GUTERMANN

ZONESCAN 800/820

CORRELATING RADIO LOGGER

Edition 0110820

Table of Contents

1. Introduction

Welcome to the ZONESCAN 800 System.

ZONESCAN 800 is a professional, easy-to-use analysis and documentation tool for detecting leaks in drinking water distributions. It consists of small, intelligent units (loggers) that are deployed throughout the distribution network for collecting analysis data and a communication unit for interactive controlling and transferring the data to a mobile computer (laptop). The components provide powerful radio transmission abilities in order to allow convenient operation from inside a vehicle. The system comprises the following functions:

- Automatic monitoring and analyzing of noise characteristics
- Calculation of leak probability with optical and acoustic indication
- Off-line correlation of sound signal for localizing leaks
- Remote listening of leak noise

For further details concerning the loggers and the communication link see also **System Components**.

The integrated ***ZONESCAN 800 Windows™*** software provides easy-to-use operation of the radio units and powerful analysis tools of the measurement data. It supports project management for easier organization of the loggers as well as integration of geographical maps. The software also contains various graphical and tabular data diagnostics tools and export functions.

The Windows software can be operated in two modes: Wizard assisted mode which provides guided functions and is easy to use or Standard professional mode. The operation mode can be switched in the initialization window.

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

This equipment complies with FCC radiation exposure limits and Industry Canada RSS102 set forth for an uncontrolled environment.
This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

RSS-GEN
Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

1.1. System Components

The ZONESCAN 800 system consists of the following components:

- Radio loggers
- System Communication Link (ZS820 Bluetooth)
- Communication cable (Serial/RS 232C)
- Mobile computer (laptop) with ZONESCAN 800 software

1.2. Radio loggers

The radio loggers continuously monitor and analyze noise characteristics. The loggers need no maintenance. Depending on the setting of radio operation period and how often the functions **Correlation** and **Remote listening** (see **Logger State**) are used, battery lifetime normally exceeds 5 years. Battery may be replaced by authorized personnel only.

1.3. System Communication Link

The System Communication Link (abbreviated: CommLink) serves as an interface for radio communication between computer and the loggers. It is connected to the computer's serial interface via the Communication Cable. When connected to the computer the System Communication Link will be automatically detected as soon as the ZONESCAN 800 software is started. It is switched off either by exiting the software or disconnecting it from the computer. Later version CommLinks have a push on/off button. Depending on the surrounding conditions, radio transmission to the loggers is possible up to several hundred metres.

2. ZONESCAN 800 software

The ZONESCAN software provides a variety of functions:

- transferring, storing and visualizing logger measurement data
- correlation of sound signals
- remote listening via PC speakers or headphone
- programming the loggers
- checking the logger state
- analyzing and printing measurement data
- exchanging data with other PCs
- audio messages during synchronization of loggers
- geographical map of loggers (standard professional mode)

The software may be easily installed on every computer by executing the file SETUP.EXE from the installation CD or installation disk 1. The installation software will guide the user through the installation procedure. Minimum system requirements are:

- Windows 95/98/Me/NT/2000
- Pentium II 120 or higher
- 32 MB RAM
- 5 MB free disk space
- Windows compatible mouse

2.1.

2.2. Initial ZS800 Commlink Setup

Identify the Commlink, does it require a cable or Bluetooth to connect to a computer. If it's a cable continue with this section. If it's a Bluetooth go to Section 2.3.

The pathway of communication between the Commlink, Zonescan software and the computer's communication ports require configuration before the loggers can be used. [Fig.1 Connect the System Communication Link via the Communication Cable to an unused COM port of the PC. If the computer does not have a RS232 inbuilt socket then a USB to RS232 adaptor will be required. USB to RS232 Adaptors are available from a computer dealer.

Fig.1commlink picture

In Windows go to device manager and expand the Ports to see which COM Port the Zonescan Commlink or USB to RS232 serial port adaptor is assigned to. [Fig.2 in the Zonescan software check COM port setting: select menu command **File - Options - Setup**, then select **Connection** and modify setting if necessary.

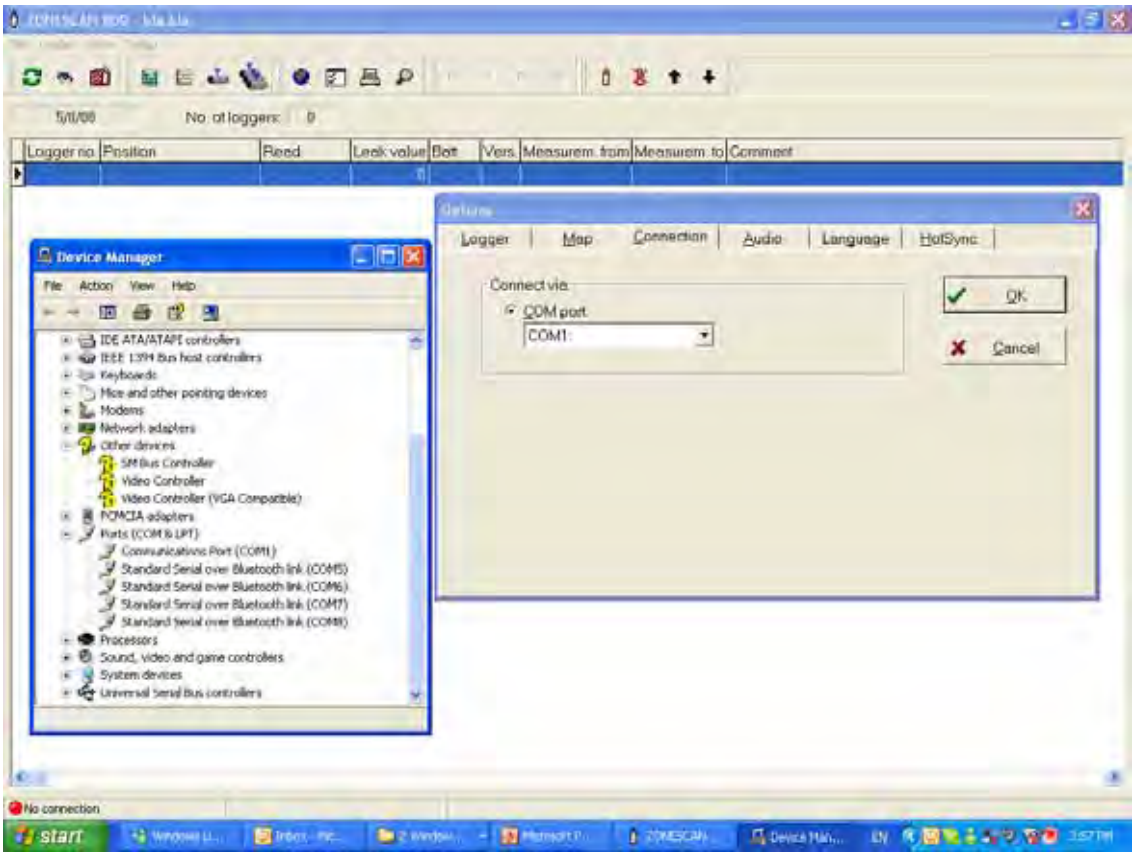
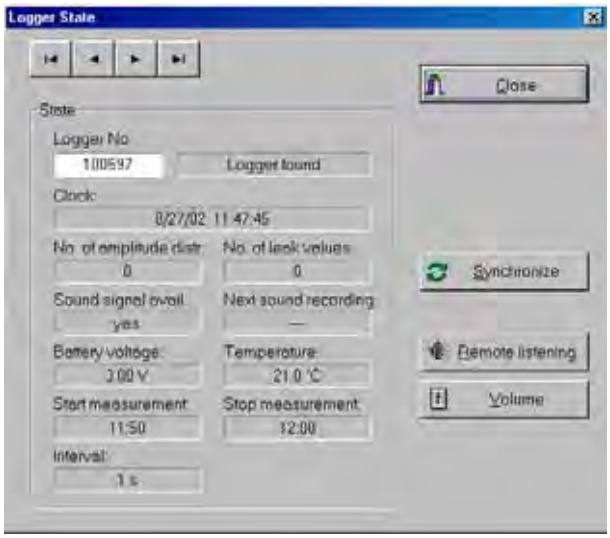


Fig.2 setting up communication port

After these basic setup steps the software is prepared for normal operation. It is recommended to check radio connection to the loggers next:

2.2. Check Radio Connection

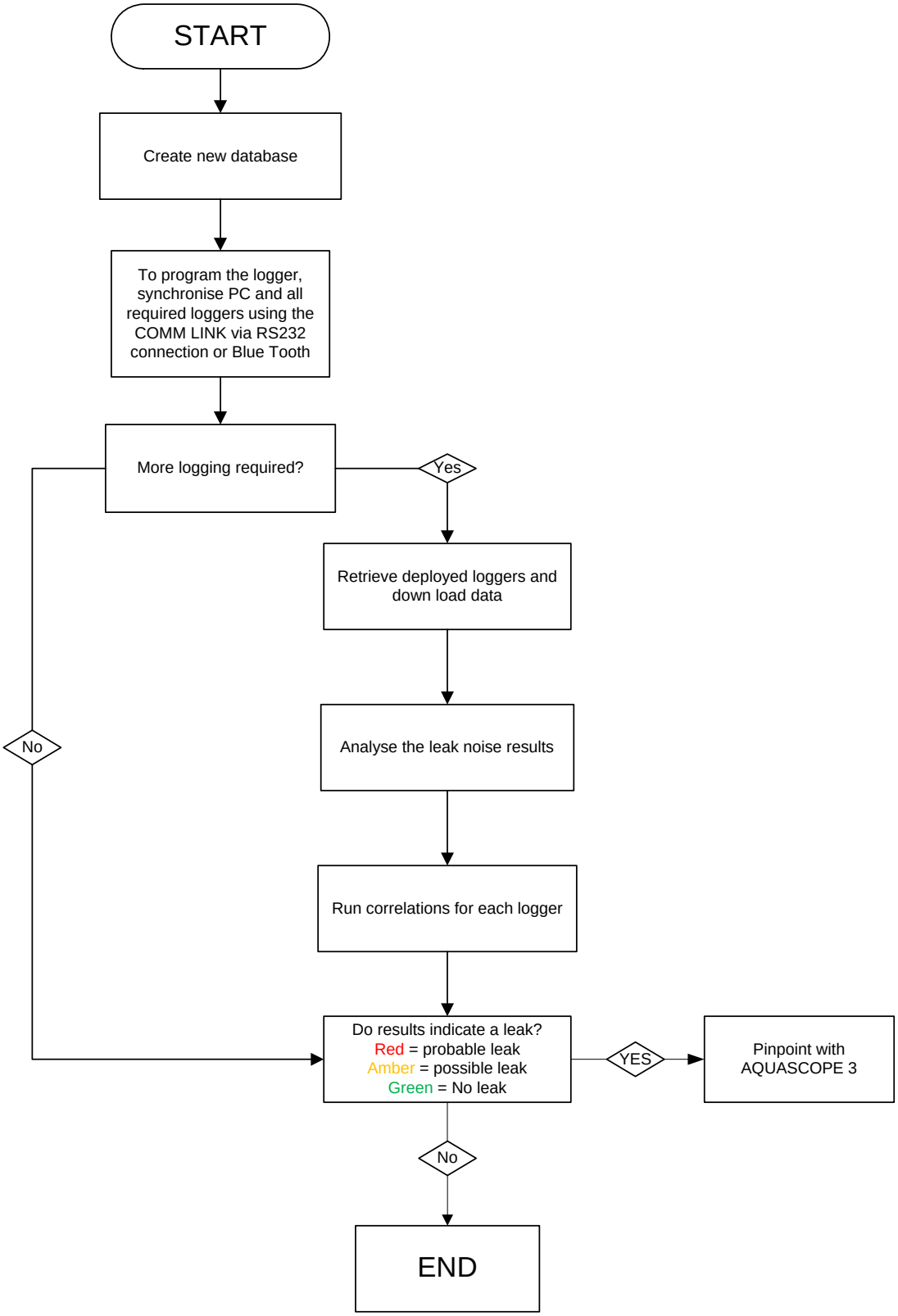
Refer to section 3.1 on how to insert a logger to use to check the Radio Connection. Select a logger in transmission range (click on according entry in logger list) and press the function button **Logger State** or the function key **F3**. Radio connection should be established after some seconds and logger state data should be visualized in the **Logger State** window.



2.3. Initial ZS820 Commlink Setup

The ZS820 Commlink is cable less and uses Bluetooth as its form of communication therefore a computer with inbuilt Bluetooth or a USB Bluetooth Dongle is required. For the Setup please refer to the section" Zonescan820 Commlink Setup" in the Appendix of this document.

1 Zonescan Loggers Process Flow Chart



3. Creating a new Database

Start the Zonescan software in standard professional mode, see page 63. The Zonescan Loggers are individually identified by a serial number which is stamped on the top of the logger. This serial number is used by the Zonescan software as a means of communicating with each logger. Fig.3 shows how to create a New Project by selecting File from the menu bar and then selecting New Project from the pull-down menu.

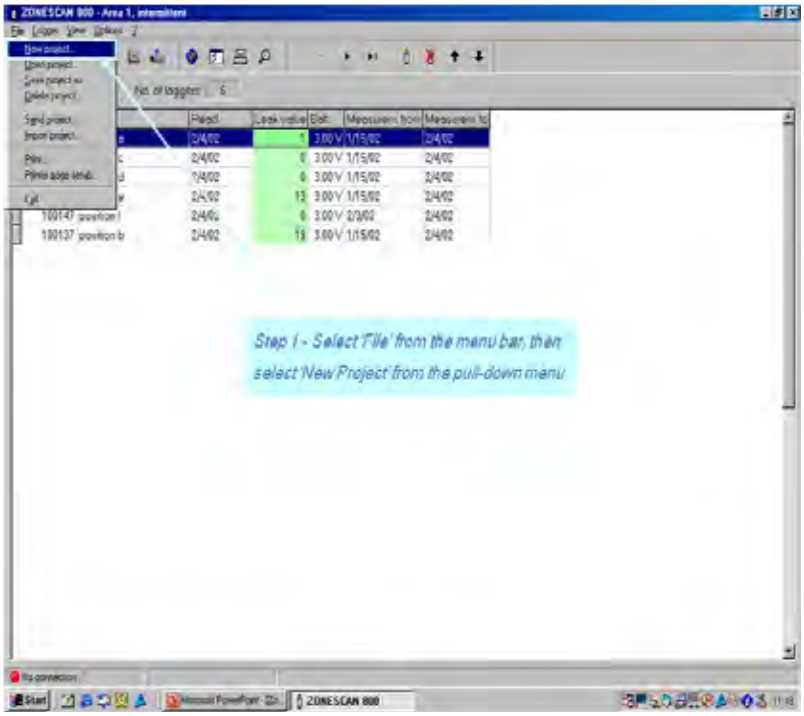


Fig.3 file new project

The cursor will flash in the box where the Project name needs to be entered. Use a name which helps identify the area where the loggers are deployed.

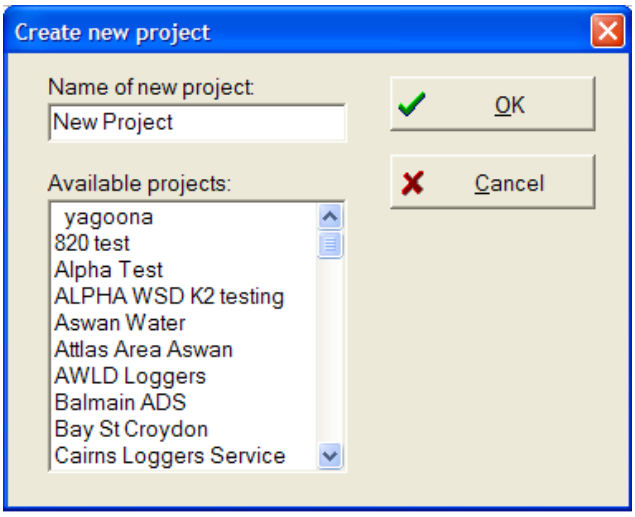


Fig.4 name new project

3.1 Inserting a New Logger

The main window is blank, its ready to insert the loggers required for the newly created project. Select the Insert New Logger as in Fig.5, a new smaller window will appear to allow the logger serial numbers to be entered. Click OK and then to enter another logger, repeat the process. The Logger Position and comment maybe filled in after the Loggers have been deployed however it is important that the logger position is noted on a Map when deployed. The Measurements will require setting before Synchronization, this will be covered later.

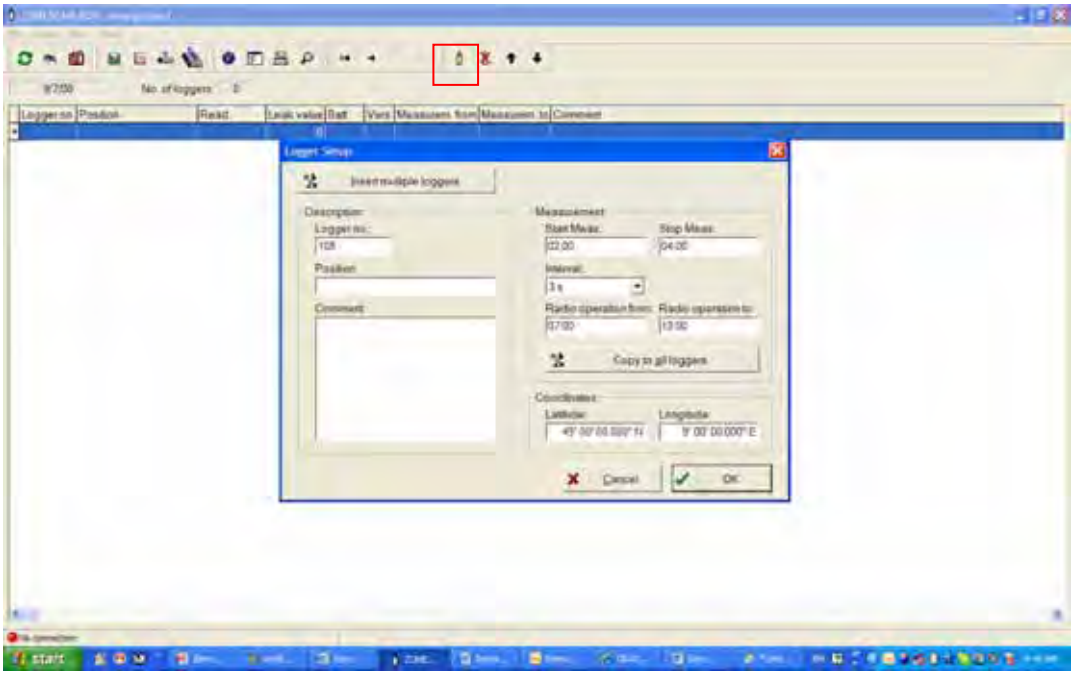


Fig.5 insert logger window

3.2 Insert Muliple Loggers

Click the Insert Multiple Loggers button to enter a large quantity of loggers. Fig.6 shows where to enter the first and last serial number for the project. Click OK and all the loggers will appear as a list in the main window.

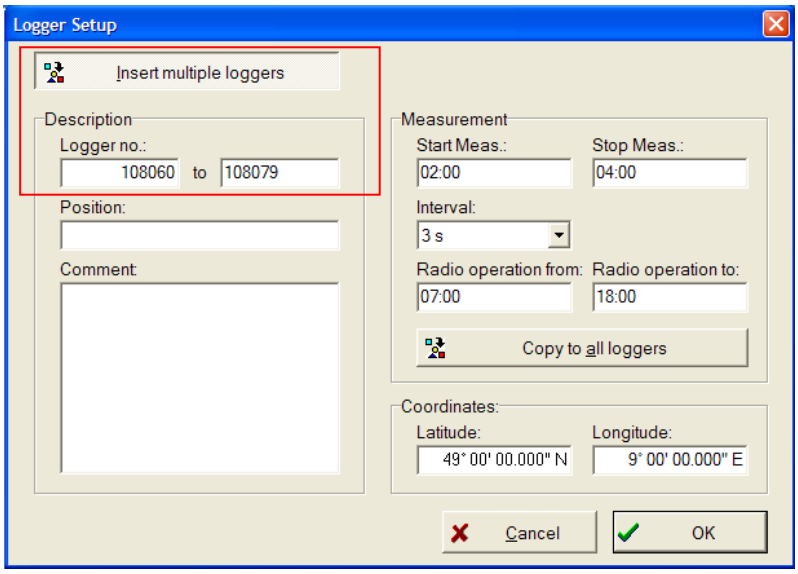


Fig.6 inset multiple loggers

3.3 Logger Setup – Measurement Settings

The Start and Stop time's aswell as the Interval (sample rate) require setting to suit your requirements, the best time period is when pressure is highest and consumption is lowest, if this doesn't happen then the standard settings will remain as in Fig.6. Click the Logger Setup Icon. Once these settings are complete then reduce the radio operational window down to the period of time for programming and downloading the Loggers, by doing this the battery life will be extended. Fig.7 the radio operation period is the time when communication with the loggers is required during operators working hours.

Use the Copy to All Loggers button to set all the loggers with the same parameters.

Note: Set the measurement Intervals as follows: 3s for 3 hours logging, 2s for 2 hours and 1s for less than 2 hours

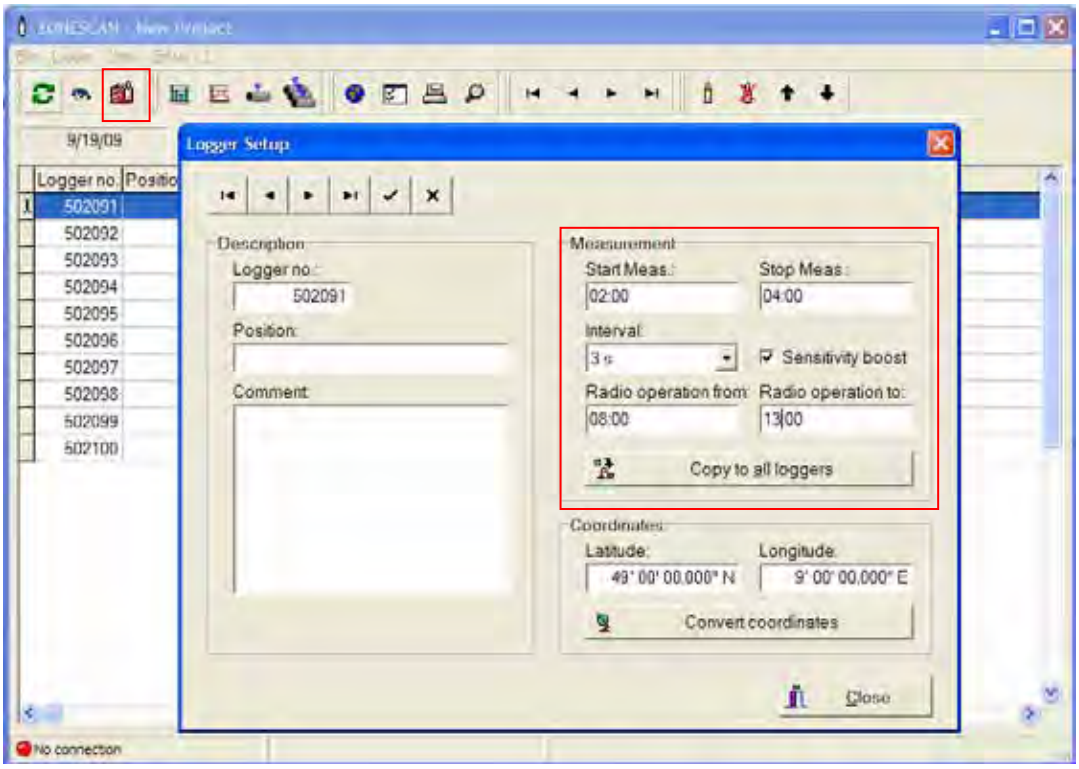


Fig.7 measurement settings in logger setup

3.4 Zonescan 820 Sensitivity Boost

The Zonescan 820 Loggers have an extra feature which Boost the sensitivity of the sensor, this is recommended for very quiet leaks. Tick the box as in Fig.8 and copy to all loggers to set the Boost.

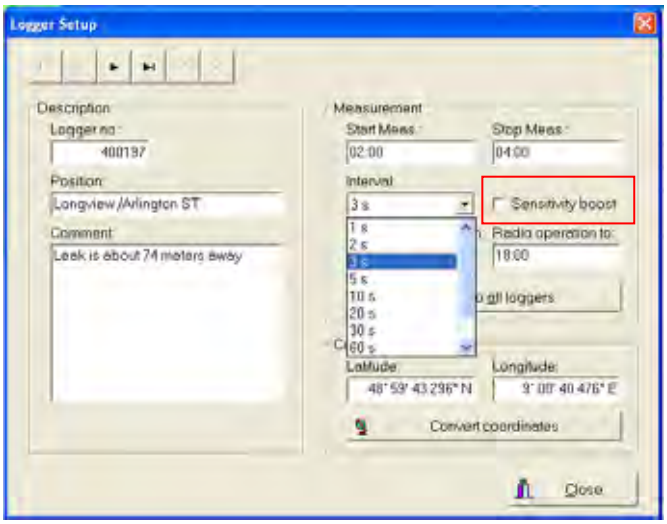


Fig.8 sensitivity boost

4 Programming the Loggers

Connect the Commlink with Antenna to the PC and switched on. Click the Synchronize button and a smaller window appears. See Fig.9. Tick the option Transfer logger settings from PC to Logger, this means the settings selected in Logger Setup and the PC time will be transferred to the Logger. The Zonescan Loggers are versatile with respect to the Order of Synchronization. 'Synchronize only reachable loggers' is used when the loggers are deployed in the field as a 'Drive By' communication. The loggers Synchronize as they come in transmission range when driving around the deployment zone.

'Synchronize according to logger list' is the method of communication when all loggers are in one place e.g. in the carry case. For more detailed explanation of this Synchronization methods see the section Logger Synchronization on page 75.

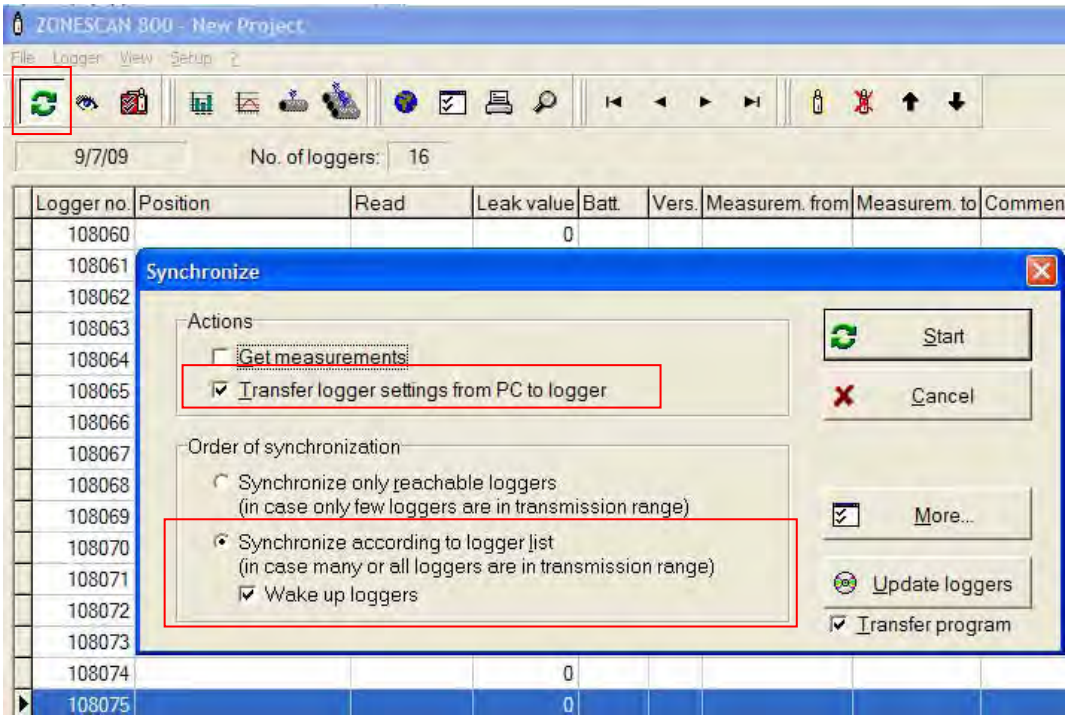


Fig.9 actions and order of synchronization settings

In the section 'Order of synchronization' select according to logger list and tick 'Wake up Logger'.

Wake up loggers: Wake up loggers that are in sleep mode. This function should be activated during synchronization outside of the logger's radio operation period (see also **Logger Setup**). This is only for synchronizing according to logger list.

Click 'More' to reveal further synchronization options. As 'Get Measurements' is not selected then leave the Fast Sync option of Leak Values selected. This is not used for programming; it's used for the download of results, see download section.

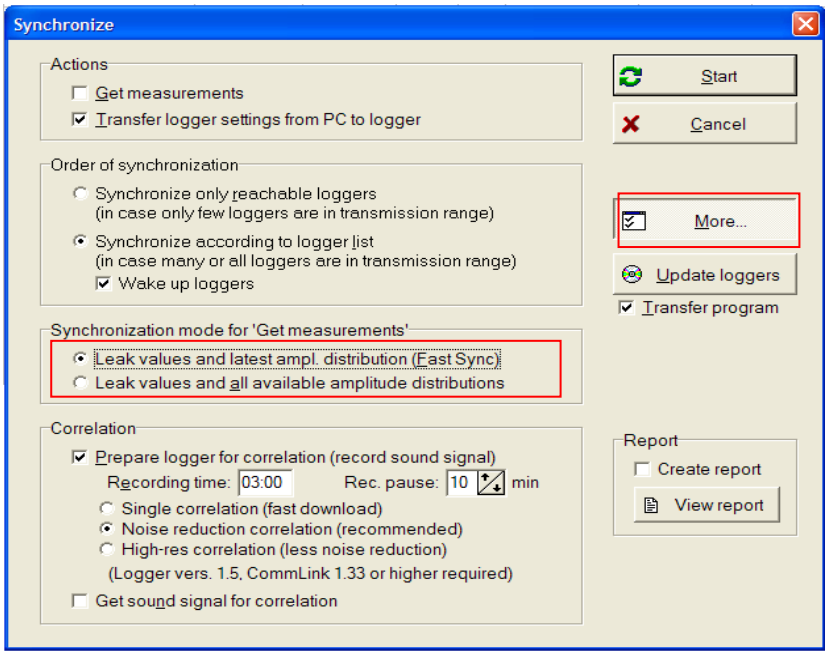


Fig.10 get measurements synchronization settings

4.1 Programming- Correlation

To take advantage of the correlation function of the Zonescan Loggers the option must be selected by ticking 'Prepare logger for correlation (record sound signal)'. Choose a Recording time which is between the measurement times of 1:00am to 4:00am, 3:00am is recommended. Leave Noise Reduction selected as this record 3 separate 8 second recordings. Choose a 5 to 10 minute Rec.pause this will help eliminate any ambiguities such as a resident flushing a toilet (false leak) during the recording time. Single correlation records 1 noise source and allows fast downloads. High-res correlation is an extension of 'Noise reduction correlation with 5 separate 8 second recordings, downloads will take longer. Sound signals record once for the first night and will require setting the next day for the following night.

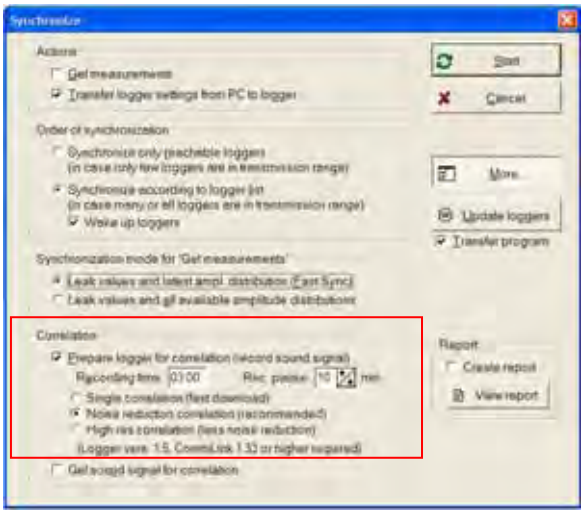


Fig.11 correlation synchronization settings

Once all the Synchronize settings are set then click start to load the settings into the loggers. The corresponding box in the 'Read' column of the database will turn green as each logger is successfully synchronized Fig.12. A green 'light' in the database window confirms connection to the Communications Link (the Commlink). Real-time progress of the synchronization process is also indicated in the bottom left corner

of the main database window, when all loggers are synchronized the progress window will be blank and the read column for all loggers will be green.

