OVARRO
CONNECTING TECHNOLOGIES

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Eureka5 User Manual

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Revision History

Version	Date	Description
1.0	22/072021	First draft
1.1	04/03/2022	2nd draft
1.2	24/03/2022	3rd draft – DoCs to be added in appendices
1.3	24/03/2022	4th draft – update to warning re hydrophone removal

Contents

1 Introduction

1.1 System Overview

Eureka5 is a high-performance leak noise correlator used for the location of leaks in buried water pipes. The system combines sophisticated technology with flexible operation to locate leaks in difficult conditions, e.g., where there is substantial background noise, where only the quietest of leak noise is present, or with a variety of pipe materials.

The Eureka5 system comprises radio transmitters, radio receiver with signal processing electronics and the EUREKA GO software application.

The transmitters and receiver are powered from internally mounted 7.2V Lithium-Ion battery packs.

The system is designed for outdoor use. However, battery charging of the equipment should only be performed in the transport case either indoors using the mains charger supplied or in a vehicle using the vehicle charge lead.

Other environmental specs can be found on the Technical Specification in Appendix A of this manual.

Transport Case, Transmitters, Receiver and Accelerometers

1.2 System Contents

1.2.1 Standard Package

The Eureka5 standard package comprises:

- Red transmitter
- Blue transmitter
- Transmitter antenna (x2)
- Receiver unit
- Receiver antenna
- Accelerometer sensors (x2)
- Headphones
- Car charge cable (12VDC)
- Main's charger
- Transport case
- EUREKA GO App available from the Android™ PlayStore™

1.2.2 Optional Items

The optional items available are:

- Hydrophone sensors
- Android™ tablet

2 Principles of Leak Noise Correlation

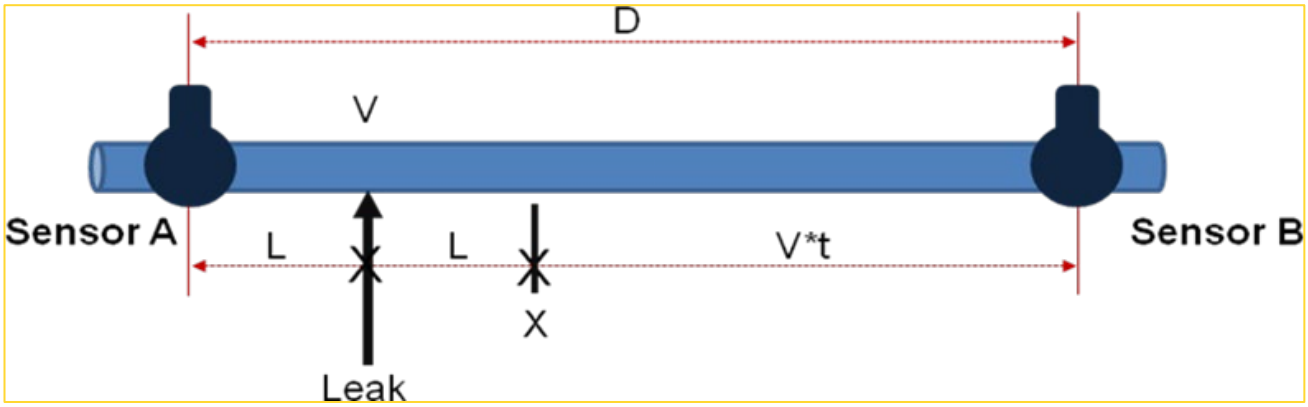
Leak noise correlation is used to detect leaks in pipelines where there is a positive internal pressure, such that a leak causes a loss of fluid to the outside. The movement of fluid through the leak causes rapid pressure changes around the site of the leak such that there is a randomly varying noise source located at the leak. This noise travels in both directions, at the same velocity, from the leak.

(Noise is not a constant frequency like a musical note but is a random and continually changing mixture of different frequencies. It is this characteristic which enables the correlator to operate.)

2.1 Methods of Location

Previous methods of leak location relied on detecting a noise, then tracing it at ground level to find the point of maximum noise, which was assumed to be directly above the position of the leak. The equipment used included listening sticks and stethoscopes, but these were difficult to use if the noise was faint or too loud to be accurately located. Background noise was another problem; electronically- filtered amplifiers were introduced in an attempt to overcome such problems.

A correlator operates by comparing the noise detected at two different points in the pipeline. Noise travels from the leak in both directions along the pipeline at a constant velocity (which depends on various factors), so that if the leak is equidistant between two sensors then these sensors will detect the noise at the same time. Conversely, if the leak is not equidistant then the sensors will detect the same noise at different times, and the difference in time (the time delay) is measured by the correlator. The following diagram illustrates this:



The sensors are located on the valves A and B (convenient access points for underground pipes), and as shown the leak site is closer to A.

By the time a particular noise from the leak has reached A, the same noise heading towards B has only travelled as far as X. The distance from X to B causes a delay t before the noise arrives at B, thus the correlator detects the delay (t) between the arrival of the noise at A and its arrival at B. If the velocity of sound is V and the distance between the sensors is D, then as the distance from X to B = V * t, (velocity x time), then D = (2 * L) + (V * t). This equation may be rearranged to give L, the distance from the nearer sensor to the leak site:

$$L = \frac{D - (V * t)}{2}$$

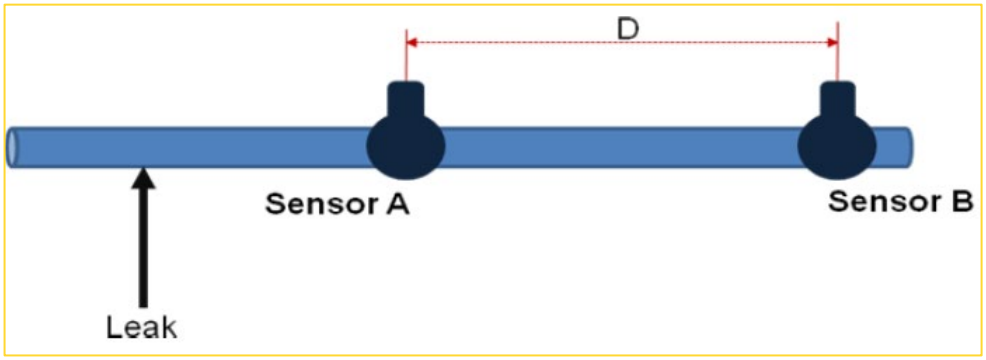
As the sound velocity can be calculated from knowledge of the pipe diameter and material, while the distance between the sensors can be determined by careful measurement, the correlator can calculate and display the location of the leak as a direct distance from its nearest sensor. Alternatively, the correlator may be used to measure the actual velocity of sound in the pipework being examined, so ensuring the highest possible accuracy in locating the leak.

2.2 Sensor Position

Correlator operation depends on having the leak located between the two sensors. There are two situations where this is not the case, and one sensor will have to be moved before an accurate correlation can be performed.

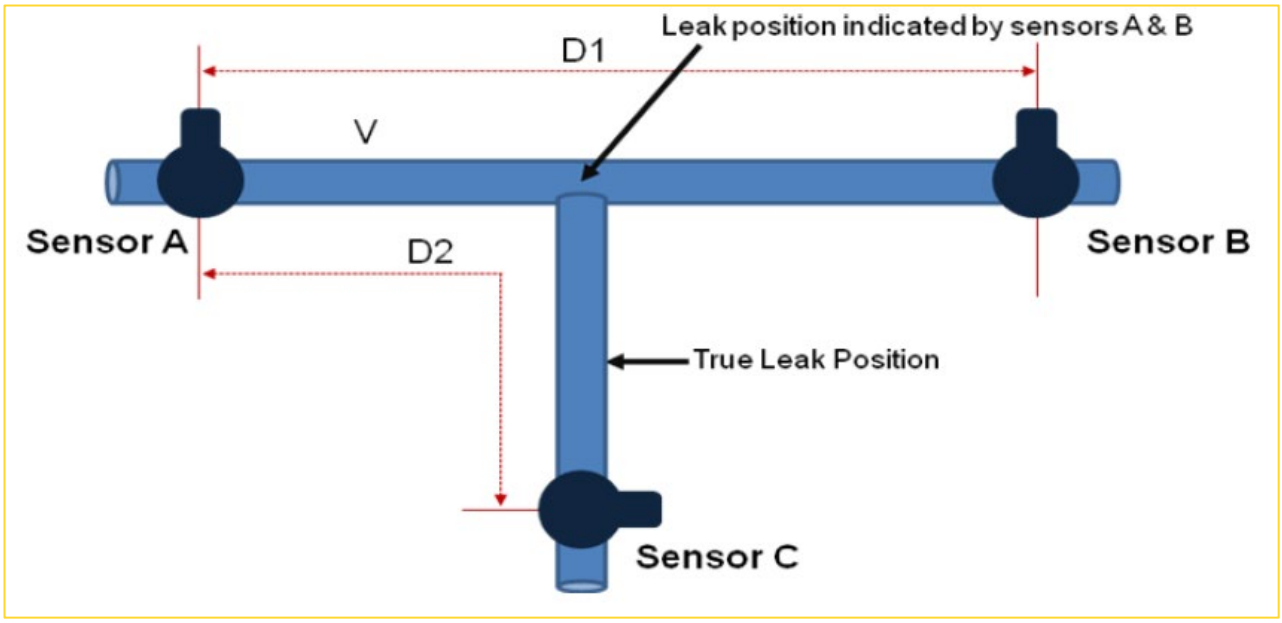
2.2.1 Leak Beyond Sensors

If the leak is located outside the length of pipe between the sensors, then the correlator will ignore the transit time from the leak to the nearest sensor, as this transit time will be the same for both sensors. This will give the result that the leak will appear to be located directly at the sensor nearest to the leak. (This is sometimes termed "out-of-bracket".) This is an indication that one sensor must be moved to locate the leak position accurately.



2.2.2 Leak on Connecting Pipe

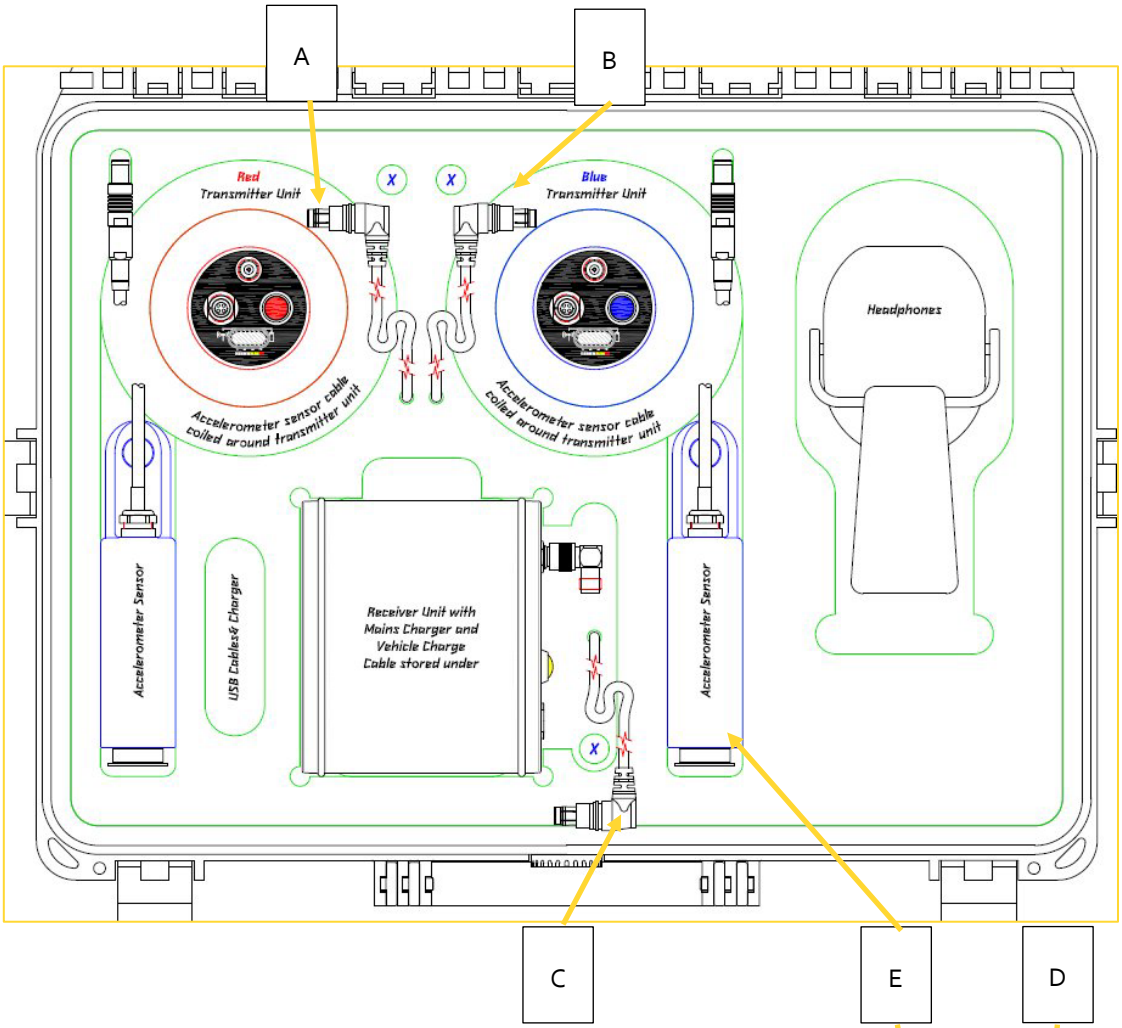
If there is a leak on a pipe that connects to the pipe being sensed, then the noise will appear to spread from the point of connection of the pipes, and so will appear as a leak at that point. It is then necessary to move one sensor to the connecting pipe (in other words, to place the leak between the sensors) to locate the leak accurately. A thorough knowledge of the layout of the entire pipe network is required to ensure that the correlator is making measurements on the correct section of pipe and that there is no possibility of leaks on branch pipes causing false readings.


