XMIC ®

XMIC User Manual

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Introduction

The Xmic is an advanced, electronic ground microphone designed to amplify the noise generated by water escaping from buried supply pipes under pressure. By means of identifying the position of the loudest leak noise indicates the position of the actual leak itself.

The Xmic system comprises a lightweight portable amplifier module complete with battery charger, a pair of aviation-quality headphones and an acoustically shielded ground microphone foot. As an optional extra, a hand-held listening probe is available. This comes with a tripod foot and two probe rods for sounding in soft ground.

The portable amplifier module has an LCD display and the advanced, easy-to-use features of the Xmic enable the operator to pinpoint leaks faster and with more confidence than ever before.

Note: The headphones supplied with the Xmic cannot be interchanged. The impedance of the headphones is matched to the Xmic control unit during manufacture.

Key features

- Sliding scale filter selection
- Backlit multi-function LCD display showing:
    - Noise level graphically and digitally
    - Dynamic sensitivity (signal strength)
    - Settings and operation mode
- Levels of leak noise can be recorded for comparison in a histogram profile (MLP)
- IP65 enclosure
- Aviation-quality headphones with volume control
- Lightweight, easily portable system
- Membrane keypad
- Versatile – ground microphone and hand probe configurations
- Military specification connectors
- Robust construction for field use
- Rechargeable batteries (up to 25 hours use)

Warnings

Lithium ion batteries

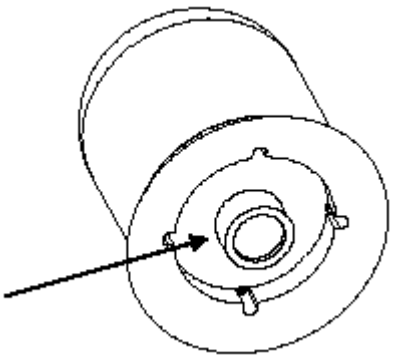
The batteries supplied and fitted to the Xmic units are rechargeable lithium ion. Do not short circuit or overcharge these batteries. Any misuse of these batteries may result in explosion or fire. They must not be used in any other application or used with any other equipment. Only batteries supplied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

Microphone foot warning

The 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 Palmer Environmental or by an authorised distributor.

Sensor: Do NOT attempt to unscrew



If the sensor does become loose it should be tightened manually so that it is "finger tight". Excessive force will cause damage.

System Description

Control unit – robust for field conditions

The control unit is the operator interface. It is very easily 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 and is environmentally rated to IP65.

The control unit has a membrane keypad, with push-key operation, and a backlit multifunction LCD display. The interface to the headphones, charger and microphone are via military-specification connectors.

Versatile leak noise sensing

The acoustically shielded ground microphone foot provides isolation from airborne noise interference and can therefore be used in wet and windy conditions.

Standard equipment list:-

1. Control/amplifier module with adjustable carry strap.
2. Acoustically shielded ground microphone foot.
3. Aviation quality headphones.
4. Lithium ion battery pack and battery charger.
5. Carry case.
6. Cables.
7. Manual.

Optional Additional Equipment

A handheld sensor unit can be added to the system as an option, providing the operator with the facility to use this as a smaller ground microphone with its tripod; or to use it with probe rods to sound fittings in deep chambers or to use in soft ground.

Xmic with optional handprobe, tripod and probe rods.

Equipment list including optional extras:-

1. Control/amplifier module with adjustable carry strap.
2. Combined hand probe and ground microphone with integral cable.
3. Two 400mm stainless steel rods.
4. One short legged tripod.
5. Aviation quality headphones.
6. Lithium ion battery pack and charger.
7. Carry case.
8. Cables.
9. Manual.