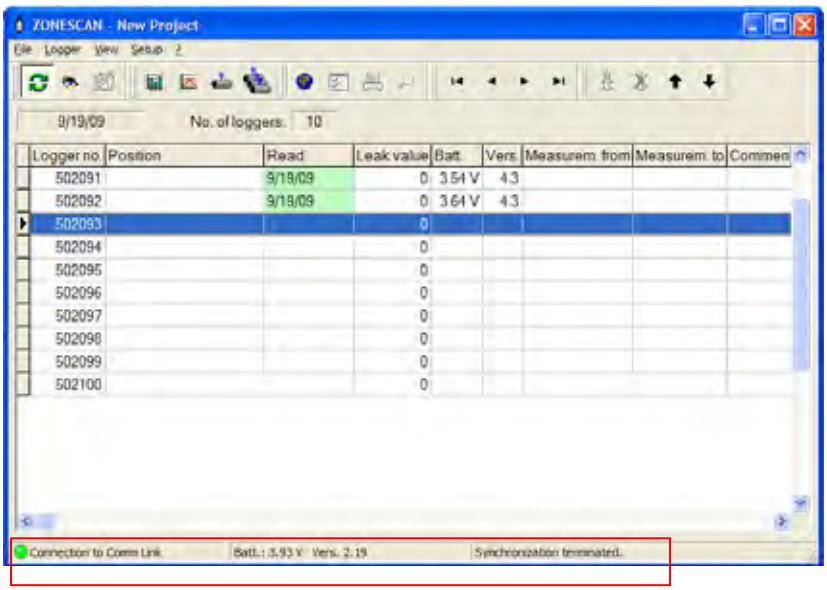


Fig.12 synchronization process

4.2 When a logger(s) fails to synchronize

If a logger fails to Synchronize then individually synchronize the logger by using the 'Logger State' (eye symbol) function. Click the Synchronize button within the 'Logger State' window.

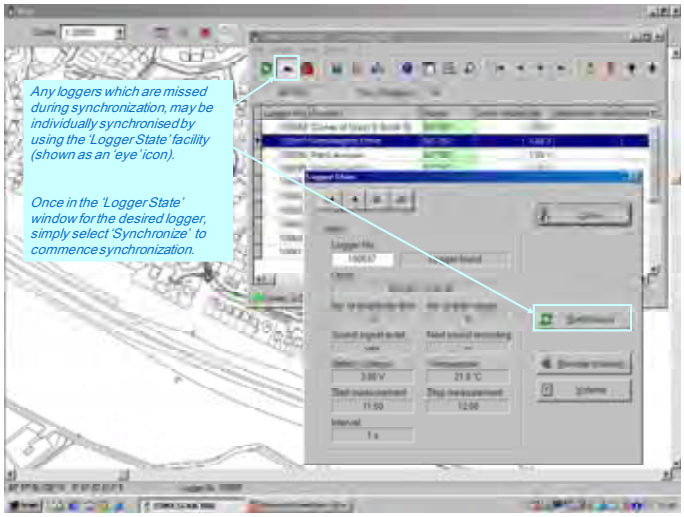


Fig.13 individual synchronization in logger state window

5 Deploying the Zonescan Loggers

Print out a paper copy of the deployment area map, as you move around the area mark the position of the Zonescan Logger's Serial number on a printed version of the Digital map. Use the Spacing Guide to help set the loggers out. It's important not to over space the loggers, use the table in Fig.15 as a guide.

Fig.14 hard copy of a digital deployment map

Pipe Material	Pressure	Diameter Less than	Maximum Logger Spacing
Ductile or Cast Iron	Higher than 25m	250mm	150m
Ductile or Cast Iron	Less than 25m	250mm	100m
A.C	Higher than 25m	250mm	120m
A.C	Less than 25m	250mm	100m
PVC	Higher than 25m	250mm	90m
PVC	Less than 25m	250mm	60m

Fig.15 Logger Spacing Guide

5.1 Deploying the Loggers in the field

Use the following photographs as a guide to quality logger deployment.

1. Open the chamber Lid

2. Clean the Hydrant or Valve with a wire brush

3. Make sure there is a good, clean, magnetic contact to the valve stem or hydrant. For optimum sound and radio transmission deploy the Zonescan vertically. To prevent the Antenna touching the metal lid and reducing transmission, fit a polystyrene block between the lid and Antenna.

4.

6 Importing a Digital Map into the Zonescan Software

Step 1. To setup and view a map from the PC hard drive, select; “Show Map” (the Globe icon) on the menu bar.

Step 2. A map window will open as shown in Fig.16. Next, click “Picture Manager” (the Map icon) in the Map window menu bar

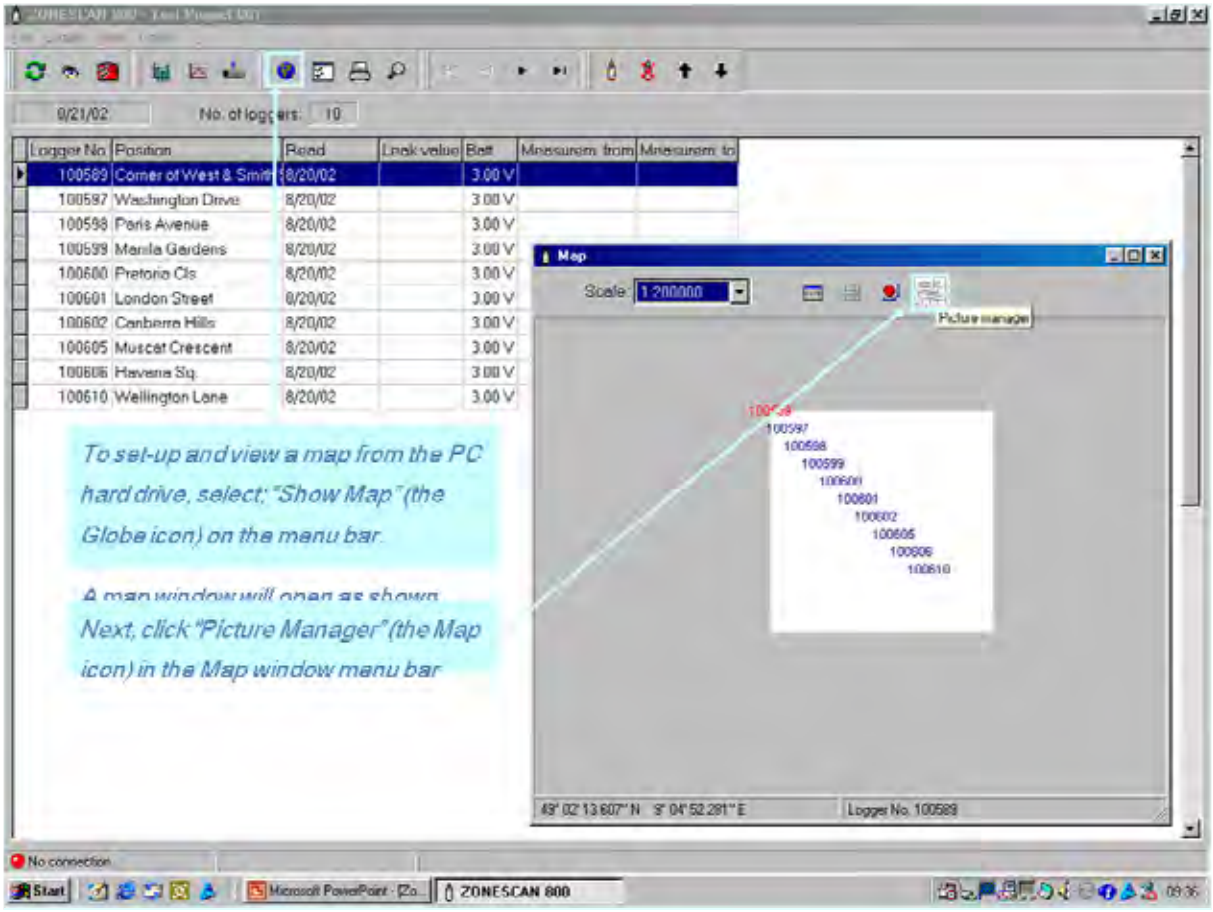


Fig.16 mapping window

Important: Save Digital Maps in a known folder in JPEG or BMP format, to convert a different file format by print screen the image and open in paint then save it as a JPEG or BMP.

Step 3. Click the first File box twice to open the “Select Picture File” window. Locate and ‘double click’ on desired picture file then close Picture Manager Window. See Fig.16.1

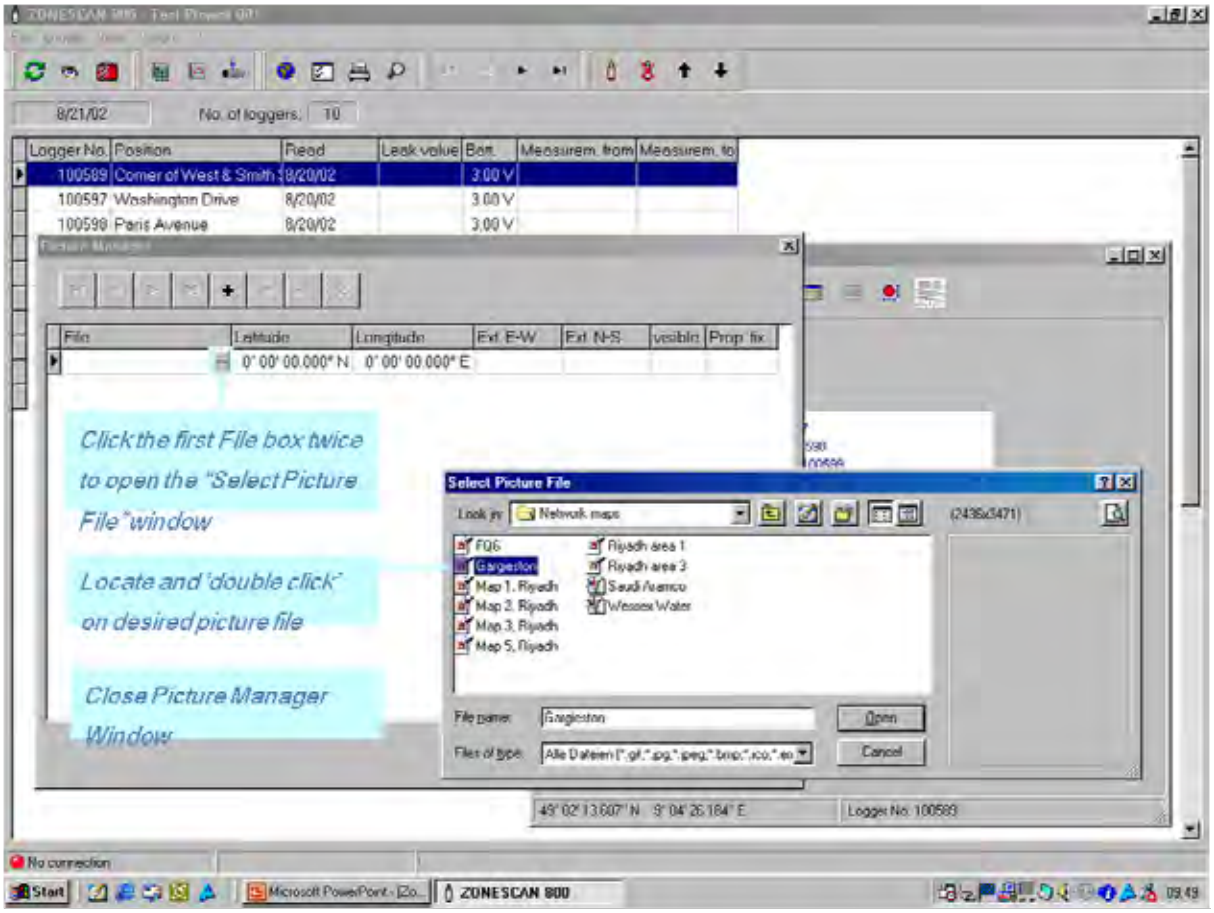


Fig16.1 Picture manager

Step 4. Zoom in by selecting the desired scale from the pull down menu or alternatively, zoom in or out one scale at a time by 'right clicking' the mouse and selecting "Zoom in" or "Zoom out"

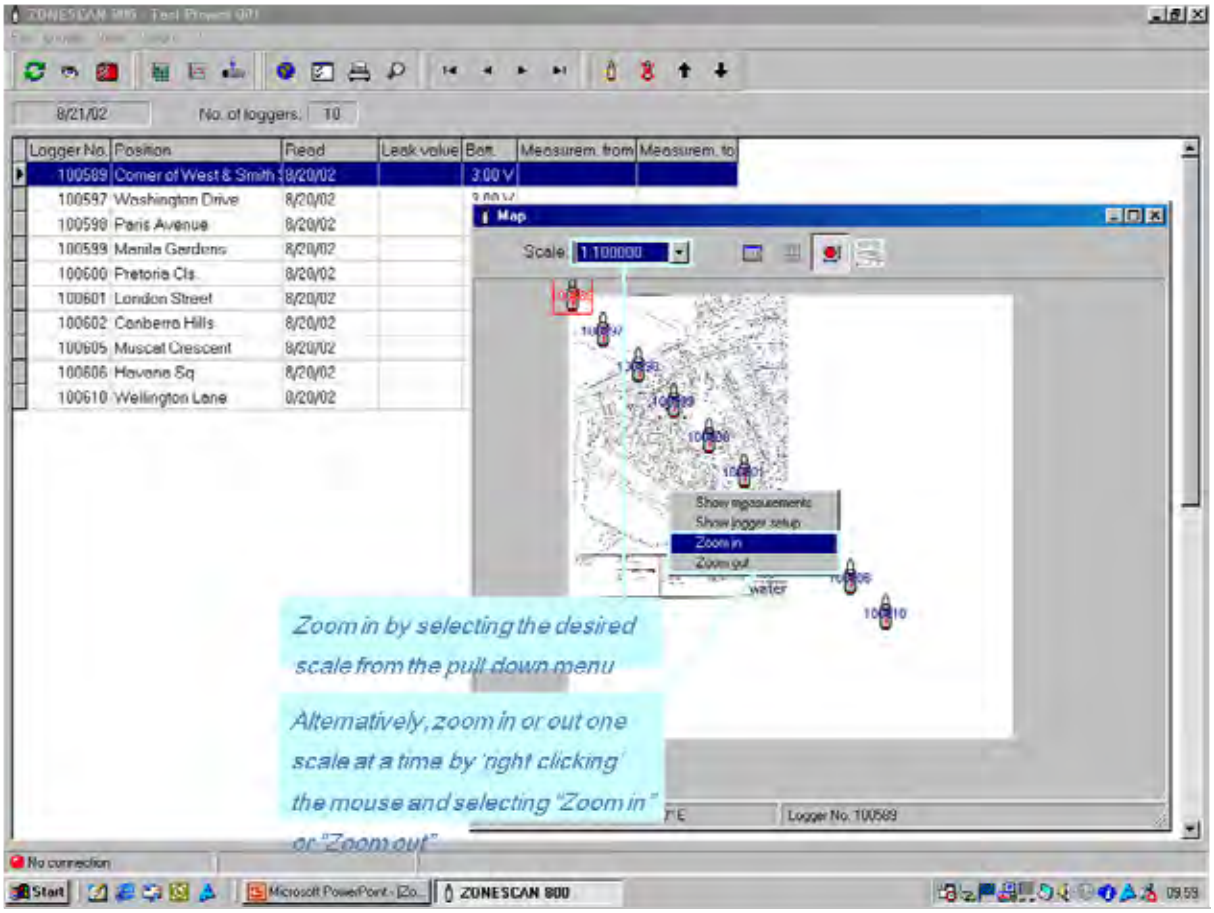


Fig16.2 Zoom in the map

Step 5.To move loggers to desired position on the map, select the “Move loggers” icon on the menu bar then, using the PC mouse, click and drag each logger to its desired position on the map

The logger being moved will also be highlighted on the logger database

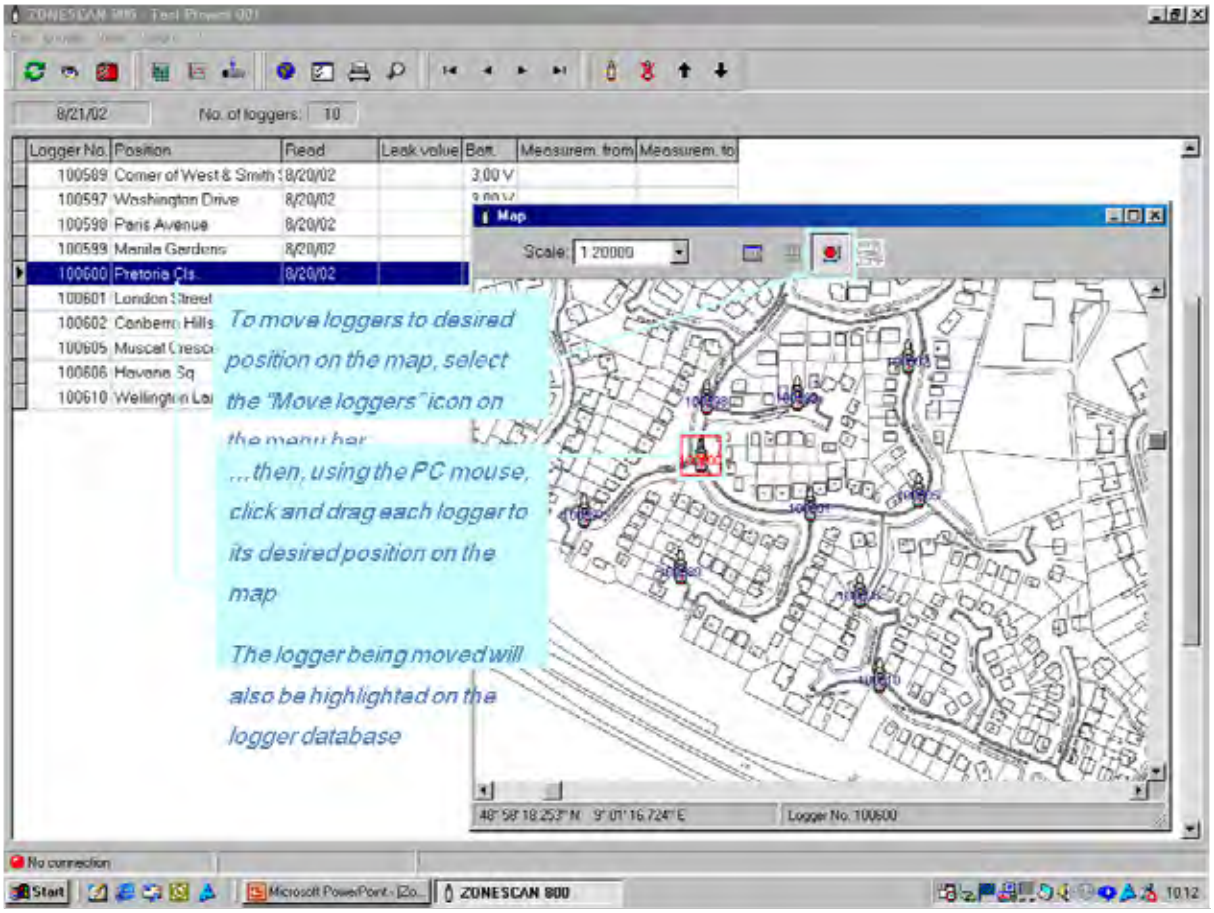


Fig.16.3 moving a logger

To view the main window (the project database) over the map at any time, click on the “Show Main Window” icon on the menu bar and reduce the main window to the desired size.

Arrange screen layout of Map and Database windows as desired using the standard Windows “Maximise” and “Restore Window” icons

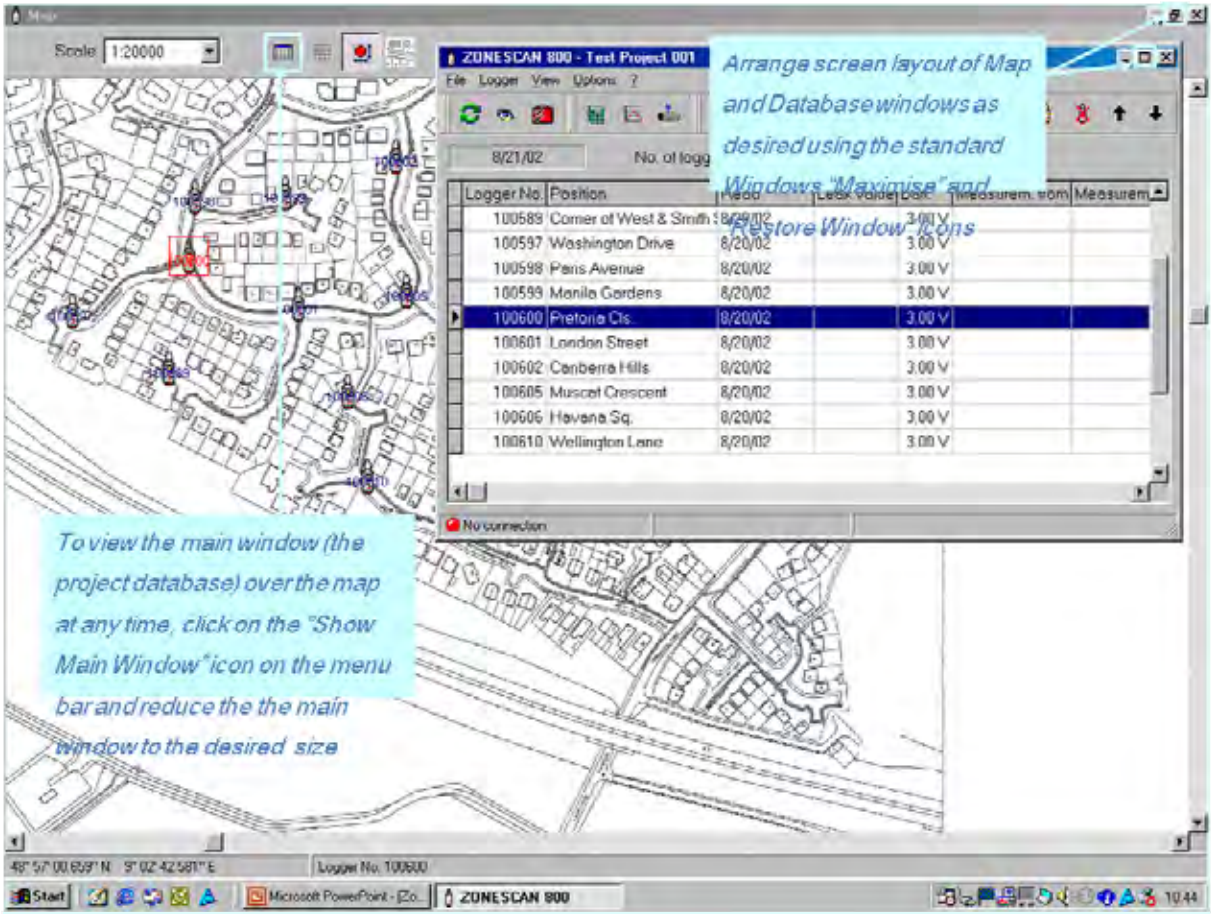


Fig.16.4 rearranging the windows

7 Downloading the data in the Loggers

Ensure the CommLink, antenna and PC connections are correctly made and switch the Commlink on. Click the Synchronize button and a smaller window appears. See Fig.17. To download the loggers, begin by selecting the box; 'Get measurements'.
If 'Transfer logger settings from PC to logger' is selected then this will prepare the loggers for the next logging session, be sure to select the Logger settings prior to Synchronization. This will clear the logger memory once the logger data has been downloaded.
If a correlation is required, also check the box 'Get noise signal for correlation' as shown (Please note: a correlation signal will only be available if the loggers were set to record a correlation during synchronization in the last 24 hrs)

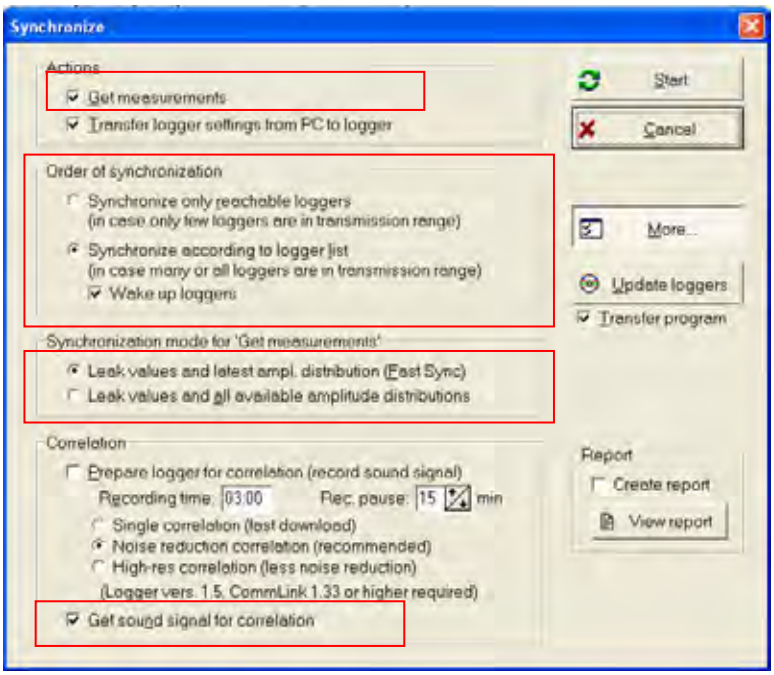


Fig.17download settings in the Synchronize window

Select box; "Synchronize only reachable loggers" if the loggers are still deployed in the field or 'Synchronize according to list' if the loggers are together in their carry case.

Synchronization mode for 'Get measurements' has 2 options 1. Leak values and latest amplitude distribution (Fast Sync) – this is used for downloading the results of the previous nights logging.
All available amplitude distributions which downloads all available nights recordings, this is usually required if the loggers have been deployed in the same location for several days without being downloaded.

Select 'Get sound signal for correlation' to download the recorded sound signal from the previous night logging. For accurate correlations download recorded sound signals with a 24 hour period.

Important: Prior to Synchronization set the Leak Threshold Levels for possible and probable Leak, for this information P.T.O.

7.1 Setting the Threshold Leak Levels

To set alarm threshold warning levels for leakage & low battery, select the “Set-Up” icon on the main database menu bar. Enter desired Possible and Probable Leak threshold value(s) see table Fig.19 for correct values to suit the pressure and pipe material.

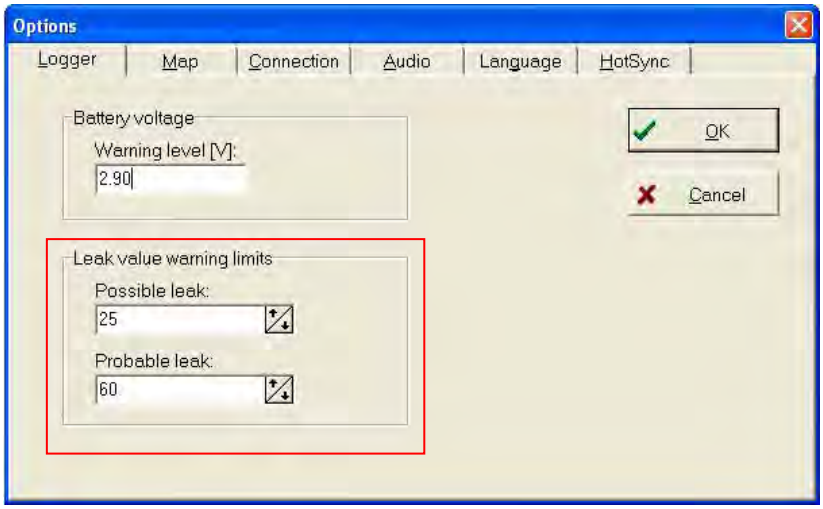


Fig.18 logger options

Pipe Material	Leak Settings	
	Possible	Probable
Ductile or Cast Iron(High Pressure Greater than25m)	50	80
Ductile or Cast Iron (Low pressure lower than 25m)	40	60
A.C (High Pressure Greater than 25m)	50	80
A.C (Low Pressure less than 25m)	40	60
PVC (High Pressure Greater than 25m)	25	50
PVC (Low Pressure less than 25m)	20	50

Fig.19 leak level thresholds

7.2 Start the Download

Now all the Threshold and Synchronization settings are entered click start. The following screen shots explain what happens during the download process.

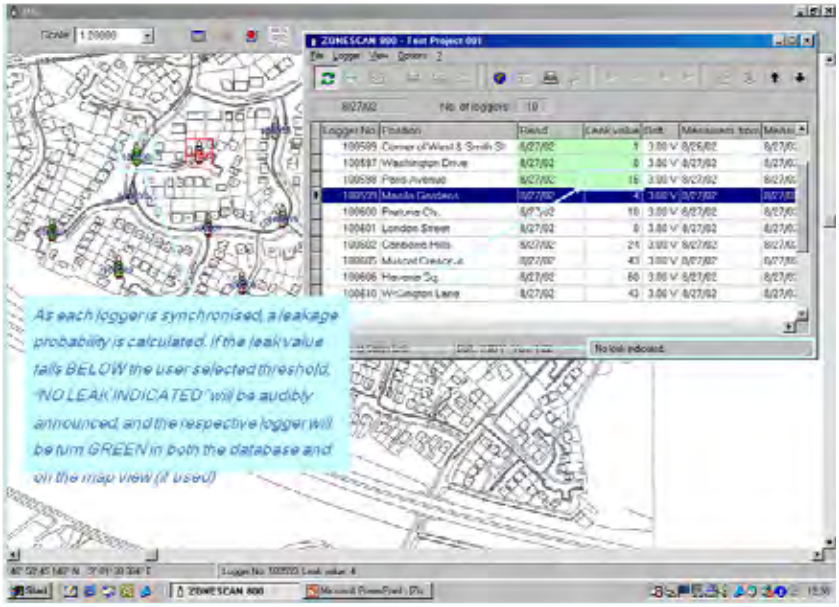


Fig.20 downloading started

As each logger is synchronised, a leakage probability is calculated. If the leak value falls BELOW the user selected threshold, "NO LEAK INDICATED" will be audibly announced, and the respective logger will be turn GREEN in both the database and on the map view (if used)
Until the synchronization for each logger is completed, the logger remains grey in colour, both in the database and in the map view

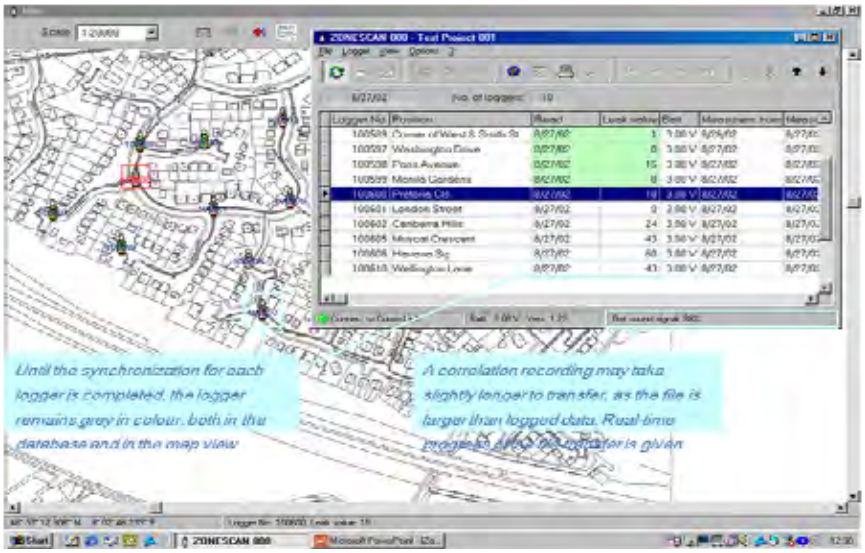


Fig.21 downloading continued

A correlation recording may take slightly longer to transfer, as the file is larger than logged data. Real-time progress of the file transfer is given.

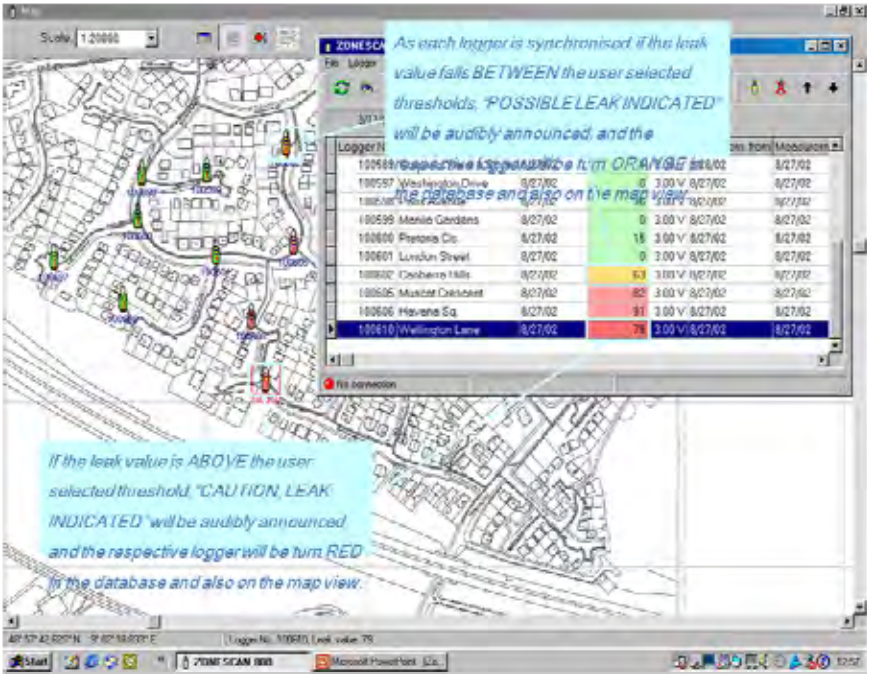


Fig.22 download complete

As each logger is synchronised, if the leak value falls BETWEEN the user selected thresholds, “POSSIBLE LEAK INDICATED” will be audibly announced, and the respective logger will be turn ORANGE in the database and also on the map view.

If the leak value is ABOVE the user selected threshold, “CAUTION, LEAK INDICATED” will be audibly announced, and the respective logger will be turn RED in the database and also on the map view

8 The Noise Logging Principal

An understanding on how the Zonescan Loggers build the Histogram will help when interpreting the results. The following section explains how the sampling process works. The tables depict when the logger takes a noise sample and what the sample is caused by, e.g a passing car or leak. Traffic & Consumption noise should be ignored. A large number of samples at the quietest level, indicate a consistant sound that could be a leak which never stops. The Leak is the closest to the loudest, quietest noise.

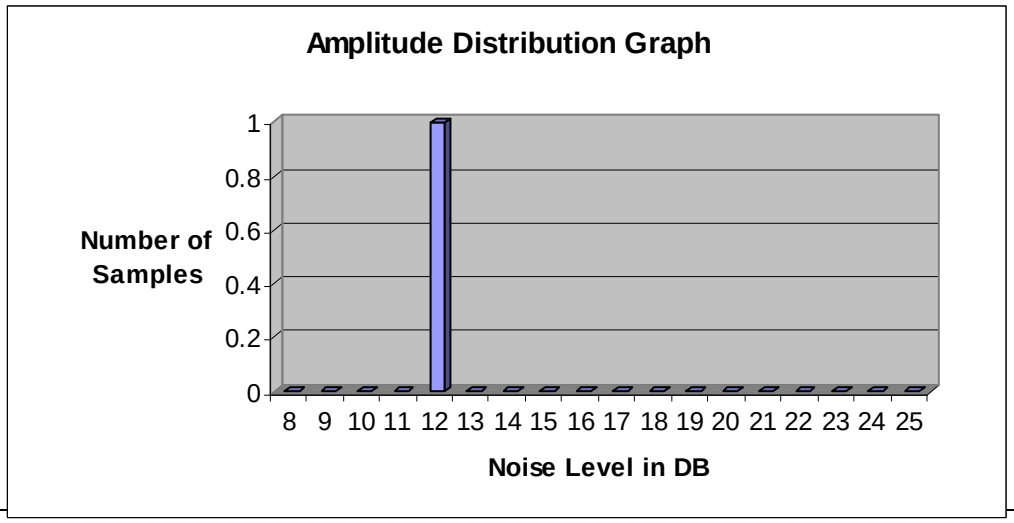
Sample Time	Noise Level (DB)	Description of Noise
2:00:03	12	Leak Noise
2:00:06	12	Leak Noise
2:00:09	12	Leak Noise
2:00:12	21	Car Coming
2:00:15	18	Car Going
2:00:18	12	Leak Noise
2:00:21	13	Leak Noise
2:00:24	12	Leak Noise
2:00:27	13	Leak Noise
2:00:30	12	Leak Noise
2:00:33	12	Leak Noise
2:00:36	12	Leak Noise
2:00:39	12	Leak Noise
2:00:42	40	Truck Coming
2:00:45	35	Truck Going
2:00:48	25	Leak Noise
2:00:51	13	Leak Noise
2:00:54	13	Leak Noise
2:00:57	25	Toilet Flush
2:01:00	25	Toilet Flush
2:01:03	24	Toilet Flush
2:01:06	25	Toilet Flush

Tab.1

Sample Time	Noise Level (DB)	Description of Noise
2:00:03	12	Leak Noise
2:00:06	12	Leak Noise
2:00:09	12	Leak Noise
2:00:12	21	Car Coming
2:00:15	18	Car Going
2:00:18	12	Leak Noise
2:00:21	13	Leak Noise
2:00:24	12	Leak Noise
2:00:27	13	Leak Noise
2:00:30	12	Leak Noise
2:00:33	12	Leak Noise
2:00:36	12	Leak Noise
2:00:39	12	Leak Noise
2:00:42	40	Truck Coming
2:00:45	35	Truck Going
2:00:48	25	Leak Noise
2:00:51	13	Leak Noise
2:00:54	13	Leak Noise
2:00:57	25	Toilet Flush
2:01:00	25	Toilet Flush
2:01:03	24	Toilet Flush
2:01:06	25	Toilet Flush

Tab.2 The first sample taken of 12dB is plotted on the histogram below in Fig. A

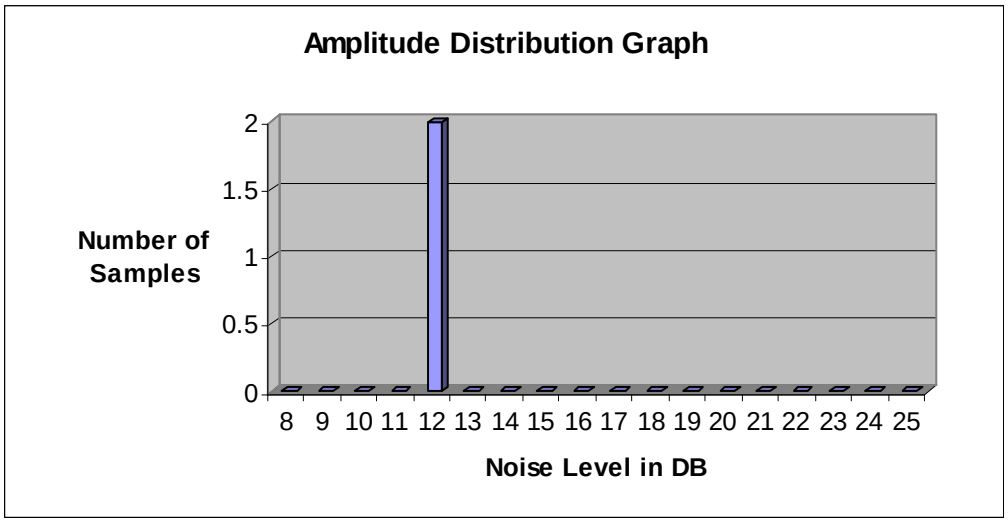
Fig. A



Sample Time	Noise Level (DB)	Description of Noise
2:00:03	12	Leak Noise
2:00:06	12	Leak Noise
2:00:09	12	Leak Noise
2:00:12	21	Car Coming
2:00:15	18	Car Going
2:00:18	12	Leak Noise
2:00:21	13	Leak Noise
2:00:24	12	Leak Noise
2:00:27	13	Leak Noise
2:00:30	12	Leak Noise
2:00:33	12	Leak Noise
2:00:36	12	Leak Noise
2:00:39	12	Leak Noise
2:00:42	40	Truck Coming
2:00:45	35	Truck Going
2:00:48	25	Leak Noise
2:00:51	13	Leak Noise
2:00:54	13	Leak Noise
2:00:57	25	Toilet Flush
2:01:00	25	Toilet Flush
2:01:03	24	Toilet Flush
2:01:06	25	Toilet Flush

Tab.3 the second sample taken of 12dB is plotted on the histogram below in Fig. B

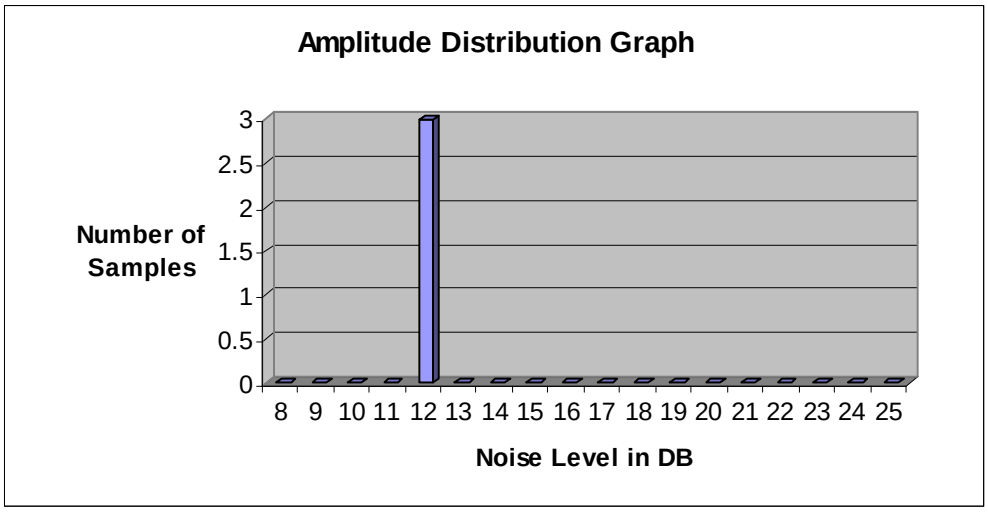
Fig.B



Sample Time	Noise Level (DB)	Description of Noise
2:00:03	12	Leak Noise
2:00:06	12	Leak Noise
2:00:09	12	Leak Noise
2:00:12	21	Car Coming
2:00:15	18	Car Going
2:00:18	12	Leak Noise
2:00:21	13	Leak Noise
2:00:24	12	Leak Noise
2:00:27	13	Leak Noise
2:00:30	12	Leak Noise
2:00:33	12	Leak Noise
2:00:36	12	Leak Noise
2:00:39	12	Leak Noise
2:00:42	40	Truck Coming
2:00:45	35	Truck Going
2:00:48	25	Leak Noise
2:00:51	13	Leak Noise
2:00:54	13	Leak Noise
2:00:57	25	Toilet Flush
2:01:00	25	Toilet Flush
2:01:03	24	Toilet Flush
2:01:06	25	Toilet Flush

Tab.4 the third sample taken of 12dB is plotted on the histogram below in Fig. C

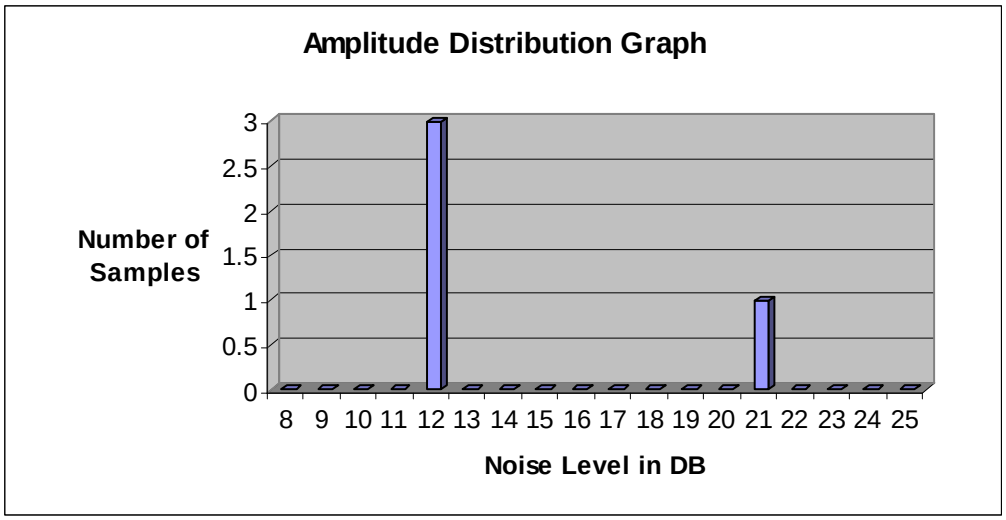
Fig.C



Sample Time	Noise Level (DB)	Description of Noise
2:00:03	12	Leak Noise
2:00:06	12	Leak Noise
2:00:09	12	Leak Noise
2:00:12	21	Car Coming
2:00:15	18	Car Going
2:00:18	12	Leak Noise
2:00:21	13	Leak Noise
2:00:24	12	Leak Noise
2:00:27	13	Leak Noise
2:00:30	12	Leak Noise
2:00:33	12	Leak Noise
2:00:36	12	Leak Noise
2:00:39	12	Leak Noise
2:00:42	40	Truck Coming
2:00:45	35	Truck Going
2:00:48	25	Leak Noise
2:00:51	13	Leak Noise
2:00:54	13	Leak Noise
2:00:57	25	Toilet Flush
2:01:00	25	Toilet Flush
2:01:03	24	Toilet Flush
2:01:06	25	Toilet Flush

Tab.5 the fourth sample taken of 21dB is plotted on the histogram below in Fig. D

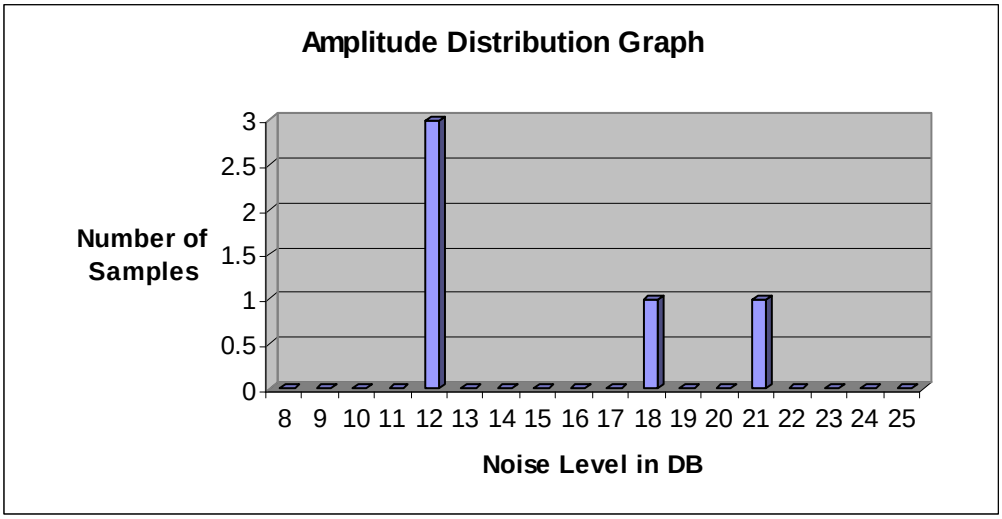
Fig.D



Sample Time	Noise Level (DB)	Description of Noise
2:00:03	12	Leak Noise
2:00:06	12	Leak Noise
2:00:09	12	Leak Noise
2:00:12	21	Car Coming
2:00:15	18	Car Going
2:00:18	12	Leak Noise
2:00:21	13	Leak Noise
2:00:24	12	Leak Noise
2:00:27	13	Leak Noise
2:00:30	12	Leak Noise
2:00:33	12	Leak Noise
2:00:36	12	Leak Noise
2:00:39	12	Leak Noise
2:00:42	40	Truck Coming
2:00:45	35	Truck Going
2:00:48	25	Leak Noise
2:00:51	13	Leak Noise
2:00:54	13	Leak Noise
2:00:57	25	Toilet Flush
2:01:00	25	Toilet Flush
2:01:03	24	Toilet Flush
2:01:06	25	Toilet Flush

Tab.6 the fifth sample taken of 18dB is plotted on the histogram below in Fig. E

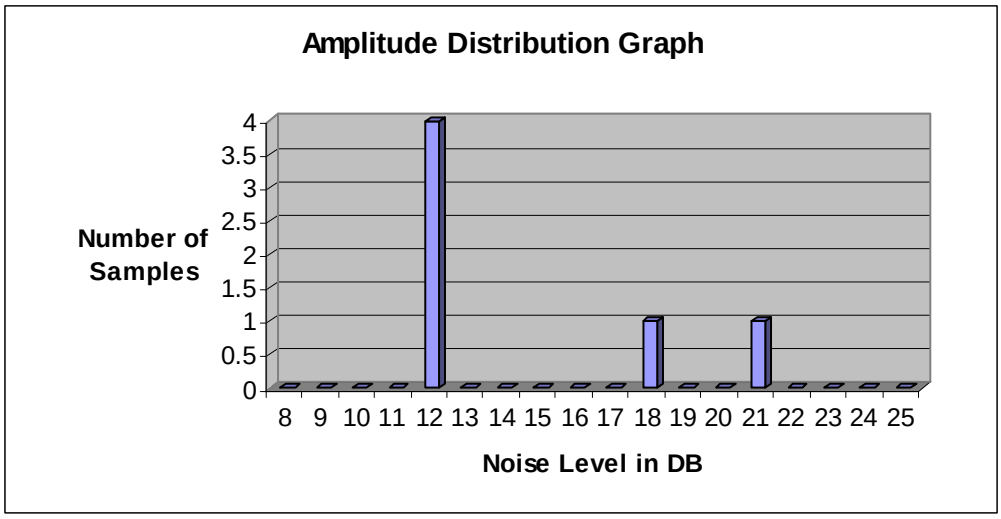
Fig.E



Sample Time	Noise Level (DB)	Description of Noise
2:00:03	12	Leak Noise
2:00:06	12	Leak Noise
2:00:09	12	Leak Noise
2:00:12	21	Car Coming
2:00:15	18	Car Going
2:00:18	12	Leak Noise
2:00:21	13	Leak Noise
2:00:24	12	Leak Noise
2:00:27	13	Leak Noise
2:00:30	12	Leak Noise
2:00:33	12	Leak Noise
2:00:36	12	Leak Noise
2:00:39	12	Leak Noise
2:00:42	40	Truck Coming
2:00:45	35	Truck Going
2:00:48	25	Leak Noise
2:00:51	13	Leak Noise
2:00:54	13	Leak Noise
2:00:57	25	Toilet Flush
2:01:00	25	Toilet Flush
2:01:03	24	Toilet Flush
2:01:06	25	Toilet Flush

Tab.7 the sixth sample taken of 12dB is plotted on the histogram below in Fig. F

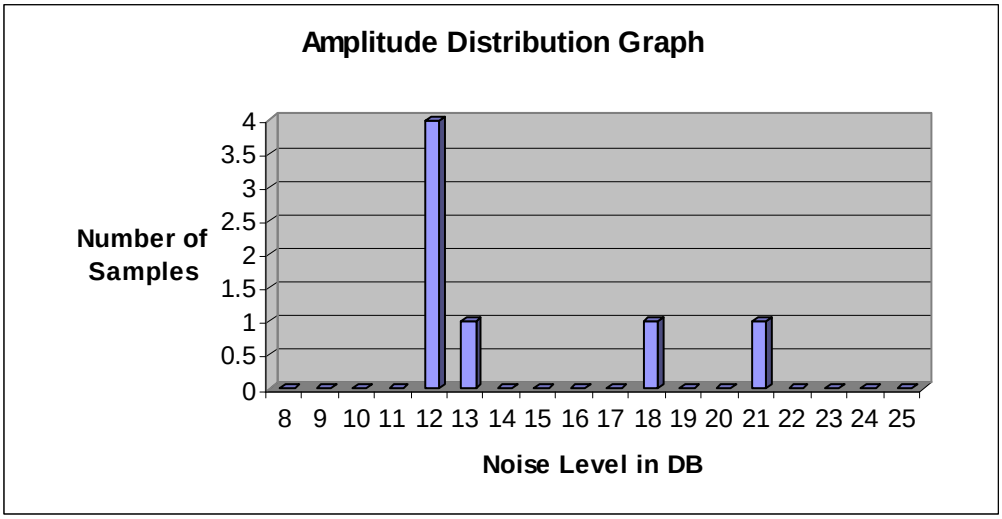
Fig.F



Sample Time	Noise Level (DB)	Description of Noise
2:00:03	12	Leak Noise
2:00:06	12	Leak Noise
2:00:09	12	Leak Noise
2:00:12	21	Car Coming
2:00:15	18	Car Going
2:00:18	12	Leak Noise
2:00:21	13	Leak Noise
2:00:24	12	Leak Noise
2:00:27	13	Leak Noise
2:00:30	12	Leak Noise
2:00:33	12	Leak Noise
2:00:36	12	Leak Noise
2:00:39	12	Leak Noise
2:00:42	40	Truck Coming
2:00:45	35	Truck Going
2:00:48	25	Leak Noise
2:00:51	13	Leak Noise
2:00:54	13	Leak Noise
2:00:57	25	Toilet Flush
2:01:00	25	Toilet Flush
2:01:03	24	Toilet Flush
2:01:06	25	Toilet Flush

Tab.8 the seventh sample taken of 13dB is plotted on the histogram below in Fig. G

Fig.G

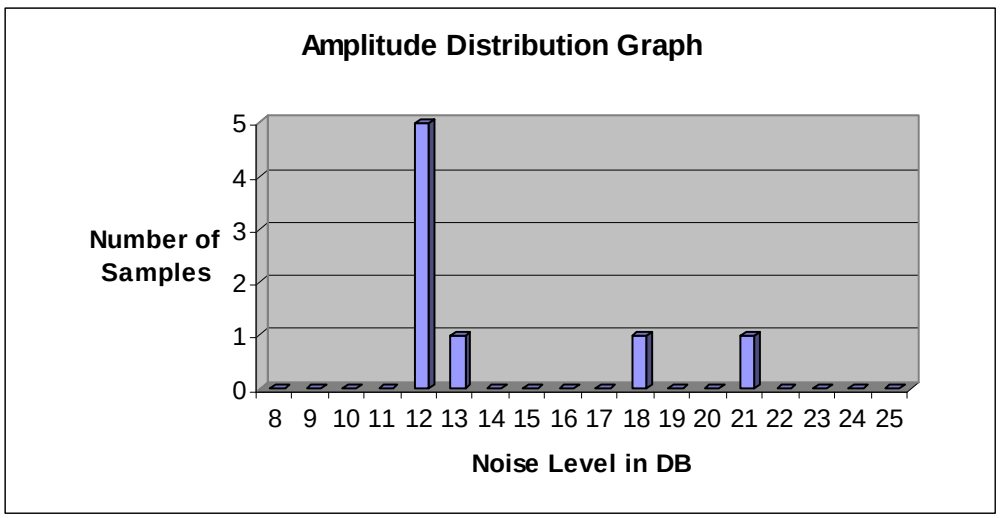


Sample Time	Noise Level (DB)	Description of Noise
2:00:03	12	Leak Noise
2:00:06	12	Leak Noise
2:00:09	12	Leak Noise
2:00:12	21	Car Coming
2:00:15	18	Car Going
2:00:18	12	Leak Noise
2:00:21	13	Leak Noise
2:00:24	12	Leak Noise
2:00:27	13	Leak Noise
2:00:30	12	Leak Noise
2:00:33	12	Leak Noise
2:00:36	12	Leak Noise
2:00:39	12	Leak Noise
2:00:42	40	Truck Coming
2:00:45	35	Truck Going
2:00:48	25	Leak Noise
2:00:51	13	Leak Noise
2:00:54	13	Leak Noise
2:00:57	25	Toilet Flush
2:01:00	25	Toilet Flush
2:01:03	24	Toilet Flush
2:01:06	25	Toilet Flush

Tab.9 the eighth sample taken of 12dB is plotted on the histogram below in Fig. H

This process continues until the logging is complete and the Histogram is built.

Fig.H



9 Analysing Results

To view the amplitude distribution graph of the logged results:

- Step #1 : select the desired logger in the database window
- Step #2: select 'Show measurements' on the menu bar (shown as a bar graph icon) or alternatively double click the desired logger to show the measurement histogram.
- Highlight the desired date to view historical recorded data for the selected logger

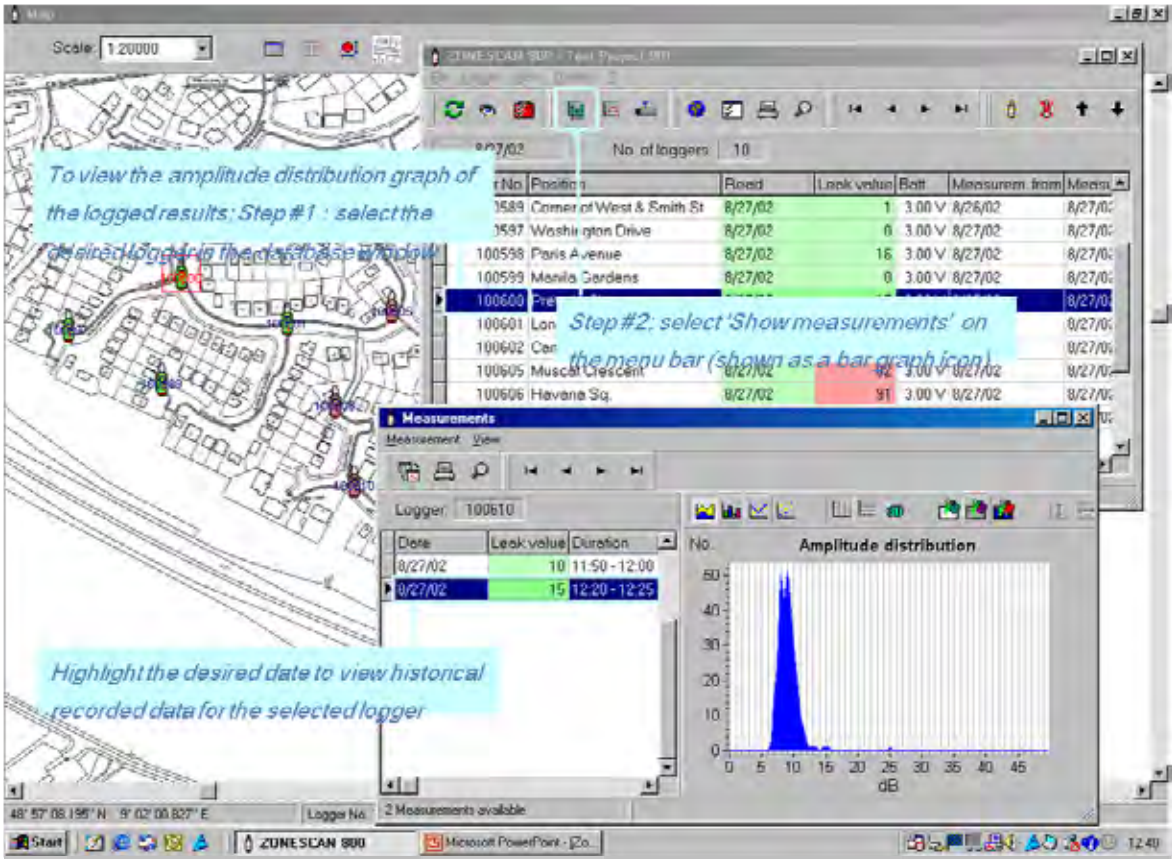


Fig.23show measurements

9.1 No Leak Result

The following screen shots show a No Leak situation.

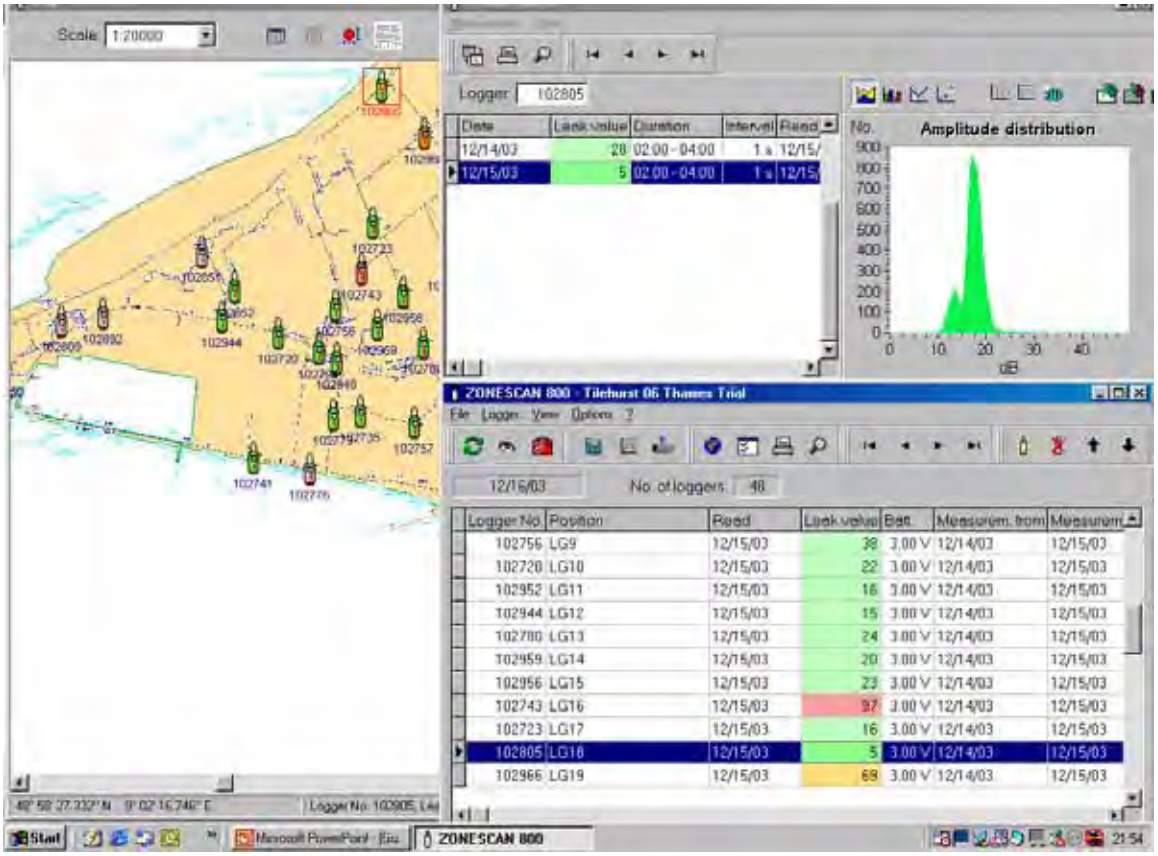


Fig.24 no leak measurement with logger list and map

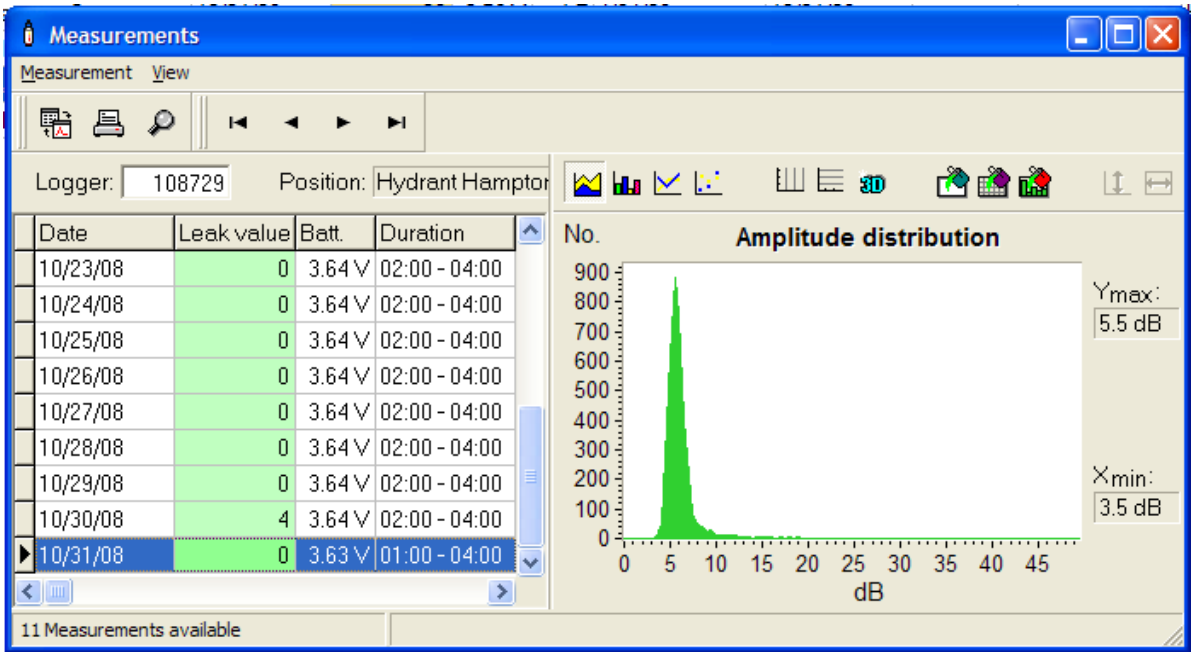


Fig.25 no leak measurement

9.2 Possible Leak Result

The following screen shot show a Possible Leak situation:

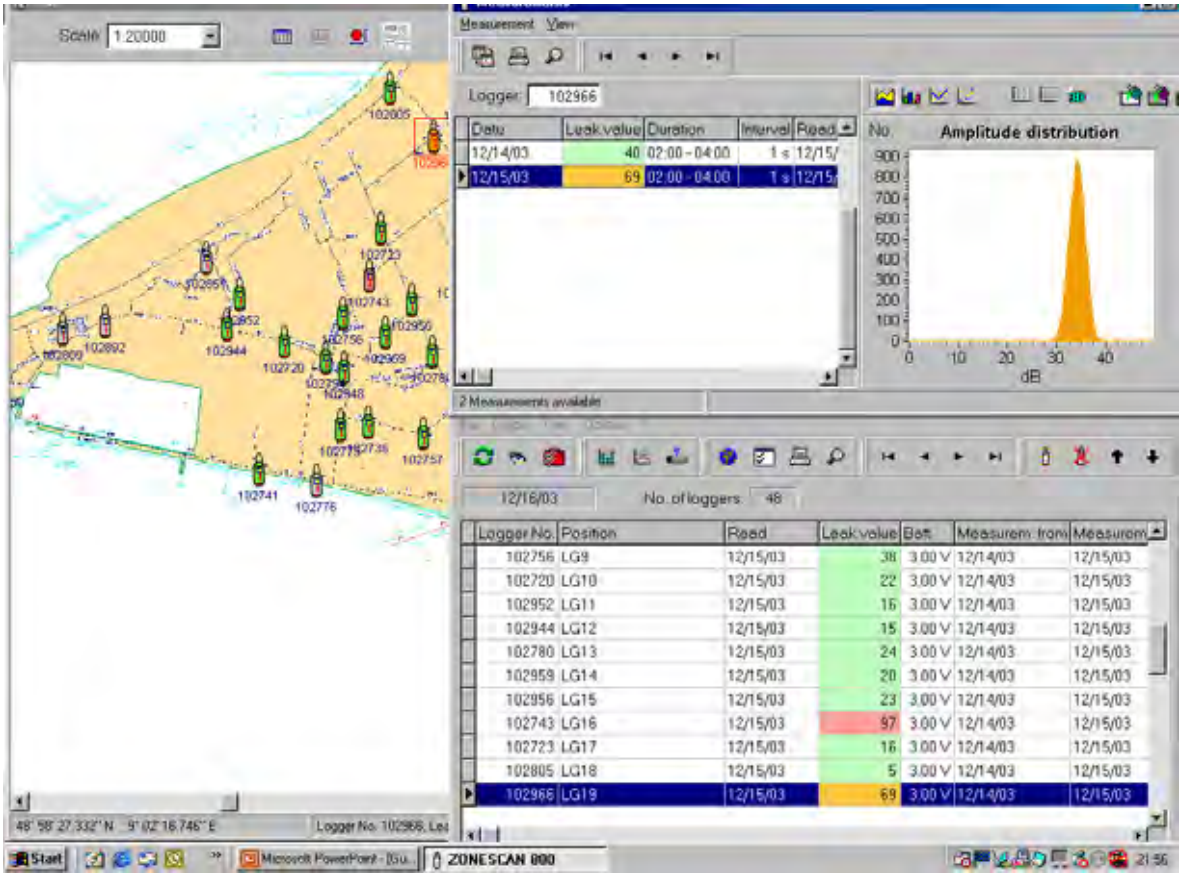


Fig.26 possible leak

9.3 Probable Leak Result

The following screen shots show a Probable Leak:

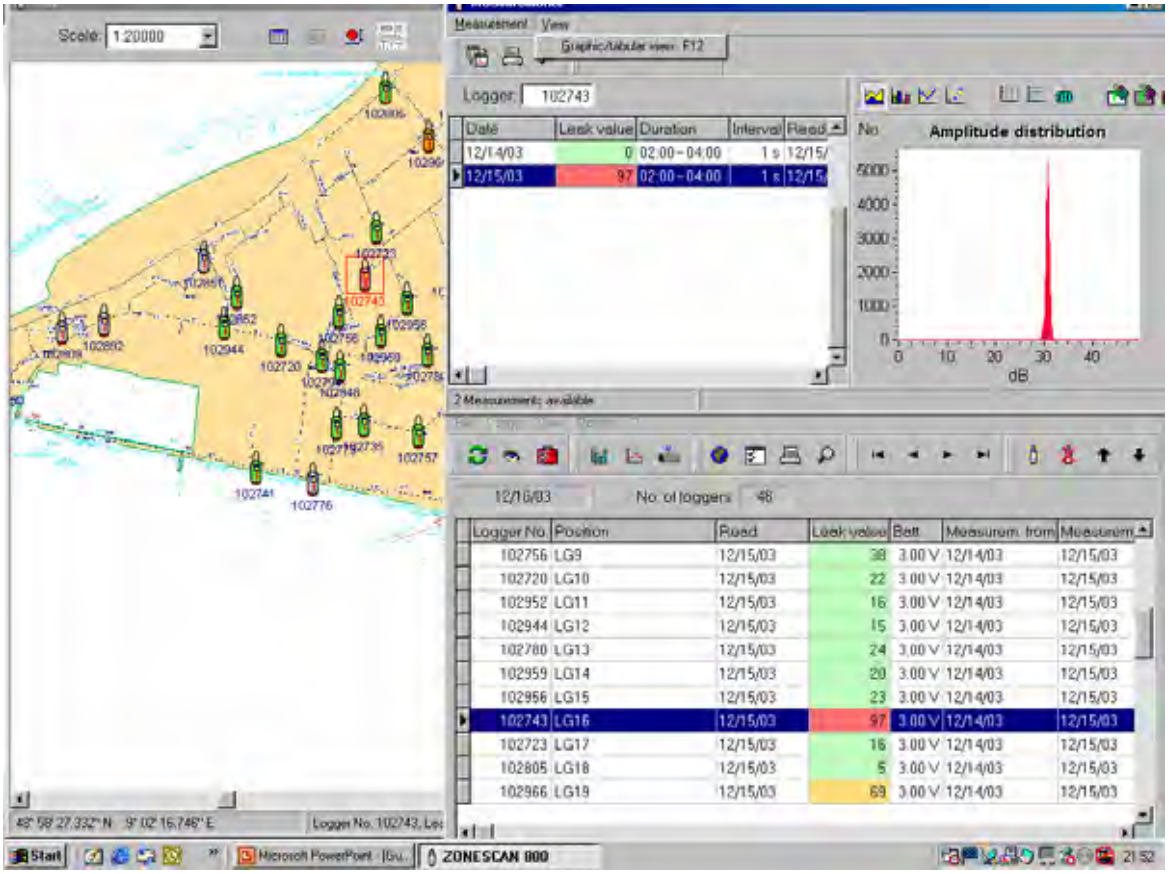


Fig.27 clear probable leak

9.4 Interpreting noise logging results

Steps 1 – Analyse all logger s Histograms to establish the “no-leak” noise level in the area.

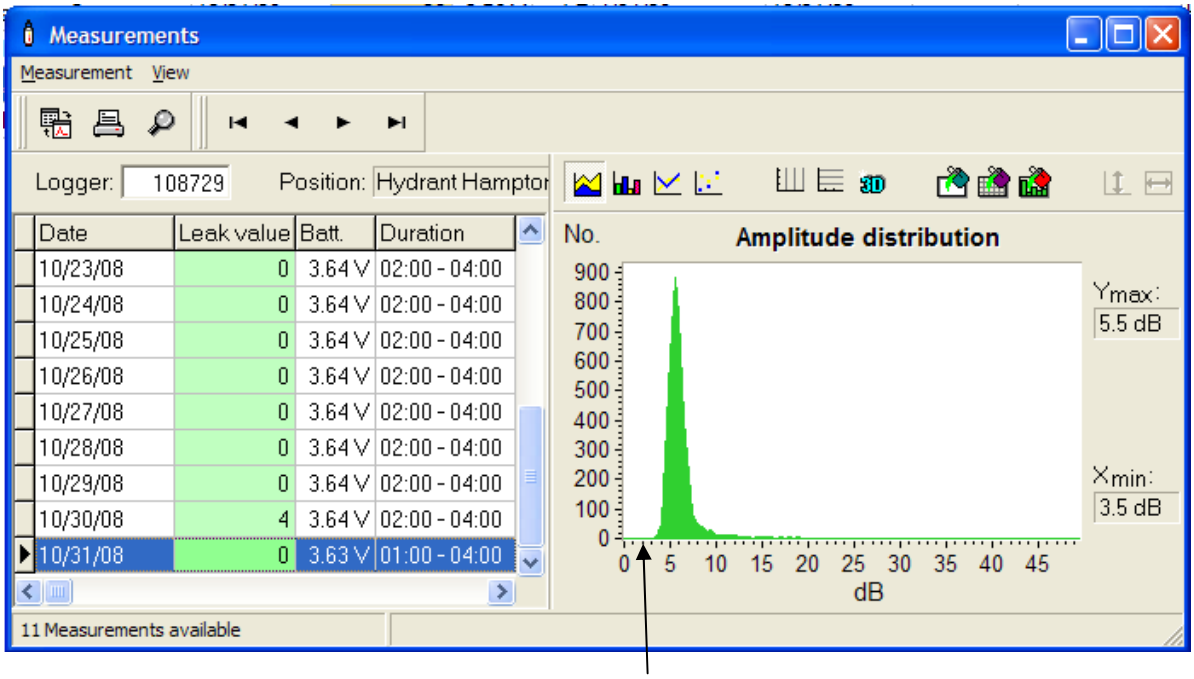


Fig.28 3.5 dB minimum noise histogram

3.5dB Minimum Noise Level

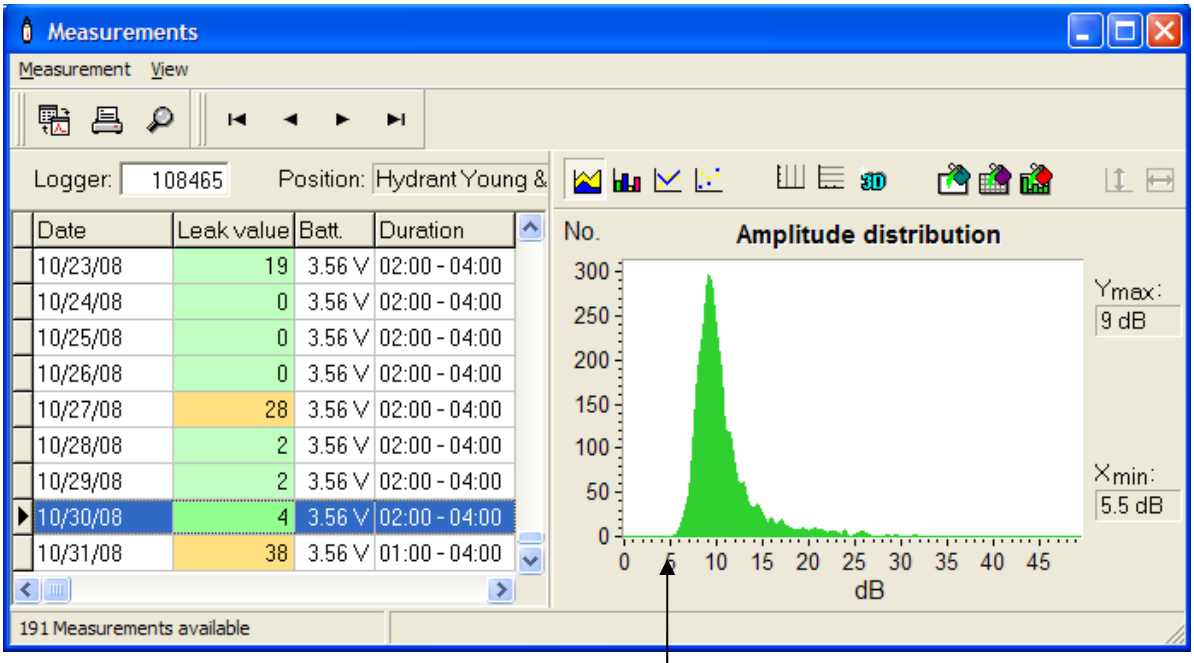


Fig.29 5db minimum noise histogram

5dB Minimum Noise Level

Step 2 – identify areas 2 to 3 db higher than the “no-leak” level

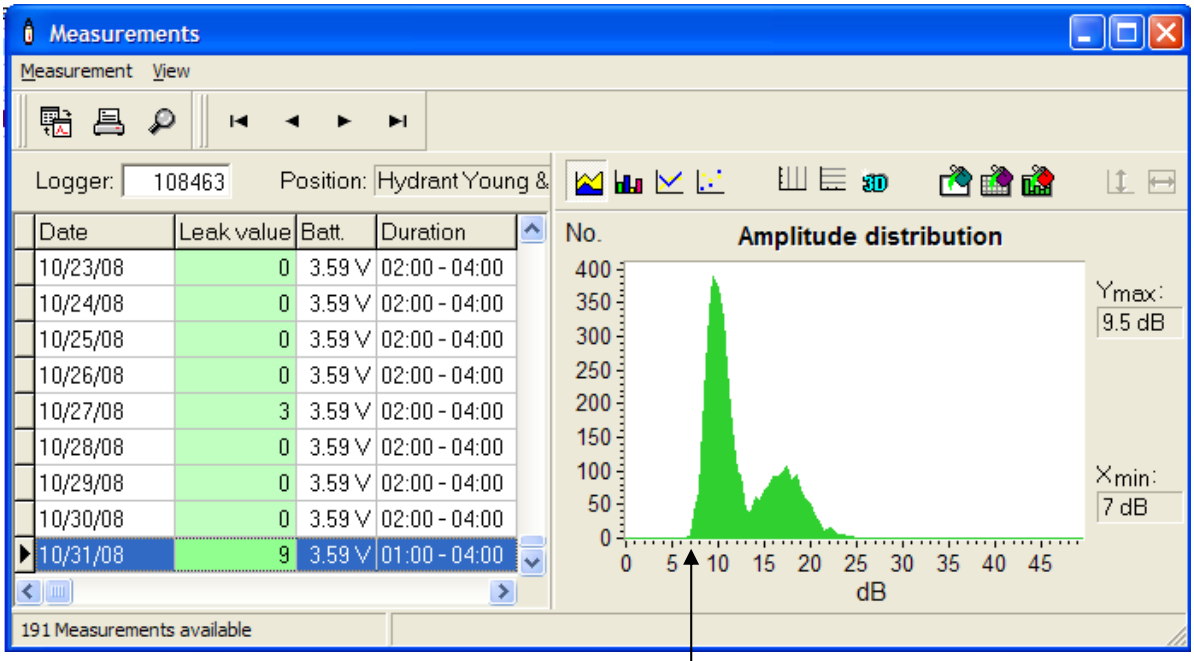


Fig.30 7dB minimum noise level

Step 3 – Determine the Areas of Interest

Analyse the minimum noise level for each logged point. Higher minimum noise levels are closer to the leak.

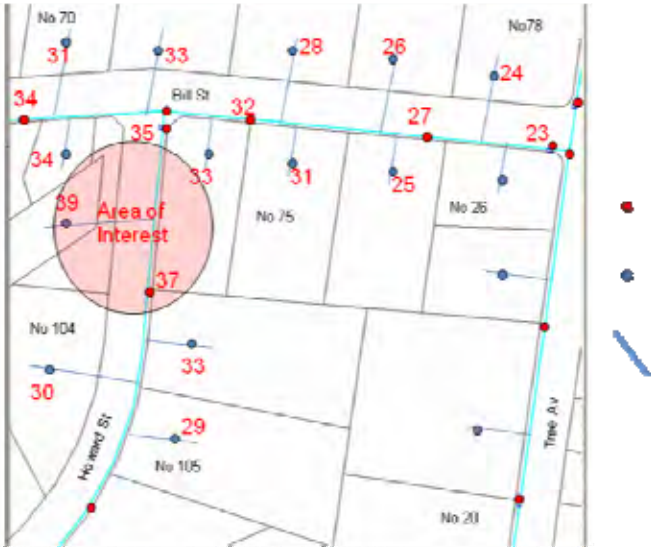


Fig. 30 area of interest

9.5 Which logger is closer to the leak?

It's only natural to use the Leak Value as an indication which logger is closest to the Leak however closer analysis of the Minimum Noise Levels is required, see the following examples.

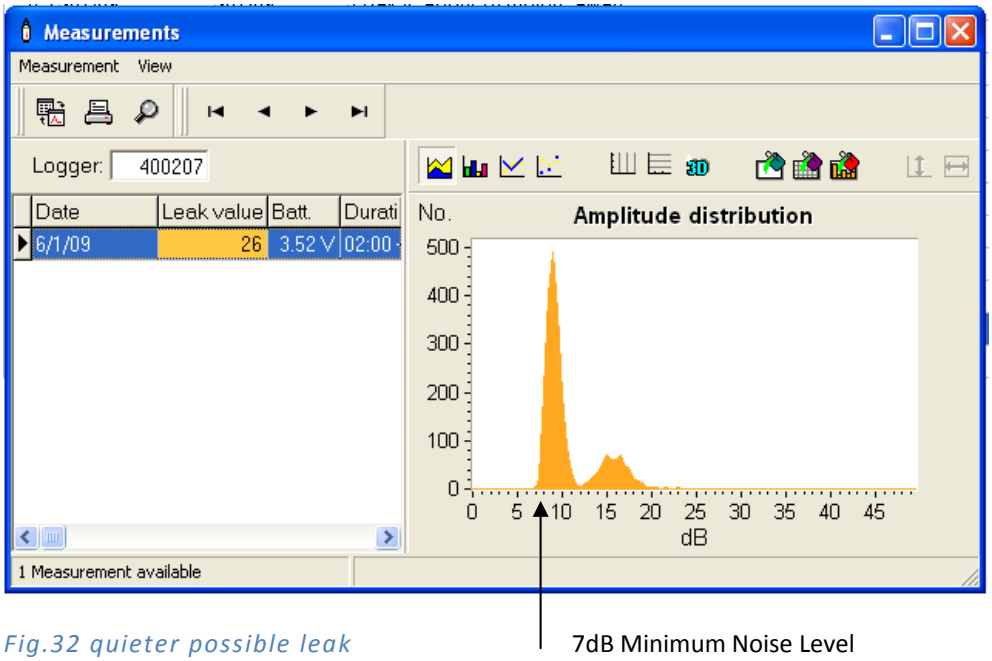


Fig.32 quieter possible leak

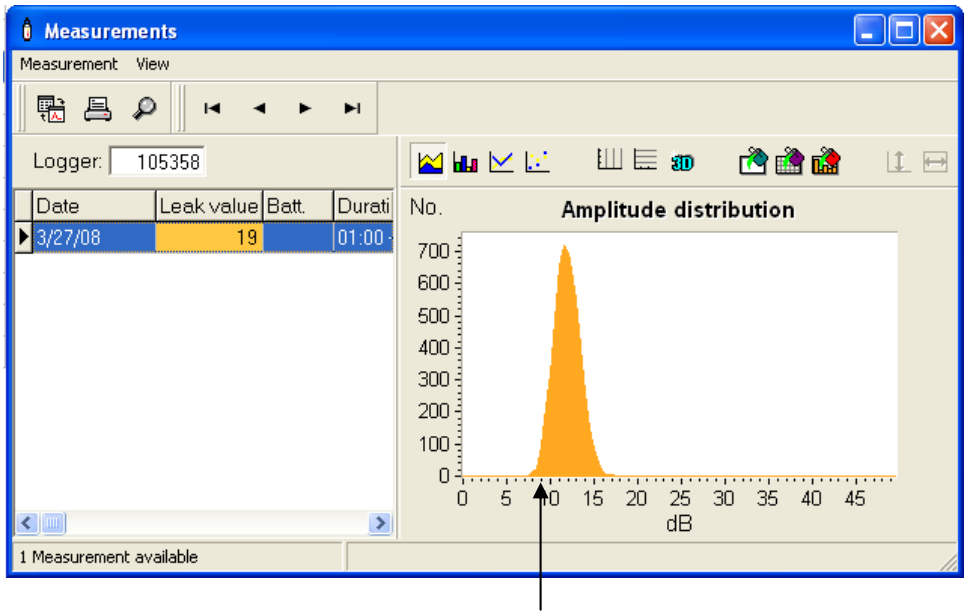


Fig.33 possible leak

Although Fig.32 has a higher Leak value than Fig.33 the later is closer to the leak with a higher minimum noise level.

9.6 What is the Leak Value?

A calculated percentage of there being a leak based on the noise level and number of samples (consistency).

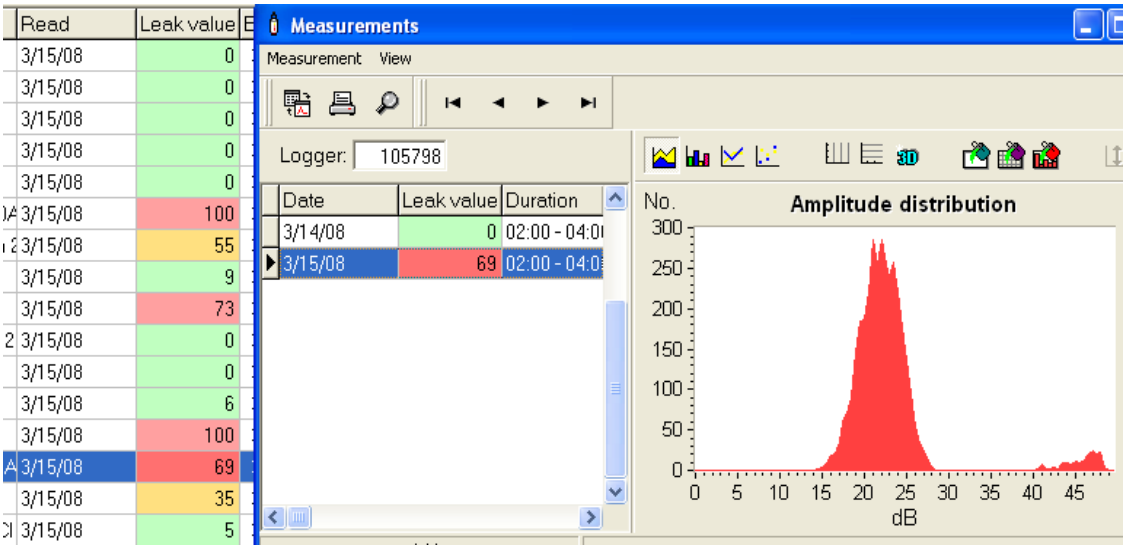


Fig.33 what is the leak value

High levels and narrow peaks create high leak values. Any leak value above 0 could be a leak especially in a quiet pipe network environment such as low pressure PVC.

9.7 Reliability of Results

The noise logged results indicate any constant noise for the logging period. Reliability is increased if logging is performed for 2 – 3 nights to see if you get the same result every night.

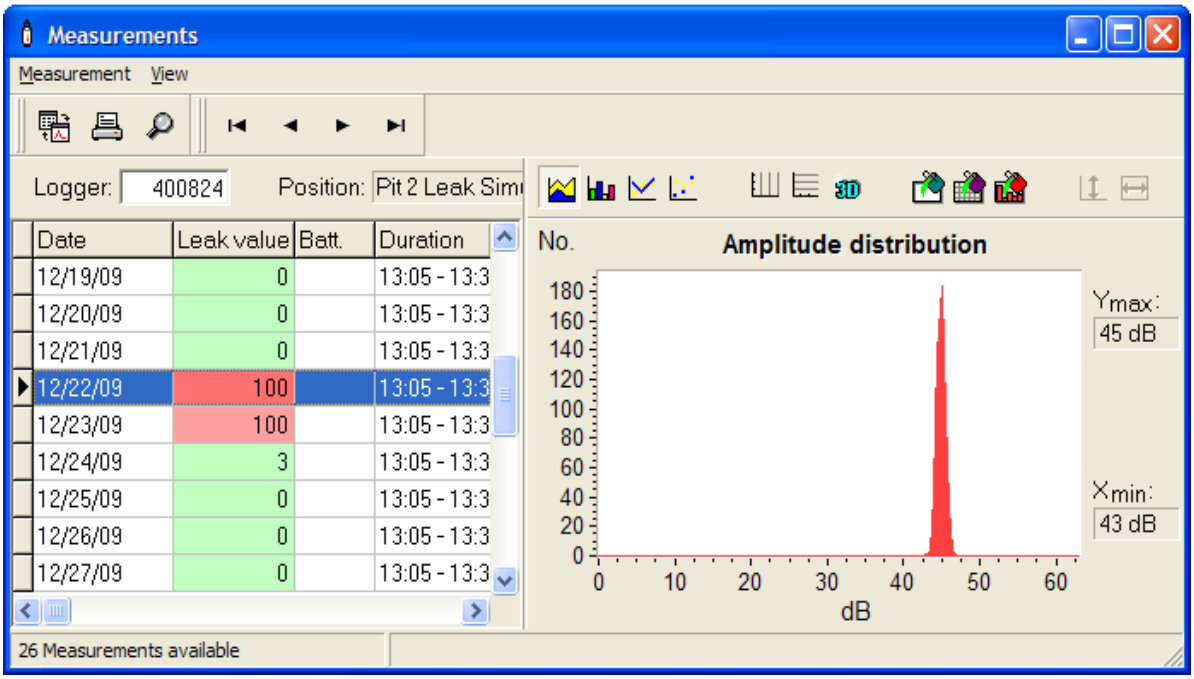


Fig.34 leaving the loggers out for at least 3 nights

10 Performing Correlations

Correlation is the process of pinpointing the position of a leak between two loggers. In order to run correlations 'Sound Recordings' must be selected in the Synchronization menu and then downloaded once the logging is complete.

10.1 Correlation between two loggers 

Click the single pipe symbol with a leak to reveal the Correlation window.

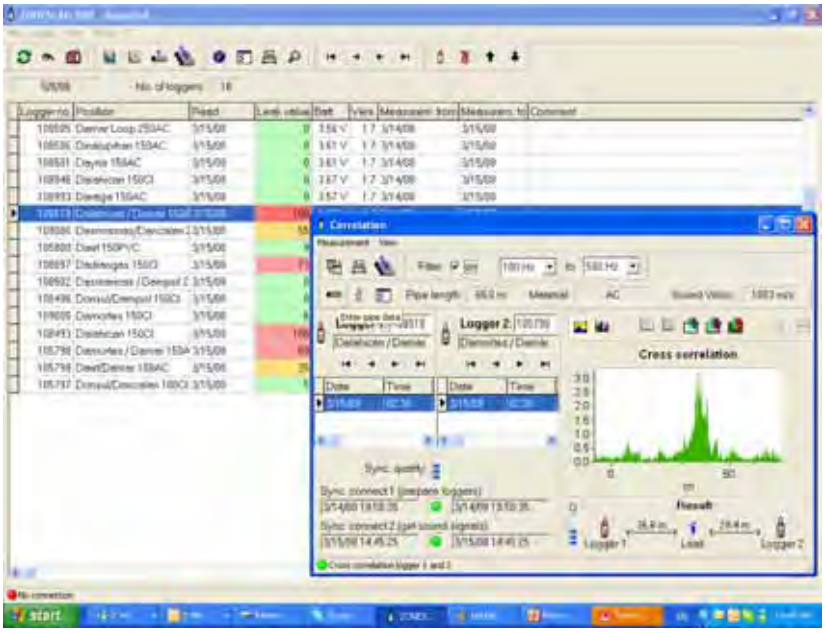


Fig.35 opening the correlation window

Step #1: Select the first logger in the database indicating leak or possible leak. This is classed as Logger1; the serial number of the logger will appear in the window.

Step #2: Then select the next logger using the 'Next record' or 'Previous record' arrow keys in the Logger2 partition.

Step #3: To enter pipe material(s), select 'Enter pipe data' symbol

Step #4: Enter distance measured along pipeline between the two loggers

Step #5: Select the pipeline material from the pull-down menu

Step #6: Select the pipeline diameter from the pull-down menu

For mixed materials repeat process for up to 4 different pipe sections between the two loggers.

See Fig.36 a screen shot of the pipe material entering process, PTO.

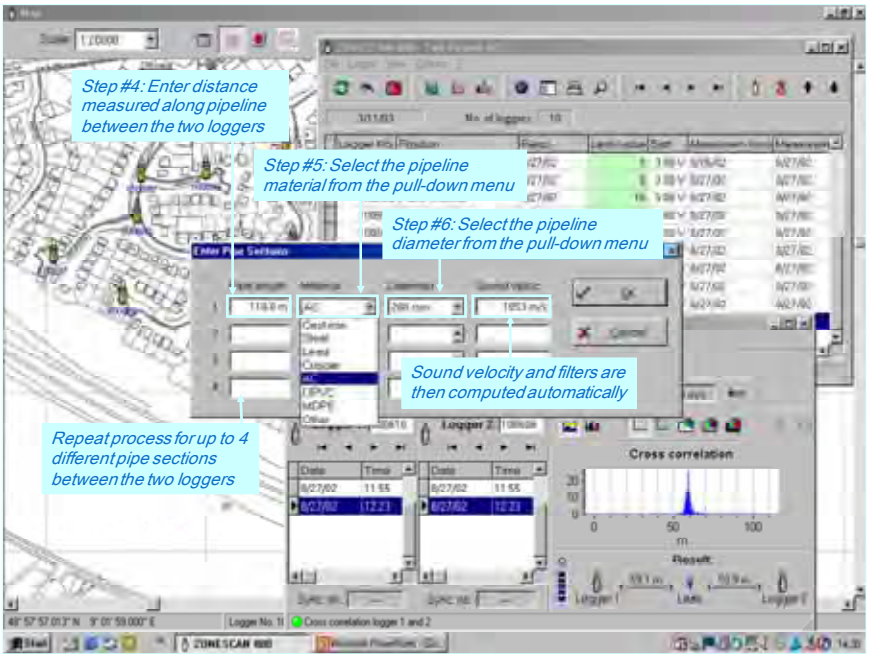


Fig.36 entering the pipe details

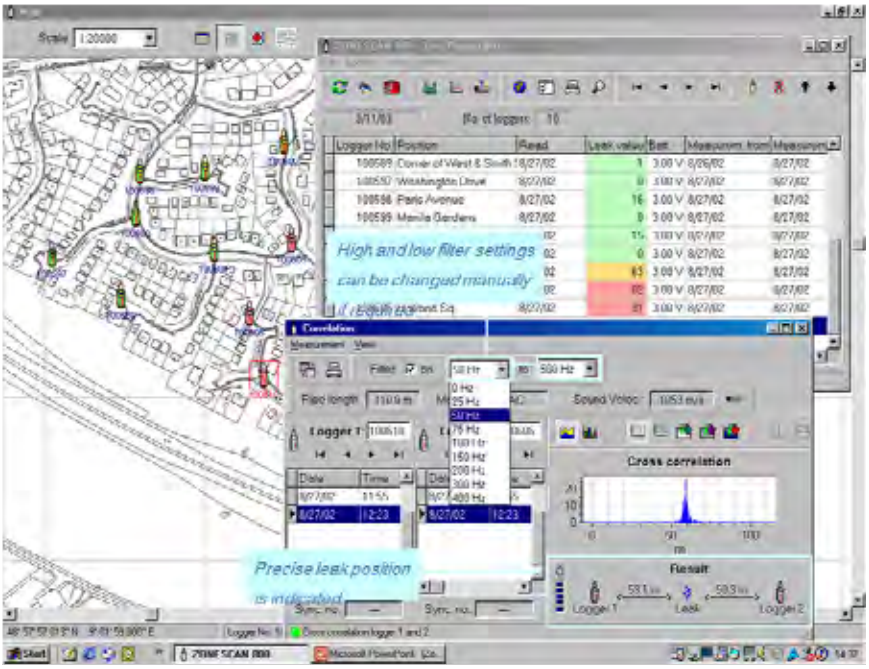


Fig.37 adjusting the filters

In the Correlation window the low and high filters maybe adjusted to clean up and fine tune the correlation graph.

10.2 The Correlation Result

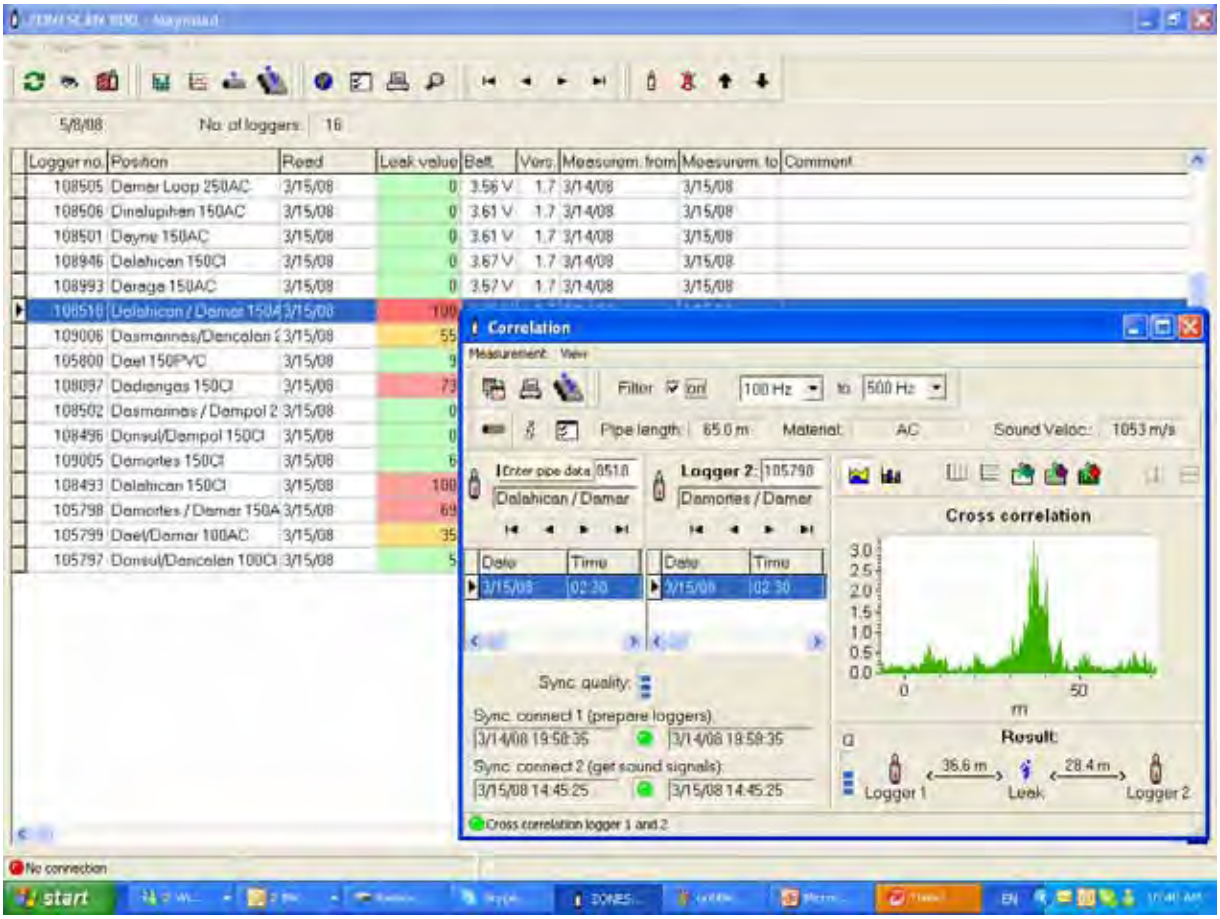


Fig.38 correlation window

When Examining the Correlation Graph a clear peak as shown in Fig.38 is required for confidence leak detection.

Q = Quality of correlation so the more bars the better.

The Position of the Leak is shown in the Result window with the distance from the Leak to either Logger is given. If incorrect distances are entered then the result will be wrong.

10.3 Exhaustive Correlation

Click on the Execute all correlations button to perform an exhaustive correlation. The window appears enabling the user to change the quality limit and distance between 2 loggers before execute correlations.

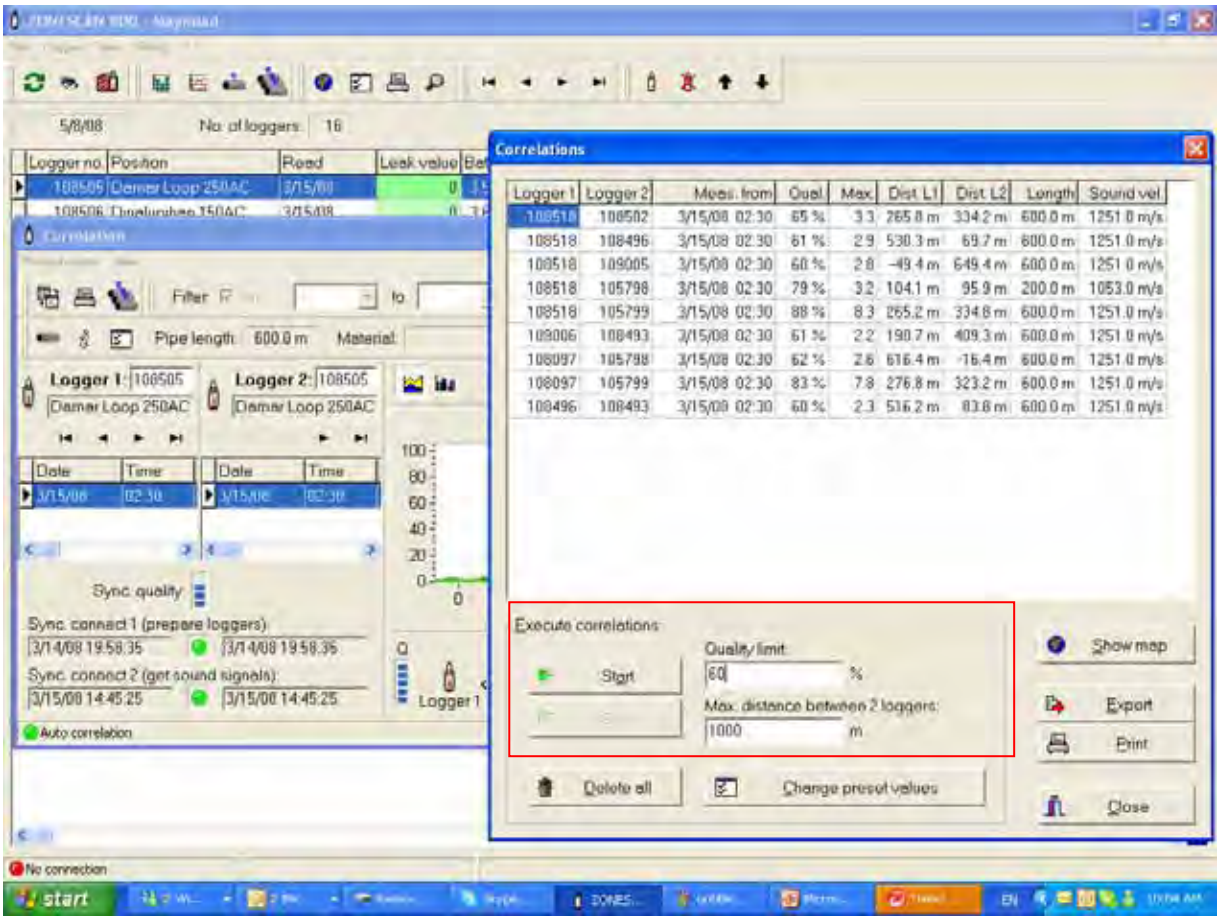


Fig.39 setting the preferences in execute correlations

Press start to correlate and all the combinations will be explored. A list of correlation greater than quality limit (e.g. 60%) will be produced. The higher the quality percentage the greater the probability of a good correlation.

Run through the list and double click on Logger 1's serial number, the single correlation window will appear which allows the pipe data to be entered and a single correlation to be performed as described in the previous section.

11 Interpreting the Correlation Results

Leak Positions in the Central Third are more accurate but beware of centre correlations. Small velocity errors will cause correlations in the outer thirds to be less accurate.

Never dig a hole based on a correlation peak, unless you have confirmed the leak position with a ground microphone.

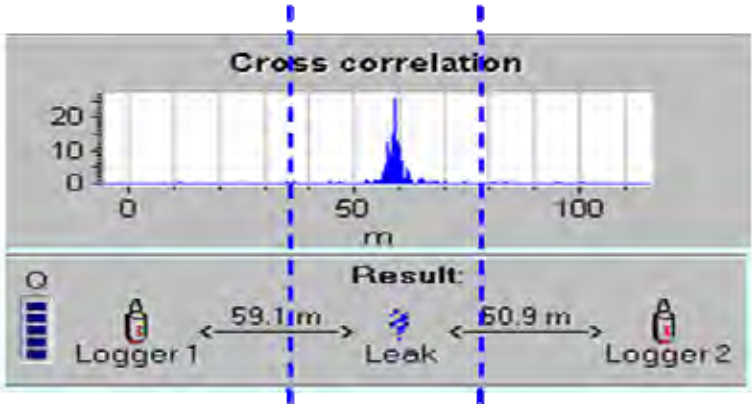


Fig.40 middle third of correlation screen

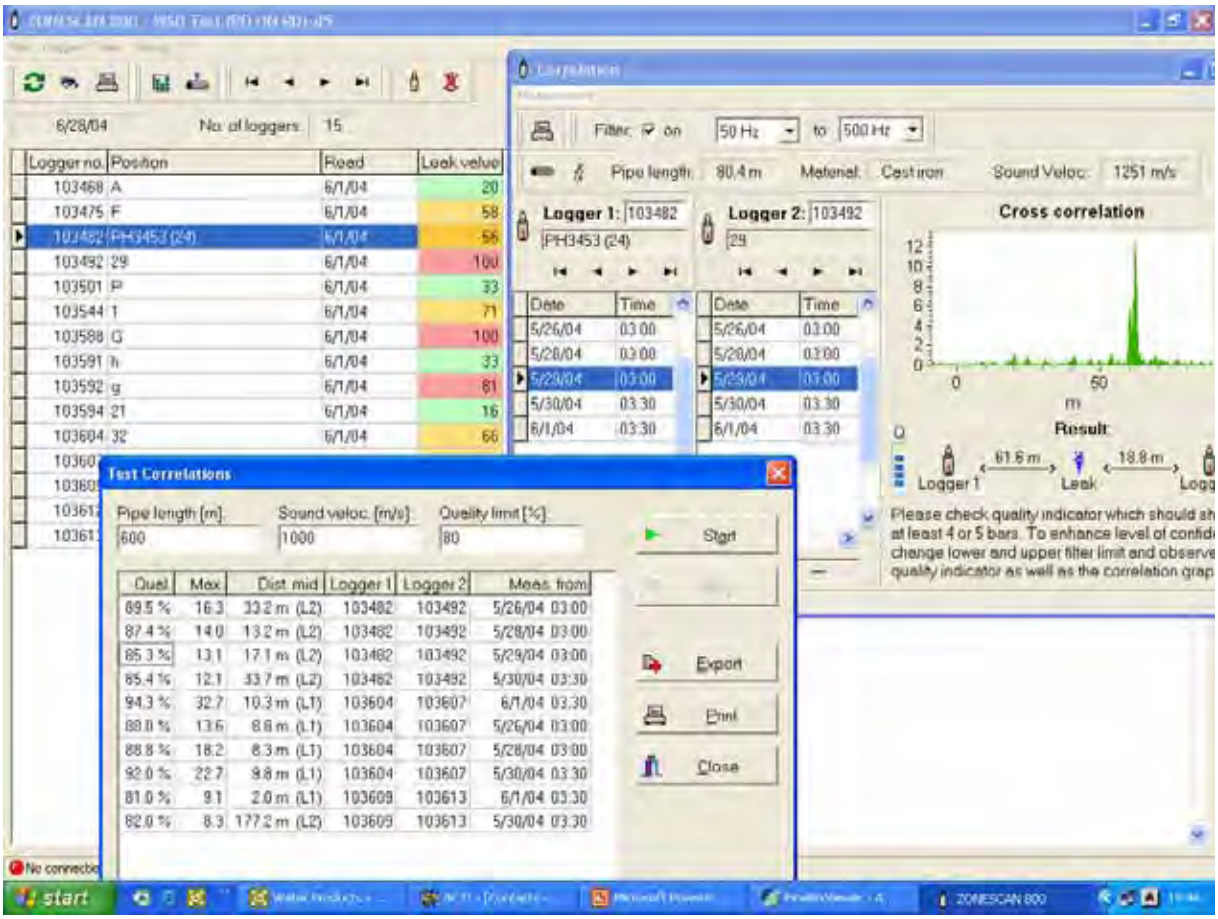


Fig.41 Example of good quality correlation on an 80m section of Cast Iron

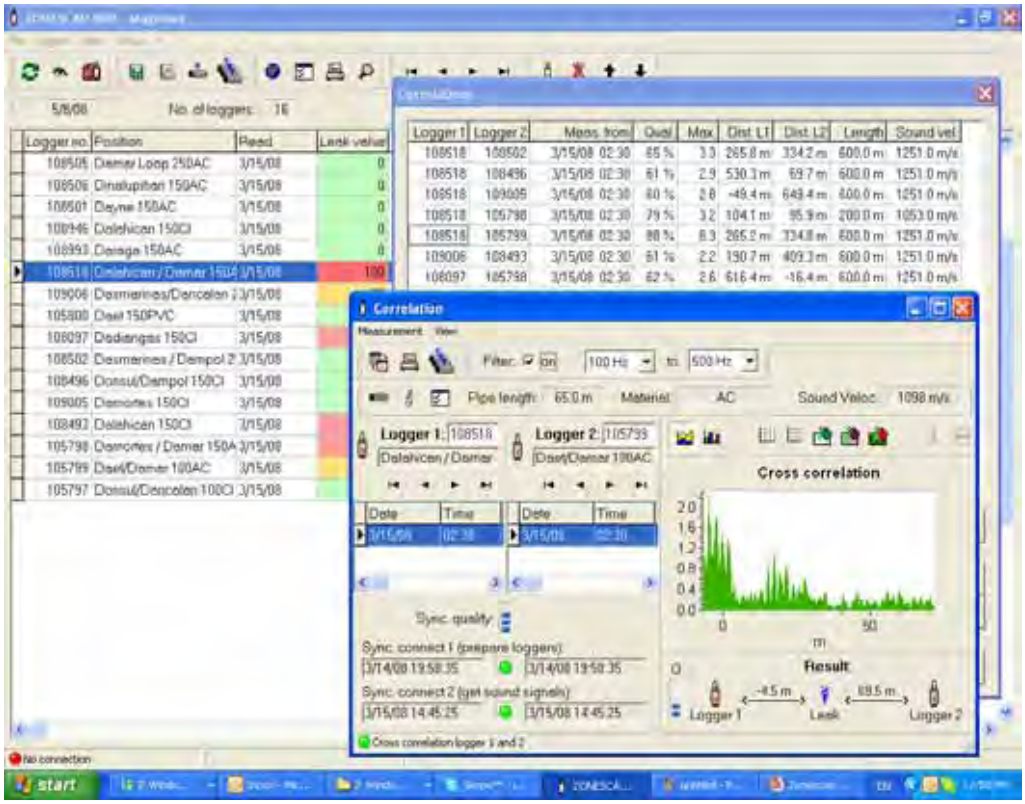


Fig.42 the following screen shot shows an example of an out of bracket correlation: the main peak on the graph is beyond the 0mand is confirmed by the -4.5mresult. Choose the next logger beyond the logger1 (108518) to bring the peak within bracket as shown below in Fig.43.

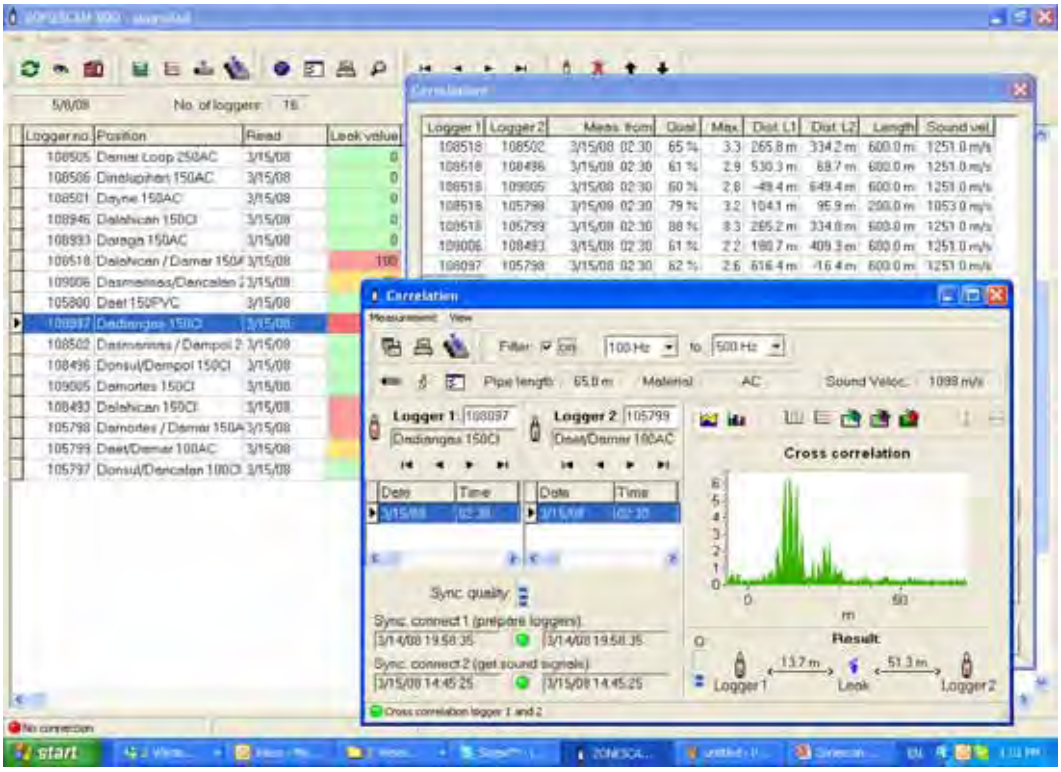


Fig.43 in bracket leak

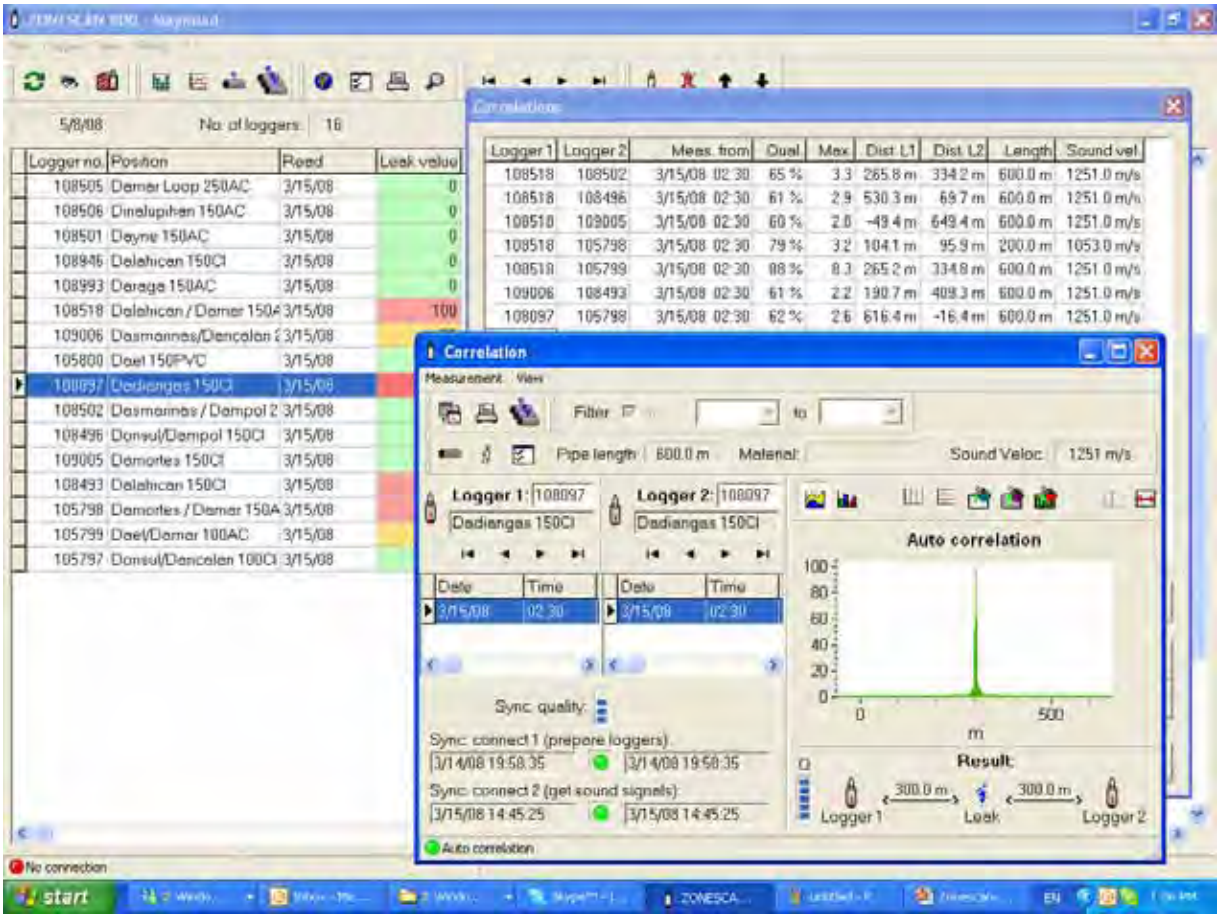


Fig.44 this shows a centre correlation created by both Loggers 1 and Logger 2 being the same logger 108097. To avoid centre correlation Logger 1 and 2 must be different serial numbers.

12 Project Management

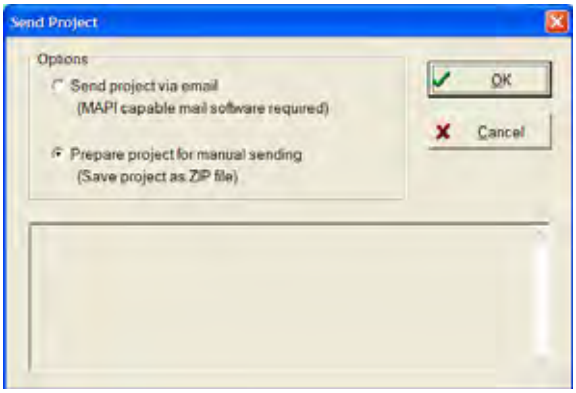
The software provides a project management in order to allow the user to manage different projects. A project may be a local distribution network or part of it (e.g. a town, a suburb, etc.) or any other organization unit. All loggers that are to be inserted into the software's database must be assigned to a project. Loggers may be inserted into several units with the same logger number. However, it has to be taken in consideration that measurement data stored in the logger can only be transferred into one project. This is because successful transferring of the data automatically empties the logger's memory.

After first time starting of the software an example project with example data will be opened. Before inserting new loggers a new project should be created (main menu command **New project...**):
A project name has to be chosen (free choice, project names may also include spaces) and after pressing the ok button the tabular logger list will be cleared.

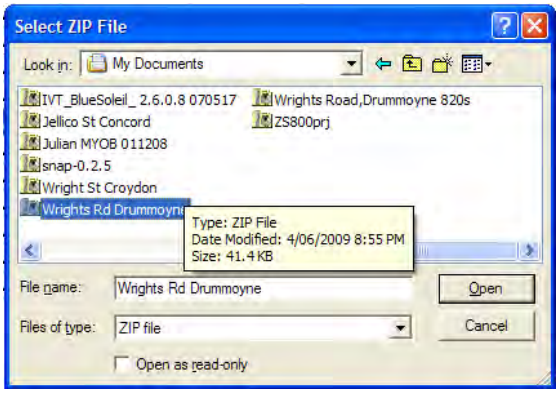
The main menu commands allow switching between different projects, as well as copying, renaming and deleting of projects.

Additionally, projects may be shared between different users by packing them into ZIP files and sending them via e-mail or transferring them by disk or network. Direct sending via email requires a MAPI-capable mail software (MAPI = Mail Application Programming Interface), e.g. Microsoft Exchange, Outlook, Outlook Express or Netscape Messenger. Other mail software can also be used by choosing the second sending option: Prepare project for manual sending. In this case a ZIP file is created that has to be attached manually to an email. The ZIP files sent via email or copied via disk or network can be easily imported on another computer by activating the **Import project** function.

Send Project:



Import Project:



13 Appendix Section

13.1 Wizard Assisted Version

How To Start:

After first time starting of the software:

1. Please select **I want to create a new project**
2. Choose a name **for the new project and enter** the name of the project
3. Insert loggers**: Enter logger no. of first lo**gger (as imprinted on logger case) and add a short description of logger position and press **OK**. If you like to add additional loggers please answer question with **Yes**
4. Repeat step 2 **for all loggers or use Insert multiple loggers** fu**nct**ion when entering logger no
5. Follow the **further steps as shown in software**
6. **If you l**ike **to transfer logger settings from PC to logge**r, **ple**ase connect the Syste**m** Communication Link **via the Communication** Cab**le t**o the PC before pr**oceeding.**

In case the so**ftwa**re is unable to establish a connection, COM port setting should be checked:

- Abort synchronization ()
- Select menu command **File - Options - Setup**, then select **Connection** and modify setting if necessary.

After these basic setup steps the software is prepared for normal operation. You can **Synchronize** the loggers now in order to receive measurement data or a check a single logger by means of the **Logger State** function ( or function key **F3**).

13.1.1 Main Window

After starting the software the main window is displayed on the screen. The window is subdivided into a menu bar, a control panel with Explorer-style function buttons, a tabular list of the loggers of the actual project and a status panel at the bottom of the window. The name of the actual selected project is displayed together with the program name (ZONESCAN 800) in the window title.
Closing the main window exits the program.

13.1.2 Function buttons

The function buttons are arranged on sub-panels that can be easily rearranged and even be detached from the main window by grabbing the left side with the two vertical lines and dragging them to the desired new position. A short description of the function of each button is displayed by moving the mouse cursor over the button (without pressing the button) and waiting a short time. The buttons provide the following functions:

- Synchronize all loggers: Initiates the synchronization process that transfers data from and to the loggers
- Logger state: Opens the Logger State window that displays settings and data of the actual selected logger (highlighted entry in the logger list of the main window). Logger state only can be displayed when the logger can be reached by radio transmission. It also allows remote listening of the sound signal recorded by the logger

- Print report: Printout of the tabular logger list

- Show measurements: Displays measurement window to view measurement results including leak value and amplitude distribution (see **View Logger Measurements**) .
- Correlate sound signals: Displays a window that allows Correlating of sound signals in case appropriate sound signals have been recorded.

- Navigation buttons: These buttons provide easy navigation functions for selecting a logger. Alternatively, logger may be selected by clicking on an entry of the tabular list or by using the arrow keys of the keyboard (only possible when list has the focus, i.e. list is the active element in the window).

- Insert new logger
- Delete logger

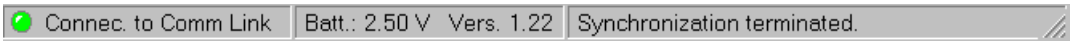
13.1.3 Logger list

The tabular logger list displays settings and readings of the loggers of the current project.

- Logger no.: Unique logger no. (must be identical with the number on the logger case)
- Position: User entry for easier identification of the logger (see **Logger Setup**)
- Read: Date of last reading (synchronizing) of the logger
- Leak Value: Evaluated leak probability value (0..100, see **View Logger Measurements**). The value is taken from the newest measurement that has been transferred from this logger. The field is shown in orange/red colour in case the leak value exceeds the warning level of a possible/probable leak, otherwise it is shown in green colour. The warning levels may be adjusted by the user (see **Program Setup**).

Double clicking on an entry of the list opens the **View Logger Measurements** window (same function as corresponding button or main menu item).

13.1.4 Status panel



The left section of the status panel indicates whether there's a connection to the System Communications Link or not. Connection is needed during synchronization and when checking the logger state.
The middle section displays battery voltage and firmware version of the System Communication Link during connection.
The right section is used for status messages, especially during synchronization.

13.2 Main Menu (Wizard Assisted Version)

13.2.1 File

New project...: Create a new empty project (see **Project Management**)
Open project...: Open an existing project
Save project as...: Save current project under a new project name
Delete project...: Delete current project including all loggers
Send project...: Pack current project into a ZIP file and send it via e-mail or save it on disk
Import project...: Import project from a project ZIP file
Print...: Print logger list of current project (for printing measurements see **View Logger Measurements**)
Printer page setup...: Adjust printer page properties (margins, font, etc.)
Exit...: Exit program

13.2.2 Logger

Synchronize all loggers: Initiate/terminate the synchronization process that transfers data from and to the loggers
Logger state...: Open **Logger State** window
Logger setup...: Open **Logger Setup** window
Logger audio recordings...: Open a window that allows creating/changing audio recordings for logger identification. Each time a logger is identified during logger synchronization the appropriate logger audio recording will be played (if available).
Disconnect Comm Link: Disconnect System Communication Link (switch off CommLink, in order to preserve battery Power)
Find logger...: Find a logger by logger no. in the logger list
Insert new logger: Insert a new logger
Import loggers...: Import loggers from another project
Sort loggers: Sort loggers in list according to logger no.
Delete logger: Delete currently selected logger
Delete all loggers: Delete all loggers of current project

13.2.3 View

Measurements...: Display measurement window to view measurement results including leak value and amplitude distribution (see **View Logger Measurements**)
Correlate sound signals...: Display a window that allows Correlating of sound signals in case appropriate sound signals have been recorded.
Synchronization report: View last synchronization report, save reports and review saved reports

13.2.4 Setup

Setup...: Open the **Program Setup** window

?

Contents: Show contents of online help
Info...: Display version and memory information

13.3 Logger State (Wizard Assisted Version)

The Logger State window may be displayed by selecting the appropriate menu item or function button in the main window or by simply pressing **F3**. It allows checking of the logger's settings, battery state and availability of measurements. Additionally, there's a remote listening function that allows the user to "listen" to the logger's input signal.

After opening the window the software first tries to establish a connection to the Comm Link. Then the Comm Link tries to obtain logger state information of the selected logger via radio transmission. This process may last several seconds. Success is indicated in the display field next to the logger no. field:

Logger found - attempt has been successful
Logger unreachable - radio transmission has failed: either logger is out of radio transmission range (this is the common reason) or logger is out of operation
Error in connection - connection to Comm Link can't be established. possible reasons: cable is not properly connected to PC or Comm Link, wrong COM port selected (see **Program Setup**) or battery voltage of Comm Link is too low

Displayed information:

Logger no.: Selected logger. Selection may be done by clicking on a list entry in the main window's logger list or by using the navigation button on the top of the Logger State window. Logger state information can be only obtained if the logger with exactly the same number on its case is in radio transmission range.

Clock: Logger clock date and time. Logger clock will be updated during synchronization as soon as the difference to the PC's clock exceeds 1 min. Thus, it is very important that the PC clock's time is checked regularly and will be adjusted if necessary.

No. of amplitude distr.: Number of available amplitude distributions (1 per day, max. 10)

No. of leak values: Number of available leak value measurements (1 per day, max. 180)

Sound signal avail.: Indicates whether sound signal recording is available or not

Next sound recording: Time of next sound signal recording. Sound signal recordings may be programmed during **Logger Synchronization**.

Battery voltage: Battery voltage of the logger. **Note:** The voltage value of a fully loaded logger battery typically remains at 3.0 V steadily for a long time, as the value can't exceed 3 V due to internal restrictions.

Temperature: Temperature inside the logger's case

Start measurement: Programmed starting time of daily measurement (see **Logger Setup**)

Stop measurement: Programmed stop time of daily measurement

Interval: Programmed measurement interval

Version no.: Logger firmware version no.

Radio operation from: Start of radio operation period (see **Logger Setup**)

Radio operation to: End of radio operation period

13.3.1 Synchronize

This button can be used to initiate the synchronizing process only for the selected logger instead of synchronizing all loggers. "Synchronizing" is the process of sending logger setup data and receiving measurement data, for details see **Logger Synchronization**. After synchronizing the logger can't be re-synchronized for about 1 min. (during synchronization of all loggers: 5 min.). The button is enabled after successful connection to logger.

13.3.2 Remote listening

Remote listening is initiated/terminated by pressing the **Remote listening** button (enabled after successful connection to logger). The noise signal monitored by the logger will be sent to the PC's sound output device depending on the hardware configuration (e.g. internal or external speakers, headphone, line-out, etc.). There's a slight delay between the real noise signal and the output signal. After 8 seconds remote listening will be interrupted for about half a second. This pause is necessary for re-syncronizing the radio transmission.

Volume: Displays a Windows™ built-in utility software that allows adjustment of the volume.

Notes:
Remote listening involves considerable current consumption, thus decreasing the logger's battery lifetime. It shouldn't be initiated too often without necessity in order to preserve battery power.

Remote listening shouldn't be initiated during measurement, i.e. during the programmed measurement time of the logger (see **Logger Setup**), as it might affect collecting of the analysis data.

13.4 Logger Setup (Wizard Assisted Version)

The Logger Setup window may be displayed by selecting the appropriate menu item or by simply pressing **F4**. It allows adjustment of the properties of the actual selected logger:

Logger no.: Each logger has its own unique logger number that is needed for identification. This number can be found on the logger case. The number has to be entered exactly into the Logger no. field for each logger of the project, otherwise the logger cannot be found by the Comm Link.

Position: A short description of the position the logger is deployed. Some data should be entered by means of easier identification of the logger.

The navigation buttons may be used to switch to another logger without leaving the Logger Setup window. Any changes to the settings won't be saved to the internal database unless they are confirmed or cancelled by the user. Confirmation is done by pressing the ok symbol button or the Return key or by switching to another logger, cancellation is done by pressing the **X** symbol button or the Escape key.

In case the Logger Setup window is invoked by the **Insert logger** function, there's also an **Insert multiple loggers** button. This function allows easy insertion of a sequence of loggers with consecutive logger numbers. After pressing this button and entering the numbers of the first and the last logger, pressing **OK** will insert all loggers at once.

13.5 Logger Synchronization (all loggers) – Wizard Assisted Version

Logger synchronization is initiated/terminated by selecting the appropriate menu item or function button in the main window or by simply pressing **F2**. Logger synchronization allows programming of the loggers by transferring the corresponding logger setup data to the logger and receiving stored measurements from the loggers.

In wizard mode the user will be guided through the synchronization setup.

Explanation of options:

Synchronize only reachable loggers (in case only few loggers are in transmission range, "drive-by-operation"): During synchronization the System Communication Link will search for the next reachable logger. This option should be used during normal operation when loggers are deployed throughout the distribution network and only few loggers are in transmission range. If too many loggers can be reached at the same time, the System Communications Link won't be able to establish radio transmission to all loggers. See also note below.

Synchronize according to logger list (in case many or all loggers are in transmission range): This mode should be used when many loggers are at the same place e.g. for initial programming or testing of the loggers. During synchronization the software will try to connect the loggers exactly in the same order as shown in the loggers list of the main window. This mode is not suited for collecting data of deployed loggers as the synchronization process follows a strict time course.

Get sound signal for correlation: Get recorded sound signal. Sound signal is only available if logger was prepared to record sound signal during a previous synchronization.

After selecting the options, synchronization process will be started automatically. According to the selected order of synchronization, the System Communication Link will search for the next reachable logger or the next logger of the logger list. Once a logger is recognized, data will be transferred from and to the logger as specified by the synchronization options. Success and failure messages as well as warning messages will be displayed in the status panel of the **Main Window**. If audio output is switched on, there will also be audio messages. After successful synchronizing a logger in **Reachable loggers** mode the logger can't be re-synchronized the next 5 minutes.

Important Notes (please read):

Please check whether the selected order of Synchronization option is adapted to the transmission situation. **Synchronize only reachable loggers** won't work properly with too many loggers and **Synchronize according to logger list** won't work properly with deployed loggers. In case synchronization of a single logger is desired please use the **Synchronize** command accessed from the **Logger State** window.

Sound signal is recorded only once (the next time the logger clock coincides with the programmed recording time). This is because sound recording needs a large amount of memory space, thus not allowing more than one recording.

The shorter the time between logger programming and receiving the recorded sound signal the more accurate the results. As a rule of thumb sound recordings should be transferred to the PC 24 hours after logger programming at the latest. This is only important for sound recordings because of the strong influence of clock accuracy on the results. Amplitude distribution measurements and leak values are not influenced by clock accuracy. The logger can store amplitude measurements up to 10 days and leak values up to 180 days without losing any data.

If the synchronization process includes programming or receiving of sound recordings, it is very important that the synchronization process won't be interrupted until all loggers will be synchronized. Synchronization process is interrupted by pressing the **Synchronize** button again, by disconnecting the Comm Link, by exiting the program or switching off the PC. Interruption of the synchronization process will cause a switch off of the Comm Link, thus losing clock synchronization. However, subsequent correlation of the recorded sound signal is only possible with proper clock synchronization of the corresponding loggers! Interruption of synchronization doesn't affect leak values and amplitude distributions.

13.6 View Logger Measurements (Wizard Assisted Version)

The Measurements window allows viewing of the stored leak values and amplitude distributions. It is displayed by selecting the appropriate menu item or function button in the main window or by simply pressing **F5**. It allows graphical and tabular representation of the stored data, as well as printing and exporting of the data.

The window is parted into a list of the stored measurements of the selected logger (left side) and the measurement data of the currently selected measurement (right side). A measurement can be selected by simply clicking on the corresponding entry of the list or by using the **up** and **down** cursor keys. The vertical dividing line between the two parts can be moved by "grabbing" it with the mouse cursor and moving it to the left or right side.

13.6.1 Measurement list

When showing leak measurements, list displays (from left to right):
Measurement date, leak value (see below), programmed measurement duration, programmed measurement interval and date of measurement transfer.
Leak value: This value is evaluated from the amplitude distribution shown on the right side. Its range is 0 to 100, characterizing the leak probability. The leak value depends on spread and shape of the amplitude distribution. It is especially influenced by sharpness and position of its main peak. The field background is shown in orange/red colour in case the leak value exceeds the warning levels of a possible/probable leak, otherwise it is shown in green colour. The warning levels may be adjusted by the user (see **Program Setup**).

13.6.2 Measurement data

The displayed measurement data is the amplitude distribution of the signal that is monitored and analyzed during the programmed measurement period (see **Logger Setup**). Analyzing the amplitude distribution allows obtaining further information concerning measurement conditions, interfering noise sources, etc.

Menu commands:

14 Measurement

Print report...: Print overview list or graphic view of the displayed measurement data
Allow multiple selection: Enable multiple measurement selection for deletion
Delete measurements: Delete currently selected measurement(s)
Delete all measurements: Delete all measurements of currently selected logger

Buttons:

The printer symbol button corresponds to the menu item **Print report**. The navigation buttons allow switching to another logger without leaving the Measurement window.

14.1 Correlate Sound Signals (Wizard Assisted Version)

The Correlation window may be displayed by selecting the appropriate menu item or function button in the main window or by simply pressing **F7**. It allows correlating of the sound signals of two loggers in order to calculate leak positions.

How to correlate:

1. Select loggers

Enter logger no. or use navigation buttons to select logger 1 and logger 2:

When selecting the same logger no. as logger 1 and 2 auto correlation will be performed, otherwise the sound signals will be cross correlated (normal operation mode for leak location).

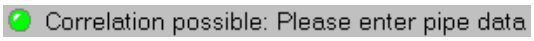
2. Select sound recordings

Click on desired sound recording in the sound recordings list of logger 1 or logger 2.
After selecting a sound recording of a logger, the software attempts to find a fitting sound recording in the logger list of the other logger. If an appropriate sound recording is found, it will be automatically selected. Cross correlation (leak location) is only possible in case the 2 selected sound recordings have been recorded at the same date and time.

15 Sync. numbers

Newer versions of the logger firmware provide so-called sync. numbers, in order to recognize whether the sound recordings have been made with the same time synchronization or not. In case a sync. no. exists (see field below sound recordings list), the sync. numbers of the 2 sound recordings have to be the same. The sync. no. will increase with every switch-on of the System Communication Link.

16 Status panel



When selecting loggers and sound recordings the status panel shows whether correlation is possible or not and gives further information.

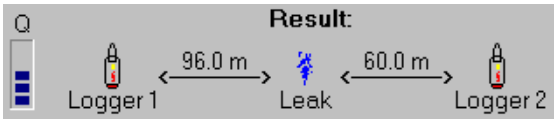
3. Enter pipe data

For calculating cross correlations, pipe data has to be entered by selecting the menu item **Measurement - Enter pipe data...** or pressing the button

Up to 4 different pipe sections may be entered by selecting pipe section length, material, diameter and sound velocity. If material or diameter is not in the list or exact sound velocity is known, sound velocity can be entered manually by selecting material **Other**. Entered pipe data will be automatically stored in internal database.

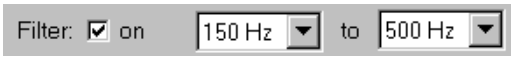
Auto correlation may be done without entering pipe data.

16.1 Result display



After entering pipe data, the correlation results will be displayed below the correlation graphics (or values table, if tabular view is selected). The result display shows the distances between the two loggers and a possible leak. On the left side there's a small bar graphics (**Q**) indicating the calculated quality of the correlation (0 to 5 bars). The higher the value the better the correlation quality and the higher the leak probability.

16.2 Filter



Quality of correlation results may be improved by using the filter function. Filter frequencies will be preselected after entering the pipe data and may be adapted manually by the user.

Test correlation

Function for a quick check whether the selected combination of loggers produces a reasonable correlation (i.e. probable leak) or not. Pipe data needn't be entered (the correlation will be calculated on base of a pipe length of 600 m and a sound velocity of 1000 m/s). Correlation quality will be calculated and will allow quick assessment whether a leak is probable.
Note: This function is not suitable to obtain leak distances. For calculating a correct correlation result (distance to leak) it is necessary to enter correct pipe data and to switch off the test correlation function.

Execute all test correlations (main menu item): Function for testing all combinations of loggers whether there are probable leaks or not. A window will appear containing the test results. It is possible to adjust the test pipe length and sound velocity, as well as the quality limit value.
After pressing the **Start** button, correlation quality will be calculated for each possible combination of loggers (value 0 to 100%), in case there are appropriate sound recordings. Only test correlations with a quality value

exceeding the limit value will be listed in the result list (correlation quality, peak maximum value, distance to the middle, logger numbers, date and time of sound recording). Results may be sorted by column (mouse click on column header). They also may be exported or printed. Execution of this function may take up some considerable amount of time, depending on the number of loggers in the main window's list.

The remaining function buttons and menu items have the same functions as in the **Measurements Window**.

Program Setup (Wizard Assisted Version)

The Program Setup window may be displayed by selecting the appropriate menu item (**Options - Setup**) or function button in the main window. It allows adjustment of general settings of the program:

17 Connection

Selection of COM port.

18 Audio

Create/change recordings of audio messages during synchronization process. The respective message can be selected by choosing a list entry. The recordings may be played (if available) or (re-)recorded. For new recording of a message the option **Allow recordings** must be enabled. Recording and playback volume settings may be changed by pressing the corresponding buttons. They will display a Windows built-in utility software that allows adjustment of the volume. Audio output may be suppressed by disabling the option **Audio output during synchronization**.

19 Language

Selection of display language.

20 HotSync

Registering and unregistering of ZONESCAN 800 conduit (see Data Synchronization via Palm HotSync®).

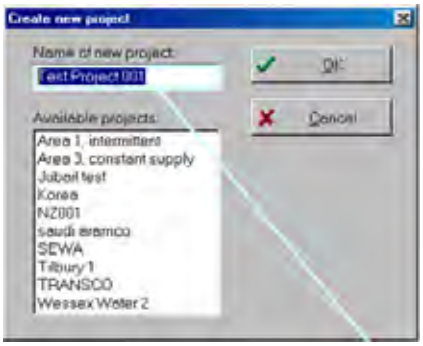
Standard Professional Version

This is the initial screen. You have 3 seconds to change the **Options** otherwise the software continues in the previously used mode. On first use of the Zonescan software standard wizard assist mode starts.

How To Start

After first time starting of the software:

1. Create new project: select menu command **File - New Project...**, and then enter project name and press **OK**.



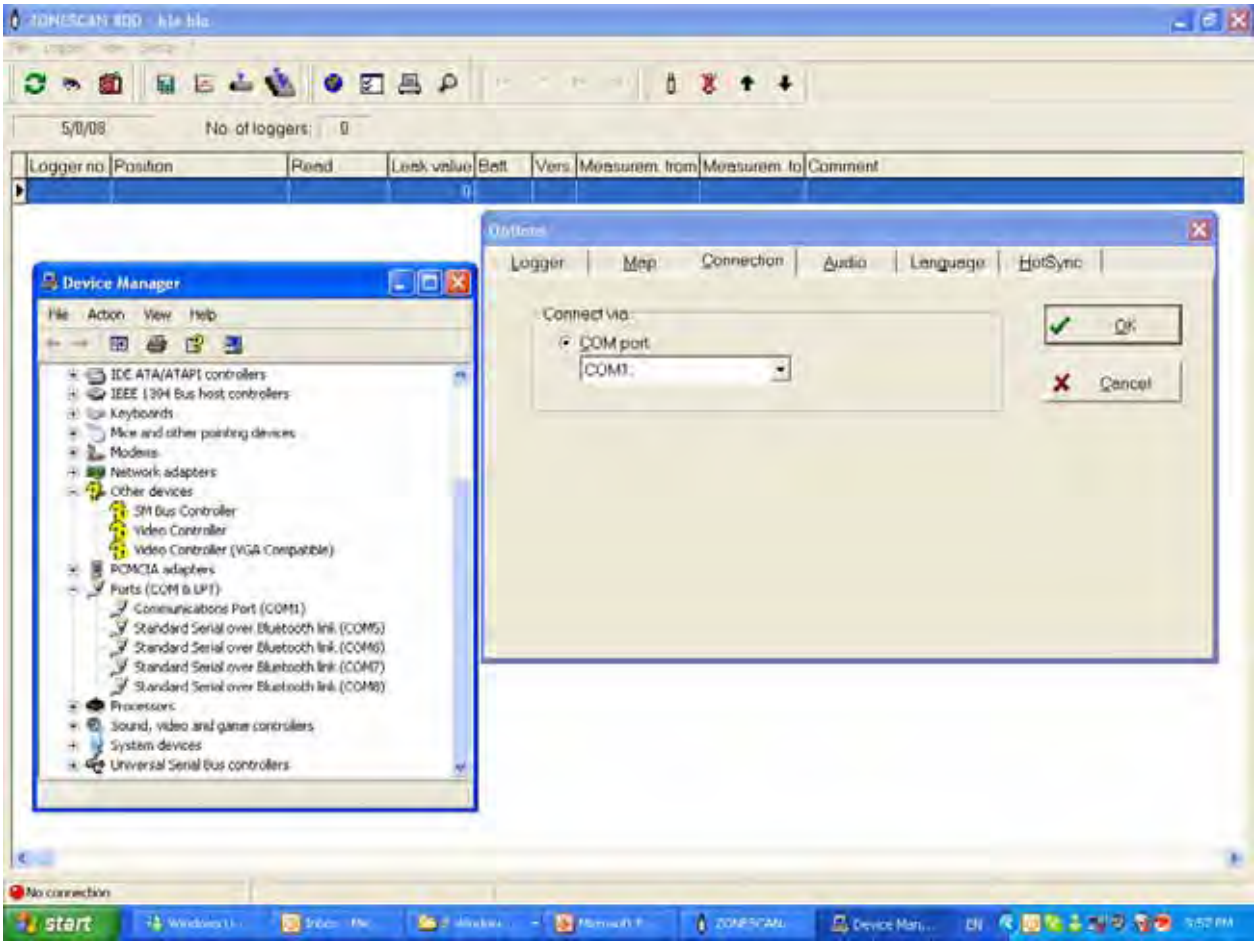
2. Insert loggers: Press function button **Insert logger**  , then enter logger no. of first logger (as imprinted on logger case), add a short description of logger position, eventually modify remaining settings and press **OK**.

3. Repeat step 2 for all loggers or use **Insert multiple loggers** function when entering logger no.

4. Connect the System Communication Link via the Communication Cable to an unused COM port of the PC.

4.

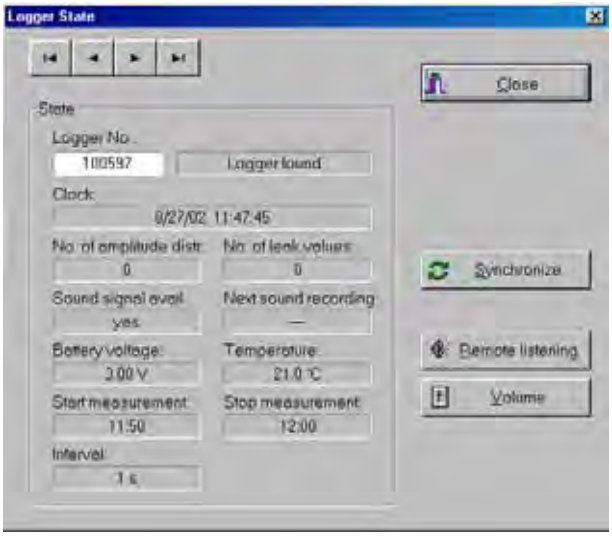
5. Check COM port setting: select menu command **File - Options - Setup**, then select **Connection** and modify setting if necessary



5..

After these basic setup steps the software is prepared for normal operation. It is recommended to check radio connection to the loggers next:

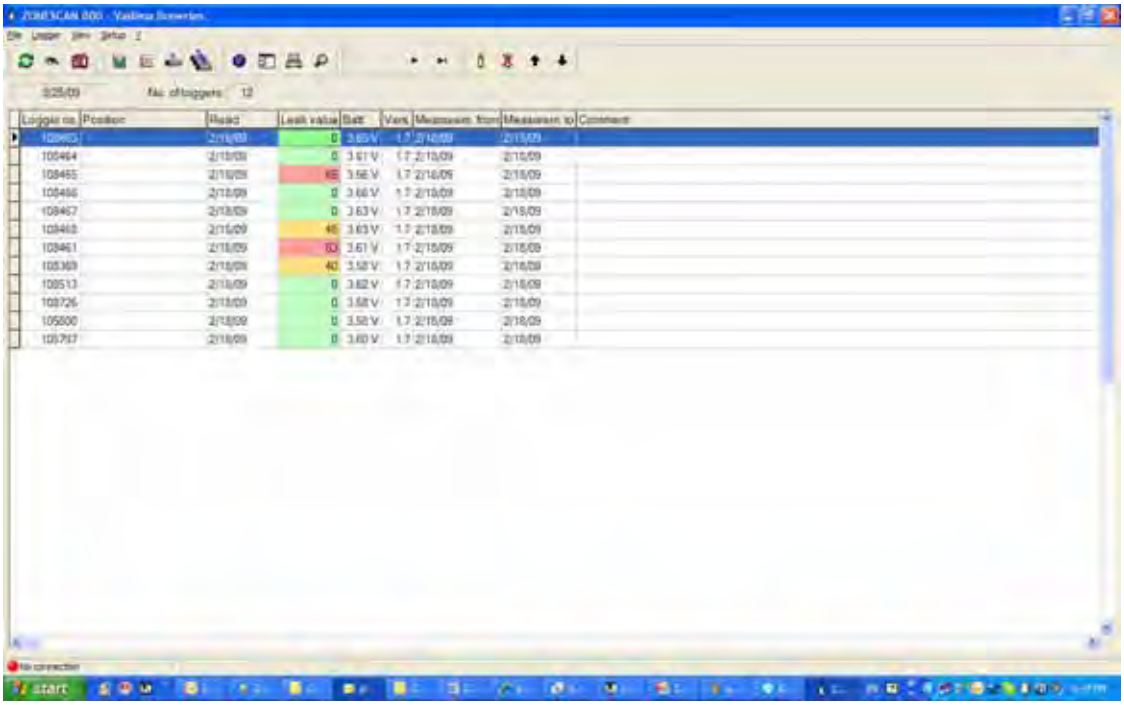
Select a logger in transmission range (click on according entry in logger list) and press the function button **Logger State** or the function key **F3** . Radio connection should be established after some seconds and logger state data should be visualized in the **Logger State** window.



After deploying the loggers in the distribution network, programming of the loggers and receiving of measurement data is done by means of the **Synchronize** function. 

Main Window (Standard Professional Version)

After starting the software the main window is displayed on the screen. The window is subdivided into a menu bar, a control panel with Explorer-style function buttons, a tabular list of the loggers of the actual project and a status panel at the bottom of the window. The name of the actual selected project is displayed together with the program name (ZONESCAN 800) in the window title.
Closing the main window exits the program.



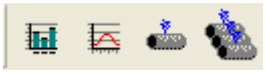
21 Function buttons

The function buttons are arranged on sub-panels that can be easily rearranged and even be detached from the main window by grabbing the left side with the two vertical lines and dragging them to the desired new position. A short description of the function of each button is displayed by moving the mouse cursor over the button (without pressing the button) and waiting a short time. The buttons provide the following functions:

Synchronize all loggers: Initiates the synchronization process that transfers data from and to the loggers

Logger state: Opens the Logger State window that displays settings and data of the actual selected logger (highlighted entry in the logger list of the main window). Logger state only can be displayed when the logger can be reached by radio transmission. It also allows remote listening of the sound signal recorded by the logger

Logger setup: Displays the Logger setup window.



Show measurements: Displays measurement window to view measurement results including leak value and amplitude distribution (see **View Logger Measurements**).

Show signal graphics: Displays sound signals that have been recorded and stored for Correlating sound signals.

Correlate sound signals: Displays a window that allows Correlating of sound signals in case appropriate sound signals have been recorded.

Execute all correlations: Displays a window that allows the correlation of all possible combination of loggers. Correlation recordings must be made to make this possible.

Show map: Opens the **Logger Map**, a graphical overview of the deployed loggers

Setup: Displays the program **Setup** window.

Print report: Printout of the tabular logger list

Find logger: Opens a small window for searching a certain logger by logger no.

 - Navigation buttons: These buttons provide easy navigation functions for selecting a logger. Alternatively, logger may be selected by clicking on an entry of the tabular list or by using the arrow keys of the keyboard (only possible when list has the focus, i.e. list is the active element in the window).

 Insert new logger

 Delete logger

 Move logger one row up in list

 Move logger one row down in list

22 Logger list

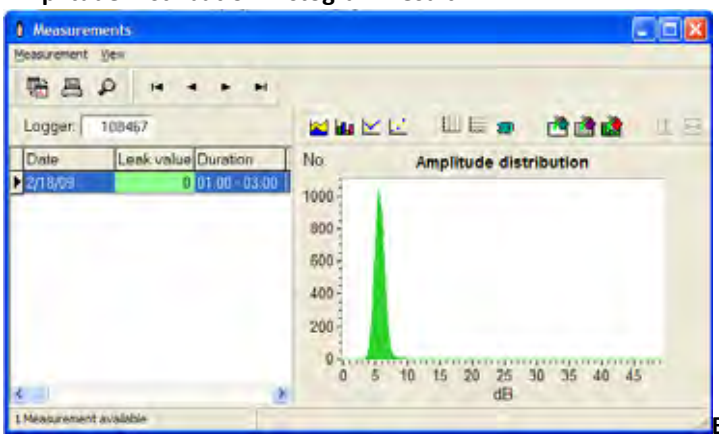
The tabular logger list displays settings and readings of the loggers of the current project.

Logger no.	Position	Read	Leak value	Batt.	Vers.	Measurem. from	Measurem. to	Comment
108463		2/18/09	0	3.60 V	1.7	2/18/09	2/18/09	

- Logger no.: Unique logger no. (must be identical with the number on the logger case)
- Position: User entry for easier identification of the logger (see **Logger Setup**)
- Read: Date of last reading (synchronizing) of the logger
- Leak Value: Evaluated leak probability value (0..100, see **View Logger Measurements**). The value is taken from the newest measurement that has been transferred from this logger. The field is shown in orange/red colour in case the leak value exceeds the warning level of a possible/probable leak, otherwise it is shown in green colour. The warning levels may be adjusted by the user (see **Program Setup**).
- Batt.: Battery voltage of the logger. Value will be updated during synchronization. The field is shown in red colour in case the value exceeds the battery warning level. The warning level may be adjusted by the user (see **Program Setup**). **Note:** The voltage value of a fully loaded logger battery typically remains at 3.0 V steadily for a long time, as the value can't exceed 3 V due to internal restrictions.
- Vers.: Version no. of logger firmware
- Measurem. from: Date of oldest measurement that has been transferred from the logger
- Measurem. to: Date of the newest measurement

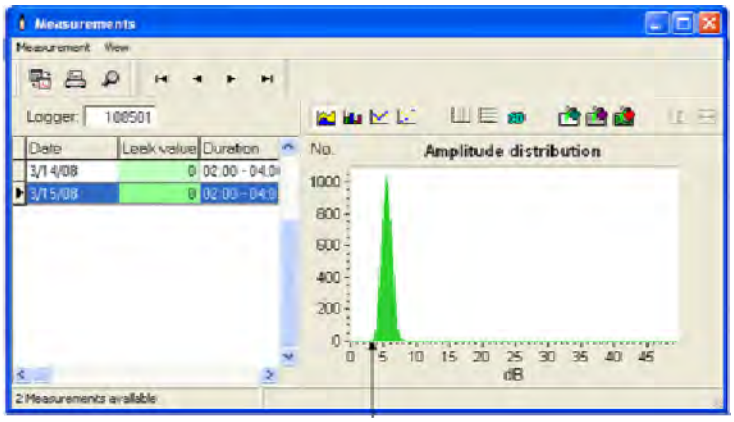
Double clicking on an entry of the list opens the **View Logger Measurements** window (same function as corresponding button or main menu item).

Amplitude Distribution Histogram Result

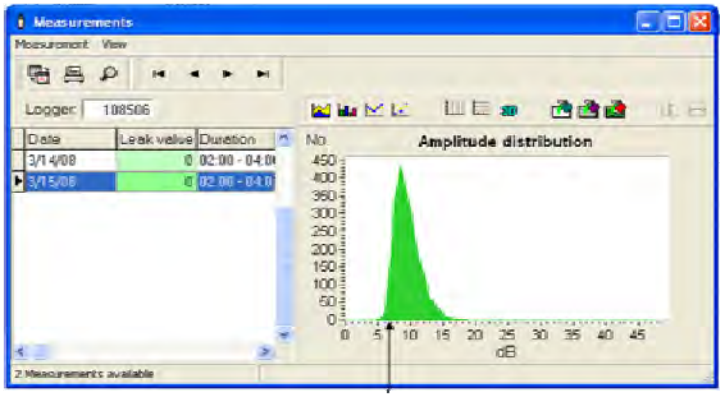


Expanded

Step 1 – establish the “no-leak” noise level in the area. Minimum noise is 4db



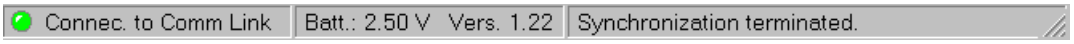
Step 2 – identify areas 2 or 3 db higher than the “no-leak” level. Minimum noise is 7db



Step 3 – Determine the Areas of Interest. Analyse the minimum noise level for each logged point.
Higher minimum noise levels are closer to the leak

Use these 3 steps to help determine which logger(s) the leaks is near to, this is especially useful in quiet PVC environments.

23 Status panel



The left section of the status panel indicates whether there's a connection to the System Communications Link or not. Connection is needed during synchronization and when checking the logger state.
The middle section displays battery voltage and firmware version of the System Communication Link during connection.
The right section is used for status messages, especially during synchronization.

Main Menu (Standard Professional Version)

24 File

New project...: Create a new empty project (see **Project Management**)
Open project...: Open an existing project
Save project as...: Save current project under a new project name
Delete project...: Delete current project including all loggers
Send project...: Pack current project into a ZIP file and send it via e-mail or save it on disk
Import project...: Import project from a project ZIP file
Print...: Print logger list of current project (for printing measurements see **View Logger Measurements**)
Printer page setup...: Adjust printer page properties (margins, font, etc.)
Exit...: Exit program

25 Logger

Synchronize all loggers: Initiate/terminate the synchronization process that transfers data from and to the loggers
Logger state...: Open **Logger State** window
Logger setup...: Open **Logger Setup** window
Logger audio recordings...: Open a window that allows creating/changing audio recordings for logger identification. Each time a logger is identified during logger synchronization the appropriate logger audio recording will be played (if available).
Disconnect Comm Link: Disconnect System Communication Link (switch off CommLink, in order to preserve battery Power)
Find logger...: Find a logger by logger no. in the logger list
Insert new logger: Insert a new logger
Import loggers...: Import loggers from another project
Sort loggers: Sort loggers in list according to logger no.
Delete logger: Delete currently selected logger
Delete all loggers: Delete all loggers of current project

26 View

Measurements...: Display measurement window to view measurement results including leak value and amplitude distribution (see **View Logger Measurements**)
Signal graphics...: Display sound signal recordings of selected logger (see **View Logger Measurements**)
Correlate sound signals...: Display a window that allows Correlating of sound signals in case appropriate sound signals have been recorded.
Show map...: Open the **Logger Map**, a graphical overview of the deployed loggers
Synchronization report: View last synchronization report, save reports and review saved reports

27 Options

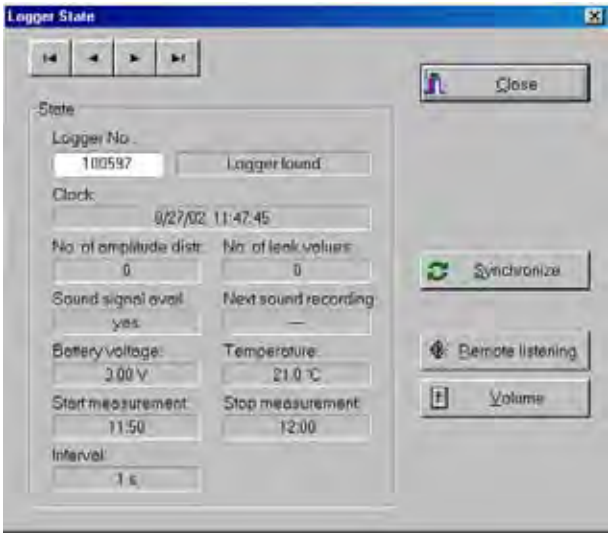
Setup...: Open the **Program Setup** window

?

Contents: Show contents of online help
Info...: Display version and memory information

Logger State (Standard Professional Version

The Logger State window may be displayed by selecting the appropriate menu item or function button in the main window or by simply pressing **F3**. It allows checking of the logger's settings, battery state and availability of measurements. Additionally, there's a remote listening function that allows the user to "listen" to the logger's input signal.
After opening the window the software first attempts to establish a connection to the Comm Link. Then the Comm Link attempts to obtain logger state information of the selected logger via radio transmission. This process may last several seconds. Success is indicated in the display field next to the logger no. field:



Logger found - attempt has been successful
Logger unreachable - radio transmission has failed: either logger is out of radio transmission range (this is the common reason) or logger is out of operation
Error in connection - connection to Comm Link can't be established. Possible reasons: cable is not properly connected to PC or Comm Link, wrong COM port selected (see **Program Setup**) or battery voltage of Comm Link is too low

Displayed information:

Logger no.: Selected logger. Selection may be done by clicking on a list entry in the main window's logger list or by using the navigation button on the top of the Logger State window. Logger state information can be only obtained if the logger with exactly the same number on its case is in radio transmission range.

Clock: Logger clock date and time. Logger clock will be updated during synchronization as soon as the difference to the PC's clock exceeds 1 min. Thus, it is very important that the PC clock's time is checked regularly and will be adjusted if necessary.

No. of amplitude distr.: Number of available amplitude distributions (1 per day, max. 10)

No. of leak values: Number of available leak value measurements (1 per day, max. 180)

Sound signal avail.: Indicates whether sound signal recording is available or not

Next sound recording: Time of next sound signal recording. Sound signal recordings may be programmed during **Logger Synchronization**.

Battery voltage: Battery voltage of the logger. **Note:** The voltage value of a fully loaded logger battery typically remains at 3.0 V steadily for a long time, as the value can't exceed 3 V due to internal restrictions.

Temperature: Temperature inside the logger's case

Start measurement: Programmed starting time of daily measurement (see **Logger Setup**)

Stop measurement: Programmed stop time of daily measurement

Interval: Programmed measurement interval

Version no.: Logger firmware version no.

Radio operation from: Start of radio operation period (see **Logger Setup**)

Radio operation to: End of radio operation period

28 Synchronize

This button can be used to initiate the synchronizing process only for the selected logger instead of synchronizing all loggers. "Synchronizing" is the process of sending logger setup data and receiving measurement data, for details see **Logger Synchronization**. After synchronizing the logger can't be re-synchronized for about 1 min. (during synchronization of all loggers: 5 min.). The button is enabled after successful connection to logger.

29 Remote listening

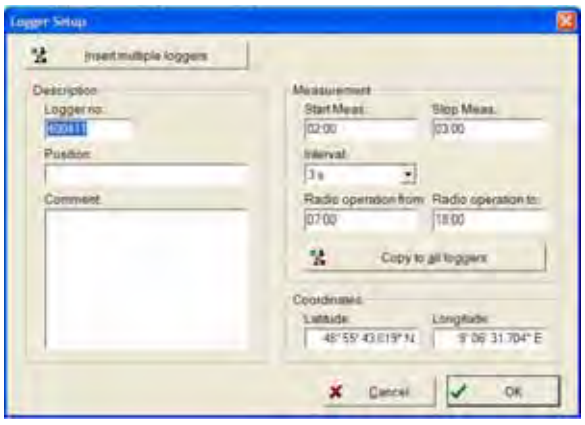
Remote listening is initiated/terminated by pressing the **Remote listening** button (enabled after successful connection to logger). The noise signal monitored by the logger will be sent to the PC's sound output device depending on the hardware configuration (e.g. internal or external speakers, headphone, line-out, etc.). There's a slight delay between the real noise signal and the output signal. After 8 seconds remote listening will be interrupted for about half a second. This pause is necessary for re-syncronizing the radio transmission.

Volume: Displays a Windows built-in utility software that allows adjustment of the volume.

Notes:

Remote listening involves considerable current consumption, thus decreasing the logger's battery lifetime. It shouldn't be initiated too often without necessity in order to preserve battery power.

Remote listening shouldn't be initiated during measurement, i.e. during the programmed measurement time of the logger (see **Logger Setup**), as it might affect collecting of the analysis data.



Logger Setup (Standard Professional Version) 

The Logger Setup window may be displayed by selecting the appropriate menu item or function button in the main window or by simply pressing **F4**. It allows adjustment of the properties of the actual selected logger:

Logger no.: Each logger has its own unique logger number that is needed for identification. This number can be found on the logger case. The number has to be entered exactly into the Logger no. field for each logger of the project, otherwise the logger cannot be found by the Comm Link.

Position: A short description of the position the logger is deployed. Some data should be entered by means of easier identification of the logger.

Comment: A data field provided for various users purposes. Entry is arbitrary.

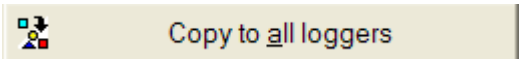
Start Meas.: Starting time of daily measurement (default value: 02:00)
Stop. Meas.: Stop time of daily measurement (default value: 04:00)
Interval: Measurement interval, selectable from 1 sec to 3 min (default value: 3 sec)
Restrictions: When setting interval to 1 sec max. measurement duration is 12 hours, otherwise it can be set to max. 23 hours 59 min.

Noise characteristics is monitored and analyzed only between starting and stop time. By restriction of the measurement time it is possible to exclude daytime periods with interfering noise sources (e.g. traffic) from being analyzed, thus leading to false evaluation results.

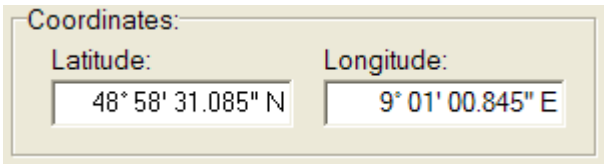
Radio operation from: Start of radio operation period. During radio operation period, loggers are reachable in 5 s periods in order to ensure easy connection during synchronization. Outside the radio operation period, loggers go to sleep mode in order to save battery capacity. In sleep mode, loggers are reachable in 30 second periods: They can be connected to within 30 seconds using the logger state function or during **synchronizing according to logger list** (in case wake up loggers function is activated, see **Logger Synchronization**). Synchronizing using "only reachable loggers mode" is not recommended outside radio operation mode.

Radio operation to: End of radio operation period

Note: Eventually, the logger clock should be checked to ensure proper operation regarding measurement and radio communication settings.



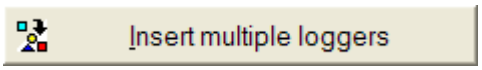
Copy to all loggers (not available when window invoked by the **Insert logger** function): For easier setup it is possible to copy changes of the measurement settings to all loggers of the project.



Latitude and longitude coordinates: (see **Logger Map**)

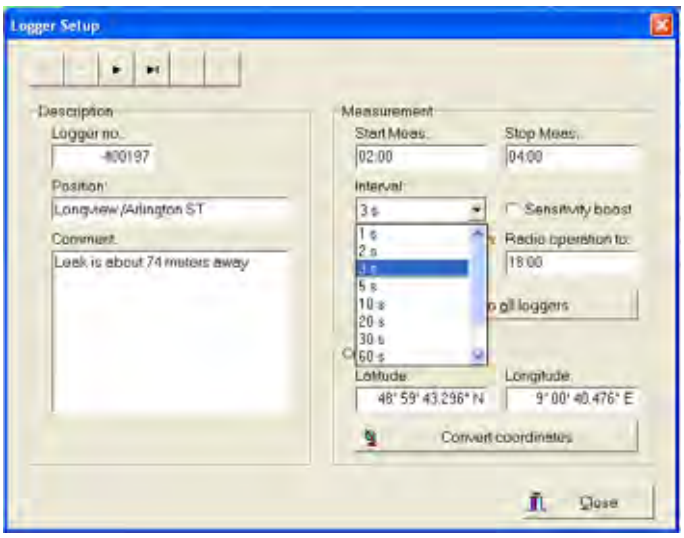
The navigation buttons may be used to switch to another logger without leaving the Logger Setup window. Any changes to the settings won't be saved to the internal database unless

they are confirmed or cancelled by the user. Confirmation is done by pressing the ok symbol button or the Return key or by switching to another logger, cancellation is done by pressing the **X** symbol button or the Escape key.



In case the Logger Setup window is invoked by the **Insert logger** function, there's also an **Insert multiple loggers** button. This function allows easy insertion of a sequence of loggers with consecutive logger numbers. After pressing this button and entering the numbers of the first and the last logger, pressing **OK** will insert all loggers at once.

Sensitivity Boost: This option is only available with the Zonescan 820 loggers and Software Version 5.13 onwards. It's used to increase the Sensor Sensitivity and is useful for logging quiet, difficult leaks. To activate, tick the box and then copy all loggers.

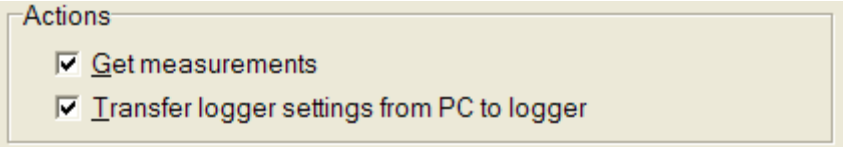


Logger Synchronization (all loggers) - Standard Professional Version

Logger synchronization is initiated/terminated by selecting the appropriate menu item or function button in the main window or by simply pressing **F2**. Logger synchronization allows programming of the loggers by transferring the corresponding logger setup data to the logger and receiving stored measurements from the loggers.

After initiating synchronization a window is displayed, allowing the user to select synchronization options. Pressing the **More...** button will reveal less often used options.

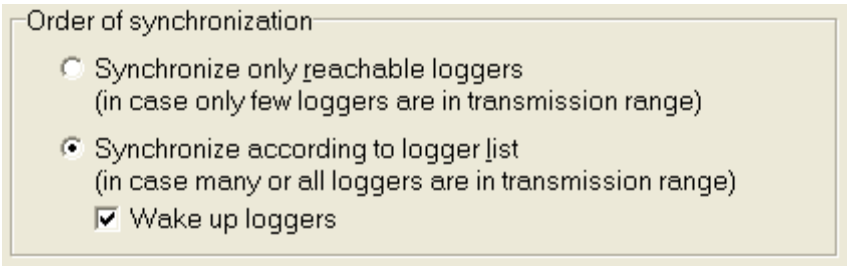
30 Actions



Get measurements: Get leak values and amplitude distribution measurements (if available)

Transfer logger settings from PC to logger: Program logger with the corresponding logger settings, see **Logger Setup**. **Important:** Transferring logger settings will erase all measurements stored in logger. It is recommended always to select the **Get measurements** option together with this option for transferring any stored measurements to the PC before erasing the logger memory.

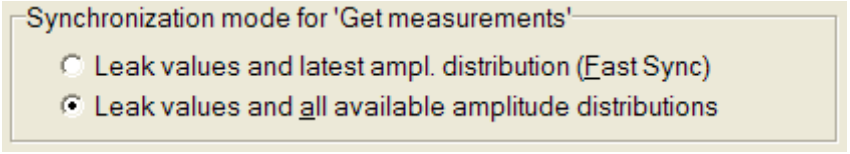
31 Order of synchronization



Synchronize only reachable loggers (in case only few loggers are in transmission range, "drive-by-operation"): During synchronization the System Communication Link will search for the next reachable logger. This option should be used during normal operation when loggers are deployed throughout the distribution network and only few loggers are in transmission range. If too many loggers can be reached at the same time, the System Communications Link won't be able to establish radio transmission to all loggers. See also note below.

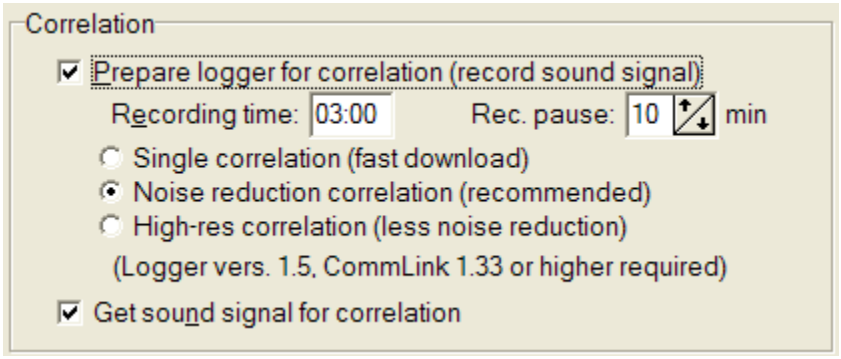
Synchronize according to logger list (in case many or all loggers are in transmission range): This mode should be used when many loggers are at the same place e.g. for initial programming or testing of the loggers. During synchronization the software will try to connect the loggers exactly in the same order as shown in the loggers list of the main window. This mode is not suited for collecting data of deployed loggers as the synchronization process follows a strict time course.
Wake up loggers: Wake up loggers that are in sleep mode. This function should be activated during synchronization outside of the logger's radio operation period (see also **Logger Setup**). Only for synchronizing according to logger list.

32 Synchronization mode

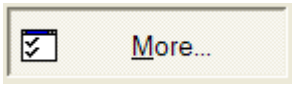


Leak values and latest amplitude distribution (Fast Sync): This allows fast synchronization of each logger, as there will be transferred max. one amplitude distribution. This mode is especially suited for drive-by collecting of data of deployed loggers.

Leak values and all available amplitude distributions: Full synchronization, may take longer time than Fast Sync mode, depending on number of stored amplitude distributions.



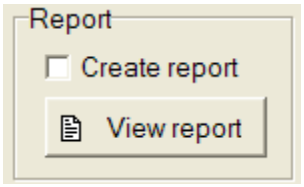
33 Correlation



Press the **More** Button to access the Correlation options

Prepare logger for correlation (record sound signal): Program logger for recording of sound signal at the desired recording time. The recording of sound signals allows correlation in order to locate the noise source (especially leaks). Correlation is only possible, when two loggers record the sound signal at the same programmed recording time. As frequent recording and transferring of the sound signal reduces battery lifetime, this option should only be used when needed.

Get sound signal for correlation: Get recorded sound signal. Sound signal is only available if logger was prepared to record sound signal during a previous synchronization, see below.



34 Report

Create report: If selected, a text file containing a short report of the last synchronization process will be created.
View report: Display report file.

35 Synchronization

Pressing the **Start** button will start the synchronization process. According to the selected order of synchronization, the System Communication Link will search for the next reachable logger or the next logger of the logger list. Once a logger is recognized, data will be transferred from and to the logger as specified by the synchronization options. Success and failure messages as well as warning messages will be displayed in the status panel of the **Main Window**. If audio output is switched on, there will also be audio messages. After successful synchronizing a logger in **Reachable loggers** mode the logger can't be re-synchronized the next 5 minutes.

Important Notes (please read):

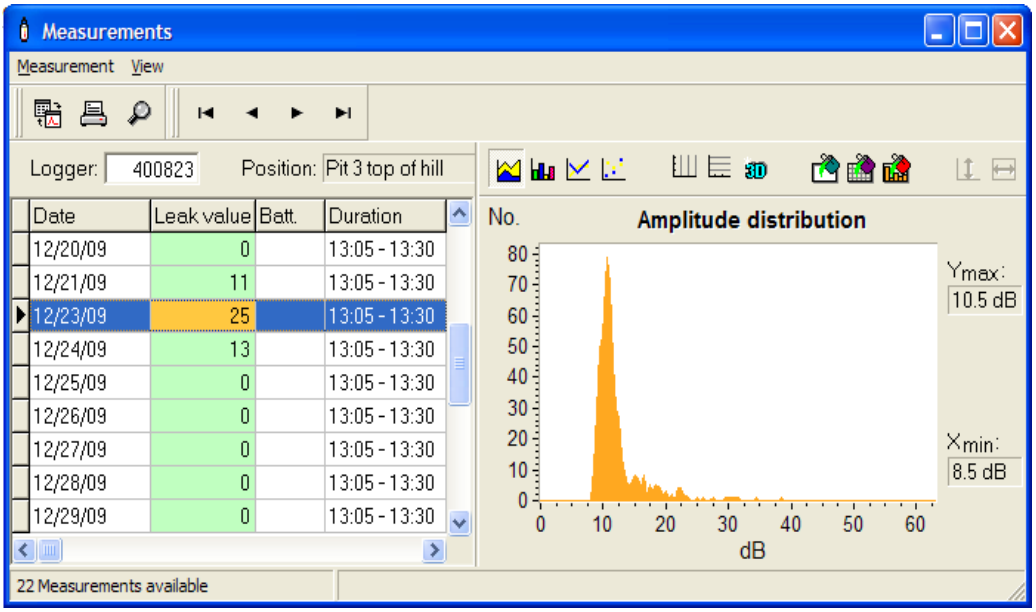
Please check whether **Order of Synchronization** option is adapted to the transmission situation. **Synchronize only reachable loggers** won't work properly with too many loggers and **Synchronize according to logger list** won't work properly with deployed loggers. In case synchronization of a single logger is desired please use the **Synchronize** command from the **Logger State** window.

Sound signal is recorded only once (the next time the logger clock coincides with the programmed recording time). This is because sound recording needs a large amount of memory space, thus not allowing more than one recording.

The shorter the time between logger programming and receiving the recorded sound signal the more accurate the results. As a rule of thumb sound recordings should be transferred to the PC 24 hours after logger programming at the latest. This is only important for sound recordings because of the strong influence of clock accuracy on the results. Amplitude distribution measurements and leak values are not influenced by clock accuracy. The logger can store amplitude measurements up to 10 days and leak values up to 180 days without losing any data.

If the synchronization process includes programming or receiving of sound recordings, it is very important that the synchronization process won't be interrupted until all loggers will be synchronized. Synchronization process is interrupted by pressing the **Synchronize** button again, by disconnecting the Comm Link, by exiting the program or switching off the PC. Interruption of the synchronization process will cause a switch off of the Comm Link, thus losing clock synchronization. However, subsequent correlation of the recorded sound signal is only possible with proper clock synchronization of the corresponding loggers! Interruption of synchronization doesn't affect leak values and amplitude distributions.

View Logger Measurements (Standard Professional Version)



The Measurements window allows viewing of the stored leak values, amplitude distributions and sound measurements. It is displayed by selecting the appropriate menu item or function button in the main window or by simply pressing **F5** (leak measurements and amplitude distributions) or **F6** (sound signals). It allows graphical and tabular representation of the stored data, plus printing and exporting of the data.

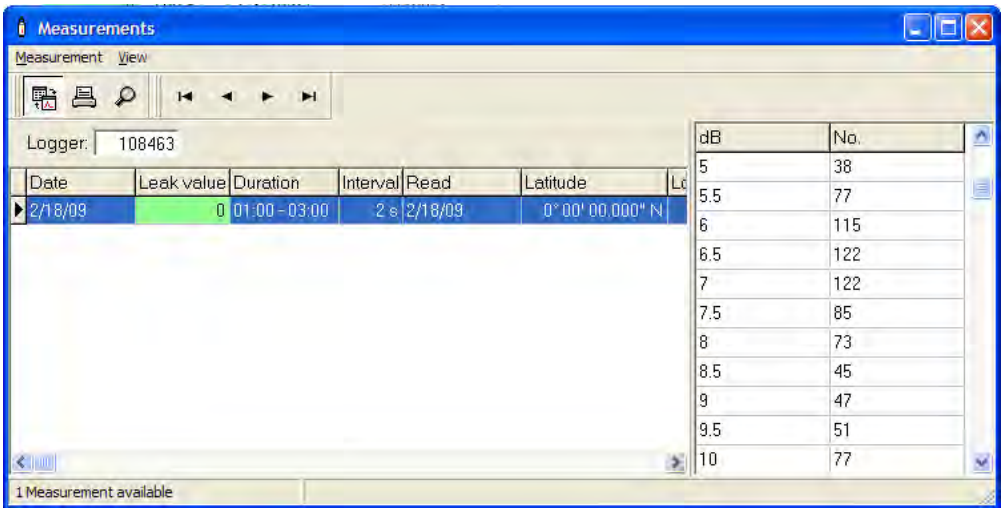
The window is parted into a list of the stored measurements of the selected logger (left side) and the measurement data of the currently selected measurement (right side). A measurement can be selected by simply clicking on the corresponding entry of the list or by using the **up** and **down** cursor keys. The vertical dividing line between the two parts can be moved by "grabbing" it with the mouse cursor and moving it to the left or right side.

36 Measurement list

When showing leak measurements, list displays (from left to right):
Measurement date, leak value (see below), programmed measurement duration, programmed measurement interval and date of measurement transfer.
Leak value: This value is evaluated from the amplitude distribution shown on the right side. Its range is 0 to 100, characterizing the leak probability. The leak value depends on spread and shape of the amplitude distribution. It is especially influenced by sharpness and position of its main peak. The field background is shown in orange/red colour in case the leak value exceeds the warning levels of a possible/probable leak, otherwise it is shown in green colour. The warning levels may be adjusted by the user (see **Program Setup**).

When showing sound signals, the list displays (from left to right):
Measurement date and time, date of measurement transfer and date of synchronization (programming).
Note: There shouldn't be more than one day between programming and measurement transfer because of the danger of inaccuracy when correlating the sound signals (see also **Logger Synchronization**)

37 Measurement data



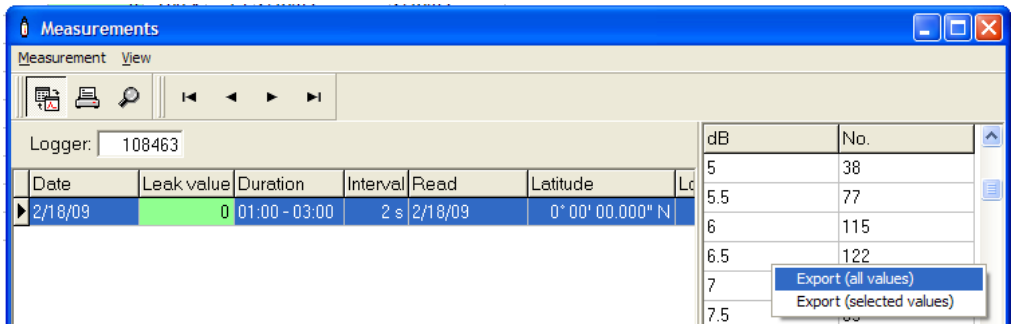
Measurement data can be shown in graphic or tabular view. Switching is done by the corresponding menu command or function button.

When showing leak measurements, the displayed measurement data is the amplitude distribution of the signal monitored and analyzed during the programmed measurement period (see **Logger Setup**). Analyzing the amplitude distribution allows obtaining further information concerning measurement conditions, interfering noise sources, etc.

When showing sound signals, the displayed measurement data is the sound signal recorded at the programmed measurement time. Due to the amplitude resolution of the recorded signal, measurement values can only be 10 or -10. In normal operation signal values should be equally distributed to positive and negative values.

Options:
During graphic view display features may be changed by the user (see **Chart Options**).

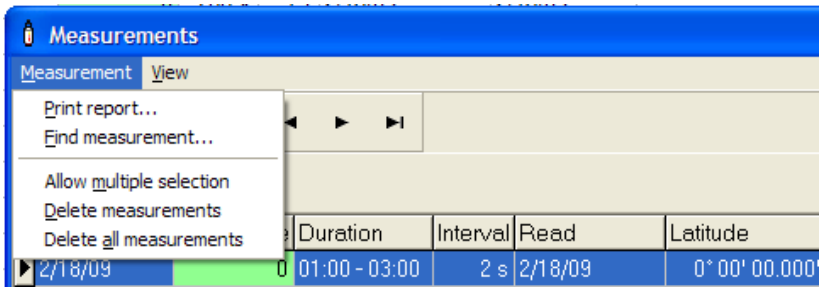
38 Export measurement data



During tabular view all or part of the displayed measurement values may be exported to a file or to the clipboard by pressing the right mouse button and selecting the appropriate item.

Menu commands:

39 Measurement



Print report...: Print overview list or graphic view of the displayed measurement data
Find measurement...: Find measurement by date
Allow multiple selection: Enable multiple measurement selection for deletion
Delete measurements: Delete currently selected measurement(s)
Delete all measurements: Delete all measurements of currently selected logger

40 View

Graphic/tabular view...: Toggle between graphic and tabular view of the measurement data

Buttons:

The function buttons correspond to the menu items **Graphic/tabular view**, **Print report** and **Find measurement**. The navigation buttons allow switching to another logger without leaving the Measurement window.

Chart Options (Standard Professional Version) 

The display features of the graphic view (chart) may be changed by the user:

Function buttons

From left to right:

Type of presentation: Area chart, bar chart, line chart, point chart

Chart options: Activate/deactivate vertical grid, horizontal grid, 3-D-view

Colours: Colour of the background, of the grid and of the foreground (measurement graph).

Unzoom functions: Adjust chart to all values (un-zoom in y direction), show all values (un-zoom in x direction). Note: Keys are not activated when the chart is displayed in the original scale.

Cursor

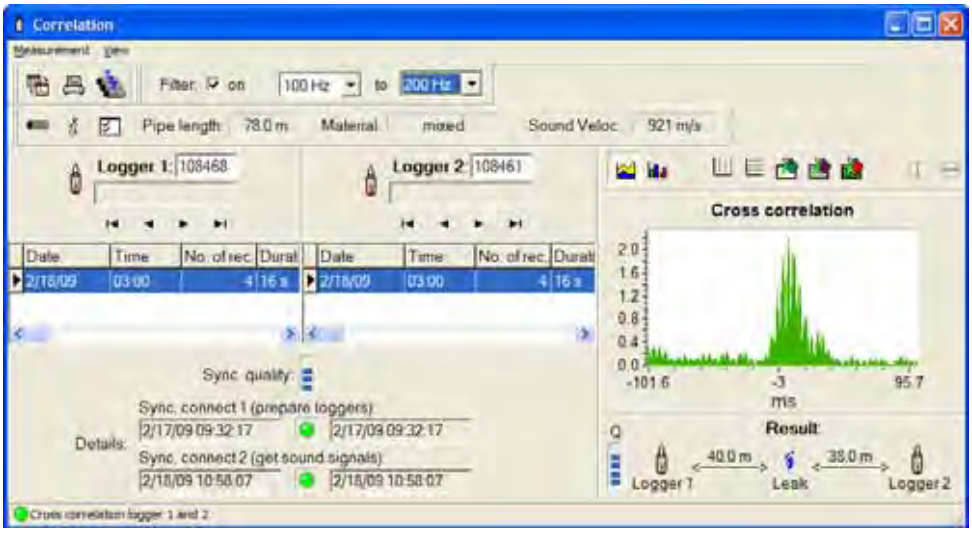
Pressing the left mouse button displays a vertical cursor line, together with a small, yellow window that displays x and y values of the cursor position.

Zoom

The right mouse button may be used for zooming in or out of the graphics. Selection of the desired zoom area is done by moving the mouse over the graphics with right mouse button pressed. Zooming may be repeated. The original representation may be recalled by using the **Un-zoom functions** (see above).

Settings will be stored at program exit and be recalled after program restart.

41 Correlate Sound Signals (Standard Professional Version)



The Correlation window may be displayed by selecting the appropriate menu item or function button in the main window or by simply pressing **F7**. It allows correlating of the sound signals of two loggers in order to calculate leak positions.

How to correlate:

1. Select loggers

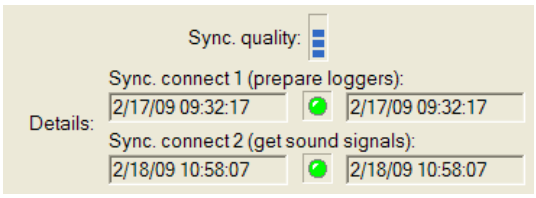
Enter logger No. or use navigation buttons to select logger 1 and logger 2:

When selecting the same logger No. as logger 1 and 2 auto correlation will be performed, otherwise the sound signals will be cross correlated (normal operation mode for leak location).

2. Select sound recordings

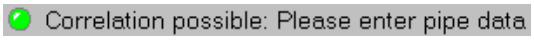
Click on desired sound recording in the sound recordings list of logger 1 or logger 2.
After selecting a sound recording of a logger, the software attempts to find a fitting sound recording in the logger list of the other logger. If an appropriate sound recording is found, it will be automatically selected. Cross correlation (leak location) is only possible in case the 2 selected sound recordings have been recorded at the same date and time.

42 Sync. Numbers



Newer versions of the logger firmware provide 'Sync. Numbers', in order to recognize whether the sound recordings have been made with the same time synchronization or not. In case a 'Sync. No.' exists (see below sound recordings list), the 'Sync. Numbers' of the 2 sound recordings have to be the same. The 'Sync. No.' will increase with every switch-on of the System Communication Link.

43 Status panel



When selecting loggers and sound recordings the status panel shows whether correlation is possible or not and gives further information.

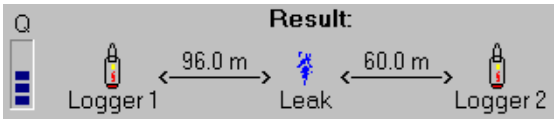
3. Enter pipe data

For calculating cross correlations, pipe data has to be entered by selecting the menu item **Measurement - Enter pipe data...** or pressing the button

Up to 4 different pipe sections may be entered by selecting pipe section length, material, diameter and sound velocity. If material or diameter is not in the list or exact sound velocity is known, sound velocity can be entered manually by selecting material **Other**. Entered pipe data will be automatically stored in internal database.

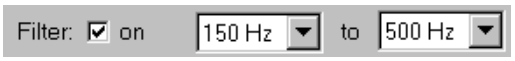
Auto correlation may be done without entering pipe data.

43.1 Result display



After entering pipe data, the correlation results will be displayed below the correlation graphics (or values table, if tabular view is selected). The result display shows the distances between the two loggers and a possible leak. On the left side there's a small bar graphics (**Q**) indicating the calculated quality of the correlation (0 to 5 bars). The higher the value the better the correlation quality and the higher the leak probability.

43.2 Filter



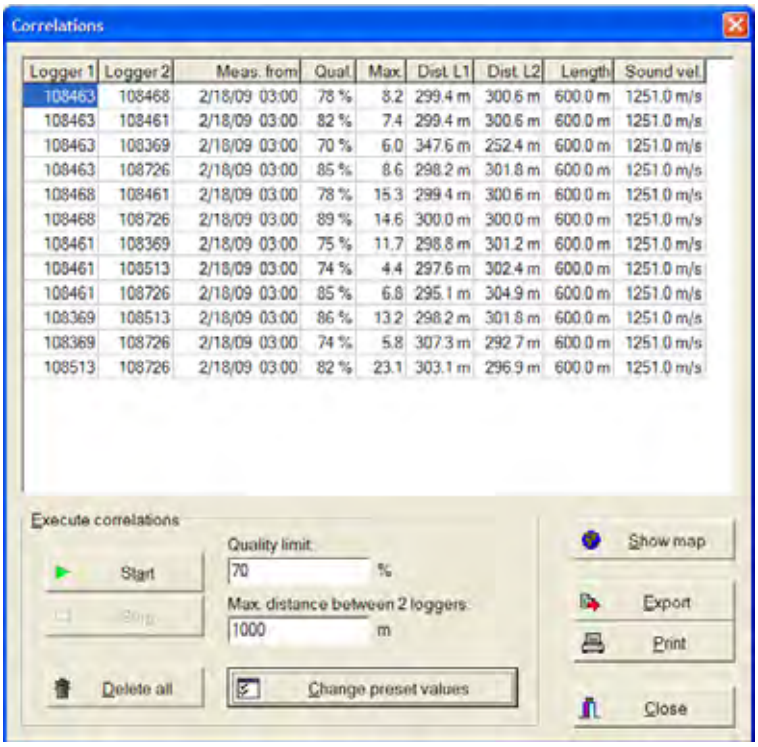
Quality of correlation results may be improved by using the filter function. Filter frequencies will be preselected after entering the pipe data and may be adapted manually by the user.

Test correlation

Function for a quick check whether the selected combination of loggers produces a reasonable correlation (i.e. probable leak) or not. Pipe data does not need to be entered (the correlation will be calculated on base of a pipe length of 600 m and a sound velocity of 1000 m/s). Correlation quality will be calculated and will allow quick assessment whether a leak is probable.

Note: This function is not suitable to obtain leak distances. For calculating a correct correlation result (distance to leak) it is necessary to enter correct pipe data and to switch off the test correlation function.

Execute all test correlations (main menu item):



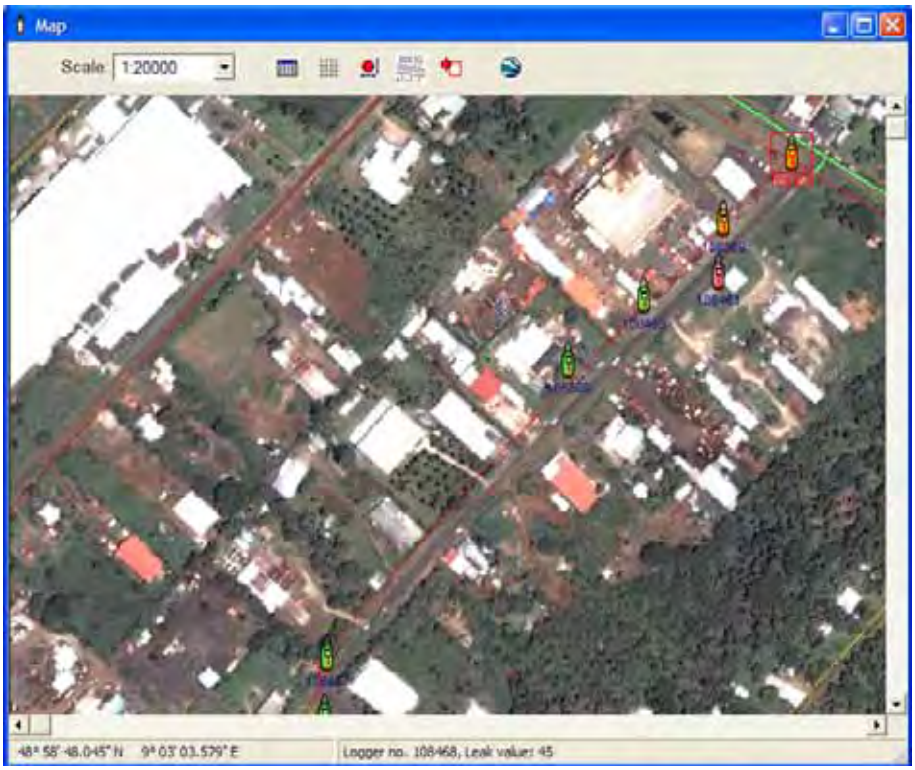
Function for testing all combinations of loggers whether there are probable leaks or not. A window will appear containing the test results. It is possible to adjust the test pipe length and sound velocity, as well as the quality limit value.

After pressing the **Start** button, correlation quality will be calculated for each possible combination of loggers (value 0 to 100%), in case there are appropriate sound recordings. Only test correlations with a quality value exceeding the limit value will be listed in the result list (correlation quality, peak maximum value, distance to the middle, logger numbers, date and time of sound recording). Results may be sorted by column (mouse click on column header). They also may be exported or printed. Execution of this function may take up some considerable amount of time, depending on the number of loggers in the main window's list.

The remaining function buttons and menu items have the same functions as in the **Measurements Window**.

Logger Map (Standard Professional Version)

The Logger Map window may be displayed by selecting the appropriate menu item or function button in the main window or by simply pressing **F8**. It is used to show a geographical view of the project's loggers.



The loggers are displayed as symbols together with their logger number on a geographical map. The loggers position can be modified either by editing the coordinates in the **Logger Setup** window (press right mouse button and choose **Show logger setup**) or by moving the logger symbol by mouse (see below). Clicking on a logger symbol will select the according entry in the logger list of the **Main Window**. Double clicking on a logger symbol will open the **Measurement Window** showing the stored leak values and amplitude distributions of the selected logger (or press right mouse button and choose **Show measurements**). The colour of the logger symbol corresponds to the background colour of the logger list leak value: In case the leak value exceeds the warning level a red logger symbol is shown otherwise an orange (possible leak) or a green (no leak) symbol is shown.

Scale:

Change scale of map. The scale may be also changed by pressing the right mouse button and selecting **Zoom in** or **Zoom out**.

44 Function buttons:

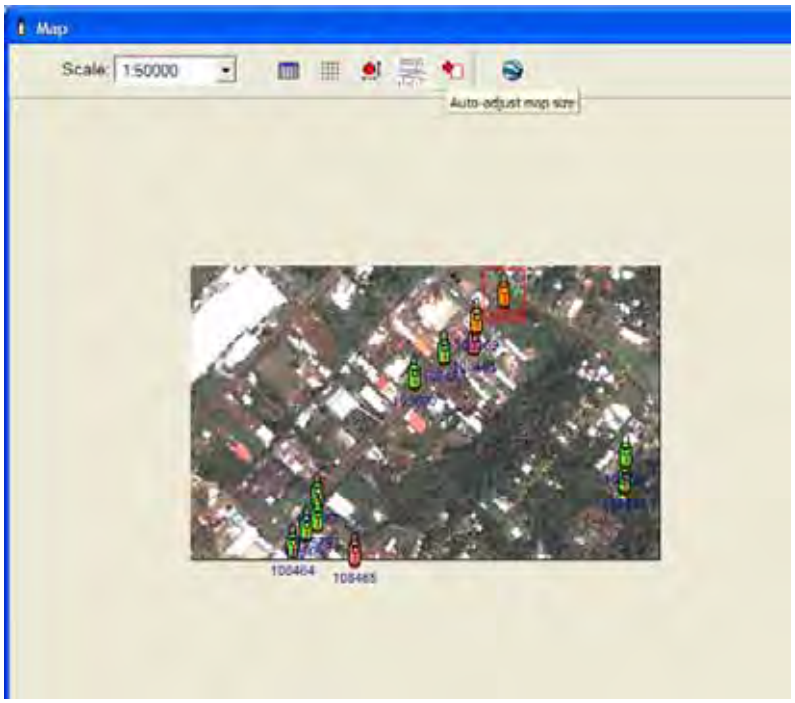
Show main window: Switch to main window.

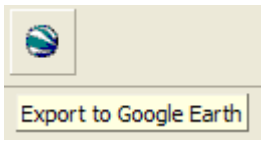
Show grid: Toggle display of a coordinates grid.

Move loggers: When pressed, loggers may be moved by mouse: After selecting a logger symbol, it may be dragged to a new position with the left mouse button.

Picture manager: Shows a window that allows managing of the background pictures (maps). One or more picture files may be inserted to the pictures list. The pictures origin coordinates and extensions may be adapted numerically or graphically (picture manager has to be open).

Auto Adjusts the Map size to fit the window and display all the loggers. This is demonstrated in the image below.





When the Loggers have the correct co-ordinates entered either manually or via a GPS Handheld PDA with Scanner when deployed then the Google Earth facility maybe used to plot the loggers on the Planet. See Lift and Shift instruction manual for further information.

Status panel:

The left section indicates the mouse cursor position transformed to geographical coordinates. The right section shows the logger number of the selected logger, together with the leak value of the newest measurement (if available).

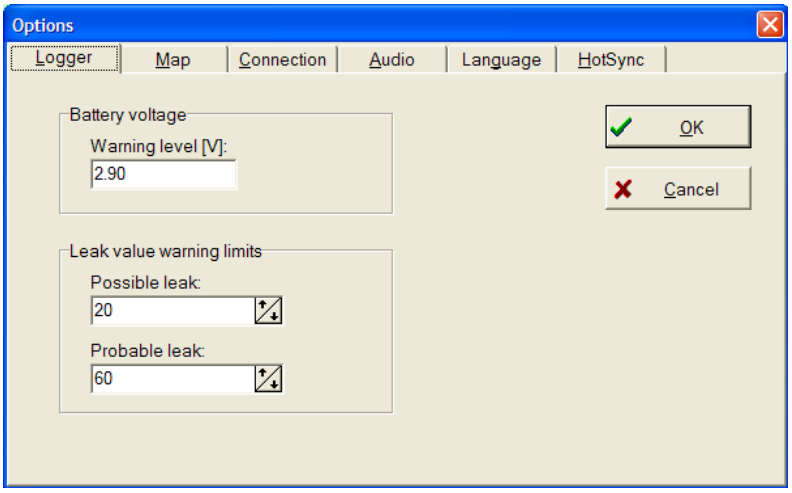
Map origin coordinates and extensions may be changed in the **Logger Setup** window.

Deployment of Loggers: when deploying the loggers around the network the logger spacing is critical especially if correlation recordings are made. Below is a guide to Logger Spacing who depends on Pipe Material and Network Pressures to determine the distance between loggers. Sometimes it's not practically possible to maintain the spacing due to actual distance between valves and hydrants therefore this table can only be used as a guide and common sense is required.

Pipe Material	Pressure	Diameter Less than	Maximum Logger Spacing
Ductile or Cast Iron	Higher than 25m	250mm	150m
Ductile or Cast Iron	Less than 25m	250mm	100m
A.C	Higher than 25m	250mm	120m
A.C	Less than 25m	250mm	100m
PVC	Higher than 25m	250mm	90m
PVC	Less than 25m	250mm	60m

Program Setup (Standard Professional Version)

The Program Setup window may be displayed by selecting the appropriate menu item (**Options - Setup**) or function button in the main window. It allows adjustment of general settings of the program:



45 Warning levels

Selection of warning levels for leak value and logger battery voltage. If the values received from the loggers exceed the warning level, the corresponding field will be shown with a different background colour (see **Main Window** and **View Logger Measurements**). Additionally, there will be a warning message in the status panel during synchronization. If audio output is switched on, there will also be an audio message. Below is a guide to what warning levels to set depending on Pipe Material and Network Pressures.

Pipe Material	Leak Settings	
	Possible	Probable
Ductile or Cast Iron(High Pressure Greater than25m)	50	80
Ductile or Cast Iron (Low pressure lower than 25m)	40	60
A.C (High Pressure Greater than 25m)	50	80
A.C (Low Pressure less than 25m)	40	60
PVC (High Pressure Greater than 25m)	25	50
PVC (Low Pressure less than 25m)	20	50

46 Map

Selection of origin coordinates and extension of the **Logger Map**.

47 Connection

Selection of COM port.

48 Audio

Create/change recordings of audio messages during synchronization process. The respective message can be selected by choosing a list entry. The recordings may be played (if available) or re-recorded. For new recording of a message the option **Allow recordings** must be enabled. Recording and playback volume settings may be changed by pressing the corresponding buttons. They will display a Windows built-in utility software that allows adjustment of the volume. Audio output may be suppressed by disabling the option **Audio output during synchronization**.

49 Language

Selection of display language.

50 HotSync

Registering and un-registering of ZONESCAN 800 conduit (see Data Synchronization via Palm HotSync®).

Data Synchronization via Palm HotSync®

The ZONESCAN 800 software package includes a software module for transferring measurement and logger setup data between a PC (laptop) and a Palm OS® driven handheld via the Palm HotSync Manager® . This software module is called a conduit.

Registering Conduit

Before using the ZONESCAN 800 conduit, it has to be registered to the HotSync Manager (Palm Desktop software has to be installed before):
- Start ZONESCAN 800 Windows software
- Select Options - Setup from main menu
- Select HotSync tab
- Register conduit (in case it is not yet registered)

In case the ZONESCAN 800 HotSync conduit is already registered a green LED will be displayed (otherwise red LED). In case of problems please refer to **ReadMe** file in **Conduit** folder.

Updates of the ZONESCAN 800 software package may contain newer versions of the conduit. Registration of updated conduit will be done automatically as soon as the ZONESCAN 800 Windows software is started, manual registering is not necessary. Therefore, it is strongly recommended to start the ZONESCAN 800 software at least once after software update before initiating a HotSync.

Note:
Besides of registering the conduit, the ZONESCAN 800 Windows software doesn't contain any functions regarding HotSync data synchronization. All data transfer is done by the conduit itself. Therefore, it is not necessary to run the ZONESCAN 800 Windows software during a HotSync. In order to avoid data conflicts, it is recommended to exit the ZONESCAN 800 Windows software before starting a HotSync.

51 Conduit Setup

Before initiating the HotSync process, the synchronization mode of the ZONESCAN 800 conduit should be checked and eventually be modified.

Click the HotSync Manager icon, then select **Custom**. Synchronization mode of the ZONESCAN 800 conduit will be displayed and may be changed:

52 Synchronize the files
This is the normal operation mode for synchronizing the databases: Measurement data will be transferred from the handheld to the PC and logger setup data will be transferred into the direction depending on where it was modified. New loggers may be added to the PC database as well as to the handheld database. Due to security reasons, deleting of loggers will not be mirrored from the handheld to the PC (in order to avoid possible data loss).
Important Note 1: The name of the handheld ZONESCAN 800 project **must** exist inside the PC database (database of last installed ZONESCAN 800 Windows software). In case the project name doesn't exist **no data transfer will occur**. The handheld project name may be adjusted by selecting Options - Settings - Project inside the handheld ZONESCAN 800 software.
Important Note 2: In this mode the handheld should always be synchronized with the same PC. It is possible to synchronize more than one handheld with the same PC but not vice versa. Synchronizing a handheld to several PCs may result in loss of the handheld's ZONESCAN data.

53 Handheld overwrites PC

Logger and measurement data will be mirrored from handheld to PC. Existing data in the PC database will not be deleted (but may be overwritten). In case the handheld project name does not exist inside the PC database, the project name will be automatically added as new project to the PC database. This mode is especially useful for transferring handheld data to several PCs.

Do Nothing (No Action)

No data transfer will occur.

Change of synchronization mode may be done temporarily (e.g. only valid for next HotSync) or permanently. In the latter case **Set as Default** has to be marked inside the Change dialog.

54 Connection Type

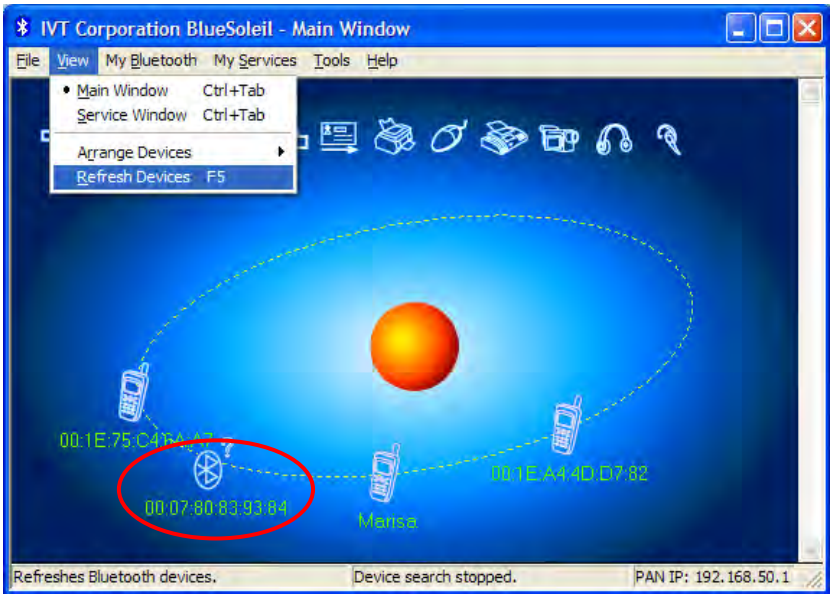
In case HotSync is done only via USB port, the serial port option should be disabled because of a possible conflict with the ZONESCAN 800 Windows software:
Click the HotSync Manager icon, then click **Local Serial** in case there's a check mark left to the entry (un-check entry).

55 Zonescan820 Commlink Setup

The Zonescan820 Commlink (shown below) uses Bluetooth to connect with a computer. The Computer either requires an inbuilt Bluetooth or a USB Bluetooth dongle for communication with the Commlink. The Bluetooth Hardware usually has Bluetooth Managing Software which controls it.

Bluetooth Manager Software

The Computers with inbuilt Bluetooth are normally activated by pressing a button or flicking a switch. Once this is done the Bluetooth symbol will appear in the right side of the task bar, some have a short cut on the desktop, double click to open. USB Bluetooth Dongles will require installing the software; a short cut will be created. The screen shot below is an example of the Bluetooth Software Manager.



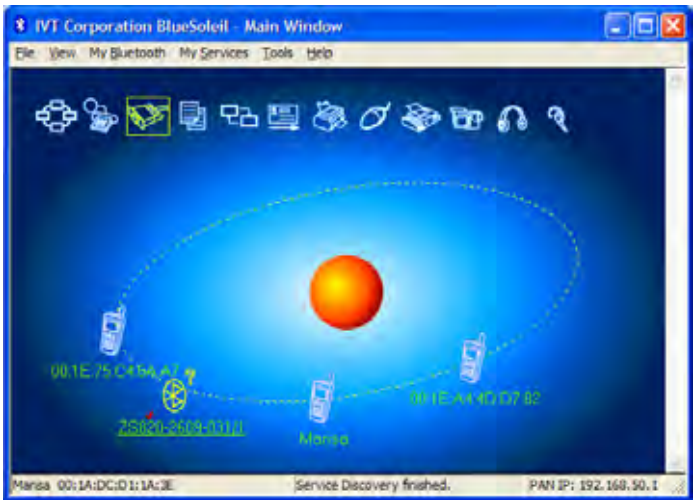
1.

1. Open the Bluetooth Manager on your PC, turn on the Zonescan 820 Commlink and refresh or search for devices. The Commlink will appear as a device but not as a mobile phone.

2. Create the Bluetooth Link by selecting the Device, double click the symbol and enter the pin code which is 4 zeros (0000) and click OK, see below.

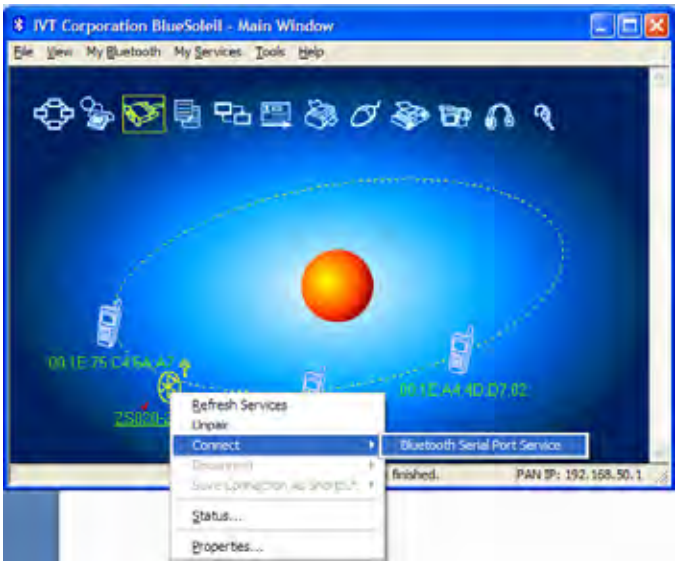
2.

3. The Serial number of the Commlink (this is on a label underneath the unit) will be displayed.



3.

4. Connect to the ZS820 Bluetooth device by choosing the option to connect or pair.

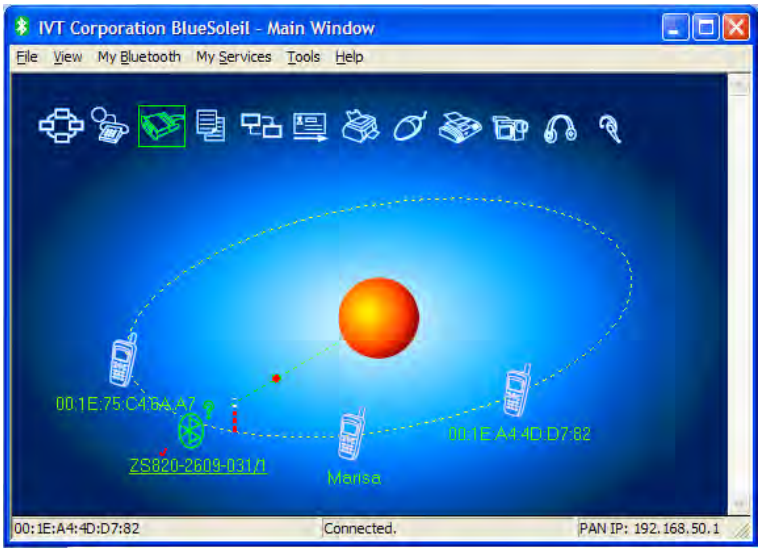


4.

5. Connection to the ZS820 Bluetooth device will happen through a designated com port. In this example it is com5- remember this port.

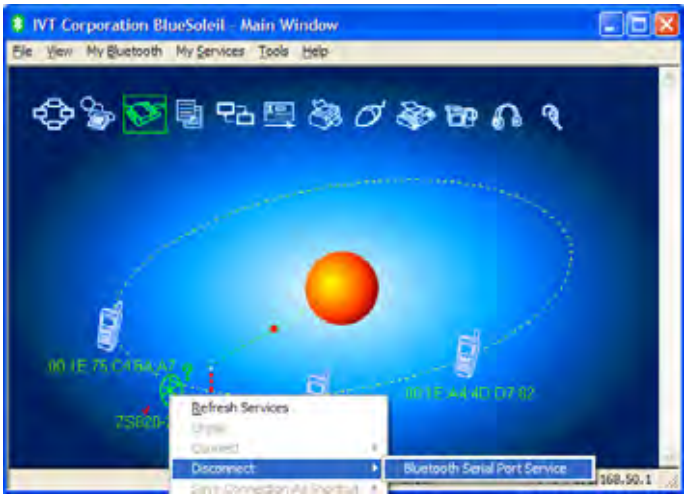
5.

6. For this Bluetooth Utility a link is shown by a dotted line to the Sun. Other Bluetooth Managers will display this in another way.



6.

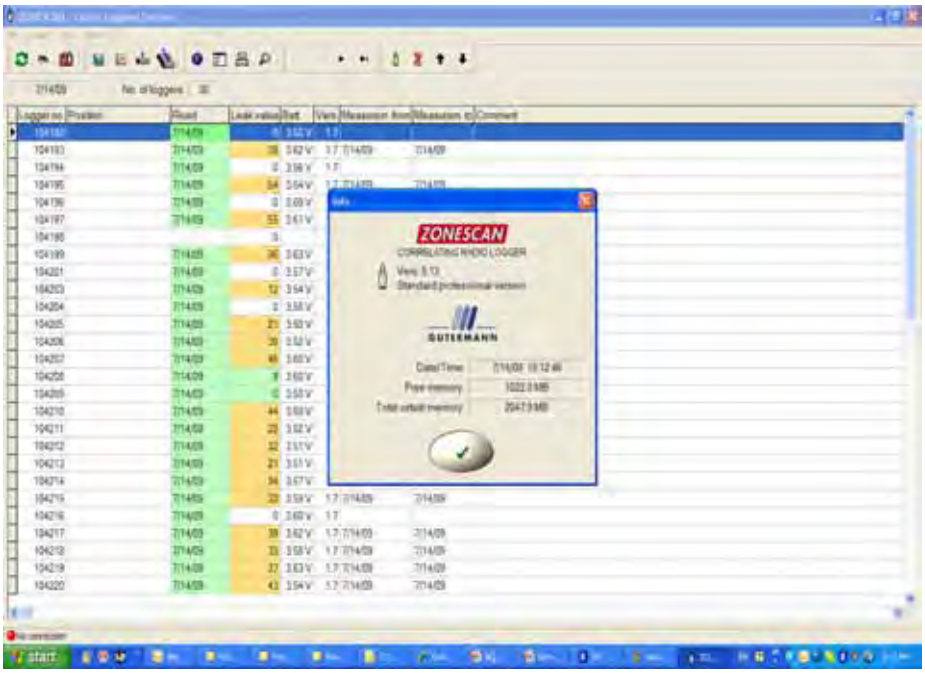
7. Disconnect from the ZS820 Bluetooth device by choosing the option to Disconnect.



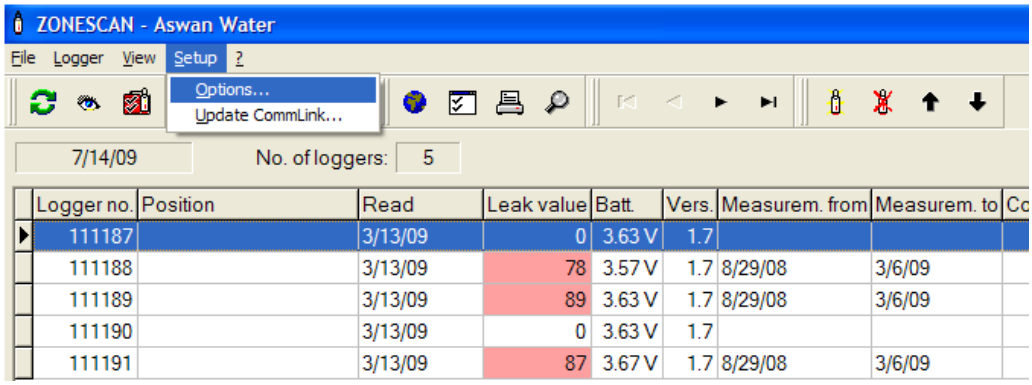
7.

56 Creating the link between the Zonescan Software and Bluetooth Manager

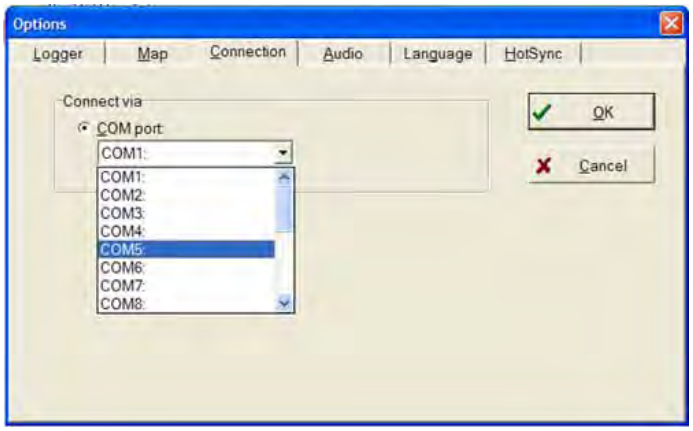
1. Open the latest version of the Zonescan Software, in this example its 5.13.



2. Go to Setup and then choose Options.



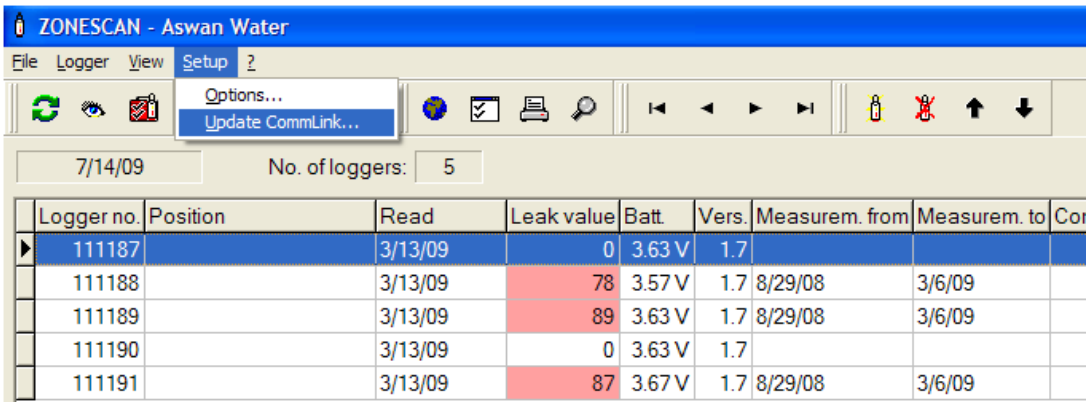
3. Select the Commlink's allocated com port, in this example COM5 in the Connection drop down and click OK. Use Logger State to communicate with a logger to check the setup is correct.



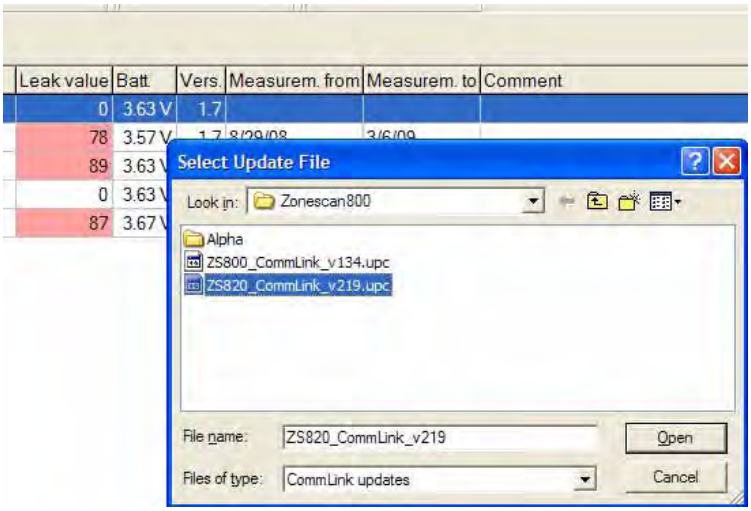
Note. The Zonescan820 is rechargeable so charge the unit before use.

57 Updating the Commlink Firmware

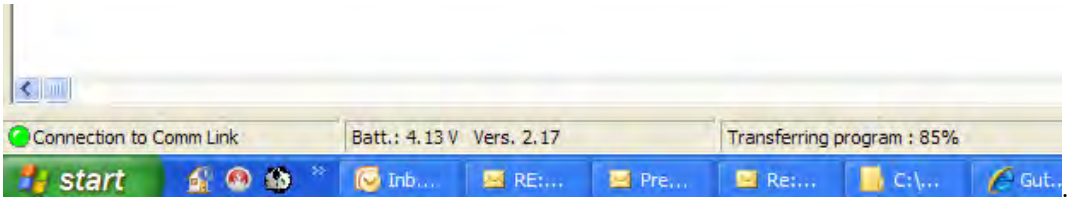
Make sure a connection is made with the Commlink by communicating with a logger using the Logger State function, then close the Logger State window.



Select Setup then Update Commlink if a new version of the firmware is released. The update takes approximately 10 minutes.

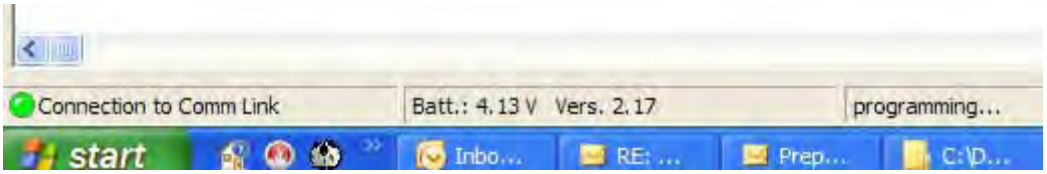


Browse for the saved latest version update file and then select and open

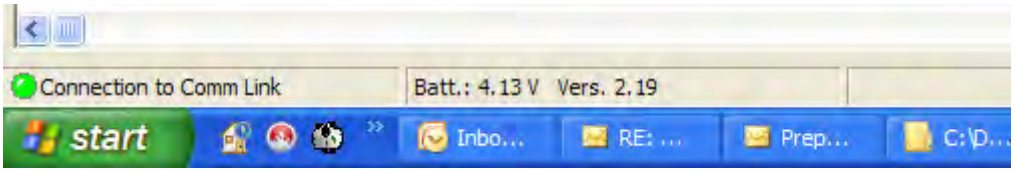


The progression of the update is displayed as a counting up percentage as shown above.

Once this reaches 100% then programming begins as shown below.



The connection will fail as the Commlink will turn itself off when programming is complete. Switch the Commlink back on and establish a connection. The new version firmware will be displayed next to the battery level.



When a new version firmware is released you will be notified by email with a copy of the new firmware file.

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Notes: