AZA-OAD Operating Manual

Version 1.0.4.7 and higher

Contents

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1 Preamble

NOTICE:

This device complies with Part 15 of the FCC Rules and with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and

(2) this device must accept any interference received, including

interference that may cause undesired operation.

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.

Attention

Changes or modifications made to this equipment not expressly approved by (manufacturer name) may void the FCC authorization to operate this equipment.

1.1 Overview

The AZA-OAD programme offers a wide range of functions and requires a certain hardware setting at full operational level. In comparison to the unidirectional AZ system, this new system is a bi-directional system with a two-component radio logger receiver. One part is a so-called Servicemaster, the other part is a device with android features to run the AZA-OAD programme.
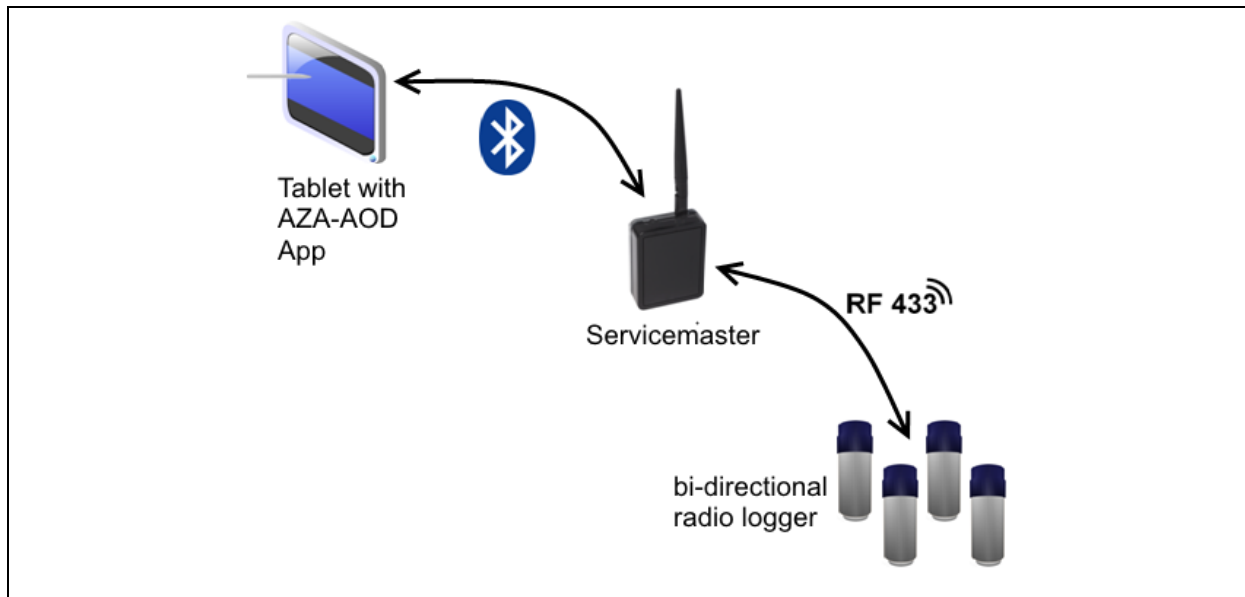
Illustration 1-1: AZA-OAD schematic

Illustration 1-1 is to give an overview of the technical structure of the receiver system and schematically displays the single hardware components and the interactions. The AZA-OAD programme controls a so-called Servicemaster. This Servicemaster processes the orders issued by the programme and forwards them to the single radio loggers. For data exchange between the AZA-OAD programme and the Servicemaster, a Bluetooth connection is applied. Data exchange between the Servicemaster and the individual radio logger is implemented through a 433Mhz band radio connection.

1.2 Tablet specifications

The tablet, which is to host the AZA-OAD programme, needs to meet certain software and hardware requirements for installation via the Play Store. The required software specification is related to the tablet operating system, which needs to be any android version between 4.0 and 5.1.1 to run the current AZA-OAD version (1.0.4.7). Concerning hardware, the following components are required for programme installation on the tablet:

- Bluetooth receiver

- WiFi or 3G / 4G network

- Rear or front camera

- GPS receiver

- Internal free memory capacity

1.3 Installing the AZA-OAD programme

Before you can download the AZA-OAD programme to your android tablet, you need to install a free Play Store account. If you already have a Play Store account, please activate it on your tablet so that you can download the AZA-OAD programme from the Play Store. If you do not have any Play Store account yet, please proceed as described below:

1. Call the "Settings" programme on your tablet.

2. Select "Accounts & Synchronization" and then "Add account" at the lower edge of the screen.

3. Please select "Google" as the type of account. You will now be asked if you intend to add an already existing account or if you wish to create a new account. Click on "New".

4. Now you need to enter your first name and your surname into the corresponding boxes, then click on "Continue".

5. The next step is to enter the requested e-mail address. Please note that you can only choose the part before the "@" symbol. This newly created e-mail address will be your log-in e-mail address for the Play Store from now on. Once you have finalized your e-mail address, click on "Continue".

6. Now please select a password for your new account. This password needs to consist of at least eight characters. The system will request you to enter your password again in the second box for verification purposes.

7. Now enter an already existing e-mail address (e.g. with GMX, Yahoo, or WEB.DE) you have access to. Please also select a security question and enter the appropriate answer in the corresponding box.

8. The system will now ask you if you also wish to register with Google+. Please note that it is not required to register with Google+ to operate the AZA-OAD app. So if you do not wish to register with Google+, click on "Not now".
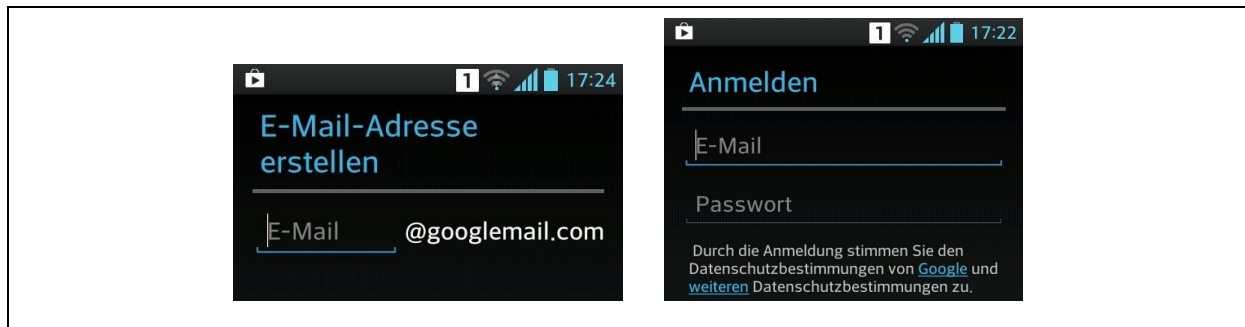
Illustration 1-2: Play Store accounts

As a final step, you can now activate the web protocol for your account. This web protocol function assimilates search results on the basis of your search requests and of the visited websites. If you do not wish to activate this function, please remove the corresponding tick. Click on "I agree" to accept the Google terms of use and the Google data privacy policy.

As soon as the account has been activated on your tablet, you can start the Play Store programme on your tablet. The corresponding icon of this programme looks like a little shopping bag. The Play Store search function is activated by tapping on the magnifying lens, which is usually located in the upper right corner. Enter "AZA-OAD" and tap again on the lens. After a while the system should display our programme as the search result. Now tap on the image of our programme in order to be directed to the Description section, where you will have to tap on the "Install" button to install the programme on your tablet. Once the programme has been installed, close the Play Store programme. The AZA-OAD programme can now be started and is ready for operation.

1.4 Interconnecting tablet and Servicemaster

The AZA-OAD programme can process the data received from the loggers as soon as the tablet has been connected to the Servicemaster via Bluetooth as shown in Illustration 1-1.

The Servicemaster has two LEDs to visualize the Bluetooth connection status: a green LED and a red LED. When the Servicemaster has been connected to the mains, the green LED starts flashing. This indicates that the Servicemaster is now ready to be used in combination with the tablet. Please do not start the AZA-OAD programme before the green light flashes. As soon as the ready-for-operation status (green light flashing) is given, interconnect the Servicemaster with the tablet as described for the "Bluetooth" menu item in Section 2.1.1. As soon as the two devices have been interconnected, the green LED stops flashing and the red LED is activated (permanent light). Please note that the Servicemaster and the tablet are

reliably interconnected only if the red LED is on. As soon as the connection has been established, data can be exchanged between the two devices.

It may occasionally happen that the connection is cut without any operator's input. In this case, the red LED will switch off and the green LED starts flashing again. The green flashing LED indicates that data cannot be exchanged between the two devices and a new connection needs to be established. One reason for such unintended interruption of the connection may be an excessive distance between the Servicemaster and the tablet. The longest possible distance between the Servicemaster and the tablet is usually around 5 metres. An excessive distance may cause data exchange failure.

1.5 Radio logger – manual connection setting

In order to allow the AZA-OAD programme, in combination with the Servicemaster, to transmit data to and to receive data from a radio logger, the particular logger needs to be set to communication mode. There are two options on how to set a logger to communication mode. If the radio logger is a relatively new device which has not yet been subjected to connection times programming (see Section 4.1.1), the radio logger needs to be set to communication mode manually. This is necessary to enable to radio logger to respond to any request issued by the AZA-OAD programme.

If you wish to activate the radio logger manually, please move the magnet along the logger cap in order to activate the logger by means of the solenoid switch integrated in the radio logger. The corresponding position of the solenoid switch is indicated on the cap label. If the solenoid switch of the logger has been activated, the radio logger starts flashing according to its particular mode. Three flashes means that the radio logger has been activated and is now ready for communication with the AZA-OAD programme. A single flash indicates that the radio logger has been switched off and does no longer interact with the AZA-OAD programme.

As soon as all connection times (see Section 4.1.1) have been saved on the radio logger and the operation mode (see Section 4.1.2) has been set to "Wake-up", the radio logger can be woken up through the "Wake up" button as shown in Illustration 2-8.
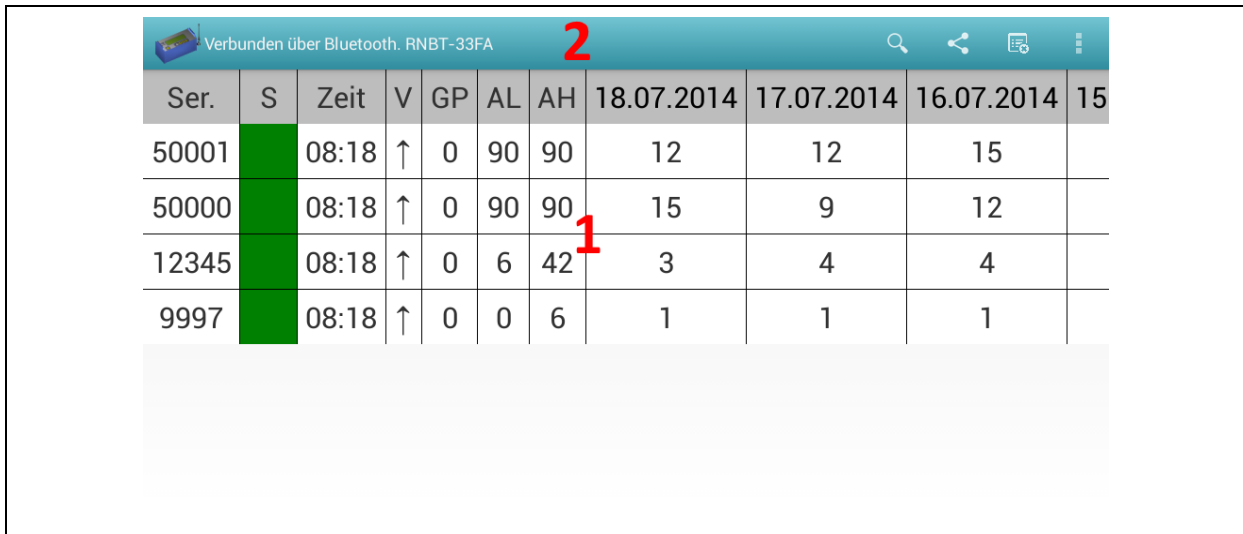
1.6 Radio logger – enforcing data transmission

The radio logger may not be programmed with any connection times (see Section 4.1.1) on delivery. If connection times have not been programmed on a particular logger beforehand, this logger does not respond to a request and thus its data cannot be received by the AZA-OAD programme. If the radio logger signal has never been received by the AZA-OAD programme before, it will not be sufficient to set the logger to communication mode (see Section 1.5) as the programme has not yet been acquainted with the particular radio logger.

For initial radio logger signal reception it is therefore necessary to enforce data transmission (unless connection times have already been programmed). In order to do so, please start the radio logger signal reception feature of the AZA-OAD programme as described in Section 2.1.1. Then attach the magnet to the radio logger cap until the logger is displayed on the signal reception list of the AZA-OAD programme. Then set the radio logger to communication mode as described in Section 1.5 and interrupt data reception on the AZA-OAD programme. You can now proceed with radio logger programming as described in Section 4.

2 Programme structure

As soon as the programme has been started, the programme main mask as shown in Illustration 2-1 is displayed. This mask is divided into two areas, which offer additional functions of the application. The first area shows the radio logger list displaying one logger per line if the particular radio logger signals have been received or saved beforehand. If no radio logger signal has been received yet, this area does not reveal any data. The Actionbar in area two offers general programme-related functions and information.

Illustration 2-1: Main mask

2.1 Actionbar

The so-called "Actionbar", marked as the second area (red "2") of the main mask in Illustration 2-1, offers access to the menu hosting additional programme-related functions. Also, this area provides status information on the Bluetooth connection between the tablet and the Servicemaster. Such status information is displayed in the front area of the Actionbar right next to the programme logo and is to visualize the status of the connection between the Servicemaster and the tablet. The radio logger data can only be received, transmitted, and/or processed if both devices are interconnected by means of the Bluetooth connection.