Leak position indicated by sensors A & B
D1
V
Sensor A
D2
Sensor B
True Leak Position
Sensor C

3 System Components

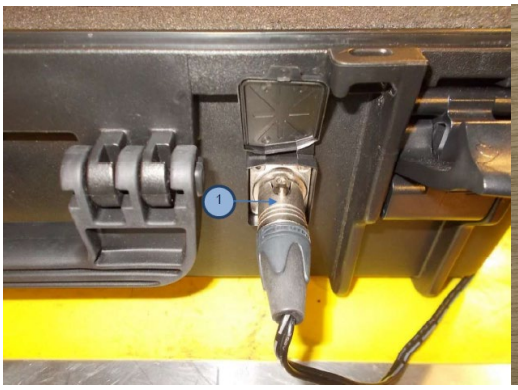
3.1 Transport Case / Charger

The transport case acts as the storage area for all the components of the system and a charger distribution/connection system to allow the Transmitters and Receiver units to be charged in-situ in the case.

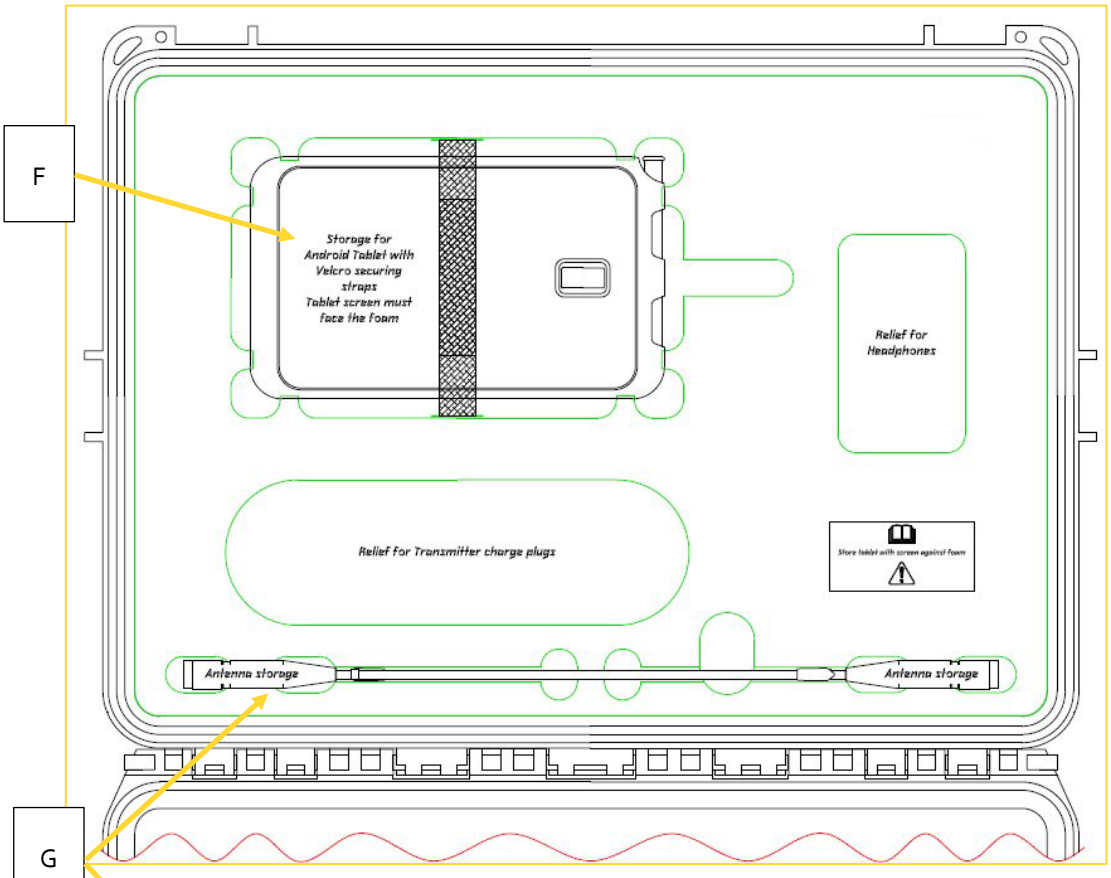


Key	Description
A	12VDC charge lead for Red Transmitter
B	12VDC charge lead for Blue Transmitter
C	12VDC charge lead for Receiver
D	12VDC charger input connector
E	Accelerometer sensor

The photos below show the charger input socket with the mains charger fitted and the mains charger.




The lid section of the transport case is used to store the tablet and the 3 antennas.



Key	Description
F	Position for Android™ Tablet
G	Antennas (x3)

3.2 Transmitters

Eureka5 has two transmitters, one red and one blue. They both listen to noise which is transmitted via an internal radio transmitter. The transmission frequency of each transmitter is different to distinguish the different noise signals.

Key	Description
A	Antenna Socket
B	Pushbutton Switch
C	External Sensor / Charger Socket
D	Indicator LEDs

3.2.1 Antenna Socket

The antenna TNC socket allows the connection of one of the three supplied antenna that are stored in the transport case lid.

3.2.2 Pushbutton Switch

The pushbutton switch has several functions.

When the Transmitter is off:

- Short press will show the battery charge on the LED Level Indicator.
- Long press (2 seconds) will turn on the transmitter

When the Transmitter is on:

- Short press will cycle the transmitter between low and high radio power output.
- Long press (2 seconds) will turn off the transmitter (press and hold until all the LEDs come on and go off).

3.2.3 External Sensor / Charger Socket

The 4-pin connector allows the connection of an external sensor (Ovarro supplied accelerometer or optional hydrophone). It alternatively connects the transmitter to the charger when it is in the transport case.

During normal operation a voltage of 5VDC is output from the transmitter to power the sensor. A low voltage (mV) analogue signal is then generated by the sensor and input to the transmitter via the same 4-pin connector. During charging, the 12VDC charging supply is connected to this connector via the mating connector inside the transport case.

3.2.3.1 External Accelerometer

This allows placing the transmitter above ground to improve the radio signal between the transmitter and receiver unit. External accelerometers from previous Eureka correlation units are compatible with Eureka5 transmitters.

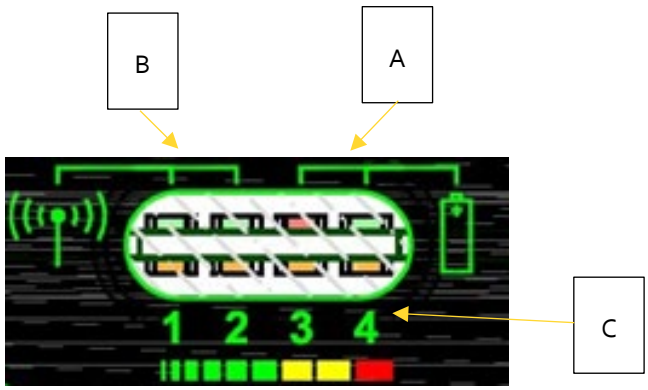
3.2.3.2 Hydrophone (Optional Accessory)

Hydrophones are an optional accessory and can be purchased separately to improve noise quality for large diameter (typically >300mm) and plastic pipes. A hydrophone can be attached to the external sensor connector on the Transmitter Unit in the same way as an accelerometer. It is then directly inserted into the pipe through a hydrant or similar fitting. This option then needs to be selected on the EUREKA GO App.

	**Adhere to local water hygiene regulations when inserting hydrophones into potable water pipes.**

	**The EUREKA GO App must have the correct information about the sensors connected.**

3.2.4 Indicator LEDs



State	Battery LEDs (A)	Tx Power LEDs (B)	Amber Bar Graph LEDs (C)
Off	Off	Off	Off
On	Battery level Green: normal Red: low Flashing red: critical	Transmit power 1 Green: low 2 Green: high	Sound level
Charging	Charging state Green: charging / fully charged Flashing red: fault	Off	Progress of charging cycle
Frequency Select	Off	Off	0V link selection indicator

3.2.4.1 Transmitter Charging

The transmitters are charged in the transport case. To charge, connect the associated charge lead in the transport case to each transmitter. Connect the transport case to the mains supply using the mains adapter or use the vehicle charge cable (12VDC).

When first connected to the charging source, the Amber LEDs on the transmitters will scroll in sequence 5 times to indicate charging has started. Whilst charging the LEDs will show the status as below:

State	Condition	LED indication
5	Charging complete	Amber: All 4 on Power: on green
4	Capacity < 90%	Amber: 1 & 2 & 3 on; 4th LED flashing Power: on green
3	Capacity < 70%	Amber: 1 & 2 on; 3rd LED flashing Power: on green
2	Capacity < 50%	Amber: 1 on; 2nd LED flashing Power: on green
1	Capacity < 30%	Amber: 1st flashing Power: on green
Fault	FAULT signal	Amber: all 4 off Power: flashing red

The over temperature state may occur when charging in high temperatures. The transmitter electronics will manage this state and continue to charge when possible.

The fault state indicates a problem, and the transmitter should be returned to an Ovarro Service Centre for further investigation.

	**Only Eureka5 charge leads should be used to charge Eureka5 transmitters. DO NOT attempt to use Eureka2 or Eureka Digital charge leads, as damage may occur which will not be covered by warranty.**

3.2.4.1.1 Charge Time

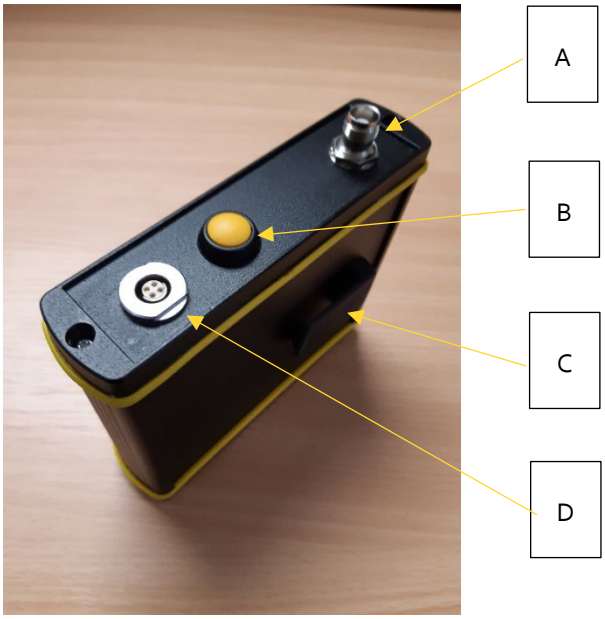
Charge time from flat to full is around 3 hours. The charge time will be longer in higher temperatures; there is automatic monitoring in the electronics to prevent the batteries overheating.

3.2.4.1.2 Battery Life

Transmitter battery life is around 11 hours, in low power transmission mode.

3.3 Receiver Unit

The Receiver Unit receives and processes the noise data from the radio transmitters and then transmits the data via Wi-Fi to a Tablet running the EUREKA GO App to produce a leak noise correlation.



Key	Description
A	Antenna Socket
B	On/Off Push Button Switch (Yellow)
C	Belt clip
D	Charge Input Socket

3.3.1 Antenna Socket

The antenna TNC socket allows the connection of one of the three supplied antenna that are stored in the transport case.

3.3.2 On/Off Push Button Switch

The on/off push button switch (B in the photo) has several functions: -

When the Receiver is off:

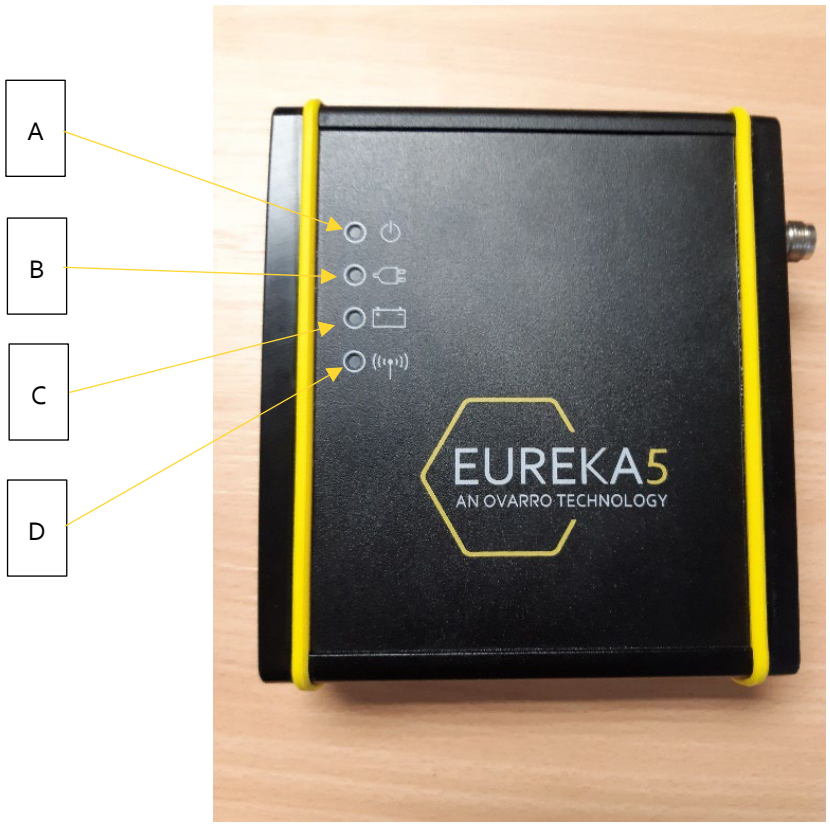
- A single press of the button will start the power on process. At this point the Power LED will turn on. Approximately 90 seconds later the Wi-Fi Status LED will start to flash fast and intermittently. The unit is not fully powered until the Wi-Fi Status LED is flashing slowly & steadily. This indicates that the Wi-Fi is trying to connect to the tablet.

When the Receiver is on:

- Two quick presses of the button will start the power down process. The Wi-Fi Status LED will flash fast and steady for a few seconds and then the Power LED will turn off. The unit is now powered down.
- Pressing and holding the button for longer than 6 seconds will cause a forced power-down and reset the unit. This operation should be avoided as it can limit the life of the internal memory card.

3.3.3 Indicator LEDs

Key	Description
A	Power On if the unit if powered on
B	External Power On if external power is connected to the unit
C	Charge status On – Charging Off - Charge complete Flashing - Error (charge suspend, input overvoltage, timer fault, no battery)
D	Wi-Fi status On - Wi-Fi connected Off - Wi-Fi not connected Fast Intermittent Flash – Powering up Slow Steady Flash – Fully powered up & Wi-Fi trying to connect Fast Steady Flash – Powering down



3.3.4 Charger Input Socket

The 4-pin connector connects the Receiver to the charger when it is in the transport case. During charging, the 12VDC charging supply is connected to this connector via the mating connector inside the transport case. No voltage is output from the charger input socket on the Receiver Unit.

3.3.5 Charging

The Receiver unit is charged in the transport case. To charge, connect the associated charge lead in the transport case to the Receiver. Connect the transport case to the mains supply using the mains adapter or connect the vehicle charge cable to the vehicle supply (12VDC).

When first connected to the charging source, the External Power LED on the receiver unit will illuminate, followed by the Charge Status LED if charging required.

If the Charge Status LED flashes, then remove the charge lead and then reconnect. If the Charge Status LED continues to flash, the Receiver unit or Eureka5 system should be returned to an Ovarro Service Centre for further investigation.

	**Only Eureka5 charge leads should be used to charge the Eureka5. DO NOT attempt to use Eureka2 or Eureka Digital charge leads, as damage may occur which will not be covered by warranty.**

3.3.5.1 Charge Time & Battery Life

Charge time from flat to full is around 3 hours. The charge time will be longer in higher temperatures; there is automatic monitoring in the electronics to prevent the batteries overheating.

3.3.5.2 Battery Life

Receiver battery life is around 7 hours, depending on usage pattern.

4 Deployment

4.1 Choosing the Transducer Type

In most cases, accelerometers will be adequate. The accelerometers provide ease and flexibility of deployment.

Consider the (optional) hydrophones for:

- Large diameter pipes (typically >300mm)
- Plastic pipes

4.2 Attach Transducers

4.2.1 Accelerometers

It is good practice to place the transmitters above ground to aid in the transmission of signals to the receiver.

1. Connect the accelerometer to a metal fitting (preferred surface: unpainted, rust-free, clean metal).
2. Ensure a rigid physical contact.
3. Check the connection by listening via headphones.

4.2.2 Hydrophones

The standard hydrophone is mounted in a hydrant cap for use with any hydrant fitting. When fitting a hydrophone to a hydrant, follow this procedure.

1. Open the hydrant carefully to ensure there is no debris in the outlet, and clean water flows(the pressure can be assessed at this point).
2. Ensure the hydrant valve is shut.
3. Ensure the seal in the hydrophone is clean.
4. Fit the hydrophone to the hydrant and tighten in place. Tightening is best performed by fitting the adaptor provided onto the castellations on the upper side of the hydrant cap, then using the standard hydrant valve key to tighten the hydrophone assembly.
5. Ensure the bleed valve is closed, and that the fitting is secure.
6. *Slowly* open the hydrant valve, and check that no leakage occurs from the hydrophone.
7. Open the bleed valve *slightly* to allow air to escape.
8. Close the bleed valve when only water is escaping.

When fitted correctly the hydrophone may be connected directly to the transmitter.

	**Before removing a hydrophone fitting, it is essential to make sure that the hydrant valve is shut. After closing the Hydrant valve the bleed valve may then be opened to check that there is no pressure. Only then should you remove the hydrophone and adapter.**

	**Adhere to local water hygiene regulations when inserting hydrophones into potable water pipes.**

4.3 Set-Up Transmitters

1. Attach antenna.
2. Position the transmitter as required.
3. Switch on the transmitter by holding down the button for 2 seconds.

4.4 Set-Up Receiver Unit

1. Connect the antenna. The magnetic vehicle mount antenna is highly recommended if operation is inside a vehicle.
2. Switch the receiver unit on with a short press on the button.

4.5 Radio Range

At manufacture every system is tested over a distance of 100 metres, line-of-sight on 'low power' mode and with the portable receiver antenna. Radio range will be considerably increased in the 'high power' mode.

4.6 Inter-Transducer Distance

An accurate inter-transducer distance is necessary to achieve accurate leak pinpointing. The accuracy of the correlation result will only be as good as the accuracy of the distance measurement.

When making distance measurements, it is the actual pipe length that must be measured; be aware that water mains do not always run in a straight line or at a uniform depth.

4.7 Velocity

An accurate sound velocity is necessary to obtain accurate leak location from the correlation result. In most cases the sound velocity that is automatically used when entering the pipe diameter and material will be adequate. However, it is always highly recommended to check and correct the sound velocity in the pipe to reduce leak position error. The method of velocity correction is described in Section 5.7.

4.8 Filter Settings

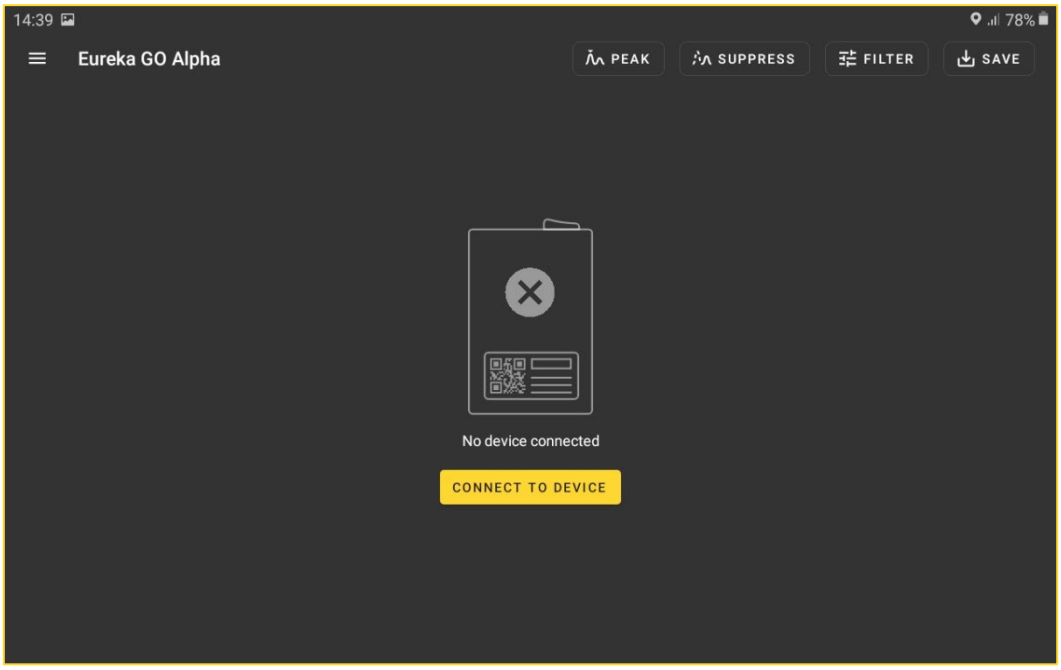
The default filter settings will give good results most of the time. Sometimes with difficult leaks adjusting the filters will obtain a more definitive result. Adjustment of the filters and the use of the coherence display are explained in section 5.9.

5 EUREKA GO App

5.1 Establish Wi-Fi Connection

The first time the EUREKA GO App is used with a Receiver Unit, the tablet needs to be connected to the Wi-Fi network generated by the Receiver unit.

Turn on the Receiver and wait for the Wi-Fi Status LED on the Receiver to flash slow and steady. This indicates that a Wi-Fi connection can be established. Start the EUREKA GO App and tap CONNECT TO DEVICE.



Next, tap the GO TO SETTINGS button. This will navigate the user to the Android™ Wi-Fi Settings menu.

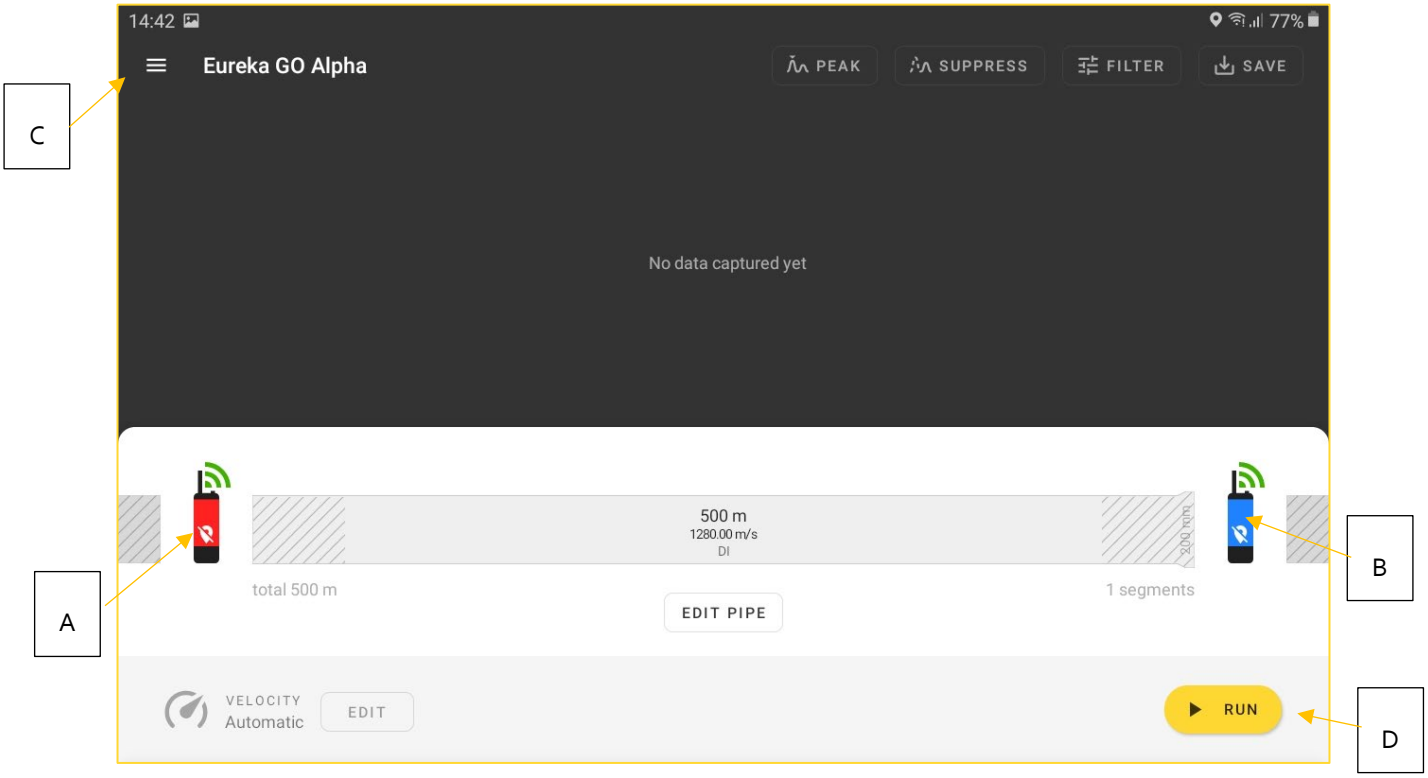
Select the SSID **eureka4-2** from the list of available connections.

When the passcode is requested for the connection, enter **ovarroeureka4-2**

Connection between the tablet and the Receiver unit is now complete.

Note, this Wi-Fi connection does not provide internet access, so if internet access is required via the tablet, an alternative connection will be required.

5.2 Main Correlation Screen



Key	Description
A	Red transmitter power icon
B	Blue transmitter power icon
C	Menu button
D	Run button (run correlation)

5.2.1 Red and Blue Transmitter Power Icons

These icons show the received signal strength from the red and the blue transmitters. The icon will flash if no signal is received. The received signal strength is indicated by the number of green bars. More bars indicate a stronger signal.

