The Sound Choice for Leak Detection.™

Permalog +

User Manual

Version F
MAN-130-0003

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Introduction

Thank you for choosing an FCS data device, we trust it will provide you with many years of service.

This manual has been written using the PermaNetPlus version 2.41 and PermaNetPlus LLC version 3.11, and as such the figures may look different to your installation.

Overview

Pipeline leaks are a constant burden to water and gas industries, which can affect the efficiency of the individual company's performance. As well as reducing the amount actually being delivered, leaks also impact the financial side of the business, and the longer the leak is left, the larger the economic, and potentially environmental, consequences. It is therefore safer and more beneficial to detect a leak and repair the damage to the pipes before it causes more damage to the business. At FCS, we pride ourselves in designing the best leak detection equipment at an affordable price for the benefit of the water and gas companies.

Our Permalog+ product family (yellow) aims to detect when a leak is found, and it has successfully done so for the last ten years of service. The Permalogs are functioning microphones that can detect the sounds emitted from a potential leak. To conserve battery life and increase their life expectancy, the loggers take one reading every 24 hours, and once deployed, the Permalogs can be programmed and read locally through radio communications.

Our SoundSens and Aqualog product ranges record the sounds detected along the pipeline and correlate them to determine where the leak is located. They have successfully detected leaks with a high accuracy, and helped companies find and repair leaking pipes. In the past, these products were used when there may have been leaks in pipes.

Our new PCorr+ system (Blue) combines the Permalog+ family with the SoundSens and Aqualog products to not only detect, but also localize the leak. By combining these products, the amount of hardware required for leak detection and localization is reduced.

The software has also been combined to deliver fast readouts from the loggers, and also determine the location of the leak. With the new software you will be able to:

- Determine whether a leak has been detected,
- Configure the loggers to read and record sound data at a specified time,
- View a map of the locations of the loggers,
- Correlate the recorded sounds to determine a location of the leak, and
- Analyze the sound recordings manually.

This document has been produced to help guide you through the features available within this powerful software. Please read through this manual to understand how the software works. Should you have any questions that are not covered by this manual or FAQs provided online, please contact the FCS Technical Support team on (800) 531-5465, or email info@fluidconservation

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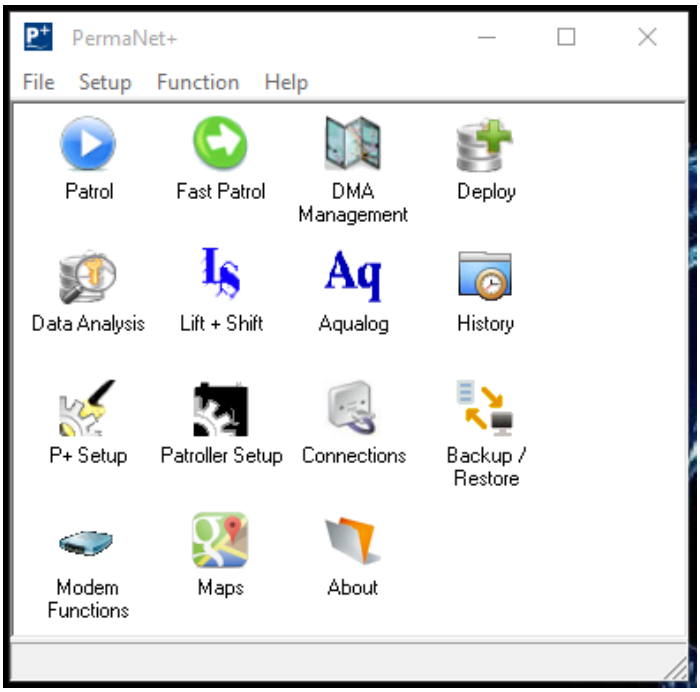
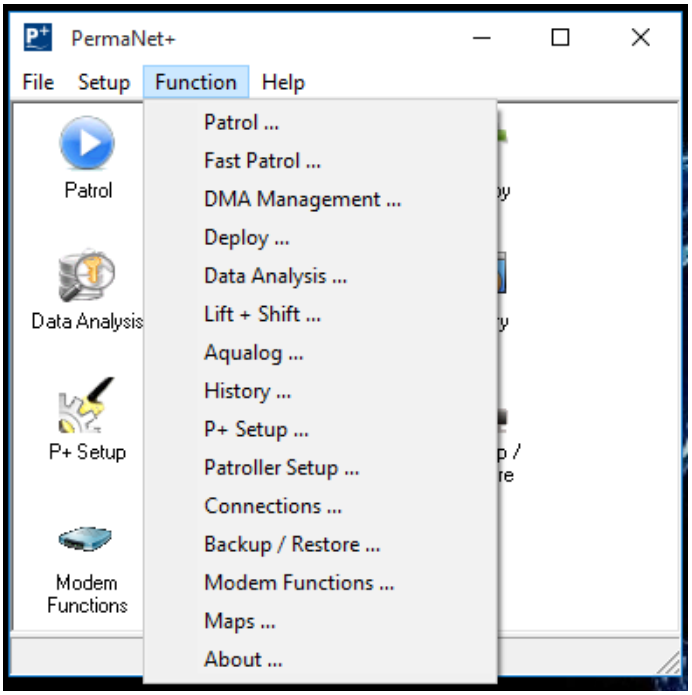
PermaNetPlus



The **Main Screen** contains a set of icons that will lead to the different functions of the PermaNetPlus software. They can also be accessed by the Function menu.



The functions displayed in the picture will now be outlined.

Patrol

The **Patrol** function reads data from the Loggers. When **Patrol** is clicked, a window will open.

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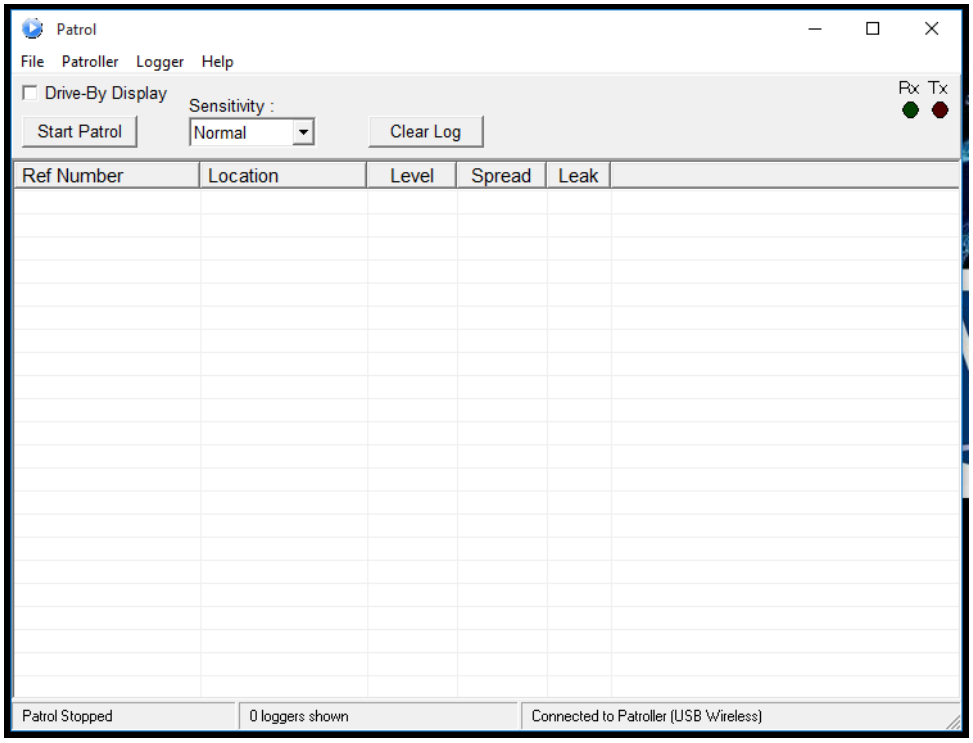
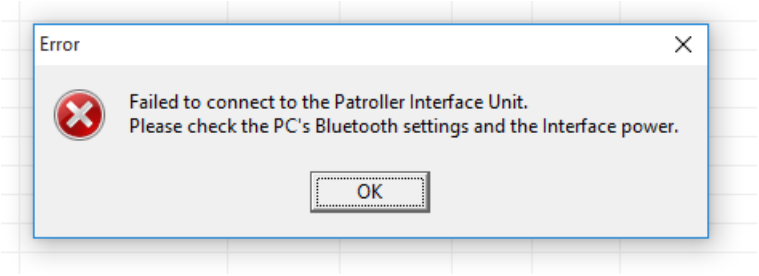


For this function to work, either a mobile Patroller unit or a wireless USB module must be used.

Note: for the Patroller unit to be used, the computer must have Bluetooth enabled, and must be connected to the Patroller unit.

If the computer does not detect either the Patroller or the wireless USB module, an error message will appear. This means no logger can be read to the PC.



Once connected, the message box at the bottom right of the window will display Connected to Patroller (USB Wireless) if connected to the USB module or the Patroller. If the local loggers' data are not read automatically, upon clicking on Start Patrol the button, the loggers' data will be read.

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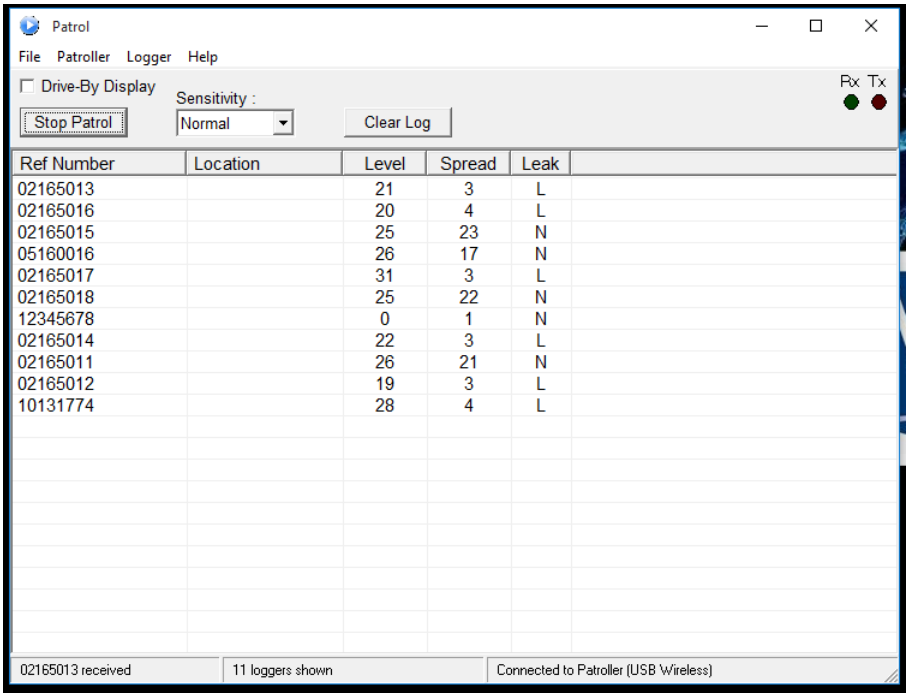

Note: for the Patroller unit (whether mobile or USB) to detect the logger, the radio frequencies of Patroller or USB transceiver must match.

Note: some sections will appear blank (locations, GPS, Address etc). This is because the loggers have not been configured with these details (see section **Deploy** on how to configure).

Note: if the logger does not appear, try swiping the logger with a magnet along the square ridge on the side of the case. **Warning**: Swiping the logger will invalidate synchronization for any sound recordings not yet downloaded.

More options and information from the loggers can be seen by clicking on File -> Options, and selecting the information of interest. The checkbox Color-codeloggers" introduces a color bar denoting leak (red) or no leak (green) detected.

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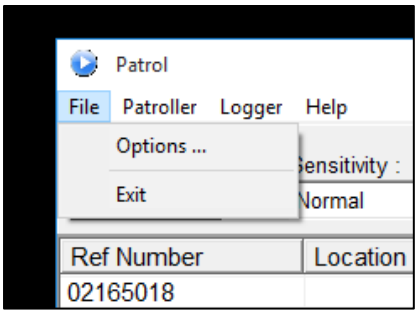
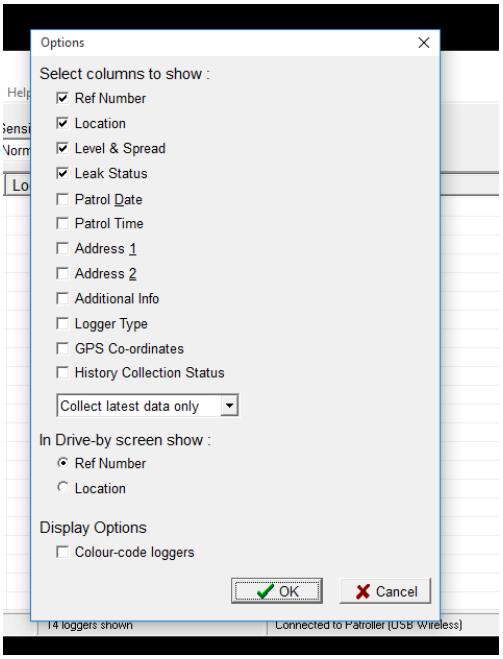
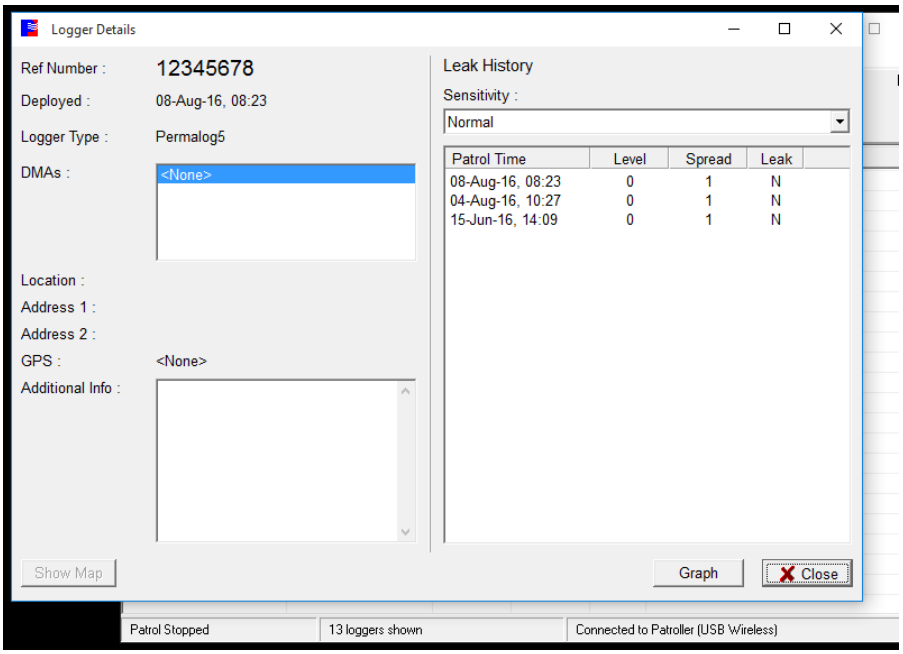




Clicking on the Stop Patrol button will freeze the logger data in place. This will allow the user to gather additional information about individual loggers by double- clicking the logger of choice.