Xmic Overview

Number	Description
1	Mute Button
2	Mode Select
3	Dynamic Acoustic Signal Level meter
4	Battery Status
5	Power On/Off and Back Light
6	Gain Level
7	Gain Increase/Decrease
8	Battery Charging LED
9	Contrast Adjustment
10	Context Sensitive Button
11	Context Sensitive Button
12	Context Sensitive Button

Number	Description
1	Headphone and Charger Socket
2	Sensor Socket
3	Retaining Screws for Battery Compartment

Preparing the Xmic for Use

The battery pack for the Xmic is supplied as a separate item in the carry case. The batteries within this pack are supplied quarter charged. To insert the battery pack, unscrew the three screws on the underside of the unit, remove the cover and packing foam and connect the battery pack. Place in the battery compartment, refit the packing foam and then replace the cover with the three screws.

Battery charging

To charge the batteries, connect the charge lead from the charger to the headphones/battery charge connector on the back of the Xmic. Plug the charger unit into the mains supply.

While the batteries are charging, the charging LED will be illuminated. This only goes out when the batteries are fully charged. The Xmic unit cannot be used while the batteries are charging. However, it can be turned on, a sensor can be plugged in and a meter reading will be given, but there will be no sound as the headphones are not connected during battery charging. The time required to charge the batteries from flat is approximately 7 hours.

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, however, the Xmic **MUST** be switched back off again in order to resume charging. When fully charged the battery icon will appear completely dark.

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 Palmer Environmental.

To replace the batteries switch the unit off, unscrew the three screws on the underside of the unit. Remove the packing foam then unplug the battery connector and remove battery pack. Connect the new battery pack, refit the packing foam then replace the cover using the three screws.

Using the Xmic

Select the sensor attachment required, either the acoustically shielded ground microphone foot, or the optional microphone unit with probe rods or tripod which must be screwed into the bottom of the microphone housing. Plug the headphones into the Xmic control unit.

Xmic Switch On/Off

Switch the unit on by momentarily pressing the On/Off switch. The unit will switch on and remain switched on until this same button is pressed again unless it is left unused. To switch the unit off, the On/off switch must be pressed and held down for 3 seconds.

Headphones mute

To switch the headphones on press the headphones button. To switch them off press the same button again. The headphones mute icon will be displayed. Note there is a rotary control on the headphones to adjust the volume. To momentarily mute the headphones, press and hold the mute button.

Back Light

To view the LCD display in bad light, illuminate the backlight by pressing the combined On/Off Backlight switch briefly. To switch it off, press this same button momentarily.

Filter Selection

To clarify the leak noise, background or unwanted noise frequencies can be filtered out using a combination of the controls on the Xmic. Unwanted frequencies can be filtered out via the bandpass, bandwidth and filter position buttons.

There are two modes of operation – survey mode and minimum level profiling mode (MLP)

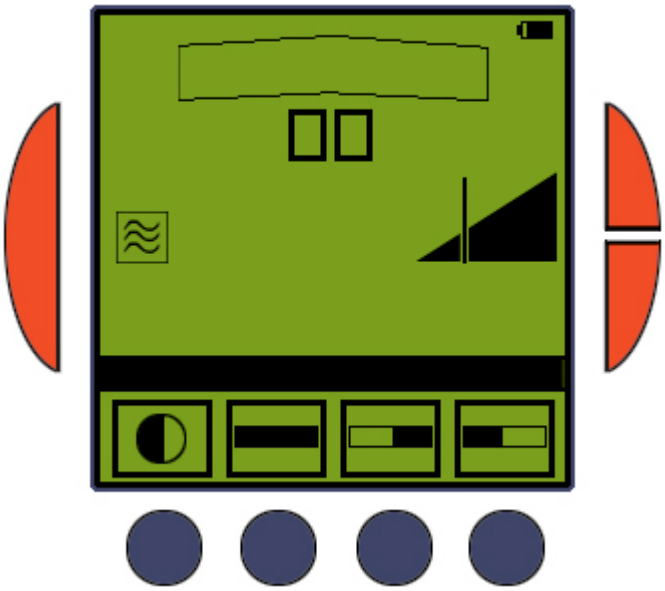
Survey Mode

In survey mode, the gain level can be adjusted for optimum volume and the filters can be adjusted to reduce unwanted ambient noise. To locate the position of an underground leak the microphone foot is placed on the ground above the line of the suspect pipe and the readings observed.