2.1.1 Menu

If you wish to open the menus located on the right-hand side of the Actionbar, tap on the corresponding symbol. Illustration 2-2 is to show the menu structure of the programme, with all dark grey areas being visible after the corresponding symbol in the Actionbar has been tapped on.
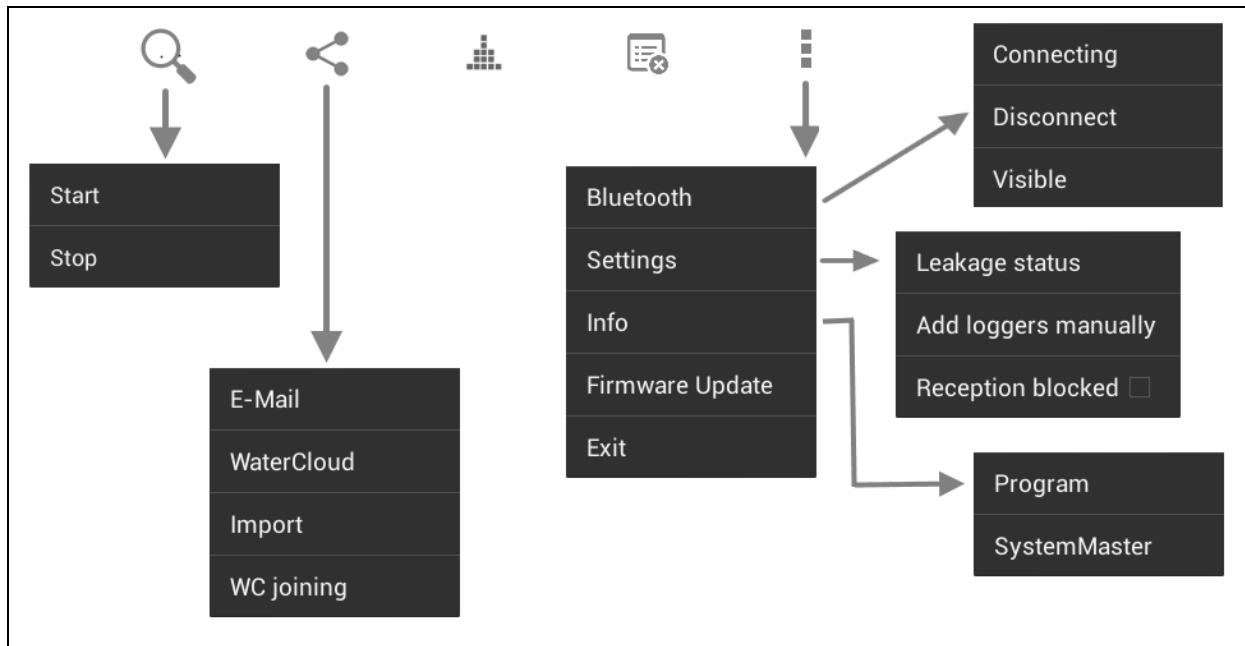
Illustration 2-2: Menus offered on the main mask

The process to receive data from the loggers can be started and discontinued through the lens symbol. Tapping on the lens symbol makes the sub-menu as shown in Illustration 2-2 appear on the screen. The sub-menu will show up underneath the lens symbol and offers the options to start and to discontinue data exchange with the radio loggers on the Servicemaster by tapping on the corresponding menu item. If the radio logger data reception process is operational, i.e. the Servicemaster is on reception mode, the data reception symbol ( ) in the lower right corner of the programme starts flashing.

The "Export" menu item allows the operator to export data from the radio logger list. One option to export such data is through the tablet, which can send the acquired data to the WaterCloud (see Section 6) directly. The other option to export the data is to e-mail the acquired data to another computer. The file attached to such an e-mail can then be imported to the AZ-Easy programme and can be processed there. The logger data contained in the exported file corresponds to the data shown in the radio logger list (Section 2.2). If displaying the logger data in the radio logger list has been limited by the filter function (see Section 2.2.1), the export file will contain proportionately limited data.

With the "Correlation" menu item, the input mask for radio logger correlation can be opened. This feature is to program the radio loggers for a correlation process or to evaluate previous correlations carried out by the radio loggers. Section 5 is to describe the comprehensive functions of this part of the programme in detail.

The "Clear list" 🗐 menu item is to clear the radio logger list (see Section 2.2). With this function, all radio loggers are deleted from the list and from the programme memory. If you wish to delete the data from the list irrevocably, tap on "Yes" in the subsequent confirmation dialog. If you tap on "No" in the confirmation dialog, the data deleting process will be stopped and the data remains saved.

The three square dotes arranged in a vertical order at the right end of the symbol array host the main menu as shown in Illustration 2-2 below the dots. You can leave and terminate the programme by tapping on the "Exit" button. The tablet will then return to the previously displayed layout.

The "Bluetooth" menu item leads the operator to the Bluetooth communication control sub-menu. The first menu item "Connect" is to establish a Bluetooth connection between the tablet and the Servicemaster. Tapping on this menu item makes the dialog appear as shown in Illustration 2-3.
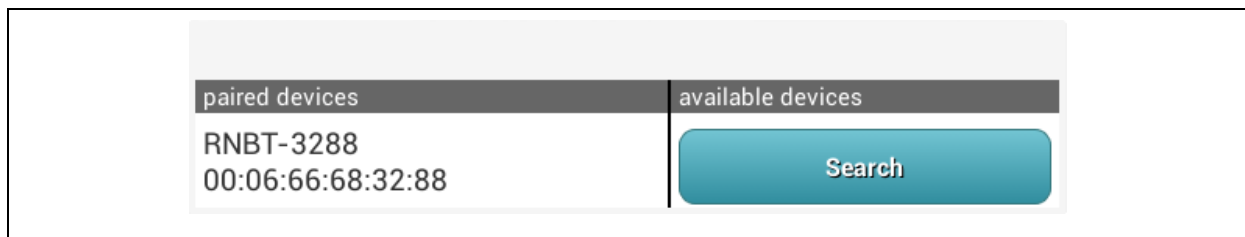
Illustration 2-3: Bluetooth connections

The "Paired devices" list shows all devices paired with the tablet so far, i.e. all devices which have already been applied and whose connection ID has already been entered. Tapping on the particular device in this dialog will close the dialog and the systems will try to establish a connection between the Servicemaster and the tablet. As soon as the connection has been successfully established, the Actionbar will display the name of the device which is now connected to the tablet.

The "Available devices" section shows all the devices located in the vicinity of the tablet. When the dialog is displayed, this section is empty at first. Tapping on the "Search" button will display all devices located nearby. Selecting a particular device terminates the searching process of the programme, and the system tries to establish a connection to this device. Establishing this initial connection to a device may take up to one minute. After this initial process, the Servicemaster should be connected with the tablet and the name of the connected device is displayed in the Actionbar.

If a particular device is to be disconnected again, tap on the "Disconnect" menu item. The name of the disconnected device will then disappear from the Actionbar.

Tapping on the "Settings" button (in the main menu) leads the operator to a sub-menu with two menu items. The "Leakage status" menu item provides a dialog where the number of days used for leakage status assessment can be selected, with 14 days usually being already preselected. This means that all noise level-related data received from the radio logger is used to determine the particular leakage status. If, however, the radio loggers are relocated to another site after three days and are read out beforehand, the leakage status can be calculated on the basis of those three days only. Consequently, this requires a reduction of the number of days used for the calculation of the leakage status to three days as otherwise an incorrect leakage status will be provided by the calculation.
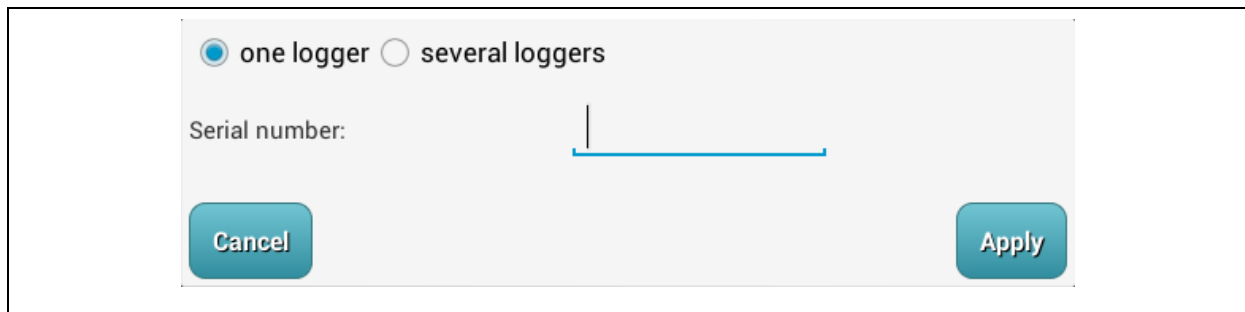
Illustration 2-4: "Creating radio loggers in the system" dialog

With the "Settings" -> "Add logger manually" menu item, the dialog as shown in Illustration 2-4 above is opened, The dialog is used to add one or a series of radio loggers to the radio logger list in the main mask. This step makes a prior reception of the particular radio logger signal needless.

Another menu item is "Settings"->"Reception blocked", which allows the operator to block the reception of radio logger signals which have not been received previously. If this function is activated, a little tick appears in the menu item and the system receives and displays only measurement values from those loggers which have already been added to the radio logger list (see Section 2.2). If data is received from a logger which is not indicated on the list, the programme ignores such data and does not save the particular values. If this function is deactivated, an empty square is displayed in the menu item.

The "Info" menu item and its sub-menu items as well as the "Firmware Update" menu item are described in detail in Section 7 as they are part of the programme service functions.

2.2 Radio logger list

The left area (see Illustration 2-5, orange area) of the table provides information on the particular radio logger (e.g. serial number, leakage status, data reception time, noise level amplification, and basic noise level) as well as on its settings. The measurement values saved by the radio logger are listed in the right part of the table (see Illustration 2-5, green area). One column always indicates the noise level measured on the day stated on the table head. If the radio logger has not acquired any noise level data on the particular day, this is indicated with "---". Wiping your finger horizontally across the display will call previous noise levels in the right part of the table. The current programme version shows the last 14 days provided the particular radio logger has transmitted any data during this period.

Illustration 2-5: Radio logger table, left and right areas

2.2.1 Filter dialog

Tapping on the table head in the left (orange) area of the radio logger table (see Illustration 2-5) for a while activates and displays the filter dialog as shown in Illustration 2-6. This filter dialog enables the operator to block the indication of radio loggers on the list. Four different filters can be selected and also combined with each other for this purpose.
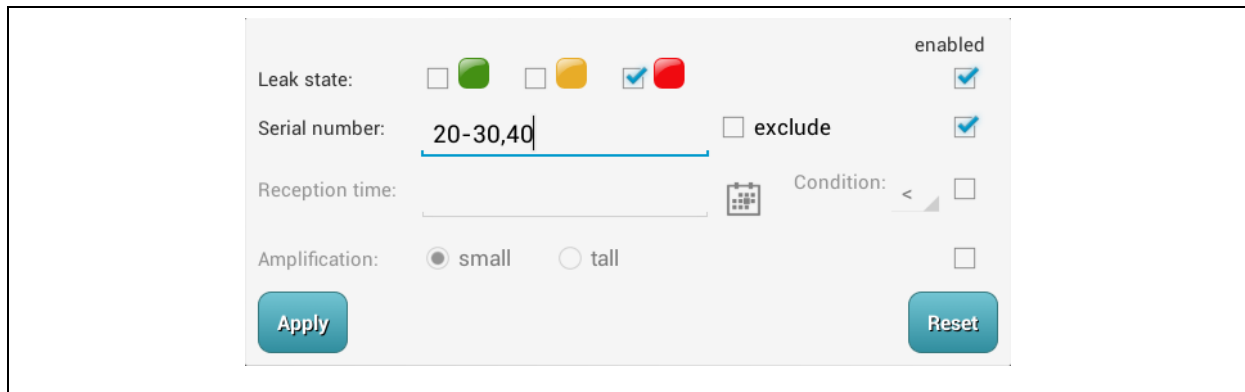
Illustration 2-6: Filter dialog

The particular filter to be applied needs to be activated beforehand by tapping on the corresponding tick box at the end of the particular line. If the box shows a blue tick, the filter is activated. If the tick can be removed by tapping on it again, and the particular filter line is blocked and cannot be applied.

The first filter is the leakage status filter, which determines the radio loggers indicating a certain leakage status and which are to be shown on the list. Only those radio loggers will then be listed whose indicated leakage status complies with the status activated in the filter dialog.

The "`Serial number`" filter allows the operator to display radio loggers with a certain serial number or to exclude such loggers if "`exclude`" has been ticked. Please note that a range of serial number can be defined by using the "-" character and also individual serial numbers can be entered separated with a comma.

The "`Reception time`" filter is to display those radio loggers on the list which feature the particular time set through the filter. The date can be selected, and also the condition to compare dates by pressing the corresponding button can be activated. Possible options for the reception date of the radio logger signal are the same date, an earlier date, or a later date including or excluding the set date.

The final filter option is the amplification. This function determines if loggers set to a small amplification or loggers set to a major amplification are to be indicated on the list.

As soon as all filters have been set, the filters can be used for the list by tapping on "`Apply`". Furthermore, the dialog closes as soon as this button has been tapped on. If filtering the table data is no longer requested or if the filter settings are to be deleted or changed, tap on the table head again for a little while to display the filter dialog. If only the filter settings need to be

changed, such change can be made now. Tapping again on the "Apply" button activates the new filter settings again. If the filters need to be deleted and thus all data on the radio logger list is to be displayed, tap on "Reset". Now all filters are deleted and the radio logger table displays all radio loggers whose signals have ever been received.

2.2.2 Value chart

The operator can open the value chart (Illustration 2-7) for a certain radio logger by tapping briefly on the particular radio logger table line. This, however, works only in the right area (orange, see Illustration 2-5) of the list, Tapping on a line in the green table area does not make the dialog open. The central area of this dialog displays the noise level values of a specific radio logger in a bar chart, with the oldest measurement value being displayed at the left end and the newest measurement value being displayed at the right end of the chart.
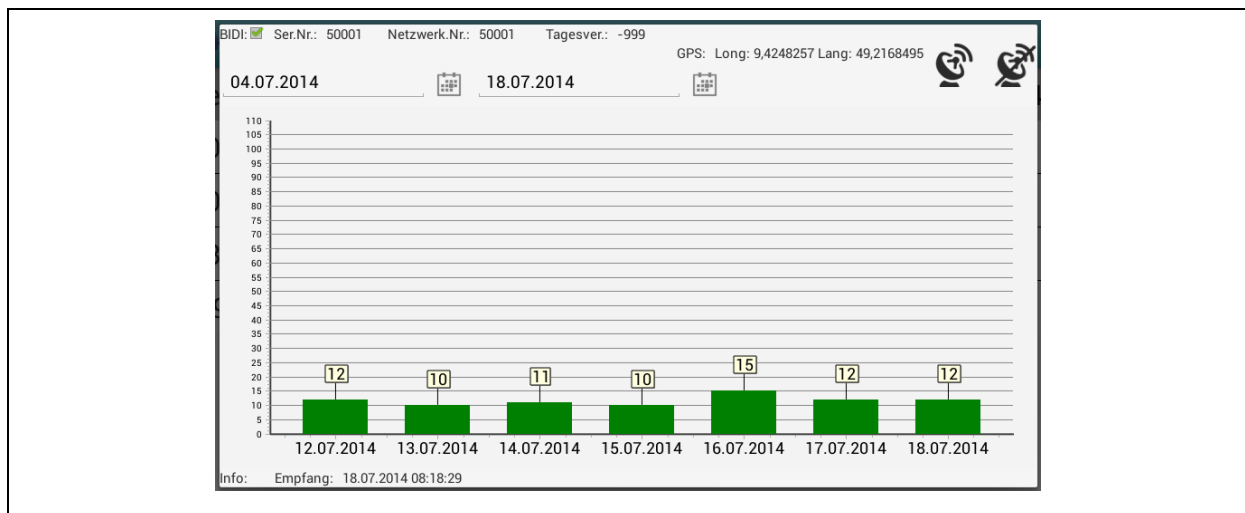
Illustration 2-7: Value chart

In general, the level values of the past 14 days (if applicable) are displayed on the chart. The time interval for the display of the level values on the chart can be changed with the calendar buttons. This allows older level values, which are only available in the tablet database, to be displayed.

The last reception time of the signal of a particular radio logger is indicated below the bar chart. The area above the bar chart displays the serial number and the network number of the chosen radio logger. Also, GPS coordinates can be assigned to the radio logger by tapping on the 📡 symbol. Please note that the GPS receiver of the tablet has to be activated beforehand. The 📡 symbol can also be used to delete the GPS coordinates. If you intend to cancel the dialog, tap on the display beside the dialog or tap on the "Return" button of the tablet.

2.2.3 Context menu

Similar to the opening process described for the value chart above, the context menu can be opened by tapping on a table line in the orange area (see Illustration 2-5). However, the menu item must be tapped on for at least 1-2 seconds. The menu functions allow access to the radio logger device parameters and to extract data from the radio logger. As the system offers a variety of functions, the entire following Section is to provide more specific and more detailed information on the context menu.
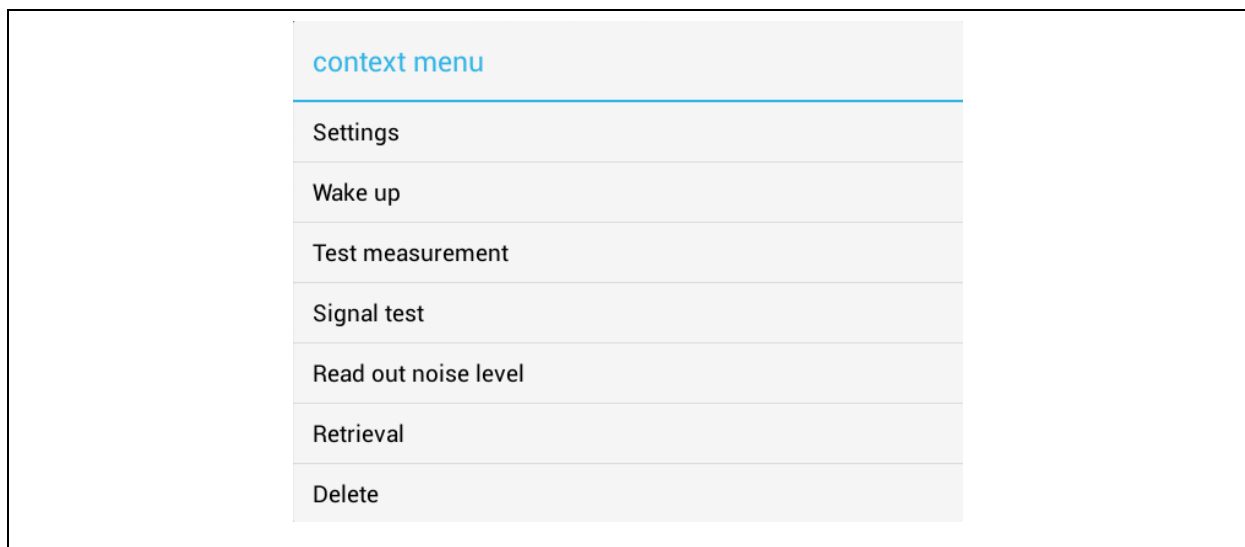
Illustration 2-8: Context menu

3 Context menu

3.1 Settings

This menu item is to open the "Radio logger settings" dialog, which accepts changes on the settings of the radio logger. Particularly the connection times, radio settings, system-related information (SW and HW), and the time can be adapted via this dialog. For a detailed overview of the functions, please refer to Section 4.

3.2 Wake-up

If the wake-up function of the radio logger is activated, the device can be set to communication mode by tapping on the "Wake-up" button. In this mode, the logger can be programmed and read out. If the wake-up function of the logger is not activated, the logger needs to be woken up and set to communication mode with the magnet (see Section 1.5). Activating the wake-up function is described in Section 4.1.2.

3.3 Test measurement

The "Test measurement" menu item allows the operator to run a test measurement with the radio logger. During such test measurement, the radio logger transmits the current level value and the corresponding frequency to the programme once a second. In the upper area of the dialog displayed as soon as the function has been started, a bar chart shows the last 10 measured level values, with the latest value being displayed at the right end of the chart.
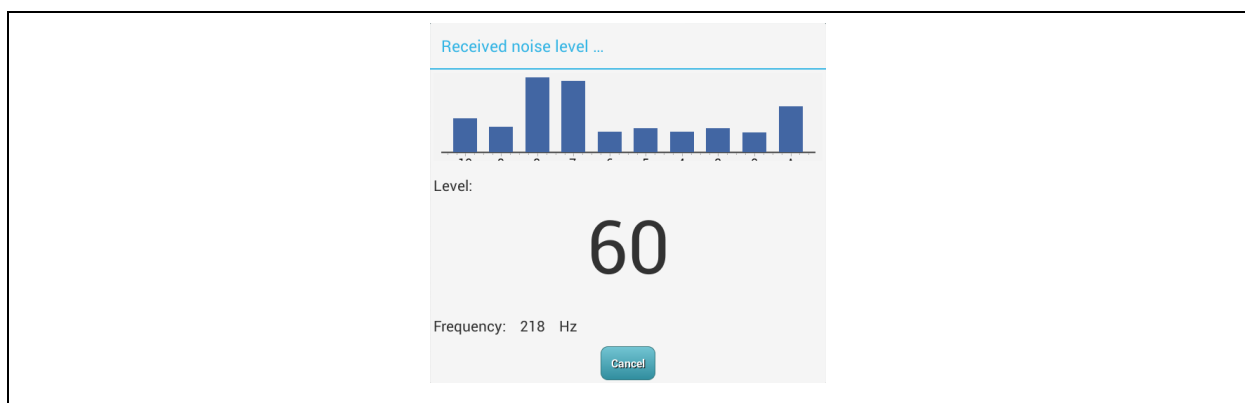
Illustration 3-1: "Test measurement" dialog

The latest level value is not only displayed visually, it is also displayed in numbers in the middle of the dialog. The range of the displayed numbers is from 1 (lowest possible level value) to 99 (highest possible level value). The currently acquired frequency of the level value

is displayed beneath the current level value. This frequency reveals the highest frequency line acquired at the point of time of data acquisition. If you wish to terminate the test measurement and the dialog, please tap on "Cancel".

3.4 Signal test

In order to check whether the radio logger can be contacted by the programme, tap on the "Signal test" menu item (see. Illustration 2-8). If the connection is stable, the communication LED on the radio logger cap starts flashing thus indicating that the programme, the radio logger, and the Servicemaster are interconnected. If the connection to the logger is flawed, an error message will appear after a few moments. This error message may have two different causes: one possible cause is that the radio logger is not set to communication mode, another possible cause may be an interrupted radio reception on the Servicemaster's side. In the latter case, press again the "Signal test" button to restart the signal test. If the error message keeps occurring, the radio logger has probably not been set to communication mode. So please activate the communication mode on the radio logger as described in Section 1.5.

3.5 Reading out the noise level & fidelity

With the "Read out noise level" and "Retrieval" menu items, the dialog as shown in Illustration 3-2 is opened. Tapping on "Retrieval" opens the dialog immediately if a noise level file has already been read out from the radio logger beforehand. If no noise level file has been read out from the radio logger previously, this dialog will not appear but a message is displayed informing the operator that a level file is not yet available.

In this case, and if a current noise level file is to be read out from the radio logger, tap on the "Read out noise level" (see Illustration 2-8). Before the dialog is displayed now, the system issues a request whether the operator only intends to read out a noise level file from the radio logger or whether a new noise level file is to be created. The radio logger creates a noise level file after every night-time measurement, which can be read out through this programme function. If the operator requires a noise level file of the current situation, the previous dialog needs to be confirmed by tapping on "Yes". Please note that if a current noise level file is created and read out, the noise level file of the previous night-time measurement will be deleted.
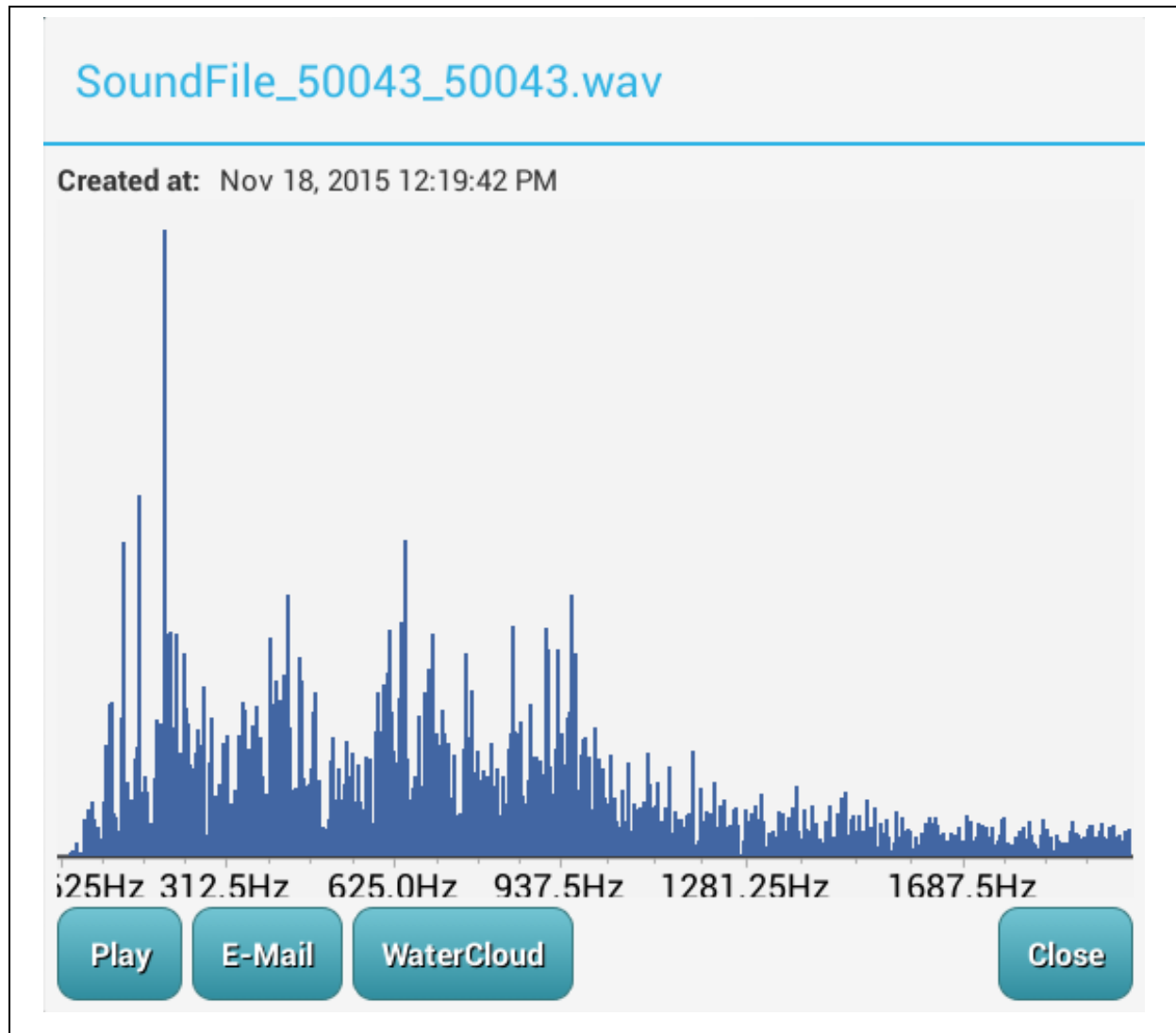
Illustration 3-2: "Noise level file" dialog

The "`Noise level file`" dialog offers some information on the noise level file. The upper part of the dialog shows the name of the noise level file and also when the file was created and transmitted to the tablet (right beneath). In the middle of the dialog, the spectrum of the leakage-borne noise is displayed. As this spectrum may be complex due to the scope of frequency distribution, it may take a little while to be displayed.

If you wish to terminate and to leave the dialog, tap on "`Close`". Tapping on "`Play`" starts the retrieval of the noise level file. If the noise is not audible, the volume has to be increased with the android volume control. Sometimes, however, the leakage-borne noise is still hardly audible. In such case, the noise level file can be transmitted to a computer by tapping on the "`E-mail`" button. The receiver's e-mail address will by requested by the system and needs to be entered before the e-mail can be sent. If the tablet is connected to the Watercloud (see Section 6), the noise level file can be directly transferred to the server with the

"WaterCloud" menu item. Pressing "WaterCloud" opens the dialog as described in Section 6.2. The file will be sent according to the procedure as described in the "Radio logger data transfer" Section.

Please note that sending a noise level file or an e-mail is possible only if your tablet is connected to the Internet. Also, a valid e-mail account has to be activated on the tablet, and the tablet needs to be connected to the Watercloud server.

3.6 Deleting the data

This menu item allows the operator to delete all data of a radio logger from the AZA-OAD programme. Tapping on the menu item makes a confirmation dialog appear on the screen to double-check if the particular logger actually is to be deleted. Pressing "Yes" ultimately deletes the radio logger from the programme. Pressing "No" cancels the deleting process.

4 Radio logger settings

The "Radio logger settings" dialog is divided into two areas similar to the main mask (see Illustration 2-1). One area is the Actionbar where the operator can switch among various radio logger parameter categories. The other area is the data area, where various parameters of the radio logger can be processed. Changing from one category to the other is made by tapping on the corresponding icon in the Actionbar. Currently, the categories "Connection times", "Measurement", and "Settings" are available. These categories are described in the following sub-Sections.

The "Close" button (Illustration 4-2) is used to close the dialog and to return the operator to the main mask of the programme. Tapping on the "Synchronize" button starts data synchronization between the radio logger and the tablet. The operator will have the choice between reading out any data from the radio logger and entering any data into the logger. It is recommended to read the radio logger parameters first once the dialog has been opened to make sure that the parameters displayed in the input mask comply with the parameters of the particular logger.

If the radio logger settings allow waking up the logger, the logger can be set to communication mode via the "Wake up" button where it can be programmed and read out. If the radio logger is not set to wake-up mode, it needs to be woken up and set to communication mode with the magnet (see Section 1.5). Section 4.1.2 describes in detail how to activate the wake-up mode.

The radio loggers are delivered with de-activated wake-up mode to extend logger battery lifetime. Therefore, the loggers need to be set to communication mode with the magnet when they are put into operation the very first time. Furthermore, it is recommended to de-activate the radio module if a logger is not used for a longer time. The dialog as shown in Illustration 4-1 is used to switch the radio transmitter on and off.
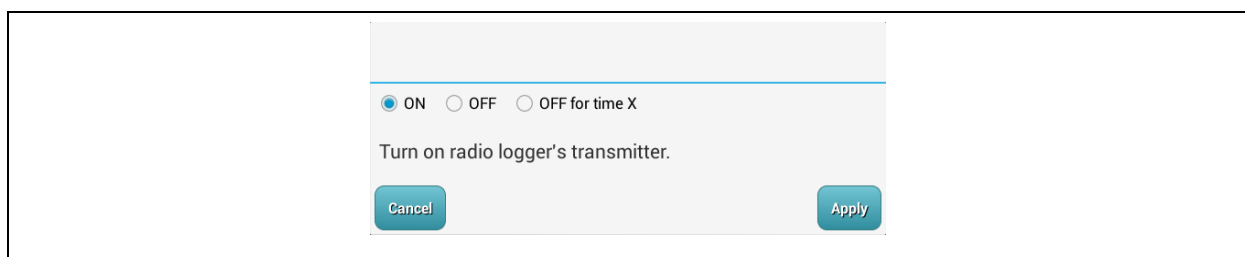
Illustration 4-1: "Logger radio connection" dialog

This dialog can be opened with the "Sleep" menu item in the "Radio logger settings" dialog (see Illustration 4-2). The radio module of the logger can be switched on and off by tapping on the "ON" / "OFF" buttons. Please note that you need to confirm you choice by tapping on the "Apply" button subsequently. If you tap on "Cancel", the dialog will be closed and the logger settings will not be changed.

4.1.1 Connection times

Time-based availability of a radio logger can be set in the "Connection time" mask. A radio logger will contact the system or send data only at certain determined connection times. Please note that the logger will not transmit any noise level data at any other time. Also, contacting or waking up the logger is not possible except at the time as set in this time frame.
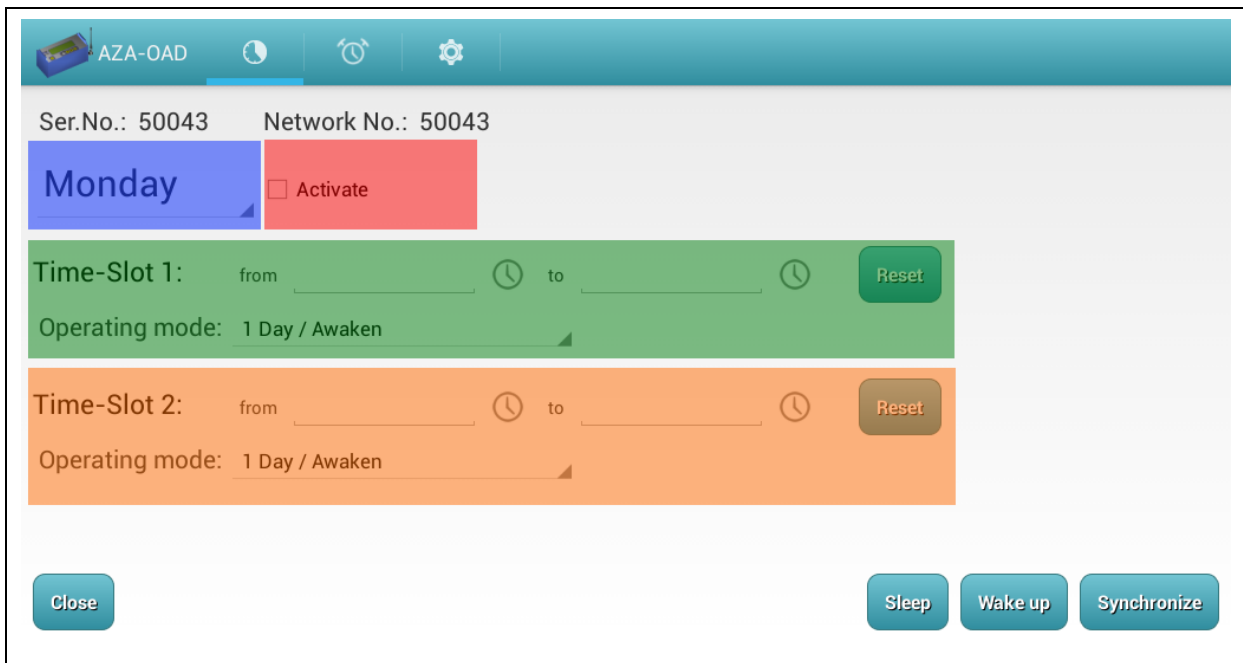
Illustration 4-2: Mask to set connection times

As shown in Illustration 4-2 above, two data transmission times can be determined for one day. However, there is no directive to set two transmission time frames, and the system also accepts only one data transmission time frame per day, i.e. the operator may set the particular time frame either with "Time-Slot 1" (green marking in Illustration 4-2) or with "Time-Slot 2" (orange marking in Illustration 4-2).

If the clock time needs to be adjusted, the clock symbol behind the corresponding menu item needs to be tapped. Once the menu item has been tapped on, a dialog will be displayed where the operator can set the hours and the minutes and confirm the setting by tapping on "OK". If

the set clock time is no longer required, tap on "Reset". A certain data transmission time can also be copied and shifted from one box to the other. For example, tapping briefly on the "Time-Slot 1" expression makes the set time frame appear in the "Time-Slot 2" time frame and vice-versa.

In addition, a copy dialog is available by tapping on the "Time-Slot 1" expression for a longer period of time (for approx. 2 seconds). This dialog allows selecting the individual weekdays where the clock times as can currently be seen on the "Connection times" mask can be copied to.

As already described, the time frames for radio logger data transmission sessions can be selected individually for each day. Tapping on the blue area as shown in Illustration 4-2 opens a shortlist where the requested day can be chosen by tapping on the particular day. Also the time frame for data transmission can be changed in this dialog, if required.

The pink area (see Illustration 4-2) is used to activate and to de-activate the data transmission times on a radio logger for a particular day. This means, that if this area does not show any tick, the radio logger will ignore the set data transmission time frame(s) for this particular day. If the settings are transferred to the radio logger and read out subsequently, the logger will show empty boxes (i.e. no time set) for those days which have not been ticked in the pink area.

The "Operating mode" determines the format of the measurement data transmitted to the AZA-OAD programme by the radio logger. Currently the following data transmission modes are available:

- Ser. / Wake up

- 1 day and 1 day / Wake up

- 7 days and 7 days / Wake up

- 7 days+ and 7 days+ / Wake up

- 14 days and 14 days / Wake up

The number of days in the corresponding mode is equivalent to the number of measurement results sent to the programme by the radio logger. So with a "7 days" setting, seven

measurement values will be transmitted by the logger provided the logger has already carried out seven measurements; and with a "14 days" setting, fourteen measurement values will be transmitted. There is also a "+" version available for the "7 days" mode. With this "+" setting, not only the particular level values but also the "ActualLow" and the "ActualHigh" values are transmitted.

The "Wake up" feature makes the radio logger go to reception mode as soon as the measurement values have been transmitted. This mode allows the operator to activate the logger by tapping on "Wake up" (see Illustration 4-3) and to communicate with it. If the operating mode without wake-up function is selected, the logger needs to be set to communication mode manually with the magnet before communication can be established.

4.1.2 Measurement

This area offers not only the starting time of the night-time measurement and the settings for the kind of data transmission from the radio logger to the Servicemaster but also the option to change the basic noise level in this mask.

Unlike the unidirectional radio logger, the bidirectional radio logger accepts an individual starting time for a measurement (level value acquisition). Of course, it is recommended to stick to night-time measurements (F.A.S.T recommends measurements to take place at 2am) as disturbing noises are reduced to a minimum at this time and thus the leakage status can be evaluated in an optimal way. Nevertheless, tapping on the clock symbol results in displaying a dialog where the clock time can be changed. Once this input dialog has been closed, the starting time for the measurement is indicated in the box to the left. Behind the clock symbol (used to enter the starting time) there is a button which allows the operator to prevent the execution of a measurement. If this button is tapped on, either a red cross or a green tick is displayed. The green tick indicates that the measurement can be carried out at the selected starting time.

The sensitivity of the sensor of a bidirectional radio logger can be changed, a feature that was already appreciated with former logger versions. This change in sensitivity is implemented through a change in amplification. In general, low amplification is recommended for pipes which make sound travel very well. For pipes which rather absorb sound and hinder sound propagation, high amplification is recommended.

Illustration 4-3: Measurement mask

With the "`Transmission power`" option, radio performance can be affected. So if the radio logger is applied in a built-up area or is placed in a deep manhole, high transmission power is more likely to provide reasonable results. And if the logger is placed in the fields or on a pillar hydrant, the low transmission power option is recommended. Of course, there is a direct relation between transmission power and battery capacity. So if transmission power is set to high, the energy of the battery will be used up more quickly than with a low transmission power setting.

The "`Signal check`" option makes the radio logger select a secure data transfer mode for the data transmission process to the Servicemaster. This setting is recommended if an increasing number of data transfer malfunctions have occurred or if a radio logger signal is not received at all.

The "`Transmission interval`" setting option allows changing the interval between single data transmission procedures from the radio logger to the Servicemaster. The interval options range from 5 seconds to 20 seconds. Please note that an extended interval extends battery capacity.

4.1.3 Settings

This area offers both functions which directly affect the radio logger and also information to be read out or to be transferred to the radio logger first with the "`Synchronize`" button.

After the radio logger has been read out, certain information such as ”Battery voltage“, ”Software version“ of the radio logger firmware, and ”Hardware version“ will be displayed. Also, the time and the date of the radio logger are displayed after the read-out. Unlike the unidirectional radio logger, the new bidirectional radio logger is capable of managing the date independently. Please note that if the date is changed, all measurement values saved so far cannot be read out anymore and thus will be lost. Therefore, it is recommended to check the date on the logger and to correct it accordingly, if necessary, as soon as the logger has been delivered to the customer either as a new device or as a repaired device.
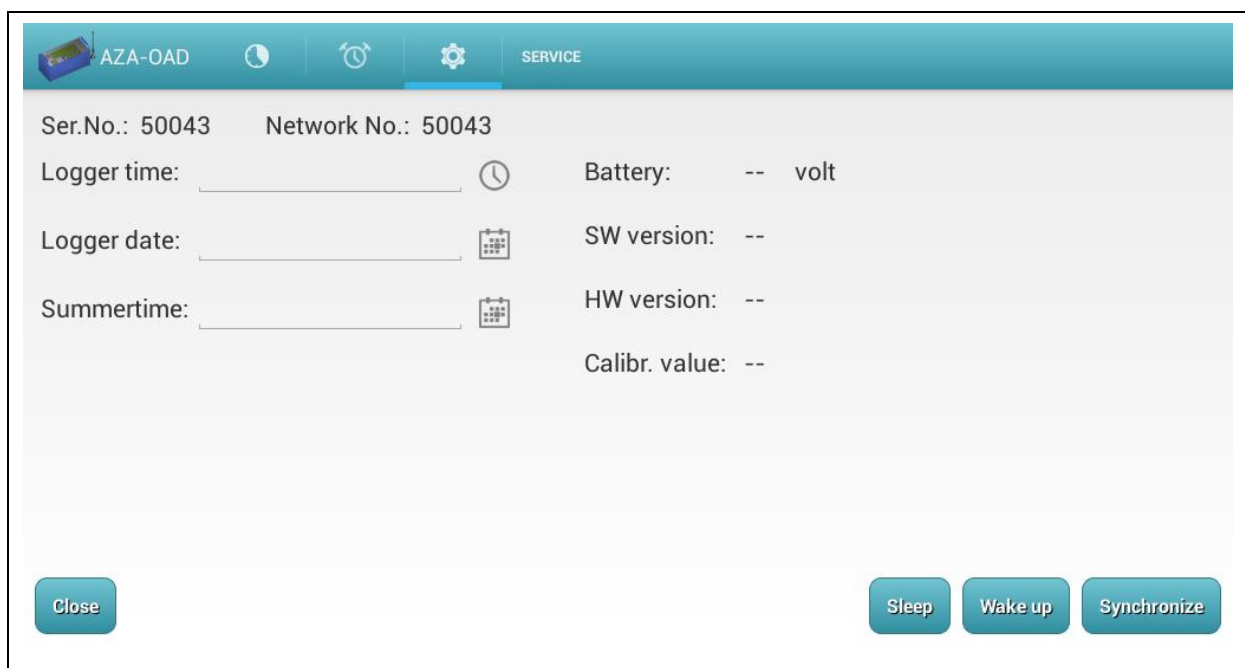
Illustration 4-4: Settings mask

The time or the date can also be changed by tapping on the button behind the input boxes. If the clock is tapped on, a dialog appears where the time can be changed. If the clock is tapped on, a dialog is displayed which allows setting the clock. If the calendar symbol is tapped on, the displayed dialog allows the selection of the date for a radio logger by means of a calendar. As soon as these two dialogs are closed, the selected values are displayed in the corresponding boxes before the symbol. Please note that the time and the date will be transferred to the radio logger only if confirmed by tapping on ”Synchronize“. Then select “Active“ in the following dialog as this step also updates the date. If you do not choose the “Active“ option, only the time will be changed on the radio logger.

5 Correlation

Programming a correlation measurement and interpreting such measurement is carried out via the main mask as shown in Illustration 5-1. This main mask is divided into four areas which are to visualize the measurement data and also to control the measurement process.
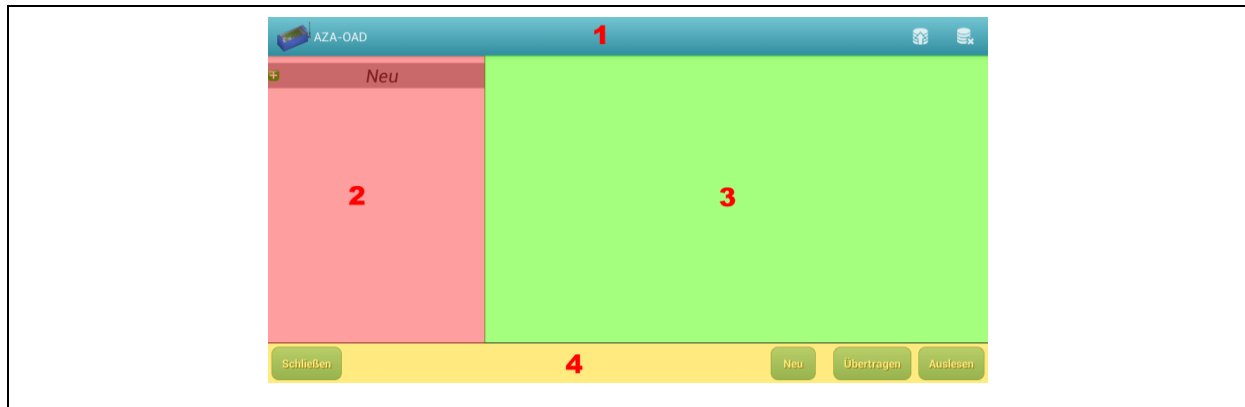
Illustration 5-1: Correlation mask

Area one is the Actionbar, which contains the menu. With this menu, any saved correlation measurement can be called or deleted from the database. For a detailed description of the menu application, please refer to Section 5.1.

The second area is to visualize and to group the single radio loggers as per their individual status. All radio loggers to be programmed are grouped in this area and can then be programmed for correlation measurement purposes. This part of the programme is also used to call display information. Section 5.2 is to describe in detail the procedure of how to program and how to read out a measurement.

The measurement results are displayed in the third area of the main mask. The programme provides the user with all measurement values acquired during a correlation process. The value diagrams are displayed as tiles after being selected. Tapping on a certain tile makes the programme display the corresponding values in a clearly arranged diagram. For further information on the functions of this area, please refer to Section 5.3.

The yellow area of this mask is the fourth area hosting all the buttons required to read out and to start a correlation measurement. The functions of the "New", "Transfer", and "Read out" buttons are described in detail in Section 5.2 as they make basic functions for measurement programming available. If you intend to close and to leave the dialog, tap on "Close".

5.1 Uploading and deleting data

Once a correlation has been read out at the radio loggers, the programme saves the corresponding measurement data directly and automatically in the database. If you wish to upload a measurement which has already been saved, just tap on the 🗄 symbol and a dialog as shown on the left-hand side of Illustration 5-2 will appear. With this dialog, a particular measurement can be selected and can be uploaded to the main mask by tapping on "Apply". If you wish to delete a measurement from the database, the dialog can also be called by tapping on the 🗄✕ symbol. With this deletion dialog, several measurements can be selected at the same time for simultaneous deletion. The deletion process has to be started by tapping on "Apply". If a measurement is neither to be uploaded nor to be deleted, the particular procedure can be cancelled by tapping on the display next to the dialog.
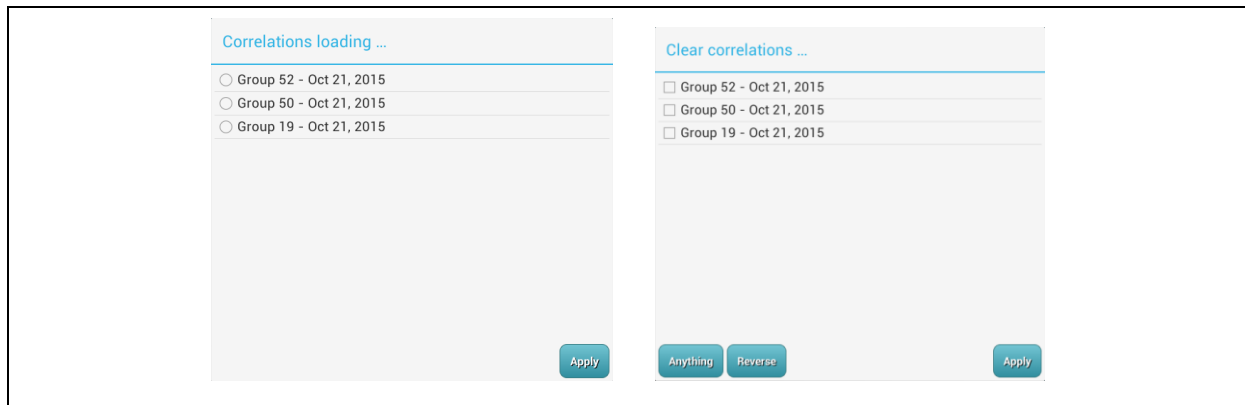
Illustration 5-2: DB dialogs: Uploading and deleting data

5.2 Measurement

The radio loggers have to be synchronized with each other prior to a correlation measurement to allow leakage-borne noise correlation. The measurement data is recorded for correlation only if the clocks have been synchronized beforehand through the Servicemaster. After the synchronizing procedure, the noise levels are recorded for 25 seconds, and the acquired measurement data can then be read out and correlated. A new correlation measurement can then either be started after 4 minutes or after 2 days. Please note that the longer the start of the measurement is postponed, the bigger will be the clock drift between the single radio loggers, which may lead to deviations in correlation. Also, reading out the measurement data requires sticking to certain guidelines. The measurement data should be read out as soon as possible after the recording to minimize any impact of a possible clock drift. However, the maximum timeline for the read-out is 29 hours after measurement data acquisition.

Currently the radio loggers be programmed only if they are set to communication mode (see Section 1.5), i.e. if the radio loggers have been activated with the magnet or with the "Wake up" command (see Section 3.2). As soon as all radio loggers to be programmed have been switched on, a measurement can be programmed.

In the second area (see Illustration 5-1), the single radio loggers are grouped or categorized according to their individual status. Such a *group element* is generally displayed in this area as a list element with a grey background. Potential *group elements*, as also shown in Illustration 5-3, are grouped in "New", "Group XXX", and "Write error" (see Section 5.2.3). In some cases, the group elements "Obsolete firmware" (see Section 5.2.5) and "Obsolete hardware" (see Section 5.2.6) are also displayed. *Radio logger elements* indicate a radio logger on the list and are always designated "Logger" plus the corresponding serial number.

The *group elements* contain either no, one, or several *radio logger elements* and indicate the logger status. If there is a *radio logger element* in group "New", the actual corresponding radio logger has not been programmed yet and is ready for correlation measurement programming. A *radio logger element* contained in group "Group XXX" (with XXX constituting a consecutive number) indicates that this logger has already been programmed for a correlation measurement. In rare cases, communication errors or other errors may occur during correlation measurement programming. If such an error occurs, the particular *radio logger elements* will be shifted to the "Write error" category. This radio logger needs to be programmed again then. Troubleshooting is described in Section 5.2.3.

5.2.1 Starting a new correlation measurement

If you wish to program a new correlation measurement on the radio logger, tap on the "New" button or on the *group element* "New". A selection dialog will then appear where the all radio loggers can be chosen you intend to apply for the correlation procedure. The important aspect for a correlation measurement is that all the radio logger whose measurement datas are to be correlated have been marked in this selection dialog before the dialog is closed again by tapping on the "Apply" button. The *radio logger elements* will be regrouped under the group element "New" as shown on the left side of Illustration 5-3. All radio loggers contained in this group will be allocated the same group number during programming. This allocation then allows correlation of the measurement datas issued by the particular loggers.
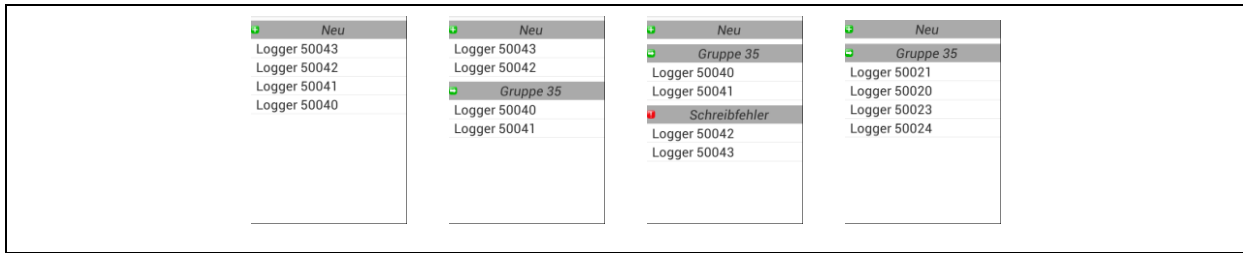
Illustration 5-3: Starting a new correlation measurement

If programming has been completed successfully, the chart as shown in Illustration 5-3 on the right will be displayed on the main mask. If there has already been some programming on radio loggers and additional radio loggers are added to the "New" group (see Illustration 5-3, second chart), the newly added loggers will be allocated a new group number and cannot be correlated with the group already displayed.

As soon as the requested radio loggers are listed under *group element* "New", programming of a correlation measurement can be started by tapping on the "Transfer" button. A dialog as shown in Illustration 5-4 on the left will appear now where you can select the date on which the correlation measurement is to be started. An overview of the set starting times is permanently displayed in the headline of the dialog. The "<" and ">" buttons below the dialog headline allow switching between date and time in this dialog. If you wish to switch to the time after you have set the date, you can also change the time. When all settings have been made, tap on "Accept" to start on the radio logger programming procedure. If neither the time nor the date is set and the dialog is closed immediately by tapping on "Accept", the programme will automatically set the start for the next correlation measurement to 4 minutes. If there is no measurement to be programmed on the radio logger, the dialog can be cancelled by tapping on "Cancel". This step, however, does not result in any radio logger programming.
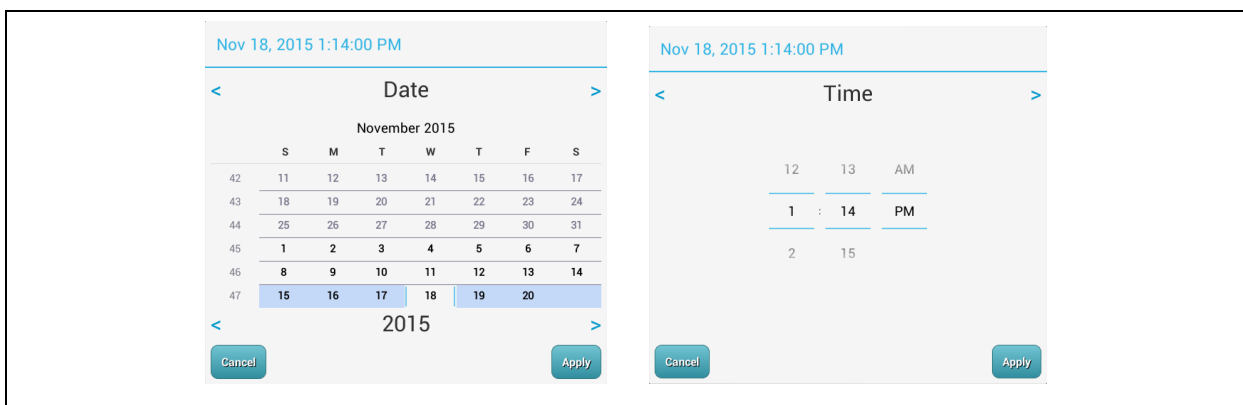
Illustration 5-4: Starting point of a measurement procedure

As soon as all radio loggers have been programmed successfully, a new group element containing all programmed radio loggers is displayed next to group element "New". The context menus (see Section 5.3.1) offer detailed information on the single radio loggers.

5.2.2 Reading out the data

Reading out the recorded measurement data from a radio logger is similar to programming a radio logger. First, the requested radio loggers to be read out need to be selected. It is important that any *group element* designated "Group XXX" from a previous programming procedure and stated on the list is deleted from the current list via "Clear list" in the context menu (see Section 5.3.1).

In order to confirm the read-out procedure, please tap on the "New" group element or on the "New" button. Then select the radio loggers to be read out in the dialog and tap on "Apply" in order to accept your logger selection. Before the read-out process can be started by tapping on "Read out", every single radio logger needs to be set to communication mode.

5.2.3 Write error

If an error has occurred during radio logger programming, this error is displayed beneath the "Write error" *group element*. There may be different reasons for an error. For example, the particular radio logger has not been set to communication mode and thus cannot communicate with the Servicemaster. Another reason may be that data transmission has been interfered or that another correlation is already active on the particular radio logger.
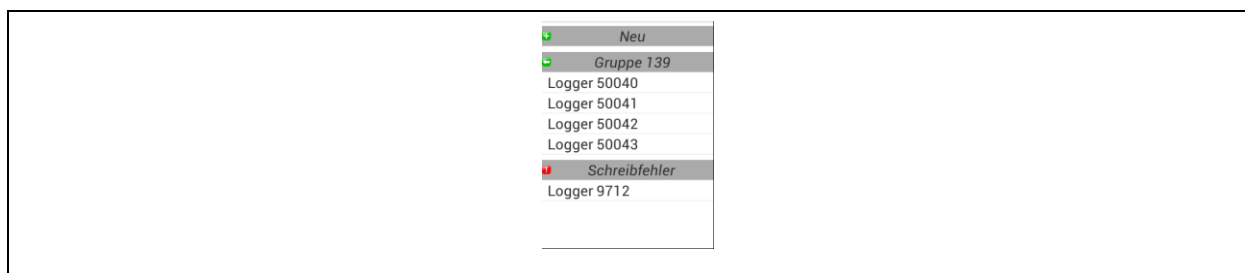
Illustration 5-5: Write error

First, press "Transfer" (see Illustration 5-1) again. The programme will now try to write the correlation data into the logger. In most cases, this step remedies the write error. If a radio logger has not been set to communication mode, it cannot exchange any data with the Servicemaster. In this case, transferring the correlation data again does not solve the problem. An appropriate solution to this transmission issue is coupling the radio logger manually with

the Servicemaster as described in Section 1.5. As soon as the radio logger is set to communication mode again, the correlation data can be programmed on the radio logger by tapping on "Transfer" again.

If a correlation is already active on a radio logger, a dialog is displayed while the operator is programming the new correlation data informing the operator that a correlation is already in progress. If this dialog is closed by tapping on "No", the programme will shift the radio logger element also to the "Write error" section. If, in such case, programming is started again by tapping on "Transfer", another information dialog will be displayed stating that another correlation is already in progress. This message needs to be confirmed with "Yes" before the system tries again to write the correlation data into the logger.

5.2.4 Read error

If a radio logger could not be read out for any reason, the logger will be listed beneath the "Read error" *group element.* Briefly tapping on the *radio logger element* (see also Illustration 5-6 „Logger 9712") makes a message appear offering detailed information on how to fix the issue. If the underlying cause is a communication error, the read-out process can be started by tapping on "Read out" (see Illustration 5-1) again.
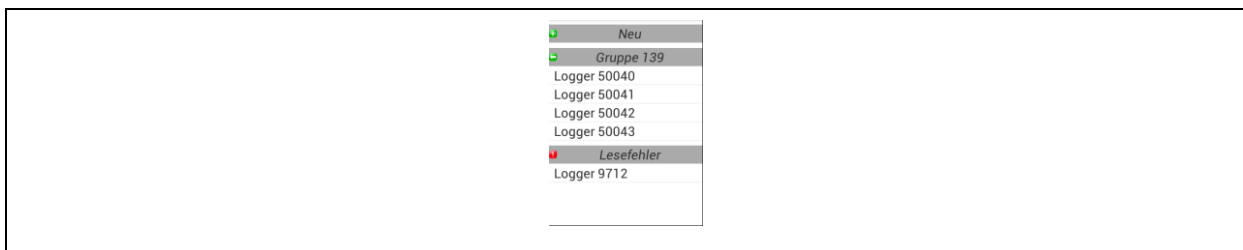
Illustration 5-6: Read error

If an error has occurred while reading out the radio logger, another reason for the error may be that reading out the other radio loggers is taking/has taken too much time or that a radio logger is leaving the communication mode and is heading for transmission mode again. This issue can be solved by applying the magnet to activate the logger as described in Section 1.5.

5.2.5 Obsolete firmware

All radio loggers listed in this *group element* cannot be used for correlation. Please note that a radio logger which is intended to be applied for a correlation process needs to feature at least firmware version 1.05 or higher. Briefly tapping on the *radio logger element* makes an information dialog appear indicating the version of the particular radio logger(s).

5.2.6 Obsolete hardware

All radio logger listed under *group element* can also not be applied for correlation. The minimum requirement for correlation is a hardware platform of version 1.30 or higher. If you have a radio logger which does not meet this requirement, you can send the particular logger to F.A.S.T for modification purposes.

5.3 Evaluating measurement data

If correlation data has been successfully read out from a group of radio loggers, the system displays the radio loggers as a group as shown in Illustration 5-7 in the second area of the main mask (see also Illustration 5-1). This correlation group generally consists of two different types of elements, which also offer different functions for the evaluation process. The first element is the *group element,* and the second element is the *radio logger element*. Please note that only radio loggers of one correlation group can be correlated with each other. Also, correlation is carried out always between two radio loggers. Therefore, a correlation group needs to contain at least two radio loggers in order to be capable of executing a correlation procedure. The second element is the *radio logger element* abstracting a radio logger and its measurement data. In contrast to the *group element,* a correlation group may contain several *radio logger elements*.
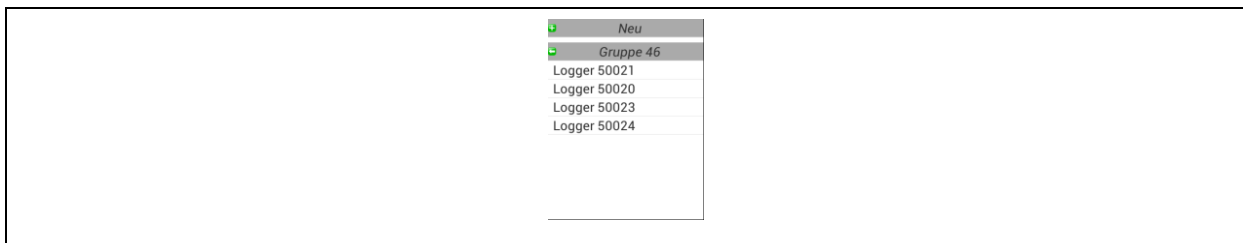
Illustration 5-7: Correlation group

Tapping briefly on the *radio logger element*, for example on "Logger 50021" in Illustration 5-7, makes both the spectrum and the time signal appear as small tiles in area three of the main mask (see also Illustration 5-1). If the tiles are activated by being tapped on, a dialog showing the spectrum and a dialog visualizing the time signal respectively (see Section 5.3.3) is opened subject to the measurement result. Either of the dialogs will be displayed in the middle of the screen. If you wish to close the dialog, simply tap on the area around the dialog or tap on "Return" on your tablet.

The correlation measurement is started by briefly tapping on the *group element*. Three small tiles will appear in area three of the main mask as soon as the results have been calculated. For a more detailed description of the correlation measurement, please refer to Section 5.3.4.

5.3.1 Context menus

Tapping on the *group element* or on the *radio logger element* for a little longer opens the context menus as show in Illustration 5-8. These context menus offer additional functions related to the particular element. If the group element is tapped on for 2 to 3 seconds, the context menu as shown in the left part of Illustration 5-8 will open up. If the *radio logger element* is tapped on for 2 to 3 seconds, the context menu as shown in the right part of Illustration 5-8 will open up.

Illustration 5-8: Context menus

As shown in the left context menu, five functions are available for a particular correlation group. Tapping on the "Compare" menu item opens a dialog where either the "Spectrums" or the "Time signals" can be chosen. If the dialog is confirmed with "OK", all correlation group spectrums and time signals respectively will be displayed as small tiles in area three of the main mask (see also Illustration 5-1). This allows comparing the different spectrums and time signals of single radio loggers with each other.

The "E-mail" menu item allows an automatic creation of a noise level file for each radio logger of a group. This file can then be sent out via e-mail. As soon as the "E-mail" button has been tapped on, the dialog used to enter the receiver of the e-mail and to forward the e-mail (by tapping on "Send") opens up. Please note if you intend to send out an e-mail, your tablet needs to be connected with the Internet, and the tablet needs to host a valid e-mail account.

The "WaterCloud" menu item appears only if the tablet has been connected with the Watercloud server. This connection requires a prior coupling process as described in Section 6, and the tablet needs to be connected with the Internet via Wifi or via a 3G net (mobile phone net). If all the connections have been established, the noise level files can be sent to the Watercloud server. The process of sending an e-mail is similar to the process as described in Section 6.2.

The "Delete" menu item serves the same purpose in both context menus: it deletes certain elements from the list. If this function is applied with a radio logger element, only the particular element the context menu was called for will be deleted. If, however, this function is applied for the group element, which in this case is the correlation group, the entire group will be deleted from the list. This deleting process does not finally delete the measurement data in the programme, and all data related to the particular correlation group can be uploaded again through the menu in the programme database as described in Section 5.1.

The final menu item of the group context menu (see left part of Illustration 5-8) is "Clear list" and removes all elements from the list. This deletion automatically resets area two (see Illustration 5-1) to the state as displayed when the mask was loaded.

5.3.2 Scaling up / Zooming in

When the spectrum dialog has been opened, you can scale up (zoom in) a particular area of interest to display this area in more detail. In order to do so, press your finger on the display. This initial touch constitutes the upper left corner of the so-called zoom window. Do not remove your finger from the display but wipe your finger from the current position to the right and down. As soon as you remove your finger from the display after the wiping process (marking the zoom window), the lower right corner of the zoom window has been determined and the programme will display the area concerned in more detail. If you wish to reset or delete the zoom window, proceed vice versa by starting in the lower right corner of the diagram and wipe your finger in an upward direction to the left. The diagram will then display the entire measurement data.

A zooming function is available for the spectrum, correlation, and coherence diagrams, but not for the time signal diagrams.

5.3.3 Time signal diagram

The time signal dialog consists of two menu items (see Illustration 5-9). The "Play" button allows playing the time signal and listening to the leakage-borne noise. In some case, the leakage-borne noise is not easily audible and the volume needs to be increased to max on the tablet. The "E-mail" button allows creating a noise level file which then can be sent out as an attachment to an e-mail. As soon as the "E-mail" button has been tapped on, a dialog appears where the receiver of the e-mail can be entered. The e-mail can then be sent off by

tapping on "Send". Please note that the tablet needs to be connected with the Internet if you wish to send off an e-mail, and the tablet needs to host a valid e-mail account.
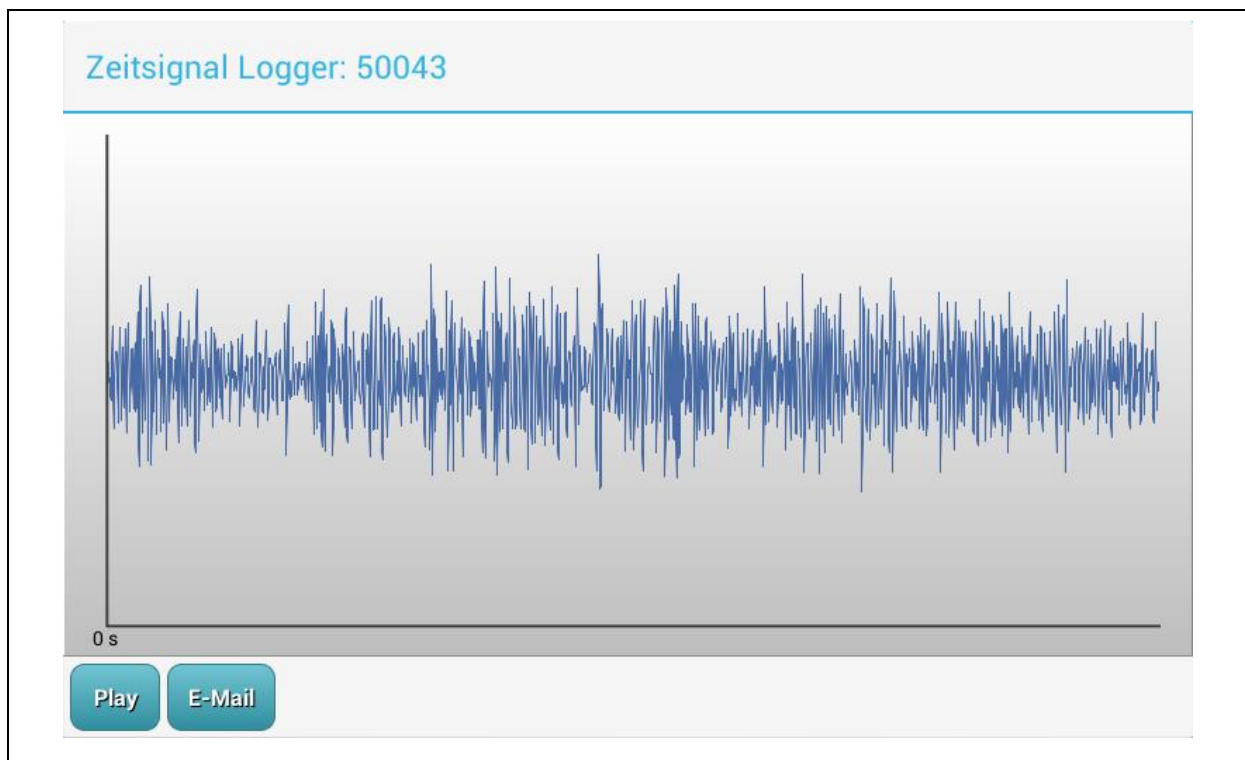

Illustration 5-9: Time signal diagram

The time signal read out for correlation purposes is 12 seconds long. This data, however, is not displayed as a whole in the diagram, the data block displayed is always 0.5 seconds long. If you wish to have a look at the entire time signal data, the time signal needs to be shifted by wiping your finger across the display to the right or to the left. The time signal is then shifted in the diagram according to the wiping direction of your finger.

5.3.4 Starting the correlation

Tapping on the group element (see Section 5.3) starts the correlation process of the measurement data. First, the selection dialog as shown in Illustration 5-10 appears where the operator can choose from any radio logger combination feasible with the particular correlation group. Of course, not every radio logger combination is reasonable. If, for example, two radio loggers were located at the same measurement point for noise acquisition purposes, a correlation between these two loggers does not provide any reasonable results. So correlation provides reasonable results only if the particular radio loggers are not located at the same measurement point.
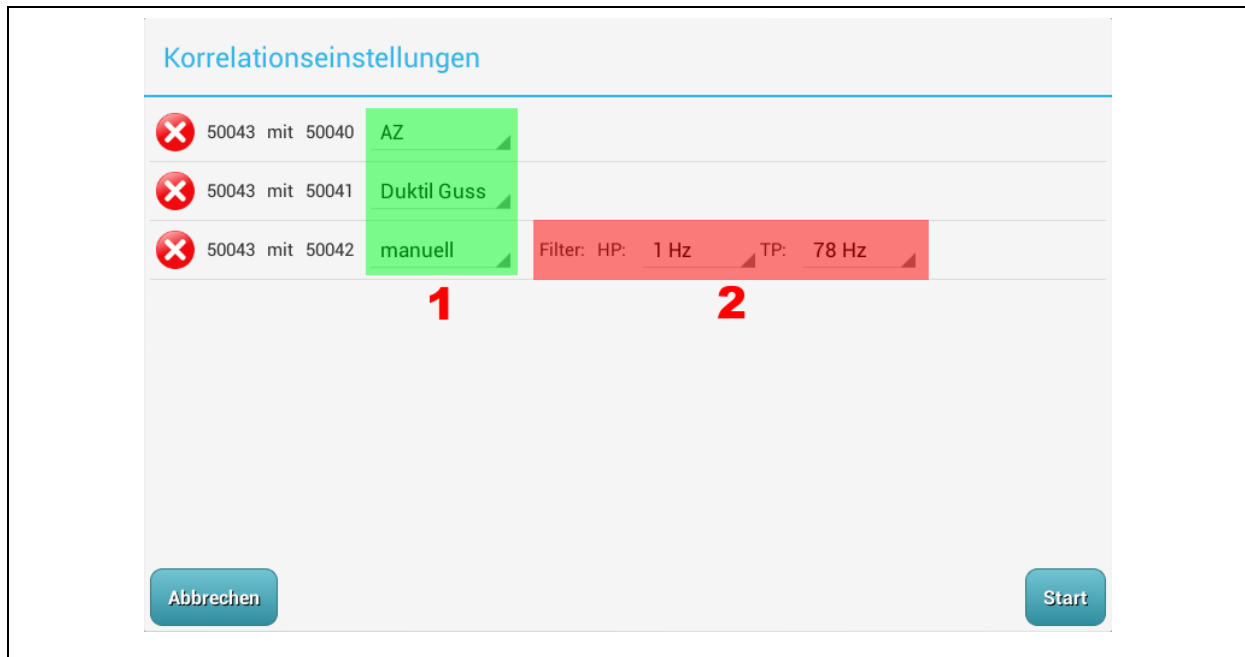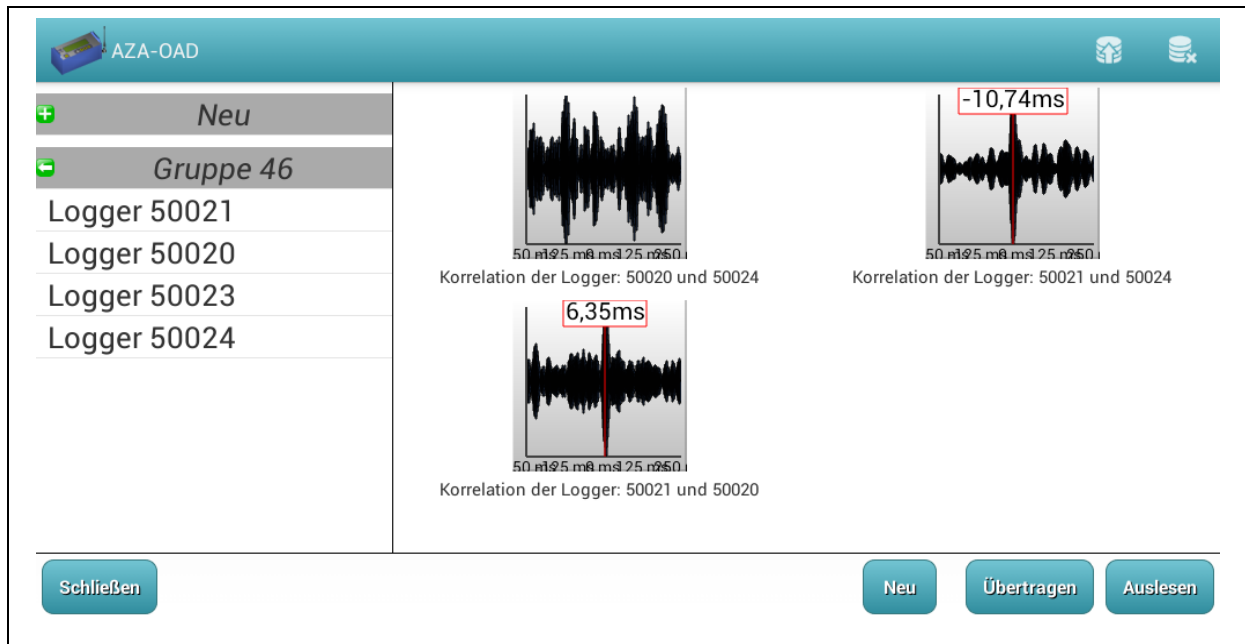
Illustration 5-10: Correlation settings

Those radio logger combinations which do not provide any reasonable correlation results can be removed from the selection dialog by tapping on the red menu item (with a white cross). The pipe material needs to be selected in the green area (area 1). This dialog also allows changes on the pipe material by tapping on the particular material designation. If the pipe material is changed, the analogue filters will be adapted to the material automatically. If such automatic analogue filter adjustment is not requested by the operator, a "manual" material selection mode can be selected. If the analogue filters are adjusted manually, the red area (area 2) will appear in the dialog (see Illustration 5-10), where the setting of the high-pass filters "HP" and of low-pass filters "TP" can be arranged manually.

As soon as all settings have been made for correlation, calculation can be started by tapping on the "Start" button. If you tap on "Cancel", the selection dialog will be closed and the data will not be calculated. Once calculation has started, the selection dialog is closed and gears will be displayed in area 3 (see also Illustration 5-1). The gears are displayed as long as correlation calculation is in progress. As soon as the correlation process has been completed, the particular gear disappears and a tile is displayed showing the correlation result. The duration of the correlation calculation may take a little moment subject to tablet performance. Finally, the main mask as shown in Illustration 5-11 will be displayed as soon as all calculations have been finalized.

Illustration 5-11: Overview of correlations

The tiles already show which calculation makes the datas issued by the two radio loggers correlate. If the tile shows a red millisecond indication, the measurement datas of the two radio loggers are correlating. If a tile shows no time indication, the measurement data does not match. In both cases, however, readjusting the digital filters may change the result.

5.3.5 Postprocessing a correlation

Postprocessing a correlation is started by tapping on the corresponding tile. Subsequently, the processing mask as shown in Illustration 5-12 opens up. In the first (red) area of this mask, there is a correlation diagram and a button for analogue filtering. The correlation diagram shows the limits of the measuring section with a red vertical line and a vertical blue line subject to sound velocity and to the length of the set pipe section. At the lower end of each line, the serial number of the particular radio logger is displayed. The longer the set measuring section and the smaller sound velocity, the longer becomes the distance between the limits. In some cases, the limits may disappear from the correlation diagram and the limits of the correlation diagram then constitute the limits of a correlation.
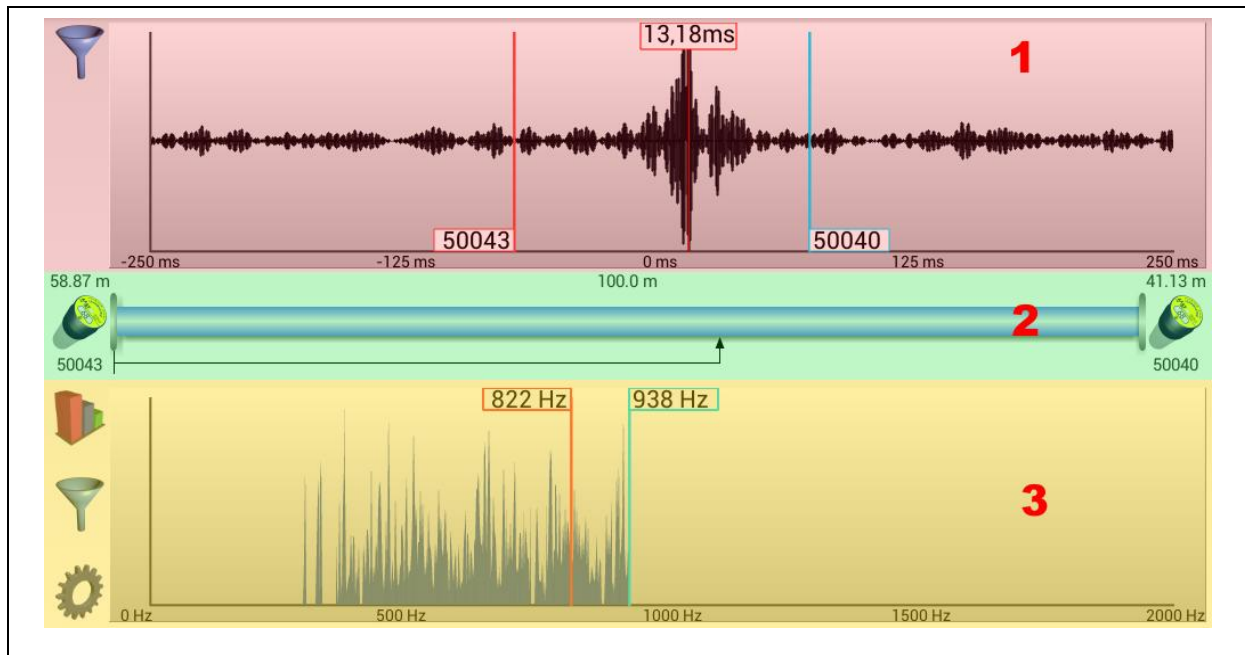
**Illustration 5-12: Postprocessing of a correlation**

With the menu item in area 1 displayed as a filter in the Illustration above the high-pass and low-pass filters can be changed. Tapping on this menu item opens a little window in the correlation diagram where the settings for the two filters can be adjusted. The analogue filters are used to filter undesired frequencies (disturbing noises) from the time signal. Therefore, the high-pass filter of the programme does not filter or damp those frequencies which are above the frequency displayed. The lower frequencies are damped with this filter. The low-pass filter, in contrast, does not filter or damp those frequencies which are below the frequency displayed and damps those frequencies which are above the frequency displayed. Consequently you should make sure that the filter settings do not interfere with each other as otherwise the programme will not be capable of acquiring any signal required to calculate the leakage. Furthermore, please make sure that an appropriate frequency range for the leakage can be processed unfiltered by the programme. As soon as the filters have been set, the little window will be closed automatically. Please note that if the analogue filter settings are changed, the correlation will be calculated again. This will require a bit of time. Once the new calculation has been completed, the entire data in the mask will be initialized again.

In the second part of Illustration 5-12 (green area) the leakages are indicated on the pipe and with a numerical value. The symbol of a radio logger is displayed to the right and to the left of the displayed pipe. The corresponding serial number of the particular radio logger is indicated beneath the particular logger symbol. The positions of the radio logger symbols constitute the limits in the correlation diagram. If the programme has detected a leakage, the distance

between the leakage and a radio logger is indicated above the particular the radio logger symbol. The central part of this section (area 2, see Illustration 5-12) displays the measuring section, and the total length of the measuring section is displayed as a numerical value above the pipe symbol.

AZ		⊢⊣ 100	⊖ 50	⊢⊪⊣ 1250	✔
Duktil Guss	100.0	50	1345		❌
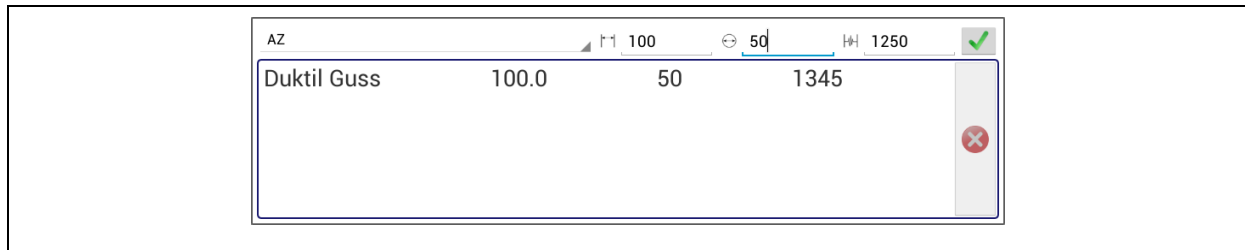
Illustration 5-13: Pipe input mask

Tapping on the pipe symbol opens the input dialog as shown in Illustration 5-13. With this input dialog, the settings of the measuring section can be changed. The lower part of the dialog shows all pipe sections defined so far. The system is capable of defining a total of four different partial sections of a measuring section. One line hosts the settings of one partial section of the entire pipe. Besides the material designation, also the pipe length, the pipe diameter, and the sound velocity are displayed. Tapping on the particular pipe section in this area will mark the partial section. You can also delete the partial section from the list later on by tapping on the delete button ❌ on the right-hand side. If you intend to enter a new pipe section, you first need to select the pipe material in the upper part of the dialog. Then enter the length of the pipe section in metre (*if you set the language in your Android to English(USA), then the program use the imperial system units, also feet*) by trapping on the input box at the ⊢⊣ symbol. Then the diameter of the pipe needs to be entered in millimetres (*if the imperial units are used, then in inches*) by tapping on the input box at the ⊖ symbol. It is usually not necessary to enter speed velocity as the programme automatically calculates the speed. If, however, a sound velocity other than calculated by the programme is requested, tap on the input box at the ⊢⊪⊣ symbol. As soon as all information has been entered, the pipe section can be added to the list by tapping on ✔. As soon as all partial sections of the measuring section have been entered, the dialog can be closed by tapping on the display next to the dialog. All settings will be accepted and the leakage position is calculated again.

The third area of the postprocessing dialog (yellow area in Illustration 5-12) is used for digital filtering. The main component of this section is the diagram used to set the digital filter for the correlation. Digital filtering requires a high-pass limiter and a low-pass limiter. The high-pass limiter is visualized with a red vertical line, the low-pass limiter is marked as a blue line.

Any signal-related information occurring between these two limiters will be applied for correlation purposes. Therefore, more signal-related information is used for correlation if the distance between the filter lines is quite long. A short distance between the filter lines reduces the amount of signal-related information the system uses for a correlation.

The filters can be shifted by tapping on the diagram. The filter limiter line next to your finger is shifted. So if you tap on the display near the blue filter line, the blue filter line will be shifted. If you tap on the display near the red filter line, the red filter line will be shifted. Please note that the lines are shifted by tapping on the display, not by wiping across the display. As soon as the filter limiters have been shifted, the programme will start on calculating a new correlation result and then displays the result.

Displaying coherence is one option, but tapping on offers other kinds of display as well. As soon as the button has been tapped on, a selection window opens up, which closes again automatically after 5 seconds. The following display options can be chosen:

- `Coherence`

- `Spectrums A + B`

- `Spectrum A`

- `Spectrum B`

- `Time signal A`

- `Time signal B`

The digital filters can be changed with any display option time except when the time signal is displayed. The "`Spectrums A + B`" display option (when activated) shows the spectrums of the two loggers superimposed. The "`Spectrum A`" display option and "`Spectrum B`" display option respectively shows the spectrum of the particular radio logger, with "`A`" designating the radio logger which is left of the pipe in area two (yellow area, see Illustration 5-12) and "`B`" stands for the radio logger right of the pipe.

Automatic setting the digital filters can be started by tapping on . As soon as the button has been tapped on, the programme starts calculating the new filter positions. This process may take a little while.

The ⚙ menu item allows switching between the "Filter" function mode and the "Zoom" function mode. Please note that, as a standard setting, the "Filter" mode is activated, where the filters in the diagram can be adjusted. If the "Zoom" has been selected, the zooming function as described in Section 5.3.2 can be used. When the system is set to this "Zoom" mode, the digital filters cannot be changed.

6 WaterCloud connection

One option to process the radio loggers signals received is transferring the data to the WaterCloud. The WaterCloud system is a Web-server based data processing system which allows saving, analysing, and storing the collected measurement data at a central location for years.

If you wish the data to be sent to your user account on the WaterCloud server, you need to establish access at www.Water-Cloud.de and you also need a valid connection between your user account and the applied tablet. If you apply several tablets to receive the AZ logger measurement values, all devices need to be interconnected with the WaterCloud server. There is no limitation for the number of tablets to be connected with the WaterCloud server. If you have not yet received user access, please contact F.A.S.T. GmbH. We will be happy to activate your access.

6.1 Interconnecting the tablet

If you wish to interconnect the tablet with the WaterCloud user account, please log in to the WaterCloud system with your user name and your password. If your log-in has been successful, the menu as shown in Illustration 6-1 on the left will appear.
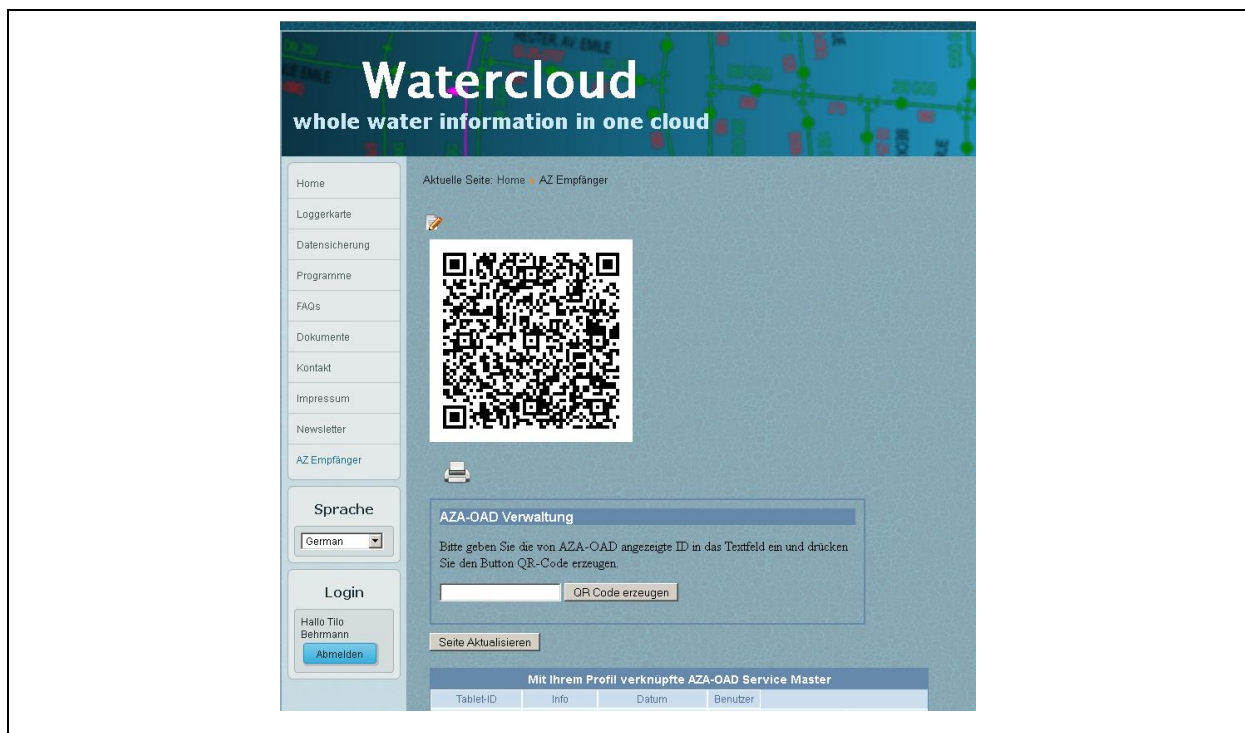

Illustration 6-1: AZ receiver

Click on "AZ receiver" in this menu to open the page as shown in Illustration 6-1. Now enter the "Device ID" of your tablet in the box left of the "Generate QR code" field.

The "Device ID" of your tablet can be obtained by opening the dialog shown in Illustration 6-2 through the "WC coupling" menu item (in the AZA-OAD programme). The letter-number combination stated in red is the device ID of your tablet and needs to be entered in the input box on the WaterCloud page. Now press "Generate QR code", and the server will generate a so-called QR code, which contains the coupling-related information required to connect with your tablet.
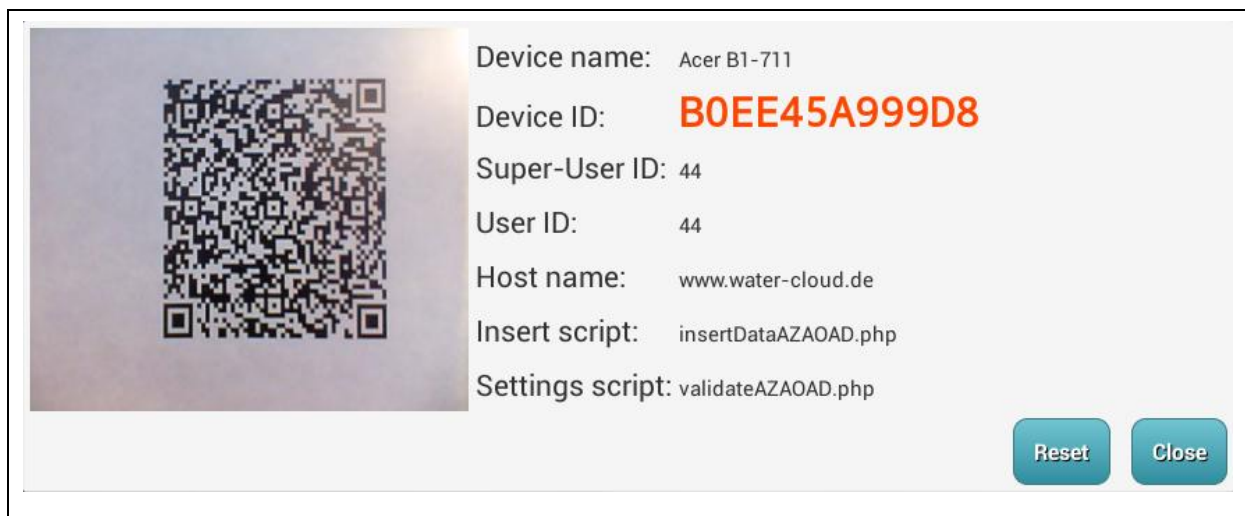
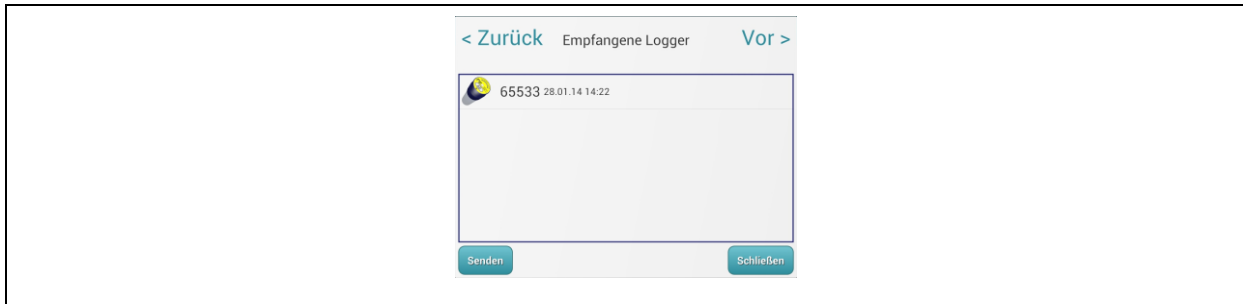**Illustration 6-2: WaterCloud interconnection with AZA-OAD**

You can either hold the tablet in front of the monitor so that the tablet camera can acquire the QR code or you print out the QR code and hold the printed-out code in front of the tablet camera. Please make sure that before the QR code is acquired by the tablet camera the Internet connection with your tablet has been activated. The Internet connection is required to validate the information contained in the QR code and to confirm the activated connection of the device to the WaterCloud server.

As soon as the AZA-OAD programme has accepted the QR code, the tablet issues a short beep, and the received data such as "User ID" and "Host name" is displayed. Your tablet is now connected with the user account on the WaterCloud server. If you press on "Update page" on the WaterCloud page, the interconnected tablet is now listed on the device list on the WaterCloud page.

6.2 Data transfer

When the tablet has been connected with a WaterCloud user account, the programme activates the "WaterCloud" menu item. This menu item is used to get to the dialog as shown in Illustration 6-3. If you wish to leaf through the three list views "Received loggers", "Sent", and "Failed", use the "<back" and "forward>" buttons. The dialog can be closed by tapping on "Close".

Illustration 6-3: Transferring AZ logger data

Tapping on the "Send" button starts data transfer from the particular AZ loggers to the WaterCloud server. Please make sure that the connection of the tablet with the Internet (Wifi, UMTS, or LTE) has been activated. If the connection has not been activated, the programme issues a corresponding message and data transfer will be discontinued.

If the tablet Internet connection is working, a dialog is displayed once the "Send" button has been pressed. This dialog informs the operator about data transmission progress. As soon as data transmission has been terminated, this dialog closes down automatically, and you can check with the "Failed" list if all data has been successfully transferred to the WaterCloud server. If no logger is listed on this list, the entire data of the radio loggers has been transferred to the server. If a logger is listed on this list, data transferred to this logger has been incomplete. In such case, you can transfer the data again to the WaterCloud server by tapping on "Send".

The particular radio loggers the data of which has to be transferred can be selected through a filter dialog which refers to the corresponding selection table on the main mask. For further information on this filter dialog, please refer to Section 2.2.1. Please note that only those radio loggers which are shown on the list on the main mask are cleared for data transmission to the WaterCloud server.

7 Service

7.1 Information

If you wish to receive any information on the AZA-OAD programme and on the Servicemaster, go to the main menu as shown in Illustration 2-2 and tap on the "Info" button. As soon as the button has been tapped on, a submenu opens where the operator can select between "programme-related information" and "Servicemaster-related information".

7.1.1 Programme

If the "Programme-related Information" button has been tapped on, the dialog as shown in Illustration 7-1 appears. The dialog shows the current programme version on your device as well as the F.A.S.T. GmbH contact details. This dialog can be closed again by tapping on "Close".

Illustration 7-1: "Programme-related information" dialog

7.1.2 Servicemaster

Tapping on the "ServiceMaster" button leads the operator to the dialog as shown in Illustration 7-2. Please note that the data displayed is read out directly from the Servicemaster. Therefore, an active Bluetooth connection between the tablet and the Servicemaster has to be established beforehand. The dialog can be closed again by tapping on "Close".

Illustration 7-2: "Servicemaster-related information" dialog

7.2 Updating the firmware

Another new feature of the bi-directional radio logger is the option to update the firmware applied on the radio logger. If you wish to do so, please open the dialog which is shown in Illustration 7-3 by tapping on the "`Firmware Update`" menu item. The dialog can be closed again by tapping on "`Close`".
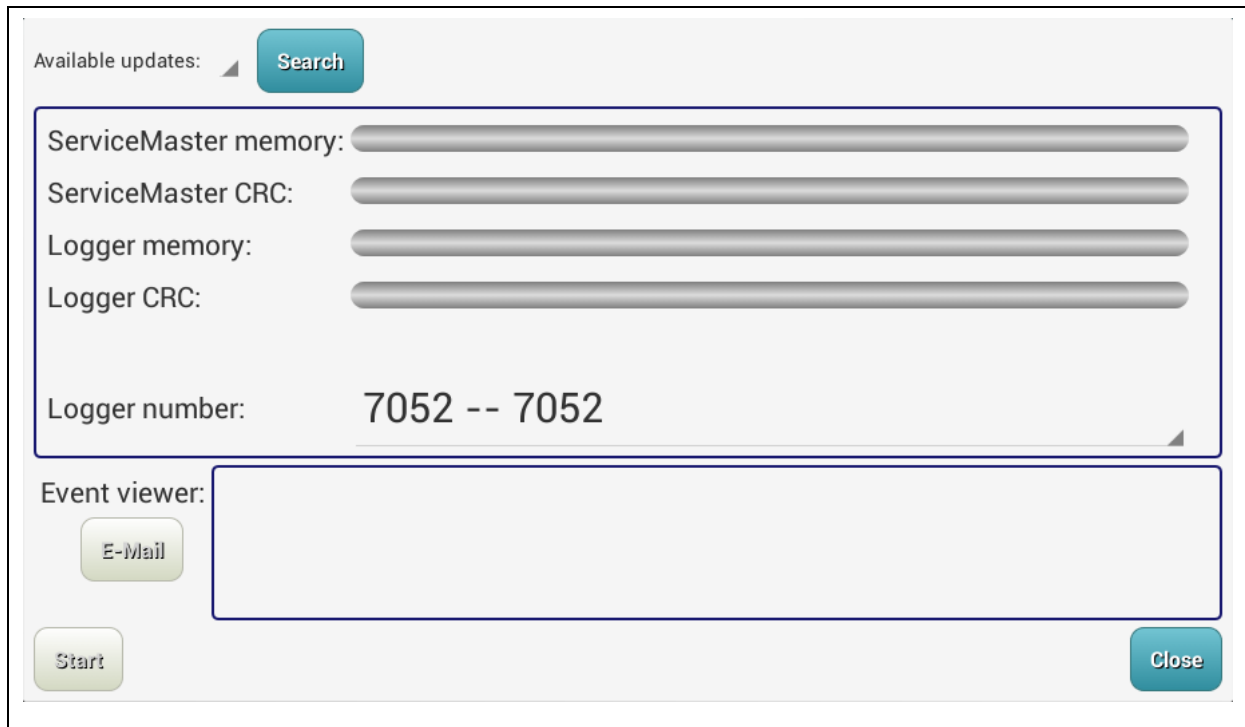
Illustration 7-3: "Firmware update" dialog

All firmware updates are filed on a server located at our company. Therefore, it is necessary that the tablet has an activated Internet connection during the firmware update. Tapping on the "`Search`" buttons makes the AZA-OAD programme issue a query to our server requesting a new firmware update for the radio loggers. If new updates are available, these updates are listed in a selection box left to the "`Search`" button. If no update is available, the selection box remains empty.

If updates are available, the particular firmware update version can be selected from the choice box. In the "`Logger No:`" selection box, a radio logger can then be selected for the update. Please make sure that the particular radio logger has been set to communication mode as otherwise the update will be discontinued if the radio logger cannot be contacted. The updating process can be started by tapping on "`Start`". Please do not close the dialog during the updating process to avoid any error on the firmware update. As soon as the update has been completed, a corresponding message is displayed in the dialog.

The firmware is updated in four steps, which are also visualized as progress bars in the dialog. In a first step, the programme data is sent to the Servicemaster and is indicated next to the field "`ServiceMaster memory:`". If the bar is completely blue, this first step has been completed successfully. As a second step, the programme data is checked at the ServiceMaster memory. The successful completion of this step is indicated with a blue bar next to the field "`ServiceMaster CRC:`". The next step is the data transfer from the Servicemaster to the particular radio logger. The progress and status of this step can be monitored next to the field "`Logger memory:`". Finally, the programme data is checked on the radio logger. Here, as well, as blue bar next to the field "`Logger CRC:`" indicates the process status. As soon as all four bars are fully displayed in blue, the logger automatically starts the firmware update. This process will take only a few seconds. When the radio logger has been activated with the new firmware, the LED on the logger cap flashes several times.

Besides graphically displaying the update progress with the status bars, a text is also issued as a log file in the "`Event viewer`". The text can be forwarded to other computers through the "`E-Mail`" button. If the firmware update generates an error, this error can be detected with the log file.