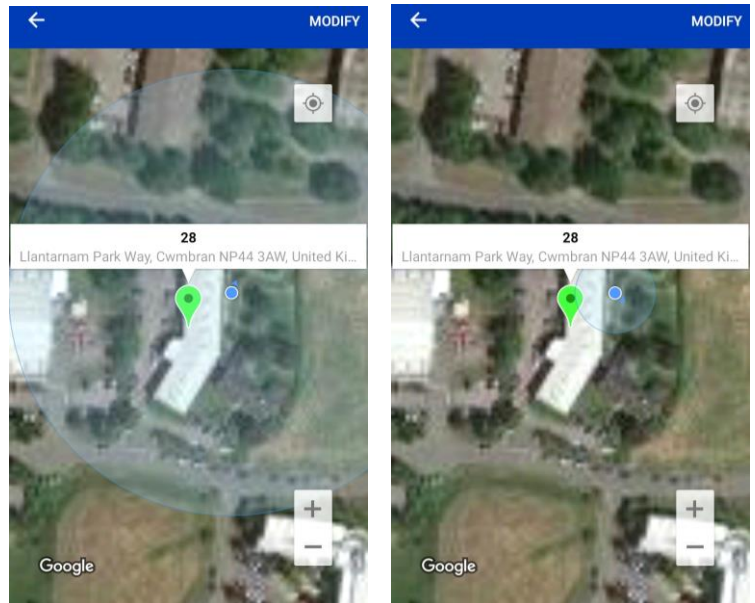
The location where the selected measurement was made can be shown on a map. ...Tap the “map” button.



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.



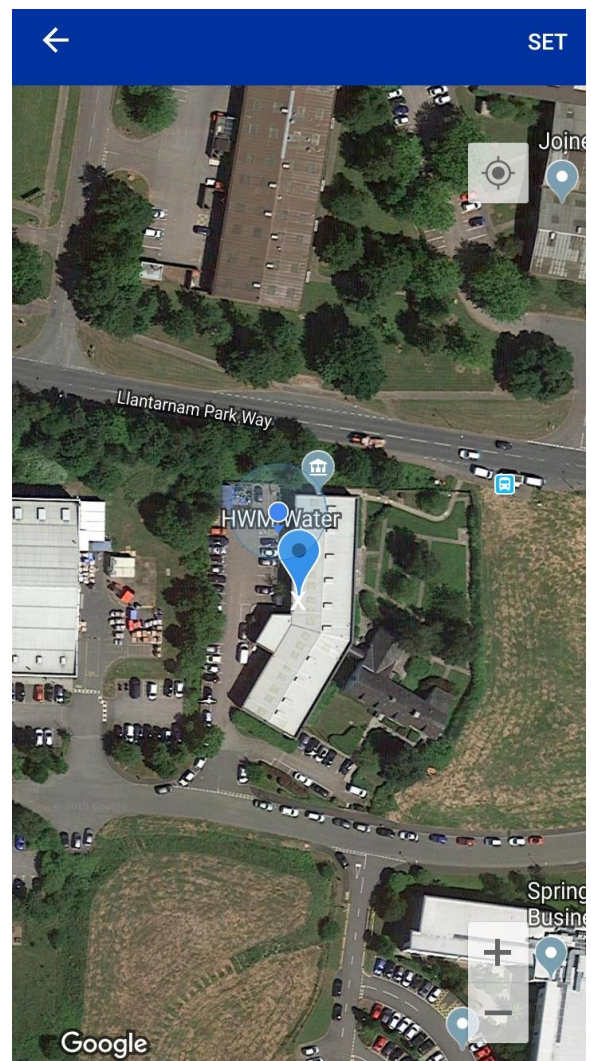
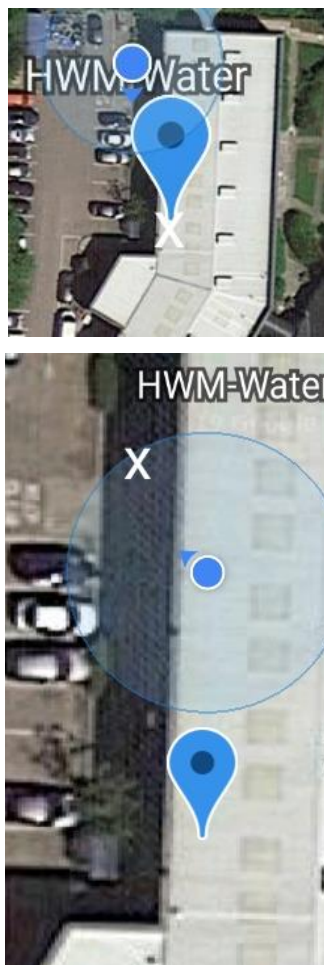
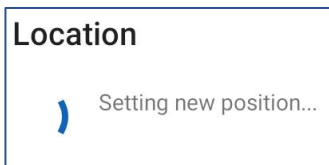
To refine the location of the measurement, tap on "Modify".

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.

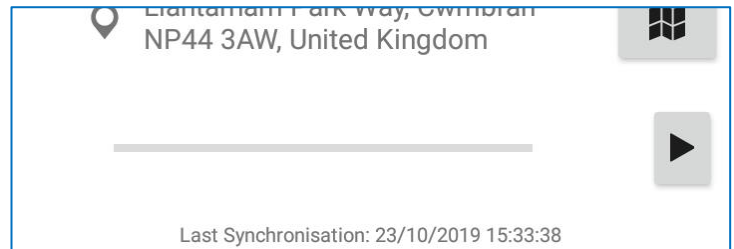


Note: If you want to know the GPS co-ordinates of the set location, these can be shown by tapping the address line.



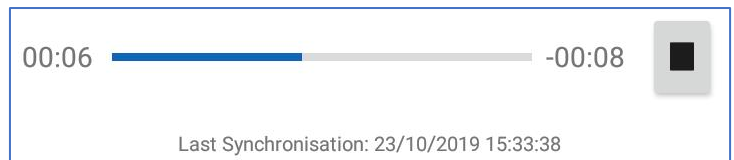
5.6 AUDIO PLAYBACK

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



A progress bar is displayed during playback.

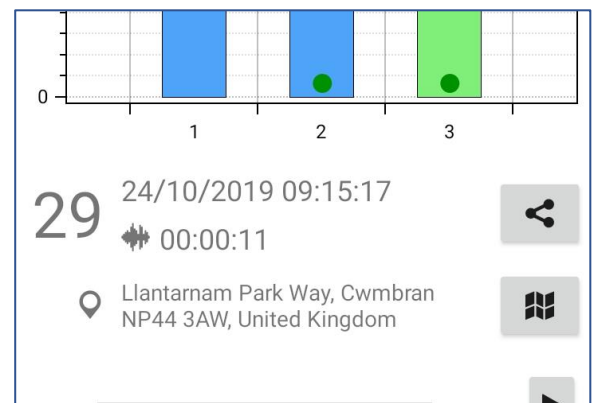
Playback has no frequency filters applied.



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

5.7 SHARING MEASUREMENTS AND SOUND RECORDINGS WITH OTHERS

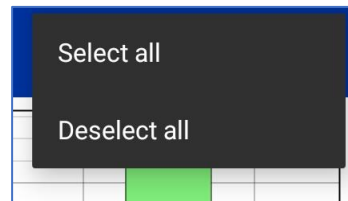
After ensuring the positions of measurements you wish to share are accurately set, tap on the “share” icon (on the main screen).



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, the data can be shared:

- To share via e-mail tap on the “Email” button. (See section 5.7.1 to continue)
- To share via DataGate tap on the “DataGate” button. (See section 5.7.2 to continue)

5.7.1 Sharing via e-mail

(Continued from section 5.7).

If any selected measurements did not include GPS data, the app allows you to cancel the request and fix the problem before re-trying (or proceed).

Missing location

Location information is missing for some of the selected measurements. Please assign a location to the selected measurements.

[Cancel](#) [Proceed anyway](#)

The “Report Summary” page is displayed.

Complete the information on the form.

Modify the address if required.

Then tap the “Send email” button.

A screenshot of the 'Report summary' screen. At the top, there is a blue header with a back arrow and the words 'Report summary'. Below the header, there is a bar chart with three bars of increasing height. Below the chart, there is a form with the following fields: 'Name of measurement set:' with the value '2019_10_23 Llantarnam Park Way'; 'Comment' with the value 'the leak is here'; and 'Operator:' with the value 'operator04'. At the bottom, there is a button labeled 'Send email'.

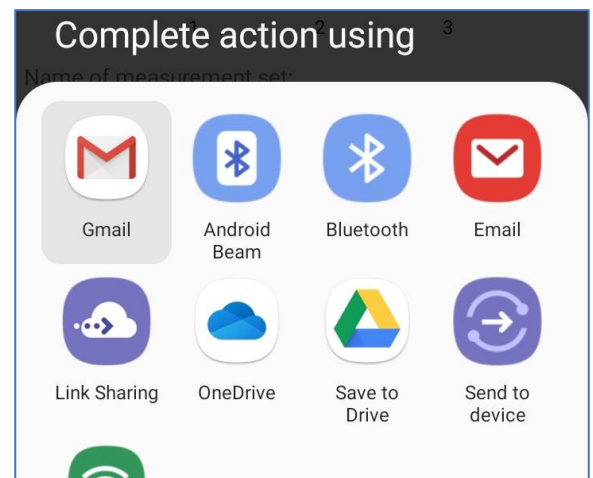
The app will generate a report for emailing.

Site Report

 Generating report...

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

Then tap “Just once” or “Always”.



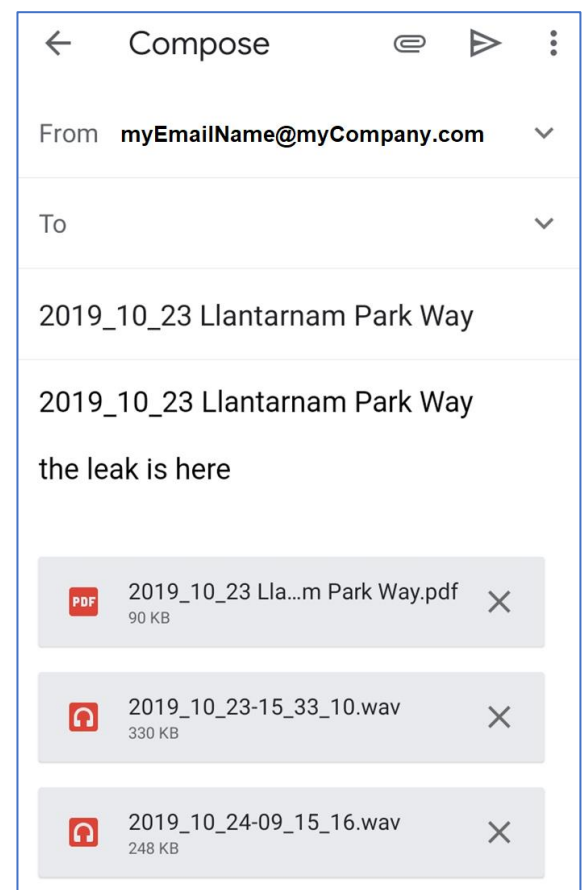
The report is generated as a *.pdf file.

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

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

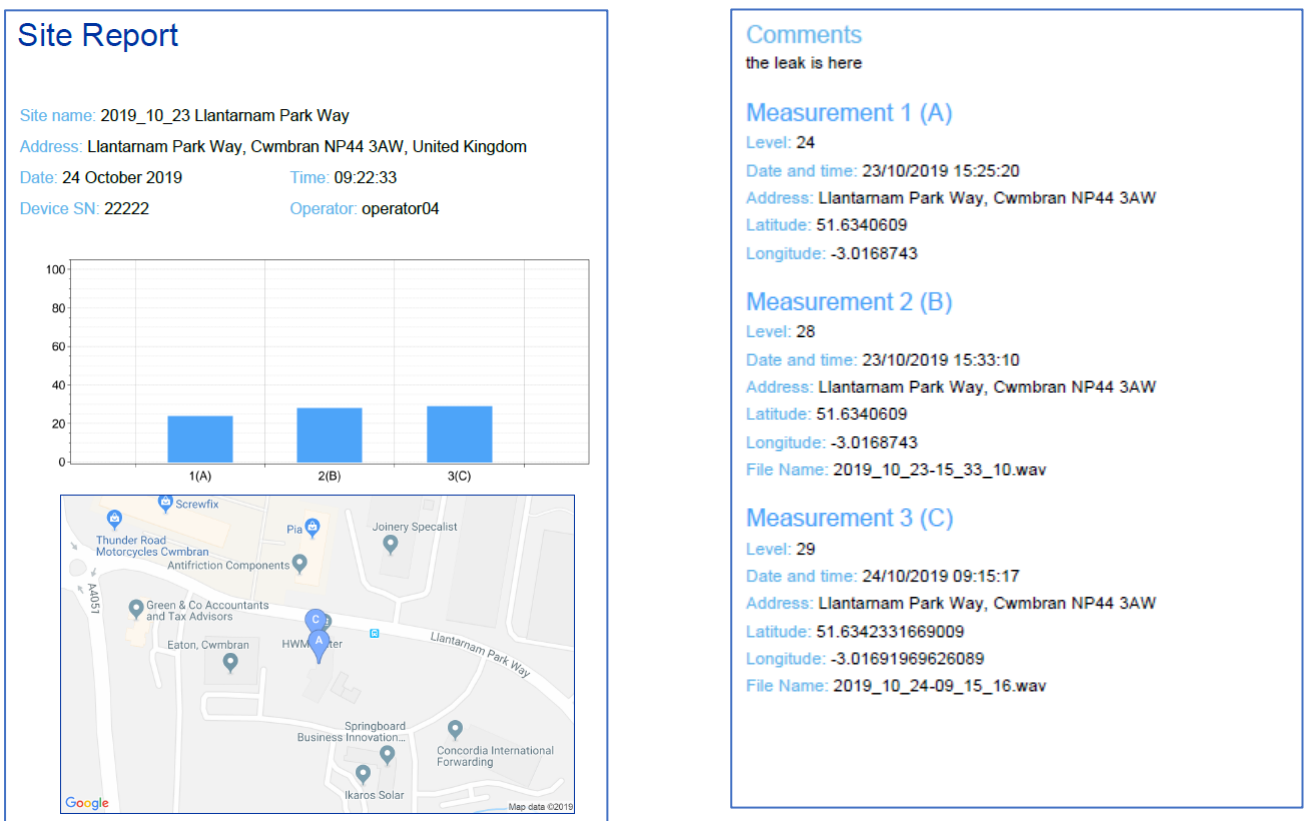
Complete the “To” section (the email address that you want to send the data to).

Then 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.

5.7.2 Sharing via upload to DataGate

(Continued from section 5.7).

If any selected measurements did not include GPS data, the app will not proceed with the request.

Fix the problem before re-trying.

Missing location

Location information is missing for some of the selected measurements. Please assign a location to the selected measurements.

OK

The "Survey" page is displayed.

Tap on the Name line if you wish to modify the details.

Tap on the "Notes" line if you wish to add any notes.

← Survey - DXmic09972

Name	2022_07_19 John Baker Close
Notes	Add notes about this survey here

A summary of the start and end dates of the set of measurements is shown.

For each measurement, a summary line is listed showing:

- The date and time the measurement was made.
- Minimum level (MLP final reading).
- If an audio file is to be included, and the duration of the sound recording.

Tap on "Upload to DataGate".

Confirm it is OK to proceed.

(The app will make a request to DataGate to save the data to a new record on the surveys database if OK is selected).

To proceed, the user must have the required credentials for the app to gain access to DataGate. The required credentials are a DataGate server URL, a username and a password that has been registered for use with the app.

(If you do not have these items, check with your supervisor or system administrator).

Enter the details for access to DataGate.

Then tap on Login.

Note: The app may also provide login by fingerprint or face recognition. Refer to section 7.2 for further details.

Measurements 19/07/2022 11:53:16 - 12/08/2022 14:32:45 (10)

0	10/08/2022 11:42:02	
16	10/08/2022 11:44:23	
34	10/08/2022 11:44:34	
0	10/08/2022 11:44:43	
0	10/08/2022 11:45:18	
0	10/08/2022 11:45:22	
0	12/08/2022 14:32:45	 (30s)

Upload to DataGate

Upload to DataGate

This will create a new survey including the specified measurements on DataGate. Do you wish to proceed?

Cancel OK



www.myserver.com

MyUsername

MyPassword

Cancel Login

If the login was successful, the app will begin communication with DataGate.

The screen shows progress with OK indications at each stage (or an error condition).

DataGate Upload	
Name	2022_07_19 John Baker Close
<div><div></div></div>	
Connection...	OK
Authentication...	OK
Server status...	OK
Survey...	OK

The survey data record will be created within DataGate.

Each of the items of data is uploaded separately.

(Any audio files uploaded are sent raw, without any applied filters).

Survey...	OK
	OK - (378)
Measurement 19/07/2022 11:53:16...	OK
Measurement 10/08/2022 11:41:30...	OK

Measurement 10/08/2022 11:45:22...	OK
Measurement 12/08/2022 14:32:45...	OK
Recording 12/08/2022 14:32:45...	OK

Tap "Done" when you have reviewed the upload details and confirmed there is no issue.

Done

For security purposes, the user should log out of the app after completing the investigation(s). This can be done from main screen of the app.

HWM DXmic Pro App LOG OUT

Survey Mode

Measurements

Device Info

(Refer to section 10 for information of how the data stored on DataGate can be viewed).

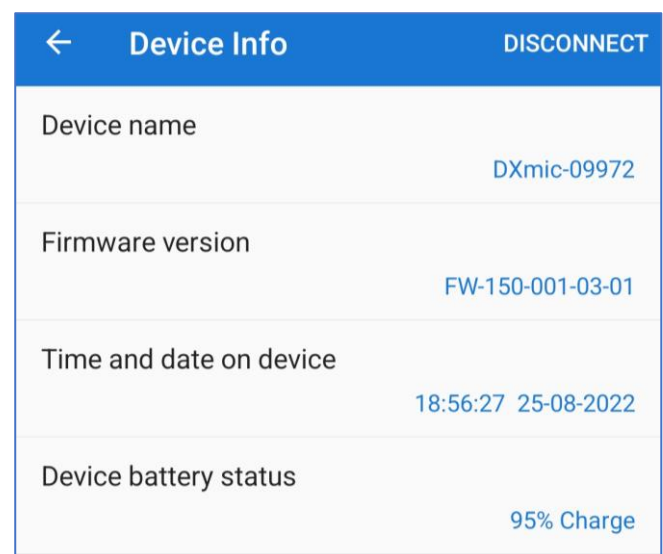
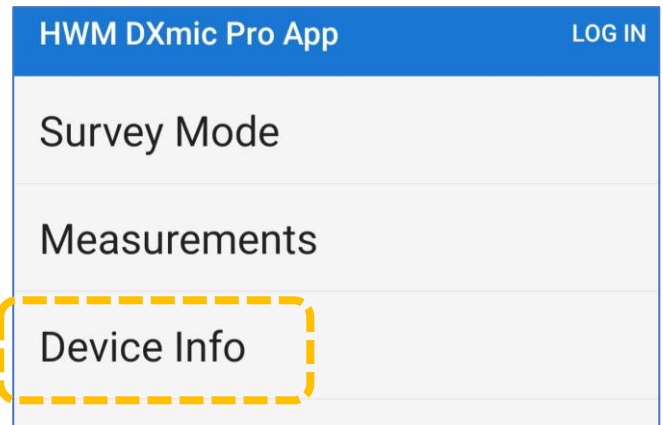
5.8 DISPLAYING DXMIC PRO UNIT INFORMATION

From the main screen:

Tap on "Device Info".

The Device info page is displayed. This gives details of the DXmic Pro device including its serial number and battery charge status.

Also, there is the option to disconnect from the device.

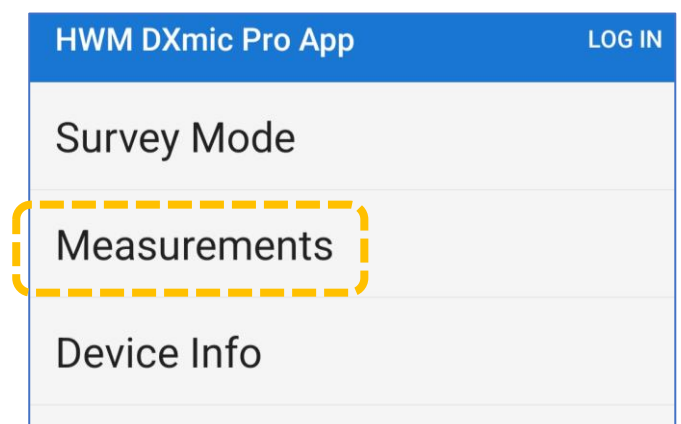


5.9 LISTING, PLAYING AND DELETING SOUND RECORDING DATA

Sound recordings that were made during a manual survey can be removed from the phone memory as follows:

From the main screen:

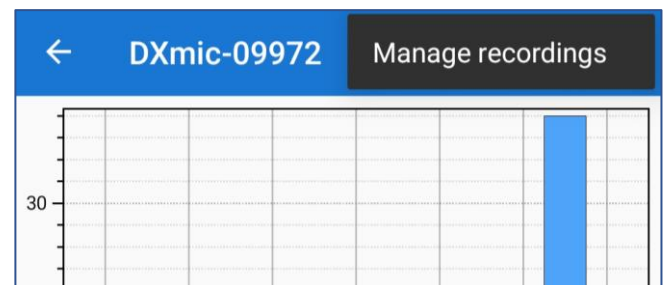
Tap on "Measurements"



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.

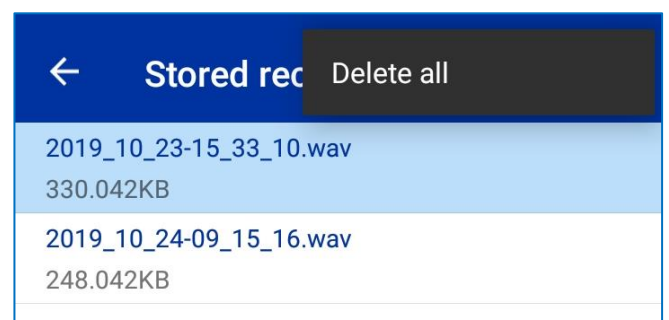
Then use the play control, located at the bottom of the screen.

(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 unit.



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 AUTO SURVEY

A manual method for making surveys using a DXmic unit was described earlier (refer to section 3.7). The results of the survey could be uploaded to DataGate if using a DXmic Pro with the app (refer to section 5).

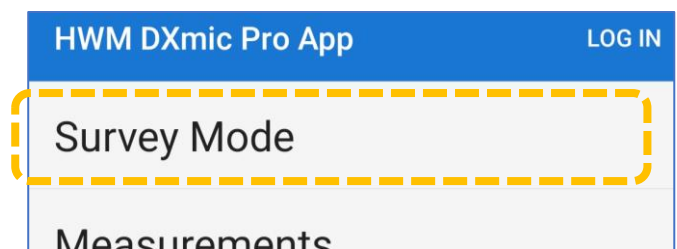
The DXmic Pro also offers an alternative (automated) method to conduct a survey when used with the DXmic Pro App. This is known as the Auto Survey mode. A summary is provided below:

- The Auto Survey mode is started from the app, not the DXmic Pro.
- The data (measurements, audio, and location details) are stored by the app, not the DXmic Pro unit. The DXmic Pro does however allow a user to decide whether to discard a measurement just after it has been made (e.g., if it may be considered to be invalid) or choose to save it to the app.
- The DXmic Pro screen gives an indication of whether the audio data obtained during the measurement has the characteristics of the sound of a near-by leak.

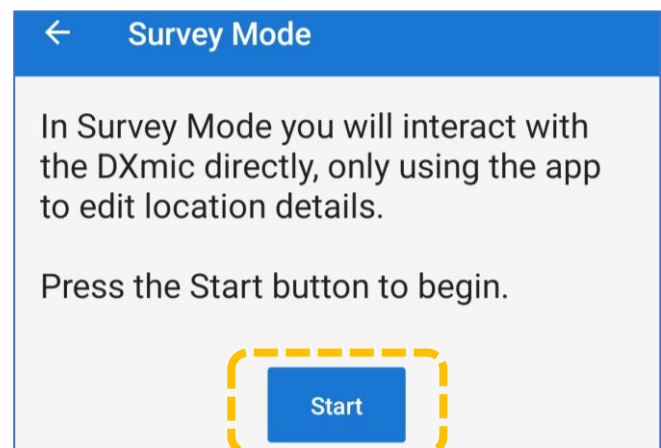
6.1 STARTING A NEW SURVEY

To start a new Auto Survey, go to the home page of the app.

Then tap on the “Survey Mode” line.

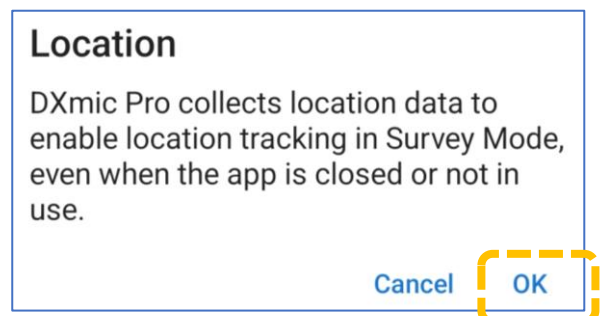


Then tap on the Start button.



There is a warning / reminder that whilst using the DXmic Pro App in the Auto Survey Mode, the phone location will be tracked, even if not the active window.

Tap OK to continue.



The app needs to be aware of what material the buried pipe is made of (in order to correctly judge whether a leak is nearby; leaks from different pipe materials have different sound characteristics).
Select a material by tapping on the relevant line.

The app now activates the Auto Survey Mode on the DXmic Pro unit.

The screen of the app shows a status (here it is shown waiting for data). The status indication shows whether it is waiting for or receiving data from the DXmic Pro.

There is a button that can be used to end the survey (use when required, later on).

6.2 MAKING THE SURVEY

The survey should be started as described in section 6.1.

The app will run quietly in the background, even if the screen is powered down or the phone is used with another application.

The user should now switch attention to the DXmic Pro unit.

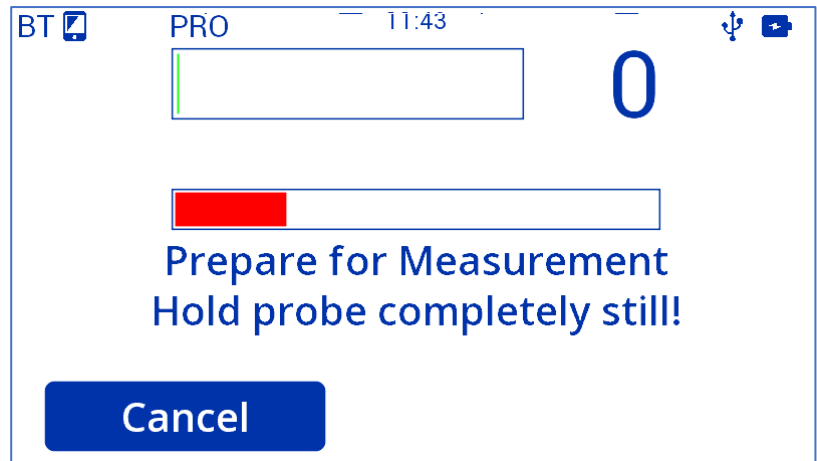
The screen of the unit will have a large button "Take Survey Reading".

There is also an "Exit" button. The user can (optionally) use this button when the survey has been completed, but it does not change the status of the app, which will remain in the survey mode. The user must (at a later time) close the survey by using the app. This will then allow the data (survey results) to be forwarded to DataGate.

(If pressed, the Exit button allows the user to gain immediate access to the DxMic Pro in its standalone operation. Confirm if that is what was intended).

Position the ground microphone in the required location. When ready, tap the large “Take Survey Reading” button.

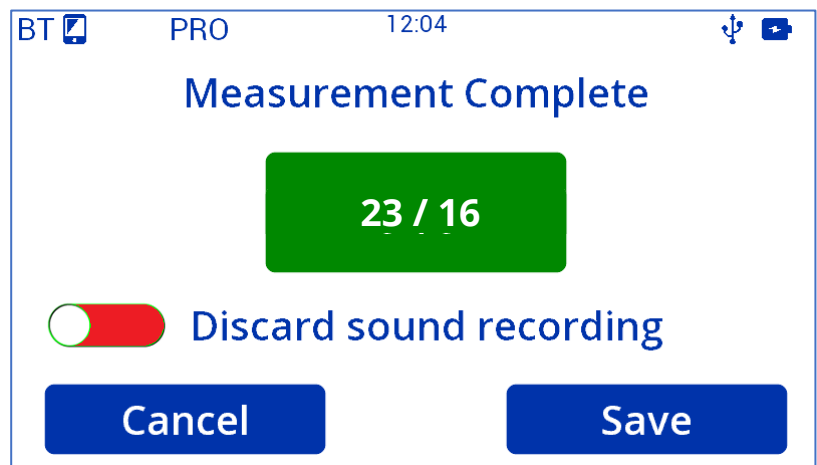
Follow the instructions on the DXmic Pro screen. The screen shows the progress of the measurement operation. (Hold the probe still and wait for the measurement to be taken).



Keep silent and hold the probe still until the screen displays “Measurement Complete”.

You should also remain still whilst the measurement is being taken.

Be aware of any background noises which may occur which could invalidate the measurement (e.g., footsteps, traffic noise). If any were present, the result can be discarded by tapping on the “cancel” button and the measurement re-taken.

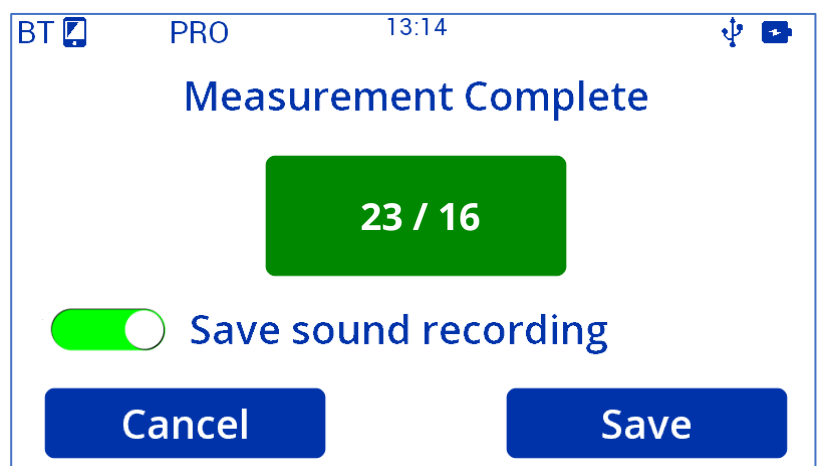


The screen will show a judgement by the DXmic Pro regarding whether a near-by water leak was detected.

- A green result panel indicates no leak was detected.



- A red result panel indicates that a near-by leak was detected.



The panel also shows numerical indications; these are the calculated ‘level / spread’ results. (The user will not usually need to refer to these, unless requested by HWM).

Prior to tapping the “Save” button, the user should pay attention to the slider control that is present; this allows the user to select to save the sound recording obtained during the measurement (or not). The app makes an initial choice and usually only

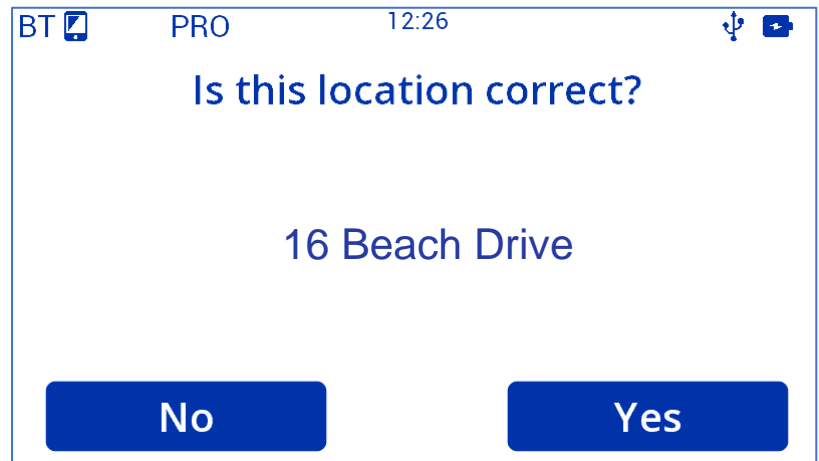
selects to save the sound recording when a leak is judged to be nearby, but the user can over-ride the initial selection; tap (not slide) to change.

When finished, tap the “save” button; this makes the choice to send the measurement (and, if selected, the sound recording) to the app. However, the user must first confirm the location where the measurement was taken from...

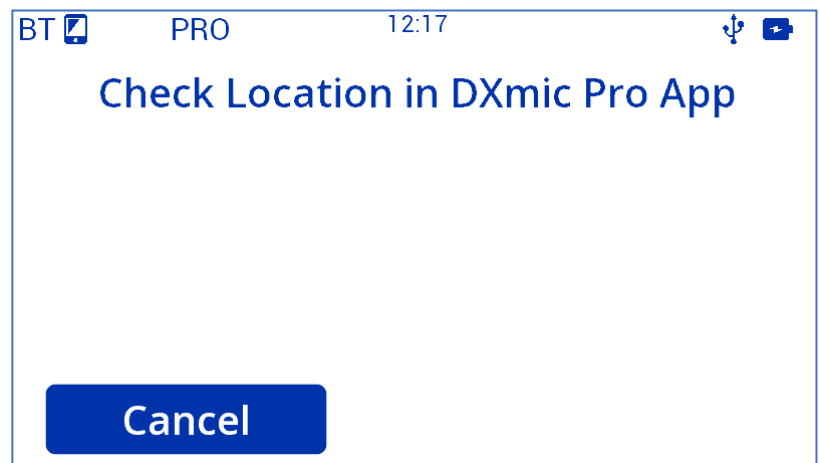
Examine the location (address) suggested by the DXmic Pro; this suggestion was sent to the unit by the DXmic Pro App.

Tap on “Yes” to accept (the adjustment instructions on the next page of this user-guide can be skipped).

Tap on “No” if an adjustment is required.



If an adjustment was required, the DXmic Pro unit refers you to the DXmic Pro App for refining the location or address details.



Return to the phone and re-activate the screen; if your phone has locked the screen, unlock it by one of the usual methods (e.g., by entering your PIN).

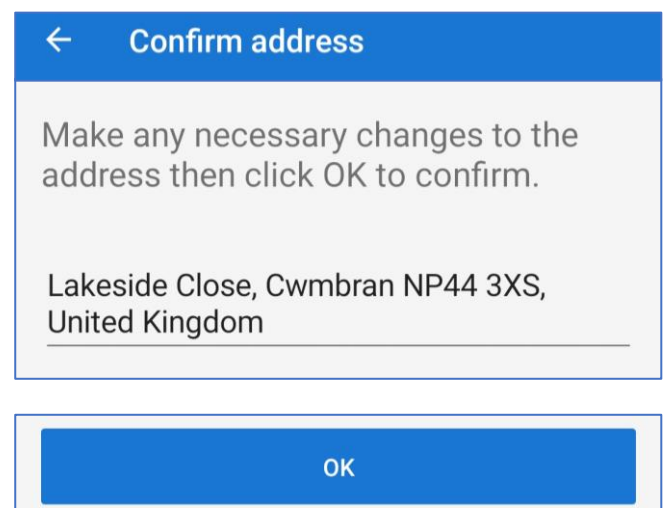
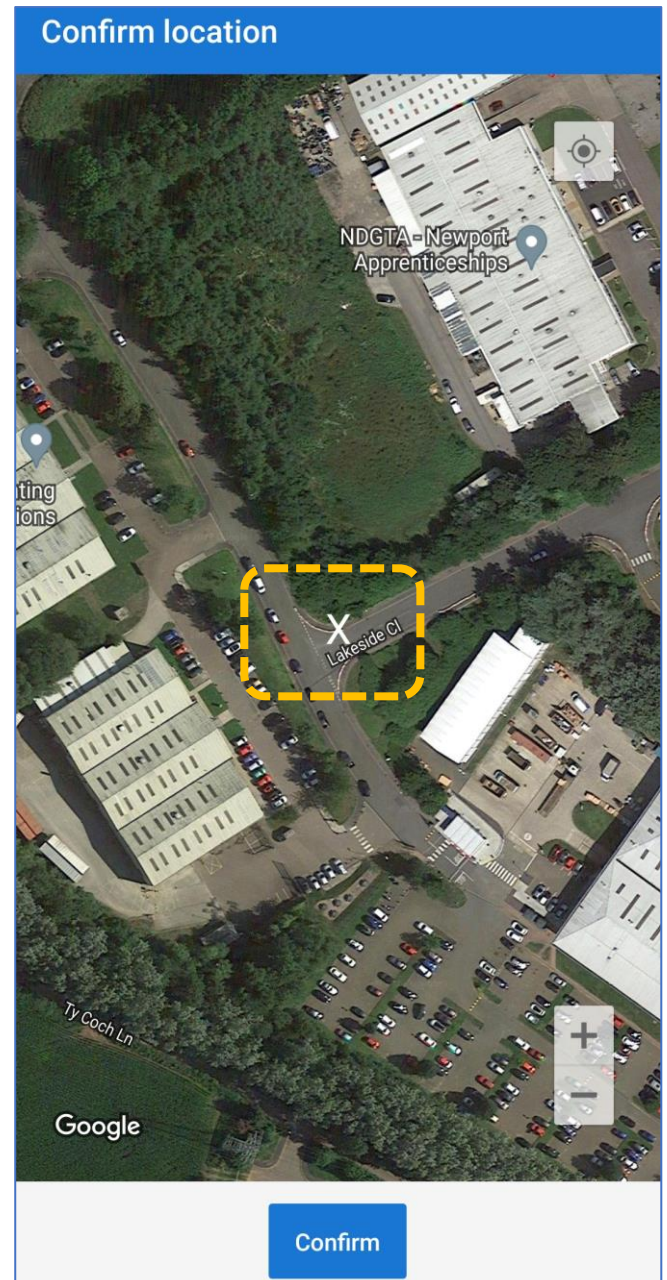
Use your finger to move the map background until the "X" symbol is placed at the location where the measurement was made.

Then tap the "Confirm" button.

If required, manually change the address or location reference.

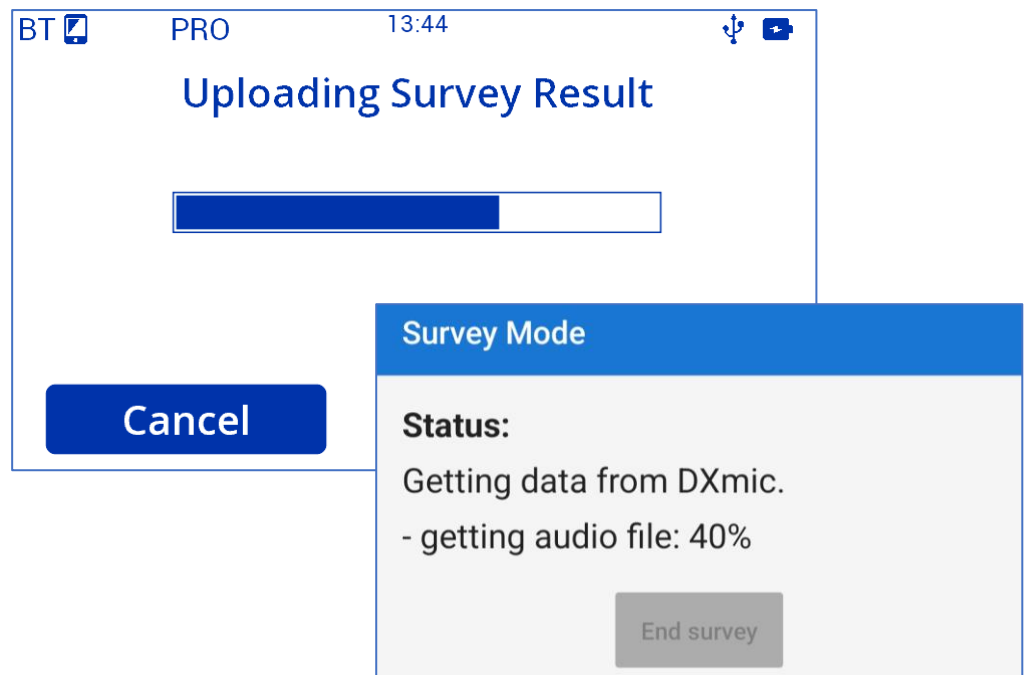
(Tap to edit).