Survey Mode Screens

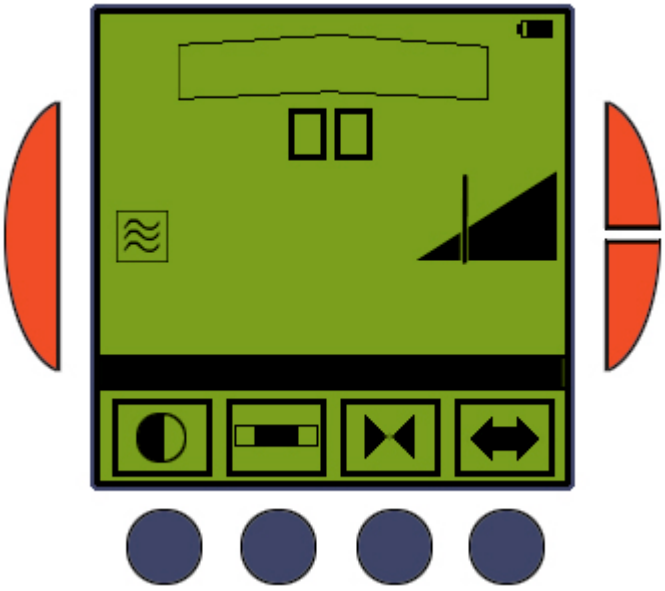
Preset Filter Screen

This is the initial screen, which appears when the Xmic is switched on.



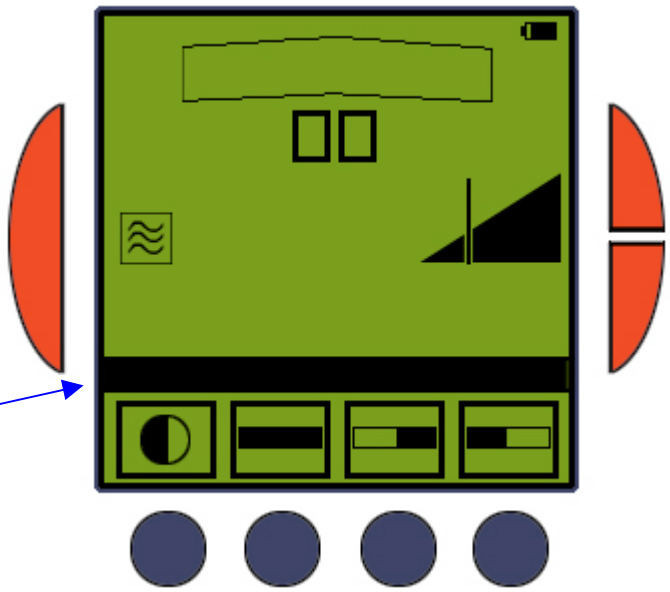
Adjustable Filter Screen

Pressing the Mode Select button (red button on left-hand side of screen) once will bring the user to the opposite screen where they can enter their own custom filters.



