ZONESCAN net
Version 1.4.0

REV 1. JW

Table of Contents

1 Introduction

Gutermann has developed the **ZONESCAN net** system for professional leak detection in water networks.

This unmanned, acoustic leak monitoring system with noise-level measurement and correlation guarantees that leak detection specialists are deployed only at the actual leak locations.

1.1 Purpose and field of use of the software

Continuous leak monitoring of the entire water network
Distributed over the entire water network, ZONESCAN loggers continuously monitor and analyze the noise characteristics and can thereby detect the presence and location of leaks.

Extensive leak database allows for a permanent reduction in water loss
Each data logger stores the leak analysis results from the last 30 days, including the detailed noise level distributions from the last 10 days. This measurement data is automatically stored in the powerful **ZONESCAN net** database. This is used to produce detailed logs for the maintenance personnel and, ultimately, a systematic analysis of historical data for optimizing future water network planning.

Integration of GPS and GIS in the ZONESCAN net system
The **ZONESCAN net** system offers the possibility to integrate GPS and GIS for automatically importing noise level, correlation data and the latest network information.

1.2 Software functionality

General description

The **ZONESCAN net** logger is mounted directly on the water network, where it stores the noises generated along the pipe network and the ambient temperature. The statistical analysis of the stored values indicates whether or not a leak is present. A number of strategically mounted **ZONESCAN net** loggers allow all segments with water losses to be identified.

The data measured by the logger is collected by the repeaters, which are mounted above ground. The repeaters then transmit the data via radio signal to the ALPHAs. The collected data is then transmitted by means of GPRS via the ALPHA to your **ZONESCAN net** program for further processing.

The software automatically evaluates the collected data daily. The more exact the pipe data entered by the user, the better the results. The results calculated in **ZONESCAN net** are numerically and graphically presented in

the form of histograms and frequency distributions, facilitating the identification of the leak locations. A numerical leak indicator simplifies the interpretation of the statistical evaluation.

Figure 1 Functionality of logger, repeater and Alpha

Interactive communication between ZONESCAN net and the leak detector

While conventional radio loggers are equipped with a simple radio transmitter, the **ZONESCAN net** loggers feature a transceiver (combined transmitter and receiver). This allows for interactive communication between the sensor located in the chamber and the leak detector. In addition to correlation and remote listening, programming of the **ZONESCAN net** logger is also performed via radio signal directly from the vehicle (i.e., without physical contact with the logger). Thus, the factory settings can be easily adapted at any time by the user to meet his specific measurement needs.

Powerful radio transmission

The **ZONESCAN net** logger is equipped with a powerful, 20 mW transmitter that enables clear and uninterrupted radio reception over longer distances. Not only does this make possible correlation with an adjacent **ZONESCAN net** sensor, but it also results in an enormous improvement in the productivity of the deployed leak specialists.

1.3 Function description

1.3.1 Structure

Note!
If the Alpha fails, no data can be collected by the repeater and logger and transmitted!

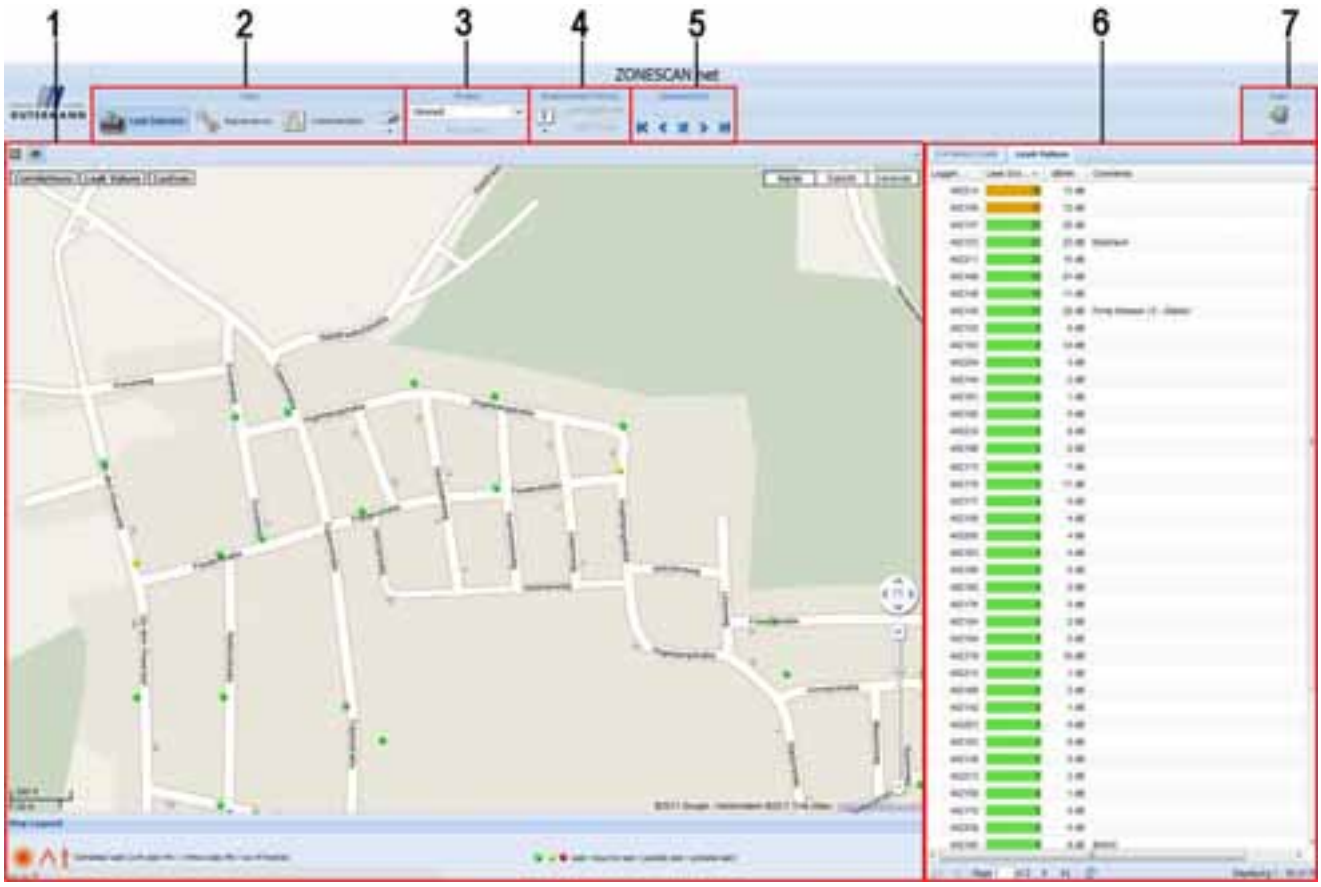


Figure 2 Structure

1 Map area	The Map area contains a Google Maps map with the area of the selected project. Use the buttons located above the map to execute various functions which vary depending on "2 View" (Leak Detection or Maintenance). For an explanation of the individual functions, hold the cursor over the button. The buttons in the upper part of the map can be used to display and hide individual elements of the map. Depending on "2 View" (Leak Detection or Maintenance), the Correlations, Leak Values and Custom or Alpha, Repeater, Logger and Custom fields are displayed. Changes made here affect the view in "6 List Area". By default, a legend is displayed in the lower part of the map.
2 View	In View, the user can switch between Leak Detection, Maintenance and Administration. Use the Printer drop-down menu to print the screen, the map, correlated leaks or the leak values.
3 Project	In the *Project* menu bar, the user can select the desired project via the drop-down menu.
4 Measurement Period	The measurement period can be changed in the drop-down menu. Select from 5 days, 30 days or

	an entire month. The current setting is displayed at the right.
5 Selected Item	Use the arrow buttons to change between the individual values in the list area. The current selection is displayed in the upper area.
6 List area	In List area, the user finds all data relevant for the evaluation.
7 Logout button	The user logs out with the logout button.

1.3.2 Google Map Area

The Google Map Area has the normal features that Google Maps offers such as changing the map view to terrain and satellite.

Figure: 2.1 Google Map

Figure: 2.2 Google Satellite

Figure: 2.3 Google Terrain

Figure 2.4 Zoom to fit All items

In the top left corner of the above window is 3 symbols, moving from left to right the first symbol is the Zoom to Fit all items which adjusts the map by automatically zooming in or out to fir all items in the Window. The second shows or hides the Map Legends at the bottom of the screen. The third, Show Marker Label which displays the logger numbers or not next to the coloured dots representing the loggers.

Figure 2.5 Zoom In

The Google Slider allows one to Zoom into an area on the map

Figure 2.6 Zoom Out

This is the opposite function to the previous Screen and allows the user to Zoom Out of the Map.

1.3.3 Logger and Correlation Layer

The user may choose their logger and correlation display preferences by ticking the relevant box within the drop down menu as shown in the following screen shots.

Figure: 2.7 Correlation Drop Down Menu

In the window above the Probable, Possible, w/o Pipe and out of bracket correlations maybe ticked to show or unticked to hide the correlation icons.

Figure: 2.8 Logger Noise Drop Down Menu

Figure 2.8 shows the Logger Noise options Probable, Possible and No leak, tick to display all the loggers on the map or untick to hide any of the options.

Figure: 2.9 Logger Custom Down Menu

Figure 2.9 allows the user the to select the Pipe Net Work created using the correlation wizard or KML layer provided by the Water Authority.

2 Leak detection

Figure: 3 Leak detection

Note!
The following description assumes a fully activated map menu!

The sorting of the tables can be changed at any time. Click the small arrow in the title field of the value that you would like to change. In the selection box that opens, you can sort in either alphabetical or reverse alphabetical order.

The fields can also be displayed or hidden from view. To do this, click the small arrow in the title field. In the selection menu that appears, move the cursor to the *Columns* item. In the list that is now displayed, you can set a check mark in the field that you would like to display or remove the check mark from a field that you would like to hide.

2.1 Correlated Leaks tab

Figure: 4Leak detection

Click the *Correlated Leaks* tab to display all values in the list area that you have displayed in the map.

2.1.1 Table fields

Quality	A statement on the quality of the correlation graph is made. The assessment ranges from 0 – 100%. The settings for the display of a possible or probable leak are made under Administration in Settings.
Maximum	Maximum describes the maximum of the correlation curve and provides additional information on the Quality field. The assessment ranges from between 0 and 100, where 0=no signal matching and 100=full signal matching. In general, the higher the value, the better the correlation.
Logger 1	Reference number of the first logger that was correlated.
Distance L1	Distance L1 specifies the distance between Logger 1 and the noise source.
Pipe Length	This is the total pipe length between Logger 1 and Logger 2.
Distance L2	Distance L2 specifies the distance between Logger 2 and the noise source.
Logger 2	Reference number of the second logger that was correlated.
Sound Velocity	The calculated or entered sound velocity is displayed here.
Pipe Setup	Located in the *Pipe Setup* field are red, orange or green indicators. Red indicators indicate that no pipe settings have been entered yet and the used data were taken over from the default values. Orange images appear if manual settings were made and not all details are known (pipe length, diameter and material are known). With manual settings, the course of the pipe cannot be changed, unlike with the Pipe Wizard. Green indicators mean that all details are known for the settings and were taken over in full from the Pipe Wizard. To enter the pipe settings, use the mouse to click the small arrow in the field that you would like to change. In the menu that appears, select *Manual Pipe Data Entry* if you would like to enter the data "manually" or *Start Pipe Wizard* if the data are to be determined automatically. To delete existing pipe data, select the *Delete Pipe Information* item.

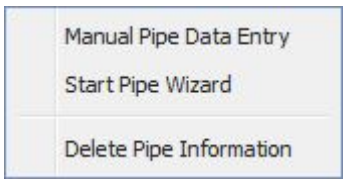


Figure 5 Entering pipe settings

Entering pipe data manually:

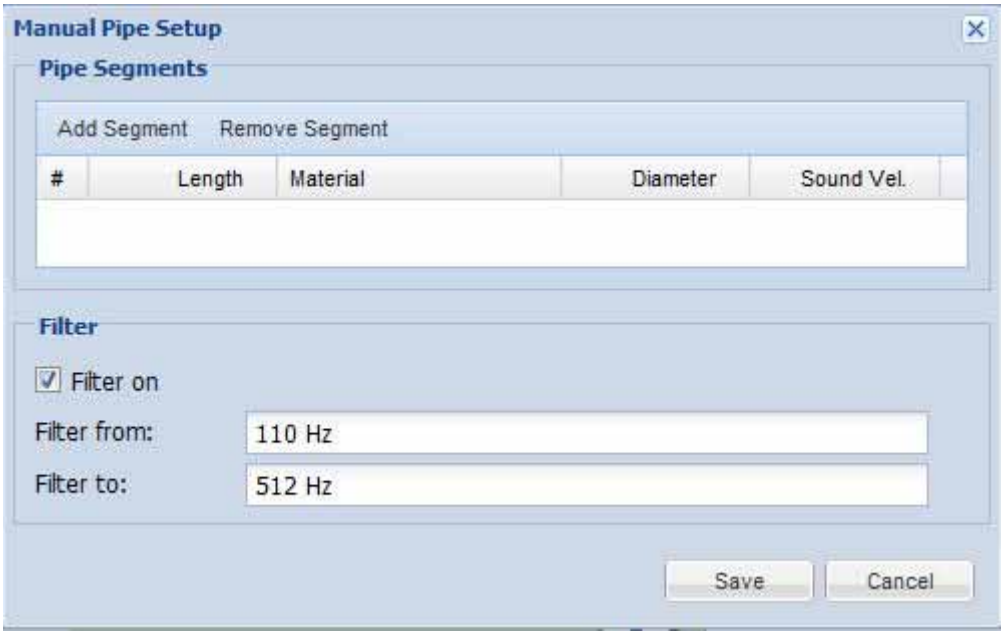


Figure 6 Entering pipe settings

Click the *Add Segment* button to enter a new pipe segment. Then complete the *Length, Material* and *Diameter* fields. The sound velocity is automatically calculated from your values and entered in the respective field. If you have more exact information on the sound velocity in this pipe segment, you may enter it manually in this field.

To set a filter according to your settings under *Maintenance > 4.4 Current Project*, activate the *Filter on* check box.

To apply the settings, click the *Save* button.

An already stored entry can be removed by clicking *Remove Segment*; confirm removal by clicking *Save*.

Entering pipe data with the Pipe Wizard:

With the Pipe Wizard, data for the pipe settings are determined automatically via the pipe network and entered.

First, you are requested – if necessary – to move the logger to the correct position. To do this, click the logger that you would like to move and drag it to the desired position. Repeat the process with both loggers until they are correctly positioned. Use *Undo* to undo your last change.

The *Logger 1* and *Logger 2* fields indicate the respective, current positions of the loggers.

Once the loggers are correctly positioned, click *Next*.

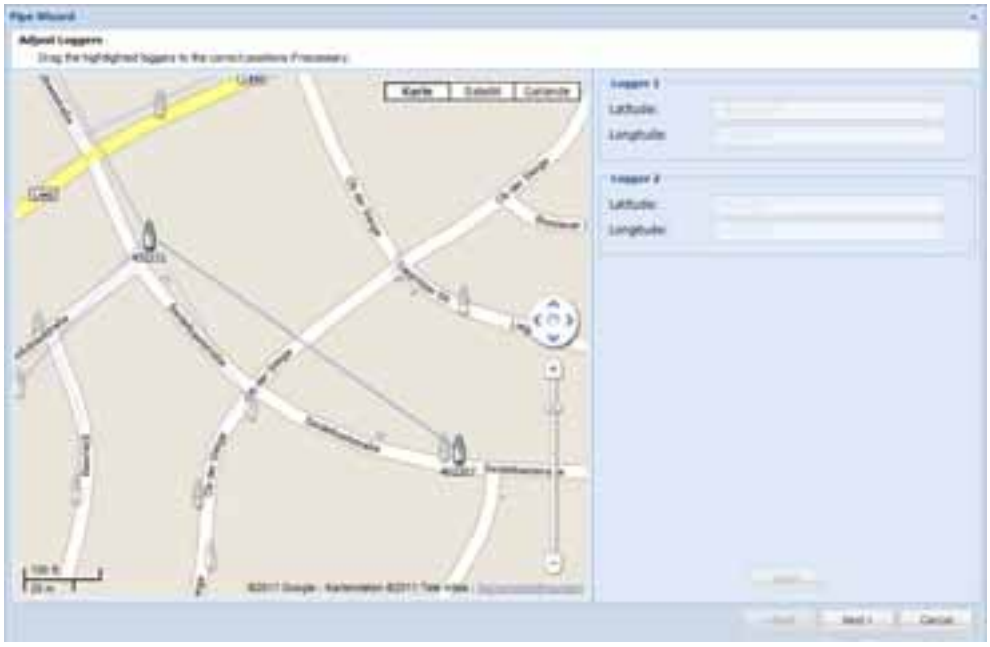


Figure 7 Adjusting loggers

In the next step, you have the option of changing the course of the pipeline. To do this, click the small box in the middle of the pipe that you would like to move. With the mouse pressed down, drag the pipe to the desired position. You can now repeat this with the individual segments until the pipeline is correctly positioned. Use *Undo* to undo your last change.

Displayed in the *Pipeline Properties* box are the current number of segments and the current pipe length.

After adjusting the course of the pipeline, click *Next.*

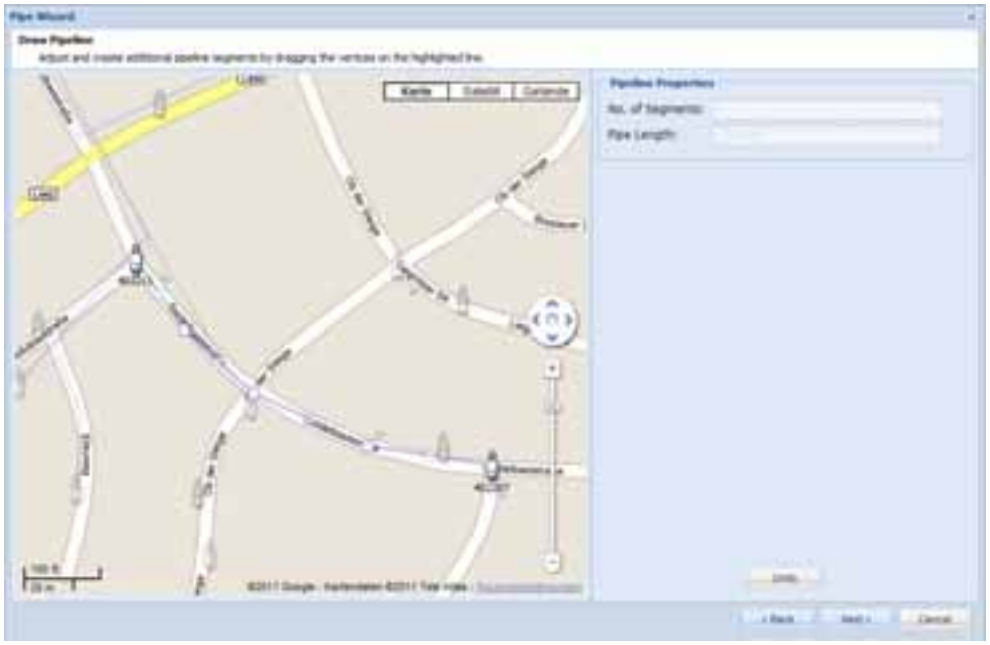


Figure 8 Adjusting the pipeline

Next, you are prompted to edit the properties of the individual segments of the pipeline. Complete the *Length, Material* and *Diameter* fields.

Note!
If the data – Length, Material and Diameter – are contained in a displayed KML layer, it can be displayed in the map by clicking the corresponding pipeline. The values can be taken over 1:1 from the pop-up window that opens.

The sound velocity is automatically calculated from your values and entered in the respective field. If you have more exact information on the sound velocity in this pipe segment, you may enter it manually in this field.

After all fields are filled, click the *Finish* button to start the calculation. The calculated values are stored automatically.

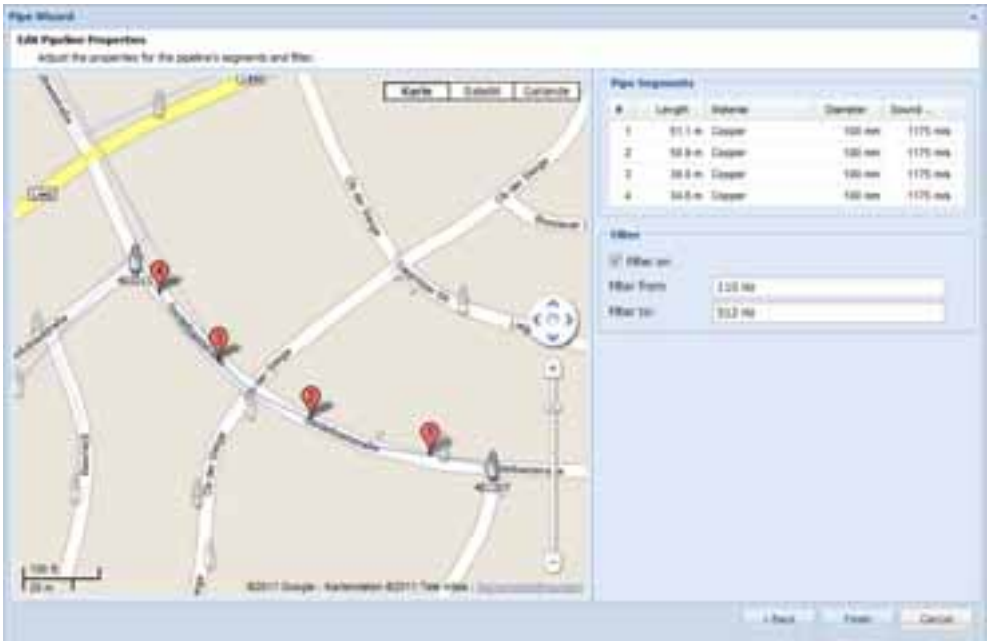


Figure 9 Adjusting the pipeline

Note!
It is possible that the Pipe Wizard calculation cannot be performed immediately. It is then performed automatically as soon as there is again a sufficient connection to the network.

Comments *Comments* is a text field with entries on, e.g., permanent noise sources.

2.1.2 Graphs

A graph can be displayed for each individual, correlated leak. To do this, select the value in the table that you would like to visualize. Right-click to open the context menu. Here, you can select the type of graph that is displayed. In addition, you can insert a comment. The same menu can be opened by right-clicking a logger on the map.

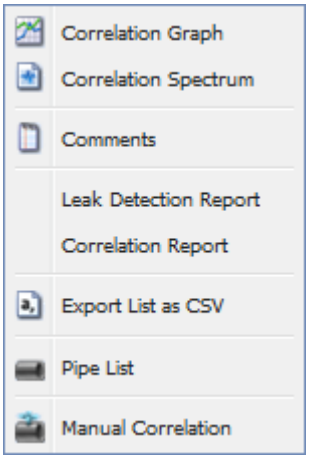


Figure 10 Graph selection for correlated leaks

Correlation graph

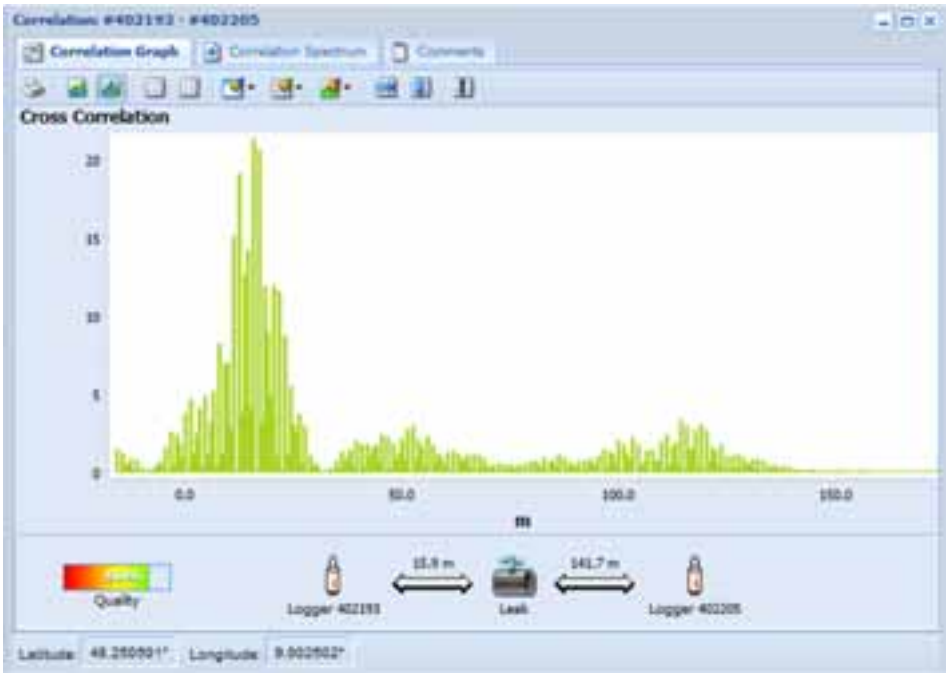


Figure 11 Correlation Graph

Correlation is a mathematical method for comparing two time series signals with one another.

A leakage noise is simultaneously recorded by two sensors at different locations. The sound emitted by the leak spreads in the water pipe at a defined sound velocity. If the acoustic event were to be brief and occur only once, e.g., a blow with hammer, it would be simple to measure the arrival at both receivers. In this case, one would only need to compare the arrival times at the two receivers with one another. If these are the same, the sound has traveled the same distance to the receivers, i.e., the sound source lies in the middle of the pipe between the receivers.

If the arrival times are different, it is possible to calculate the distance to the two receivers from the measured time difference. The sound arrives at the closer sensor before the more distant sensor.

In the context of leakage noises, the goal of the correlation measurement is primarily to determine the propagation time difference of two signals.

Because the correlation curve also includes spectral information, it is often of interest to define the character of the leakage noise, particularly for distinguishing noises that are not related to the leak, provided this can be detected by means of a frequency analysis (e.g., electrical noise). The correlation curve can also be mathematically filtered for the purpose of retroactively separating such interfering noise to better identify the correlation maximum caused by the leak.

Correlation spectrum

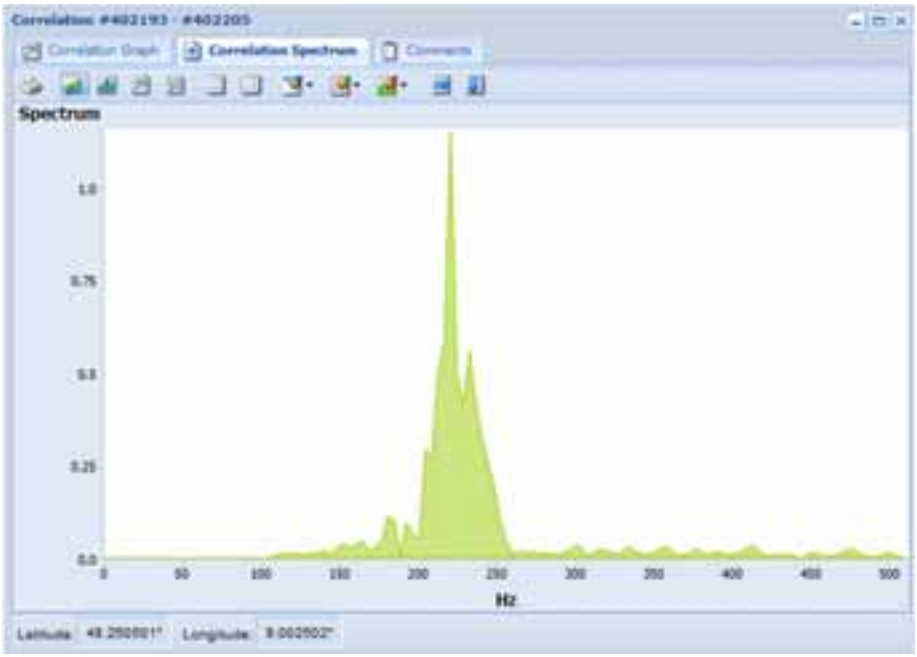


Figure 12 Correlation Spectrum

The correlation spectrum is a combination of the signal spectra of the two sensors, which is used for the correlation on the pipeline between the two sensors. In these common spectra, it may be possible to identify the influence of noises not related to the leak (e.g., electrical noise or pumps) on the correlation result (see also 2.2.2 Graphs - Signal spectrum).

2.2 *Leak Values* tab

Displayed in the *Leak Values* list area are all values that are needed for an evaluation.

2.2.1 Table fields

Logger No. Reference number of the displayed logger.

Location The *Location* field is a text field in which the location of the logger, e.g., the

street and street number, can be entered.

Leak Score

The Leak Score is specified in a range from 0 to 100. The higher the number, the greater the probability that measurements will actually detect a leak.

The goal of the noise measurement with loggers is to obtain as reliable a statement as possible regarding the presence of a leak at a specific point of the monitored water network. For the greatest reliability with respect to the presence of even small leaks, all information that is indicative of a leak near a logger should be included. Misinterpretations should be avoided in this process.

The measurement values obtained from the histogram (see 2.2.2 Graphs) – particularly the lowest ascertained sound-level value dBmin – which are a strong general indicator of a leak, are included in the subsequent processing.

In addition to the described histogram evaluation, the Leak Score includes, above all, knowledge from the frequency response (spectrum). These values are used, in particular, for removing background noise.

The correlations measured between the loggers also play a role with respect to the assignment to the loggers.

The result is output as the Leak Score in a range from 0 to 100. The settings for the display of a possible or probable leak are made under Administration in Settings.

dBmin

The smallest dB value measured during the last measurement.

dBenv

In this field, the measurement sensitivity of the logger can be adjusted to the environmental sound intensity.

Comments

Comments is a text field with entries on, e.g., permanent noise sources.

2.2.2 Graphs

A graph can be displayed for each leak score of a logger. To do this, select the value in the table that you would like to visualize. Right-click to open the context menu. Here, you can select the type of graph that is displayed. In addition, you can insert a comment. The same menu can be opened by right-clicking a logger on the map.

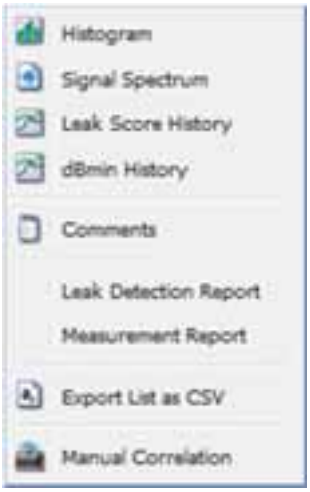


Figure 13 Graph selection for leak score

Histogram

The histogram is the graphical display of a frequency distribution of the measured sound level.

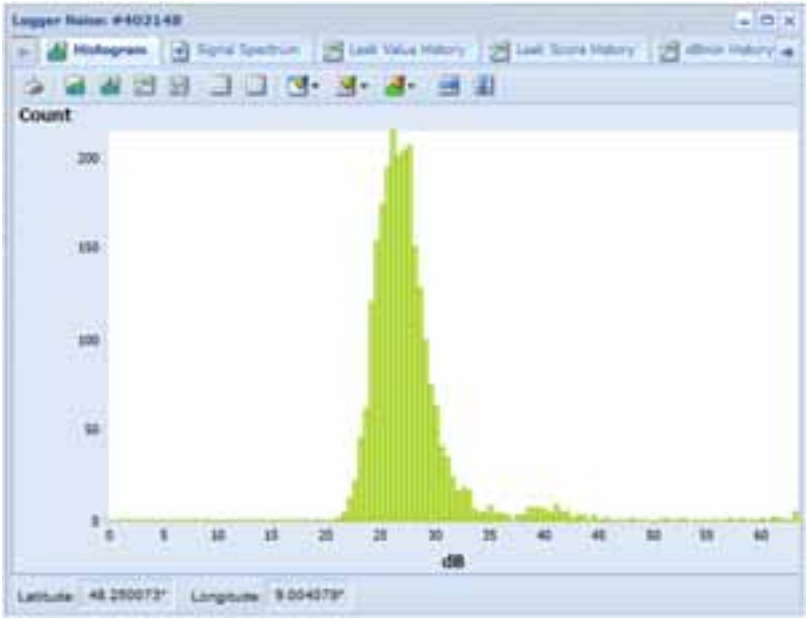


Figure 14 Logger Histogram

During noise monitoring, the noise level is repeatedly measured in intervals of a few seconds. During a two-hour measurement period (e.g., from 2 a.m. to 4 a.m.), more than 1000 individual measurement values may be collected in some cases. The sound level is measured in dB. If, for example, the sound intensity of 15 dB is measured 120 times, this sound intensity has a frequency value of 120. Other sound intensity values are measured with a different frequency. If all of these frequencies are plotted as y values against a scale of the various dB sound intensities (x axis), one obtains the so-called histogram as a frequency distribution.

This histogram is a representation of the noise distribution in the measured period of time. The curve has a maximum, which represents the most frequently measured noise sound intensity.

For leakage noise monitoring, the quietest noise detected in the observed period is of particular interest. It is the smallest dB value for which a measurement value exists. Because a leakage noise is always present, one assumes that this value most likely characterizes the leakage noise, while higher dB sound intensity values arise from the addition of primarily random noise sources (e.g., vehicle traffic).

The so-determined smallest sound intensity value, found at the left edge of the histogram curve, is referred to as the dB-min value and plays a key role in the evaluation of the leakage noise.

Signal spectrum

The signal spectrum can be used to make a statement about a possible leak.

Figure 15 shows a spectrum with electrical influence. If the curve has this appearance, one can assume that no leakage noise is present.

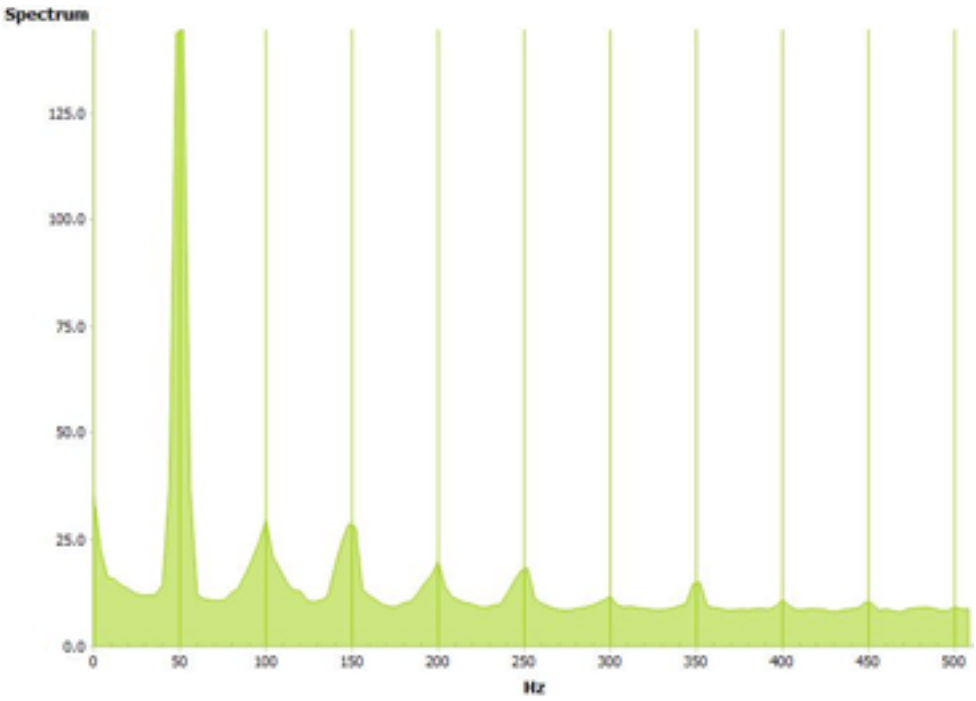


Figure 15 Spectrum with electrical influence

In Figure 16, you see a typical spectrum of a leakage noise. It is clearly seen that the curve differs from that of a spectrum with electrical influence. If the graph has an appearance similar to that shown in Figure 16, one can assume a leakage noise.

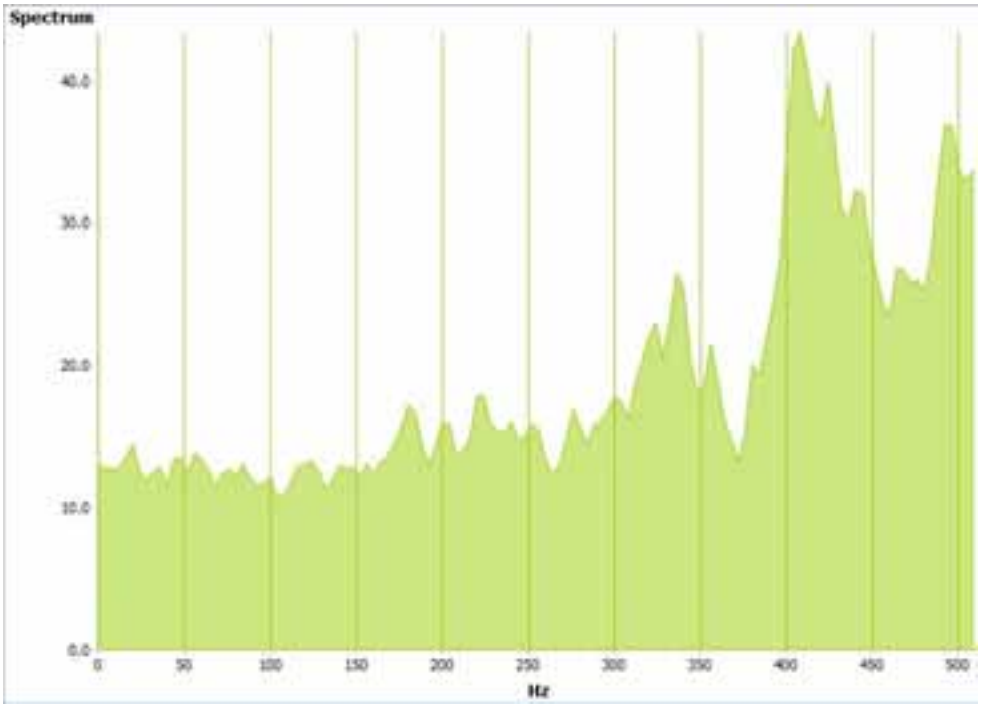


Figure 16 Spectrum with leakage noise

Leak Score History

The *leak Score History* visualizes the historical values from the last 30 days, 3 months, 6 months or 1 year as long as the data is available for the time span. If the data available is less than a chosen period then the software will adjust the window to fit.

Figure 17Logger Leak Score History

dBmin History

The *dBmin History* visualizes the historical values from the last 30 days, 3 months, 6 months or 1 year if the data is available.

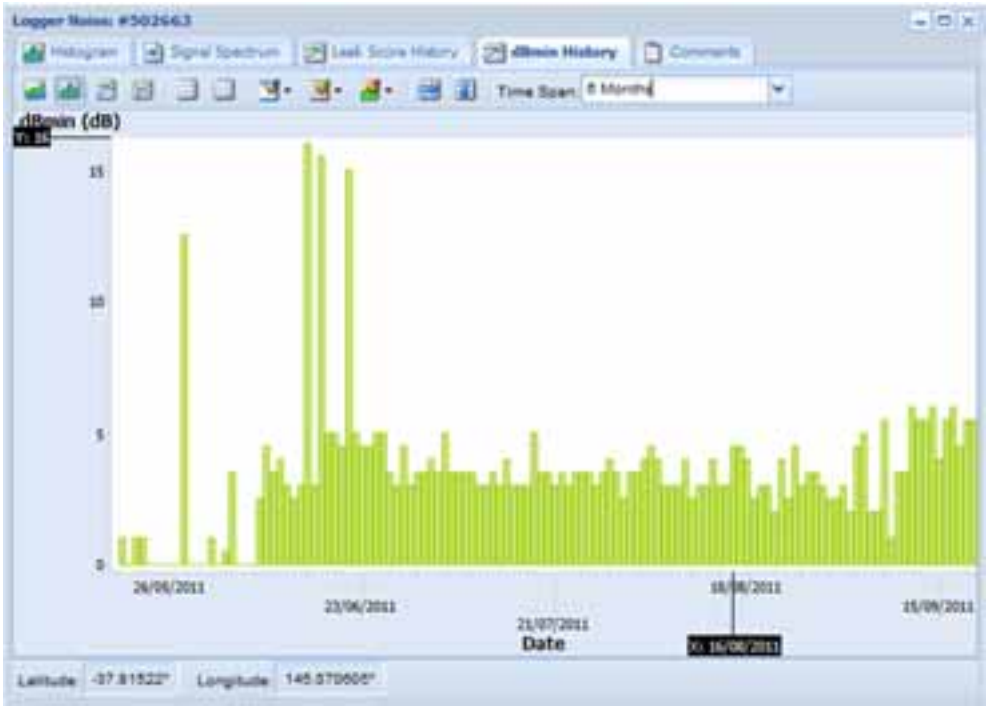
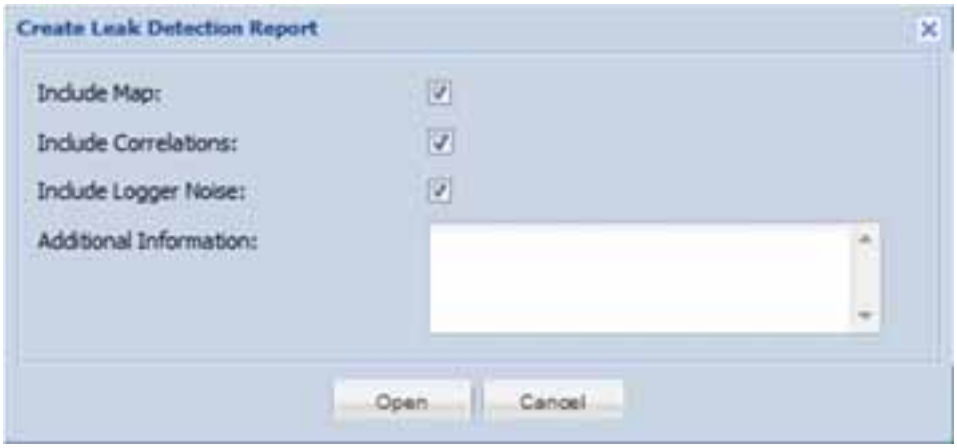


Figure 18 Logger dBmin History

Leak Detection Report

The *Create a Leak Detection Report* allows one to choose the options in the window below before creating a report. Click open and a separate window will open which then can be sent to print.



.Figure 19 Create a Leak Detection Report

Measurement Report

The *Create a Measurement Report* allows one to choose the options in the window below before creating a report. Click open and a separate window will open with the requested data ready to send to Print.

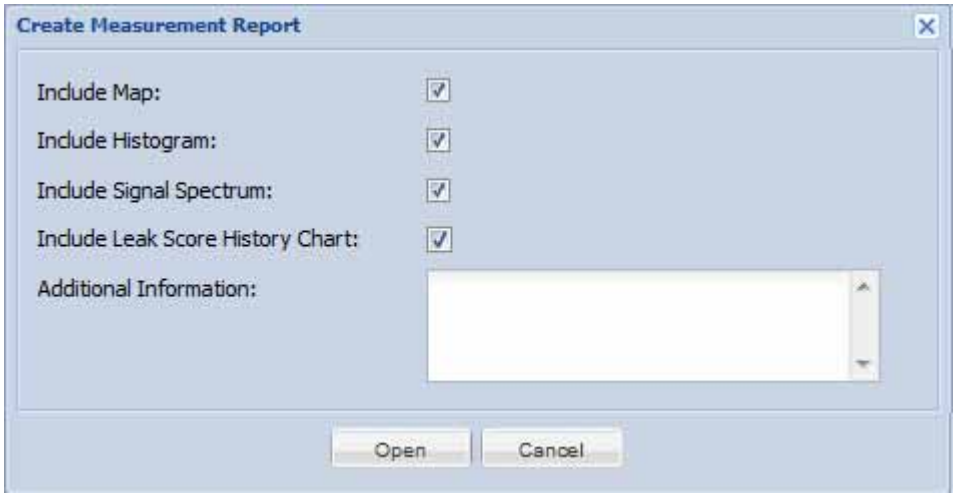


Figure 20 Create a Measurement Report

Export to CSV

The *Export to CSV* will download the loggers Leak Score into CSV file format and automatically open Excel with the data.

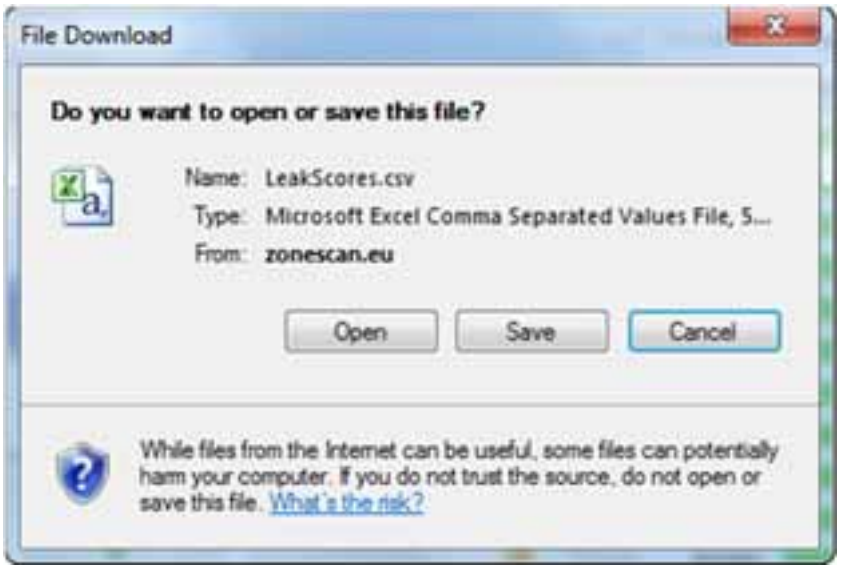


Figure 21 Create a Measurement Report

Manual Correlation

The *Manual Correlation* opens a separate window and allows the user to pick any 2 loggers in the project to correlate between.

Figure 22 Manual Correlation Window

Use the following section to select your chosen loggers, averaging mode and date.

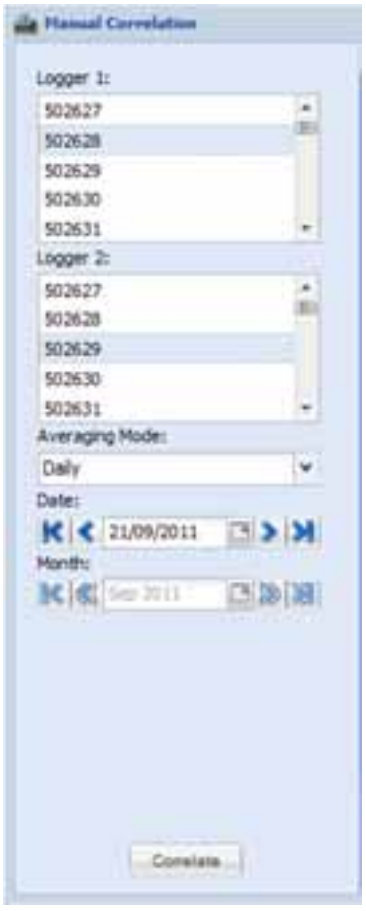


Figure 23 Selecting the Loggers

Click Correlate and the screen will display the two chosen Zonescan Loggers on a new window with an arrow depicting a correlation was performed. The quality of correlation will be there however the pipe data is missing. Analyse the correlation Graph to make sure the correlation is of good quality.

Figure 24 Manual Correlation between 2 loggers

Figure 25 Manual Correlation Result

3 Print Project

Figure 26 Print Project Menu

The print section has 4 options which include print Leak Detection Report, Correlation Report, Measurement Report and the Map.

The Leak Detection Report includes the Leak Scores, Correlations and Map for the chosen date. A window will appear which gives the user the option to remove correlations, Logger Noise or Map before printing.

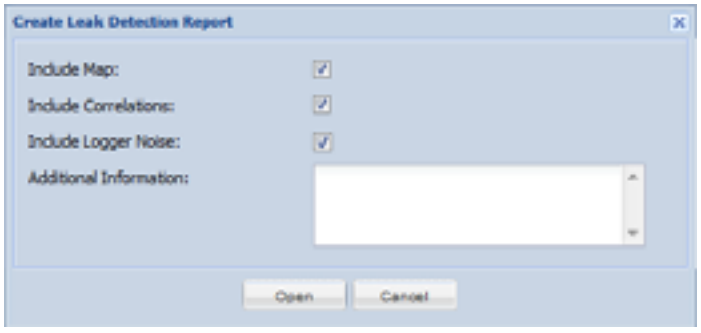


Figure 27 Print Report Window Options

A new browser window opens with the report; use the print button on the browser.

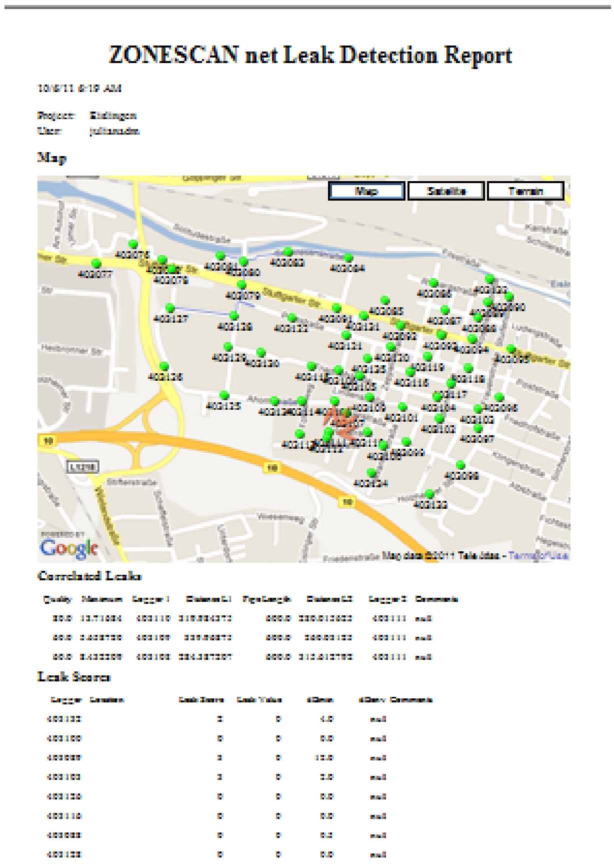


Figure 28 Print Report Page

4 Maintenance

Figure 29 Maintenance

Note!
The following description assumes a fully activated map menu!

The sorting of the tables can be changed at any time. Click the small arrow in the title field of the value that you would like to change. In the selection box that opens, you can change the sorting from A-Z or from Z-A.

The fields can also be displayed or hidden from view. To do this, click the small arrow in the title field. In the selection menu that appears, move the cursor to the *Columns* item. In the list that is now displayed, you can set a check mark in the field that you would like to display or remove the check mark from a field that you would like to hide.

4.1 *Alpha* tab

In the *Alpha* tab, all Alphas of the current project are displayed.

Figure 30Alpha Tab

4.1.1 Table fields

Alpha No.	Reference number of the displayed Alphas.
Last Reached	The date on which the Alpha was reached for the last time.
Batt.	Current battery charge of the individual Alphas.
Version	Version of the respective Alpha
Min Temp.	The lowest temperature measured during the last measurement.
Max Temp.:	The highest temperature measured during the last measurement.
Comments	*Comments* is a text field with entries on, e.g., permanent noise sources.

4.1.2 Options

You can change the base settings of this tab by right-clicking an entry in the table.

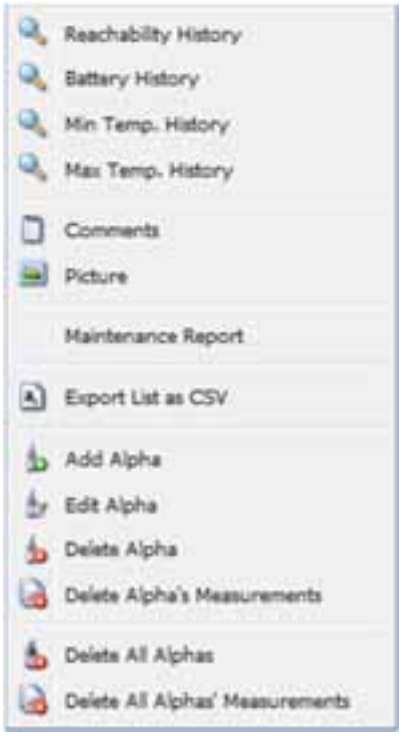


Figure 31Alpha settings

Reachability History	To display the History of when the Alphahad communication with the Zonescan Net
Battery History	To display the charge state of the selected Alpha, click the *Battery Curve* item.
Min Temp History	To display the Minimum Temperature of the selected Alpha, click the *Min Temp* item.
Max Temp History	To display the Maximum Temperature of the selected Alpha, click the *Max Temp* item.
Comments	To add a comment about an Alpha, select the *Comments* item. Enter the desired comment in the text field that appears. Click *Apply* to store the entered comment. The text is displayed in the table in the *Comments* field.
Picture	To Add a Picture of the selected Alpha.
Maintenance	To Print out a report for the selected Alpha to include all the fields in the Tab

Add Alpha	Click *Add Alpha* to add a not-yet existing Alpha to the list. In the window that opens, enter the values for *Alpha No*., *Location*, *Latitude* and *Longitude*. Click the check box to select the logger to which you would like to assign the Alpha. After entering all values, confirm your entries by clicking the *Save* button.
Edit Alpha	To make changes to the base settings of existing Alphas, select *Edit Alpha*. Make the desired changes and then click *Save*.
Delete Alpha	Alphas listed in the table can be deleted with the *Delete Alpha* item.
Delete Alpha's Measurements	To delete the measurement data of an Alpha, click the *Delete Alpha's Measurements* item.
Delete All Alphas	Use this item to delete all Alphas for the current project.
Delete All Alphas' Measurements	The measurement data of all Alphas is deleted by clicking this item.

4.2 *Repeater* tab

In the *Repeater* tab, all repeaters of the current project are displayed.

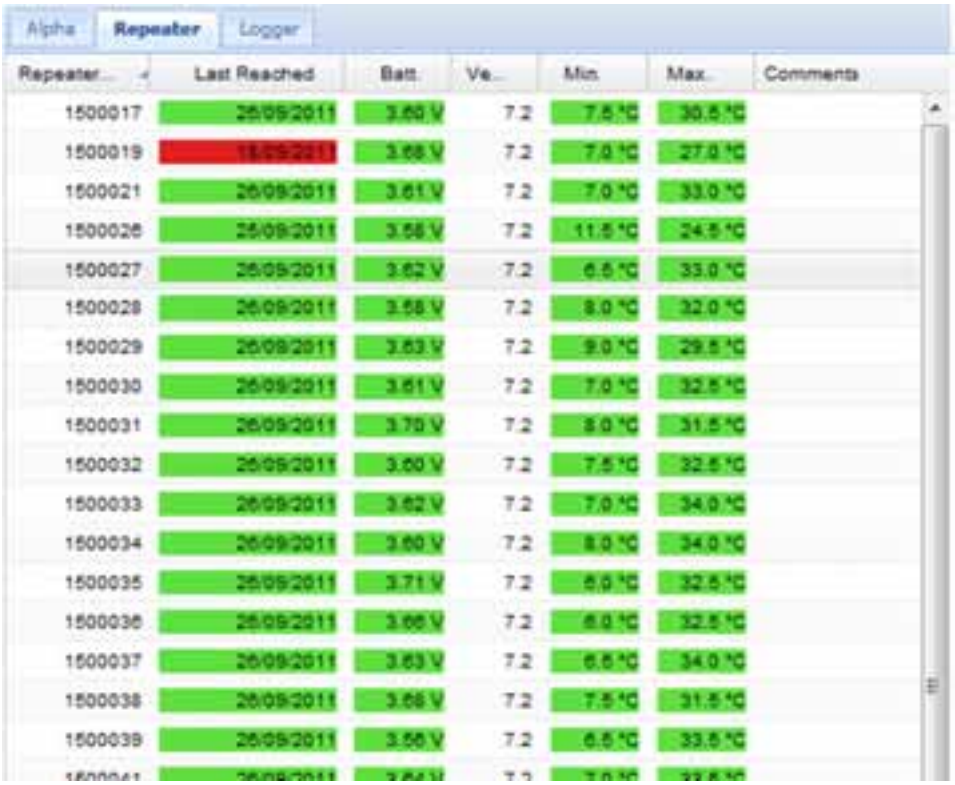


Figure 32 Repeater Tab

4.2.1 Table fields

Repeater No.	Reference number of the displayed repeaters.

Last Reached	The date on which the repeater was reached for the last time.
Batt.	Current battery charge of the individual repeaters.
Version:	Version of the respective repeater
Min Temp.	The lowest temperature measured during the last measurement.
Max Temp.	The highest temperature measured during the last measurement.
Comments	*Comments* is a text field with entries on, e.g., permanent noise sources.

4.2.2 Options

You can change the base settings of this tab by right-clicking an entry in the table.

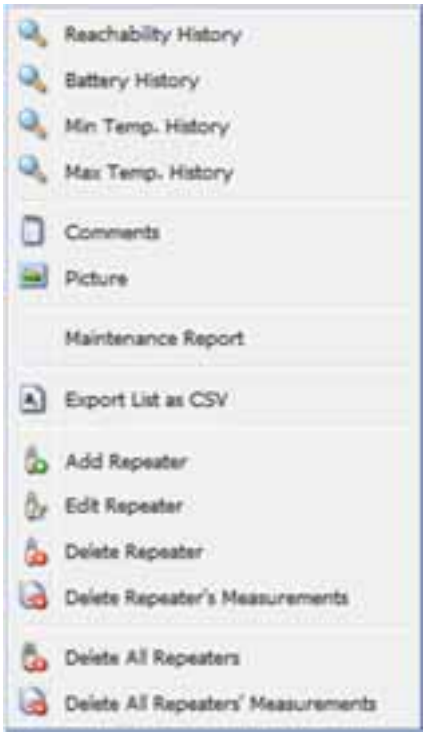


Figure 33 Logger settings

Reachability History	To display the History of when the Repeater had communication with the Zonescan Net
Min Temp History	To display the Minimum Temperature of the selected Repeater, click the *Min Temp* item.
Max Temp History	To display the Maximum Temperature of the selected Alpha, click the *Max Temp* item.
Battery History	To display the charge state of the selected repeater, click the *Battery History* item.
Comments	To add a comment about a repeater, select the *Comments* item. Enter the desired comment in the text field that appears. Click *Apply* to save the entered comment. The text is displayed in the table in the *Comments* field.

Picture	To Add a Picture of the selected Repeater.
Maintenance	To Print out a report for the selected Repeater to include all the fields in the Tab
Add Repeater	Click *Add Logger* to add a not-yet existing logger to the list. In the window that opens, enter the values for *Repeater No*., *Location*, *Latitude* and *Longitude*. After entering all values, confirm your entries by clicking the *Save* button.
Edit Repeater	To make changes to the base settings of existing repeaters, select *Edit Repeater*. Make the desired changes and then click *Save*.
Delete Repeater	Repeaters listed in the table can be deleted with the *Delete Repeater* item.
Delete Repeater's Measurements	To delete the measurement data of a repeater, click the *Delete Repeater's Measurements* item.
Delete All Repeaters	Use this item to delete all repeaters for the current project.
Delete All Repeaters' Measurements	The measurement data of all repeaters is deleted by clicking this item.

4.3 *Logger* tab

In the *Logger* tab, all loggers of the current project are displayed.

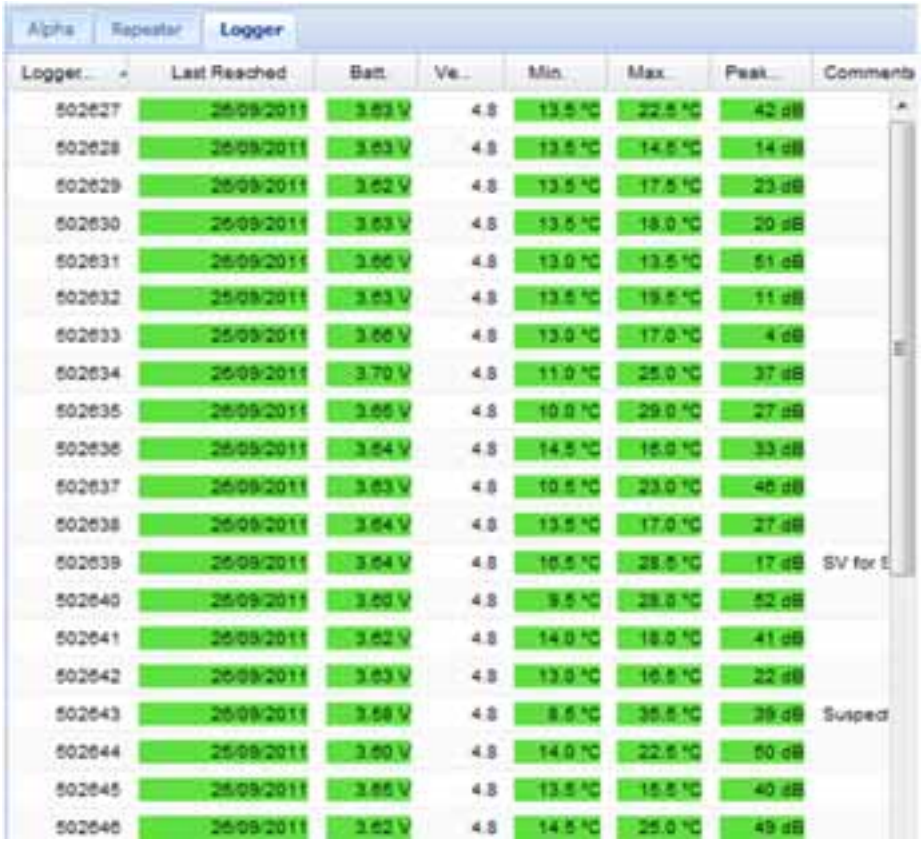


Figure 34 Logger Tab

4.3.1 Table fields

Logger No.:	Reference number of the displayed logger.
Last Reached	The date on which the logger was reached for the last time.
Batt.:	Current battery charge of the individual loggers.
Version:	Version of the respective logger
Min Temp.:	The lowest temperature measured during the last measurement.
Max Temp.:	The highest temperature measured during the last measurement.
Peak dB	The largest dB value measured during the last measurement.
	.
Comments:	*Comments* is a text field with entries on, e.g., permanent noise sources.

4.3.2 Options

You can change the base settings of this tab by right-clicking an entry in the table.

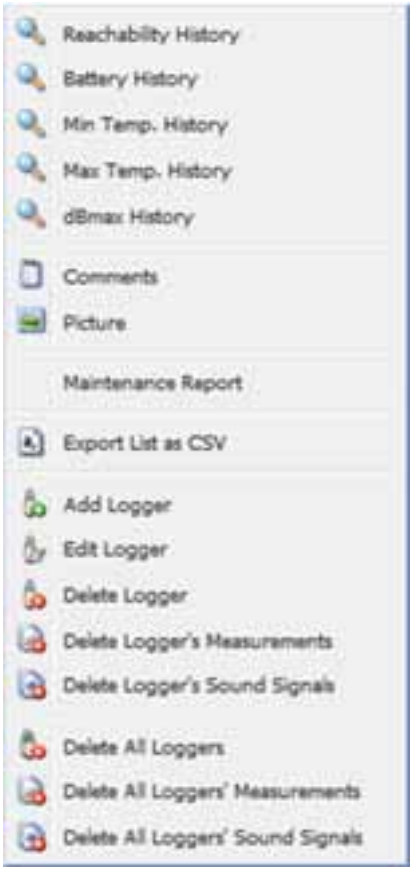


Figure 35 Logger settings

Reachability History	To display the History of when the Logger had communication with the Zonescan Net

Min Temp History	To display the Minimum Temperature of the selected Logger, click the *Min Temp* item.
Max Temp History	To display the Maximum Temperature of the selected Logger, click the *Max Temp* item.
Battery History	To display the charge state of the selected logger, click the *Battery History* item.
Comments	To add a comment about a logger, select the *Comments* item. Enter the desired comment in the text field that appears. Click *Apply* to save the entered comment. The text is displayed in the table in the *Comments* field.
Picture	To Add a Picture of the selected Logger.
Maintenance	To Print out a report for the selected Logger to include all the fields in the Tab
Add Logger	Click *Add Logger* to add a not-yet existing logger to the list. In the window that opens, enter the values for Logger No., Location, Latitude and Longitude. After entering all values, confirm your entries by clicking the *Save* button.
Edit Logger	To make changes to the base settings of existing loggers, select *Edit Logger*. Make the desired changes and then click *Save*.
Delete Logger	Loggers listed in the table can be deleted with the *Delete Logger* item.
Delete Logger's Measurements	To delete the measurement data of a logger, click the *Delete Logger's Measurements* item.
Delete Logger's Sound Signals	Click *Delete Logger's Sound Signals* to delete the recorded signals.
Delete All Loggers	Use this item to delete all loggers for the current project.
Delete All Loggers' Measurements	The measurement data of all loggers is deleted by clicking this item.
Delete All Loggers' Sound Signals	Click this item to delete the sound signals of all loggers.

Administration-

Note: This section is only releavent for Project Administrators

Figure 36 Administration

To change the settings of an existing project, click *Administration* in the *View* area of the menu bar. In the *Project* area, select the project that is to be changed. In the navigation bar, then click the *Current Project* > *Settings* item.

To save your settings, click the *Save* button in the respective tab.

4.4 Current Project

4.4.1 Settings

Note!
The preset values are guide values and may vary.

General tab

Figure 37 Settings > General

Project Name:
The name of the project is automatically taken over from the menu bar.

Operating Type

You can select the appropriate operating type according to operating mode. The *Alpha* item is preset. If you are working in a fixed network, click *Fixed Network* here. The data is then integrated in your network.

Alpha tab

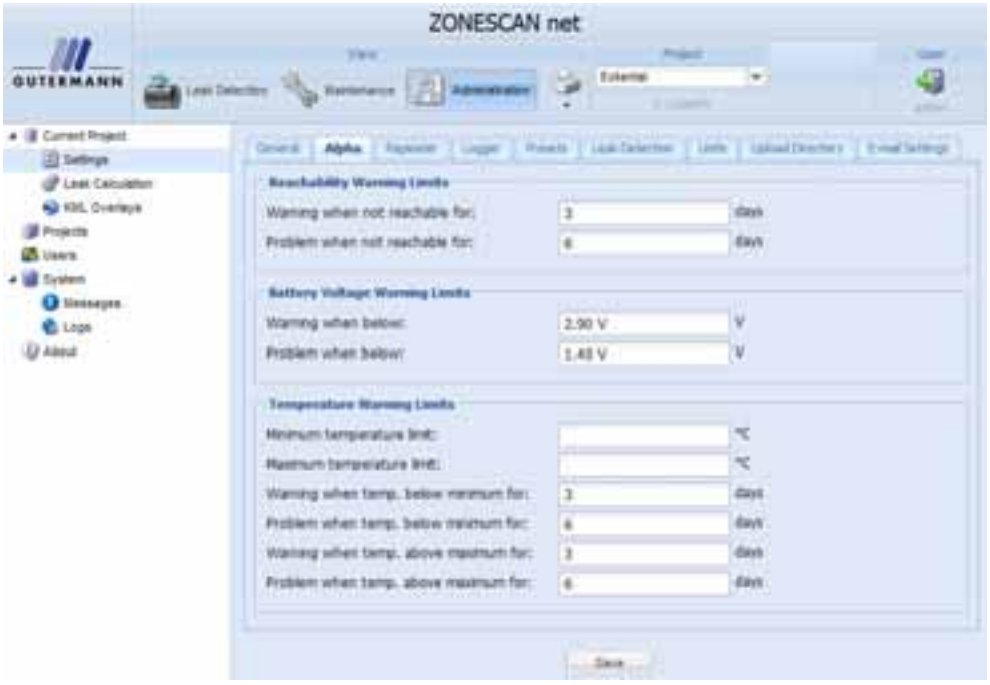


Figure 38 Settings > Alpha

Reachability Warning Limits

Warning when not reachable for:
Define the number of days after which a warning is displayed if an Alpha was not reached.

Preset: 2 days

Problem when not reachable for:
Define the number of days after which an error is displayed if an Alpha was not reached.

Preset: 4 days

Battery Voltage Warning Limits

Warning when below:
Enter the charge state of the batteries of the Alphas below which a warning is displayed.

Preset: 6.00 V

Problem when below:
Enter the charge state of the batteries of the Alphas below which an error is displayed.

Preset: 5.50 V

Temperature Warning Limits

Minimum temperature limit:
Enter the lower temperature value below which a warning or an error is displayed.

Preset: -30.0°C

Maximum temperature limit:
Enter the upper temperature value above which a warning or an error is displayed.

Preset: 70.0°C

Warning when temp. below minimum for:
Enter the number of days after which a warning is displayed if the temperature measured at the Alpha remains below the limit value entered above.

Preset: 2 days

Problem when temp. below minimum for:
Enter the number of days after which an error is displayed if the temperature measured at the Alpha remains below the limit value entered above.

Preset: 4 days

Warning when temp. above maximum for:
Enter the number of days after which a warning is displayed if the temperature measured at the Alpha remains above the limit value entered above.

Preset: 2 days

Problem when temp. above maximum for:
Enter the number of days after which an error is displayed if the temperature measured at the Alpha remains above the limit value entered above.

Preset: 4 days

Repeater tab

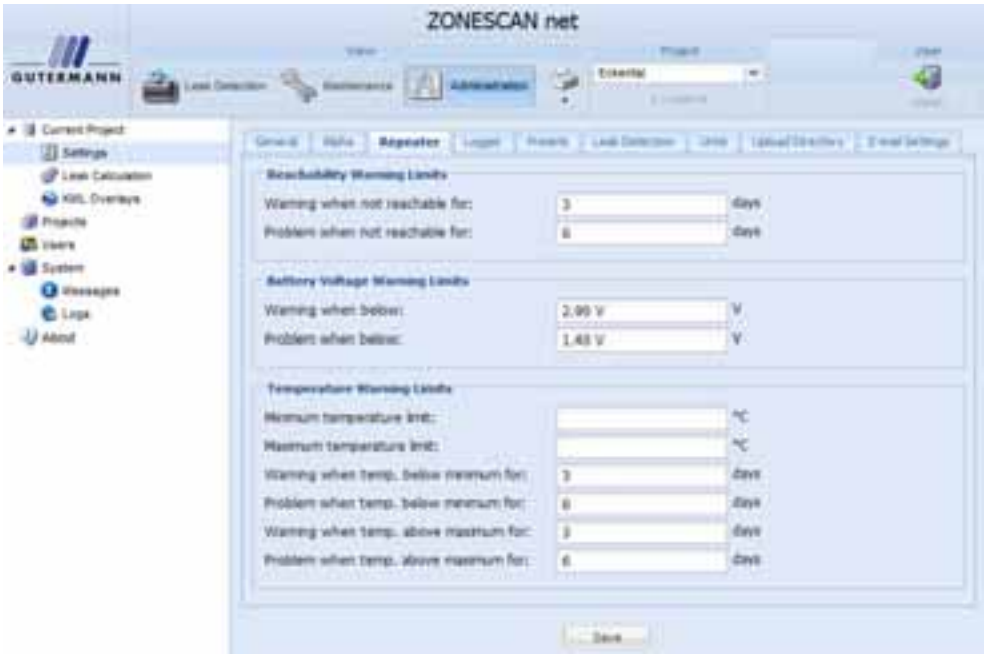


Figure 39 Settings > Repeater

Reachability Warning Limits

Warning when not reachable for:
Define the number of days after which a warning is displayed if a repeater was not reached.

Preset: 3 days

Problem when not reachable for:
Define the number of days after which an error is displayed if a repeater was not reached.

Preset: 6 days

Battery Voltage Warning Limits

Warning when below:
Enter the charge state of the batteries of the repeaters below which a warning is displayed.

Preset: 2.80 V

Problem when below:
Enter the charge state of the batteries of the repeaters below which an error is displayed.

Preset: 2.60 V

Temperature Warning Limits

Minimum temperature limit:
Enter the lower temperature value below which a warning or an error is displayed.

Preset: -30.0°C

Maximum temperature limit:
Enter the upper temperature value above which a warning or an error is displayed.

Preset: 70.0°C

Warning when temp. below minimum for:
Enter the number of days after which a warning is displayed if the

temperature measured at the repeater remains below the limit value entered above.

Preset: 3 days

Problem when temp. below minimum for:
Enter the number of days after which an error is displayed if the temperature measured at the repeater remains below the limit value entered above.

Preset: 6 days

Warning when temp. above maximum for:
Enter the number of days after which a warning is displayed if the temperature measured at the repeater remains above the limit value entered above.

Preset: 3 days

Problem when temp. above maximum for:
Enter the number of days after which an error is displayed if the temperature measured at the repeater remains above the limit value entered above.

Preset: 6 days

Logger tab

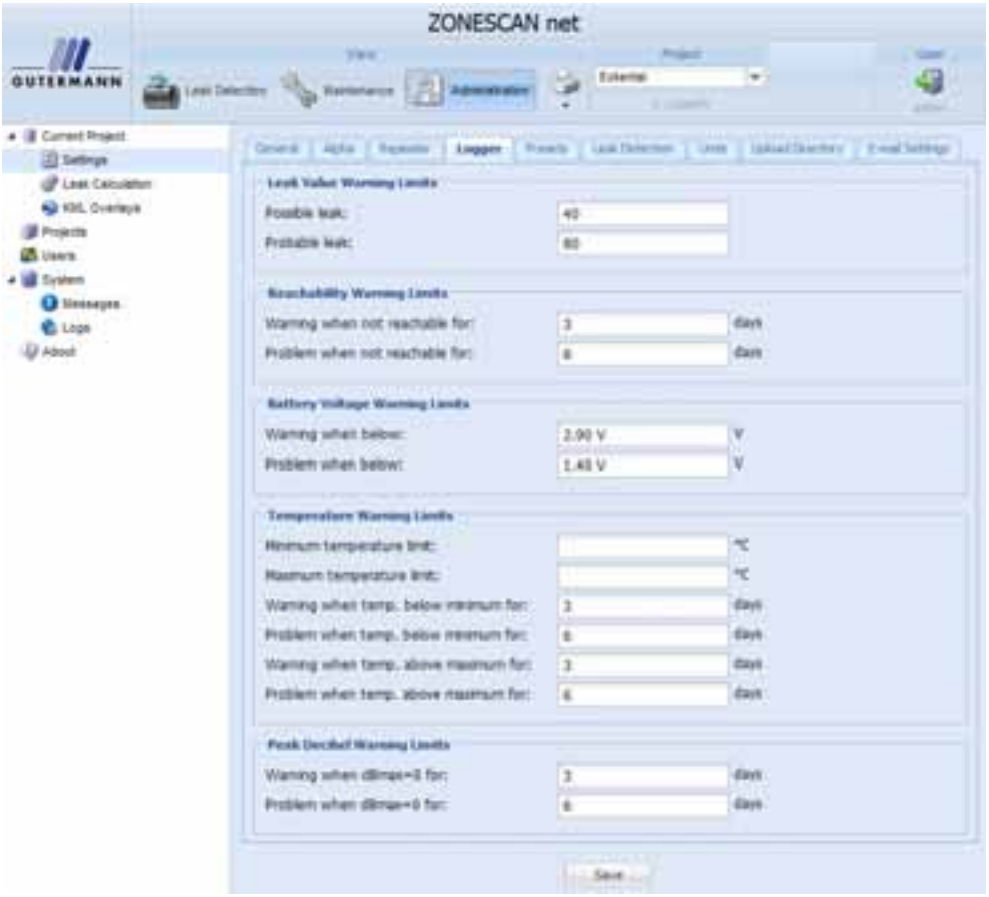


Figure 40 Settings > Logger

Leak Value Warning Limits	Possible leak: Enter the values based on experience for displaying a possible leak. Preset: 40 *Probable leak:* Enter the values based on experience for displaying a probable leak. Preset: 70
Reachability Warning Limits	*Warning when not reachable for:* Define the number of days after which a warning is displayed if a logger was not reached. Preset: 4 days *Problem when not reachable for:* Define the number of days after which an error is displayed if a logger was not reached. Preset: 8 days
Battery Voltage Warning Limits	*Warning when below:* Enter the charge state of the batteries of the loggers below which a warning is displayed. Preset: 2.90 V *Problem when below:* Enter the charge state of the batteries of the loggers below which an error is displayed. Preset: 1.40 V
Temperature Warning Limits	*Minimum temperature limit:* Enter the lower temperature value below which a warning or an error is to be displayed. Preset: -30.0°C *Maximum temperature limit:* Enter the upper temperature value above which a warning or an error is to be displayed. Preset: 70.0°C *Warning when temp. below minimum for:* Enter the number of days after which a warning is displayed if the temperature measured at the logger remains below the limit value entered above. Preset: 4 days *Problem when temp. below minimum for:* Enter the number of days after which an error is displayed if the temperature measured at the logger remains below the limit value entered above. Preset: 8 days *Warning when temp. above maximum for:* Enter the number of days after which a warning is displayed if the

temperature measured at the logger remains above the limit value entered above.

Preset: 4 days

Problem when temp. above maximum for:
Enter the number of days after which an error is displayed if the temperature measured at the logger remains above the limit value entered above.

Preset: 8 days

Peak Decibel Warning Limits

Warning when dBmax=0 for:
Enter the number of days after which a warning is displayed if the highest dB value measured at the logger is equal to 0.

Preset: 1 day

Problem when dBmax=0 for:
Enter the number of days after which an error is displayed if the highest dB value measured at the logger is equal to 0.

Preset: 2 days

Presets tab

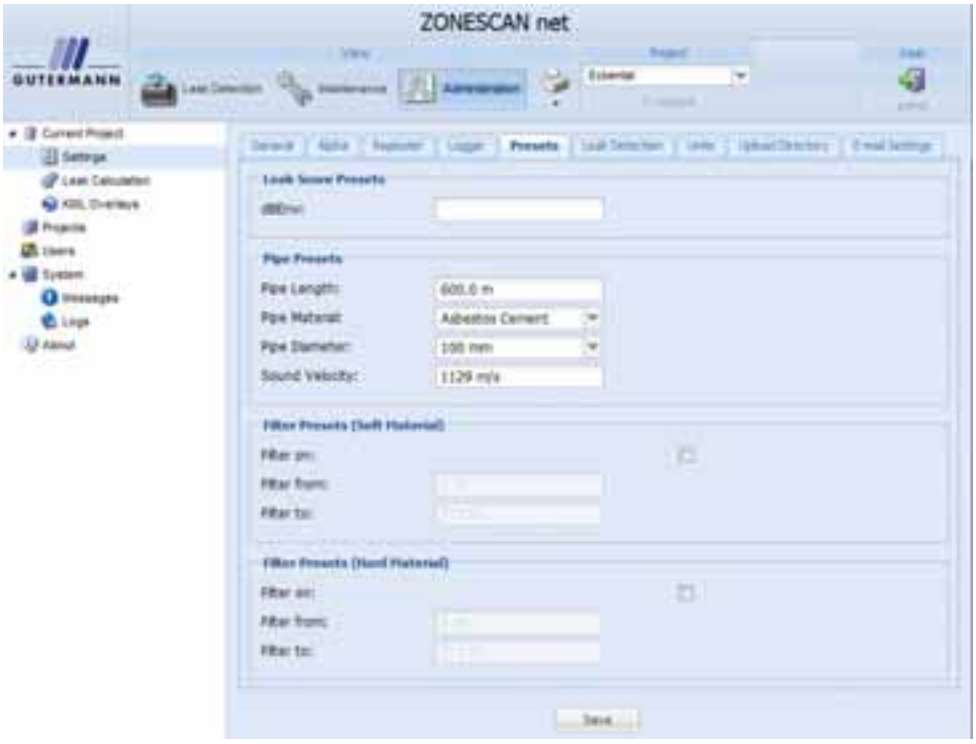


Figure 41 Settings > Presets

Leak Score Presets

dBEnv:
Determine this value together with the manufacturer to obtain the most accurate evaluations of the measurement data.

Pipe Presets

Pipe Length:
Enter the distance between two loggers.
Preset: 600m

Attention!
Incorrect evaluations will result if the entered length is shorter than the actual pipe length. Enter a value here that exceeds the actual spacing between the loggers.
Example:
actual pipe length: 255m
entered pipe length: 600m

Pipe Material:
Select your pipe material from the drop-down list.
Preset: Ductile Iron

Pipe Diameter:
Select your pipe diameter from the drop-down list.
Preset: 100mm

Sound Velocity:
The sound velocity is dependent on the pipe material and is automatically set by the system upon selection of the pipe material.
Preset: 1334 m/s

Filter Presets (Soft Material)

Filter on:
Select the check box if your pipe is made of soft material.

Filter from:
Enter the lower Hz value above which filtering is to be performed.
Preset: 0 Hz

Filter to:
Enter the upper Hz value up to which filtering is to be performed.
Preset: 512 Hz

Filter Presets (Hard Material)

Filter on:
Select the check box if your pipe is made of hard material.

Filter from:
Enter the lower Hz value above which filtering is to be performed.
Preset: 120 Hz

Filter to:
Enter the upper Hz value up to which filtering is to be performed.
Preset: 512 Hz

Leak Detection tab

Figure 42 Settings > Leak Detection

Leak Quality Thresholds

Possible leak when above:
Enter the percentage value calculated together with the manufacturer above which a possible leak is displayed.
Preset: 40%

Probable leak when above:
Enter the percentage value calculated together with the manufacturer above which a probable leak is displayed.
Preset: 80%

Max. Distance between 2 Loggers:
Enter the maximum distance between two loggers here. A value of 1,000m has proven effective.

Preset: 800m

Server Configuration

Automatically Calculate Correlations:
Select the check box if the correlation is to be calculated automatically.

The check box is selected by default.

Calculate Correlations Daily at:
Select the time for the automatic calculation of the correlations from the drop-down list.

Preset: 6:00 AM.

Attention!

When entering the time, note that the calculation is useful only after e-mail has been checked. The time at which e-mail is checked can be defined in the E-mail Settings tab.

Leak Scoring

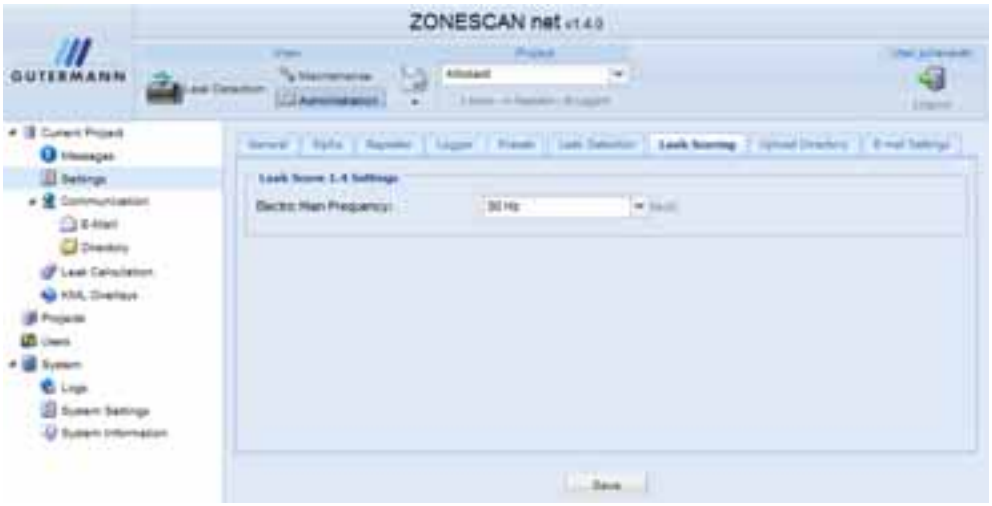


Figure 43 Settings > Units

Leak Score 1.4 Settings

Set this to the Electric Mains Frequency for the country the Project is in. This will help identify and eliminate noise caused by electrical transformers during the logging process.

Upload Directory tab

Figure 44 Settings > Upload Directory

Directory Settings

Directory Name:
Enter the name of the directory that is to be searched.

Server automatically checks directory:
Select when the server checks the directory:

- Never
- Daily at
  Select the desired time from the drop-down menu
- Every X minutes
  Enter the number of minutes after which the directory is checked.

Preset: Daily at 5:00 AM

E-mail Settings tab

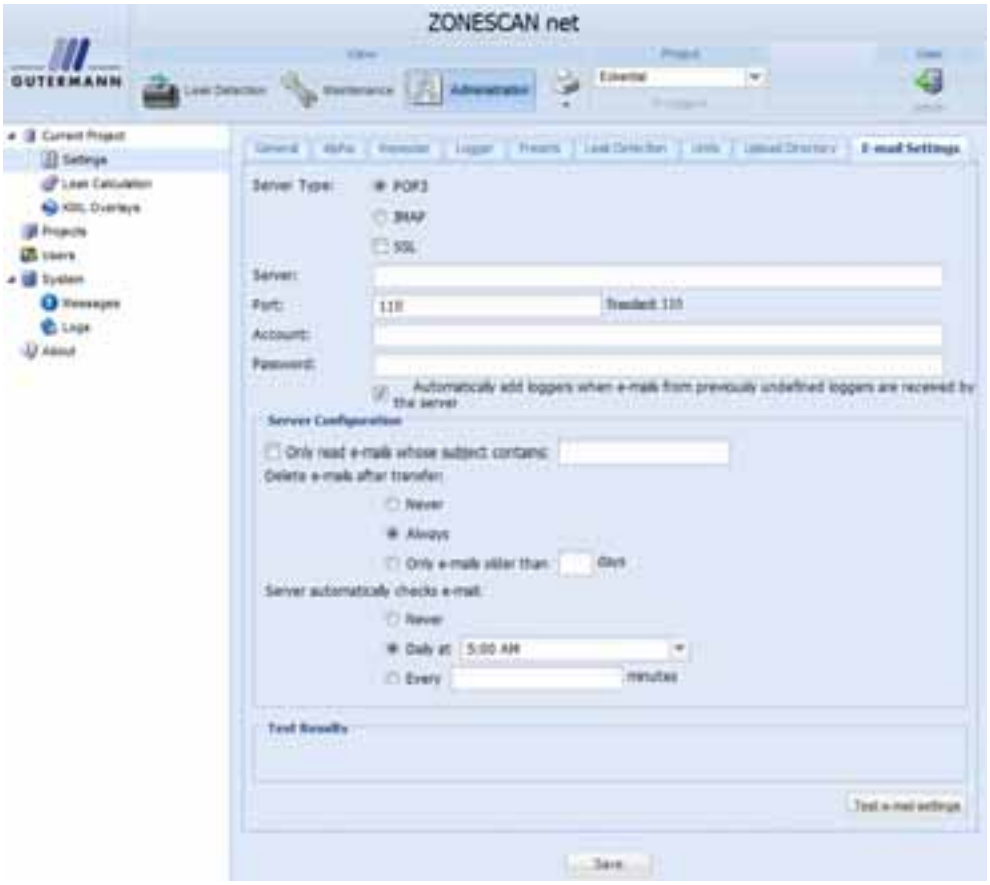


Figure 45 Settings > E-mail Settings

Server Type:
Click to define your server type. Select the SSL check box if necessary.
Preset: POP3

Server:
Enter your server's name.
Example: pop.1and1.com

Port:
Enter the port enabled for e-mail reception.
Preset: Port 110

Account:
Enter the e-mail account that is to receive the **ZONESCAN net** e-mail here.
Example: eckental@zonescan.eu

Password:
Enter the password for the e-mail account entered above.

Select the *Automatically add loggers when e-mails from previously undefined loggers are received by the server* check box to avoid having to manually set up new loggers.
Preset: check box is selected

Server Configuration

Only read e-mails whose subject contains:
Select the check box and enter *ZS-Net* in the text field.

Delete e-mails after transfer:
Select whether and when the transferred e-mails are deleted:

- Never
- Always
- Only e-mails older than X days
  Enter the number of days after which e-mails are deleted.
  Preset: Always

Server automatically checks e-mail:
Select whether and when the server checks for new e-mail.

- Never
- Daily at
  Select the desired time from the drop-down menu
- Every X minutes
  Enter the number of minutes after which the server checks for new e-mail.
  Preset: Daily at 5:00 AM

Attention!
When entering the time, note that the calculation is useful only after e-mail has been checked. The time of the correlation calculation can be defined in the Server Configuration tab.

Test Results

If you have tested the e-mail settings with the *Test e-mail settings* button, the test results appear here.

Use the *Test e-mail settings* button to test whether your settings are correct and e-mail can be received. The results of the test appear in the *Test Results* field.

4.4.2 Leak Calculation

Figure 46 Leak Calculation

Start Leak Calculation	Perform leak calculation manually.
Interrupt Leak Calculation	Interrupt leak calculation.
Delete Leak Scores	Delete all leak scores.
Refresh Data	Check e-mail.

4.4.3 KML Overlays

The uploaded KML overlay files are displayed here in a list.

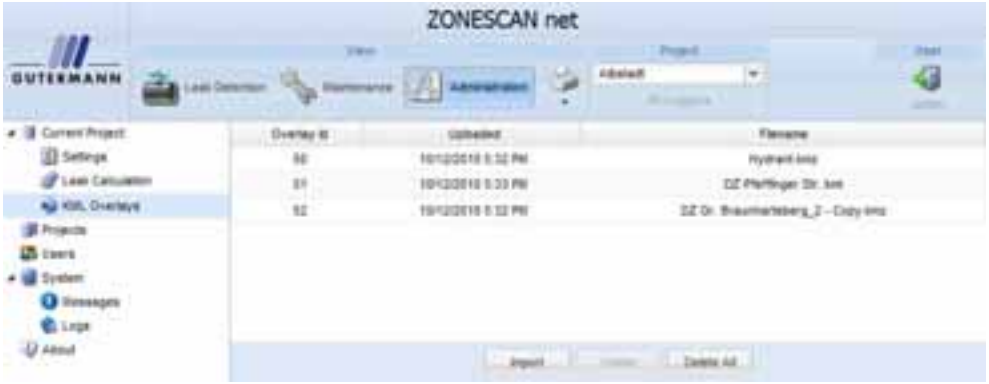


Figure 47 List of the KML files

Import	Click Import to upload the KML files stored on the PC.
Delete	Click to delete a selected KML file from the list.
Delete All	Delete all KML files in the list.

4.5 Projects

All currently running projects are displayed in a list.

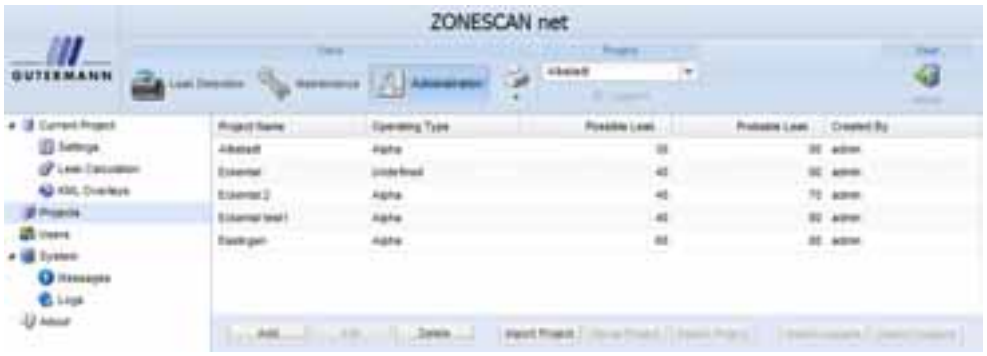


Figure 48Project list

Add	Create a new project.
Edit	Edit a project selected in the list.
Delete	Delete a selected project from the list.
Import Project	An existing project stored on the PC is imported.
Merge Project	To merge two projects, you need an (exported) project file that is then imported into an already existing project. In the project list, select the project into which the file is to be imported. Then click *Merge Project*.
Export Project	All projects are exported.
Import Loggers	Selected loggers are imported.
Export Loggers	All loggers contained in the project are exported.

4.6 Users

All users and their assigned projects are displayed in this tab.

Figure 49Users

Add Click *Add* to create a new user. In the window that opens, enter user name, password, user type as well as the first and last name. Click to assign the user individual projects. Once all data has been entered, click *Save* to activate the profile.

Edit Click the *Edit* button to edit an existing profile.

Delete Click *Delete* to remove an existing profile.

4.7 System

All system messages from the system are displayed here.

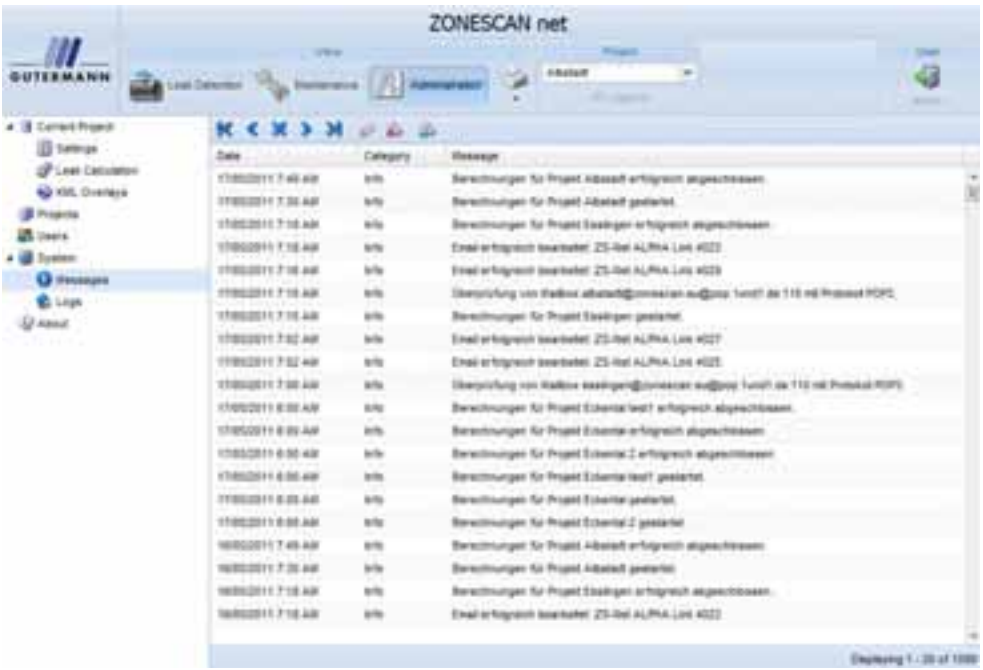


Figure 50 System Messages

4.7.1 Messages

There are two types of messages.

Info This is a simple status message about system activities and background processes.

Warning Please contact support if a message is displayed with the warning status.

5 Appendices

5.1.1 Correction Explained in detail

Leakage noise is generally a wild mixture of tones, each of which can be associated with individual frequencies (tone pitches, oscillations). The distribution of this frequency content is referred to as a spectrum.

First, the time series signal is recorded. These time series values can undergo a mathematical transformation, Fourier analysis.

A particularly efficient computational technique of Fourier analysis is the FFT (Fast Fourier Transform). This is used to calculate the frequency content and, in particular, identify the presence of dominant individual frequencies. Using this information, it is possible, for example, to draw conclusions on disturbances (e.g., electrical machines).

Frequencies are specified in units of Hz (Hertz) as the number of oscillations per second. For leakage noises, one usually finds a uniform mixture of frequencies, primarily located in the range from 50 to 1000 Hz.

The knowledge of the spectrum, i.e., of the frequency response, is particularly helpful for the computational use of filters, by means of which one can separate the useful and the interfering portions of the noise measurement spectra.

Correlation is a mathematical method for comparing two time series signals with one another.

A leakage noise is simultaneously recorded by two sensors at different locations. The sound emitted by the leak spreads in the water pipe at a defined sound velocity. If the acoustic event were to be brief and occur only once, e.g., a blow with hammer, it would be simple to measure the arrival at both receivers. In this case, one would only need to compare the arrival times at the two receivers with one another. If these are the same, the sound has traveled the same distance to the receivers, i.e., the sound source lies in the middle of the pipe between the receivers.

If the arrival times are different, it is possible to calculate the distance to the two receivers from the measured time difference. The sound arrives at the closer sensor before the more distant sensor.

Leakage noise, however, is not a one-time acoustic event, but it is also not completely monotonous. Small, irregular changes in sound intensity and frequency occur. These changing signatures travel to the two receivers in the same way as a hammer blow and may arrive at the sensors at different times.

Because the identification and comparison of an individual signature is not as simple as in the case of a hammer blow, the two time series signals are first recorded for a period of time; the time series includes many individually measured signal values.

The two time series signals are mathematically compared with one another, i.e., correlated with one another. If the leakage sound arrived at the sensors simultaneously, the same signatures are compared and the signals are then similar and the correlation is high.

In general, however, the respective signatures arrive at the sensors at different times and simultaneously recorded signals do not correlate with one another. Because the signals were digitally recorded and stored, it is possible to retroactively shift the signals with respect to one another and re-correlate them with one another.

This is performed systematically. From the results, one obtains a correlation curve that includes the individual correlation values over the respective computationally performed time shift.

If, during this process, one reaches precisely the time shift that corresponds the propagation time difference from the sound source to the two receivers, the signal signatures match and one obtains a correlation maximum at this point.

Because this is the comparison of two different signals, it is also called a cross correlation.

In the context of leakage noises, the goal of the correlation measurement is primarily to determine the propagation time difference of two signals.

Because the correlation curve also includes spectral information, it is often of interest to define the character of the leakage noise, particularly for distinguishing noises that are not related to the leak, provided this can be detected by means of a frequency analysis (e.g., electrical noise). The correlation curve can also be mathematically filtered for the purpose of retroactively separating such interfering noise to better identify the correlation maximum caused by the leak.