When finished, tap "OK".

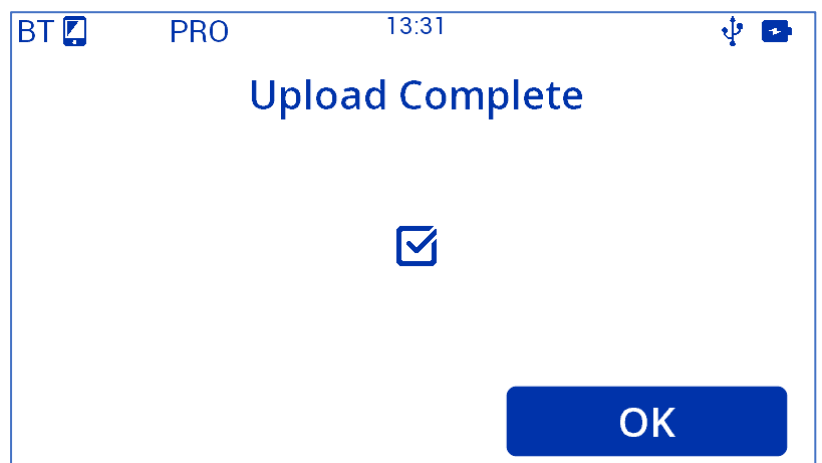


After finalising the address, the DXmic Pro unit shows the progress of transfer of the measurement data to the DXmic Pro App.

The app similarly shows what data is being transferred.

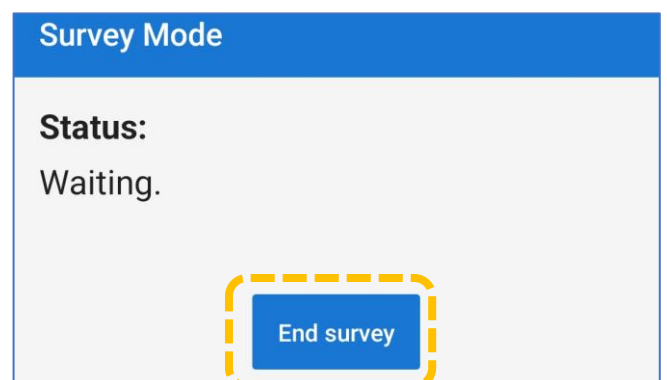


When the DXmic Pro unit has completed the data transfer, it temporarily shows an "Upload Complete" message; this will self-clear after approximately 5 seconds.



The upload is simply the transfer of one set of measurements. However, it is normal to re-locate the ground microphone to several different locations and take measurements in order to make a complete survey of an area. The app therefore returns to a status of "waiting" and the DXmic Pro unit returns to a status of showing the "Take Survey Reading" button.

This continues until the user has completed measuring at various locations and wishes to end the survey. ... Tap on the "End Survey" button when finished.

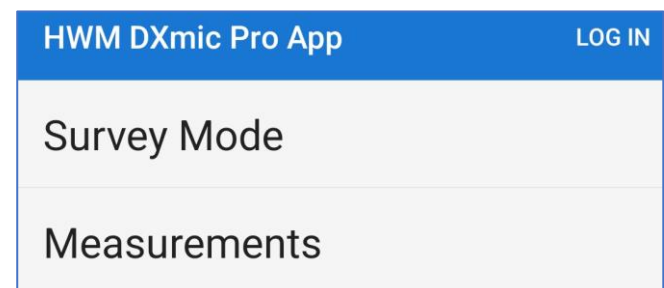
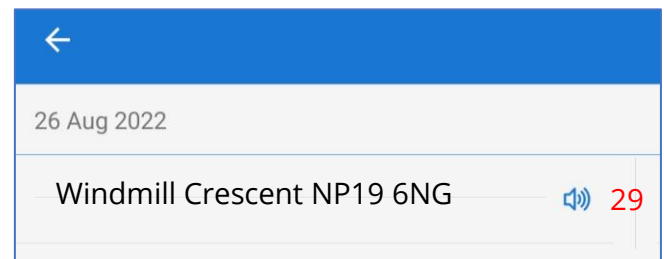
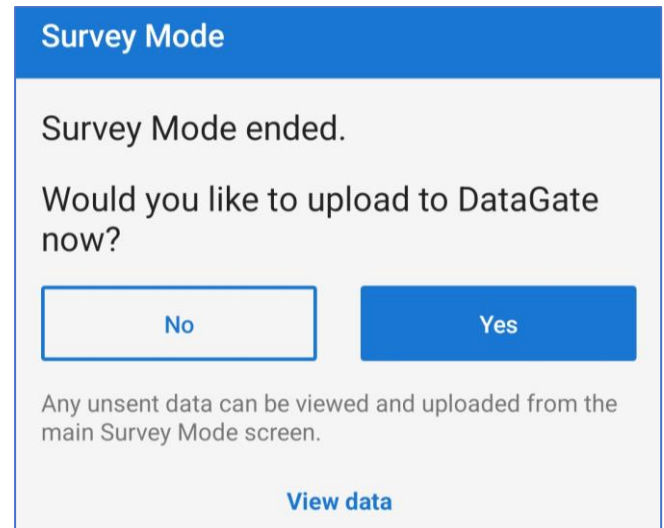


After ending the survey, the app will confirm the survey has ended.

The app does not ask for a survey to be named until just before it is uploaded to DataGate. It is therefore best practise to ensure valid addresses are selected within each survey location. Where the survey refers to multiple addresses on an 'unnamed road' be sure to make a note of where the road is located, so that an appropriate location reference (name) can be used later.

The user can choose to:

- View the data.
(The survey results are shown, but no selection tools offered).
- Select "Yes". (Upload data now).
(Refer to section 6.3)
- Select "No". (Do not upload data now).
The app will return to the main screen.
(The user can select to upload data or to view data at a later point in time; refer to sections 6.3 and 6.4).

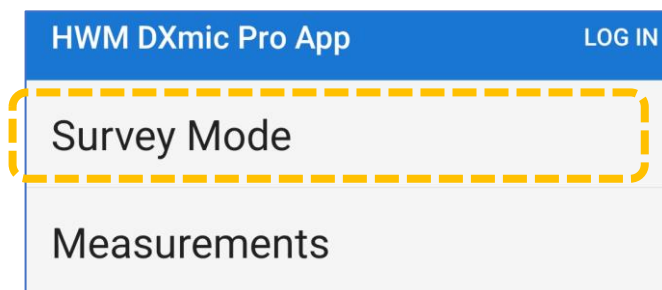


Note: Selecting 'No' after a survey ended may, for example, be chosen if the user wishes to wait until a Wi-Fi connection is available. This will reduce the data being sent using the mobile data, which may have monthly usage limits.

6.3 UPLOADING RESULTS OF AN AUTO SURVEY TO DATAGATE

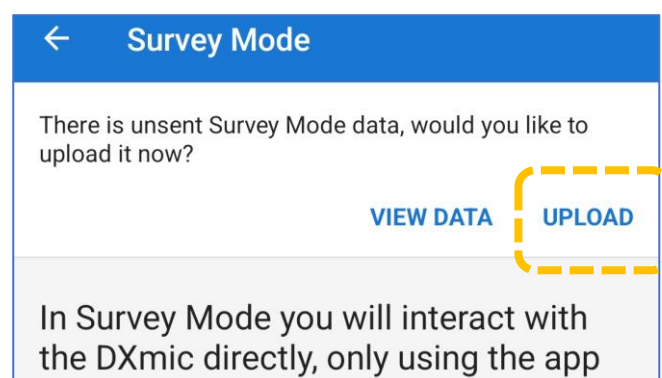
The user is given a choice to upload survey data to DataGate immediately after an Auto Survey is completed (see section 6.2). If they opt to defer the uploads to a later point in time, the upload process can be started as follows:

From the main screen, tap on the Survey Mode line.



When unsent data exists, the user is given the option to upload the unsent survey mode data.

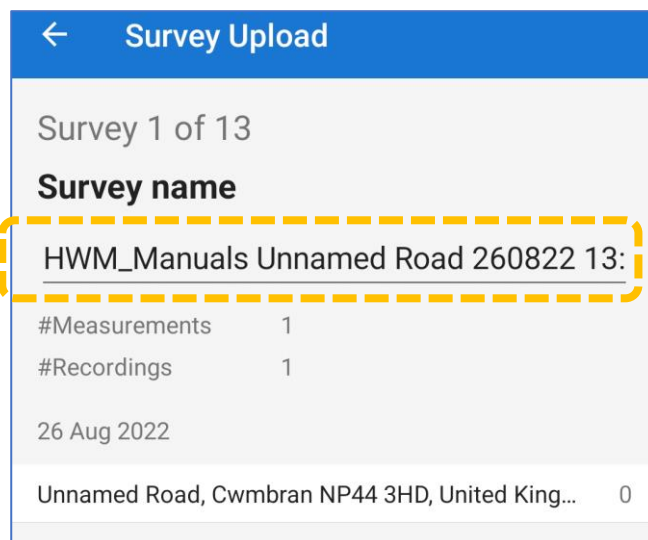
Tap on the "Upload" button.



After starting the Upload (to DataGate) process within the app, the "Survey Upload" screen is shown.

Depending how the app has been used, there may be several unsent surveys queued to be sent. Each one to be named before being sent; the app shows one survey at a time.

The app offers a suggestion for the name of the survey. This can be edited by tapping on the Survey Name line.

