

FS Future Serie®

FS-Reflexion

User's manual

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1 Preface

Dear customer,

in the first instance we want to thank you that you made your decision on a product of OKM Ortungstechnik GmbH.

With our team of specialists we guarantee that our products are under recurrent control. Our specialists try to implement new developments in terms of further quality improvements for you.

Of course by selling our products we cannot guarantee that you really make a find during your research. The recognition of hidden objects and structures depends on a high number of factors - like you know. Determining factors are the dielectricity constant of the ground, the grade of mineralisation and the dimensions of an object relating to its depth. Specially in very wet soil, clay and sand with high conductivity of the ground, recording of the measured results can be falsified strongly.

With this product you purchased a device which stood the tests in regular operation like all other products of us. If you are interested in where our devices have gone into action please visit our homepage.

For our company it is necessary that we protect our developments within the framework of existing legislation to a patent or trademark registration. Therewith we offer you a higher warranty while using our products.

Please take your time consecutively, read this user's manual and familiarize yourself with the utilisation and operation of this FS-Reflexion.

2 Technical specification

The following technical indications are medial values. During operation small variations are quite possible.

2.1 Control unit with seismic vibration transducer

Dimensions (H x W x D)	22 x 30 x 22 cm
Weight	about 3 kg
Voltage	12 VDC \pm 10%
Operating temperature	0 °C – 45 °C
Storage temperature	-20 °C – 60 °C
Air humidity	5% – 75%
Waterproof	No
Power consumption (typical)	about 12 W
Effective range	4 – 22 Hz (via vibration transducer)
Processor	AMD LX800, 500 MHz
Memory	256 MB RAM, 128 MB data
Vibration transducer	seismic, piezo system

Table 1: Technical specification (Control unit with seismic vibration transducer)

2.2 Transmitter

Voltage	12 VDC, internal batteries
Output power (maximal)	150 W
Operating temperature	0 °C – 45 °C
Frequency (internal control)	4 – 22 Hz

Table 2: Technical specification (Transmitter)

2.3 Data transmission (Bluetooth)

Technology	Bluetooth
Range of frequency	2.4 – 2.4835 GHz
Maximum Transfer Rate	1 Mbps
Receiving Sensitivity	-85 dBm
Maximum Range	about 100 meters

Table 3: Technical specification (Data transmission, Bluetooth)

2.4 Data transmission (USB cable)

Technology	USB
Maximum Transfer Rate	19200 Baud

Table 4: Technical specification (Data transmission, USB cable)

2.5 Computer, minimum requirements

The computer is not part of the scope of delivery. The indicated values should help you for a correct selection of a suitable computer for analysis of your measured results.

CD-ROM drive	minimum 4x
Interface (data transmission)	USB
Free Memory	minimum 50 MB
Working memory (RAM)	minimum 256 MB
Grafic card	minimum 128 MB, OpenGL-compatible
Operating system	Windows XP, Windows Vista

Table 5: Technical Specification (Computer, minimum requirements)

3 Scope of delivery

In the following section you can find all standard equipment. The scope of delivery can be different in some circumstances because of some optional accessories which should not be included in the basic equipment.

- 1 Control unit
- 1 External power supply
- 1 Charger for external power supply
- 1 Manual
- 1 Carrying case
- 1 Software Visualizer 3D
- 1 USB cable
- 1 Vibration transducer
- 1 Spiky positioner for vibration transducer
- 1 Platy positioner for vibration transducer
- 1 Transmitter
- 1 Charger for transmitter

Table 6: Scope of delivery

Beware that pictures in this manual could be different to delivered parts.



Figure 1: Scope of delivery

4 Control elements

This section describes in details all basic control elements of the measuring instrument. All connections and sockets will be explained in detail.



Figure 2: Reflexion with control unit, transmitter and vibration transducer

Figure 2 shows a general overview about the most important components of the FS-Reflexion.

The transmitter generate vibrations, which will be conducted or damped depending on the local soil conditions. Via the seismic vibration transducer the control unit will receive measurement values, which are used to draw conclusions to underground structures. The analysis take place immediately on the monitor of the control unit or inside the software on a computer.

4.1 Control unit

The control unit is the data processing center of the Reflexion. All measured data will be processed and if needed stored.

4.1.1 Front view

Figure 3 shows all control elements on the front side of the Control unit.

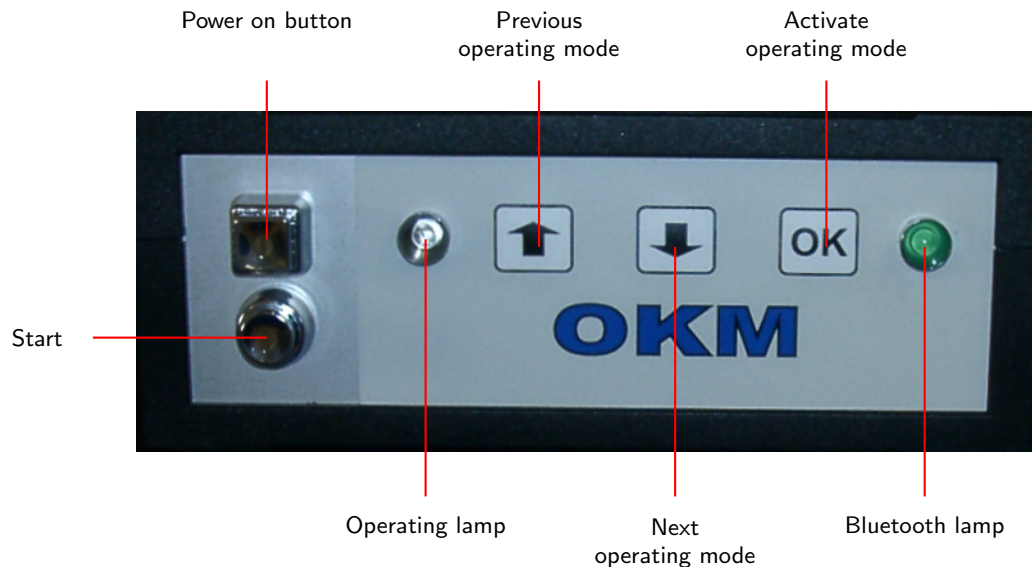





Figure 3: Front view of control unit

The power on button is used to switch on the device. Before you like to operate your measuring instrument make sure that the delivered external power supply is connected and powered on.

The button start is necessary to start a measurement in the *Scan Mode*.

The operating lamp indicates the state of readiness of the control unit and shines red, as soon as it will be powered on.

The bluetooth lamp shines green, as soon as the bluetooth connection is established between the control unit and the transmitter.

By using the keys  (Previous operating mode) and  (Next operating mode) you can select every single operating mode of the main menu. To confirm your selection please press the button  (Activate operating mode). Within each operating mode the keys will have a different configuration, which will be explained at the moment in time in this user manual.

4.1.2 Back side

Figure 4 shows the back side of the Control unit and its connections.

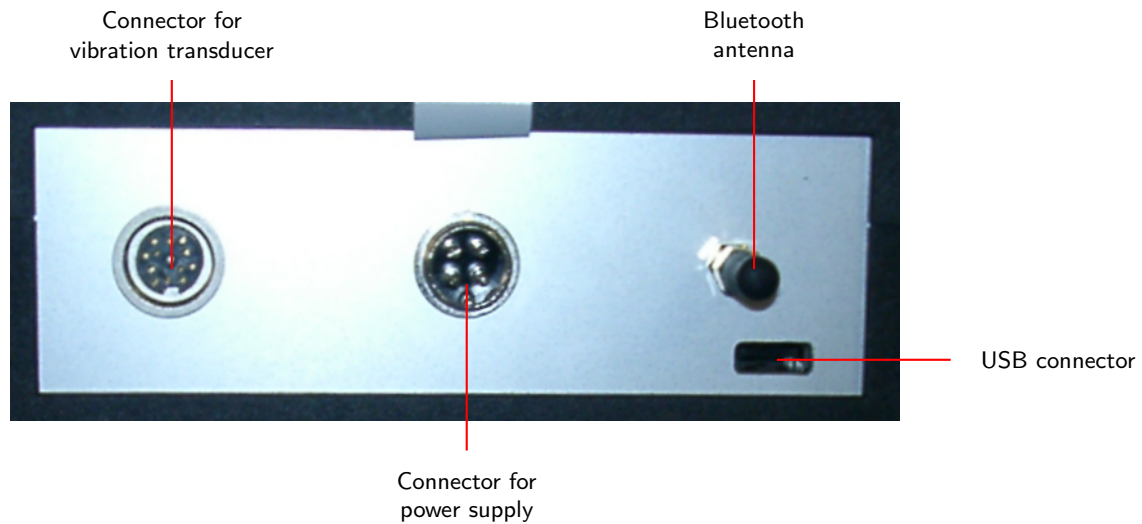


Figure 4: Back side of the control unit

On the Connector for vibration transducer the seismic vibration transducer has to be connected. Via the vibration transducer the measured data will be detected and processed in the control unit.

On the Connector for power supply the External power supply has to be connected.

Via the USB connector the control unit can be connected to a computer via a USB cable, to transfer the stored measured values and represent them in a software.

4.2 Transmitter

The transmitter generates vibrations into the soil which are the basis for the measurement with the seismic vibration transducer.

Figure 5 shows the complete transmitter with all its components.



Figure 5: Transmitter with its components

Because of the vibration electronics and the internal batteries the Transmitter is very heavy. The Carrying straps facilitate the transportation of the Transmitter.

The Control panel includes control elements to power on and off or recharge the Transmitter. A detailed description you can find in the next section.

4.2.1 Control panel

Figure 6 shows the Control panel of the Transmitter with its switches and connectors.

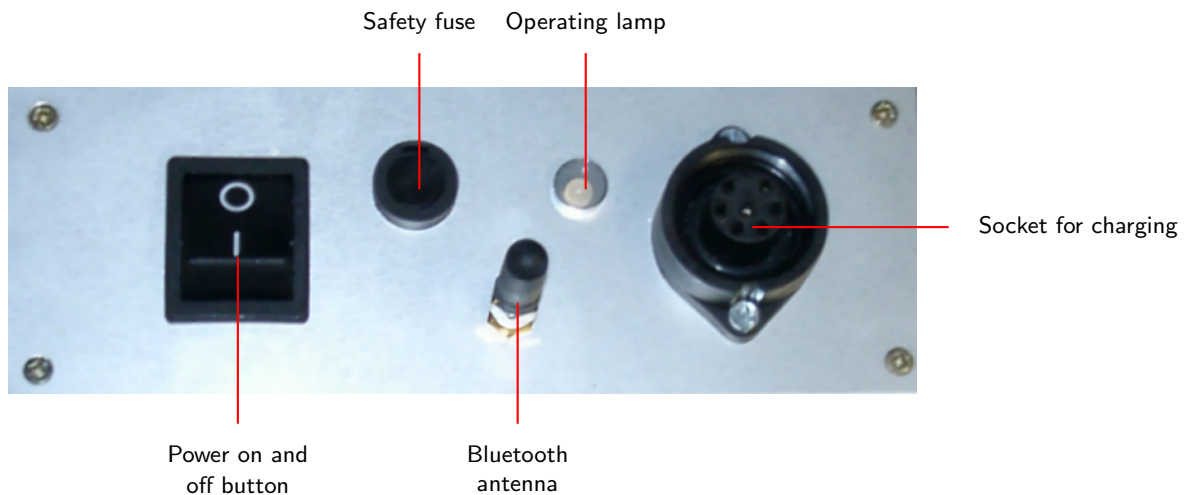


Figure 6: Control panel of transmitter

The Power on and off button is used to power on (“|”) or off (“○”) the Transmitter. After switching-on the device the green Operating lamp is shining. After switching-off the device the lamp will go out. The Operating lamp indicates also the charge condition of the internal batteries. During the operation the color will change according to the charge condition from green (full charged) to yellow, orange or red (low batteries). When the lamp is shining red it is necessary to recharge the Transmitter.