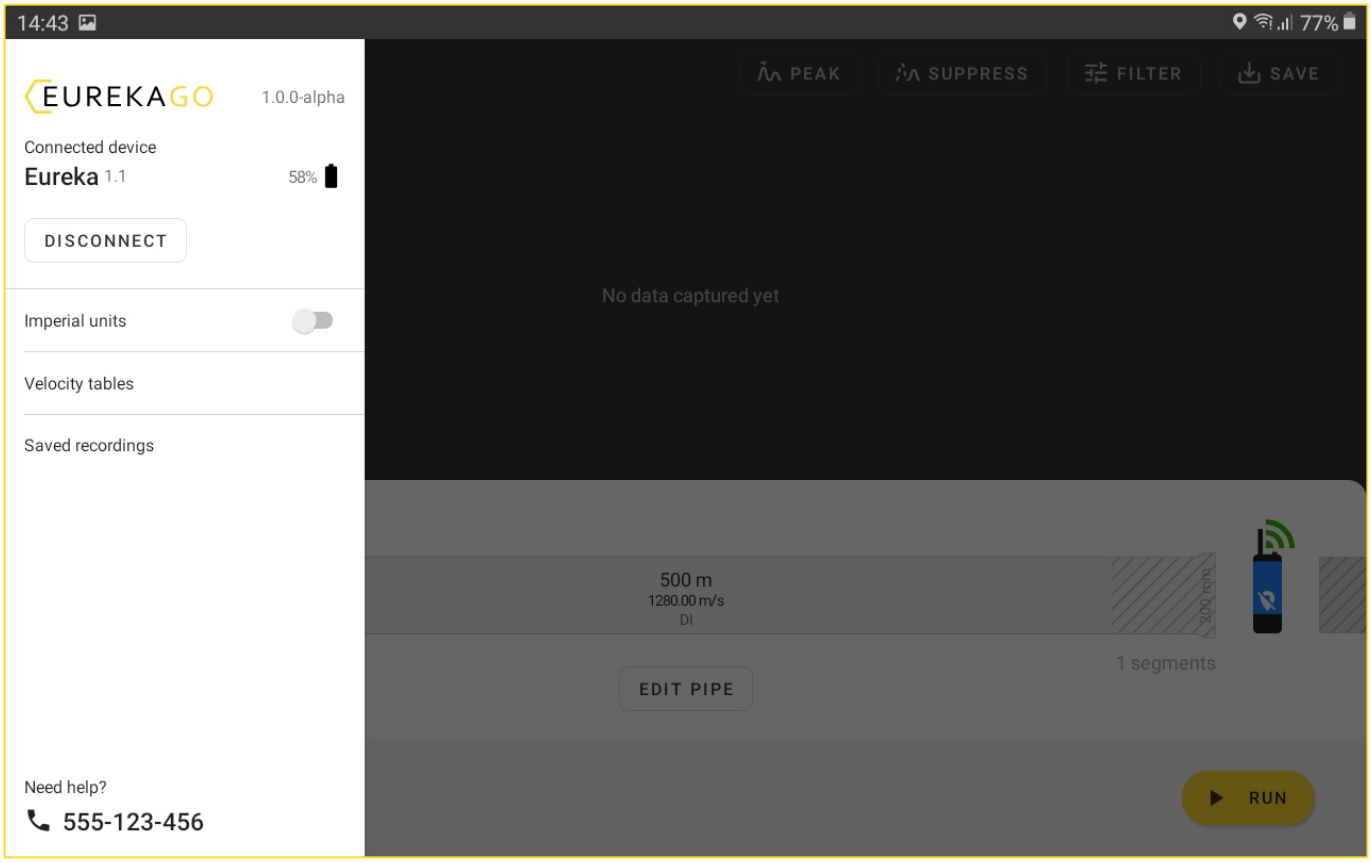
5.2.2 Menu Button

Tapping on the menu button at the top left of the screen will open the Menu Screen. See section 5.3.

5.2.3 Correlation Button

Tapping on the RUN button will start a Correlation. See section 5.5.

5.3 Menu Screen



5.3.1 Receiver Unit Battery Level

From the menu screen the percentage battery charge remaining for the Receiver unit can be viewed.

5.3.2 Disconnect Button

Pressing this will disconnect the app from the receiver unit.

5.3.3 Imperial units

This toggle allows the user to select imperial or metric units to be displayed in the app.

5.3.4 Velocity table

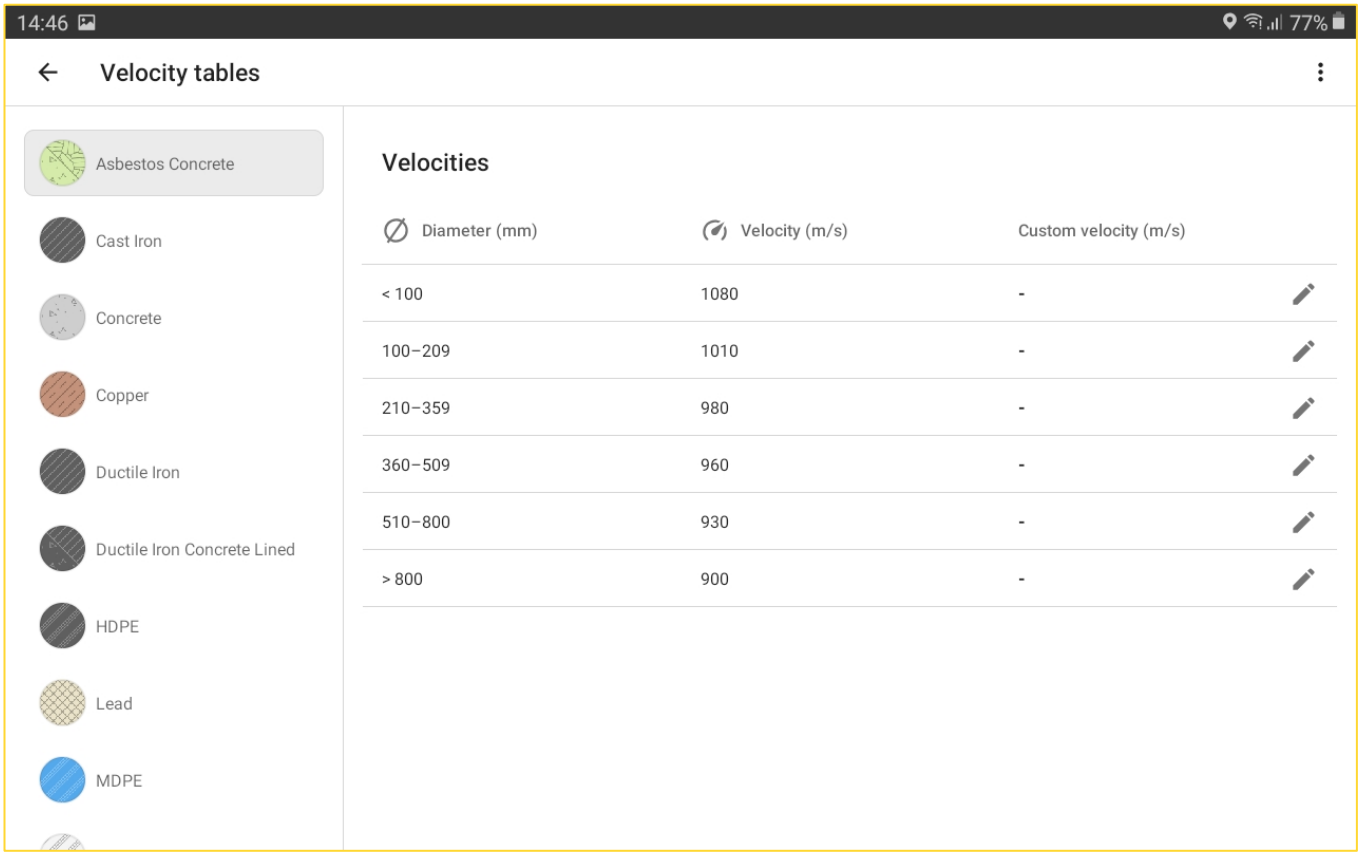
The EUREKA GO software allows customisation of the velocity values used for correlation. The tables programmed into the unit have been formulated after many years' experience and should not be changed without proper thought. Changing the velocity used for a correlation will result in a different leak position.

To access and change the velocities table, tap the velocities table button; this will open the Velocities Table Screen (see section 5.4).

5.3.5 Saved recordings

This button will allow the user to view the list of saved recordings that have been uploaded to Primeweb.

5.4 Velocities Tables Screen



5.4.1 Pipe Materials

This is the current pipe material (whose velocity data for various pipe diameters is shown). Select the required pipe material and the current velocities for that material will be shown.

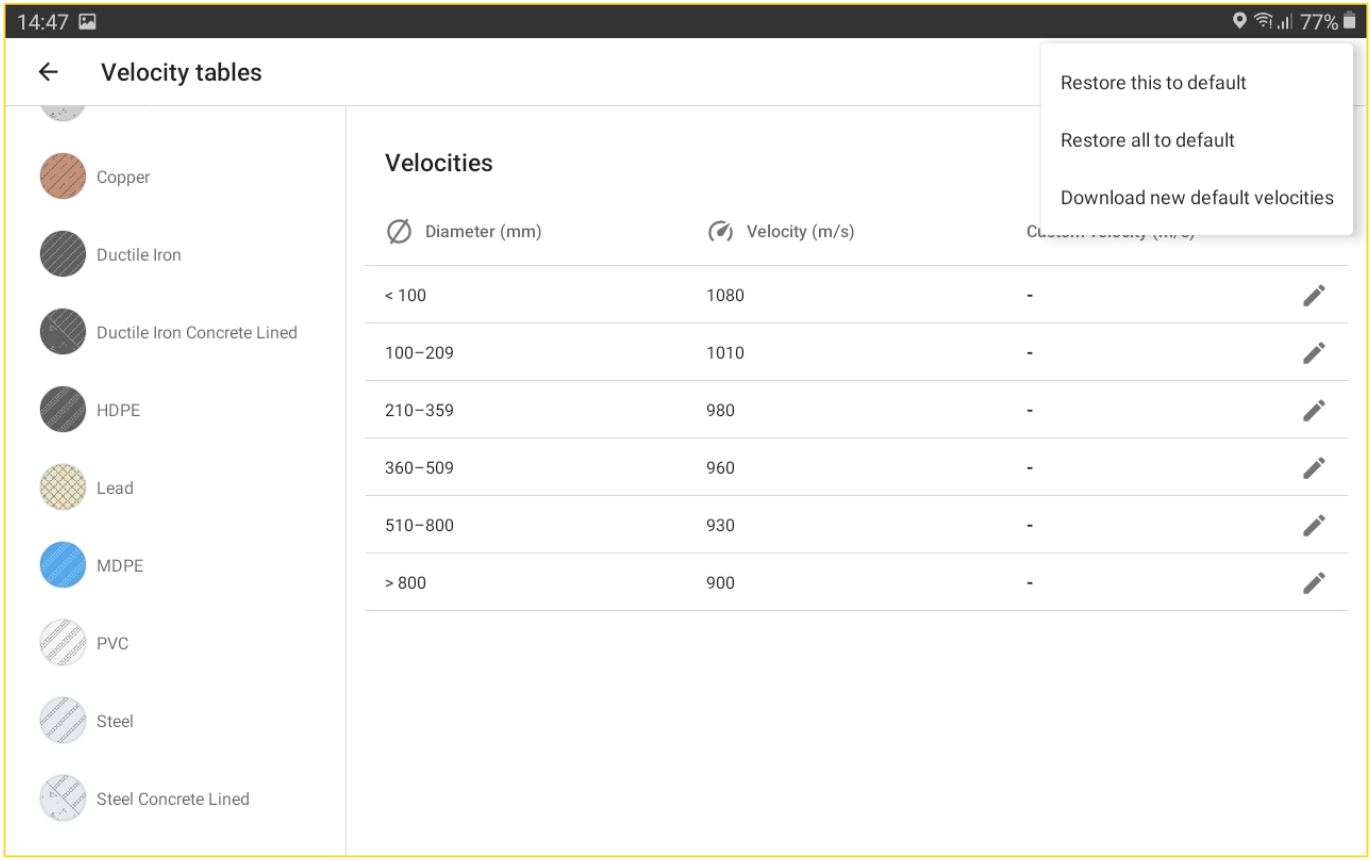
5.4.2 Velocities

This table shows the velocity value for the currently selected pipe material and diameter range as shown in the left part of the screen. Tap on the edit icon next to the velocity value and the numeric keyboard will be displayed. Tap the required numbers to enter a new velocity. Tap the done button to confirm the changes and return to the table. The backspace/delete key can be used whilst entering data to delete numbers.

If an invalid value is entered, a warning message is displayed and the theoretical minimum or maximum will be placed at this location in the table.

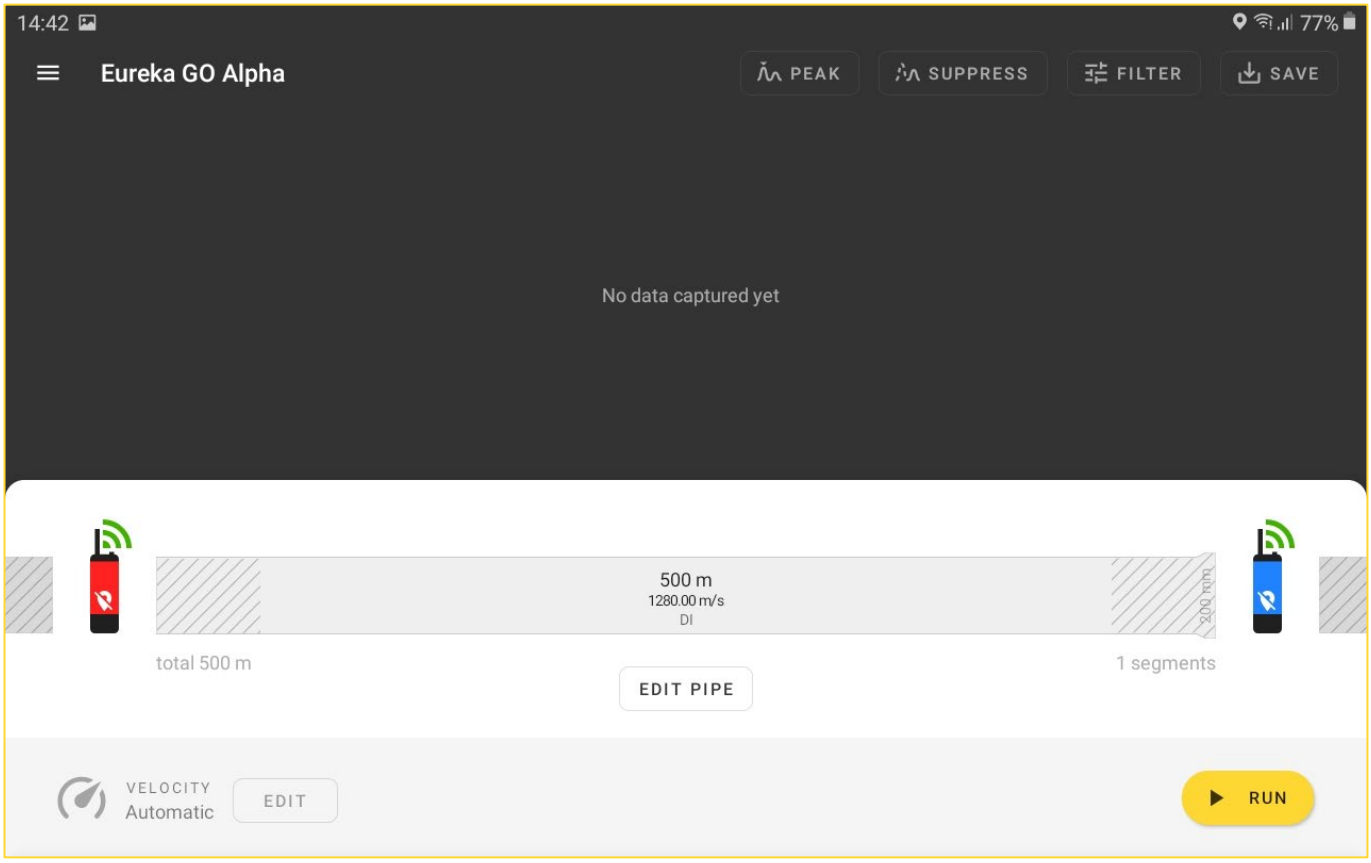
	Note: The only validation on entered velocity values is that they are within the theoretical minimum and maximum. There is no validation that the velocity entered fits between other values in the table.

5.4.3 Restore Factory Defaults



Tap the three-dot icon at the top right of the screen to open the restore defaults menu, the required restore default option can then be selected.

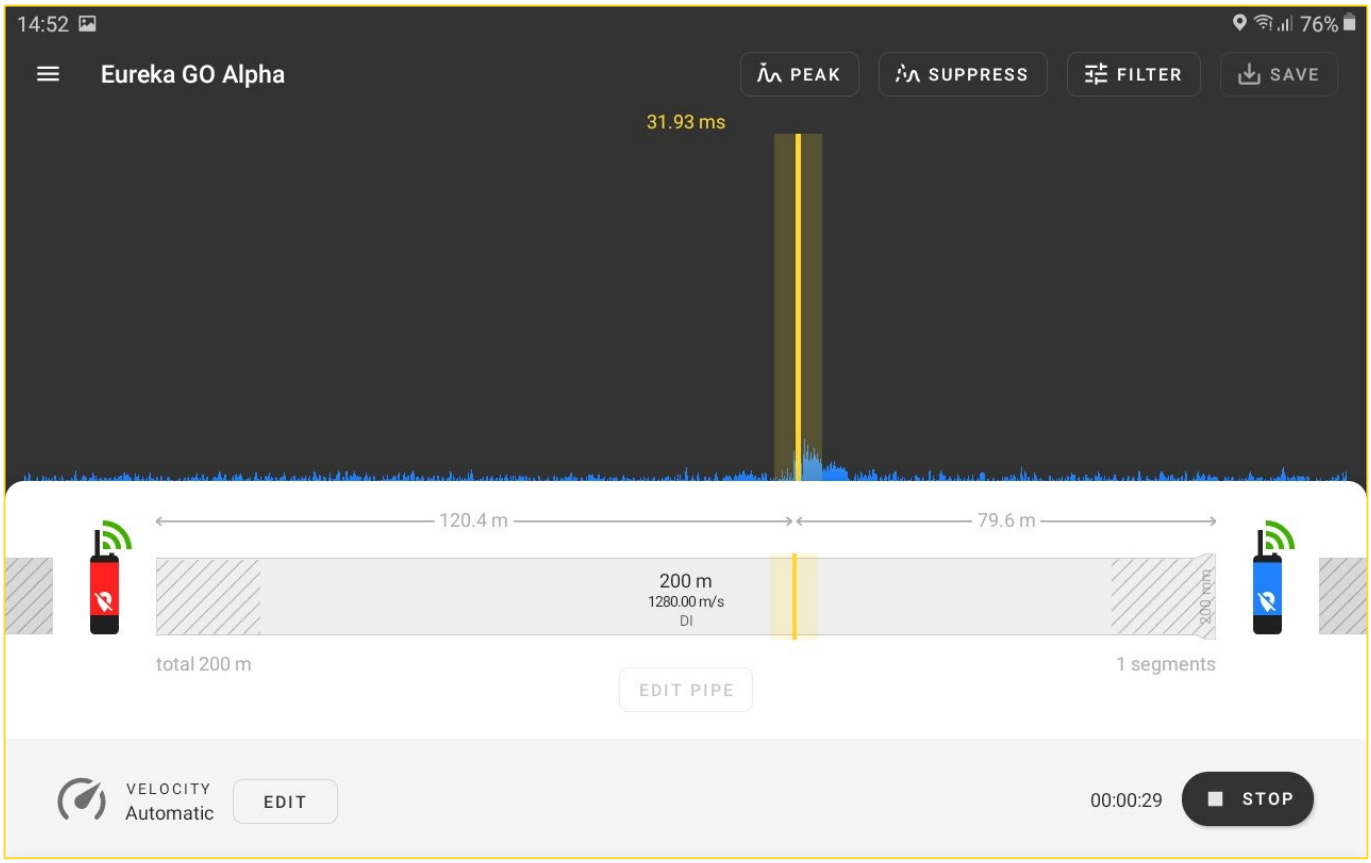
5.5 Main Correlation Screen



The correlation screen is where the main correlation functionality is controlled and viewed

5.5.1 RUN Button

To start a correlation, tap the RUN Button. This button will automatically update to become the STOP button. Whilst a correlation is running, the elapsed time will be shown in the top of the screen. A correlation can continue for a maximum of 5 minutes. If the STOP button has not been tapped before 5 minutes has elapsed the correlation will stop automatically.



5.5.2 PEAK Button

Tapping this button will move the cursor to the highest peak as determined by the software. The distances displayed under the pipe model will give an estimate of leak position from each transmitter. Drag the line to move the cursor manually.

	**"Out of brackets" indicates the correlation peak is at or beyond one of the sensor positions. Most likely the pipe model has not been entered accurately, or the velocity being used is incorrect. Check the accuracy of the measurement of the pipe model and then perform a Velocity Correction.**

5.5.3 SUPPRESS Button

If an area of excess noise is shown on the correlation display it can be suppressed. This could be a known noise from water consumption, a valve, flowmeter etc.

5.5.3.1 Turn Noise Suppression On

To suppress an area of noise, tap the SUPPRESS Button. To position the area of noise suppression, touch the screen in the required location, and drag over the noise. The suppressed area will be shown in grey. Only one noise suppression area can be active on each correlation.

5.5.3.2 Turn Noise Suppression Off

To turn off noise suppression tap the SUPPRESS Button, the grey highlight will disappear, and the noise suppression button will return to the blue off indication.

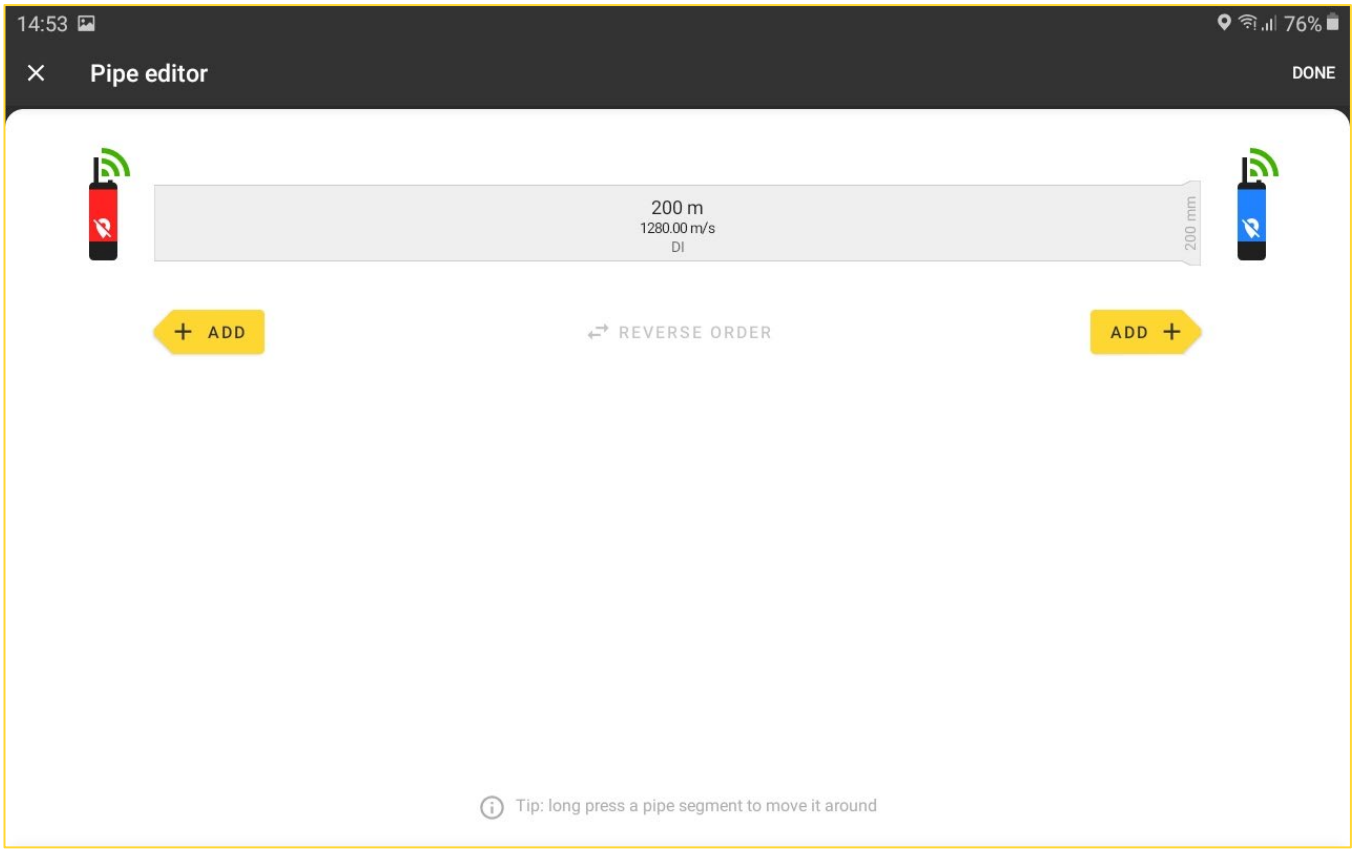
5.5.4 EDIT PIPE Button

Tap this button to open the Pipe Editor screen to enter or edit pipe details.

5.6 Pipe Editor

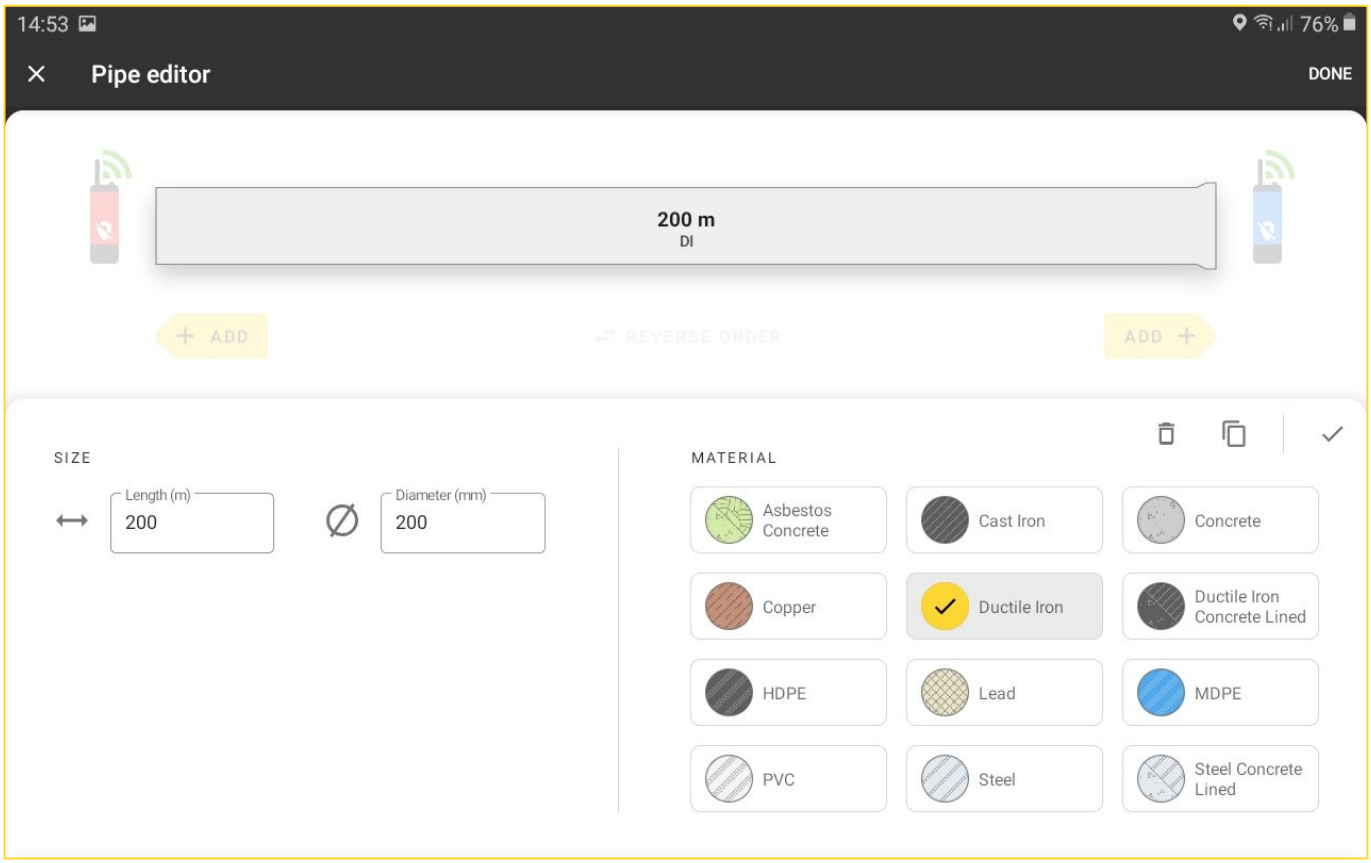
	**It is recommended that a measuring wheel is used to accurately measure the length of each section of pipe.**

	**Initially default values for the length, diameter and pipe material are displayed.**



It is possible to edit sections of pipe, changing the length, diameter and pipe material. Extra sections of pipe can be added as required. When all pipe data has been entered tap on the DONE button to confirm the selected pipe model.