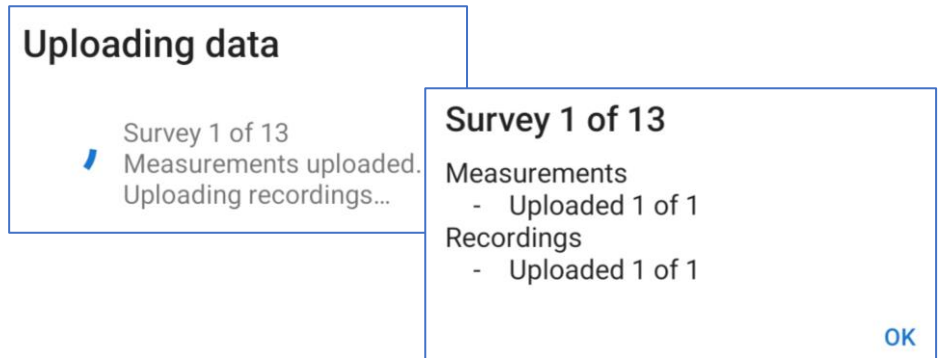


When happy with the survey name, tap on the Upload button to send the (one) survey to DataGate.



Note: If you are not currently logged into DataGate, the app will present a login page at this stage. Log in with your usual username and password, as described in section 5.7.2.

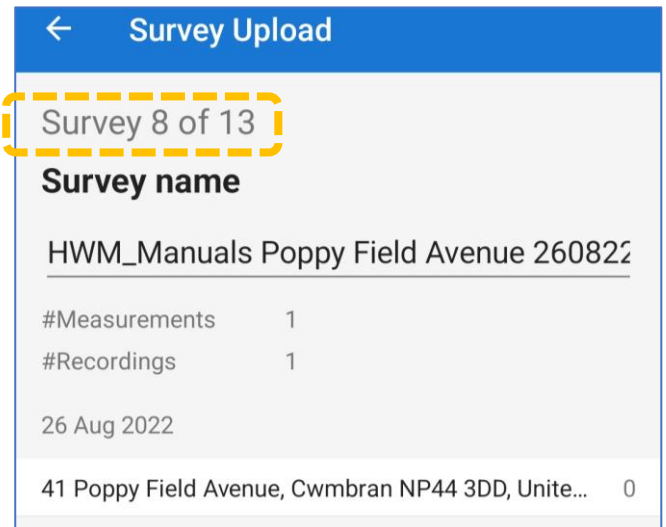
The app shows upload progress for this particular survey.



The upload process will loop through each survey, under the control of the user.

(Progress through the list of unsent surveys is shown by the app).

Continue to upload the unsent surveys until they are finished.

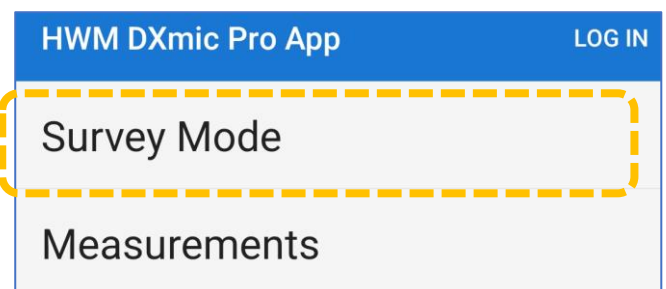


Note: After uploading the surveys the data is deleted from the app and is no longer available to view.

6.4 VIEWING UNSENT AUTO SURVEY DATA / EDITING

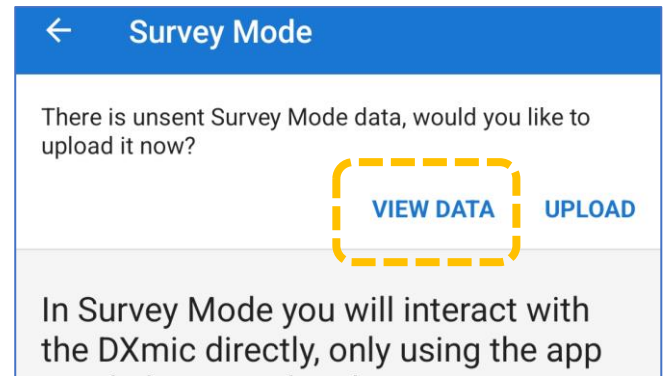
If a user has deferred upload of Auto Survey data, they are given a choice to view and edit the data prior to it being sent to DataGate.

From the main screen, tap on the Survey Mode line.



When unsent data exists, the View Data option will be shown.

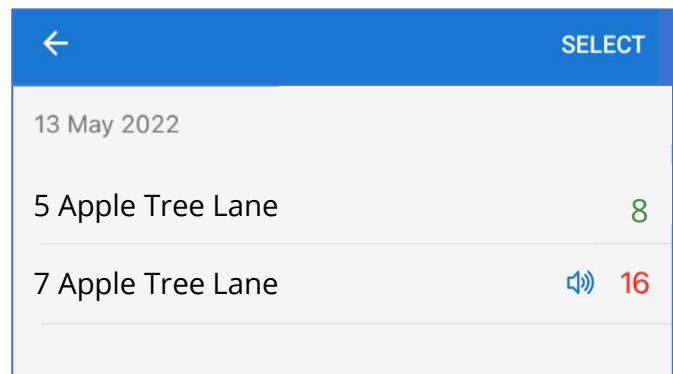
Tap on the "View Data" button.



The unsent data will be displayed.

Each set of survey data is headed by a date, followed by a list of addresses which correspond to a measurement location.

(The measurement result shown is the minimum noise level obtained during the measurement period).



- Where the DXmic Pro unit judged that there is a strong indication that a nearby leak may exist, the result is shown in red.
- Where the DXmic Pro unit judged that there is a weaker indication of a near-by leak, the result is shown in orange.
- Where the DXmic Pro unit does not consider that a nearby leak may exist, the result is shown in green.

A speaker icon is displayed whenever the uploaded measurement includes a sound recording file.



Tap on the Select button if you wish to make selections from the list.

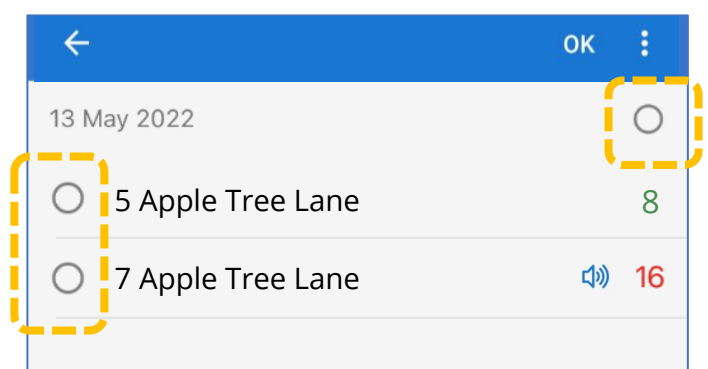


Selector controls will appear.

Use the left-hand selector to select / deselect individual lines.

Use the right-hand selector to select the entire set of measurements related to the survey.

(The 3-dots menu also has a facility to select or de-select all).

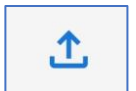


(An example of selected data items is shown opposite).

		←	OK	⋮
13 May 2022		✓		
✓	5 Apple Tree Lane	8		
✓	7 Apple Tree Lane	16		

When selections have been made, additional controls become available to use:

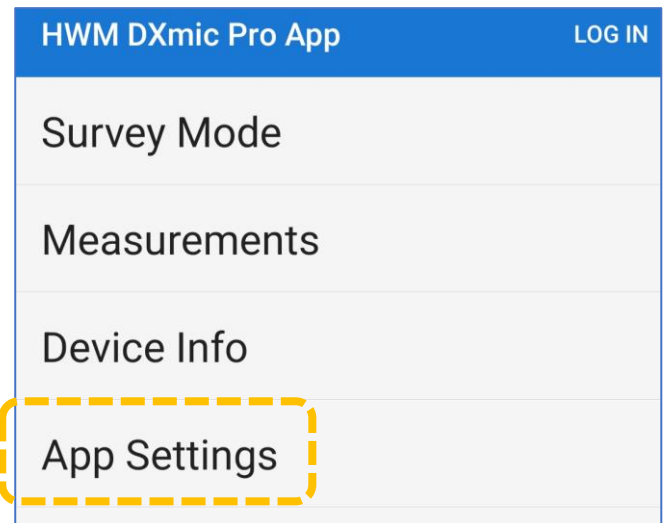
- The selected measurements may be permanently deleted, using the bin button. (This is the only edit function allowed).
- The selected measurements may be uploaded to DataGate by using the upload button. (The uploaded measurements are also removed from the phone by the app).



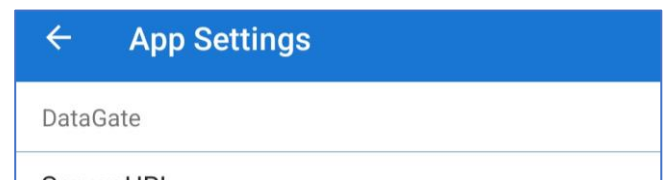
7 ADDITIONAL DXMIC PRO APP FUNCTIONS, FEATURES, SETTINGS

7.1 APP SETTINGS

The app settings page can be accessed from the main page by tapping on the “App Settings” line.



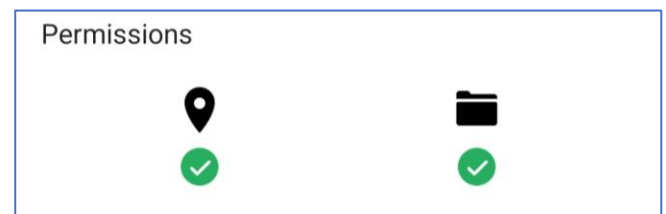
The app settings screen is shown.



The bottom of the page shows the software build version of the app; this may be requested if you make a call to HWM customer support.



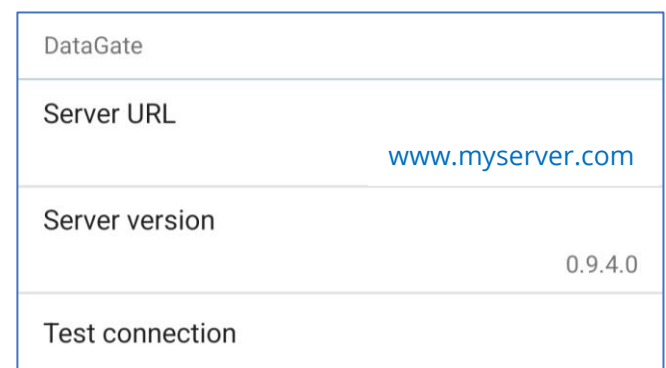
The page may be used to confirm the app has been given the required permissions to access the location services of the phone and also use files (e.g., photos) stored in the phone's memory.



The DataGate panel displays the URL for the server being used.

(The server version may be requested if you make a call to HWM customer support).

“Test connection” will test the URL to ensure the server can be reached and is responding. (This is not an authentication test).



Options exist to visit the HWM website and also to view the HWM privacy policy.

Visit the HWM website

View the privacy policy

The “Allow upload by mobile data” control allows the user to restrict uploads of measurement data to times when a Wi-Fi connection is available. This limits the internet traffic sent or received by the app using the data allowance of the SIM card contract. The app still uses mobile data for operational purposes (e.g., for login to the app and obtaining information for background maps).

Allow upload by mobile data



Tap the slider control to minimise mobile data usage (the control is greyed out).

Allow upload by mobile data



7.2 LOGIN USING BIOMETRIC DATA

The app may allow a user to log in using fingerprint or face recognition, subject to the following conditions:

- The phone you are using, and its operating system, must support fingerprint or face recognition login methods. These must be in an operational condition within the phone.
- The user must have set up the phone with the relevant data; fingerprint or face details must be registered and stored within the phone.
- The user must have previously used the app to register with DataGate using the normal (password entry) method.
- The server URL and Username fields are still required to be correct.

7.2.1 Login by Fingerprint recognition

The app will show when fingerprint ID is available by displaying an additional prompt below the Login button. (Examples are shown opposite).

Tap on the prompt to activate the login by fingerprint process. Then follow the on-screen directions.

If the fingerprint is accepted, the app continues with the login process as usual.



Login with Touch ID

7.2.2 Login by Face recognition

The app will show when face ID is available by displaying an additional prompt below the Login button.

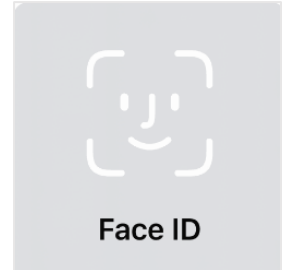
(Examples are shown opposite).

Tap on the prompt to activate the login by face recognition process.

Ensure your phone's camera is pointing towards your face.
Then follow any on-screen directions.

If the face is accepted, the app continues with the login process as usual.

Login with Face ID



8 TROUBLESHOOTING AND MAINTENANCE

8.1 DXMIC PRO CONNECTION / PAIRING ISSUES

If your DXmic Pro is of the “-A” type (see section 2.6.2) then it first needs to be paired with your phone via the regular operating system pairing process before the DXmic Pro App will recognise it; an unrecognised DXmic Pro will not be listed during device scan.

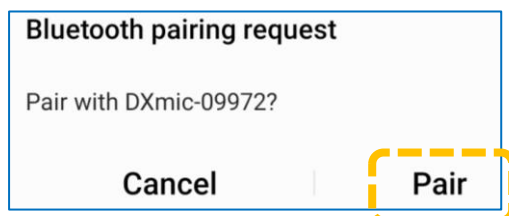
The pairing process is operating system specific, but an example is given below (for a phone using a version of Android).

Load the quick settings screen and long-press the Bluetooth icon.

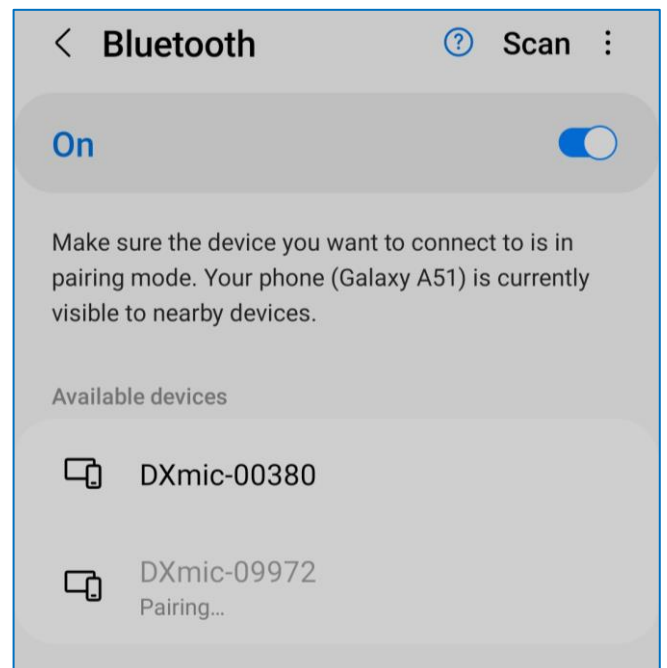


The Bluetooth settings page of the operating system has a scan button; any DXmic Pro in the area will be shown (along with other devices).

Select your DXmic Pro from the list (check the serial number) and tap on the ‘pair’ button.



Allow the pairing process to complete.



The DXmic Pro should now work correctly and will be listed in a Bluetooth device scan from within the app.

8.2 AUTO SURVEY MODE DOES NOT WORK

The Auto Survey mode requires a DXmic Pro unit to work; DXmic units are not able to use the DXmic Pro App.

The Auto Survey mode also requires the DXmic Pro to have a minimum firmware version of V3.00. If your DXmic Pro requires a firmware upgrade, please contact your HWM representative for advice, or refer to section 8.5.

8.3 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.

8.4 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.

8.5 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.

8.6 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.

8.7 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.

9 GUIDANCE TO EFFECTIVE ACOUSTIC LEAK DETECTION

9.1 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.

9.2 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.

9.3 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.

10 VIEWING DXMIC PRO DATA USING DATAGATE / PERMANETWEB

10.1 SETUP OF DATAGATE FOR DXMIC PRO INTEGRATION.

For DXmic Pro App to send measurement and audio data from a DXmic Pro unit, the unit must first be registered on DataGate. The unit is assigned an "SMS number" (even though it has no SIM). The number begins with "4415000000" and is followed by the unit's serial number (including leading "0"s added).

e.g. DXmic Pro unit with a serial number of 04321 would be SMS "441500000004321".

Note: HWM sometimes registers the DXmic Pro unit prior to shipping it to a customer, but this is dependent on whether HWM has administration access to the server being used by the customer.

The user of DXmic Pro must have a DataGate username, password, and any relevant permissions to edit site data.

Audio files (if uploaded) are linked to "measurements", which are in turn linked to a "survey" in the DataGate database. Surveys are linked to an account; the parent account of the user of the DXmic Pro App.

The account being used for DXmic Pro results also needs to have at least one site associated with it. This is unrelated to DXmicPro but is a requirement of PermaNETWeb for generating the map display.

An example of the setup of DXmic and account setup on DataGate is shown below:

Site ID: [DX-63922](#)

Create Date: [12-Dec-2018](#)

GPS: [51.634091569944,-3.01682450580628](#)
([329722,193299](#))

Start Date:

End Date:

Height AOD:

Owned By: [engineering](#)

Address: [Llantarnam Park Way, Cwmbran NP44](#)
[3AW, United Kingdom](#)

Chamber Type -

Address 2:

Pipe Size -

Non Communicating (Quiet) Days: [Default \(3\)](#)

Valve Type -

☐ Enable Alarm Forwarding For This Site

Pipe Material -

☐ Maintenance Required

☐ Valve Lid Modified

Notes:

Device Details [Edit](#)

SMS Number: [441500000022222](#)

Device Type: [DXmic 2.02](#)

Last Restart: [N/A](#)

Easy ID:

Battery Level:

Last Call In: [N/A](#)

Device Serial Number: [22222](#)

Signal:

Last Call In Type: [\[212.10](#)

Network:

Sensor Serial Number:

TZ : [N/A](#)

Technology Type:

IMSI:

Owned By: [engineering](#)

IMEI:

Modem Type & Firmware: [N/A](#)

Previous Battery Replacement Date:

Next Battery Replacement Date:

Notes:

10.2 VIEWING UPLOADED DATA

DXmic Pro data stored on DataGate can be viewed using the PermaNETWeb viewing portal (website).

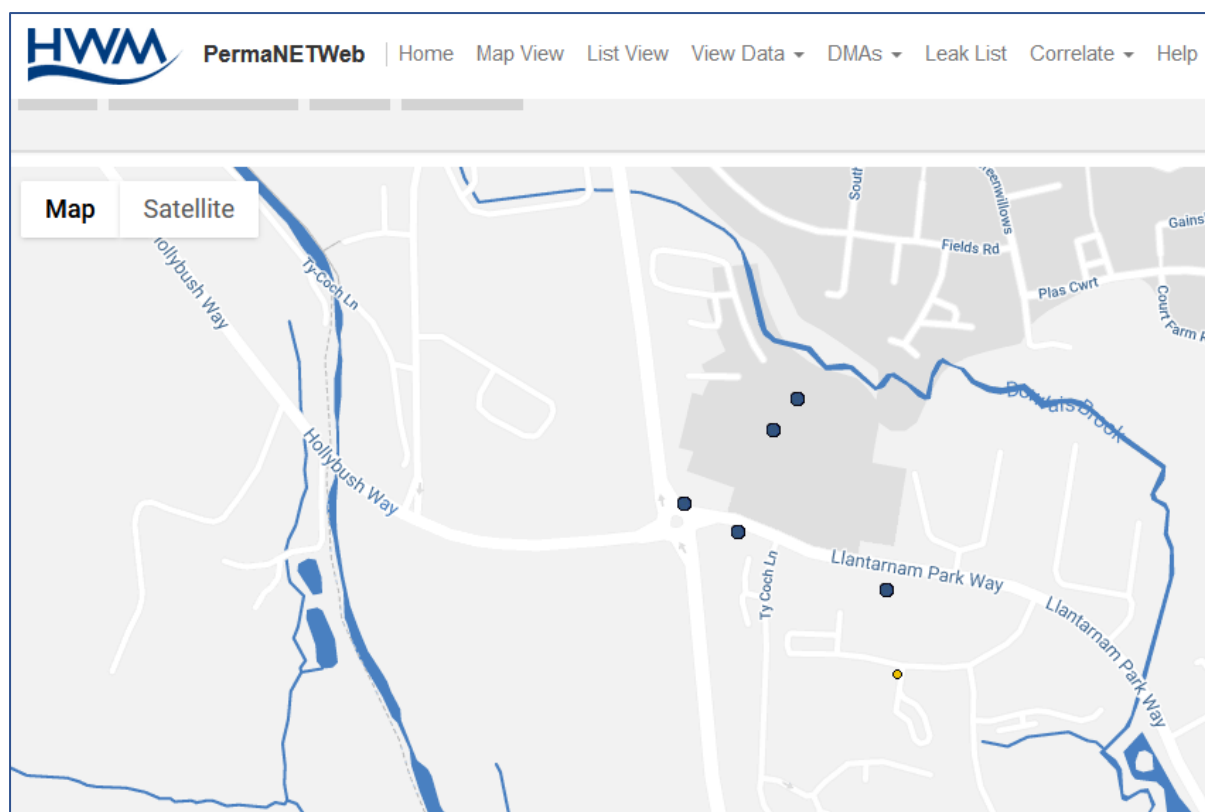
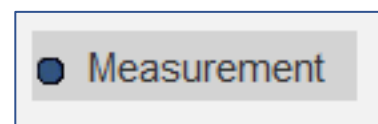
The user of PermaNETWeb must have a Username, password, and any relevant permissions to view the data. (If you do not have these items, check with your supervisor or system administrator).

Log into PermaNETWeb and navigate to the desired account.

The key within PermaNETWeb will show an icon for DXMic Pro measurements, shown opposite.

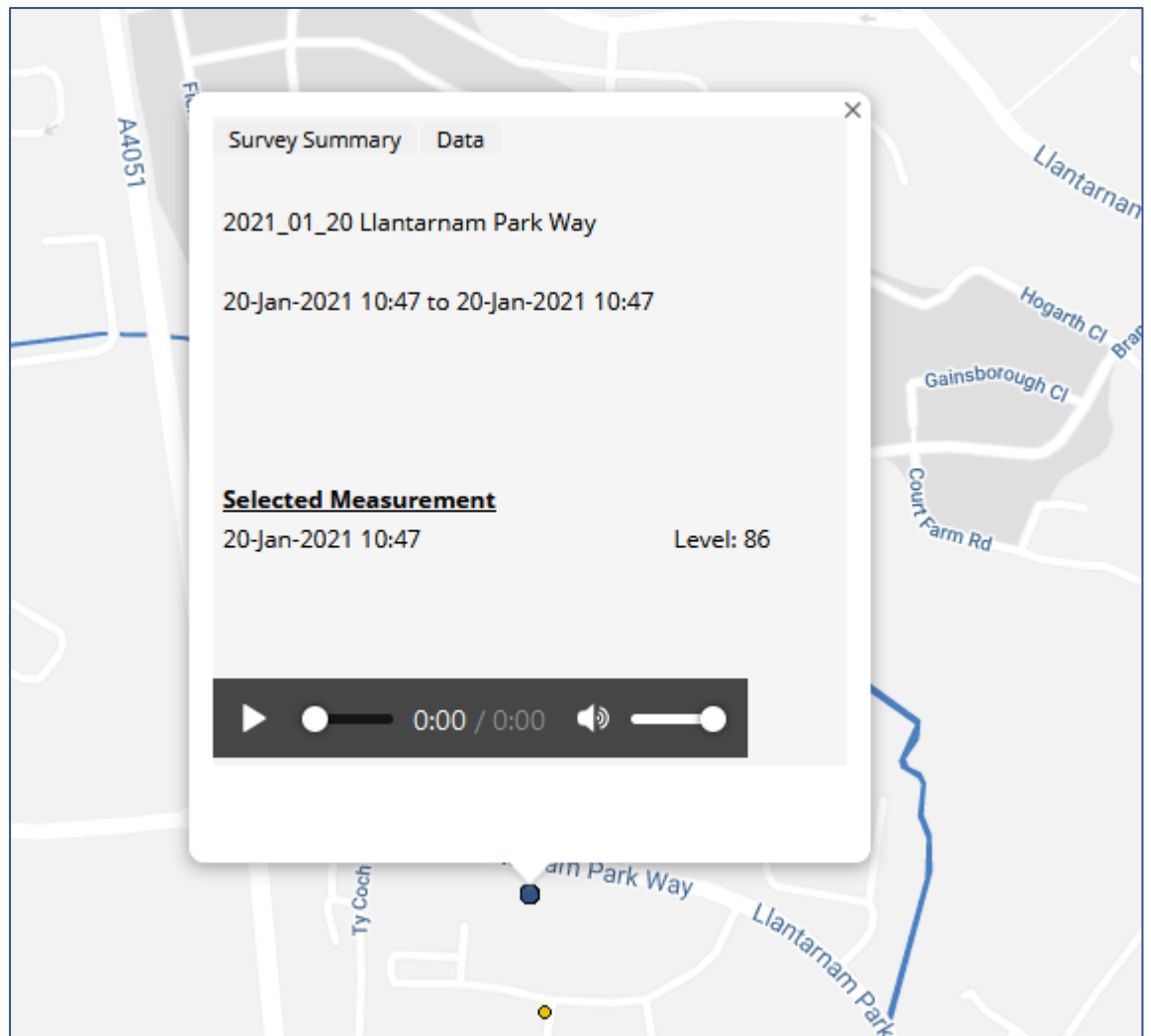
Hover the mouse cursor over this icon to animate the measurements (bounce up and down) within the map area;

This can be used to locate them more easily if they are not readily distinguishable from other features displayed on the map.



The picture above shows 5 locations at which measurements were made and uploaded.

Click on a measurement icon ... an information pop-up box appears with Survey details.

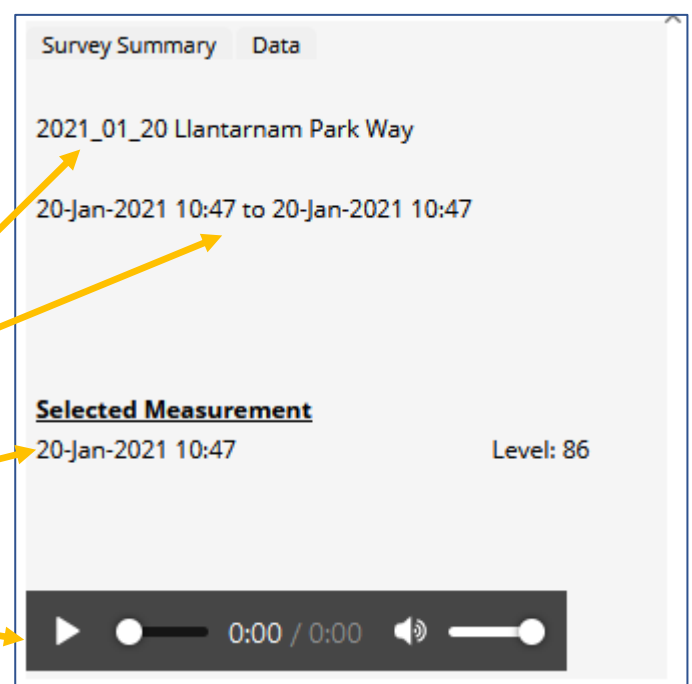


The pop-up has 2 tabs:

- Survey summary
- Data

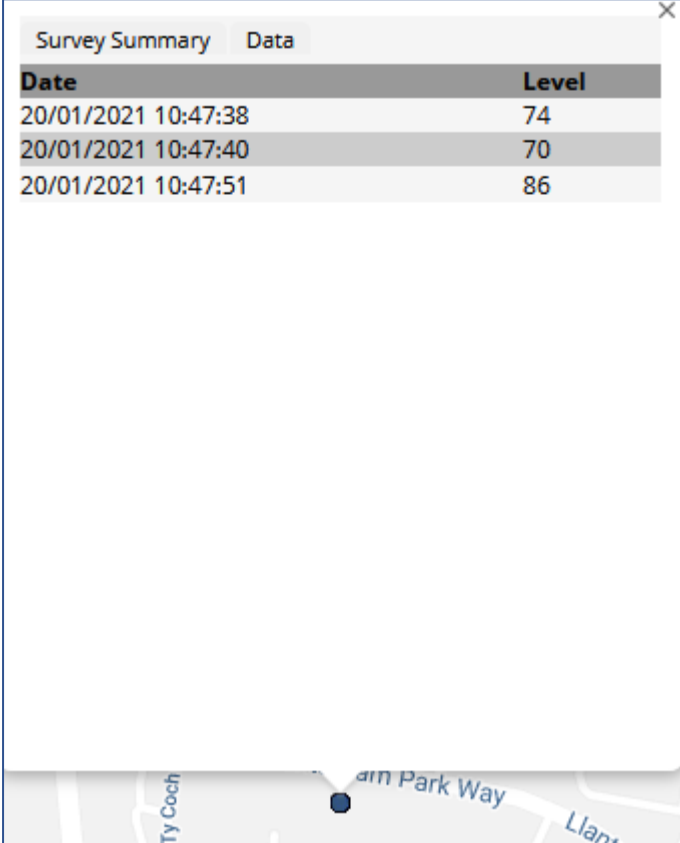
The Survey summary tab shows:

- An address for the measurement.
- A date-range for the survey.
- Details of the selected measurement including the minimum level (MLP final value).
- An audio playback tool (if there is an audio recording linked to the measurement).



The Data tab shows:

- A list of every measurement linked to the uploaded survey.
- Details of the minimum level (MLP final value) for each measurement in the survey.



Survey Summary Data	
Date	Level
20/01/2021 10:47:38	74
20/01/2021 10:47:40	70
20/01/2021 10:47:51	86



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