Into the Socket for charging the delivered charger has to be connected to recharge the internal batteries of the Transmitter. The charging procedure takes about 10 hours if the batteries are completely empty.

The safety fuse protects the Transmitter against high charging or discharging current. During the usage of the delivered charger there is no danger.

Attention: Use only the 16 A-safety fuse of same construction type if needed! Other safety fuses or jumpers can cause fire or explosion.

5 Mode of operation

In this section the physical principle of detecting subterranean voids with *FS-Reflexion* will be described. The best measurement results you will receive, if you know how the measured values are recorded and how they has to be analysed.

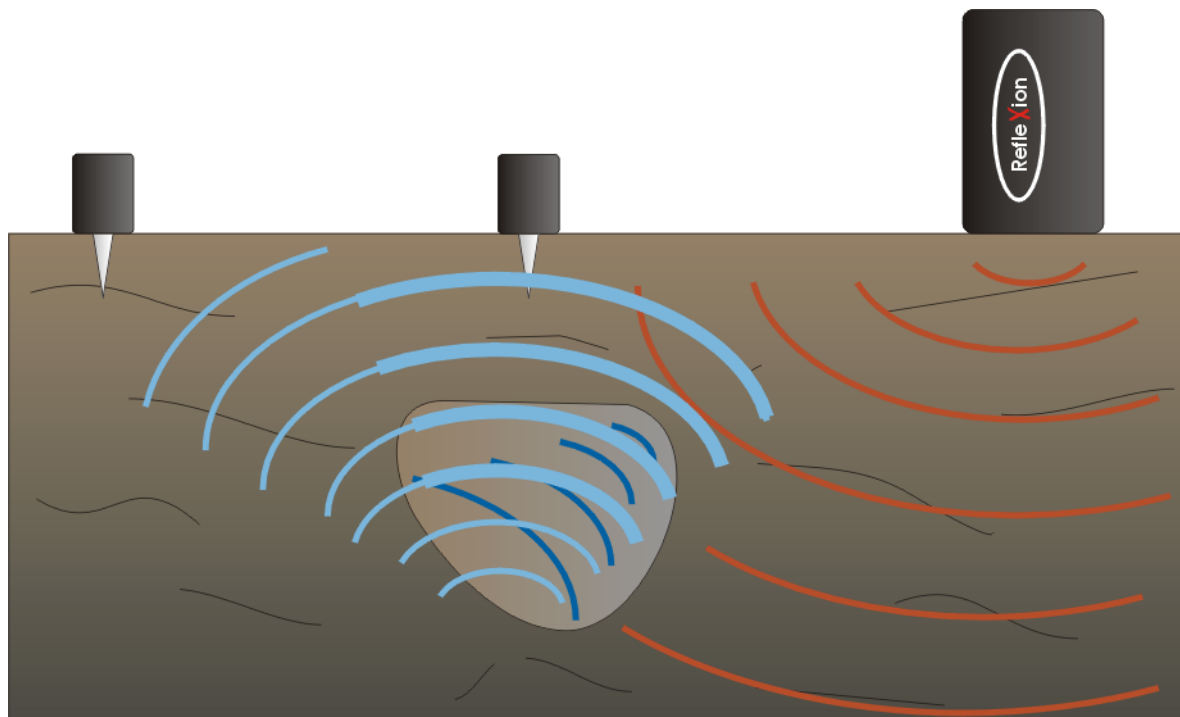


Figure 7: Schematic representation of the mode of operation

In Figure 7 you can see the schematic representation of the mode of operation. The transmitter generates vibrations in different frequencies, which will be transfused into the ground. During this process each frequency will be generated only for a certain period of time until the next frequency will be generated. While using the operating mode *Fast Scan Mode* the unit will not pass through all available frequencies.

Depending on the condition of the subsoil, the different seismic waves will be transmitted more or less into the ground. Especially applicable are dry and compact soils. Loosy or wet soil types, like e.g. swampland or sand are less suitable. In case of a serious change inside the ground, like e.g. caves, inclusions or fillings, the vibrations will be well transmitted or absorbed. In case of an existing void, it will start to resonate in its own frequency. As a result an heterodyne vibrancy will be delivered to its environment. This vibrancy can be measured by the vibration transducer as soon as it reaches the surface of the ground. This amplification of the origin vibration will be represented in the frequency-energy-graph of the control unit as a high amplitude.

How deep the seismic vibrations can be transmitted into the ground, does strongly depend on the condition of the soil (resistance, humidity). The more compact the soil is, the deeper

cavities can be located.

As shown in figure 7 the transmitter can influence the vibration transducer if both are placed next to each other in a too small distance. In this case the vibration transducer will only record the vibrations emitted by the transmitter. This is the reason why the transmitter should be placed at least 3 meters far away from the measured area and the seismic vibration transducer.

6 Operating modes

The device offers different operating modes which you can select in the main menu. In figure 8 the main menu with its functions is represented.

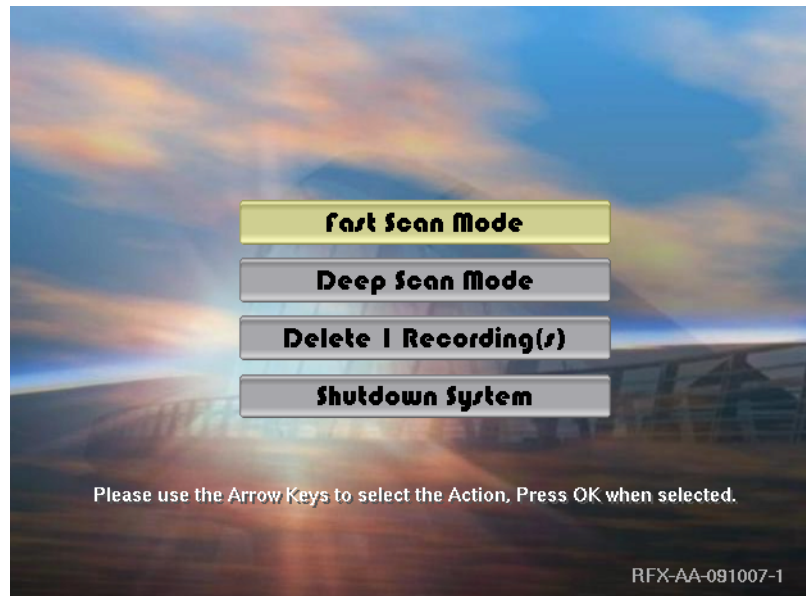





Figure 8: Representation of operating modes in the main menu

By using the buttons  and  you can switch between the operating modes. As soon as you press the button  the selected operating mode will start.

In the bottom right corner of the main menu the serial number of your device will be indicated. In figure 8 you can see the number *RFX-AA-091007-1* which is our example.

The proper functions of the main menu will be explained in the following section in detail.

6.1 Fast Scan Mode / Deep Scan Mode

With the operating modes *Fast Scan Mode* and *Deep Scan Mode* you are able to do seismic measurements. Here are the main differences of these two operating modes:

- In operating mode *Fast Scan Mode* you have the possibility to do a fast scanning. The device will not pass through all available frequencies. The frequency range of the transmitter will not be traversed completely, which means that some frequencies will be skipped. It is a raw measurement which is less accurate than a measurement in *Deep Scan Mode*. One measurement procedure takes about 10 seconds.
- In operating mode *Deep Scan Mode* a complete seismic measurement takes place where the transmitter pass through the complete range of frequencies. This measurement method is much more accurate than a measurement in *Fast Scan Mode*. One measurement procedure takes about 80 seconds.

The recorded measurement values will be indicated in real time on the monitor of the control unit and can be analysed immediately. In figure 9 the graphical display is represented, to explain the proper elements.

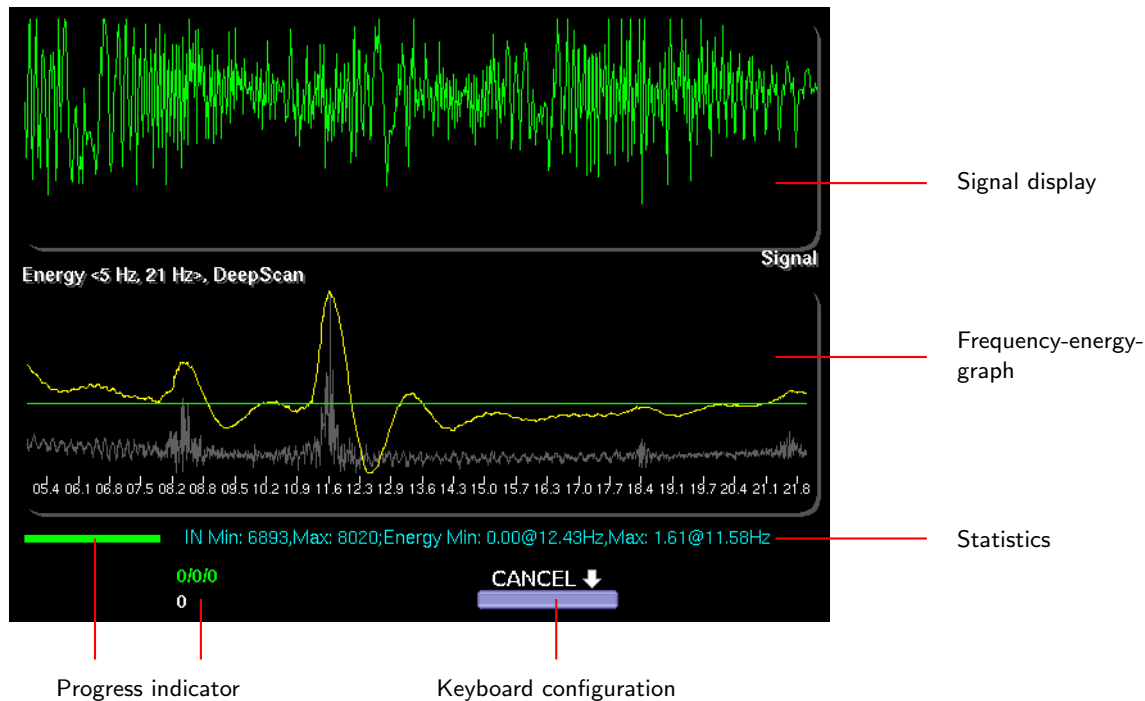


Figure 9: Graphical display in the monitor of the control unit

The signal display shows the raw measurement values of the seismic vibration transducer. The measurement results are shown in real time during the measurement. The measurement values in the frequency-energy-graph will be calculated and represented only after finishing the measurement procedure. Only these values are relevant for analysing the measurement. In section 9 on page 44 you can find detailed information about the correct analysis of measurements.

The statistics represents at first the minimum and maximum of the raw data of the signal display and after that the minimum and maximum incl. the appropriate frequency indication of the frequency-energy-graph.

The keyboard configuration explains which buttons are configured with which function. During proceeding a measurement it can happen that some buttons are configured with different functions. Due to this indication the button configuration is easy visible.

The progress indicator consists of two parts, the progress bar on the left side and the information on the right side next to it. The progress indicator is represented in figure 10 in large size.

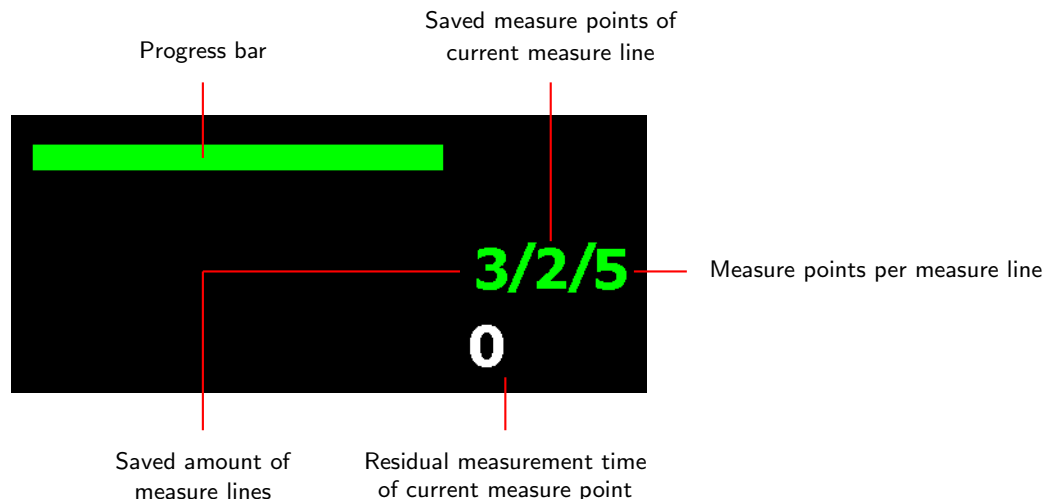


Figure 10: Graphical display in monitor of control unit

The residual measurement time for current measure point indicates how many seconds are still needed to finish the current scan of this measure point. The progress bar shows the timetable of the measurement procedure graphically.

The indications saved amount of measure lines, saved measure points of current measure line and measure points per measure line show at every moment how many measurement values has already been stored in the memory. In our example of figure 10 the 2. measure point of the 3. measure line has been stored in this moment, and totally every measure line consists of 5 measure points. The next step will be to proceed the 3. measure point of the 3. measure line. The basic procedure how to do a measurement is explained in section 8 on page 38.

The two different possibilities of recording a measurement and the exact procedure of a measurement will be explained in the following sections.

6.1.1 Check Mode

In *Check Mode* the seismic normality of the underground will be controlled. The transmitter is not activated and does not generate any vibrations into the ground. The purpose of this measurement is to recognize perturbing seismic interferences and finally to avoid falsified measurement results in *Scan Mode*.

Imagine that there are construction works in the surrounding area and large machinery like dredges are excavating a foundation. There are many vibrations in the ground, which could influence the measurement in a negative way. If you proceed a measurement in *Check Mode* under these circumstances you may recognize a large amplitude. These seismic perturbations, caused by the heavy machinery will give negative results in the measurement of *Scan Mode*.

In such a case the measurement has to be done on a later moment, when all perturbations are disappeared.

To start the measurement select operating mode *Fast Scan Mode* or *Deep Scan Mode* inside the main menu and confirm your selection with the button . No matter which operating mode

you select, a representation like in figure 11 will appear on the screen of the control unit.

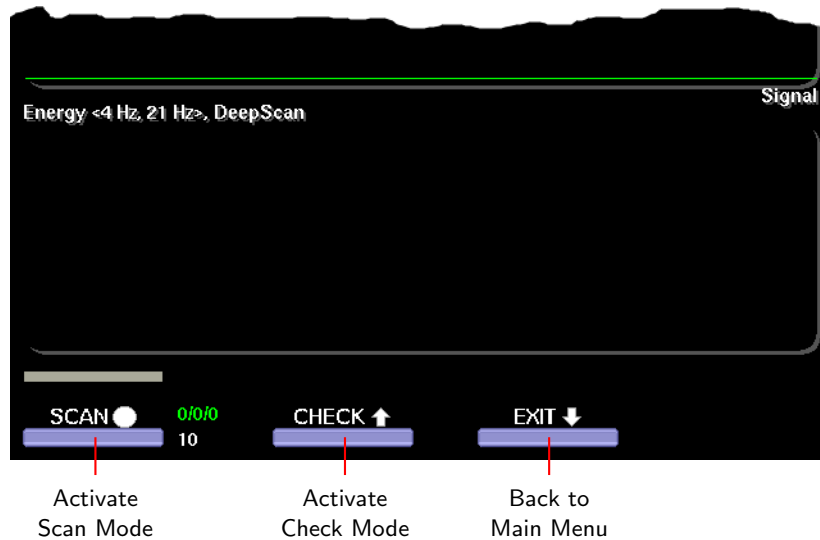



Figure 11: Options in operating mode Deep Scan Mode

Press the button  (“Check”), to start the measurement in *Check Mode*. The signal display on the monitor of the control unit shows the signal level of the vibration transducer. As soon as the measurement has been finished, the result will be visible in the frequency-energy-graph.

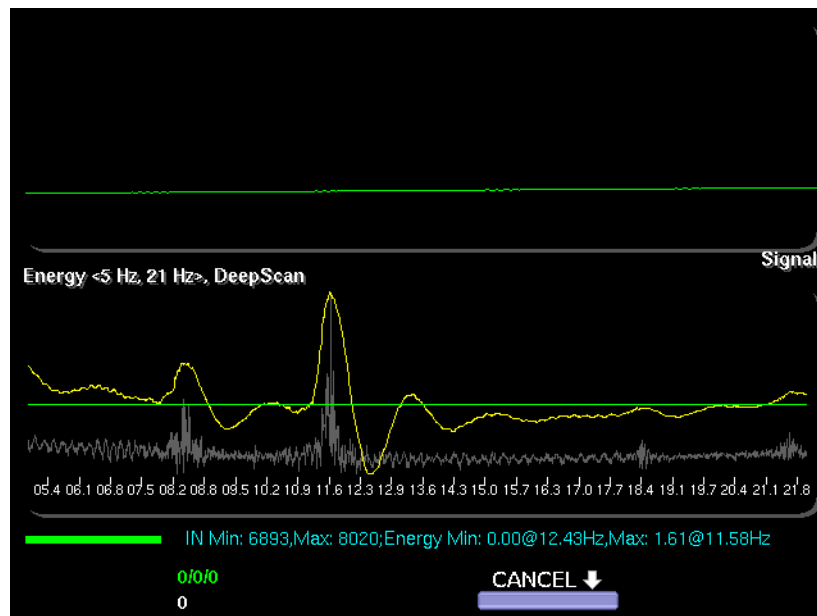




Figure 12: Check Mode in operating mode Deep Scan Mode

Figure 12 shows a possible representation in the *Check Mode*. To finish the measurement and come back to the control menu press the button  (“Cancel”). The measurement result will still be visible after that. For a detailed description how to analyse the measurement values

please read section 9 on page 44!

To come back to the main menu press the button  (“Exit”). If you like to do a measurement in *Scan Mode* you have to press the button Start (“Scan”).

6.1.2 Scan Mode

Inside the *Scan Mode* of the operating modes *Fast Scan Mode* and *Deep Scan Mode* you have the possibilities to detect buried structures like e.g. voids. During this measurement method the transmitter is activated and generates vibrations into the ground. Furthermore there is the possibility to store the measurement, transfer it to a computer and represent it as a three-dimensional graphic and finally analyse it.

The exact procedure to record a measured area is described in detail in section 8 on page 38. There the exact procedure of a complete measurement in *Scan Mode* of the operating mode *Deep Scan Mode* is explained in detail. All important steps beginning from preparing a measurement, to recording data up to transferring data to a computer will be explained. That is why we set this matter aside in this section.

Before you start the measurement in Scan Mode we recommend you a first check in Check Mode. So all seismic interferences can become visible.

For a detailed analysis of the recorded measurement values please read the section 9 on page 44!

6.2 Delete Recording(s)

Select the operating mode *Delete Recording(s)*, to delete older measurements from the internal memory. Because of security reasons after the first confirmation you will be asked again to confirm the deletion of the measurements.

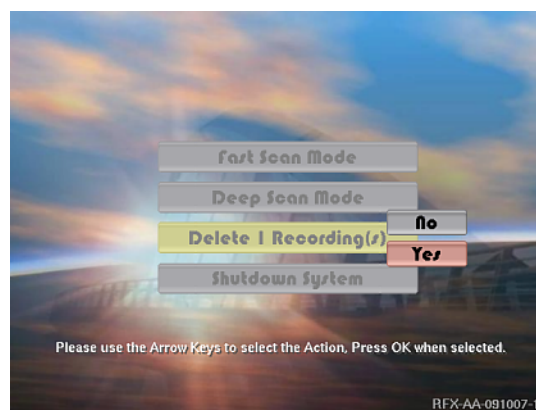



Figure 13: Security check before deletion of measured values

A small submenu like in figure 13 will appear where you can select *Yes* or *No*. If you select *Yes* in this submenu and afterwards press the button  all available data will be deleted from the

internal memory. It is not possible to delete one single measurement from the internal memory.

The amount of stored measurements you can find directly inside the main menu. If there are 5 stored measurements the main menu will indicate *Delete 5 Recording(s)*, if there are 13 stored measurements *Delete 13 Recording(s)* and so on.

The total amount of measurements which can be stored inside the device depends on the size of each measurement. When the free memory run short a warning will appear on the screen.

6.3 Shutdown System

Power off the device *always* via the menu point Shutdown System!

As soon as you select the operating mode *Shutdown System* inside the main menu the control unit will be powered off. Please wait until the device has powered off itself completely before you power off the external power supply.

The transmitter can be powered on and off independently from the control unit.

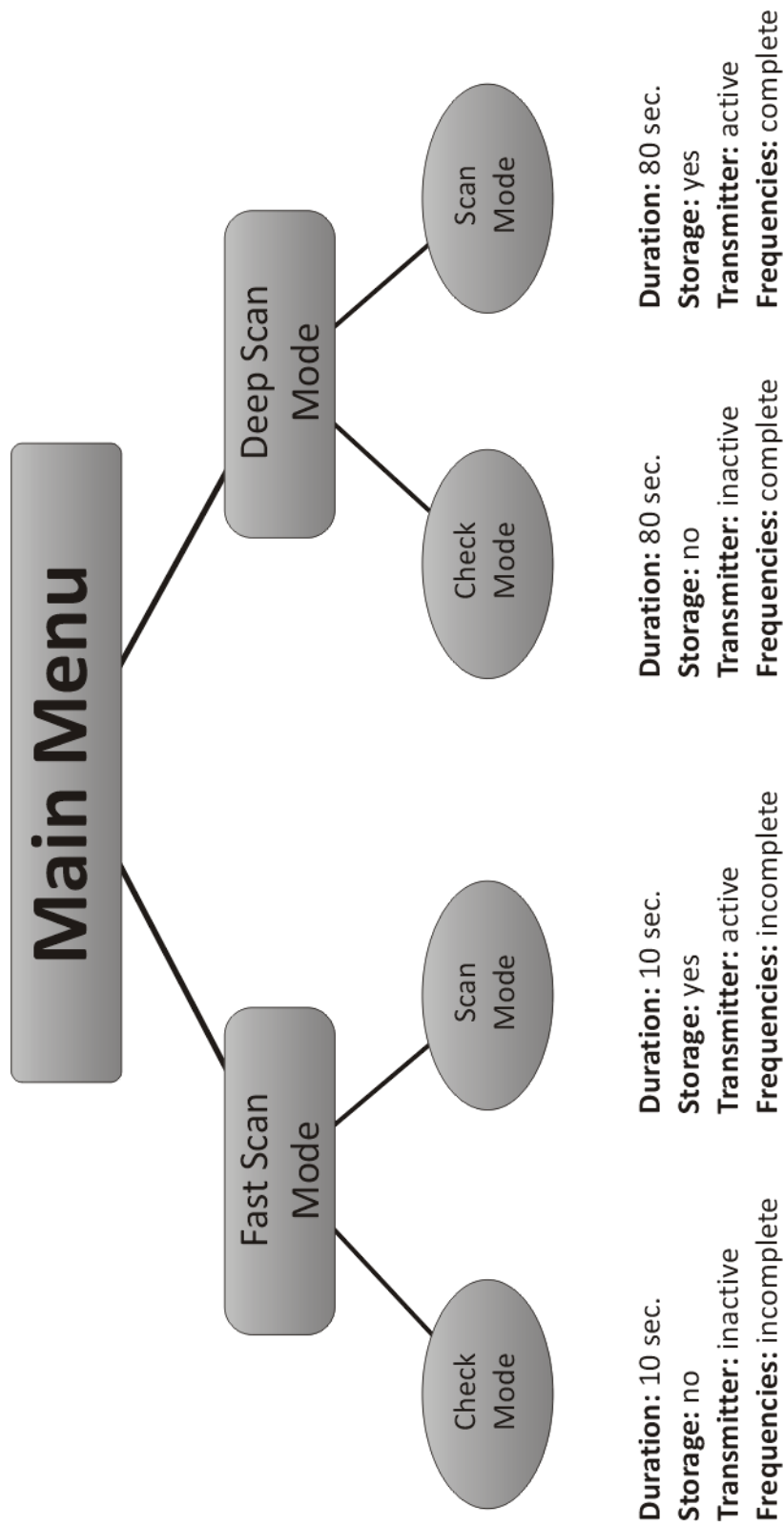


Figure 14: Overview: Fast Scan Mode / Deep Scan Mode

7 Install/Uninstall of USB drivers

Before you can transfer data from the device to your computer you have to install the USB drivers. Connect the active computer and the control unit via USB cable and follow the instructions in the appropriate subsection.

7.1 Windows XP

The instructions in this section are only valid for the operating system Windows XP. If you are using Windows Vista as operating system of your computer, please read the instructions in section 7.2 on page 32!

7.1.1 Install drivers

The installation of the USB drivers in Windows XP is relatively simple. After you have connected the device with your computer, powered it on and the message from figure 15 appears on your screen.

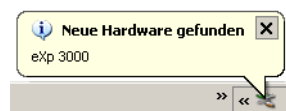


Figure 15: Install USB drivers: Windows XP, Step 1

If you prosecute Windows XP with Service Pack 2, you will be asked in dialog from figure 16 if Windows Update has to search for drivers up to date. Mark entry *No, not this time* and click on *Next*.

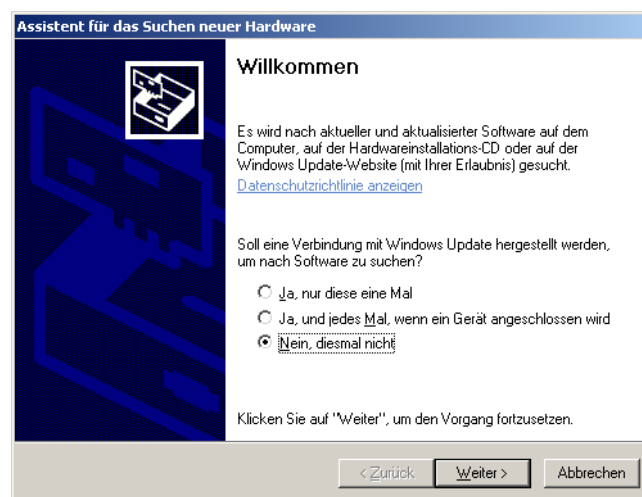


Figure 16: Install USB drivers: Windows XP, Step 2

In other versions of the operating system Windows this dialog window should not appear.

In the following dialog window like figure 17 select the entry *Install software from a list ...* and click on button *Next*.

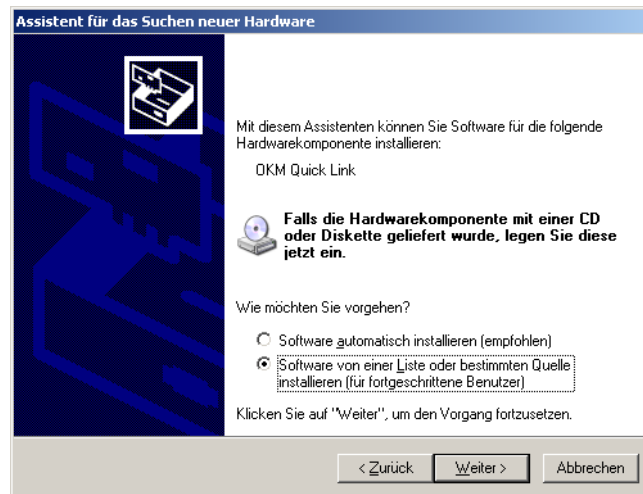


Figure 17: Install USB drivers: Windows XP, Step 3

In the next dialog window from figure 18 mark the entry *No search, select driver individually* and click on *Next*.

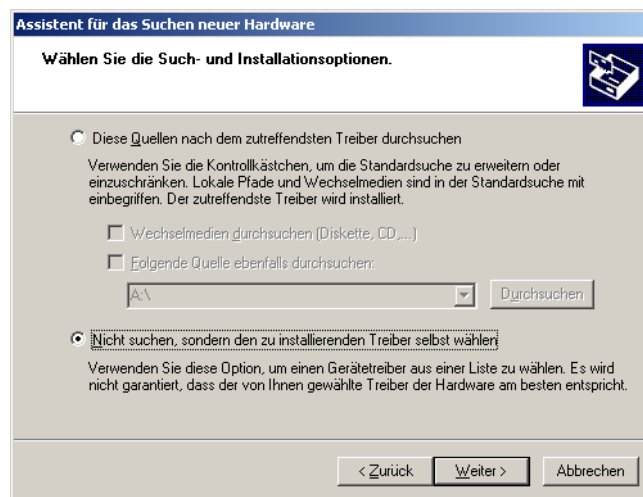


Figure 18: Install USB drivers: Windows XP, Step 4

Another window will open, represented in figure 19, where you have to select the driver file. Therefore click on *Data carrier...* Immediately another window appears where you click on the button *Search...* Then select the file *OKM_LE.INF*, which you can find in the directory *\drivers\usb_cable* of your software CD. Afterwards you have to click on *Open*, *OK* and *Next*, to start the installation of the files.

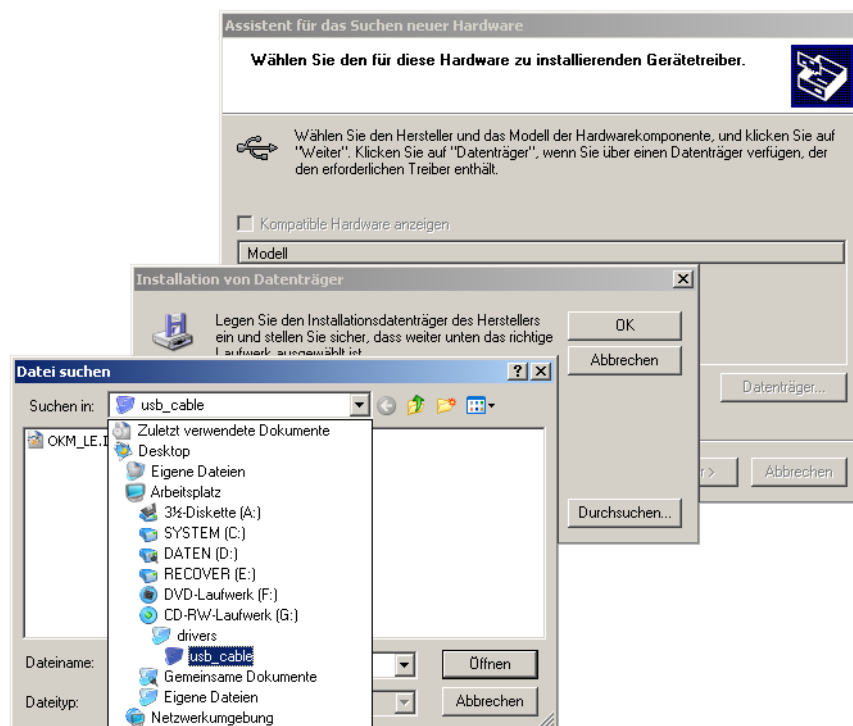


Figure 19: Install USB drivers: Windows XP, Step 5

After successful installation of the driver a message like in figure 20 will appear on your computer screen. Now the drivers of your device are installed and you can transfer data to your PC.



Figure 20: Install USB drivers: Windows XP, Step 6

7.1.2 Uninstall drivers

If you need to delete the USB drivers from your operating system because of a wrong installation for example, please open the device manager of Windows XP. Therefore please click on *Start* → *control panel*, like represented in figure 21.

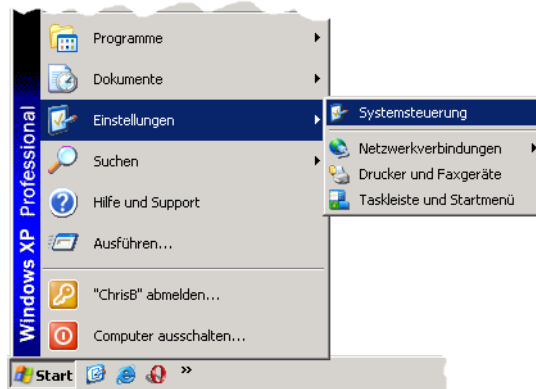


Figure 21: Uninstall USB drivers: Windows XP, Step 1

After that a dialog like in figure 22 appears. There you can find the entry *system* and click twice on it.

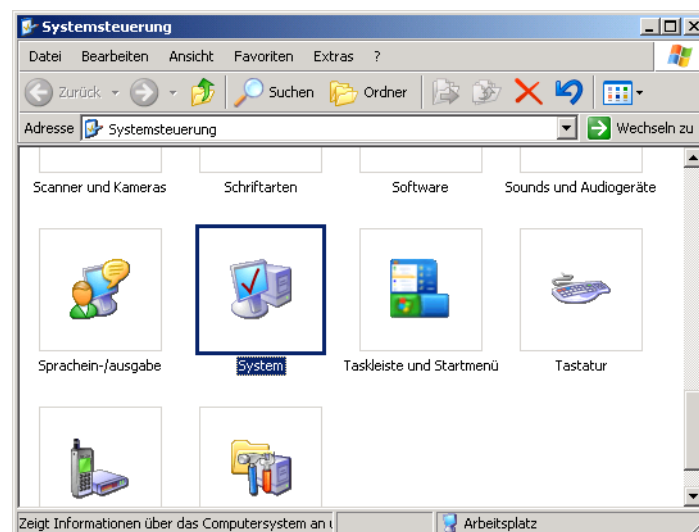


Figure 22: Uninstall USB drivers: Windows XP, Step 2

The dialog from figure 23 appears on your screen. Click on the tab *hardware* and after that the button *device manager*.

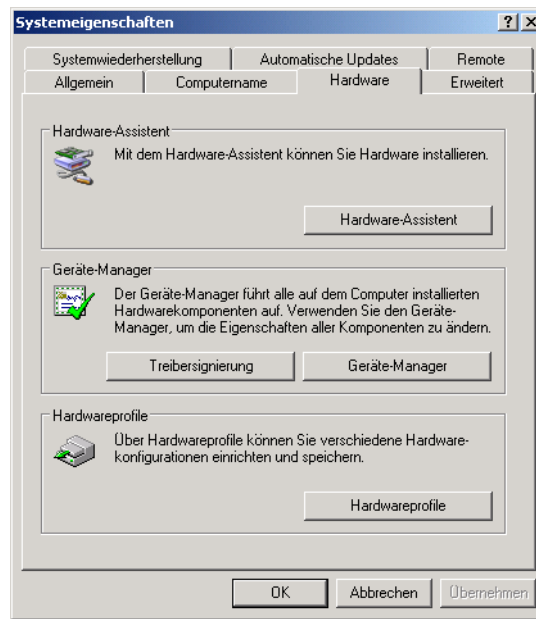


Figure 23: Uninstall USB drivers: Windows XP, Step 3

A list of devices like in figure 24 will be represented. There you can find the entry *USB-Controller*. By clicking the plus symbol next of this entry, all available USB devices will be shown.

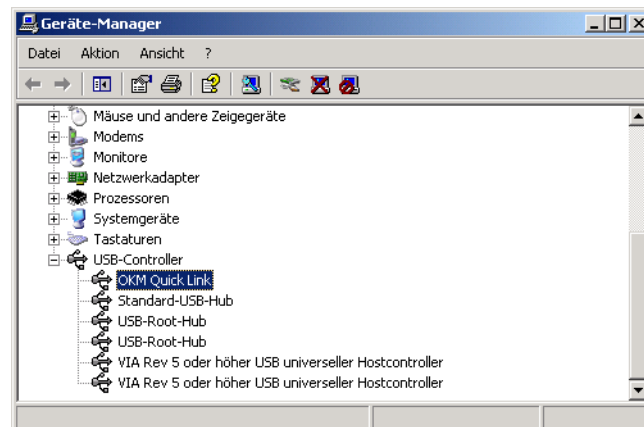



Figure 24: Uninstall USB drivers: Windows XP, Step 4

Mark the device which you like to delete, which means *FS-Reflexion*. Eventually the device can be listed as *OKM Quick Link*. Then click on the button . Alternatively you can select in the menu *Action* the entry *Uninstall*.

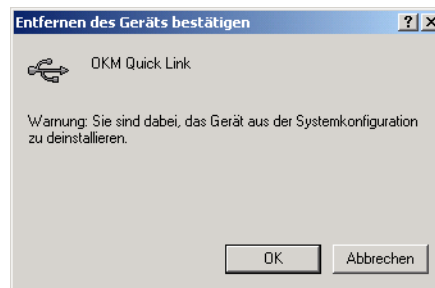


Figure 25: Uninstall USB drivers: Windows XP, Step 5

The dialog from figure 25 appears. Click there on the button *OK*. Now all drivers will be deleted from your computer. If needed you can now install the USB driver again in the correct way.

7.2 Windows Vista

The instructions in this section are only valid for the operating system Windows Vista. If you are using Windows XP as operating system of your computer, please read the instructions in section 7.1 on page 26!

7.2.1 Install drivers

The installation of the USB drivers in Windows Vista is relatively simple. After you have connected the device with your computer, powered it on and the message from figure 26 appears on your screen.

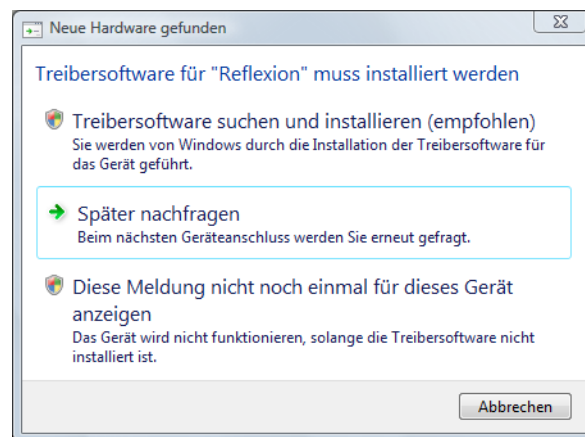


Figure 26: Install USB drivers: Windows Vista, Step 1

Click on the button *Search and install driver software (recommended)*. Following the message from figure 27 appears on the screen.

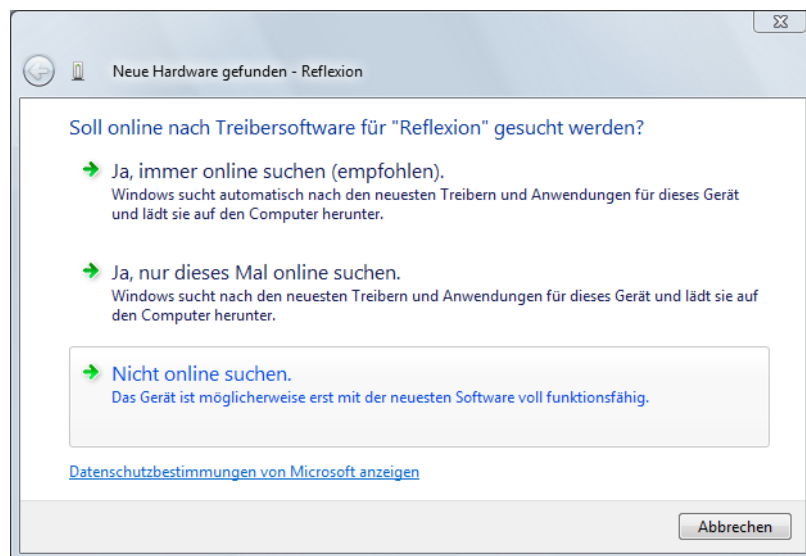


Figure 27: Install USB drivers: Windows Vista, Step 2

Click on the button *Do not search online*. Another dialog will appear on the screen, like represented in figure 28.



Figure 28: Install USB drivers: Windows Vista, Step 3

Now insert the software CD with the USB driver into your CD drive and click on the button *Next*. Windows is now searching for the correct USB driver in all directories. After a few moments the message from figure 29 will appear.

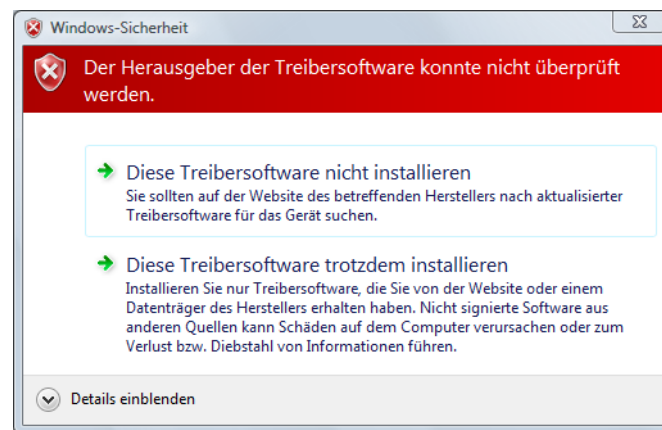


Figure 29: Install USB drivers: Windows Vista, Step 4

Click on the button *Install this driver software anyway*, to install the USB driver on your system. After completing the USB installation a dialog like in figure 30 will appear.

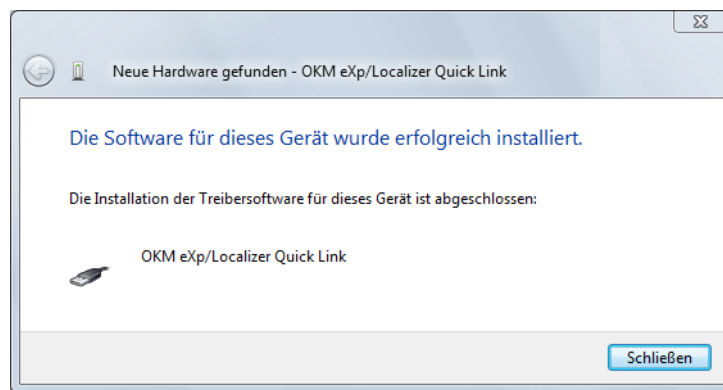


Figure 30: Install USB drivers: Windows Vista, Step 5

Additionally the information from figure 31 will appear on the down right side of your screen.

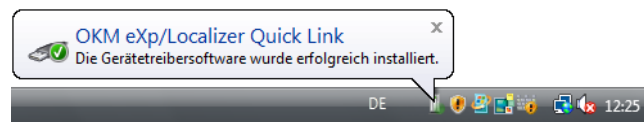


Figure 31: Install USB drivers: Windows Vista, Step 6

Now you have completed the installation of the USB drivers in Windows Vista.

7.2.2 Uninstall drivers

If you need to delete the USB drivers from your operating system because of a wrong installation for example, please open the device manager of Windows Vista. Therefore please click on *Start* → *control panel*, like represented in figure 32.



Figure 32: Uninstall USB drivers: Windows Vista, Step 1

After that a dialog like in figure 33 appears. There you can find the entry *system* and click twice on it.

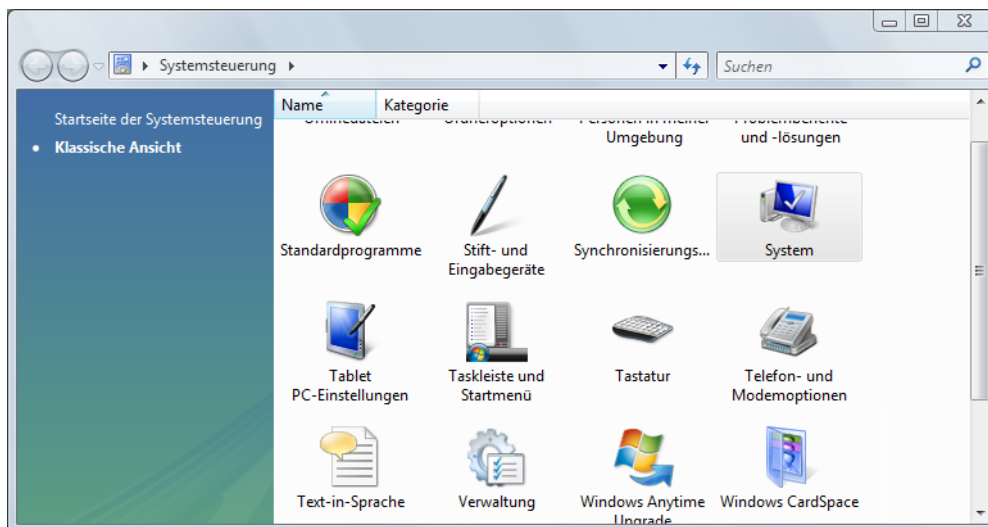


Figure 33: Uninstall USB drivers: Windows Vista, Step 2

A window like in figure 34 appears on your screen. Click there on the entry *device manager* on the upper left side.

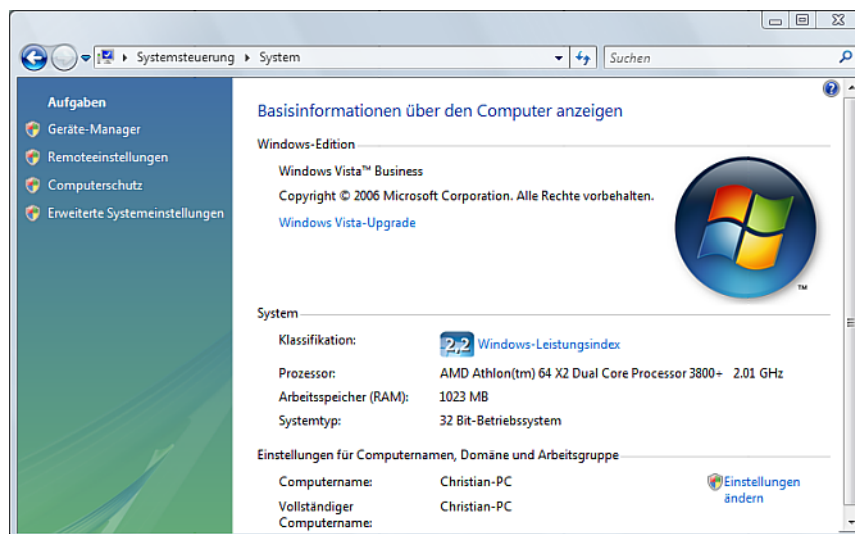


Figure 34: Uninstall USB drivers: Windows Vista, Step 3

A list of devices like in figure 35 will appear. Please look there for the entry *USB-Controllers*. By a simple click on the plus symbol next to the entry all USB devices will be shown.

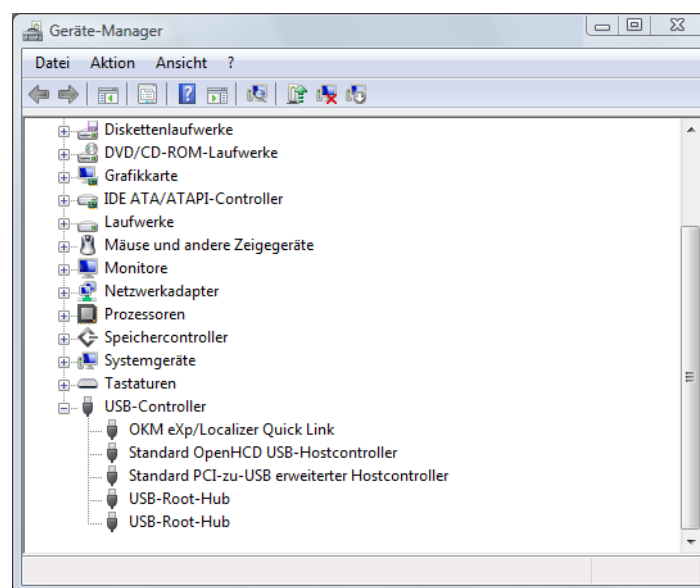



Figure 35: Uninstall USB drivers: Windows Vista, Step 4

Mark the device which you like to delete, which is *“FS-Reflexion”*. Eventually the device can be mentioned also as *“OKM Quick Link”*. After that click on the button . Alternatively you can select in the menu *Action* the entry *Uninstall*.

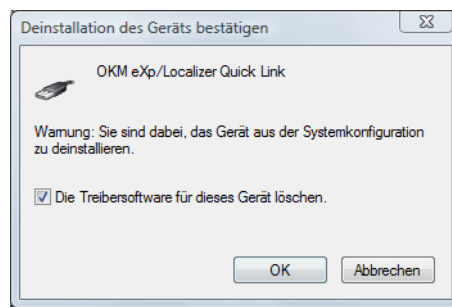


Figure 36: Uninstall USB drivers: Windows Vista, Step 5

The dialog from figure 36 will appear. Mark the entry *Delete driver software for this device* and click after that on the button *OK*. Now all drivers will be deleted from your computer. If needed you can install the USB driver now again in the correct way.

8 Tutorial – Accomplish a measurement

In this section it will be explained step by step how to do a measurement in *Check Mode* and *Scan Mode* inside the operating mode *Deep Scan Mode*.

Before starting the measurement make sure that the batteries of the transmitters and the external power supply of the control unit have enough power to process the following measurement.

8.1 Positioning the transmitter

Place the transmitter at least 3 meters away from your measured area on the ground. This distance is important to avoid direct disturbances to the vibration transducer caused by the generated vibrations. Also take care that the transmitter is placed over the whole surface evenly on the ground like shown in figure 37.



Figure 37: Right positioning of transmitter

The lower surface of the transmitter has to be in contact to the ground over the complete surface, otherwise the generated vibrations will be less or not at all transmitted into the underground.



Figure 38: Wrong positioning of transmitter

Figure 38 shows some examples, where the transmitter is wrong placed. The space between the soil and the transmitter avoid that a proper transmission of the vibrations into the ground will be possible.

8.2 Positioning vibration transducer

Depending on the condition of the soil put the seismic vibration transducer into the ground on the first measurement point of your measured area or place it evenly in the underground like represented in figure 39. Therefore please use the according positioner, which you screw on the vibration transducer.

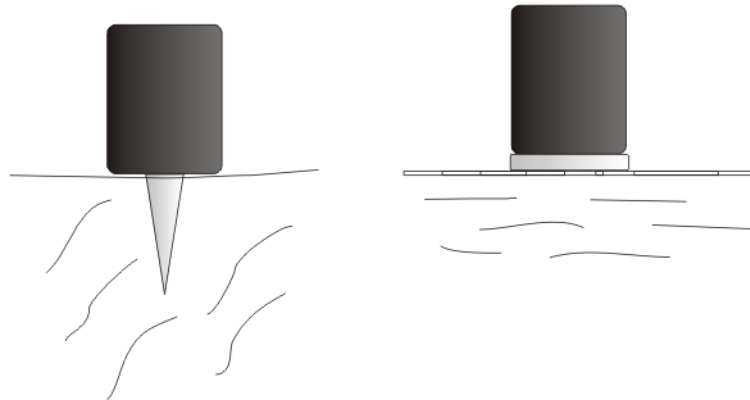


Figure 39: Positioning of vibration transducer

After that please connect the vibration transducer to the control unit and power on. The integrated pc module of the control unit will now be started and after a short moment the main menu will be visible in the monitor.

8.3 Measurement in Check Mode

Before you can measure a complete area, we will do a measurement in the *Check Mode* to find out if there are some disturbing signals at this place.

Select the operating mode *Deep Scan Mode* from the main menu and confirm it by pressing the button . Now you are in the *Deep Scan Mode*, like represented in figure 11 on page 22. Now please press the button , to execute the measurement in *Check Mode*. Wait until the recording of measurement values is completed and the frequency-energy-graph will be displayed.

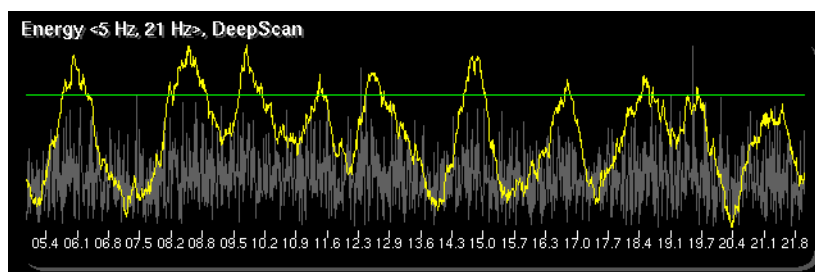


Figure 40: Measurement result in Check Mode of operating mode Deep Scan Mode

Figure 40 indicates a possible measurement result. There are no striking signals which indicate

a seismic disturbance. Now you can continue your measurement in the *Scan Mode*.

Detailed information about the analysis of measured results displayed in the frequency-energy-graph you can read in section 9.1 on page 44 of this user manual!

8.4 Measurement in Scan Mode

Check if the transmitter is powered on. If not, please power it on now! It will be needed for the measurement in *Scan Mode*.

To receive a correct graphical representation on your computer, the measurement has to be performed in a certain scheme. In figure 41 the principle positioning of each measure point in one measurement area is represented schematically.

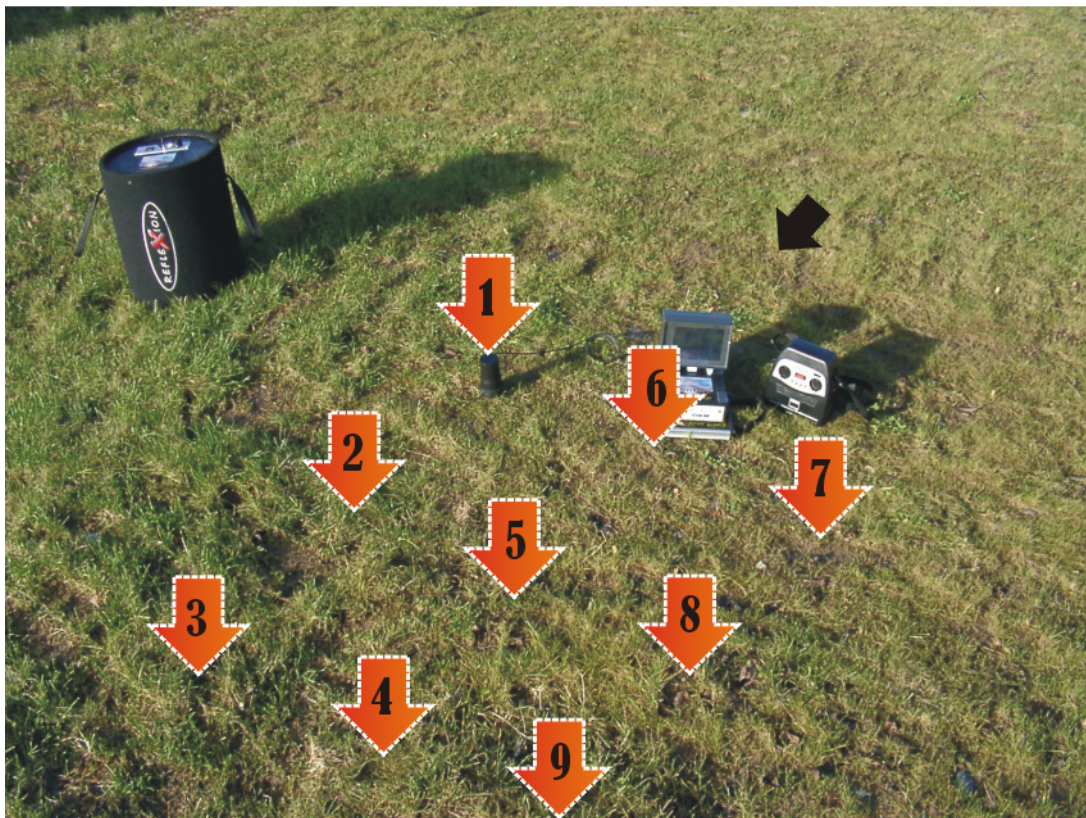


Figure 41: Scheme of a complete measurement

Please take a look at figure 41 and imagine you are staying on the black arrow and face to the direction of the arrowhead. In this way the measure point 1 is on the right down corner of your measured area. There we start the measurement and work off every measure point in the given way. The measure area in our example consists of 9 measurement points in total. There are 3 measurement lines with 3 measurement points on each line. Of course a measurement can consist of more measurement points. The number of measurement points depends on the size of the measured area and the desired precision.

With increasing size of the measured area, the number of measure points and number of measure lines should be increased.

The distance between two single measure points should not be larger than 1 meter. Optimal would be even less distance like e.g. 50 cm.

The less distance between two measure points, the more accurate will be the complete measurement and the generated graphics.

You start your measurement always on the down right corner of your measured area and record the first measure point. Place the vibration transducer on this position and press the button Start (“Scan”). Now wait until the measurement procedure will be finished. The indicator of progress shows how long the measurement will take. As soon as the measurement is completed you have the possibility to save the measured values of this measure point. Therefore press the button (“Save”). In case the effected measurement is failed because of sudden disturbances or others than you can repeat the measurement for the current measure point.

Only after you saved the current measured data of this measure point the vibration transducer will be placed on the next position of the measured area. Press again the button Start (“Continue”). After finishing the measurement recording of this measure point press the button (“Save”), to save also this measure point inside the control unit.

Repeat the same procedure again for the last measure point of the 1. measure line (measure point **3**). After saving the data please press the button (“Done 1st”), to finish the 1. measure line. The message from figure 42 (left) appears on the screen.



Figure 42: Finish first measure line

Press now the button , to confirm the finish of this measure line. Every other button will stop the process. In the following message from figure 42 (right), it will again be indicated how many measure points one measure line has. In our example it is 3.

Place the vibration transducer now on the first measure point of your next measure line – in our example it is measure point **4** – and repeat the complete measurement procedure, until you

have recorded all measure points of the 2. measure line. After saving the last measure point of this current measure line a message like in figure 43 appears on the screen of the control unit.



Figure 43: Finish current measure line

The control unit memorize the amount of measure points per measure line and so every further measure line will be finished automatically. Only the very first measure line has to be finished by yourself. Now you can measure as long as needed to complete your measured area. To finish the measured area please press the button ("Finish"). Again a message appears on the screen to confirm the finish of the measured area. Therefore please press again button .

Now you have saved a complete measure area in the control unit.

8.5 Transfer measured data to a computer

After you saved one or more measured areas inside the control unit, you can transfer the data to a computer. Therefore it is necessary to connect the control unit via the USB cable to a computer. Please make sure that USB drivers are installed like described in section 7 on page 26.

In the Visualizer 3D software click now on the menu *File* → *Import* → *Reflexion*, see figure 44. The dialog from figure 45 appears on the screen where you have to adjust the following parameters:

- **Measuring instrument, device:** In this input box the serial number of your device is listed. If you have more than one device you have to select the device from which you like to transfer the data.
- **Destination folder:** Here you have to select the folder where your measured data should be placed. In our example the destination folder is `C:\Programme\Visualizer 3D\ScanImages\`.
- **USB connection:** Make sure that this box is marked.

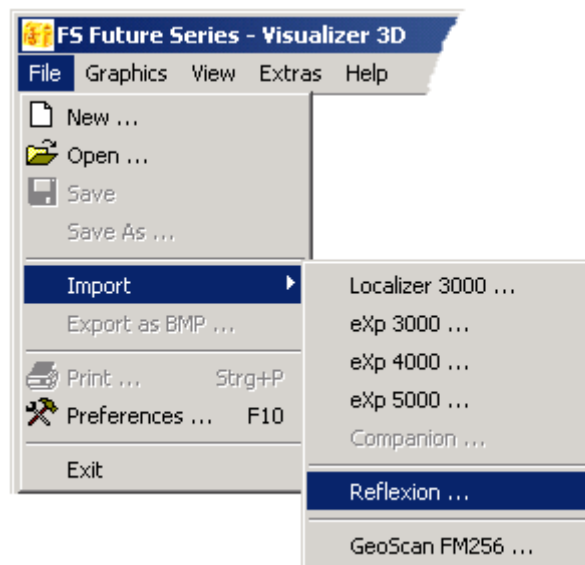


Figure 44: Import of measured data to computer

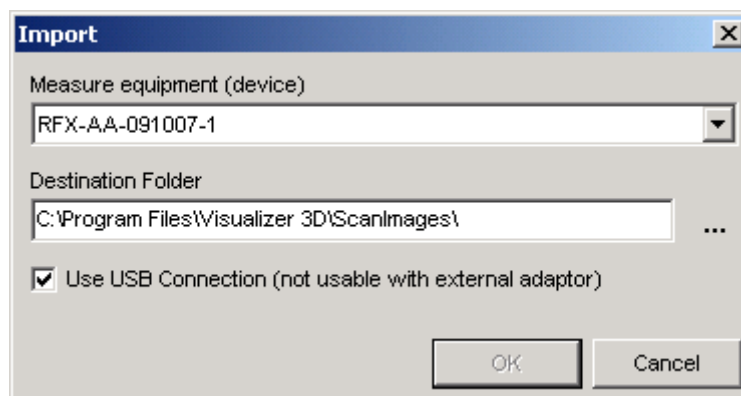


Figure 45: Adjustings for import

If all adjustings has been done please click on the button *OK*, to start the data transfer. Wait until all measurements are transfered successfully to your computer. After that you can open the measurements to see and analyse it.

Therefore click on the menu *File* → *Open* and select the corresponding file. The saved scan images have the following form: 20071130150246.rfx. The following representation shows the meaning of each digit.

	<i>Month</i>	<i>Hour</i>	<i>Second</i>
2007	11	30	15
02	46		
<i>Year</i>	<i>Day</i>	<i>Minute</i>	

The measurement of file 20071130150246.rfx has been recorded on the 30th of november 2007 at 15 hours (which mean 3 pm), 2 minutes and 46 seconds.

9 Analyse measurements

In this section you can find important information how to analyse graphical representations. Unfortunately it is not possible to discuss every single measuring result because of its many uncountable forms of appearance.

9.1 Frequency-energy-graph

During the work with the control unit you already noticed the frequency-energy-graph. In every measured point, no matter if recorded in *Scan Mode* or *Check Mode* of operating mode *Fast Scan Mode* or *Deep Scan Mode* the frequency-energy-graph is visible as a result. In figure 46 such a graph is illustrated.

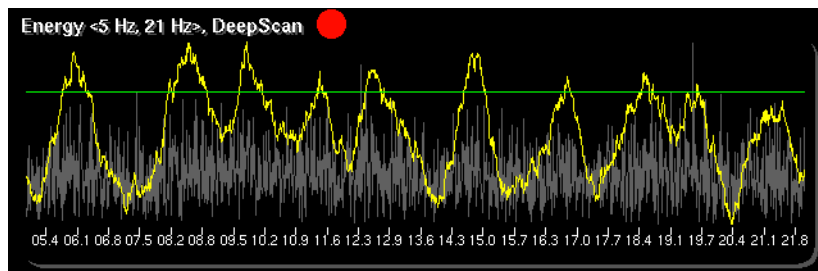


Figure 46: Frequency-energy-graph (example 1)

The grey colored graph represents the raw data as distribution of energy, the green colored graph shows the average value of the energy in the range of all frequencies and the yellow graph displays an interpolated distribution of energy. The diagram in figure 46 shows a typical measurement result on normal ground without any occurrences. There are no large disturbances visible. The average value is typically very high. The red point in the diagram shows that there has no discovery to be expected.

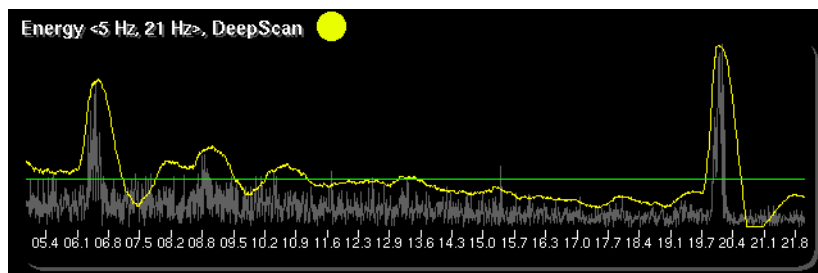


Figure 47: Frequency-energy-graph (example 2)

In figure 47 there are 2 maximum values visible. The first value is at 6,5 Hz and the second value is at 20 Hz. The average value is situated lower than in the first example. But it is not typically that there are two extreme values in such a large distance to each other. It could be a seismic disturbance. The green-yellow colored point inside the diagram indicates that it can be possible that there is a discovery.

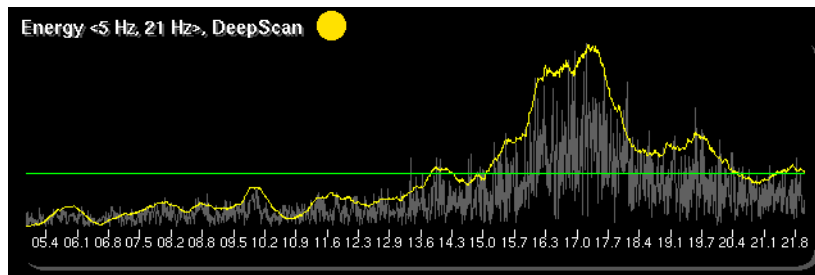


Figure 48: Frequency-energy-graph (example 3)

The third example is shown in figure 48. There are some higher measured values just next to each other. The average value is relatively high. It is recommended to repeat the measurement at the specific measured point to concretize these measurement results. The yellow point inside the diagram indicates that there may be no discoveries at this place to be expected.

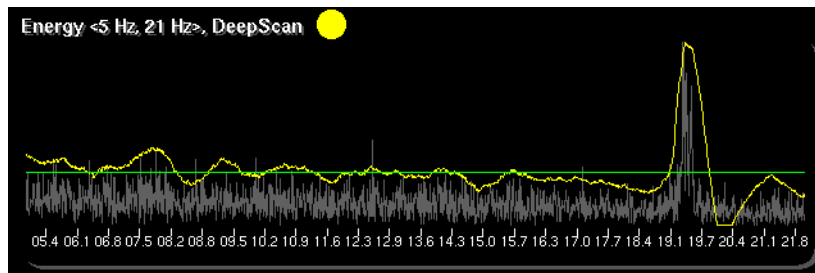


Figure 49: Frequency-energy-graph (example 4)

In figure 49 the maximum value is much higher and the amplitude of neighbor values is small. A subterranean structure may be expected. Nevertheless the average value could be much more lower to give a correct statement.

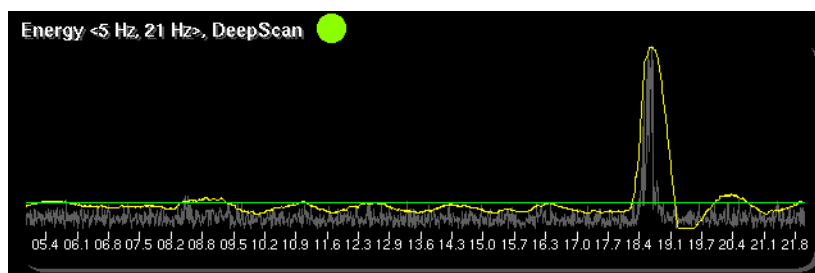


Figure 50: Frequency-energy-graph (example 5)

The last example shown in figure 50 indicates a very good measurement result. There is a high maximum value without much scattering and the average value is very low. The green point indicates that a target object is quite possible.

In summary the following aspects can be said to find hidden cavities:

- **Maximum value:** There is a single maximum value with highest amplitude available in the frequency-energy-graph without much scattering. Also the maximum value has to be visible in the interpolated distribution of energy (yellow graph).
- **Average value:** The average value over all measuring values must be very low.

The more measured data is available the more conclusions about hidden objects can be made. If one measurement gives conflicting results, repeat the measurement in different intervals to avoid the influence of seismic disturbances.

The higher the maximum value and the lower the average value is the more likely there exists a target object.

9.2 Graphical representations in 3d

Unlike the frequency-energy-graphs the three-dimensional representations can only be created by using the function *Scan Mode* of the operating modes *Fast Scan Mode* and *Deep Scan Mode*. After recording all measuring points of a scan area and transferring them to a personal computer, graphical representations like shown in figure 51 and 52 will be displayed.

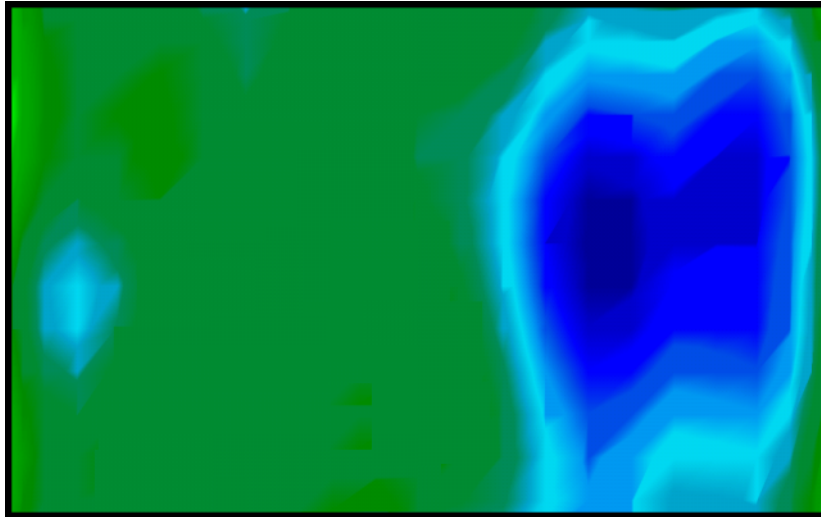


Figure 51: Graphical representation of a cavity in 3d

These graphics represent the distribution of maximum energy in every single measured point of a certain scan area. Thus you can see potential changes in the underground immediately, which might point to hidden cavities at specific positions of the measured scan area. Blue color is used to display cavities inside the graphical representations.

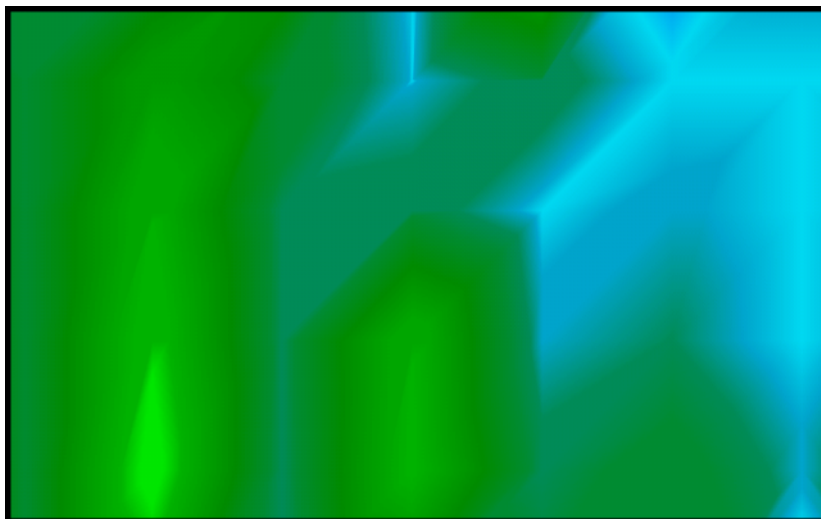


Figure 52: Graphical representation in 3d

In figure 51 there is an obvious anomaly shown on the right side of the graphic, whereas figure 52 shows no specific objects. By using one of the numerous functions of the software Visualizer

3D all the scan images can be reprocessed. So it is possible to determine the dimensions of detected cavities. Further explanations concerning the features of the software Visualizer 3D can be found in its user's manual!

By moving the cross-hairs onto a specific measured point within the graphical representation and pressing the enter key afterwards, the frequency-energy-graph of that measured point becomes visible again. One example chart is displayed in figure 53.

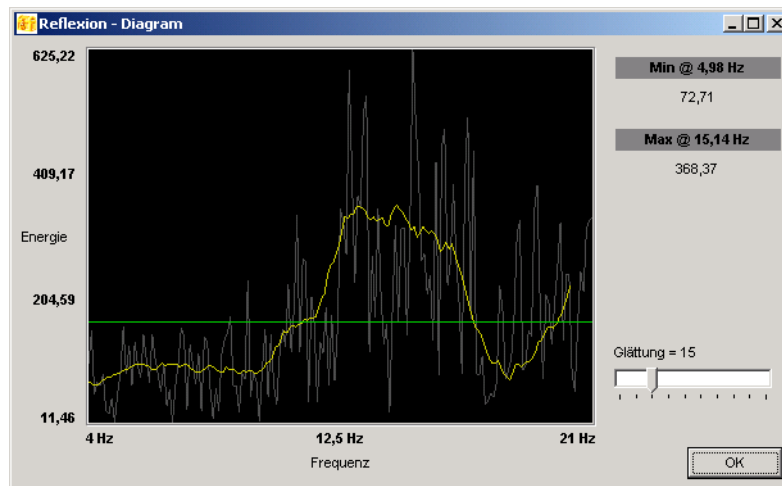


Figure 53: Frequency-energy-chart in Visualizer 3D

In that way you are able to analyse all available measured data for each single measured point.

10 Maintenance and Services

In this section you will learn how to maintain your measuring instrument with all included accessories to keep it in good condition a long time and to get good measuring results.

The following list indicates what you absolutely should avoid:

- penetrating water
- strong dirt and dust deposits
- hard impacts
- strong magnetic fields
- high and long lasting heat effect

If you want to clean your device please use a dry rag of soft material. To avoid any damage you should transport the device and accessories always in the appropriate carrying cases.

Beware that all batteries and accumulators are always charged fully while operating with your system. Please recharge your batteries after each usage completely! In this way a long durability of the used batteries is guaranteed. During a long time storage period, the batteries should be charged from time to time!

To load the external and internal batteries you have to use only chargers which are part of our scope of delivery.

11 Error Messages

In this section you can find possible error messages which can appear during the work with the device.

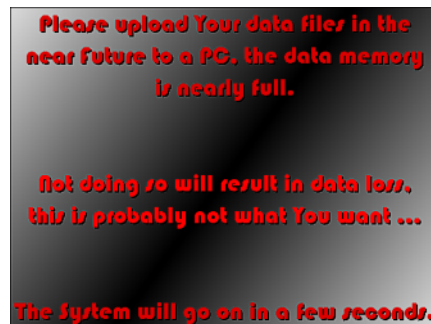


Figure 54: Only a small amount of memory available

Because every scan in the operating mode *Ground Scan* will be stored in the internal memory of course the memory place will decrease over time. As soon as the free memory cell is less than 20% the following message like in figure 54 will appear.

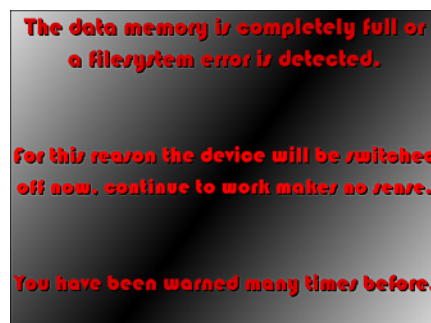


Figure 55: No free memory available

If there is no more free memory available you will see a message like in figure 55. You can create more memory space if you transfer all stored data with optional software to your computer or if you select option *Empty Memory* to delete all stored data without having transferred them to your computer.

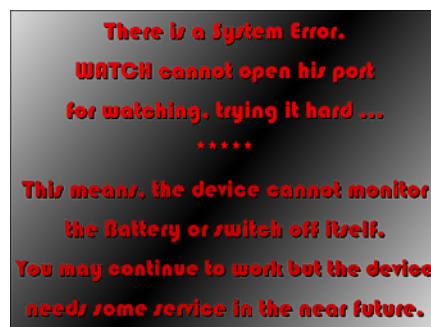


Figure 56: Internal Hardware Error

If message 56 appears the device cannot control the operating voltage. This also means it cannot warn you in case of a low status of the battery. Also the automatic shutdown of the device may be affected. It is advised to let the device check from the manufacturer to avoid further damages. Ask your dealer for further help.



Figure 57: The external power supply has to be charged

Message 57 appears if the battery is low because of a long operating time with the device and not enough voltage is available. You should power off the device and charge the external power supply as soon as possible. If you continue operating with the device it could be possible that data can get lost.

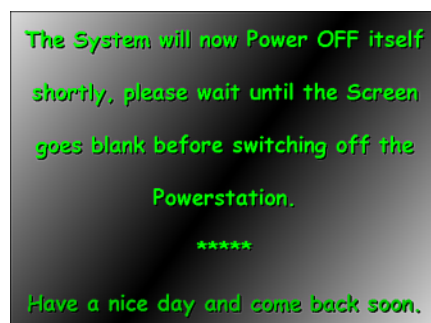


Figure 58: Shutting down the system

Because there is a PC module integrated in the device you have to shutdown it like a normal

computer. Therefore you have to use option *Exit* from the main menu. The following message like in figure 58 remind you to wait until the device powered off by itself.

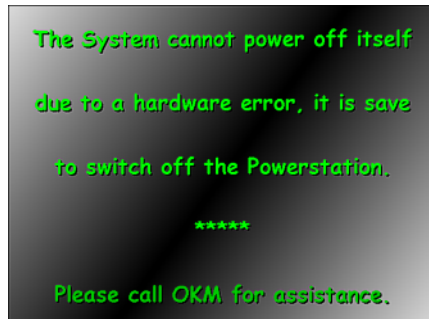


Figure 59: Shutting down the system is not possible

If the device itself is not able to power off, a message like in figure 59 is shown. In this case you simply power off your external power supply.

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