On the **Patrol** window, clicking on the Clear Log button will clear the screen of all data.

Drive-by Mode

By selecting Drive-By Display, the window will split between the loggers' data screen and the latest received logger leak information.

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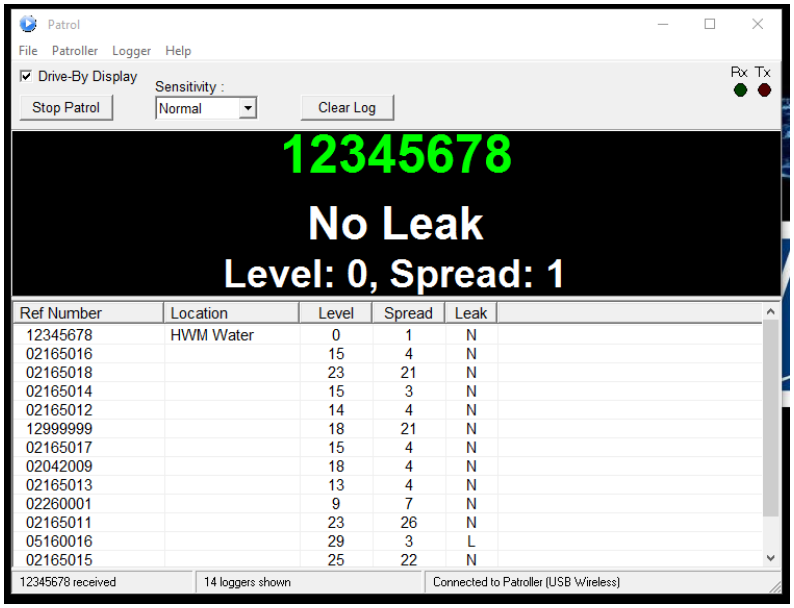


Fast Patrol

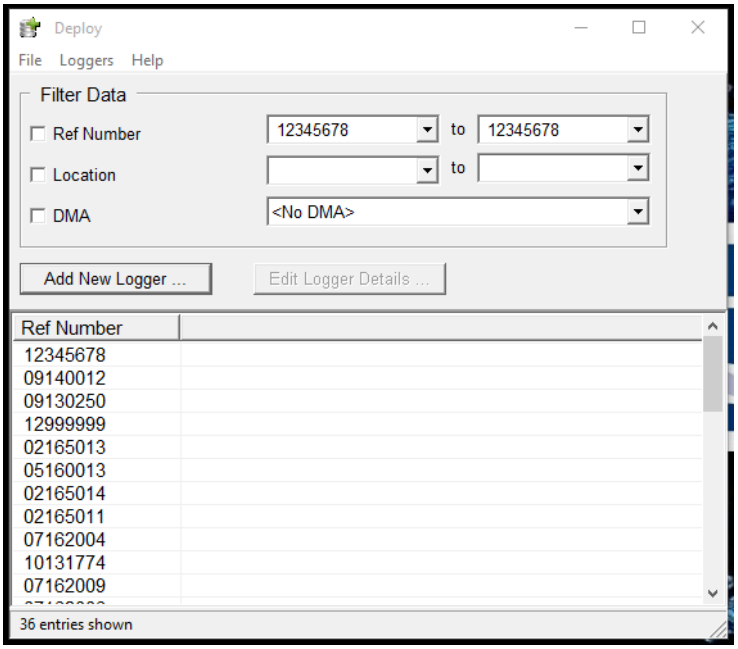
The **Fast Patrol** function allows for a fast drive-through patrol of the loggers in a specific DMA, and functions in a similar way as the **Patrol** function in that it scans for detectable loggers. However, **Fast Patrol** tends to be used for quick check-ups on the loggers. It may be useful to turn Drive-By Patrol on.

DMA Management

Refer to **FAQ 376** on the FCS website for details on creating and editing DMAs using the **DMA Management** function.

Deploy

The **Deploy** function allows the loggers' details to be modified.



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Any unrelated loggers can be filtered out by using the options in the Filter Data sub- box. If a box is unchecked, that filter will not be applied. The current version of PermaNetPlus (v2.41) only filters by Reference Number (serial code), alphabetical location, and DMA:

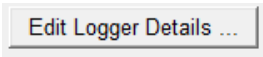
Reference Number:	Show loggers whose reference number lies within the given range.
Location:	Show loggers whose location lies within the given range. **Note**: location is sorted in numerical and alphabetical order.
DMA:	Show loggers within the specific DMA deployment information.

Add New Logger

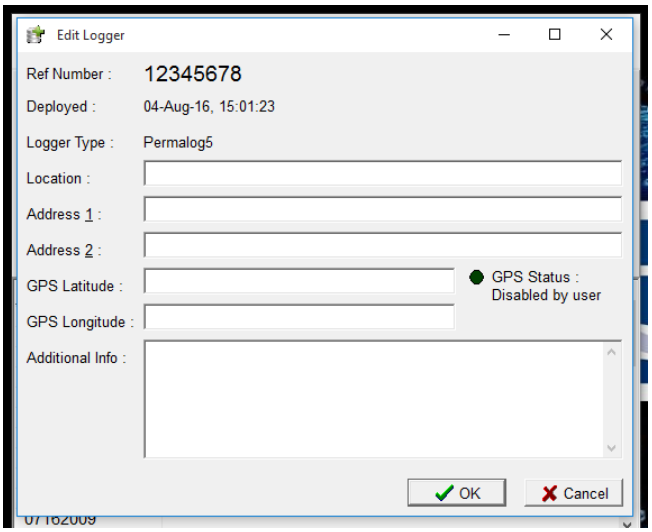
To add a new logger to the database, click the

button. In the new window, add a reference number of choice. This may be the serial number or the phone number associated to the logger, and it is the minimum required to add a new logger to the database.

Edit Existing Logger

By selecting a specific logger and clicking the 

button, a window will open to allow the logger's details to be edited.



Any desired details can now be added.

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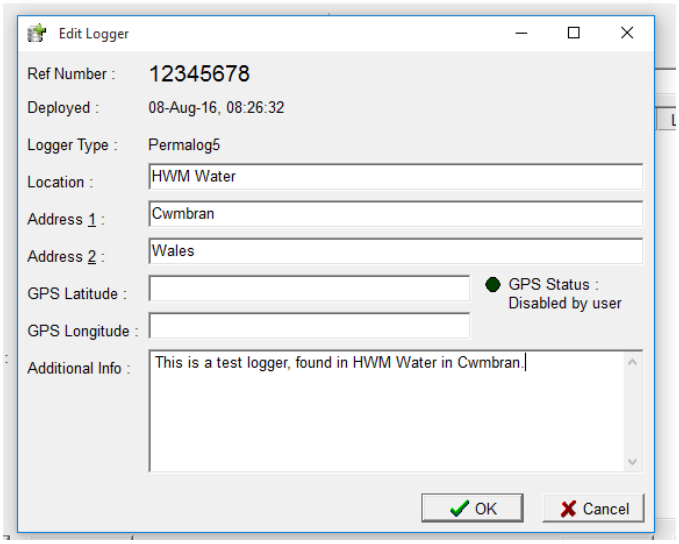
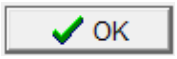
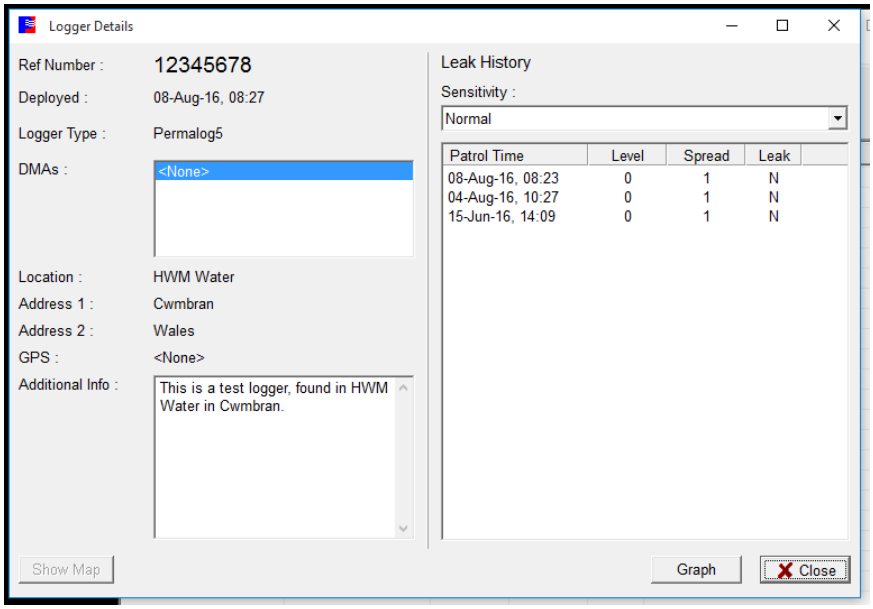


Click 

to save these details. These details can be checked and confirmed by double-clicking a logger.



Note: the GPS latitude and longitude coordinates must be relative to the map server used in **Maps**. For example, if the map server uses Google Maps, the GPS coordinates must be of the same structure and format as those used for Google Maps.

Data Analysis

The **Data Analysis** function looks at filtering out any unwanted loggers, and leaving behind the loggers and their data that will be analyzed. On opening **Data Analysis**, a window will open up with the option to filter data.

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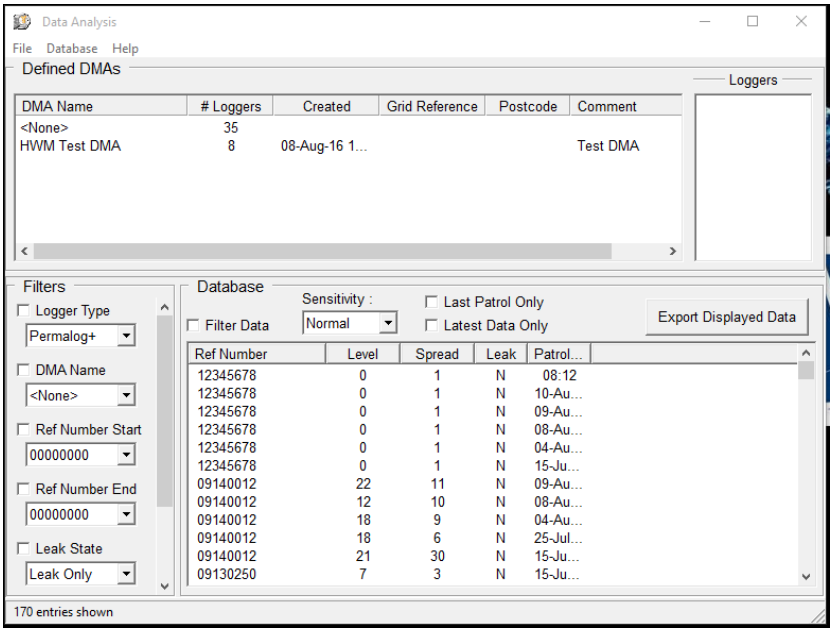

Under 'Defined DMAs', DMAs can be chosen to see which database loggers belong to. Loggers that do not belong to any DMA will be under <None>.

Under the 'Filters' section, loggers can be filtered out using the specific filter options. To enable a chosen filter, tick the checkbox next to the filter name. Current filters that can be enabled are: Logger type, DMA Name, Reference number range, Leak state, and active Patrol date range.

Under the 'Database' section, chosen filters can be applied to the list of loggers and their data by ticking the checkbox next to "Filter Data". More columns can be added to the list of t loggers to give more information for each logger by clicking on File -> Options, and selecting the information desired.

The tabulated data can be exported to a .csv file by either clicking the Export Displayed Data button, or by clicking File -> Create CSV File -> Export Currently-Displayed Loggers.

Lift + Shift

The **Lift+Shift** function is used for loggers who do not stay in the same place, and take one measurement only at various locations. If at any point the list of loggers does not appear, try the following:

- Ensure the correct database is selected. To do this click the Database parameter, and select the correct database.
- Go to File -> Options, and ensure the Ref Number checkboxes are ticked for both Lift Screen and Shift Screen.

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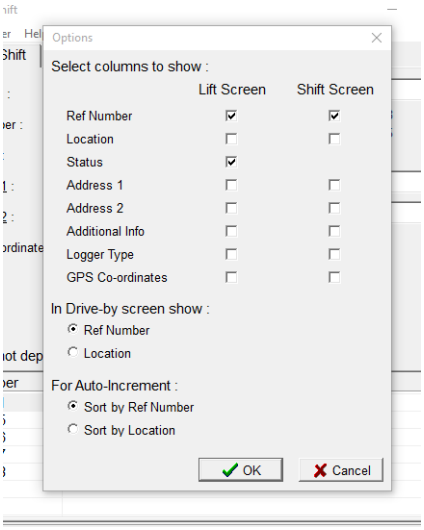
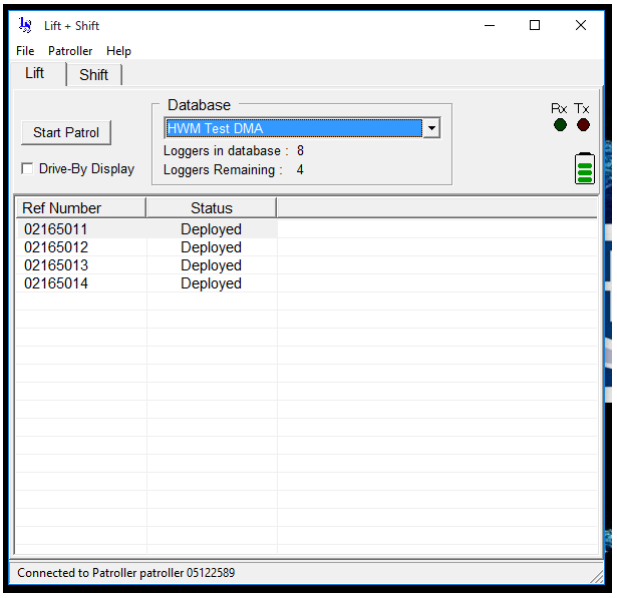


Lift

To withdraw a logger to move it, select the Lift tab, and select the desired database.



Double-click the logger to withdraw.