Unfiltered Noise

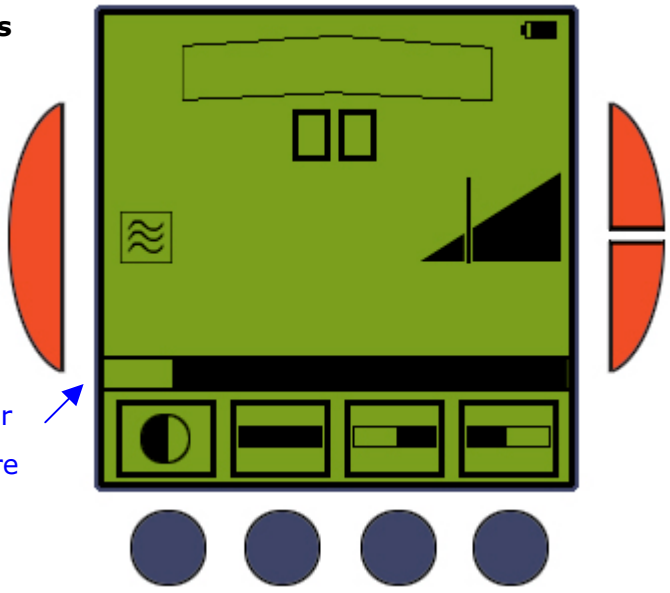
This is the default screen showing no filters have been applied.



Frequency spectrum indicator bar shows that all frequencies are available

Preset Filter for High Frequencies

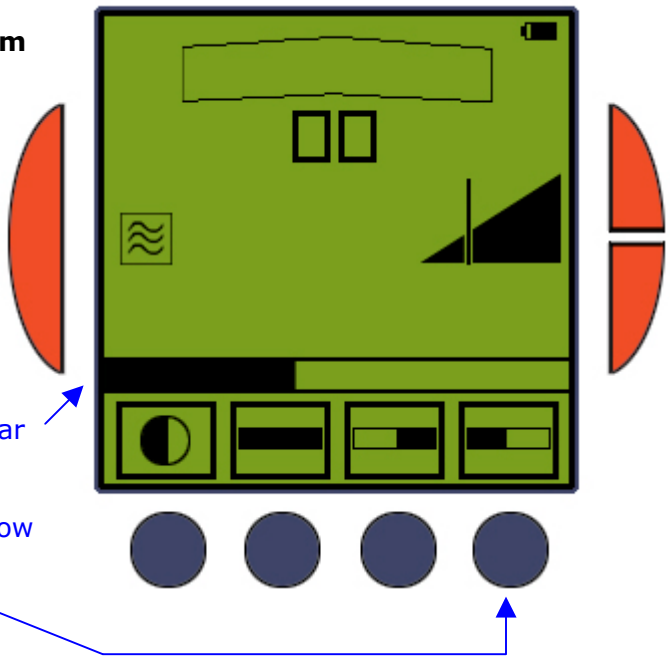
Used on metal pipes.



The frequency spectrum indicator bar shows only the higher frequencies are allowed through when the high pass filter button is pressed

Preset Filter for High and Medium Frequencies

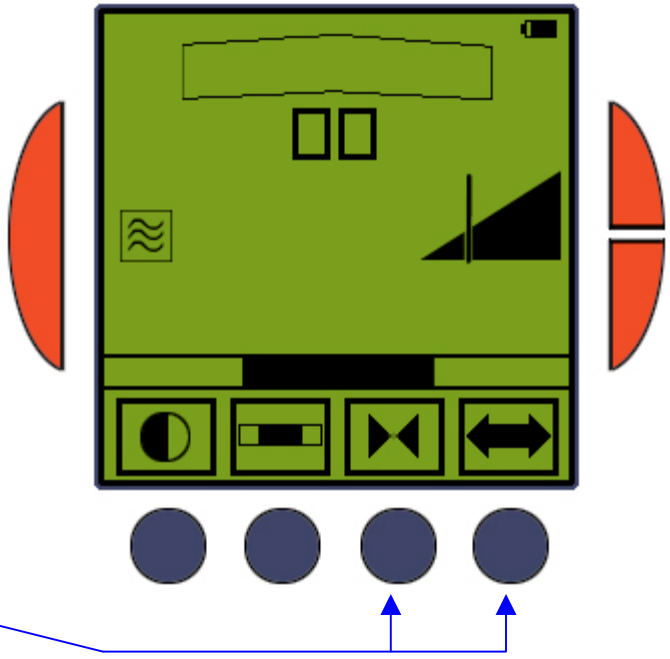
Used on plastic (MDPE) pipes.



The frequency spectrum indicator bar shows both medium and higher frequencies are allowed through. Low frequencies are filtered out.

Adjustable Filters - Bandwidth

Pressing the Mode Select button (red button on left-hand side of screen) once will bring the user to the opposite screen where he/she may enter their own filters according to the job in hand.



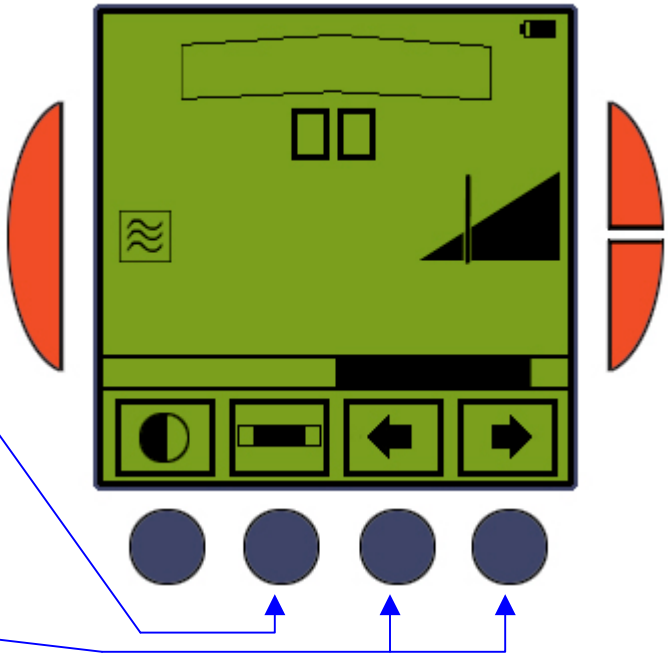
The bandwidth of the frequencies allowed through can be adjusted using the double-headed arrow buttons as shown here.

Adjustable Filters - Bandpass

To access this screen press the second button from the left (bottom row) whilst in the adjustable filters screen (see previous page)

Pressing this button again will revert to the previous screen

The position of the bandpass frequencies can be adjusted up or down the spectrum using the left and right arrows



MLP Mode

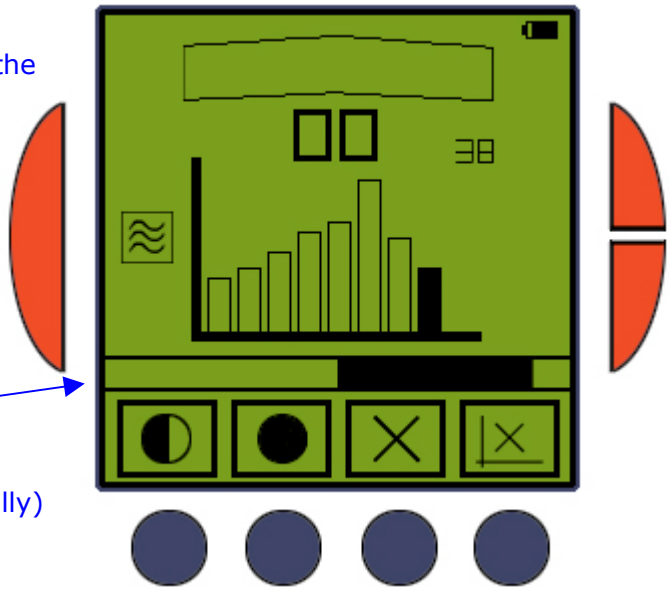
MLP stands for **M**inimum **L**evel **P**rofiling. This is performed by stepping along the line of the suspect pipe and recording the sound levels. The ground microphone is placed on the ground and the sample button pressed momentarily. The Xmic then records the minimum noise over three seconds.