5.6.1 Pipe Length



Tap the pipe section to edit the pipe section details. Enter the length in the box. There is no minimum pipe section length; the maximum is 2500 metres.

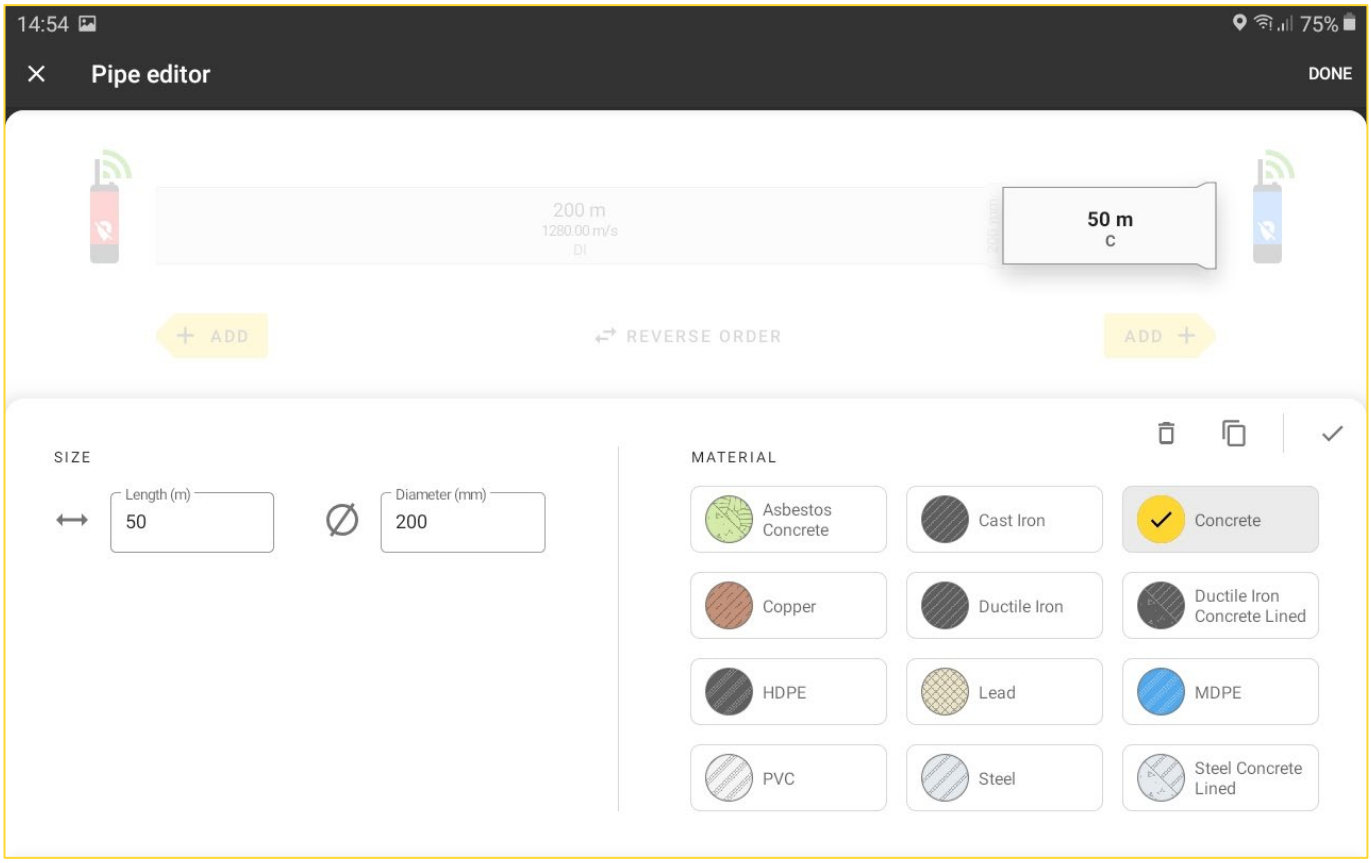
5.6.2 Pipe Diameter

Enter the diameter in the box. The minimum pipe diameter is 8mm and the maximum is 2000mm.

5.6.3 Pipe Material Type

Tap on the required material to change the type of material.

5.6.4 Add Pipe Section



To add a pipe section, tap on either of the ADD buttons at the end of the pipe model. A new section will be created with default length, diameter and material. These can be changed using the actions above. Up to six sections of pipe can make up the pipe model.

5.6.5 Remove Pipe Section

To remove a section of pipe, tap on the X button toward the top right of the section; this section will then be removed from the model. A pipe model must consist of at least one section of pipe, so it is not possible to remove the last remaining section.

5.7 Velocity Correction

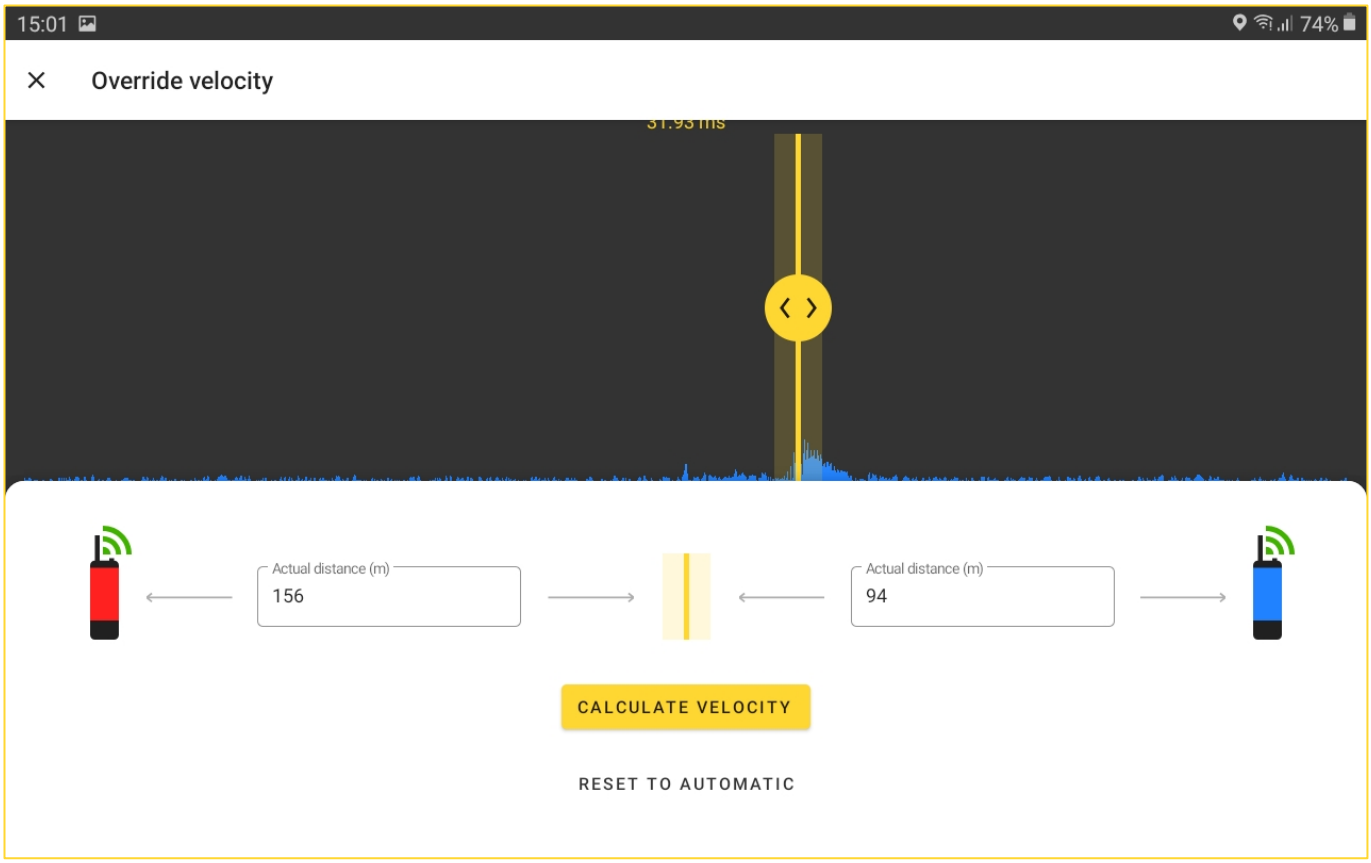
Velocity correction overcomes the largest error for accurate leak position.

It allows the true velocity of sound in the pipe(s) to be measured, meaning the accuracy of the distance to the leak can be improved for multiple materials and/or aging pipes. There must be a leak in the pipe work at a known location to use this feature; this is commonly produced by opening a hydrant.

5.7.1 Velocity Correction Example

- Correlate the leak as usual on site:

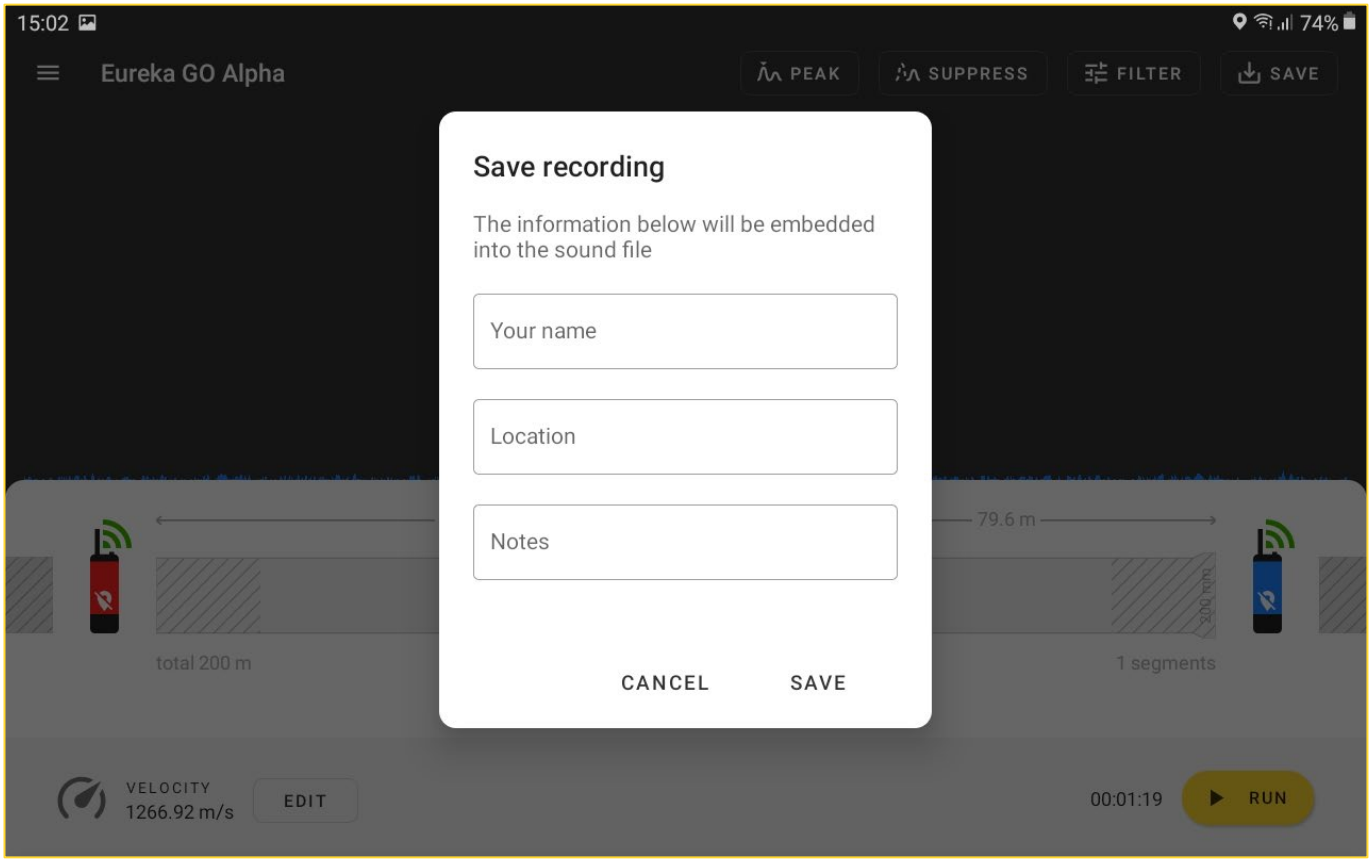
- Tap the EDIT button next to the Velocity icon



- Open the hydrant (or create another known source of leak noise) and perform another correlation. The peak will be formed at the source of noise. Drag the line to the peak.
- In this example the hydrant is located at 156 metres from the red transmitter. Enter this value in the box next to the Red transmitter icon.
- Tap the CALCULATE VELOCITY button.
- Tap the X to return to the main screen. The original correlation graph will now return to the foreground, with the new velocitybeing applied, giving a more accurate leak position. The value of velocity being used will be displayed in the bottom left corner of the screen.

If any changes are made to the pipe model after a velocity correction has been performed, the EUREKA GO App will return to using the default velocity for that pipe material.

5.8 Save Data



Tap the Save button to save data to device memory.

When the icon is tapped the save screen opens; this has the following items:

- Operator Name
- Location
- Notes

5.8.1 Operator Name

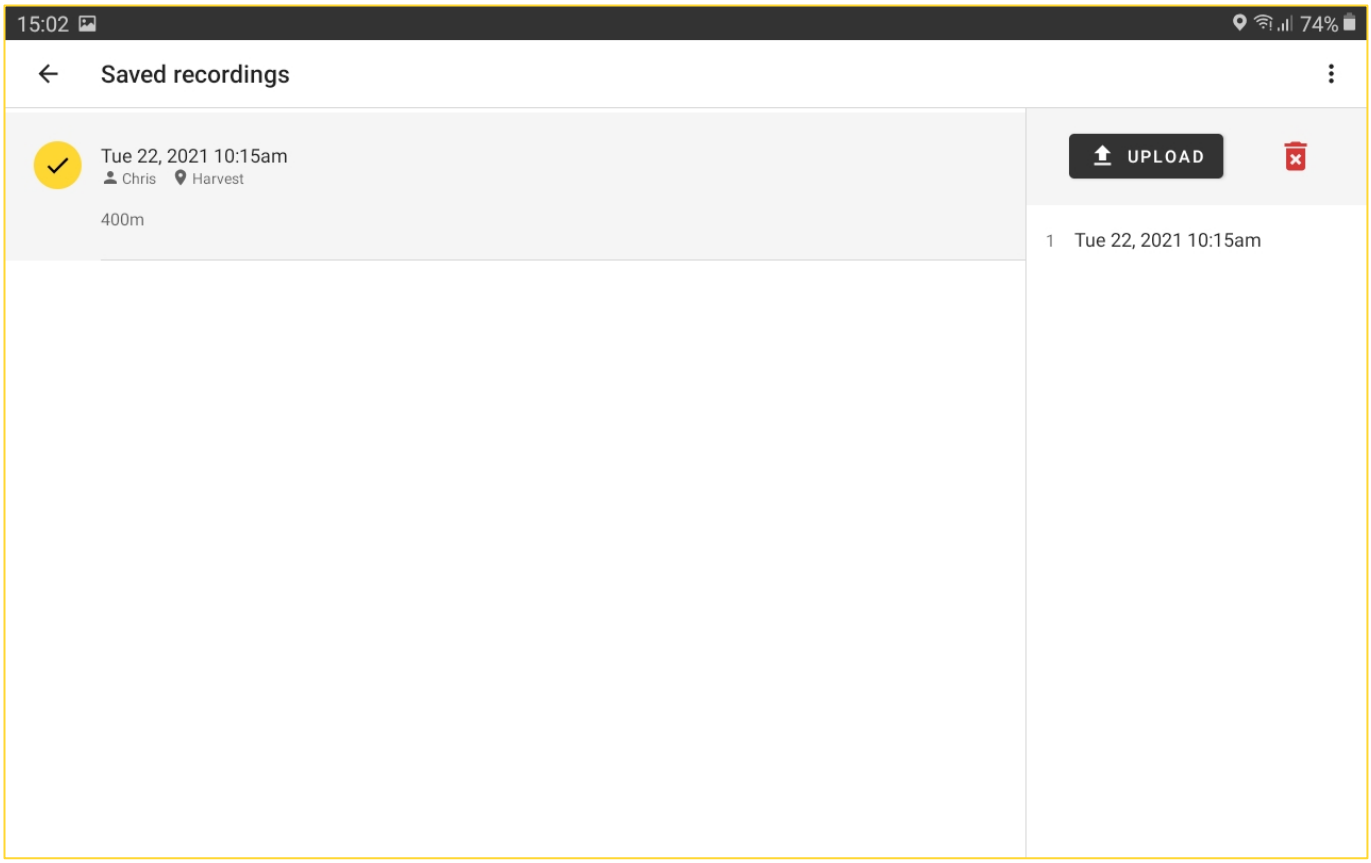
Tap within this field and a keyboard appears; enter operator data as required. Tap on SAVE when finished.

5.8.2 Location

Tap within this field and a keyboard appears; enter location data as required. Tap on SAVE when finished.

5.8.3 Notes

Tap this field and a keyboard appears; enter comments as required. Tap on SAVE when finished.

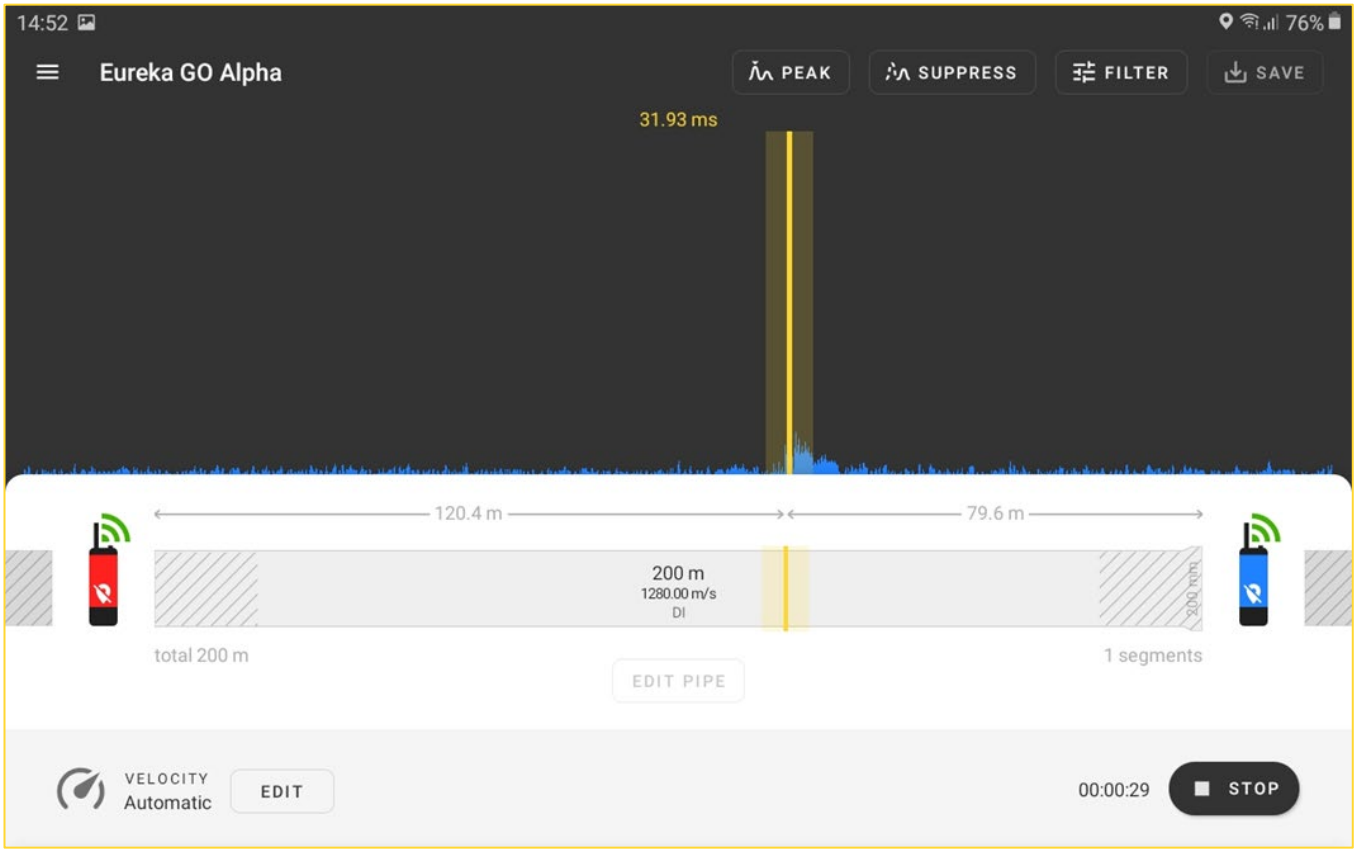


5.8.4 Saved Recordings

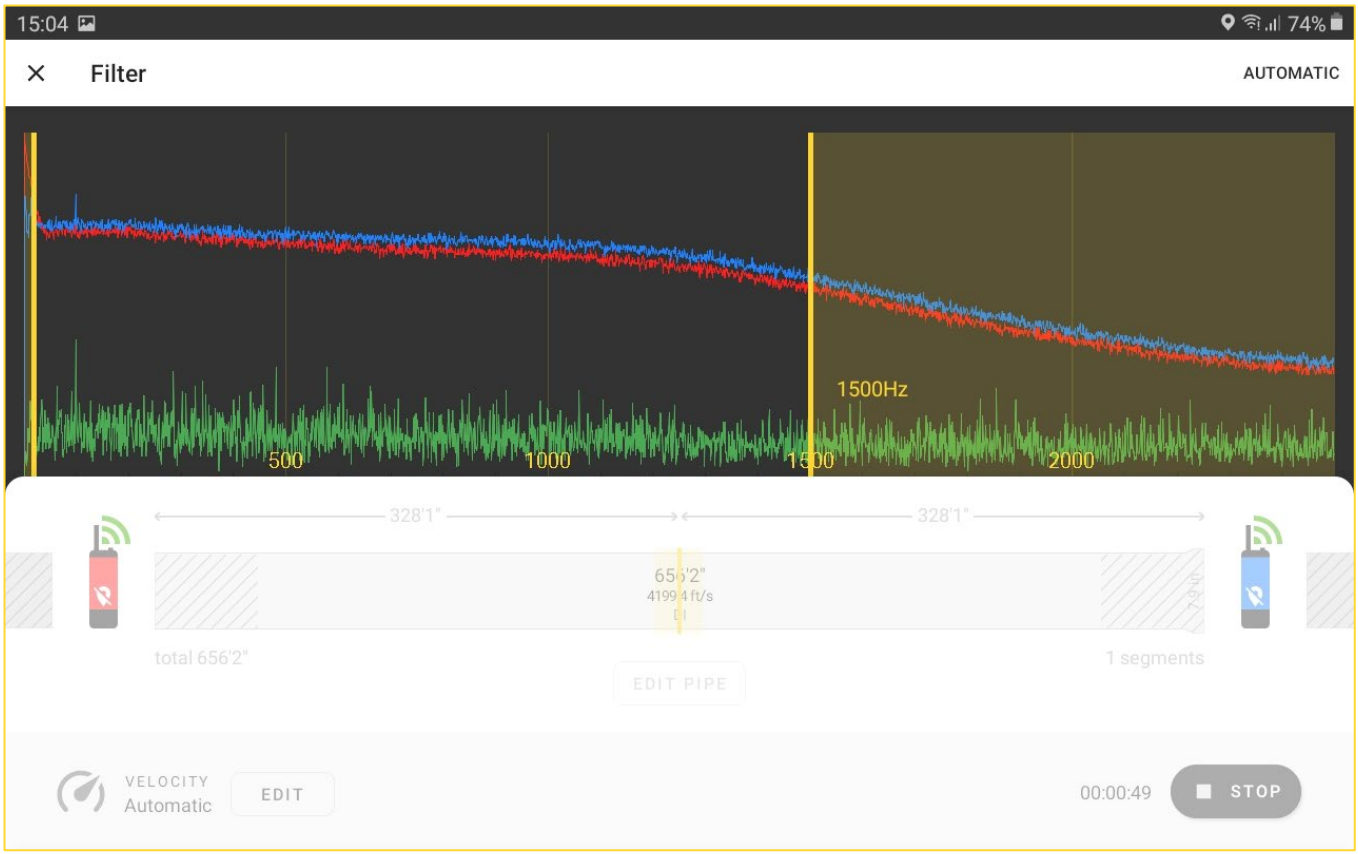
Once the file has been saved it can be uploaded to Primeweb.

Select the file and then tap the Upload button to upload the file to Primeweb. (Note the WiFi connection of the tablet needs to be changed to a network that gives the operator Internet connection or use Mobile Networks).

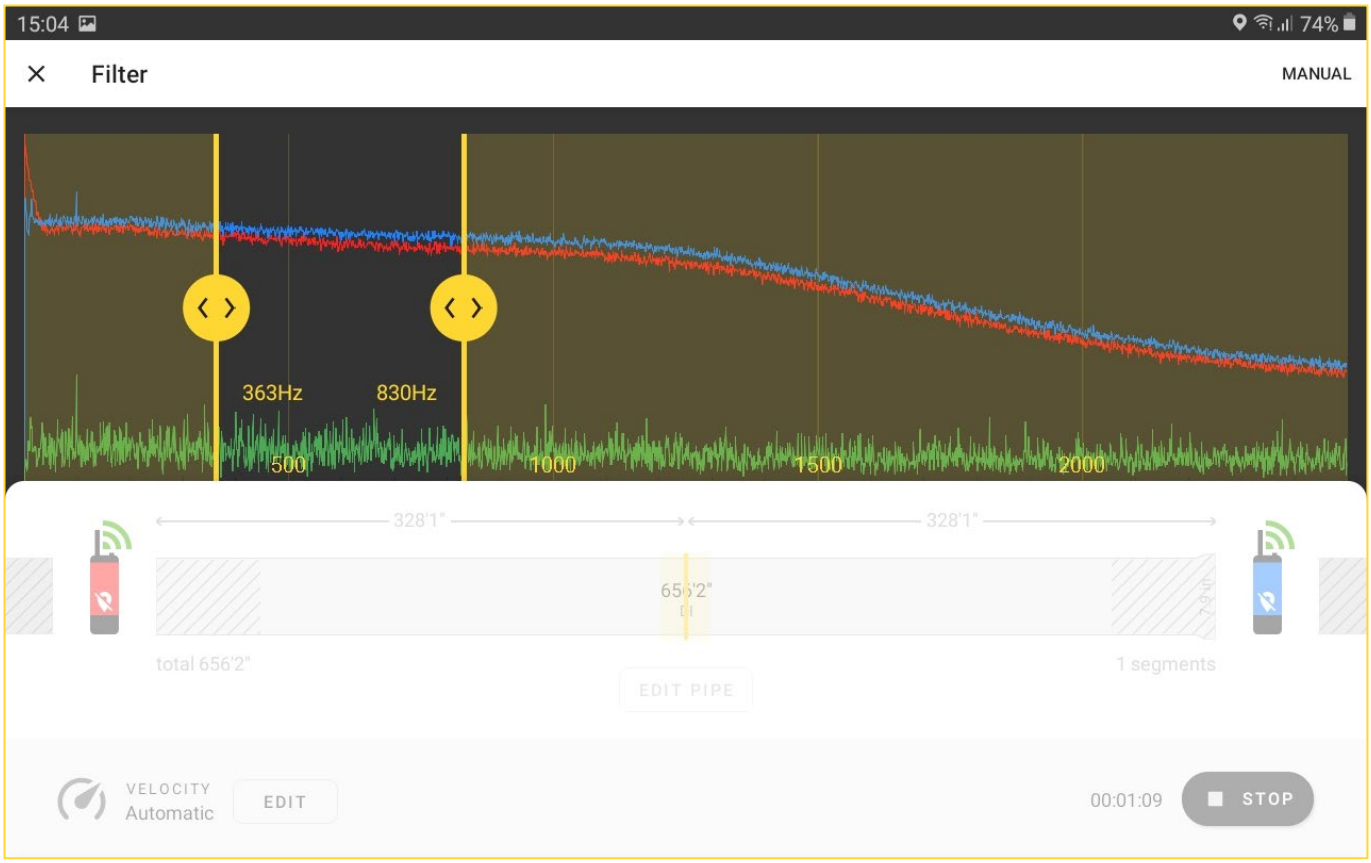
5.9 Filter Screen



To manually select the filters tap the FILTER Button. This will take the user to the Filter Screen.



Tap Automatic to change to manual filter selection.



	**Filters can only be adjusted when a correlation is not running. Any filter changes made will become active when a new correlation is started.**

	**Only a single high/low pass filter is available for selection in EUREKA GO.**

5.9.1 Low Filter Value

This shows the lower frequency limit of the filter. To change, drag the line to the required frequency.

The low filter value must be 3Hz or above in addition to being below the high filter value.

As the value of the low filter is changed the range of frequencies shown as to be used for the correlation on the frequency spectrum display will change.

5.9.2 High Filter Value

This shows the higher frequency limit of the filter. To change, drag the line to the required frequency.

The high filter value must be 5000Hz or below in addition to being above the low filter value. As the value of the high filter is changed the range of frequencies shown as to be used for the correlation on the frequency spectrum display will change.

5.9.3 Frequency Spectrum Data

The frequency spectrum for each transmitter is displayed in the appropriate colour. The graph displayed represents the amplitude of each frequency component of the noise received. If only one colour is visible, then check the transmitter icon at the top of the screen to ensure there is adequate received signal.

5.9.4 Coherence

The coherence shows the similarity between the two spectra at each frequency. Where the coherence is higher, use the filters to select this band of frequencies to increase the quality of the correlation graph.

	**Any filter changes made will be used on future correlations. The current correlation graph is not updated to reflect the newly selected filters.** **Filters are applied immediately to the sound output to the headphones.**

6 Maintenance & Troubleshooting

6.1 Care of Your Eureka5 System

Your Eureka5 system is designed for outdoor use. The sensors, Transmitters and Receiver Units all have appropriate IP ratings for use outside. The equipment is designed to be transported in the ruggedised transport case.

However, battery charging of the equipment should only be performed in the transport case either indoors using the mains charger supplied or in a vehicle using the vehicle charge lead.

The Eureka 5 Transmitters and Receiver contain no customer serviceable parts and must not be opened.

6.2 Sensor Replacement

Sensor replacements or alternatives (such as hydrophones) are available vis Ovarro Customer Support.

6.3 Battery Replacement

The battery packs inside the Transmitters and Receiver are not user replaceable. If a unit will not operate or charge and a problem with the battery is suspected, then the equipment should be returned to an Ovarro Service Centre.

6.4 Troubleshooting

If after following the instructions in the user manual you cannot operate the equipment, or in the event of unresolved problems or faults, please contact Ovarro Customer Support.

6.5 Maintenance & Service

The Eureka5 system contains no user serviceable parts. Maintenance and service of the of the equipment should only be carried out by an Ovarro Service Centre.

7 Appendix A - Technical Specification

Attribute	Eureka5
CORRELATION APP / TABLET	
Time delay range	±2500ms
Maximum distance (theoretical) in pipe material – Iron	3000 m
Maximum distance (theoretical) in pipe material – PVC	1300 m
Distance resolution	0.1 m
Signal sampling	16-bit
Signal frequency range	3Hz – 5000Hz
Multiple pipe entry	Maximum six materials
Noise suppression function	Yes
Coherence function	Yes
Velocity correction function	Yes
Leak noise post-processing	Via Web Upload
Display (suitable for use in sunlight)	Tablet (yes)
GPS position feature	Yes
Internal Memory	As tablet specification
Leak noise data storage (internal memory)	As tablet specification
USB ports	As tablet specification
Battery operating time: Power/Operating life	As tablet specification
Recharge time	As tablet specification
Language availability	Multiple
Protection rating	As tablet specification
Dimensions	As tablet specification
Weight	As tablet specification
Operating temperature	As tablet specification
TRANSMITTER UNITS	
Radio frequency range	407 – 472MHz (dependent upon country of use)
Power output high/low	500mW / 50mW
Powered by internal rechargeable Lithium-Ion battery pack	7.2VDC 3.2Ah 23-25Wh – not user replaceable
Battery operating time	11 hours approx. (in low power mode)
Recharge time	3 hours approx. (temperature dependant)
Battery pack charging currents	Pre/terminate charge = 0.16A, fast charge = 1.6A @ 8.4VDC
Charger DC input	12VDC (15VDC max) 1.5Amax (fitted with 3.5A fuse)
Dimensions (not including antenna)	185mm x 65mm diameter
Weight	0.52kg
Operating temperature range	-10°C to +50°C
Charging temperature range	0°C to +45°C
Ingress Protection	IP67 (with mating connector fitted)
Relative Humidity	5-95% max
Altitude	2000m max

RECEIVER UNIT	
Radio frequency range	407 – 472MHz (dependent upon country of use)
Powered by internal rechargeable Lithium-Ion battery pack	7.2VDC 3.2Ah 23-25Wh – not user replaceable
Battery operating time	7 hours approx. (depending upon usage pattern)
Recharge time	3 hours approx. (temperature dependant)
Battery pack charging currents	Pre/terminate charge = 0.16A, fast charge = 1.6A @8.4VDC
Charger DC input	12VDC (15VDC max) 1.5A max (fitted with 3.5A fuse)
Dimensions (not including antenna)	135mm x 138mm x 36mm
Weight	0.69kg
Operating temperature range	-10°C to +50°C
Charging temperature range	0°C to +45°C
Ingress Protection	IP67
Relative Humidity	5-95% max
Altitude	2000m max
ACCELEROMETERS	
Powered from Transmitter unit	5VDC
Sensitivity	10V/g
Cable length	2m
Ingress Protection	IP68
HYDROPHONES (OPTIONAL ACCESSORY)	
Powered from Transmitter unit	5VDC
Sensitivity	-195dB
Frequency range	0-2400Hz
Attachment	1” BSP connection + pipe adaptors
BATTERY CHARGER / TRANSPORT CASE	
Transport case	Ruggedised with in-case battery charging connection points Input: 12 VDC (15VDC max) 5.0A 60W max
Mains charger	Input: 110/240 VAC 1.8A 50/60Hz. Output: 12VDC 5.0A 60W max
Vehicle charge	12 VDC (15VDC max) 5.0A 60W max
Environmental Usage	Outdoor when system in use, indoor when used as charger
Ingress Protection	IP67
Relative Humidity	5-95% max
Altitude	2000m max
SYSTEM COMPONENTS	
Receiver unit	
Transmitters (x2)	
Headphones	
Transport case (with in-case charging connections)	
Mains charger and Vehicle charge cable	
Accelerometer sensors (x2)	
OPTIONAL EXTRAS	
Hydrophone sensors, Sensor extension cables, Magnetic vehicle mount antenna for Receiver, Measuring wheel, Android™ tablet	Optional

8 Appendix B – User Information Sheet

Please adhere to the following for safe operation of the Ovarro Eureka5 System.

Batteries:

- The Eureka5 Transmitters and Receiver units contain Lithium-Ion rechargeable battery packs.
- The battery packs are not user removeable or user replaceable and can only be replaced by an Ovarro Service Centre.
- Battery packs must be disposed of in accordance with EU and local government regulations.
- For safe operation only charge these battery packs in-situ in the transport case using the charger/equipment supplied by Ovarro.
- Do not expose the Eureka5 system to temperatures outside of the operating temperature range quoted on the specification sheet.

Environmental:

- To ensure correct operation of the Eureka5 System, operate within the recommended temperature range quoted on the specification sheet.
- Do not drop the Eureka5 Transmitters or Receiver from a height of more than 1m and not onto solid ground.
- The equipment is designed for outdoor use when operating, however it is intended charging takes place indoors or in a vehicle.

Transmitters:

- The Eureka5 transmitters contain a radio module. The Electromagnetic Exposure complies with the 20cm rule. Do not operate the Eureka5 transmitters with anyone closer than 20cm to the unit or it's antenna. This does not apply to the receiver unit.

Charger:

- System only to be charged using the mains charger supplied or using the vehicle charge lead suppled.
- Specification of charger and 12V input as quoted in the specification sheet.

Warranty:

- Unauthorised tampering or modification to the Eureka5 system will invalidate any warranty.
- Any operation of the Eureka5 system outside the specification parameters, this information sheet or the user manual will invalidate any warranty.
- Battery packs are excluded from any warranty.

For all operational and safety issues consult the user manual or talk directly to Technical Support at Ovarro LD Ltd.

9 Appendix C – Lithium-Ion Battery

Important transport safety data for the Lithium & Lithium-Ion batteries used in Ovarro LD products.

1. Introduction

New transport regulations affecting Lithium, Lithium-Ion and/or Lithium Polymer batteries came into force during 2003 and 2004.

These regulations require that all Lithium, Lithium-Ion and Lithium Polymer cells and batteries must pass several UN tests before they may be transported by road, rail, sea or air. In addition, Lithium, Lithium-Ion and Lithium Polymer cells and batteries containing more than certain limits of lithium or "lithium equivalence" must be shipped as Class 9 hazardous goods. For cells and batteries, the classification is UN3480 and when contained in Equipment or Packed with Equipment, the classification is UN3481.

For Lithium-Ion batteries classified under UN3480 or UN3481, the product is handled as Non-Dangerous Goods by meeting the UN Recommendations on the Transportation of Dangerous Goods Model Regulations Special Provision SP188.

(a) For a lithium-ion cell, the Watt-hour energy rating is not more than 20 Wh

(b) For a lithium-ion battery, the Watt-hour energy rating is not more than 100 Wh.

Lithium-Ion batteries subject to this provision shall be marked with the Watt-hour rating on the outside case.

This is a guide and should not be used as an alternative to the official regulations. The regulations are subject to change and this document is not intended to track those changes.

2. Lithium-Ion Battery Energy Rating in Eureka5

The battery packs used in the Eureka5 Transmitter and the Eureka5 Receiver units have an energy rating less than 100 Wh.

3. Transportation

3.1 Applicable Regulations

The primary authorities responsible for issuing dangerous goods regulations are:

- **Air** - International Air Transport Association (IATA), Dangerous Goods Regulations (DGR)
- **Road** - European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR)
- **Sea** - International Maritime Organisation (IMO), International Maritime Dangerous Goods Code (IMDG)

Dangerous goods are assigned to UN numbers and proper shipping names according to their hazard classification. For Ovarro's products the lithium metal batteries are contained in the equipment and the regulations identified by UN classification UN3091 Lithium metal batteries contained in equipment, Class 9, Packing Group II, Packing Instruction 970

Batteries used in Ovarro products must not be transported separately from the equipment. Separate freighting is covered by another UN classification and not covered in this document.

Lithium batteries transported within the United States are subject to additional limitations as specified in the US national dangerous goods regulations contained in Code of Federal Regulations Title 49 (49 CFR). These limitations are not covered in this document.

3.2 Requirements

The person/company wanting to transport the goods is termed The Shipper and they must choose a Freighting Agent who is familiar with the UN3091 packing instruction. Only qualified personnel are permitted to process the packing and shipping of dangerous goods to ensure the correct packing and labelling are met as follows and as detailed in the applicable regulations.

- Correct packing of product
- Maximum quantity of lithium not exceeded
- Correct labelling of package which should include Class 9 hazard label and markings that identify UN3091 Lithium metal batteries contained in equipment
- Completion of a Shipper's Declaration for Dangerous Goods

3.3 Transportation from Ovarro

Ovarro Limited (UK) holds certification for meeting the above requirement. All new or repaired products leaving Ovarro are packed in accordance with the regulations. If the product(s) is to be transported to a second destination (after leaving Ovarro) it must be declared as Dangerous Goods to the Freighting Agent together with the information required by the above regulations. It is the responsibility of the Shipper to ensure they are working to the current regulations.

3.4 Transportation other than at 3.3 Above

Lithium batteries that have been damaged or have the potential of producing a dangerous evolution of heat, fire or short circuit are forbidden for transport. Therefore, before equipment is transported it is essential that it is opened, and the battery examined. If any sign of battery damage, or ingress of water to the product, is observed then the battery must be removed before transportation. For advice do contact Ovarro Customer Support (contact details below).

4. UN Test Requirements and Design Safety

Ovarro specifies only batteries and battery packs that meet the relevant UN certification.

5. Disposal

All batteries and cells must be disposed in accordance with local regulations.

This product is subject to the EU Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE) and should not be disposed of as unsorted municipal waste.

For further information on air-freighting these products or the air-freighting regulations, please contact Ovarro Customer Support.

10 Appendix D – UKCA DoC

TBA

11 Appendix E – EU DoC

TBA

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