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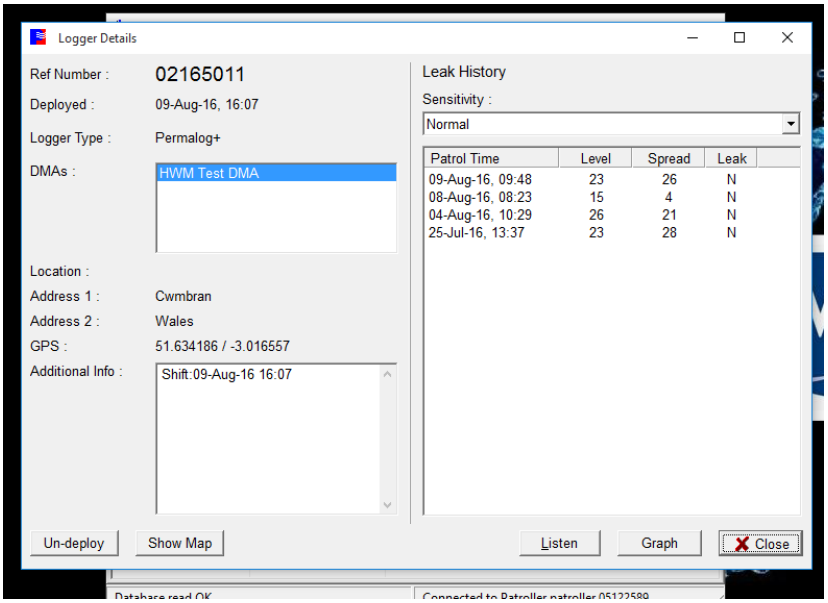


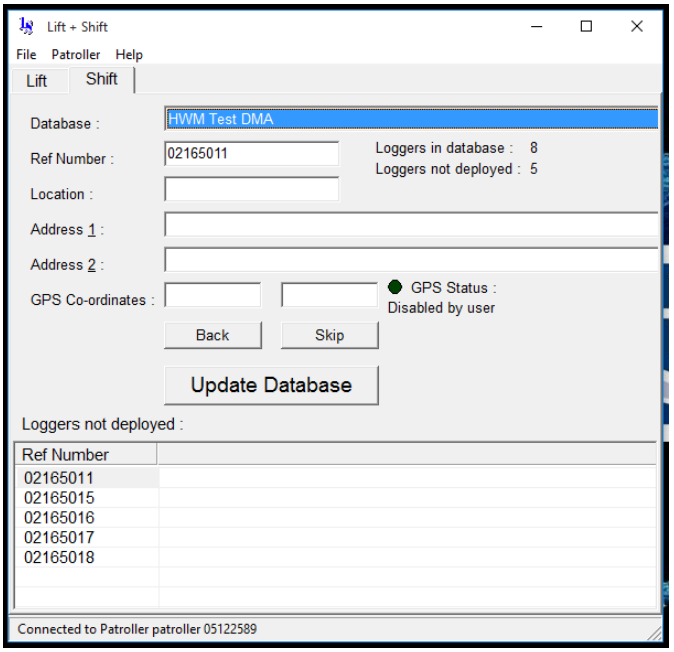
Click on the

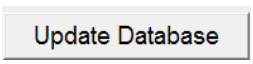
button, and click

. Un-deploying the logger will clear its location data, including any GPS and address data.

Shift

To deploy a logger, select the Shift tab, and select the logger that would be deployed from the list of loggers available.



Select the desired logger, and fill in the details as required, and click the 

button.

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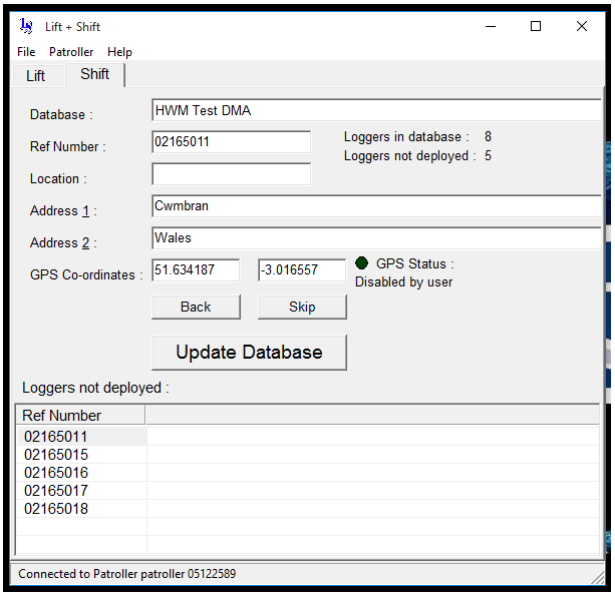
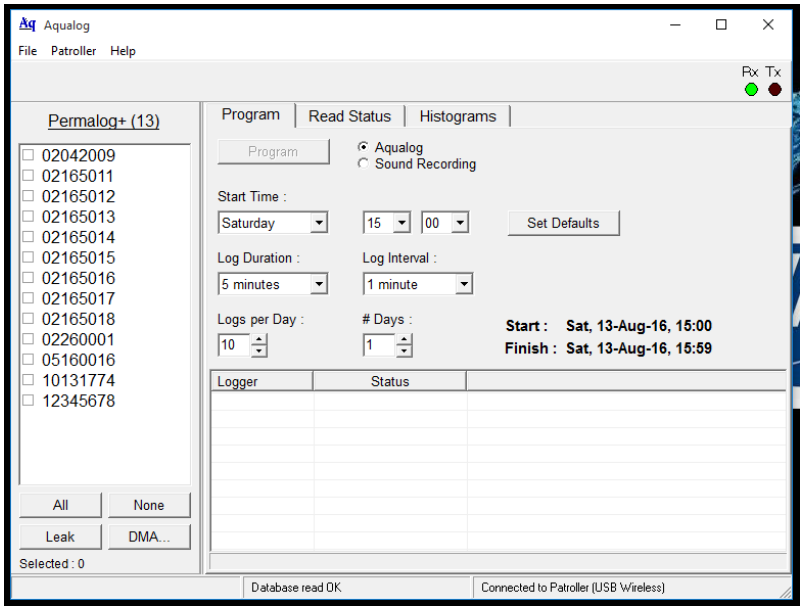


Aqualog

The **Aqualog** function is used to program and configure the loggers to either Aqualogs or perform sound recordings. This varies from product to product.

On clicking the **Aqualog** icon, a window will open.



Under Permalog+, a list of detectable loggers will be continuously updated. This may be in the form of the logger's serial number or phone number. Once a logger becomes unavailable or out of range, it will automatically be removed from the list.

To program or read one (or more) logger, the desired logger(s) must be ticked in the checkbox.

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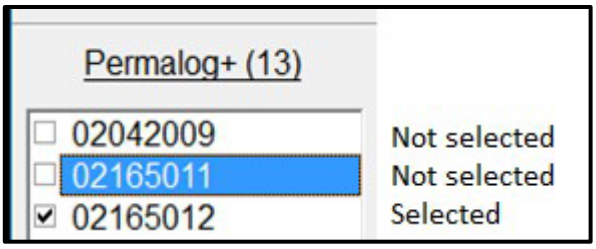
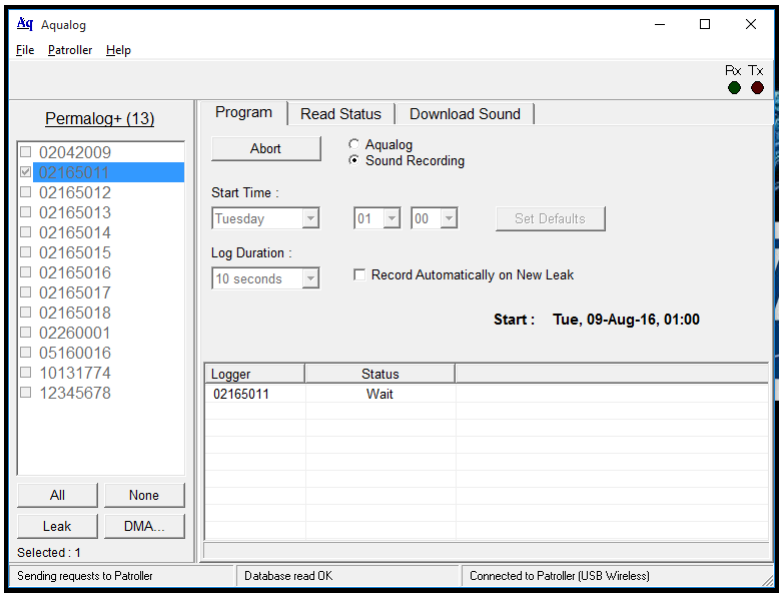


Program

Under the Program tab, any logger can be programmed for Aqualog, but only some can be programmed for Sound Recording. **Note**: if Aqualog has been selected, the third tab will display Histograms; if Sound Recording has been selected, the third tab will read Download Sound. Below is an outline what each parameter setting does.

Start Time: Sets the starting date and time of the logger (**Note**: Start Time cannot be set in the past).
Log Duration: Sets the length of time over which readings are taken.
Log Interval: Sets the time between readings (Aqualog only).
Logs per Day: Sets the number of logs taken per day (Aqualog only).
 # Days: Sets the number of days to be active for (Aqualog only).

Upon selecting the logger of choice, and setting the desired parameters, clicking the Program button will start the programming sequence. The logger's number and programming status will appear in the table.



IMPORTANT: For accurate correlation of sound recordings, the loggers must be programmed together at the same time, and not separately. The loggers can be programmed and downloaded separately, but this will introduce an error of typically 5m per minute of time difference.

Once the logger has been programmed, the status will change from "Wait" to "Initializing" to "Programmed", and the message box in the bottom left corner will display "Reading 100% successful".

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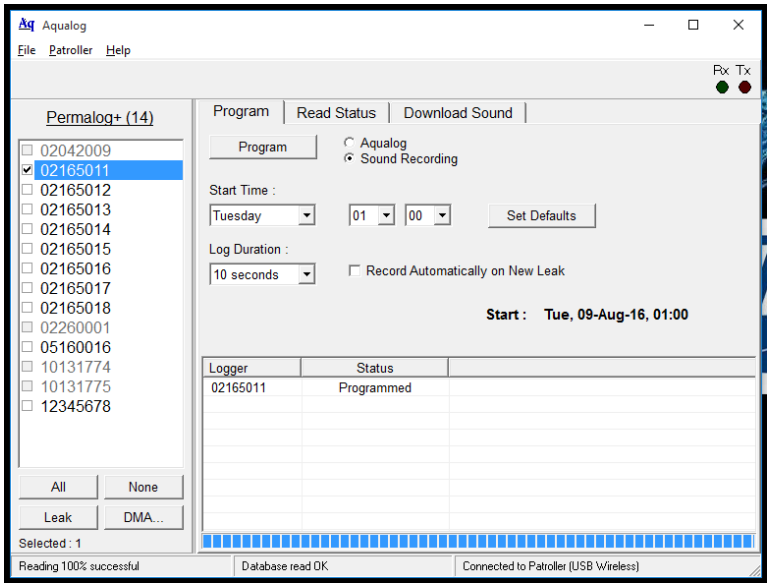
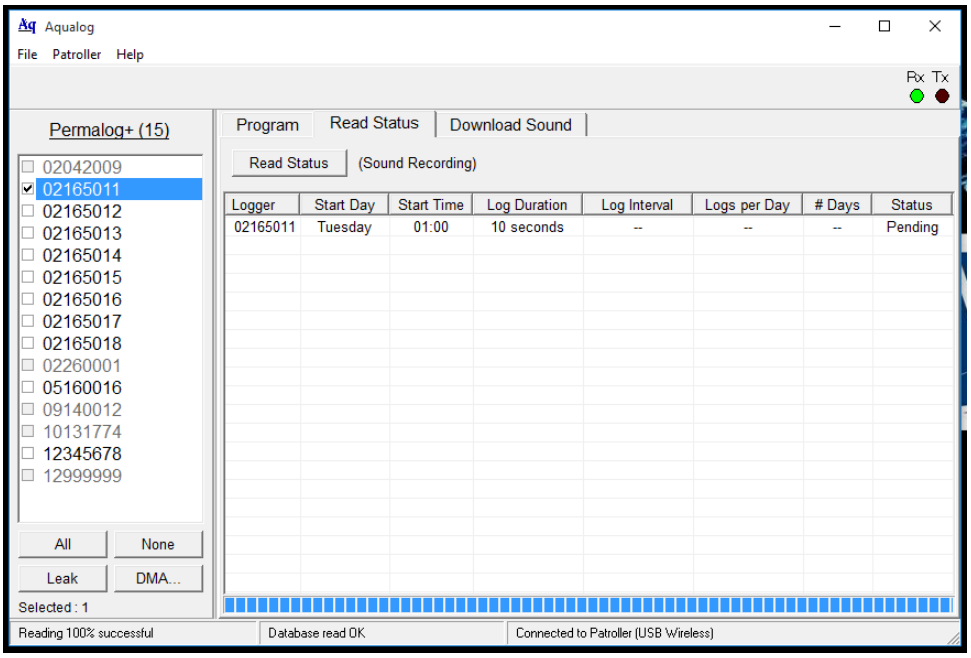


Read Status

Under the Read Status tab, a table shows the relevant logger details that would be displayed. Select the logger(s) that would be read, and click Read Status the button. The logger's parameters will be displayed.



A logger with "--" in the columns "Log Interval", "Logs per Day", and "# Days" has been previously programmed for Sound Recording. Otherwise, it has been programmed for Aqualog.

Histograms

Under the Histograms tab, select the logger to retrieve graph data, and click the Download All Graphs button. The software will download information about the

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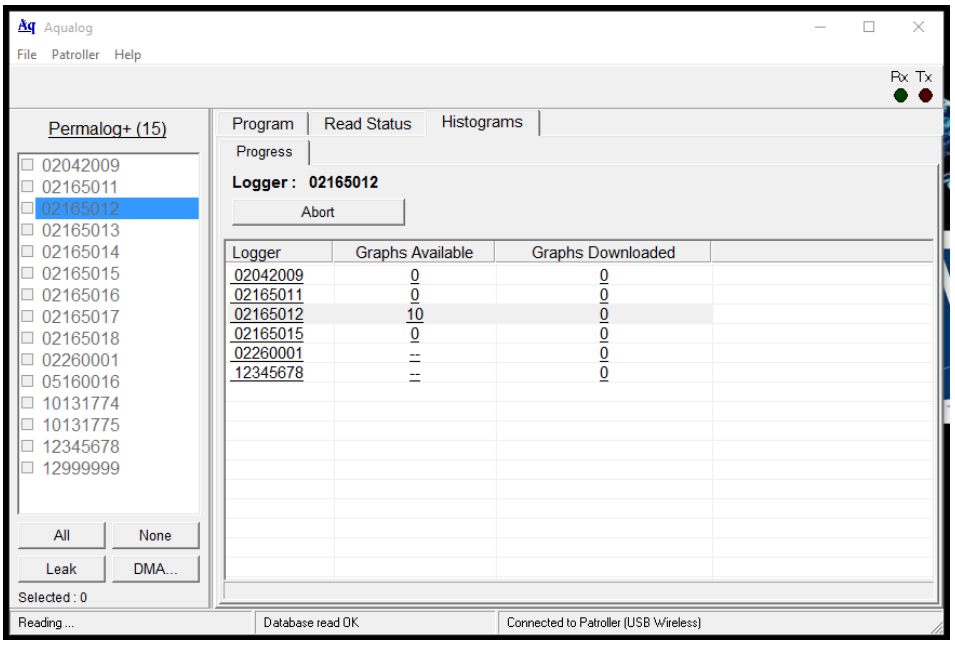
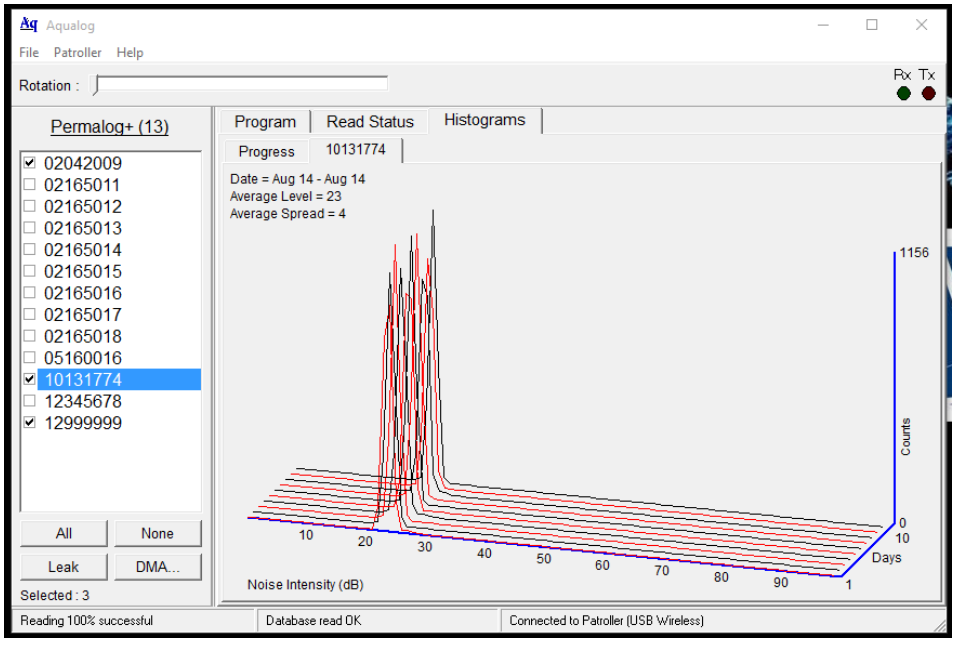
graph data and the graphs themselves. Please wait until this finishes. The time will depend on how much data there is to read.



When the graphs have been downloaded, a new tab will appear, and will be labeled with the logger's reference number. This will show graphs of the logged data at the time of activity.



Download Sound

Under the Download Sound tab, the logger's data can be downloaded to the PC and correlated to determine the possible location of the leak. Clicking on Select New Sound will automatically select the loggers with new sound data. Otherwise, select the logger(s) whose data should be downloaded, and click the Add to List button.

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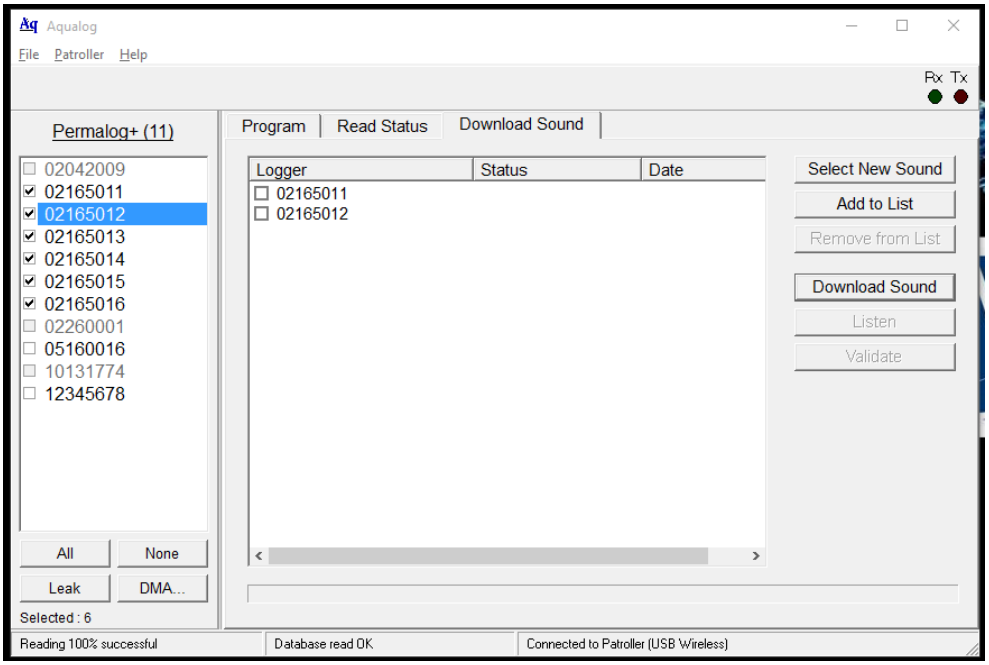
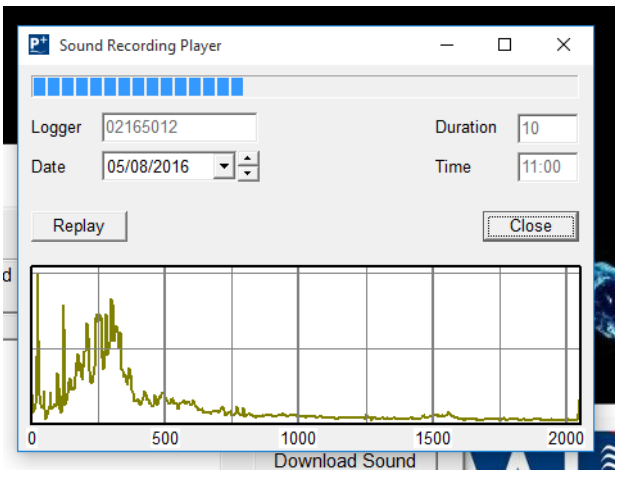


To remove a logger from the list, select the logger, and click the Remove from List button.

Once the Download Sound button is clicked, all the listed loggers' sound data will be downloaded. Please wait while it downloads all the data. Once completed, the status should display "Complete" and the date should be the start date and time of the logged data.

Clicking on the Listen button will open a window, and the sound will be played. To the right of the date parameter, clicking the up and down arrows will navigate through the downloaded sound data. A graph showing the current sound data will also be displayed.



Click on the Validate button to correlate the sound files. The sound files must be of the same time stamp for the correlation to work. Correlation is not possible if *** is seen by the logger time.

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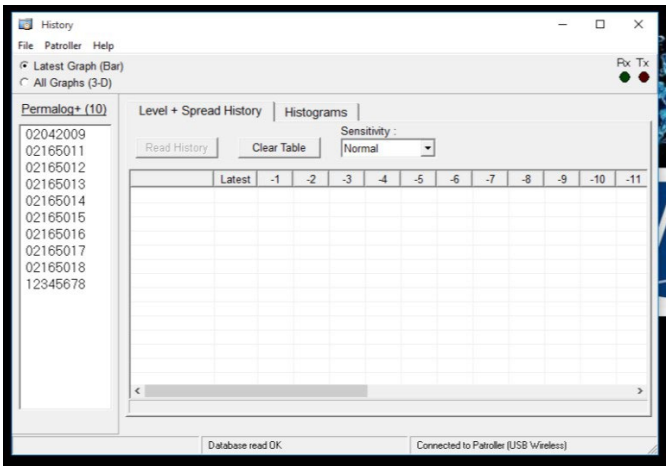
IMPORTANT: For the correlation to work accurately, the Permalogs must be programmed together at the same time, and not separately. **Warning**: Swiping the logger at any time between programming the logger and downloading the sound file will invalidate the synchronization, and correlation will no longer be possible.

History

The **History** function allows previous level and spread data from the loggers, starting from the latest data, to be presented in the form of either 2D or 3D histograms. These histograms will show the sound and data recorded over time. Leak detection is then possible through careful observation.

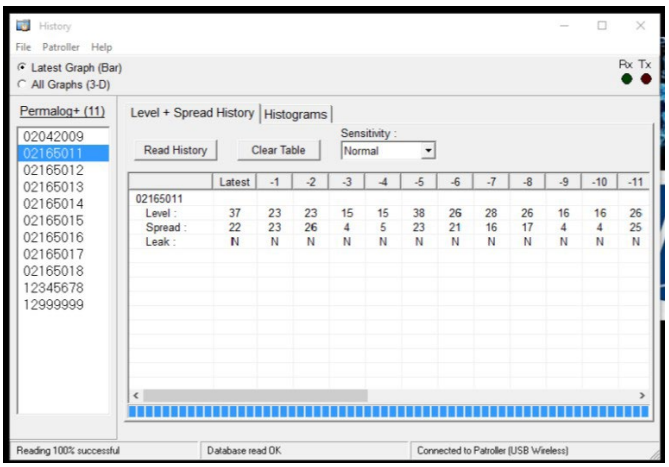
Level + Spread History

Under the Level + Spread History tab, the loggers' level, spread, and leak data can be downloaded. This may span from 1 day's to 28 days' worth of historical data.



Select the logger to download data, and click the Read History button. Please wait while data is downloaded.

Once data is downloaded, it will be displayed in columns, starting with the latest data, running through however many days' worth.



Clicking the Clear Table button will clear the data from the table.

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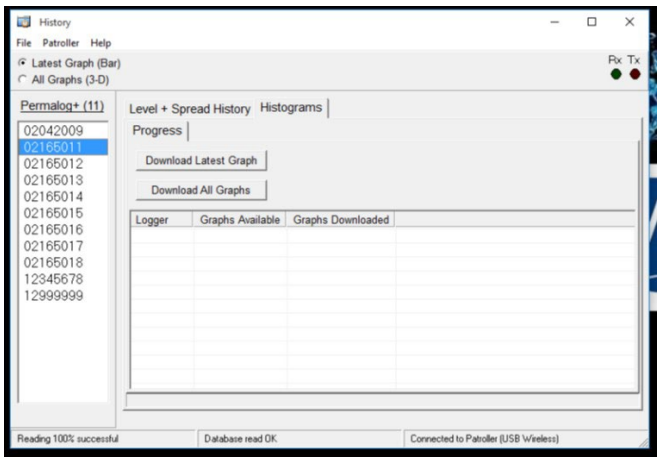
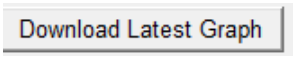
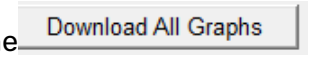
Histograms

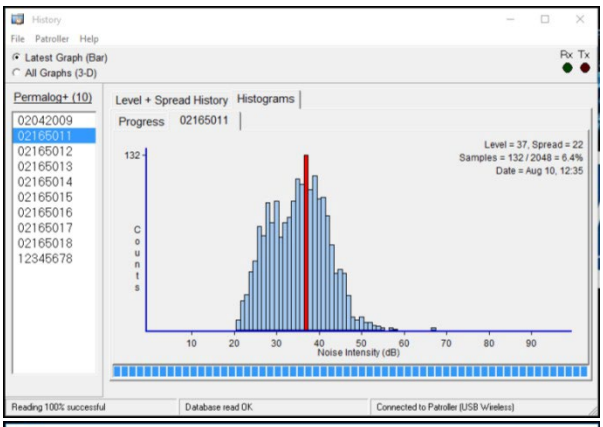
Under the Histograms tab, graph data can be downloaded and analysed.



Clicking on the 

button will download the latest data only, whilst clicking the 

button will download all the graph data available in the logger. Please wait while data is downloaded.



Please refer to **FAQ 204** on the FCS website, which covers understanding and interpreting the graphical data.

These graphs can be downloaded and saved to the hard drive by clicking File -> Save as CSV.

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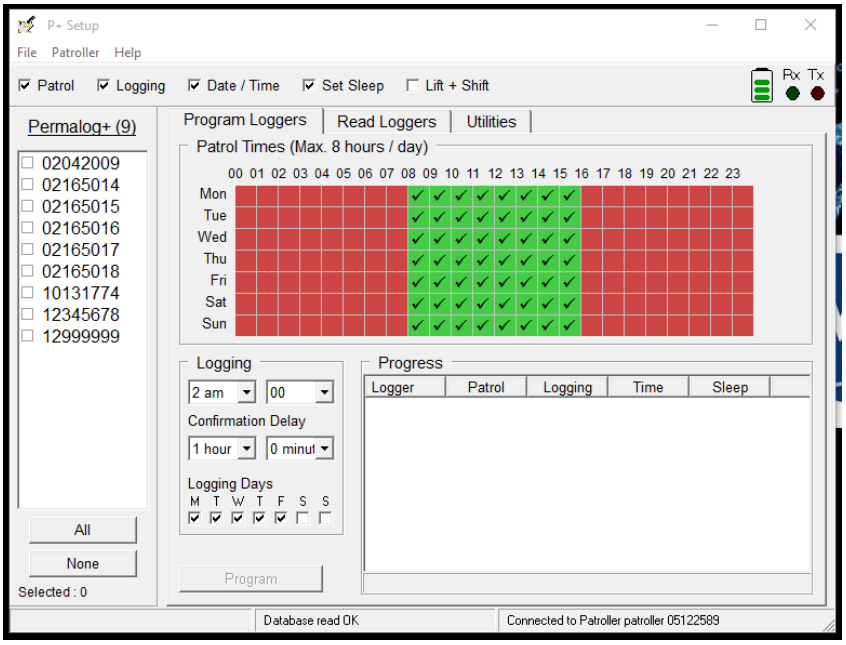
P+ Setup

The **P+ Setup** function sets the patrol times and the logging times of the loggers. These times will determine when the loggers will be detectable by the Patroller unit, and when they log data. Refer to **FAQ 203** on configuring the logger to 'Sleep Mode'.

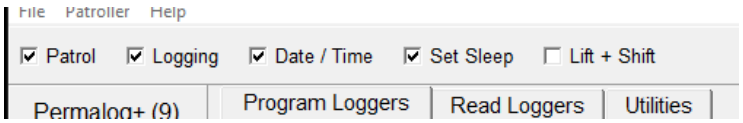


Program Loggers

Default settings only permit the loggers to be transmitting to a Patroller unit up to a maximum of 8 hours per day. This can be changed using the distributor's password in the Options menu of the **Main Screen**. The times loggers are available to Patroller units are denoted by the green ticks on the timetable, and can be changed by simply clicking on the green or red tiles.

Logging times are set to once per day, at quarter-hour intervals. The Logging Days parameter determines what days during the week the loggers take readings.

To program the loggers, select the desired logger by ticking the box, and clicking the Program button. Be sure to enable or disable which parameters to program by using the checklist at the top of the window.



Read Loggers

Under the Read Loggers tab, the loggers of choice can be read, which will give their current settings laid out.