As each recording is made the histogram graph is built up showing the difference between each reading visually and numerically making noise level comparison a simple task.

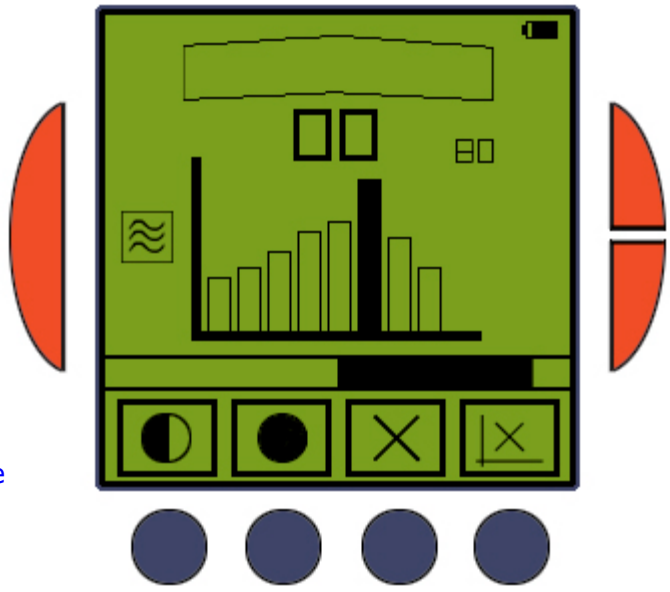
For each sample taken a number appears on the top right of the screen. This noise level value is a relative indicator for each sample. Once several readings have been taken the operator can select a sample by pressing the + or - button on the right of the Xmic. The numerical noise level value is then shown for each sample.

MLP Mode Screens

Once filters have been selected go to the MLP (**M**inimum **L**evel **P**rofiling) screen by pressing the Mode Select button, to carry out a leak noise comparison.



Each time this button is pressed momentarily the leak noise aquired in the previous three seconds is recorded and displayed as a vertical bar on a histogram. In the example above, eight consecutive readings have been taken by stepping the ground microphone along the length of the pipe and pressing the sample button at each position.



Guidance to Effective Acoustic Leak Detection

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 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.

Hand probe

For normal soft ground surfaces the single pointed extension rod should be connected - do not over-tighten the screw thread. 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.

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.

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.

Xmic Technical Specification

Control Unit

Processor: 4MHz 16 bit

Input impedance: 1MOhm

Output impedance: 6 to 16 Ohms

Amplification: 46dB

Frequency range: 30 to 3000Hz

Distortion: Better than 1%

Battery: 2 x Lithium ion 1.8Ah rechargeable batteries

Battery life: Minimum 25 hours (without backlight)

Battery charge: Maximum 8 hours

Charger: Universal 110-240V AC mains charger with 12V DC output

Weight: 1kg

Dimensions: 206mm x 167mm x 86mm

Environmental rating: IP65

Operating temperature range: 0 - 50°C

Operating humidity: 0 – 95% non-condensing

Connection: Military specification Amphenol

Keypad: Membrane with push button

Display: 128 x 128 transflective LCD

Signal level display 0 – 99

Filter Options

Variable High Pass and Low Pass filters across frequency range

Three automatic filter settings based on pipe material

Metallic – High Pass 350Hz, Low Pass 3kHz

Plastic – High Pass 75Hz, Low Pass 3kHz

Broadband – High Pass 30Hz, Low Pass 3kHz

Microphone

High sensitivity piezo-electric sensor mounted in windproof, nitrile rubber housing

Low noise 1.5m cable (detachable)

Weight: 2.9kg

Hand Probe Attachment (Optional Upgrade)

The hand probe option includes the tripod and two stainless steel probe rods (each 400mm in length)

Combined weight of rods 162g

Headphones

Aviation quality headphones are supplied as standard with the Xmic.

CONTACT

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