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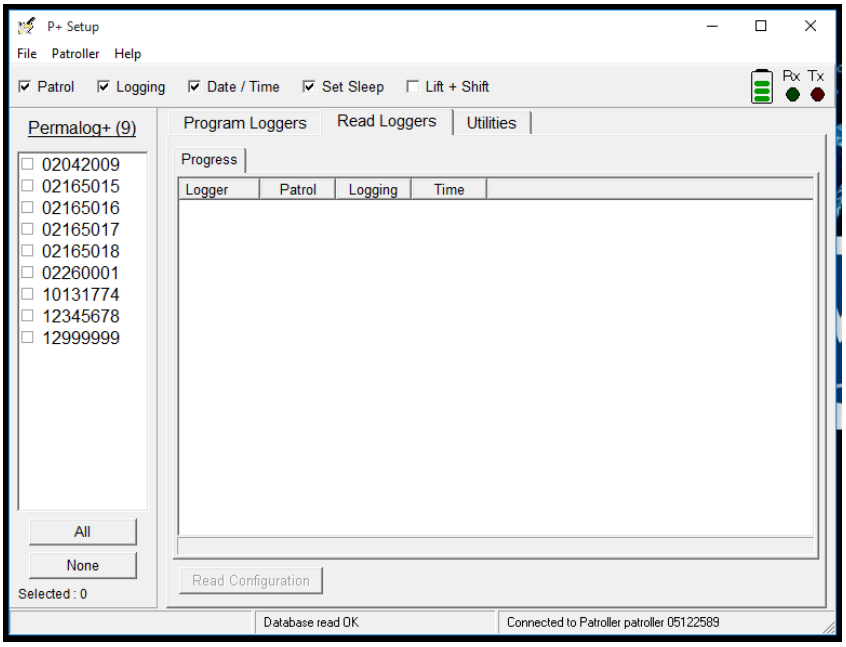
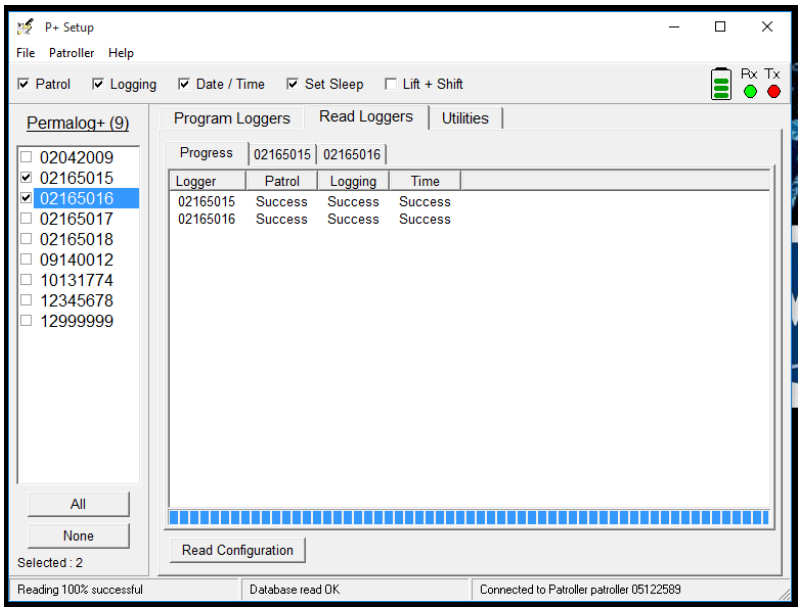


To read the loggers' current configuration, select the desired loggers, and click Read Configuration button. This will initiate the reading process. Please wait until this completes.

Once it does complete, there will be a new tab for every logger selected. Each tab will show the current configuration for the loggers, including the patrolling times, logging time, delay time, and their active days of the week.



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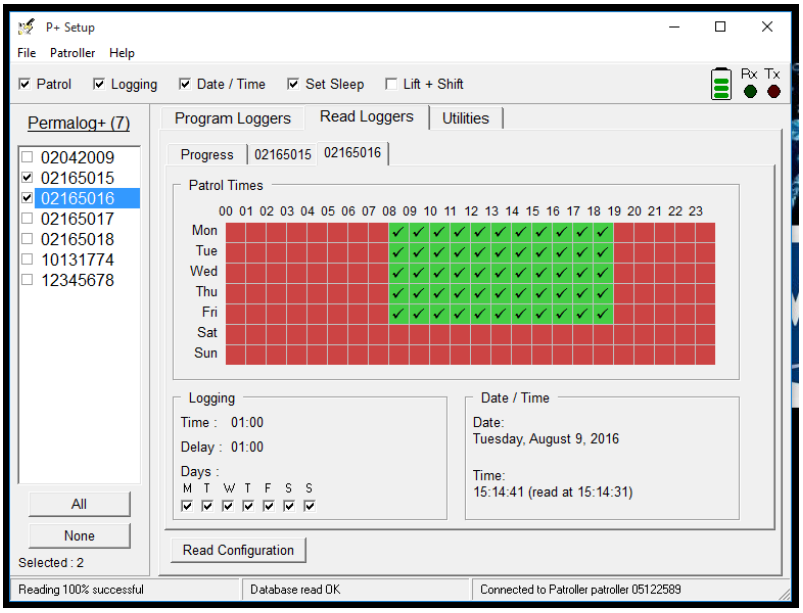
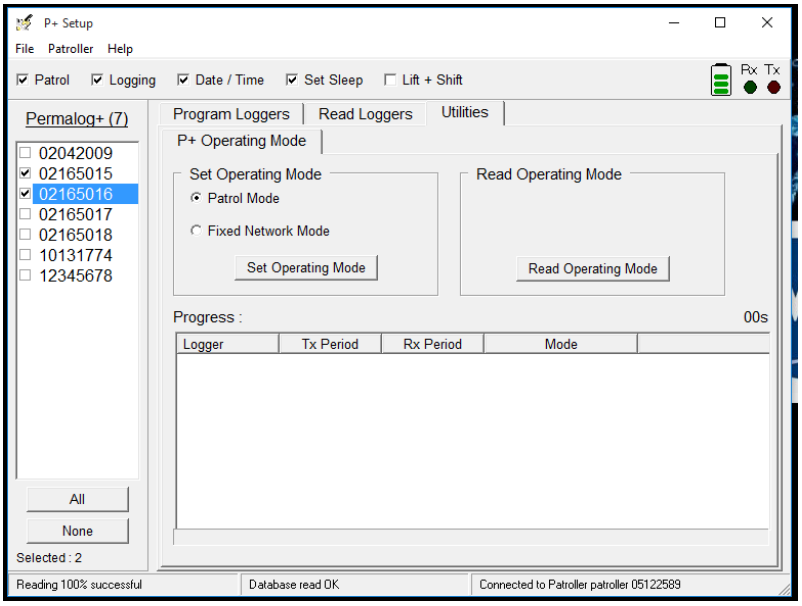


Utilities

The Utilities tab configures the loggers to be set in Patrol Mode or Fixed Network Mode. Patrol Mode is for loggers without a GSM option, and require a Patroller unit to scan and read their data. Fixed Network Mode is for loggers with a GSM option that do not need to be constantly scanned. These loggers can send their data to the FCS server, where their readings will be stored. Refer to **FAQ 208** on the FCS website for more information on the operating modes.



To set the logger's operating mode, select the logger by ticking the checkbox, select which operating mode to set, and click the Set Operating Mode button.

To see which mode a logger is set to, select the logger by ticking the checkbox, and click the Read Operating Mode button. The loggers' operating mode will be displayed in the table.

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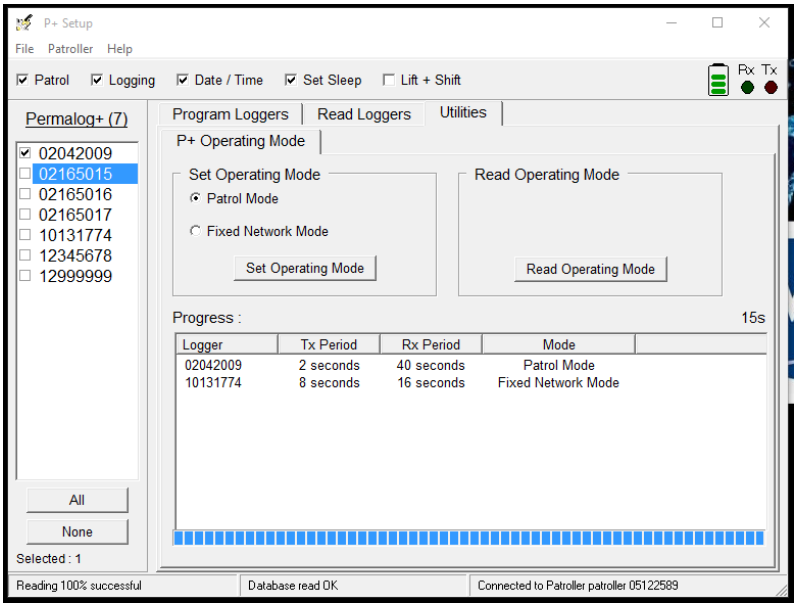
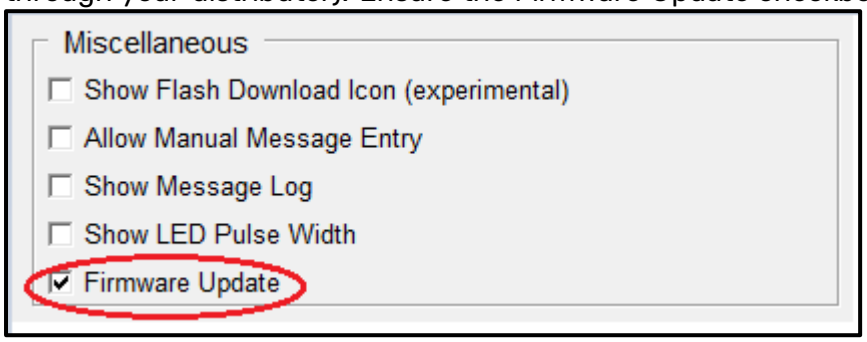


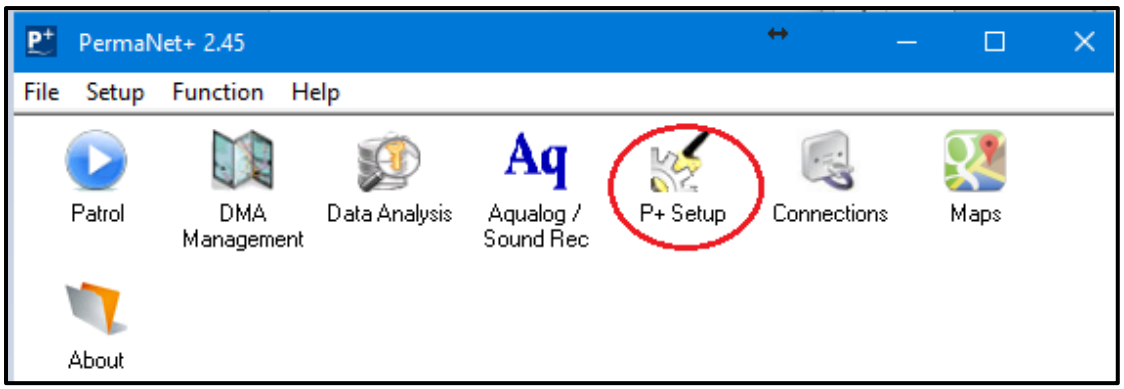
Firmware Upgrade

Using the Main Screen, select Setup and Options (Note: the password is available through your distributor). Ensure the Firmware Update checkbox is ticked:



Ensure your interface is configured using the wireless USB module (refer to section Connections > Patroller/USB Wireless).

Select P+ Setup from the Main Screen.



Navigate to the Utilities tab, and select the logger required for upgrade from list on the left by ticking the logger's checkbox.

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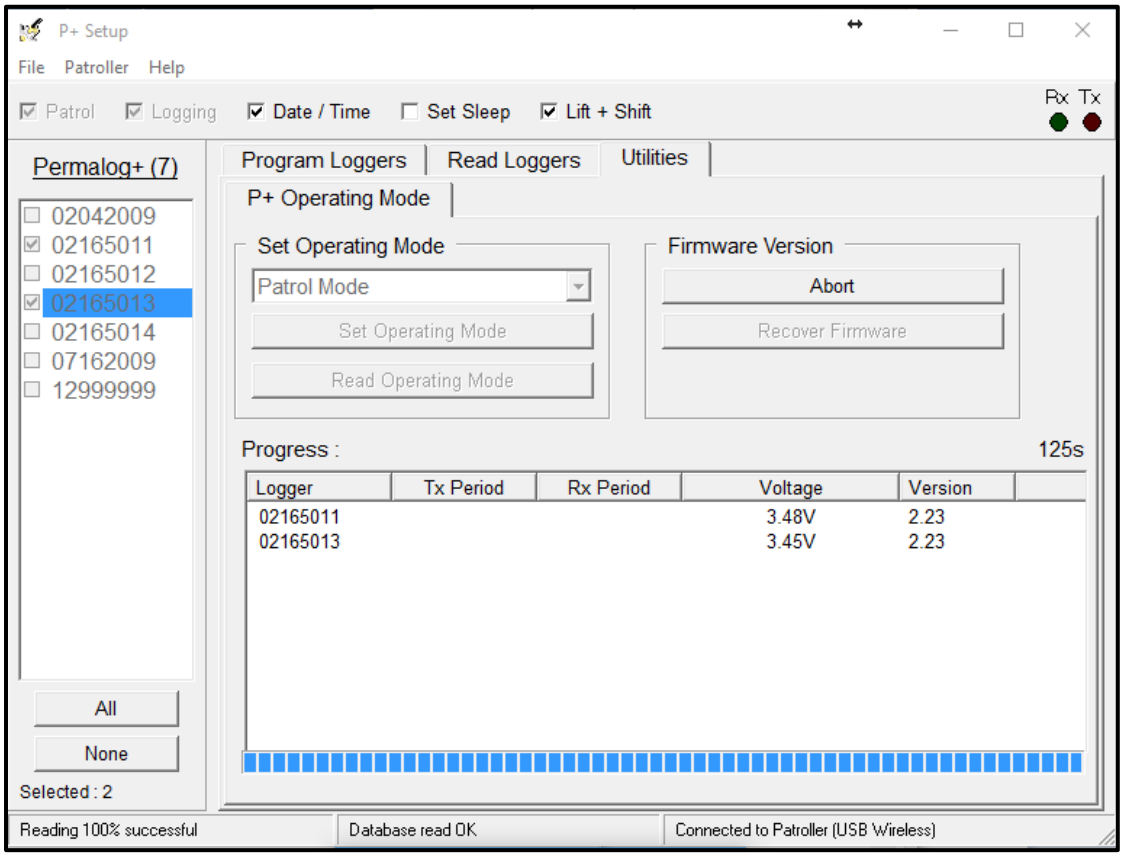
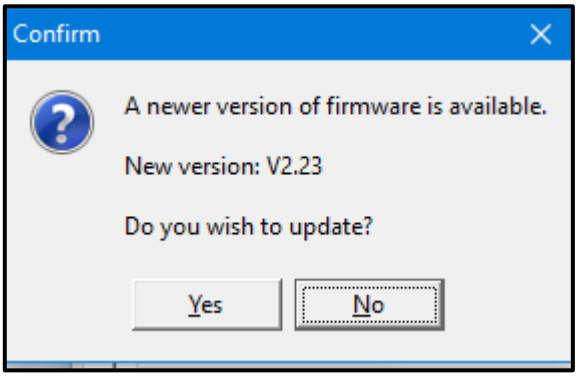
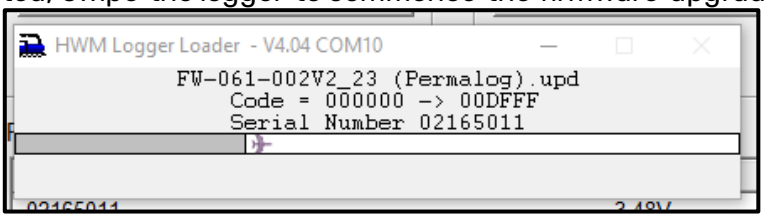
Click on the Read Version button and wait for the logger to call in with their current status:



If a new firmware update is available, a notification box will ask to update the firmware. Selecting "Yes" will start the firmware upgrade procedure. Selecting "No" will return to the Utilities tab.



When requested, swipe the logger to commence the firmware upgrade.



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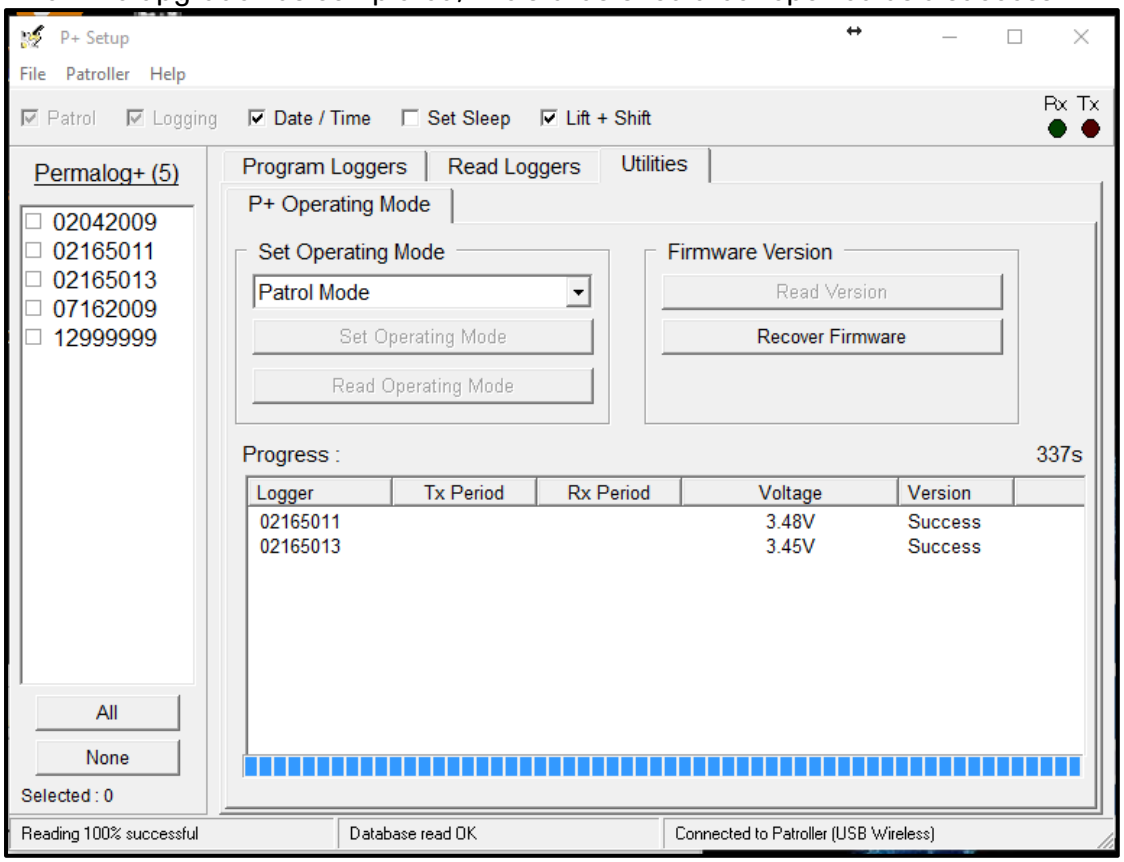
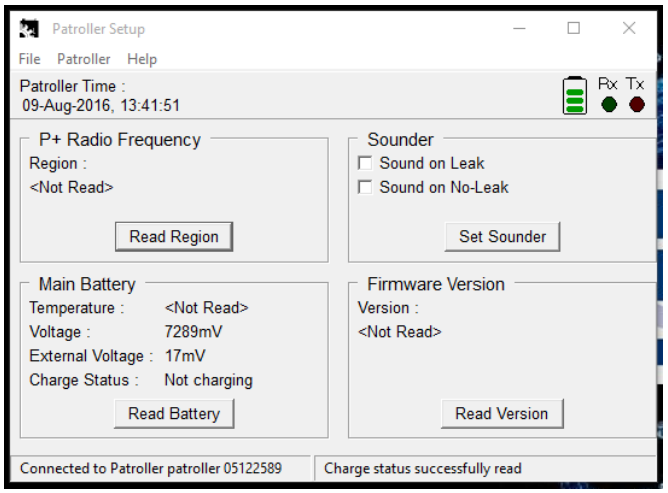
When the upgrade has completed, the status should be reported as a success.



If the upgrade fails, select the logger that failed to upgrade (by ticking the checkbox of the logger) and click on the Recover Firmware.

Patroller Setup

On clicking the **Patroller Setup** icon, a window will open up.



Clicking the Read Region button will detect the operating radio frequency, and therefore the area which the loggers and Patroller unit are in use.

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Clicking the Set Sounder button will configure the Patroller unit to toggle an alarm when there is a leak and/or when there is not. This is not compulsory, and can be left blank.

Clicking the Read Battery button will give details of the Patroller unit's battery.

Clicking the Read Version button will give the current version of the Patroller unit's firmware.

Note: the **Patroller Setup** is only available with a mobile Patroller unit, and not the USB wireless module.

Connections

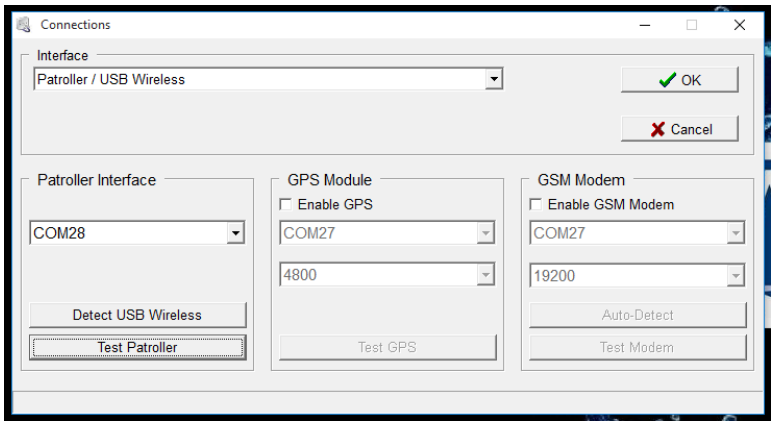
The **Connections** function sets up the connection between loggers and the software. The logger data my come from the logger, the DataGate, or from a file stored on the computer's hard drive. The **Connections** window allows connections to be tested to make sure data would be transmitted to the software, depending on the interface.

Patroller/USB Wireless

The Patroller/USB Wireless interface uses either the Patroller unit or the USB Wireless module.

Note: to connect to the Patroller unit, a Bluetooth connection must be made, and may take several attempts at pairing before a successful connection is made.

To confirm there is a successful connection, select the port number of the communications interface, GPS module (if used), and GSM modem (if used), and click either the Detect USB Wireless button (if using the USB Wireless module), or the Test Patroller button (if using the Patroller unit). Upon successfully connecting, a message should appear in the bottom left of the window saying, "Connected to XX", where XX is either the Patroller unit or the USB Wireless module.



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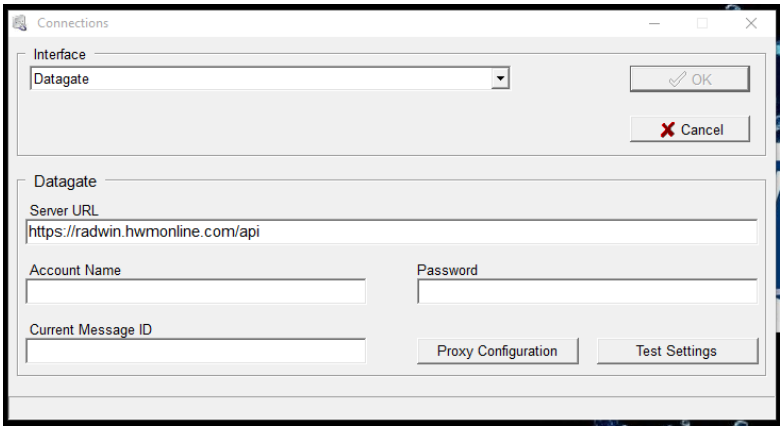
DataGate

The DataGate interface uses the logger data available on the FCS server to gather data.

Note: there must be an active internet connection to access the FCS server.

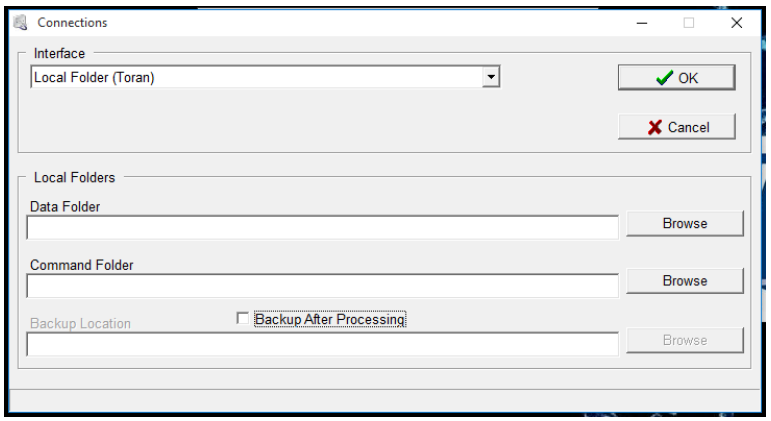
Enter the Server URL, Account Name, Password, and Current Message ID. Configure the proxy settings, if required, and check the connection is successful by pressing the Test Settings button. On successfully connecting, the message "Connected to Datagate" will appear in the bottom left corner of the window.



Local Folder (Toran)

The Toran interface uses locally stored data to process the logger data. Enter the path of the folder containing the data into the Data Folder parameter, and the path of the folder containing the necessary commands into the Command Folder parameter.

A backup of the original data can be made if "Backup After Processing" is ticked. Enter the path of where the backup will be saved.



Backup/Restore

On clicking the **Backup/Restore** icon, a window will open, prompting to either backup or restore the database.

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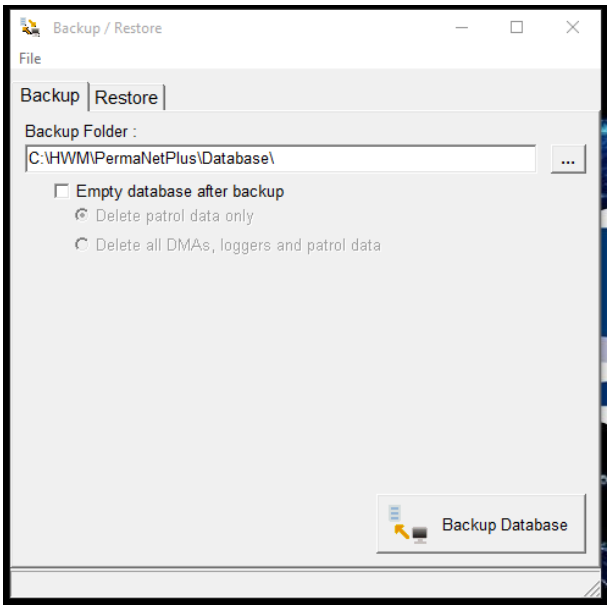
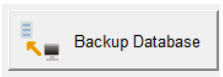
Backup

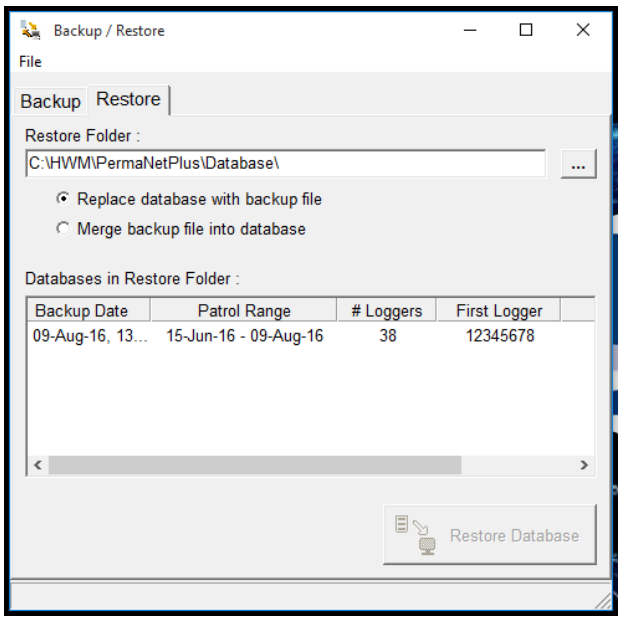
Select the Backup tab, and enter the folder location of where the backup will be saved in the Backup Folder parameter. Alternatively, click the ... button and navigate to the desired folder. The database may be cleared after the backup by ticking the “Empty database after backup” checkbox.



Click the  button to backup the database.

Restore

Select the Restore tab, and enter the folder location of where the restore is saved in the Restore Folder parameter. Alternatively, click the ... button and navigate to the desired folder. The new database may completely replace, or it may be merged with the existing database.



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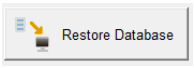
The window will also display the databases present in the current folder. The correct database must be chosen for the correct set of loggers.

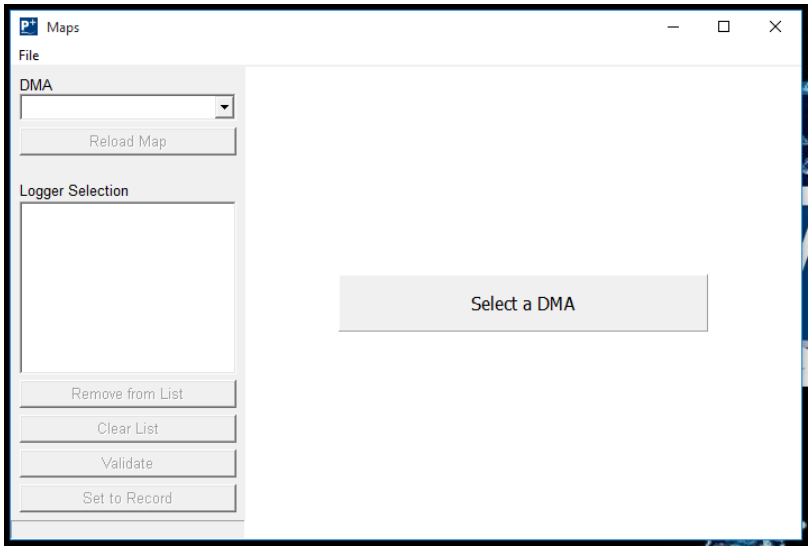
Click the 

button to restore the database.

Maps

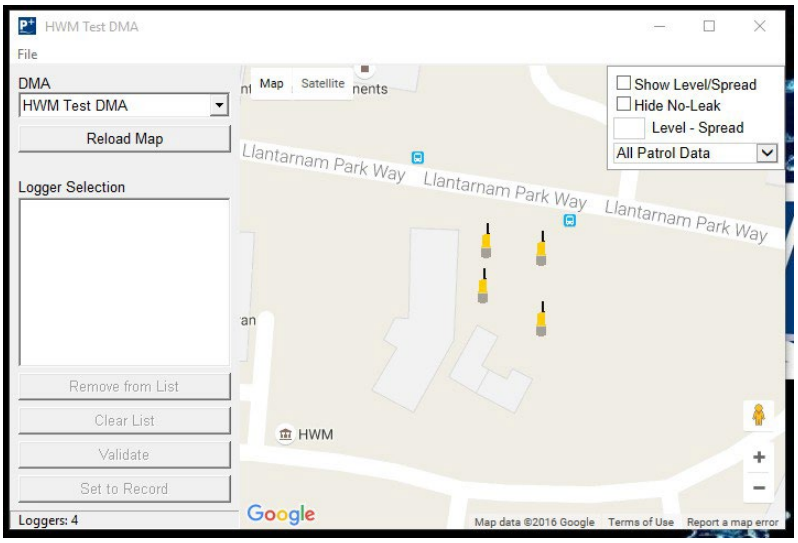
The **Maps** function shows the loggers' locations on Google Maps. From there, the loggers' details may be retrieved.

On clicking the icon, a window will open.



For **Maps** to work, it needs a DMA (see section **DMA Management**). Select the dropdown menu under "DMA", and choose the DMA of choice. Upon selecting it, a map will be generated with the loggers' sites listed in the DMA.

Note: loggers will need a set of GPS coordinates to appear on the map. See section **Deploy** to edit and configure loggers.



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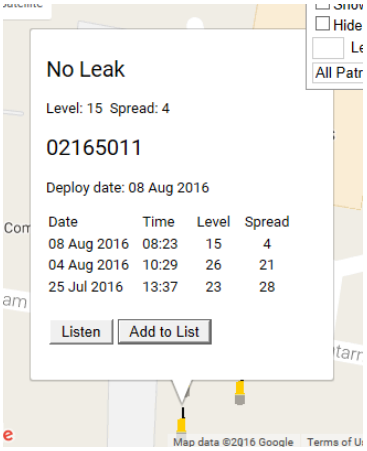
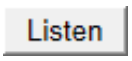
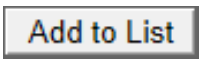
Sites in yellow denote no leak detected, whilst sites in red denote a possible leak. Selecting “Show Level/Spread” will display the current level and spread at each site. Selecting a site will give more details.



If the logger at the site has data, and the data has been downloaded in **Aqualog**, it can be listened to by clicking the  button.

On clicking the  button, the logger at the site will be added to the Logger Selection box for validation and correlation.

About

The **About** icon gives the current information about the PermaNetPlus software package. It also contains the End User Software & Firmware License Agreement.

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PermaNetPlus LLC

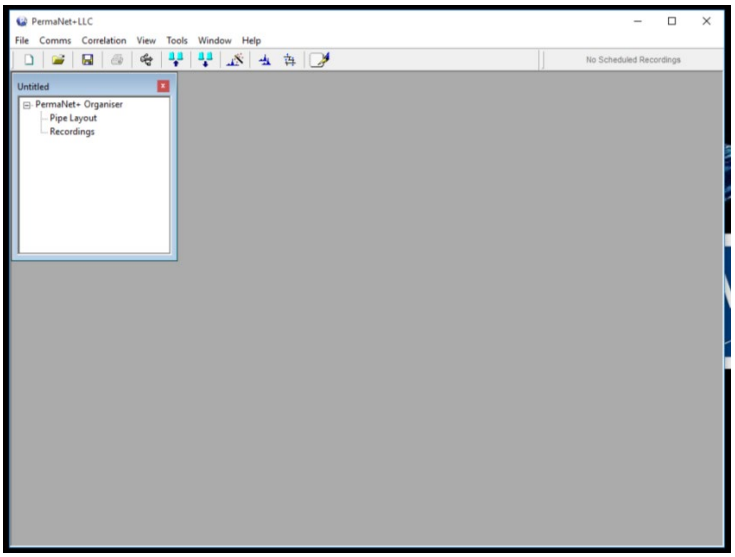
The PermaNetPlus LLC (Leak Location & Correlation) software is an addition to the PermaNetPlus software which uses the data obtained by the loggers to determine where a possible leak is. This section will outline the basics of the software and how to interpret the results.

Prerequisites

In order for the LLC to function accordingly, recordings and data must have been downloaded from the loggers prior to opening and running the software. Without the data, the software will not be able to implement the loggers' data.

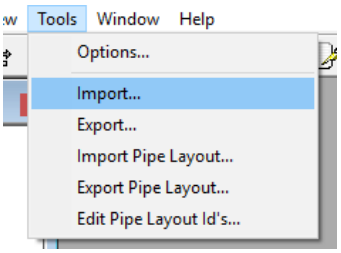
Main Screen

On opening the LLC, a new untitled project will automatically open. If it does not, click on File -> New.



Importing Sound Data

To import data to cross correlate, click on Tools -> Import.



Select the data to import, and click Open. Multiple files may be selected by holding down the Ctrl key and selecting the files.

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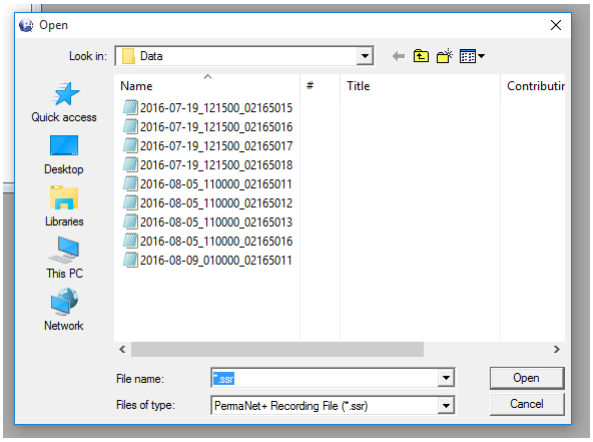
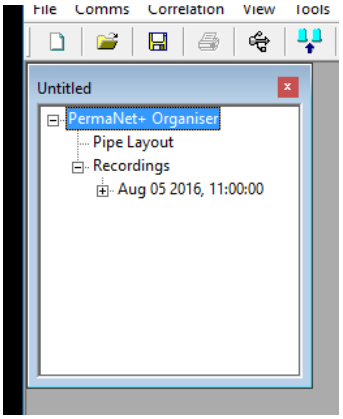
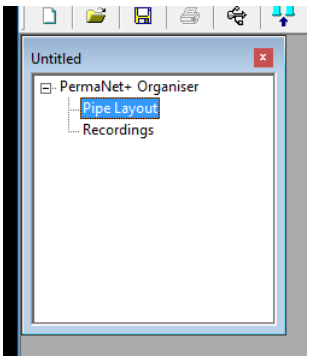


This data will be put into the Recording menu, under PemaNet+ Organiser.



Creating a Pipe Layout

The LLC software can create pipe layouts for analysis. To create a pipe layout, double-click Pipe Layout under PermaNet+ Organizer.



A window will open, with a pipe layout interface.

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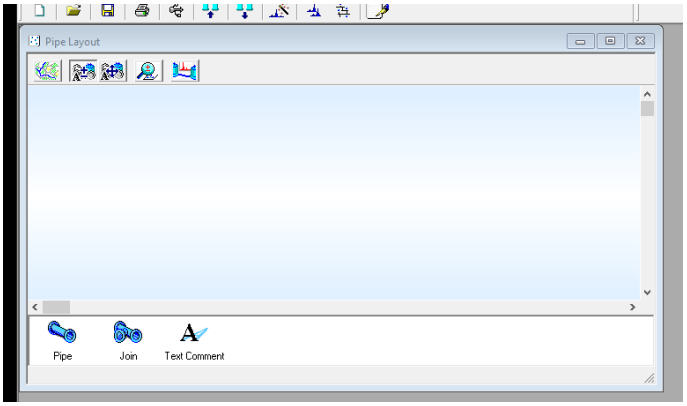
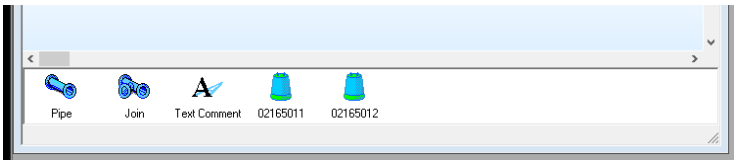


Below is an explanation of the buttons:

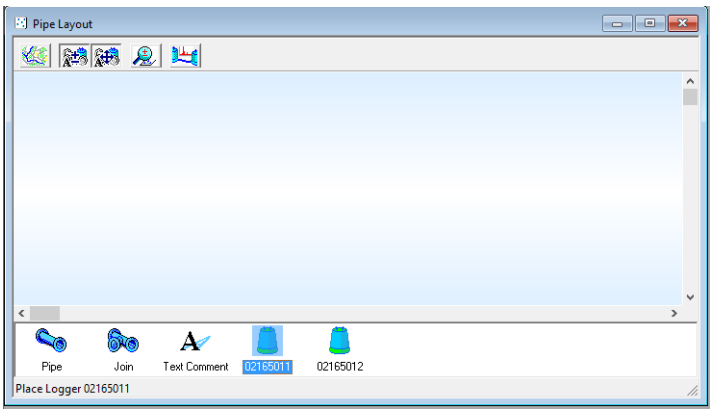
	Map/Background. Sets the background image. The pipe layout will overlay this image, and may make it easier to draw the layout with a map image of the location. This is an optional feature.
	Add/Remove Components. Gives you the option to add/remove loggers, pipes, pipe joints, and text comments.
	Move Components. Moves components to desired locations.
	Zoom. Zooms in and out.
	Cross Correlate. Performs a cross-correlation analysis on two or more loggers. See section Cross Correlation for more information.

Click on the button. If logger data has not been imported, import logger data. See section Importing Sound Data for further information.

Once imported, loggers will appear as components that can be placed in the layout.



To add components, click on the component icon, and then click on the layout.



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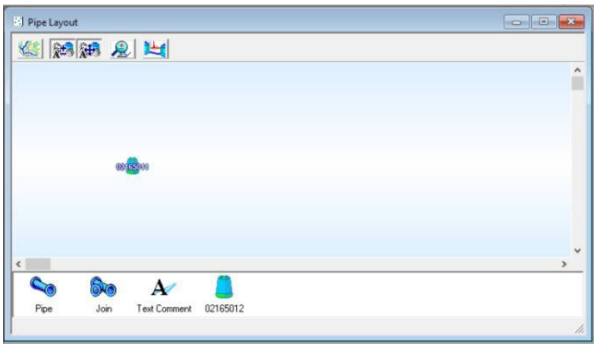
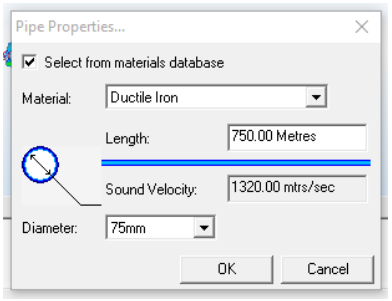


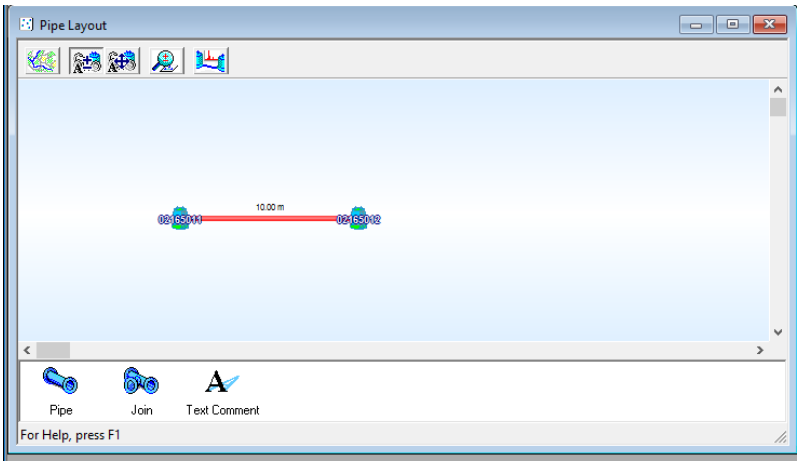
Note: placing loggers will remove them from the components menu. This is because loggers can only be placed once.

Once two or more loggers have been placed, a pipe can be drawn. Select the Pipe icon and draw a line from one logger to the other. On releasing the mouse button, a configuration box will appear.



Select the material the pipe is made from, the length of the pipe, and the diameter of the pipe. Click OK.

Now the pipe has been drawn and configured.



Note: It is not necessary for the pipe layout to be a 1:1 scale. The pipes' lengths are set in the Pipe Properties box upon drawing a pipe, and can be changed by right-clicking on the pipe, and selecting "Pipe Properties".

Exporting Pipe Layouts

Once a layout has been drawn, it can be exported into a single file. Click Tools -> Export Pipe Layout.

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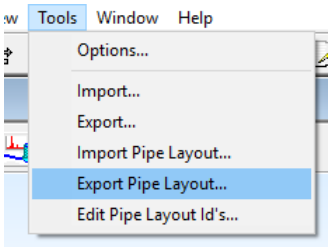
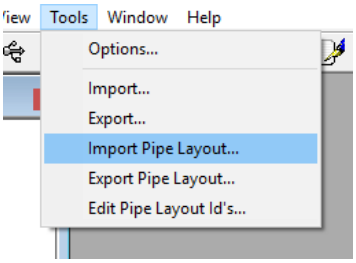


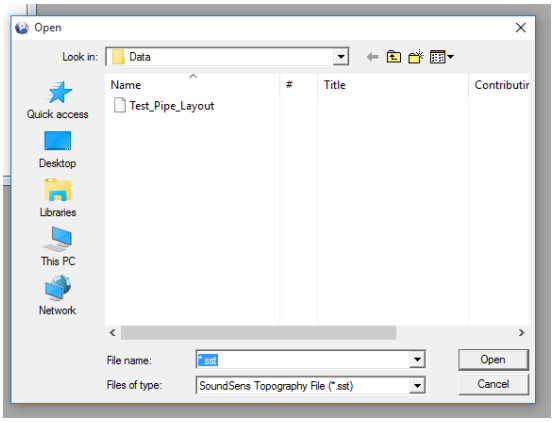
Save the file in a directory of choice.

Importing Pipe Layouts

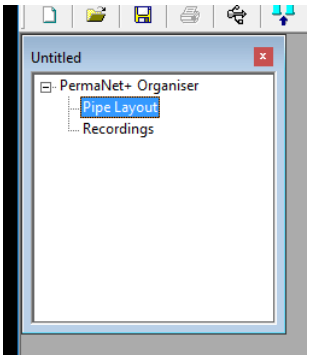
If a previous pipe layout design was created and exported, it can be imported by clicking Tools -> Import Pipe Layout.



Select the desired pipe layout, and click Open.



Under PermaNet+ Organizer, double-click “Pipe Layout”.



The pipe layout will appear.

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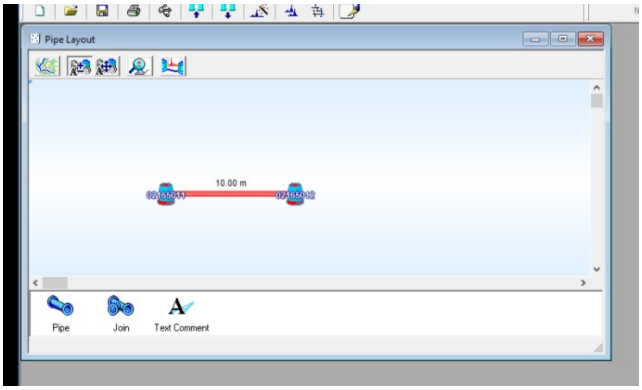


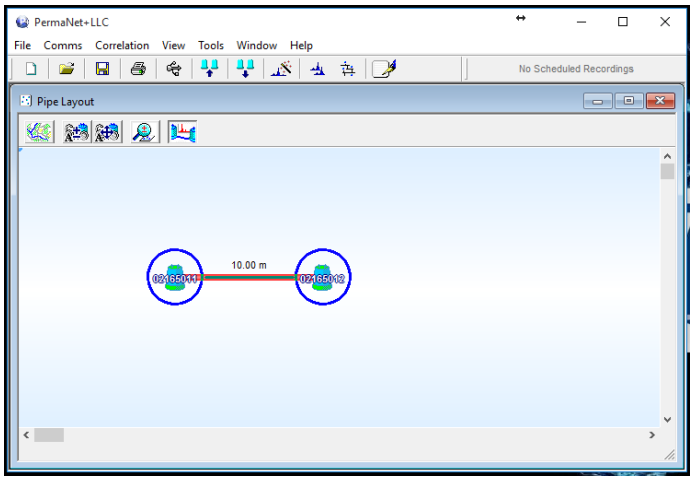
Note: logger data will not be imported.

See below for details on logger icons:

	Red Icons. This means that the software does not recognize the logger, and the data must be imported. See section Importing Sound Data to import data. Ensure that the imported data times match, and that one logger's data is not newer/older than the rest.
	Yellow Icons. This means the software has recognized there is a logger, but any data associated to it is not available for cross correlation, most likely due to misalignment with the recording times. Importing the correct logger data from the correct time stamp will fix this.
	Green Icons. This means the software has recognized there is a logger, and data is readily available for cross correlation.

Cross Correlation

There are two methods for cross-correlation. For the first method, click on the button. Then, click and hold on one logger, and drag the cursor to the second logger.



The software will cross-correlate the data from the two loggers, and display the estimated location of a possible leak in the correlation window.

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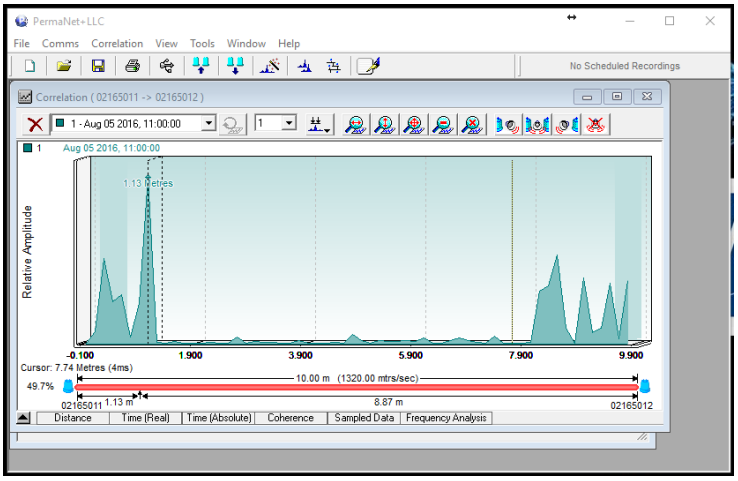
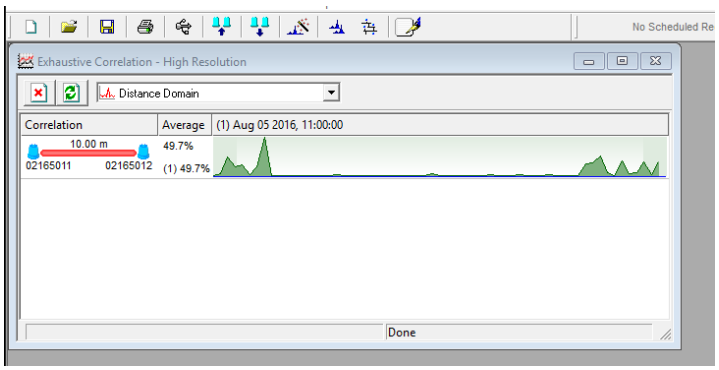


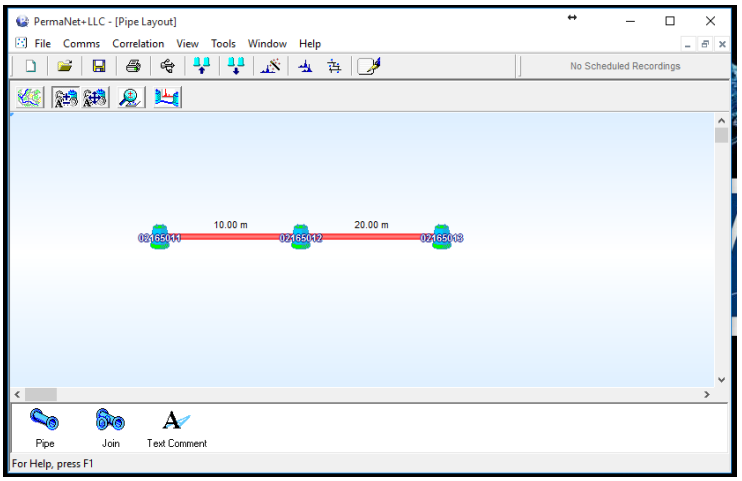
For the second method, click on the button. This will display the correlation between all the loggers.



Double-click on the correlation desired. This will open the correlation window, giving an estimate of where a possible leak is.

IMPORTANT: For the correlation to work, the Permalogs must be programmed together at the same time, and not separately.

Note: if more than two loggers are on the pipe layout, the software will cross correlation between all pairs of loggers:



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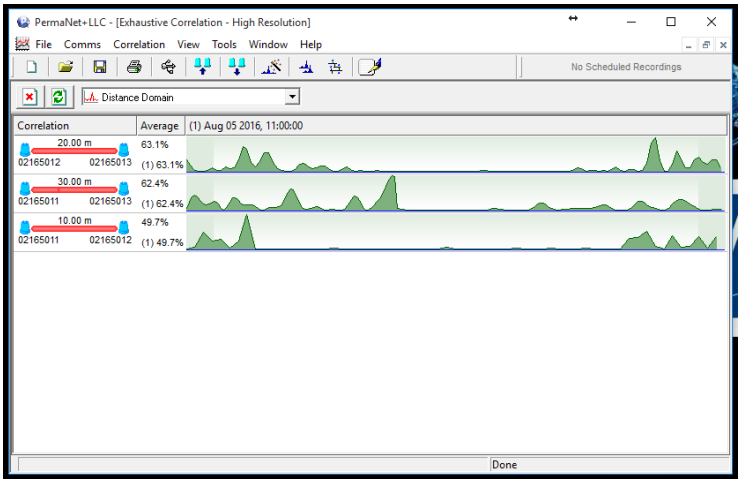
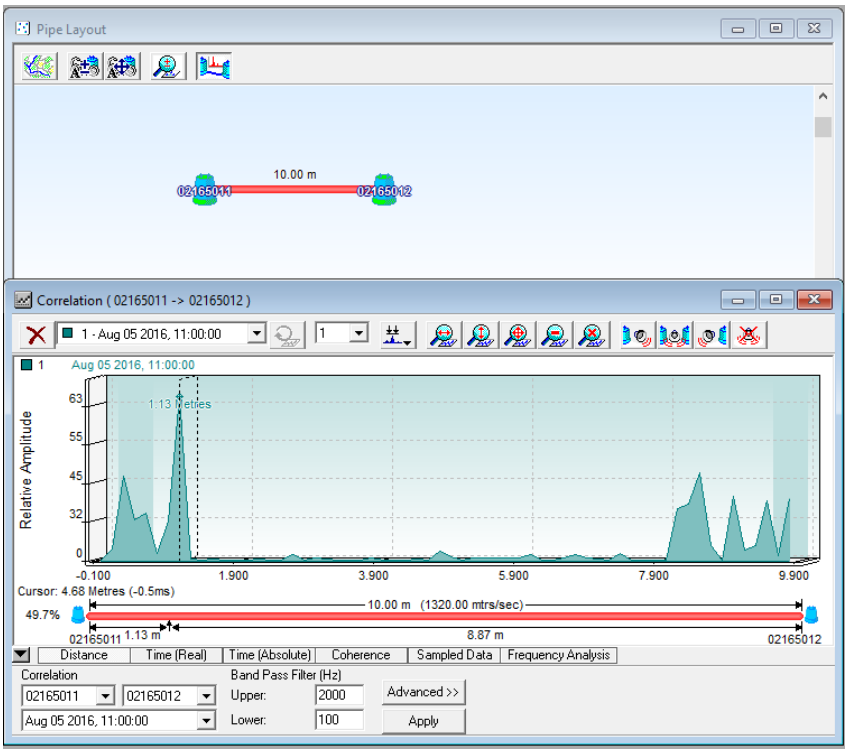


No Leak Determined

If the software cannot determine or find a leak, a location of the highest peak detected will be shown, with the likelihood of this peak being the location of a leak.



As the text and numbers under the graphical data is in black, the software has concluded it is not a leak.

Leak Determined

If the software detects a leak, a pair of leak markers will appear on the pipe layout, highlighting between which loggers the leak is suspected, and the text on the correlation window will appear red.

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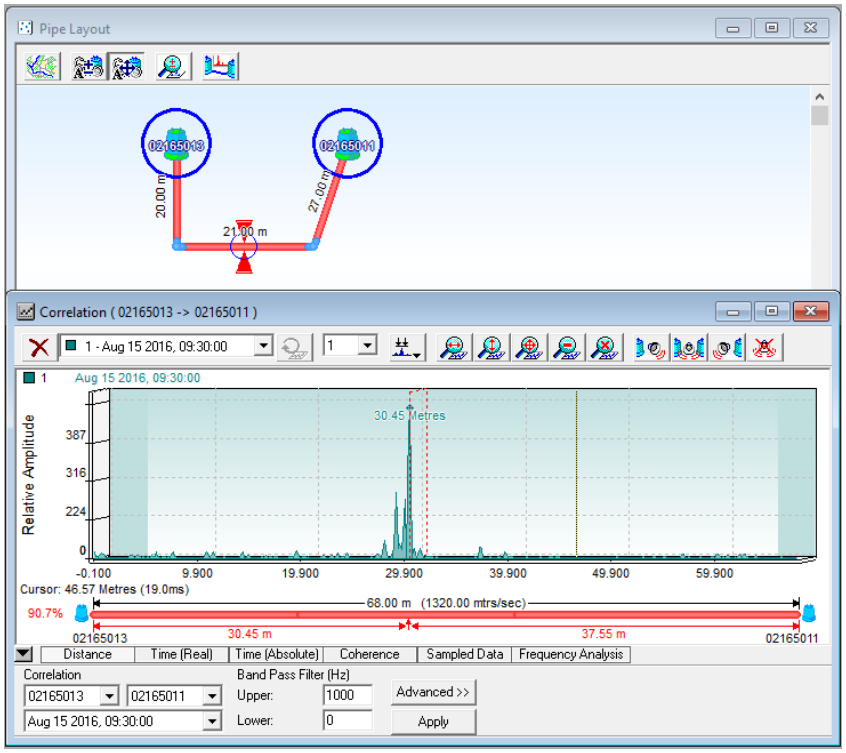
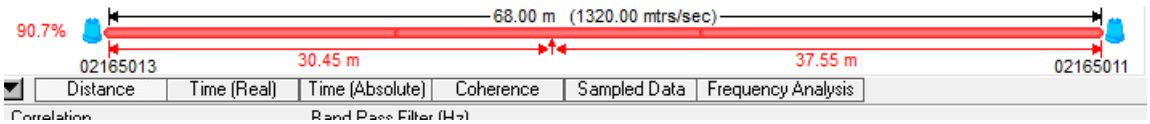


The correlation window will display the results from the correlation algorithms and the probable location of a possible leak.

WARNING: the results from the correlation are an estimate, and should not be taken as the exact final result.



Note the numbers on the pipe diagram. These numbers give the approximate location of the leak, with the percentage showing the leak certainty. In the image above, the software has determined there is a 90.7% chance there is a leak located 30.45m from logger 02165013.

IMPORTANT: For the correlation to work, the Permalogs must be programmed together at the same time, and not separately.

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FAQs

For common queries with the software, please consult the frequently asked questions (FAQs) section on the website.

Associated FAQs:

- FAQ 037 – Interfacing Google Maps to the PermaNetPlus software.
- FAQ 202 – How to Discover the logger using the Patroller and software.
- FAQ 203 – How to put the logger into 'sleep mode'.
- FAQ 204 – Understanding and interpreting graph data.
- FAQ 206 – Saving 29-day historical data.
- FAQ 208 – Operating modes explained.
- FAQ 372 – How to set auto data download.
- FAQ 376 – Creating a new DMA.

Troubleshooting

To reduce the chances of problems occurring, please ensure the latest software has been downloaded and installed. Newer software will have bug-fixes and optimized algorithms that would not be available with older versions of the software.

The latest software can be downloaded from
https://www.fluidconservation.com/support/customer-resources/

For any problems, or more technical queries, please contact FCS Technical Support on (800) 531-5465, or email info@fluidconservation . Our staff will always seek to resolve any technical enquirers and are fully supported by the FCS Engineering Team to guide you to a satisfactory outcome. In the rare event that a product develops a defect within the warranty period, it will need to be returned to FCS for inspection and repair.

Warnings

FCC warning statement:

- This device complies with Part 15 of the FCC Rules.

  Operation is subject to the following two conditions:
  (1) This device may not cause harmful interference, and
  (2) This device must accept any interference received, including interference that may cause undesired operation.
- This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

- Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment