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# eXp 4500

Version 2.0



## User's Manual

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# CHAPTER 1

## Introduction



## 1.1 Preface

Dear customer,

all of the engineers, sales, training and support staff at OKM GmbH would like to thank you for your purchase of the eXp 4500.

The eXp 4500 detector works on the principle of Electro-Magnetic Signature Reading (EMSR). Besides the detection of metallic objects this device is also capable of detecting natural features of the earth like formations of strata, cavities, voids, faults, ground water and other non-metallic objects. Then of course this equipment is best suited at detecting burials, graves, sepulchers, treasure, buried utilities, tanks and the like.

The eXp 4500 is able to locate, document and analyze buried objects within various structures and vessels non-intrusively without having to excavate the area. Using EMSR is particularly useful in areas where detection is a must and excavation is not possible. The facile and flexible handling of the eXp 4500 can easily and quickly give reproducible results.

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.

By purchasing or using one of our products, we cannot guarantee that during your research that you will be successful and have a find. The recognition of hidden and buried objects depends on a huge number of factors. As you well may know there are different soil types all over the world with different levels of natural attenuation. Variable soil properties can and will hamper and alter ultimate scan measurements. Areas where there is an extreme amount of ground water, varying clays, sands and wet soils making scanning more difficult and may reduce the maximum depth capabilities of any and all detection equipment, regardless of make or model.

For more information regarding where this equipment has been used and operated, please visit our website. Our equipment is constantly being tested and when improvements or upgrades are available, we will list them also on our website.

It is necessary for our company to protect our developments and all the information learned during the "Research and Development" phases in creating our technology. We strive to stay within the given framework of legislation, patents and trademark registration.

Please take your time to read this User Manual and familiarize yourself with the operation, functionality and how to utilize the eXp 4500. We also offer training for your equipment in our factory and on-site. We strive to maintain worldwide dealer network for assistance and support. Please visit our web site for more information.

## 1.2 Important Notes

Prior to using the eXp 4500 and its accessories, please read these operating instructions carefully. These instructions give information on how to use the detector and potential sources where precautions should be taken.

The eXp 4500 and its accessories serve for the analysis, documentation and detection of sub-surface anomalies and ground disturbances. The recorded data of the ground structure will be transmitted to a PC to give a visual representation using our proprietary software program. Any additional notes to the software should be observed. Please read the user manual of the software!

### 1.2.1 General Notes

Being an electronic device, the eXp 4500 has to be treated with caution and treated with care as with any electronic device. Any failure to observe the safety precautions given or any use for purposes other than the ones it is designed for may result in damage or destruction of the processing unit and/or its accessories or connected components.

The device has a built in anti-tampering module which will destroy the unit if it is improperly opened. There are no end user serviceable parts on the inside of the unit.

### 1.2.2 Possible Health Hazards

If used properly this device normally does not pose any health hazards. According to current scientific knowledge, the high-frequency signals are not harmful to the human body on account of their low power.

### 1.2.3 Surrounding Area

When moving this unit from a cold environment to a warmer environment, watch out for condensation. Do not immediately operate the unit until any possible condensation could have evaporated. The unit is not weather proof and water or condensation can destroy the unit.

Avoid strong magnetic fields, which may occur in places where there are large electric motors or unshielded loudspeakers. Try to avoid using this equipment within 50 meters (150 ft) of this type of equipment.

Metallic objects on the ground such as cans, tin, nails, screws or debris can influence your scan data and present negative results regarding your scan data. Also it is a good habit to remove any metallic objects off of your person like cellular telephones, keys, jewelry, etc... Do not wear steel toe boots.

### 1.2.4 Voltage

The power supply should not be outside the indicated range of values. Use only approved chargers, batteries and rechargeable batteries which are included in the scope of delivery.

Never use the 115/230 Volt mains supply.

### 1.2.5 Data safety

Data errors can occur if:

- the range of the sender module has been exceeded,
- the power supply of the device or the batteries are too low,
- the cables are too long,
- the unit is operating too close to devices which send out disturbances or
- atmospheric conditions (electrical storms, lightning, etc...).

## 1.3 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

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

Prior to using your eXp 4500 please be sure that all batteries and accumulators are fully charged. Also allow the batteries to completely discharge before recharging them, regardless if you are working with the external battery or with internal accumulators. This way your batteries will have a long and durable life.

To charge the external and internal batteries, use only the approved chargers which are part of our scope of delivery.

## 1.4 Danger of Explosion during Excavation

Unfortunately, the last two world wars also made the ground in many places of the world a potentially explosive scrap heap. A host of those lethal relics are still buried in the ground. Do not start digging and hacking for an object wildly when you receive a signal of a piece of metal from your device. Firstly, you might indeed cause irreparable damage to a truly rare find, and secondly, there is a chance that the object reacts in a hostile fashion and strikes back.

Note the color of the ground close to the surface. A red or reddish color of the ground is an indicator of rust traces. As regards the finds themselves, you should definitely pay attention to their shape. Curved or round objects should be a sign of alarm, especially if buttons, rings or little pegs can be identified or felt. The same applies to recognizable ammunition or bullets and shells. Leave that stuff where it is, do not touch anything and, most importantly, do not take any of it home with you. The killing machines of war made use of diabolical inventions such as rocker fuses, acid fuses and ball fuses.

Those components have been rusting away in the course of time, and the slightest movement may cause parts of them to break and be triggered. Even seemingly harmless objects such as cartridges or large ammunition are anything but that. Explosives may have become crystalline over time, that is, sugar-like crystals have formed.

Moving such an object may cause those crystals to produce friction, leading to an explosion. If you come across such relics, mark the place and do not fail to report the find to the police. Such objects always pose a danger to the life of hikers, walkers, farmers, children and animals.

# CHAPTER 2

## Install/Uninstall USB drivers on Windows

In this chapter you will learn how to install the USB drivers, that are necessary to transfer data from the machine to your computer software. Please make sure to read the proper section appropriate to your Windows operating system.

## 2.1 Windows XP

The instructions in this section are only valid for Windows XP.

### 2.1.1 Install USB drivers on Windows XP

The installation of the USB drivers in Windows XP is relatively simple. After you have connected the device with your computer, switch it on and the message from figure 2.17 appears on your screen.

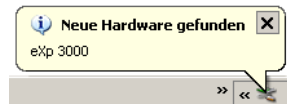


Figure 2.1: Install USB drivers: Windows XP, Step 1

If your Windows XP has Service Pack 2 installed, you will see the dialog from figure 2.2 if Windows Update has to search for drivers up to date. Mark entry "No, not this time" and click on Next.

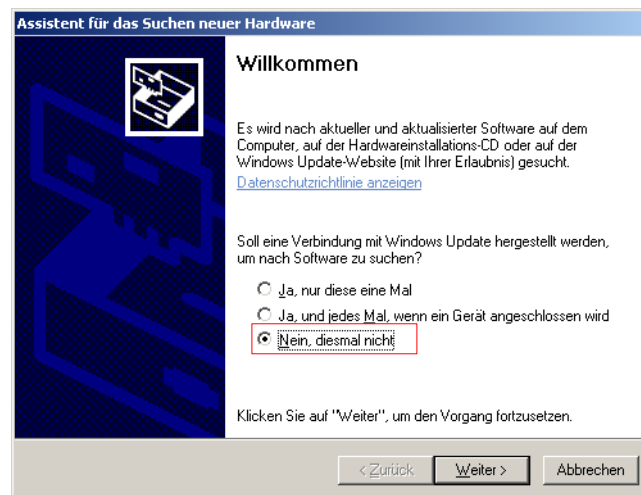


Figure 2.2: Install USB drivers: Windows XP, Step 2

In other versions of Windows this window should not appear.

In the following dialog window like figure 2.3 select the entry "Install software from a list ..." and click Next.

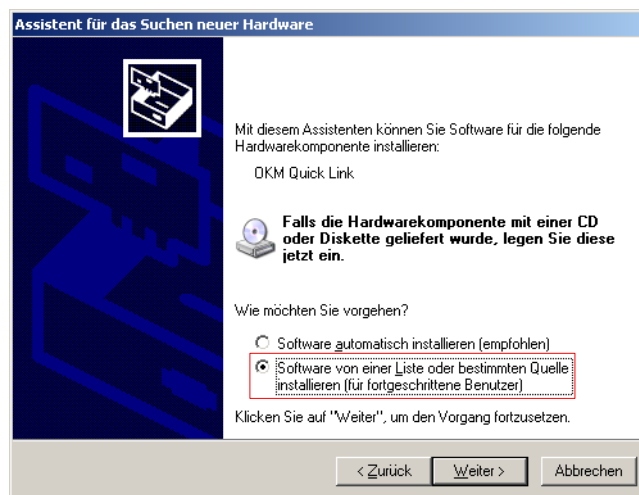


Figure 2.3: Install USB drivers: Windows XP, Step 3

In the next dialog window from figure 2.4 mark the entry No search, select driver individually and click on Next.

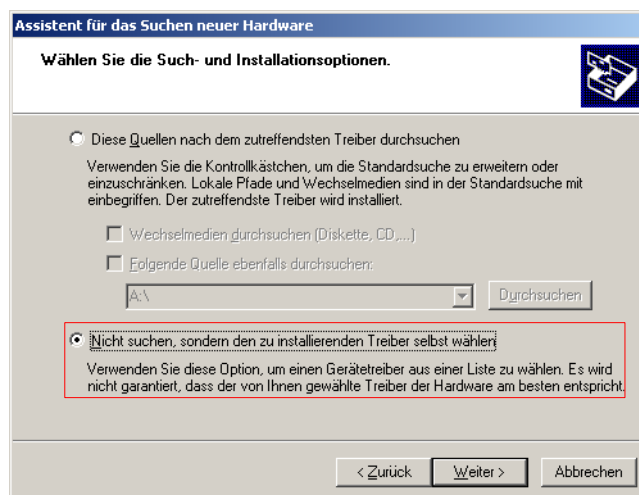


Figure 2.4: Install USB drivers: Windows XP, Step 4

Another window will open, represented in figure 2.5, 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.

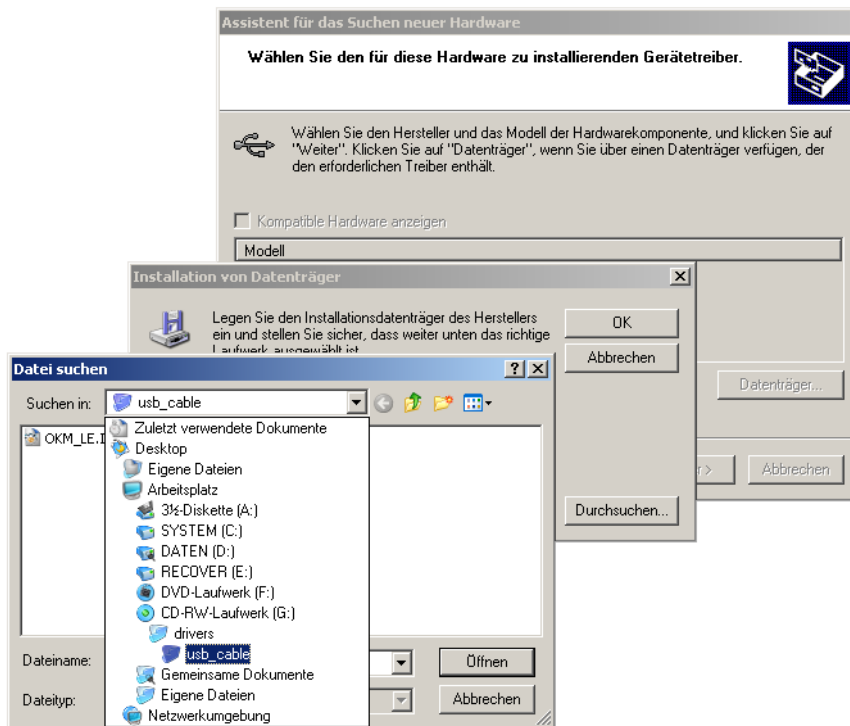


Figure 2.5: Install USB drivers: Windows XP, Step 5

After successful installation of the driver a message like in figure 2.6 will appear on your computer screen. Now the drivers of your device are installed and you can transfer data to your PC.



Figure 2.6: Install USB drivers: Windows XP, Step 6



## 2.1.2 Uninstall USB drivers on Windows XP

If you need to delete the USB drivers from your operating system because of a wrong installation, please open the device manager of Windows XP. Therefore please click on Start > control panel, like represented in figure 2.7.

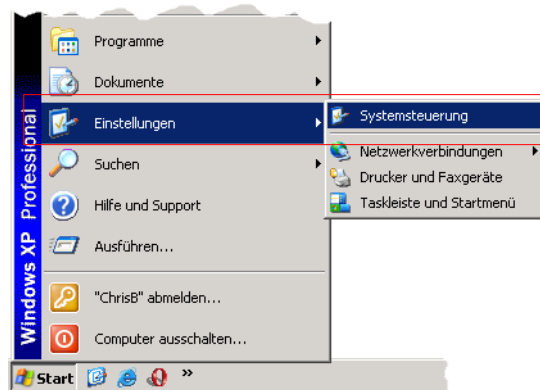


Figure 2.7: Uninstall USB drivers: Windows XP, Step 1

After that a dialog like in figure 2.8 appears. There you can find the entry system and click twice on it.

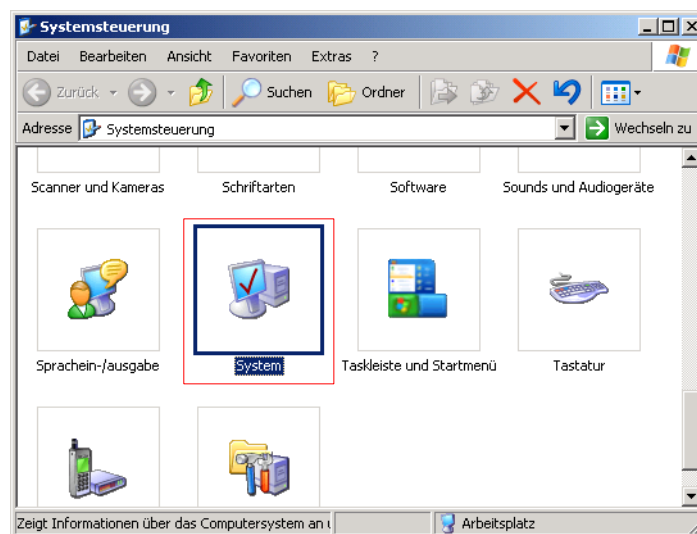


Figure 2.8: Uninstall USB drivers: Windows XP, Step 2

The dialog from figure 2.9 appears on your screen. Click on the tab hardware and after that the button device manager.

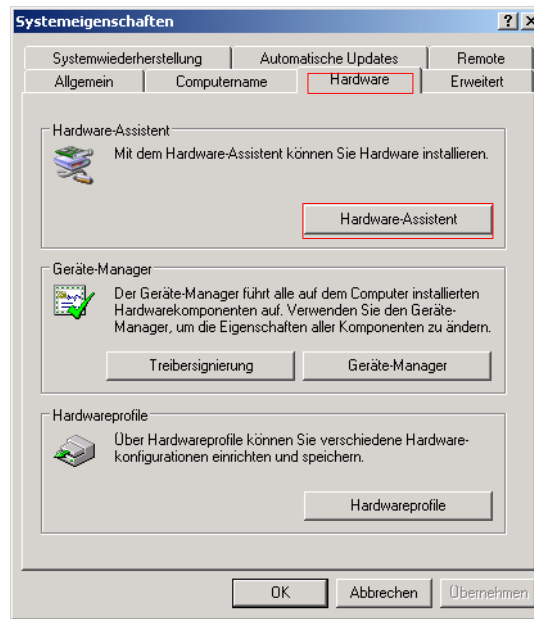


Figure 2.9: Uninstall USB drivers: Windows XP, Step 3

A list of devices like in figure 2.10 will be represented. There you can find the entry USBController. By clicking the plus symbol next of this entry, all available USB devices will be shown.

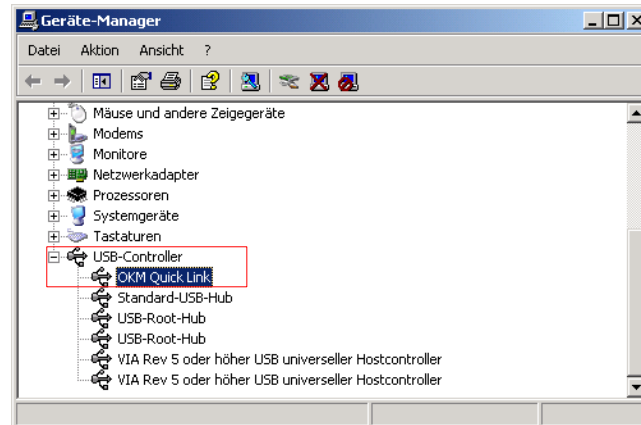



Figure 2.10: Uninstall USB drivers: Windows XP, Step 4

Mark the device which you like to delete, which means "eXp 4500. Additionally the device may be listed as "OKM Quick Link". Then click on the button . Alternatively you can select the entry Uninstall in the menu Action.

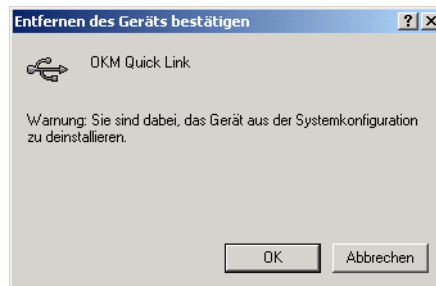


Figure 2.11: Uninstall USB drivers: Windows XP, Step 5

The dialog from figure 2.11 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 correctly.

## 2.2 Windows Vista

The instructions in this section are only valid for the Windows Vista operating system.

### 2.2.1 Install USB drivers on Windows Vista

The installation of the USB drivers in Windows Vista is relatively simple. After you have connected the device with your computer, switch it on and the message from figure 2.12 appears on your screen. Click on **Locate and install driver software (recommended)**.

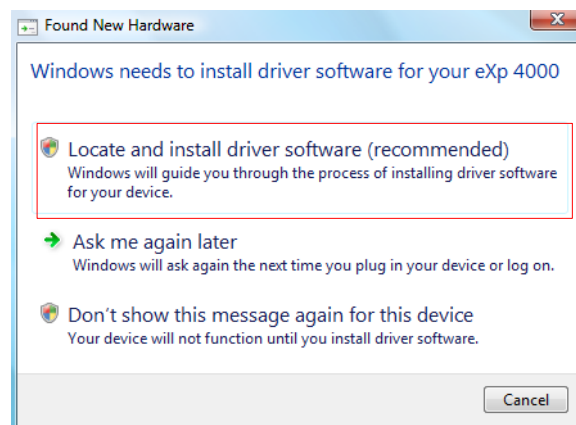


Figure 2.12: Install USB drivers: Windows Vista, Step 1

At the next window, shown in figure 2.13, click on **Don't search online**.

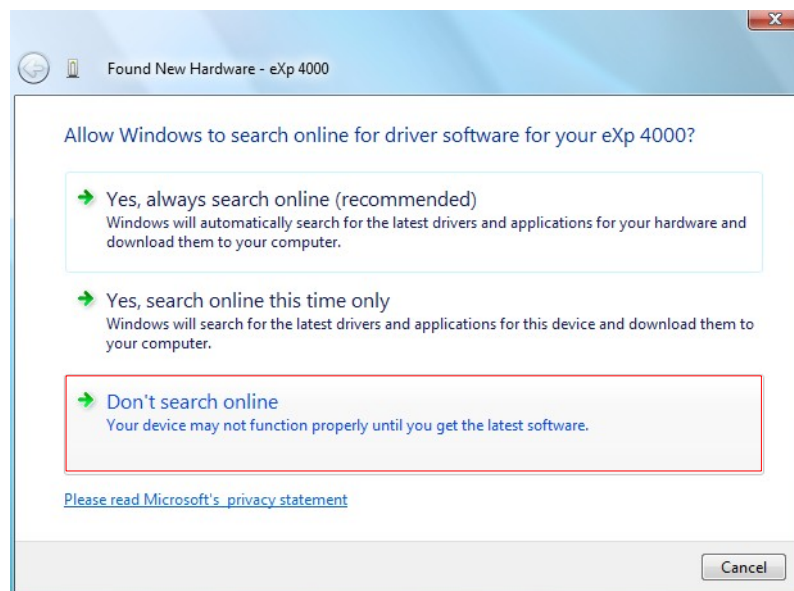


Figure 2.13: Install USB drivers: Windows Vista, Step 2

When the window from figure 2.14 is visible, insert the software CD with the USB drivers into your CD drive and click on the **Next** button. Windows will now search for the correct USB drivers automatically.

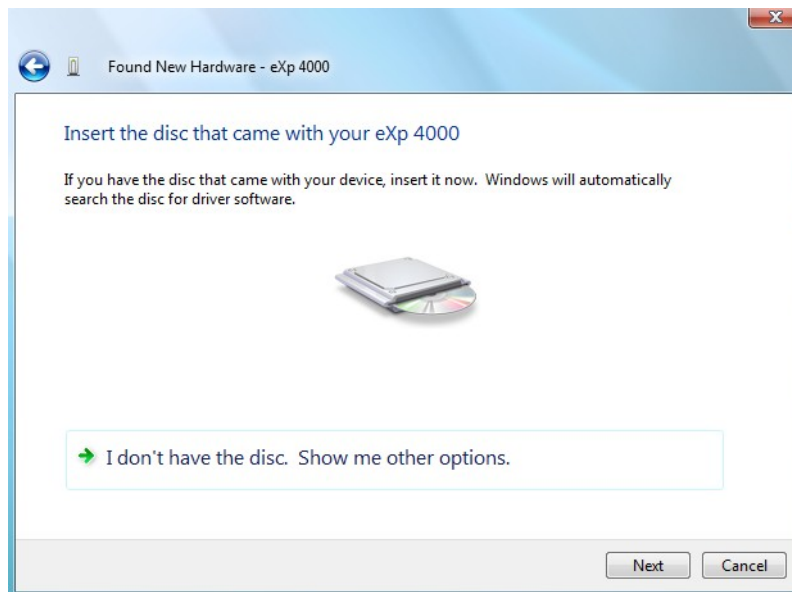


Figure 2.14: Install USB drivers: Windows Vista, Step 3

When the installation has finished the completion screen from figure 2.15 is displayed. Press **Close** to close this window.

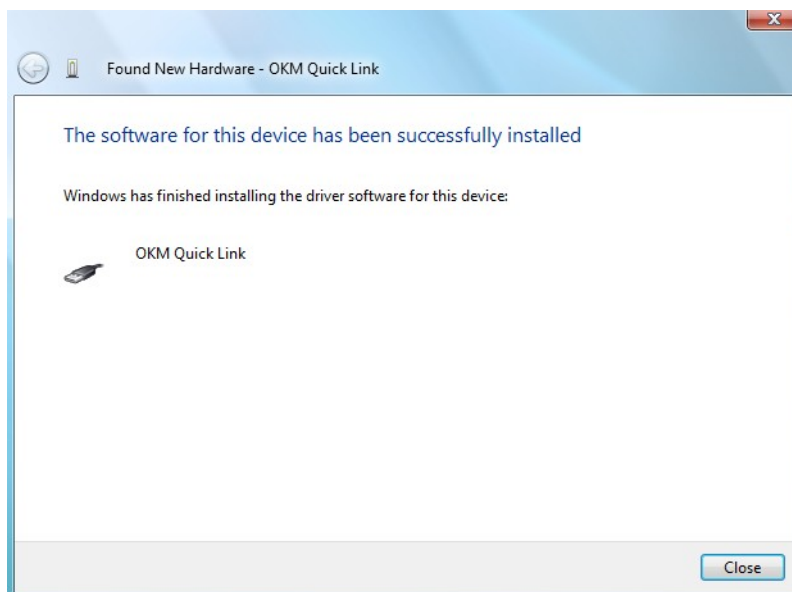


Figure 2.15: Install USB drivers: Windows Vista, Step 4

Now you have completed the installation of the USB drivers in Windows Vista, which will be confirmed by presenting the message from figure 2.16.

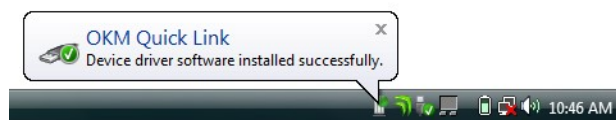


Figure 2.16: Install USB drivers: Windows Vista, Step 5

### 2.2.2 Update USB drivers on Windows Vista

If you need to update the USB drivers on your operating system or the initial installation failed, please open up the Device Manager of Windows Vista. There

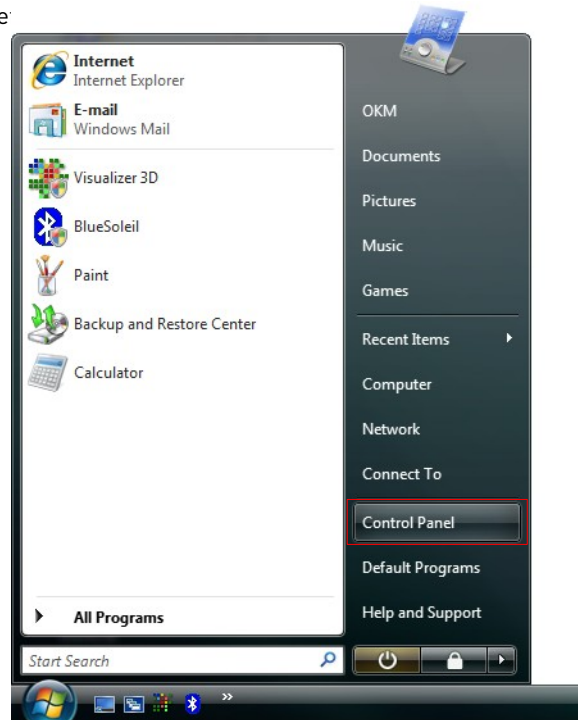


Figure 2.17: Update USB drivers on Windows Vista, Step 1

At the next screen, shown in figure 2.18, select **View hardware and devices** which can be found on the bottom of the left sidebar.

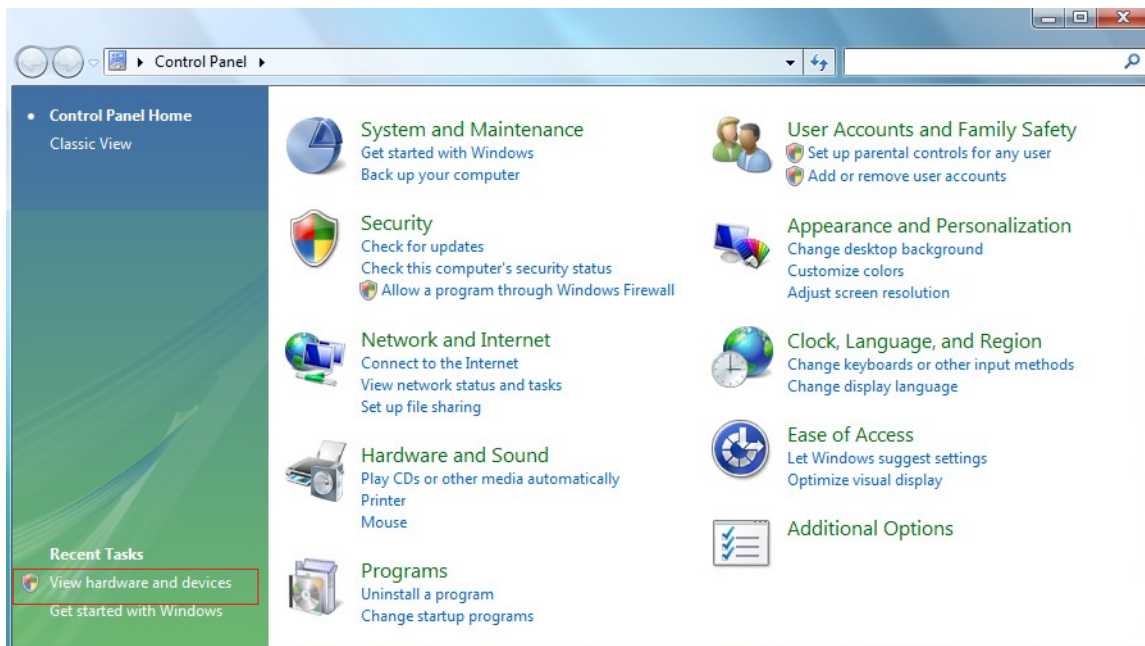


Figure 2.18: Update USB drivers on Windows Vista, Step 2

In the Device Manager (see figure 2.29) there will be a device under *Other devices* with a yellow warning symbol to indicate a problem i.e. no driver installed. If the drivers has been installed already it will show up under *Universal Serial Port Controllers*. The text next to this device will depend on the device attached. In this example the device was an eXp

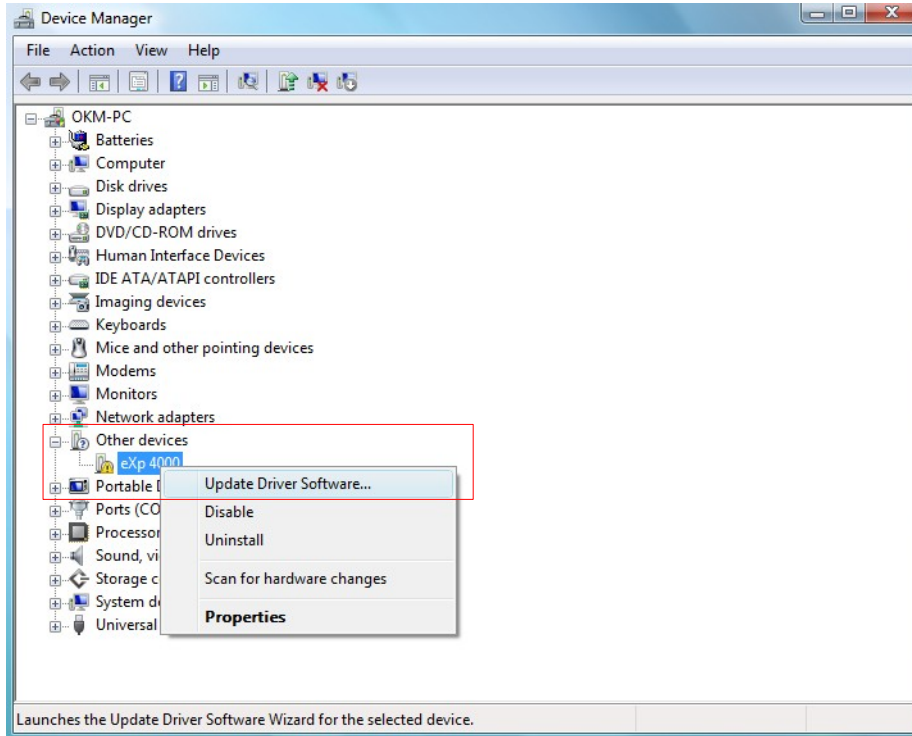


Figure 2.19: Update USB drivers on Windows Vista, Step 3

4500 device. Right click on the device (eXp 4500 in this example) to bring up a menu as shown below.

From the displayed menu select **Update Driver Software...** which then displays the option for an automatic or manual search. Select the second option to browse manually.

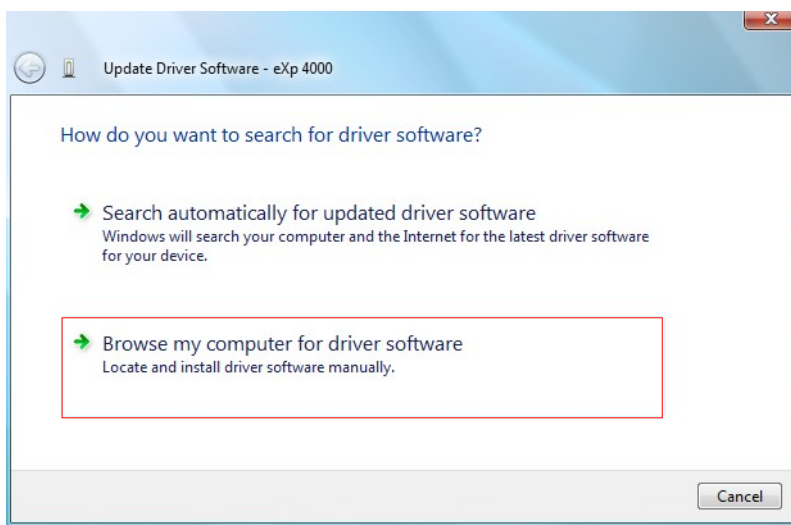


Figure 2.20: Update USB drivers on Windows Vista, Step 4

In the address box put the exact location where the drivers have been saved to. Usually this may be your software CD or a folder on the PC if you downloaded the drivers from our website. It is not necessarily the exact same location as shown in the screenshot of figure 2.32.

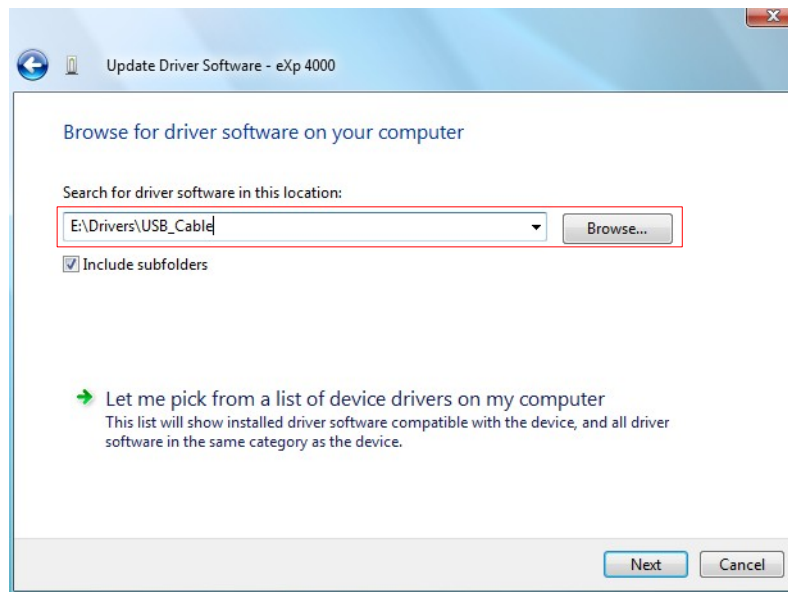


Figure 2.21: Update USB drivers on Windows Vista, Step 5

After entering the drivers location select **Next** to start the installation.

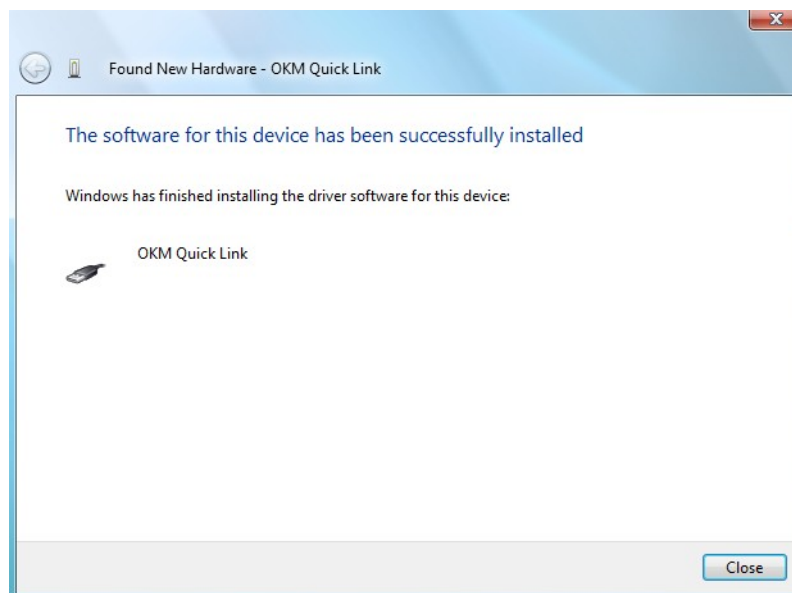


Figure 2.22: Update USB drivers on Windows Vista, Step 6

When the installation has finished the completion screen from figure 2.31 is displayed. Press **Close** to close this window and go back to the Device Manager.



The Device Manager will now show a device under *Universal Serial Bus Controllers* indicated in the screenshot below as *OKM Quick Link*.

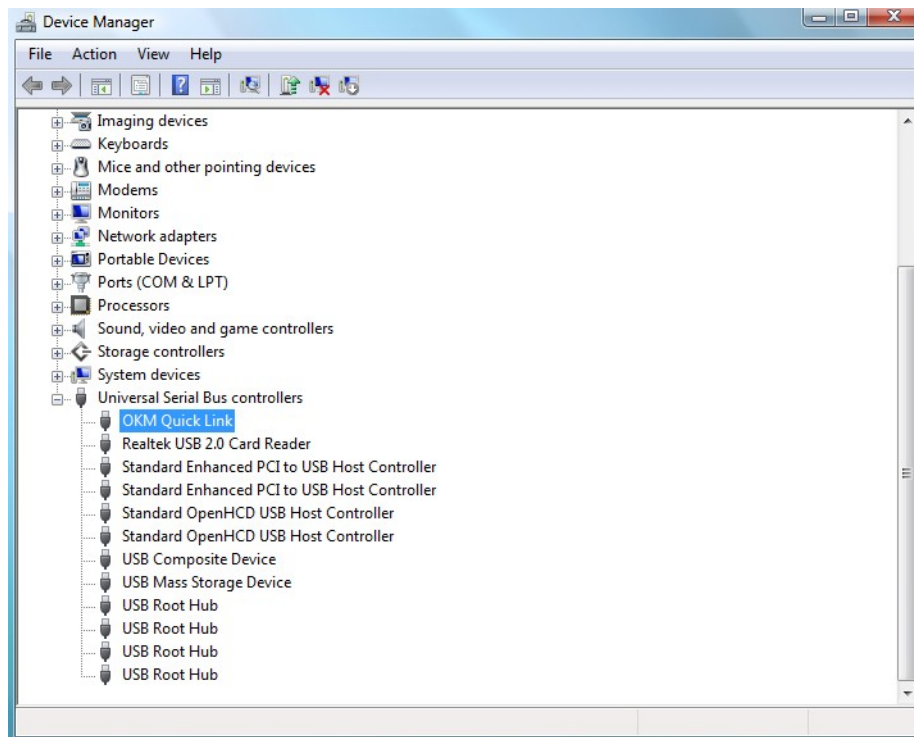


Figure 2.23: Update USB drivers on Windows Vista, Step 7

The USB drivers are correctly updated/installed now and you can close the Device Manager window.

### 2.2.3 Uninstall USB drivers on Windows Vista

If you need to delete the USB drivers from your Windows Vista operating system, please open up the Device Manager as described in the previous subsection.

Installed devices can be removed using the Device Manager by simply right-clicking on the mouse and selecting **Uninstall**. This will delete the associated registry entries for that device only.

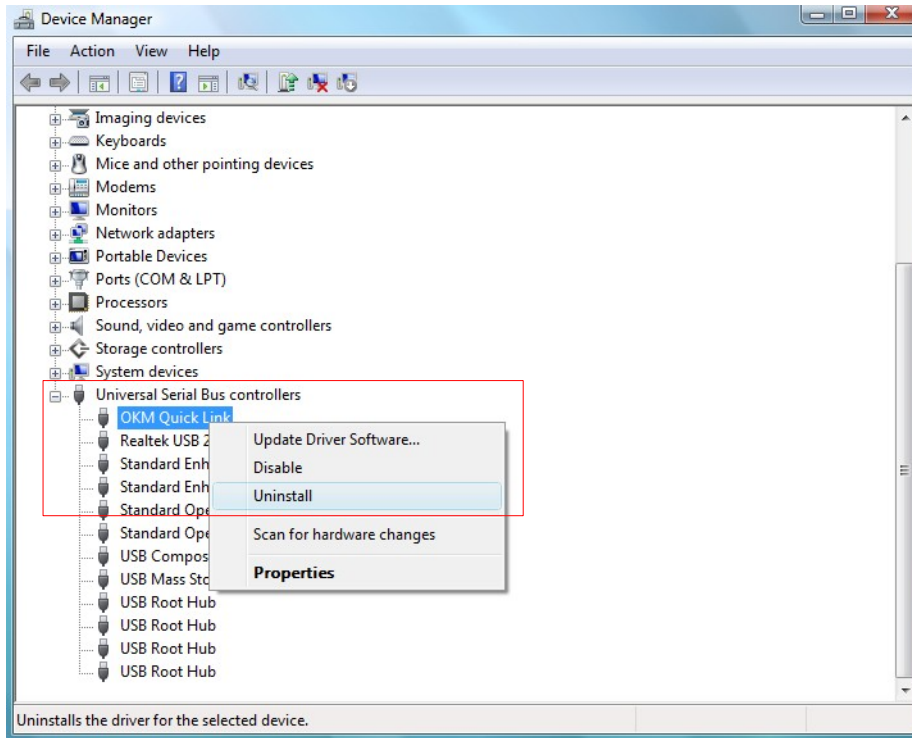


Figure 2.24: Uninstall USB drivers on Windows Vista, Step 1

Windows Vista provides an automatic method to delete driver files via check box "Delete the driver software for this device" on the uninstall dialog box. Just mark the check box and click **OK** to remove the installed USB drivers of your device.



Figure 2.25: Uninstall USB drivers on Windows Vista, Step 2

## 2.3 Windows 7 and later

The instructions in this section are only valid for the Windows 7 operating system.

### 2.3.1 Install USB drivers on Windows 7 and later

The installation of the USB drivers on Windows 7 is a little bit different as known from previous Windows versions. Connect the device to a spare USB port on your PC and make sure everything is switched on. Windows 7 is now trying to install the latest USB drivers and displays the message from figure 2.26.

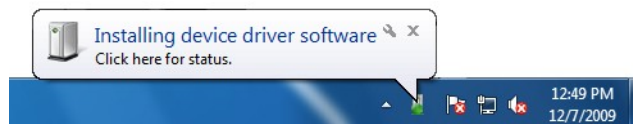


Figure 2.26: Install USB drivers on Windows 7 - Step 1

Shortly after this Windows 7 will bring up a new message as shown in figure 2.27 to inform you about the fact that it could not install any drivers for your device successfully.

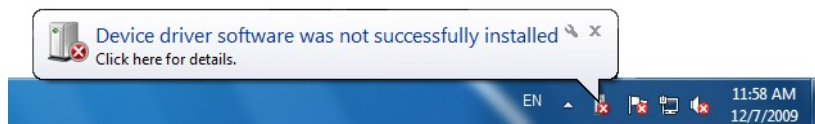


Figure 2.27: Install USB drivers on Windows 7 - Step 2

Press the Windows 7 start button to bring up the start menu and select **Control Panel** as shown in figure 2.1.

This will open up the control panel window as shown in figure 2.19. From the control panel window you have to select

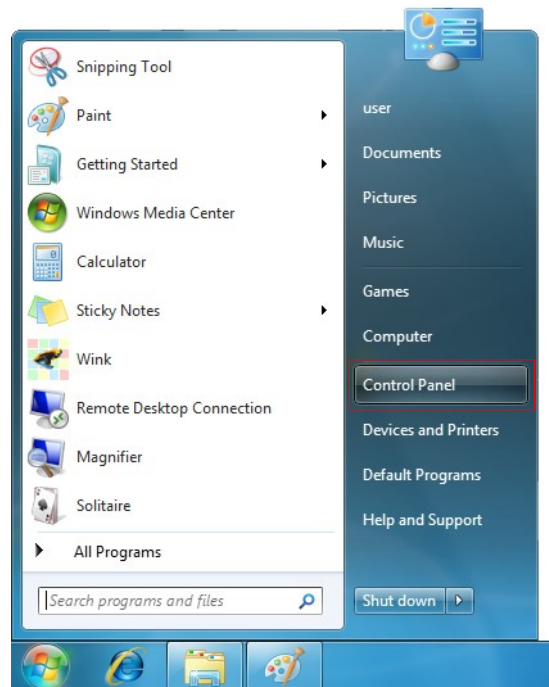


Figure 2.28: Install USB drivers on Windows 7 - Step 3

**Hardware and Sound.**

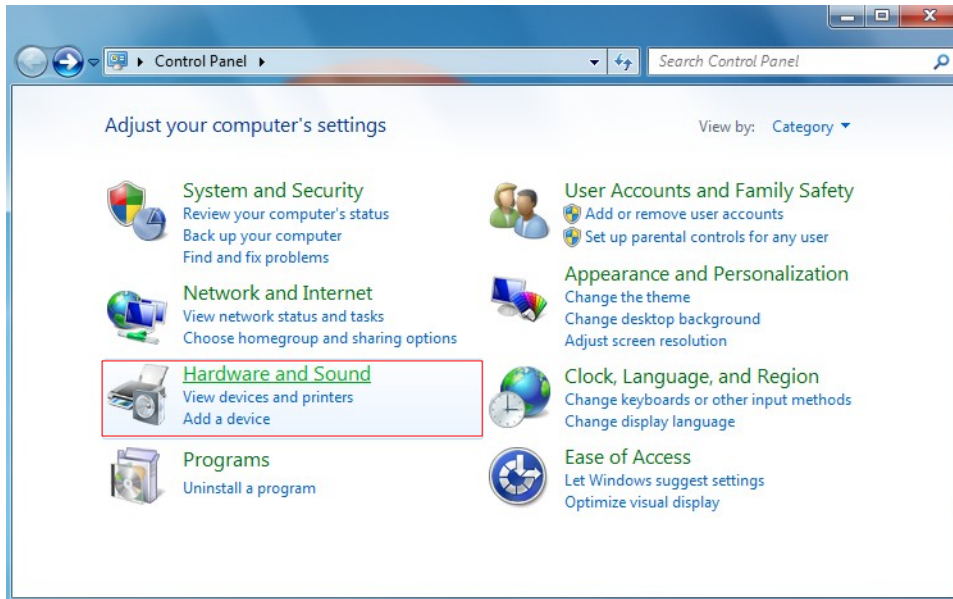


Figure 2.29: Install USB drivers on Windows 7 - Step 4

At the next screen, shown in figure 2.20, select **Device Manager** which can be found under *Devices and Printers*.

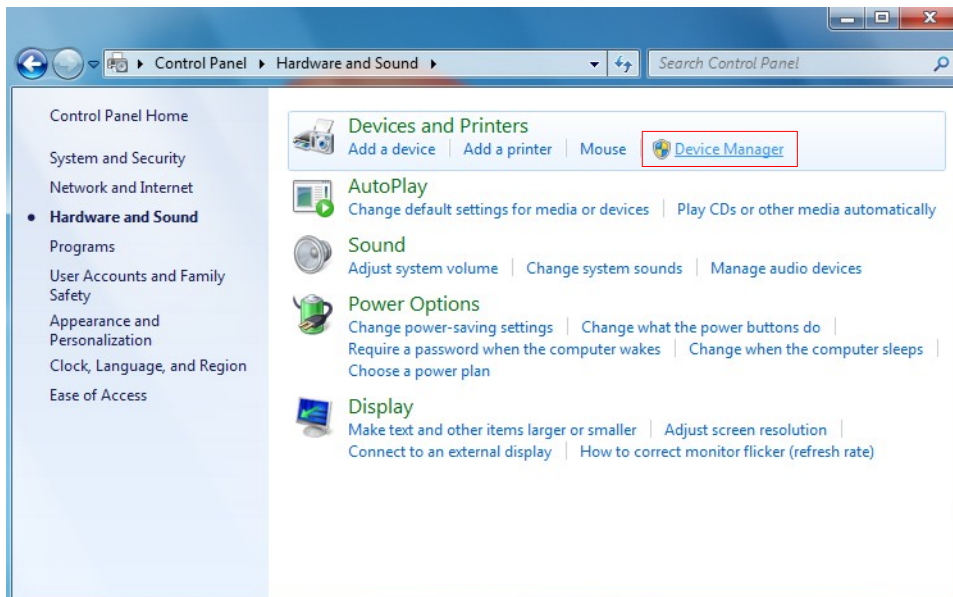


Figure 2.30: Install USB drivers on Windows 7 - Step 5

In the Device Manager (see figure 2.29) there will be a device under *Other devices* with a yellow warning symbol to indicate a problem i.e. no driver installed. The text next to this device will depend on the device attached. In this example the device was an eXp 4500 device. Right click on the other device (eXp 4500 in this example) to bring up a menu as shown below.

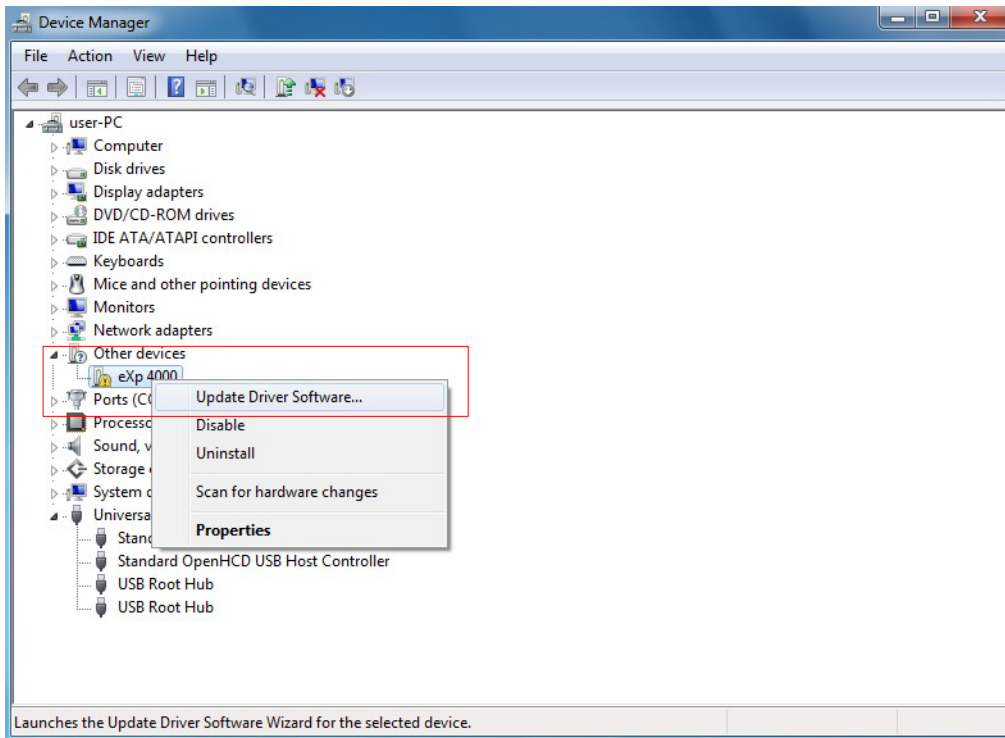


Figure 2.31: Install USB drivers on Windows 7 - Step 6

From the displayed menu select **Update Driver Software...** which then displays the option for an automatic or manual search. Select the second option to browse manually.

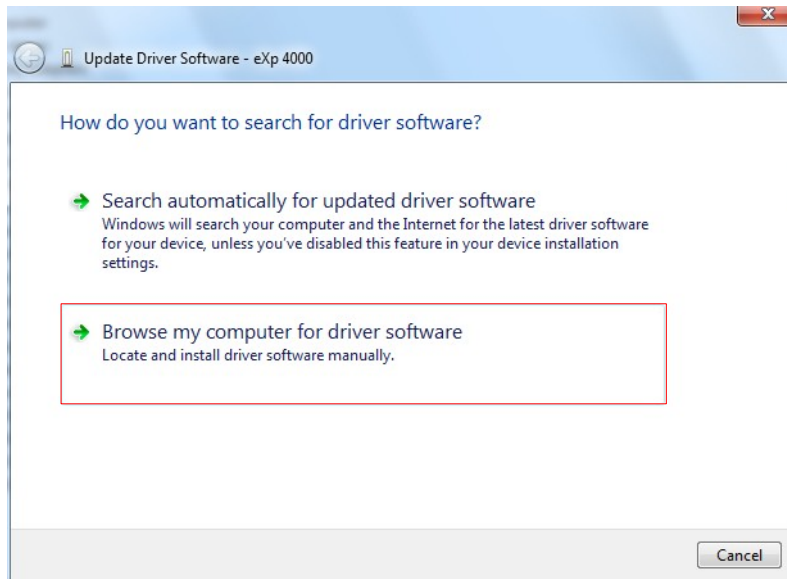


Figure 2.32: Install USB drivers on Windows 7 - Step 7

In the address box put the exact location where the drivers have been saved to. Usually this may be your software CD or a folder on the PC if you downloaded the drivers from our website. It is not necessarily the exact same location as shown in the screenshot of figure 2.30.

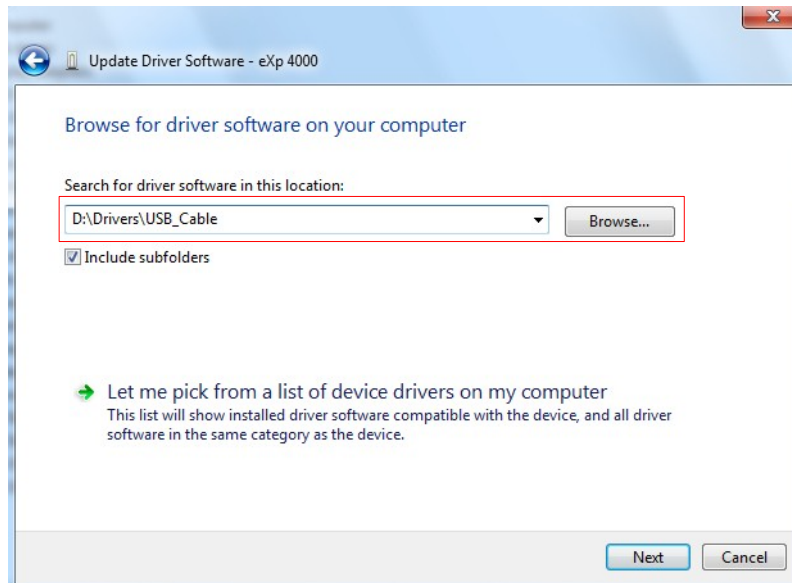


Figure 2.33: Install USB drivers on Windows 7 - Step 8

After entering the drivers location select **Next** to start the installation.

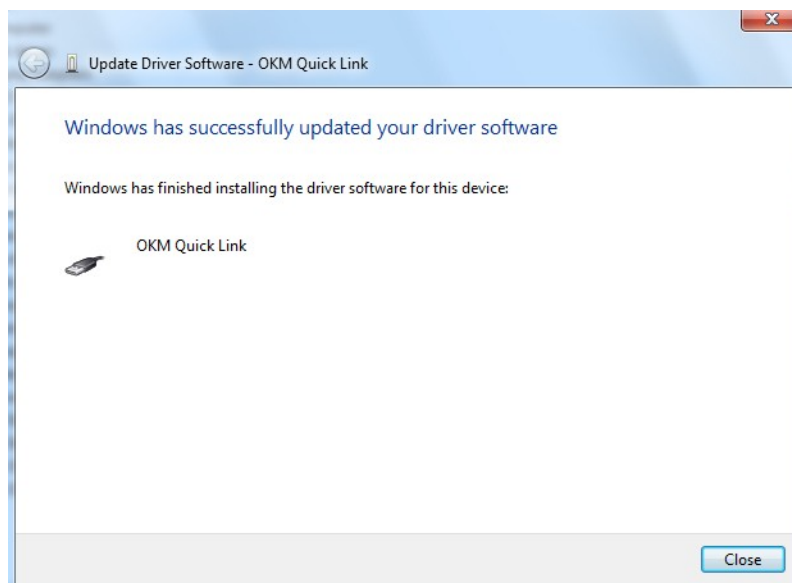


Figure 2.34: Install USB drivers on Windows 7 - Step 9

When the installation has finished the completion screen from figure 2.28 is displayed. Press **Close** to close this window and go back to the Device Manager.

The Device Manager will now show a device under *Universal Serial Bus Controllers* indicated in the screenshot below as *OKM Quick Link*.

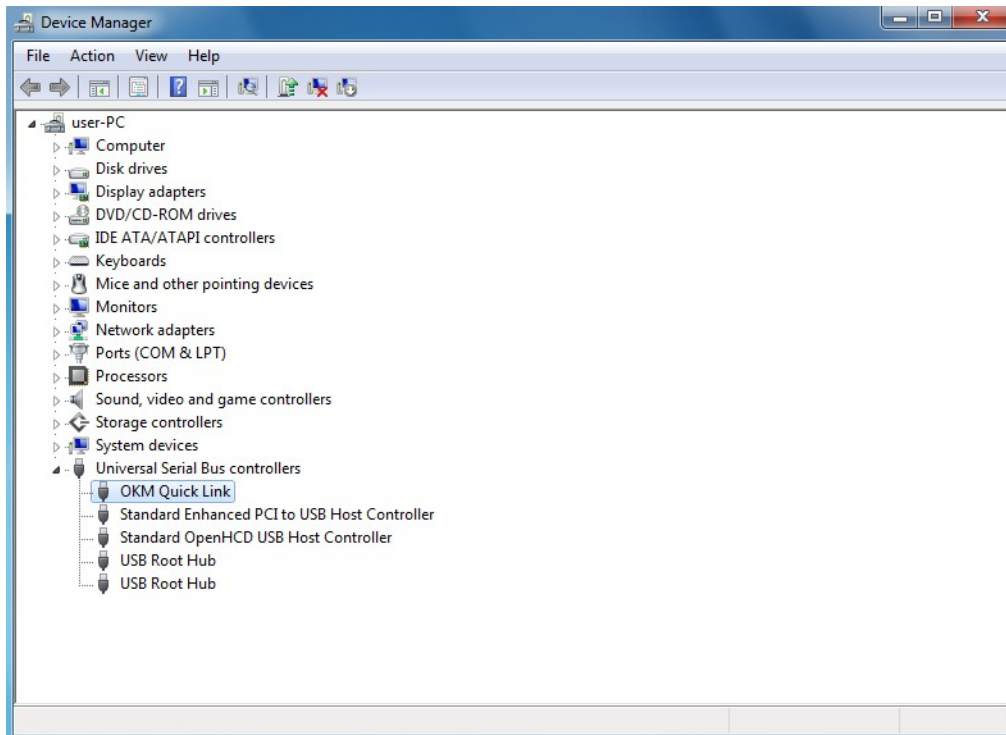


Figure 2.35: Install USB drivers on Windows 7 - Step 10

The USB drivers are correctly installed now and you can close the Device Manager window.



### 2.3.2 Uninstall USB drivers on Windows 7 and later

If you need to delete the USB drivers from your Windows 7 operating system, please open up the Device Manager as described in the previous subsection.

Installed devices can be removed using the Device Manager by simply right-clicking on the mouse and selecting **Uninstall**. This will delete the associated registry entries for that device only.

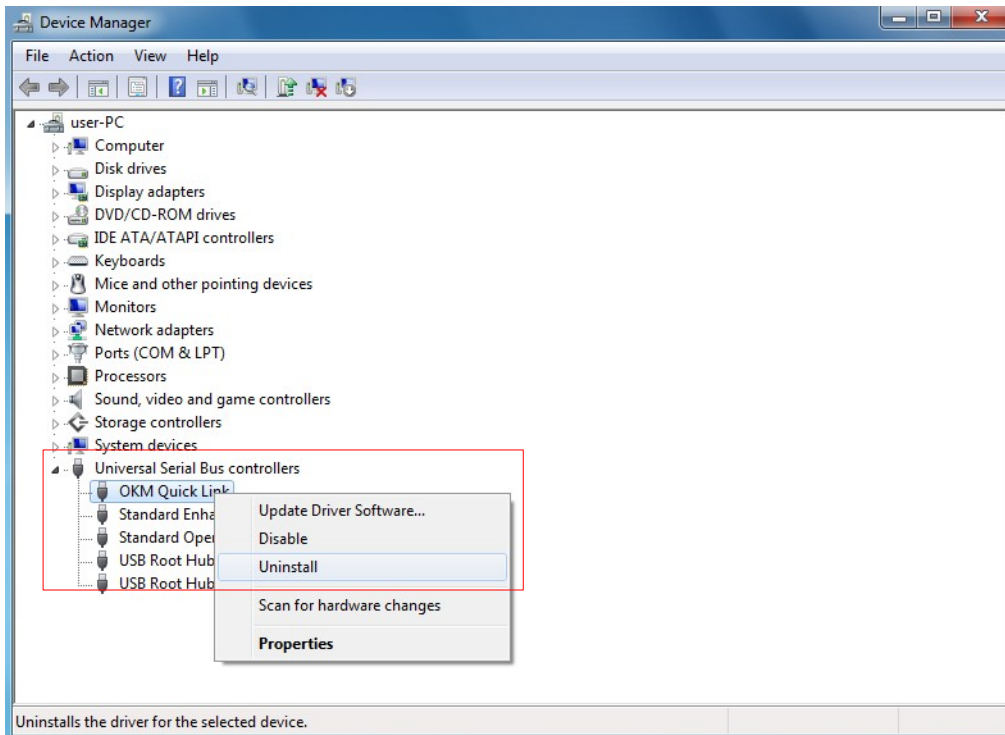


Figure 2.36: Uninstall USB drivers on Windows 7 - Step 1

Windows 7 provides an automatic method to delete driver files via check box "Delete the driver software for this device" on the uninstall dialog box. Just mark the check box and click **OK** to remove the installed USB drivers of your device.



Figure 2.37: Uninstall USB drivers on Windows 7 - Step 2



# CHAPTER 3

## Technical Specifications

### 3.1 eXp 4500 Control Unit

Dimensions (H x W x D) .....	70 x 140 x 300 mm
Weight .....	about 1530 g
Voltage .....	12 - 14.4 VDC, 22 W maximal
Safety Class .....	IP40
Operating Time (full charged Power Pack, 25 °C) .....	about 3 hours
Operating Temperature .....	0 °C – 40 °C
Display .....	1000 mcd Background lighting, 6.5" Diagonal, 640 x 480 Pixel TFT, Color, Anti-Glare
Computer .....	AMD-GX, Dual-Core 1 GHz Processor, GPU 300 MHz
Working Memory (RAM) .....	2 GB
Data Memory .....	8 GB
Feedback .....	acoustic, visual
Storage temperature .....	-20 °C – 60 °C
Air humidity .....	5 % – 75 %
Waterproof .....	No
Data Transmission Technology .....	USB
Maximal Data Transmission Rate .....	115200 Baud

### 3.2 Computer, Minimum Requirements (not included)

Processor .....	minimum 1.5 GHz
CD-ROM Drive .....	minimum 4x
Port (Data Transmission) .....	USB
Free Memory .....	minimum 50 MB
Working Memory (RAM) .....	minimum 256 MB
Graphic Card .....	minimum 128 MB, OpenGL-compatible
Operating System .....	Windows XP, Windows Vista, Windows 7, Windows 8, Windows 10

### 3.3 Super Sensor

Length .....	100 cm
Weight .....	about 770 g
Receiver .....	Dual / Hi-Gain – Vertical - Geophysical Phase Reader – EMSR
Sensor technology .....	TCFX-01-A

### 3.4 GPR 25 cm

Length ..... 25 cm  
 Weight ..... about 400 g  
 Receiver ..... Dual Geophysical Phase Reader – EMSR  
 Sensor technology ..... TCFX-01-A

### 3.5 GPR 50 cm

Length ..... 50 cm  
 Weight ..... about 490 g  
 Receiver ..... Dual Geophysical Phase Reader – EMSR  
 Sensor technology ..... TCFX-01-A

### 3.6 GPR 75 cm

Length ..... 75 cm  
 Weight ..... about 620 g  
 Receiver ..... Dual Geophysical Phase Reader – EMSR  
 Sensor technology ..... TCFX-01-A

### 3.7 GPR 100 cm

Length ..... 100 cm  
 Weight ..... about 750 g  
 Receiver ..... Dual Geophysical Phase Reader – EMSR  
 Sensor technology ..... TCFX-01-A

### 3.8 Tunnel Sensor

Length ..... 50 cm  
 Weight ..... about 520 g  
 Receiver ..... Dual Geophysical Phase Reader – EMSR  
 Sensor technology ..... TCFX-01-A

# CHAPTER 4

## 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.

	Light	Professional	Professional Plus
eXp 4500 Control unit incl. carrying strap	1	1	1
Wireless Headphones	1	1	1
Super Sensor	1	1	1
Power Pack with charger and travel adapter	1	2	2
Carrying case	1	1	2
3D Software (Visualizer 3D)	1	1	1
USB cable	1	1	1
Joystick	1	1	1
User's manual	1	1	1
Telescopic rod assembly for GPR antenna	optional	1	1
GPR antenna 50 cm	optional	1	1
GPR antenna 25 cm	optional	optional	1
GPR antenna 75 cm	optional	optional	1
GPR antenna 100 cm	optional	optional	1
Tunnel Sensor	optional	optional	1

Table 1: Scope of delivery

# CHAPTER 5

## Control Elements

In this section you will learn more about the fundamental use of all control elements for the eXp 4500 measuring instrument. All connections, inputs and outputs are explained in detail.

## 5.1 Overview of the eXp 4500

The key components to the eXp 4500 are shown below.



Figure 5.1: Control unit with standard GPR probe and Super Sensor

Horizontal antennas like the GPR antennas require the Telescopic rod assembly whereas vertical probes like the Super Sensor can simply be held in your hand.

## 5.2 Control Unit

The control unit is the processing center of the eXp 4500. Via the control unit, various functions can be selected, all measured values can be recorded and stored.

### 5.2.1 Front View

Figure 5.2 shows the front side of the control unit with its control elements.



Figure 5.2: Control unit, front view

Via **display** you can see the navigation menu and all recorded scans.

All functions are controlled by the **Multifunction Control Knob**. To operate the device, turn the knob to the desired function and push the knob to select.

The **Power switch** is used to power on the device. Before using the unit, connect the external Power Pack and turn it on.

Never switch off the device by simply turning off the Power Pack. Read chapter 7.8 "Exit" on page 69 to get information about shutting down your unit.



## 5.2.2 Rear View

Figure 5.3 shows the rear view of the control unit and its connections.

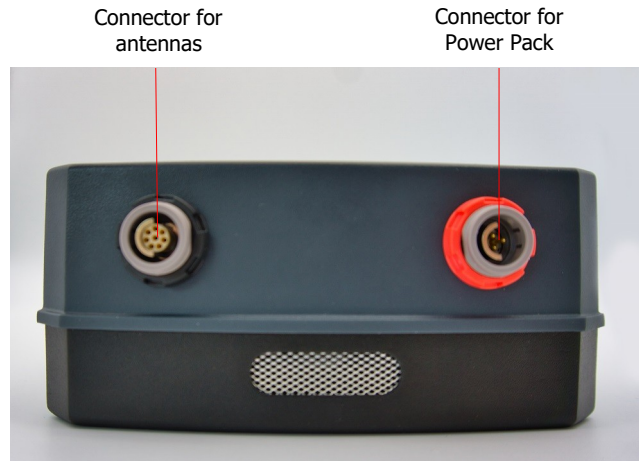


Figure 5.3: Control unit, front view

The **connector for Power Pack** is used to connect the Power Pack. Align the marking points on the Power Pack connector with the marking points on the device to insert the plug. Red connector to Red plug.

The **connector for antennas** is used to connect all the probes. Align the marking points on the probe connector with the marking points on the device to insert the plug. Black connector to Black plug.

## 5.2.3 Side View

Figure 5.4 shows the side view of the control unit and its connections.



Figure 5.4: Side View of eXp 4500

Via the **connector for USB cable** the device can be connected to a computer via the USB cable. This is necessary to transfer data from the device to a computer.

# CHAPTER 6

## Assembly

This section explains how to assemble the eXp 4500 and to prepare the unit for operation.

Before using the eXp 4500 for a field measurement, we recommend to take note of the following steps.



Figure 6.1: Connection of probe

### Step 1

Connect the probe which you would like to use to the control unit. Regardless of which probe you are using, you will always use the same plug for each probe.

You can only use one probe at a time for one measurement.

When establishing the connections, remember to align the plug with the Black end to the Connector also with Black. The same is for the Power Pack, it has a red color on the control unit and a red connector.



Figure 6.2: Connection of Power Pack

### Step 2

Now you can connect the Power Pack to the control unit. After powering on the Power Pack you can put it in your pocket.

Now power on the device by using the Power Switch.



Figure 6.3: Connection of Joystick

### Step 3

If you are going to conduct a scan in „Manual“ mode, plug in the joystick to the control unit.

If the Joystick is not available, the Power Switch can also be used. Simply press the Power Switch to execute the measurement.

# CHAPTER 7

## Operating Modes

In this section you will learn more about the different operating modes of the eXp 4500. Every function is explained in its proper subsection.

Selecting the correct operating mode depends primarily on the desired output. So for example there are some functions which have to be used for an initial first measurement in an unknown area to get a general overview, whereas others are more suitable for a more detailed search and analysis with a special processing software program.

The eXp 4500 has the following primary operating modes:

- **Ground Scan**  
Measurement with graphical evaluation, whereby measured data can be stored in the internal memory of the device for later review.
- **Pinpointer**  
Tool used to give the exact position of the detected anomaly.
- **Magnetometer**  
Search an area with the integrated magnetometer.
- **Tunnel Scan**  
Ground measurement to detect tunnels, voids and other cavernous anomalies.
- **Mineral Scan**  
Ground measurement for the detection of naturally occurring mineralization.
- **Browse Scans**  
Review your stored scan data – ordered by scan mode.
- **Settings**  
Change language, date, time, volume and further settings.
- **Exit**  
Power off the device and shut down the integrated PC module.

Select and confirm your desired operating mode via the multifunction control knob.

## 7.1 Ground Scan

This operating mode allows to do measurements with a graphical representation. This mode can be used with all antennas. To view previously stored scan data, go to the menu item *Browse Scans*.

The Ground Scan mode is a primary function. The mode allows to find targets and locate areas of disturbed soils. When something is buried, the person who buried the object had to dig a hole. Hence, look for the disturbance in the soil at first. If a hole was dug 1.5 m (4.5 ft) deep, after a couple of years the hole will appear to be about 2 m (6 ft) in diameter at the surface. Start with a scan that has an impulse approximately every 30 to 60 cm (1 to 2 ft) forward and to the sides. Do not go too detailed on the first scans until you have a possible anomaly. Look for the holes: Usually, if you do not detect holes, you could be looking at mineralization.

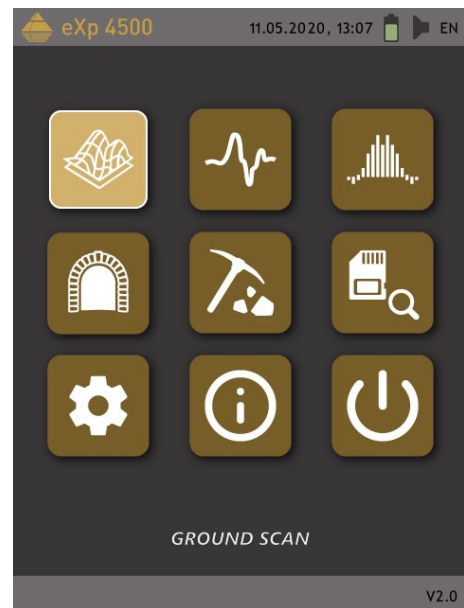


Figure 7.1: Ground Scan

### 7.1.1 New Ground Scan

After selecting the operating mode you are asked to adjust certain settings. There are different parameters which influence the measurement. In figure 7.2 you can see the corresponding sub-menu.

Modify the following parameters (the underlined values correspond to the setting made by the factory):

- **Field Length (Auto, 5 m, 10 m ..., 50 m)**

Number of measured values per search line (the eXp 4500 uses 6 impulses per meter). If you select "Auto", the number of impulses can be adapted to the current length of your search line. During the first line the device will read values regularly without stopping. When you want to finish your first line you, have to depress the multifunction control knob to stop the measuring process of the current line. The device will store the number of impulses and use it for all further scan lines on the same scan. By selecting the value 5 m, 10 m, 20 m, ..., or 50 m you can preset the distance or the number of impulses you need in one measured line.

- **Impulse Mode (Automatic, Manual)**

This is the mode that determines how the measurement points will be recorded. Automatically or Manually. For the smooth and flat terrain, most use the Automatic Mode, for rough terrain the Manual Mode can be used.

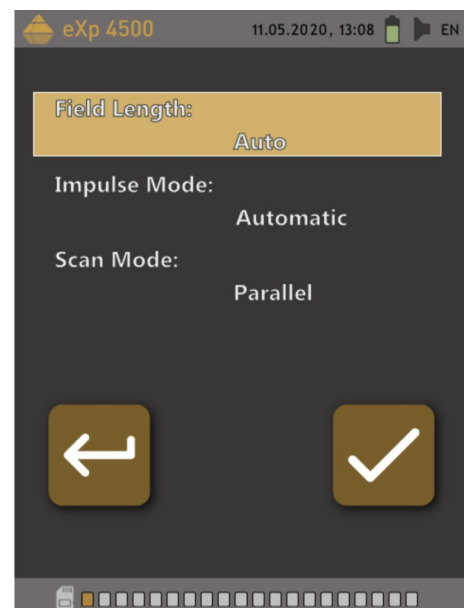


Figure 7.2: Ground Scan – Parameter

- In the Automatic mode, the eXp 4500 will take the measurements automatically as predetermined in the "Field Length" selection.
- In the Manual mode, the eXp 4500 will record a measurement point only when using the Joystick or by depressing the Power Switch. The eXp 4500 uses 6 impulses per meter.

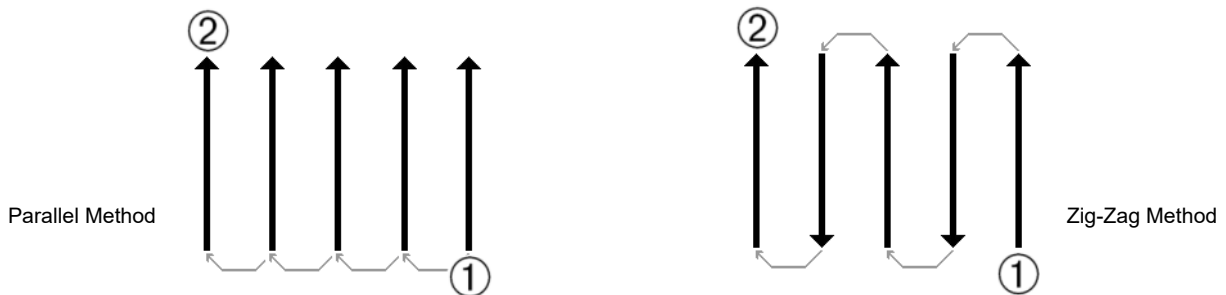


Figure 7.3: Parallel or Zig-Zag

- **Scan Mode (Parallel, Zig-Zag)**

Scan Mode defines the method of scanning an area. In the Parallel mode a measurement starts always from the starting line (recommended), whereas in the Zig-Zag mode measurements starts at the end of the line which was scanned before, like represented in figure 7.3. In the last scanning method (Zig-Zag) you have to take care not to change the orientation of the antenna, which means if the arrow on the probe is pointing to the north, for example, it must remain in that direction for every measured line. Rotating the probe will create an error.

Select the parameter, which you want to change with the multifunction control knob, until it is highlighted. Now depress the knob. The marking will change, so that only the current value is highlighted as shown in figure 7.4.

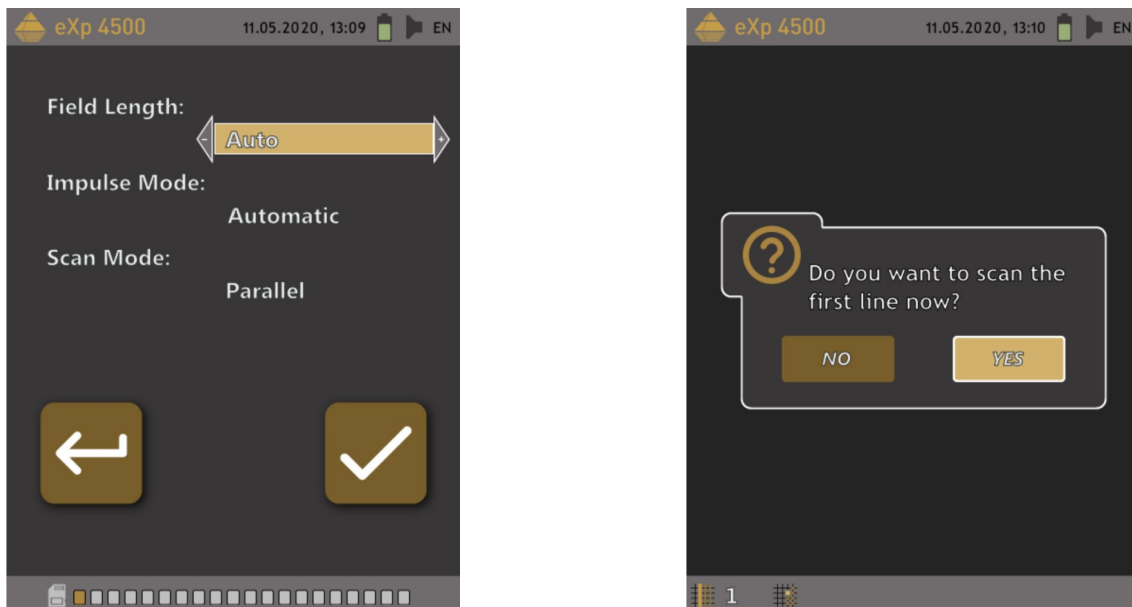


Figure 7.4: Select parameters and start first scan line

Now you can change the value of the selected parameter by rotating the multifunction control knob to the desired selection. To finish, press the knob.

Go to your start position and adjust all necessary parameters to your needs. Then you have to select the option "Start Scanning" (the tick symbol) to start the measurement. The message from figure 7.4 will appear and ask if you are ready to start your first scan line now. Rotate the multifunction control knob and select "Yes". As soon as you depress the knob, it is important to begin walking immediately since the eXp 4500 is now recording data.

As soon as your first scan line is finished, a new message will appear, where you have to select "Yes" if you want to scan another line of your field. If you select "No", you will be asked if you want to save your current scan: select "Yes" or "No" to finish the Ground Scan procedure.

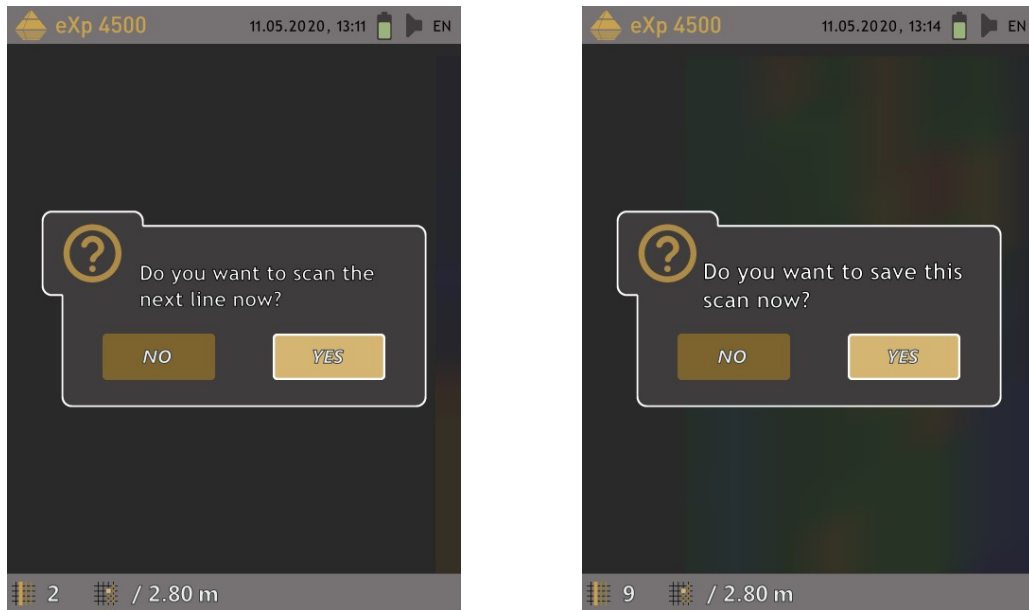


Figure 7.5: Continue with next scan line and/or save the scan

Repeat this procedure until your complete area is scanned. Learn more about how to analyze the scan in figure 7.6 :

The graphic where a target is present should primarily be a blue color for the background. The green area represents the hole in the ground. The red/orange object (in this example) is a non-ferromagnetic object that is in a hole. Metallic objects are normally represented in red for non-ferrous items, red and blue for ferrous items and blue for cavities, water reserves and earth interferences. Areas where ground mineralization is present is often shown with the full variety of colors. It is important that when doing a scan, that the objects in the ground do not move. Remember "Real Targets Don't Move!"

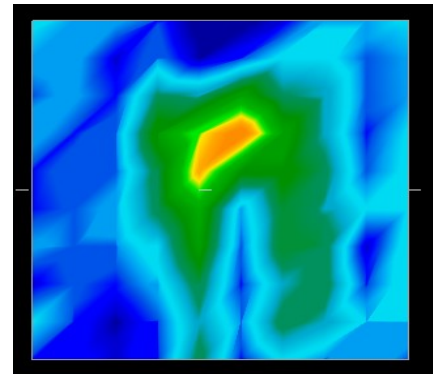


Figure 7.6: Graphical Representation of a Measurement in Operating Mode Ground Scan



## 7.2 Pinpointer

This operating mode is used to identify and give the location of buried treasure, metals and cavities. Therefore, it is necessary to connect the Super Sensor. The function can also be used over freshwater e.g. from a boat. For water operation, please contact our trainers at OKM GmbH in Germany to get more detailed instructions on proper usage.

Pinpointer mode does not require a specific manner or direction during the scan. You can walk as you wish in every direction. It is still important that the antenna always remains in the same direction. This operating mode is most effective after the detection of a possible object and allows to get details about it.



Figure 7.7: Pinpointer

You can slowly move the Super Sensor from one side to the other above the possible object. The Super Sensor should not swing and it should not be turned or pivoted. It must remain in the vertical orientation and point vertical to the ground. You might conduct a "ground balance" by turning the control knob to adjust the sensor to the current ground value.

Try to capture the complete object: That means you should measure beyond the edges of the object. Repeat this measurement a few times to get a clear signature of the object. There are 3 different signatures, from which you can recognize a specific characteristic of any target.

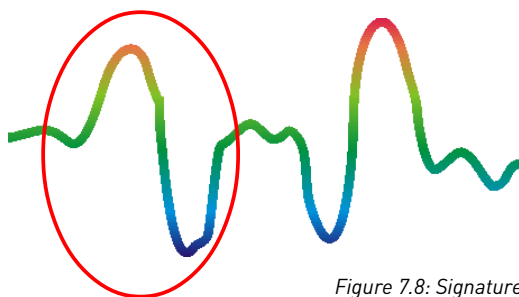


Figure 7.8: Signature of a ferromagnetic metal target

### Ferromagnetic metals

Ferromagnetic targets have a positive-negative-signature.

The figure 7.8 shows a typical signature of a ferromagnetic metal like iron. The signature includes a positive (red) and a negative (blue) amplitude. When looking closely you can see even 2 ferromagnetic signatures. The first signature starts

with a positive amplitude and the second signature starts with a negative amplitude. The order is not important, it depends on the direction of movement of the Super Sensor. If you keep moving the probe from one side to another, these 2 signatures will change continuously.

Take care that you move the Super Sensor slowly and at the same height above the ground and above a detected object to get a clear signature.

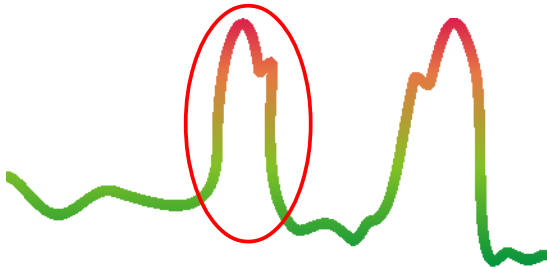


Figure 7.9: Signature of a non-ferromagnetic metal target

The figure 7.9 represents a signature of a possible non-ferrous target. You can recognize that there is only a positive amplitude (red). Also here the order of amplitude and the small peak is not important and depends on the scan direction.

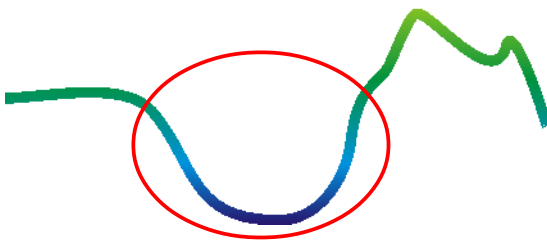


Figure 7.10: Signature of a non-metallic target

The last of the typical signatures is represented in figure 7.10. It is the signature of all non-metallic targets and structures. These can be voids, tunnels or buried plastic pipes or boxes. You can recognize that there is only a negative amplitude (blue).

#### **Non-ferromagnetic metals**

Non-ferrous targets have a pure positive signature.

#### **Non-metallic targets**

All non-metallic items have a pure negative signature.

## 7.3 Magnetometer

By selecting the Magnetometer operating mode from the main menu, you can scan the sub-surface for ferromagnetic targets and areas of the soil with a low iron content. Also, you may view the oscilloscope output on the monitor to be able to identify ferromagnetic materials in the ground.

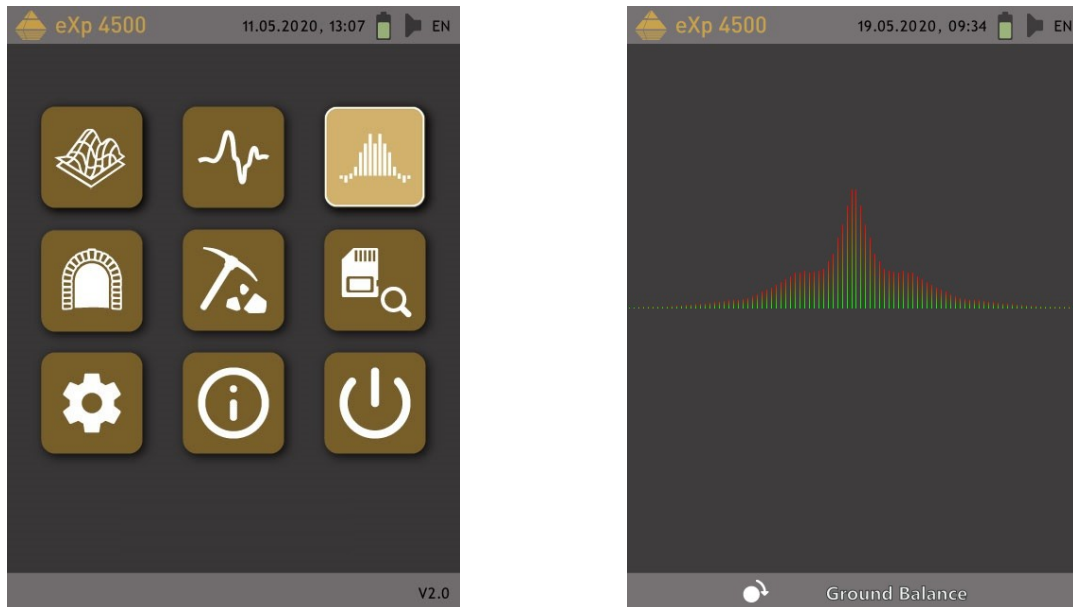


Figure 7.11: eXp 4500 Main Menu

The Magnetometer mode can be used with the Super Sensor and all the GPR antennas. After selecting the operating mode "Magnetometer", we recommend to adjust the sensor to the current ground value of the antenna location (called "ground balance") by turning the control knob. A successfully completed ground balance is indicated by a green check mark (shown for 2 seconds).

Activate the Magnetometer only above neutral soil. Afterwards, all the signals that go in the upward direction (red) are the positive magnetic poles on a ferromagnetic object and all the signals that go downward (blue) are the negative magnetic poles. When activating the Magnetometer mode, be sure that you are not above a piece of iron or metallic object, this can cause a false ground balance and produce erroneous results.

If you realize that the function was activated over a piece of metal, turn the control knob to conduct a new ground balance in a clear area of the soil.

## 7.4 Tunnel Scan

This operating mode is used to identify tunnels, voids and caverns. To use this mode, it is necessary to connect the Tunnel Sensor. If you do not have the optional Tunnel Sensor, one must be obtained prior to using this mode. This is an extremely powerful function and can assist you in identifying tunnels, voids and caverns.

### 7.4.1 New Tunnel Scan

After activating this operating mode you have the possibility to adjust the impulse mode setting.

Please refer to section “New Ground Scan” on page 49 for further explanations concerning the impulse mode setting.

Then, go to your start position and start the measurement. A message will appear and ask if you are ready to start your measurement. Select “Yes” and press the knob to start your measurement. Please note: As soon as you press the knob, it is important to begin walking immediately for the eXp 4500 is now recording data.

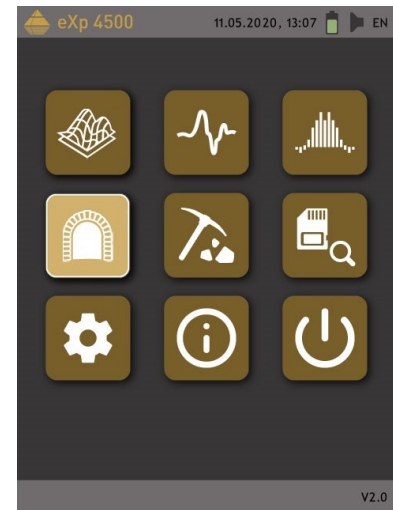


Figure 7.12: Tunnel Scan

### 7.4.2 Scan Technique

When looking for tunnels, voids or caverns below the surface, the procedure is basically the same as when looking for natural minerals. The primary difference is that the signal strength will be much stronger and the typical coloration will be a darker blue.

A tunnel signal in the Visualizer 3D software, is typically represented by a depression from the top of the scan. The software will show in many cases the curvature or the top of the tunnel, opening or void, like that in 7.13. The relative soil will still show the natural mineralization that is in the ground. Though a tunnel is normally much wider than a buried treasure, the signal strength is much lower for it is a void. The void is similar to an air pocket under the surface and other signals may mask a tunnel signal. In the event that a tunnel signal is realized, conducting the control scans is necessary for a proper analysis.

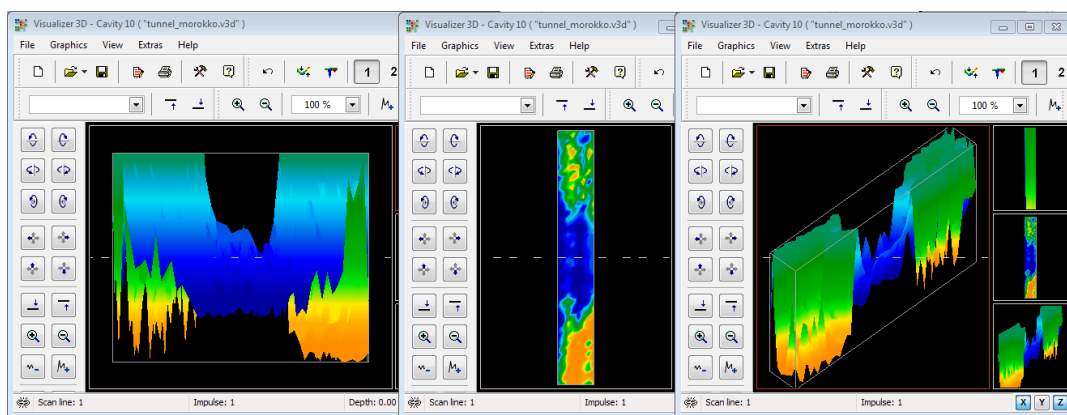


Figure 7.13: Tunnel shown in multi-line scan

In the figure above, the scan was conducted using a normal traditional ground scan with multiple scan lines. When conducting a traditional ground scan, the parallel method of scanning must be used. With the three views, one can clearly see where the tunnel is.

The figure 7.14 to the right is another example of how a tunnel may appear. Though the overall signal values are not very strong, the repeatability of the object has made it so that the form of the tunnel is easily recognized.

To best find a tunnel there are two possible scanning methods that can be used. The first scanning method is the Parallel method which is explained earlier in this manual. When using this method, the "Ground Scan" function will be used.

The second method is the Single line method. Selecting the "Tunnel Scan" will create the precedence to conduct only a single line. The scan line starts at the beginning and at the end of the line the scan can be saved into the internal memory. A multiple line scan is not possible.

It is important to set your starting point and be sure that you are walking a straight line. While walking the line it is also very important that the height of the antenna does not change. Since the Antenna for Tunnel Detection is shorter than the Super Sensor, it is important that the antenna be held in the vertical position. Do not bend over to bring the antenna closer to the ground. It is designed to be higher above the ground to eliminate some of the smaller signals that can create false anomalies within the scan.

Prior to beginning the scan, some important items that one needs to remember is:

- Create a path and be sure that it is free and clear of obstacles.
- The path must be straight. We recommend to draw a line or rope from the beginning to the end of the path.
- Be sure that during the scan the antenna is held at the same height.
- The speed or distance between impulses has to be maintained. Changing the speed results in inaccurate scans.
- Complete the control scan. A control scan is the repetition of a scan using the exact same parameters.

When all the scanning is done correctly, conducting the data analysis is much easier.

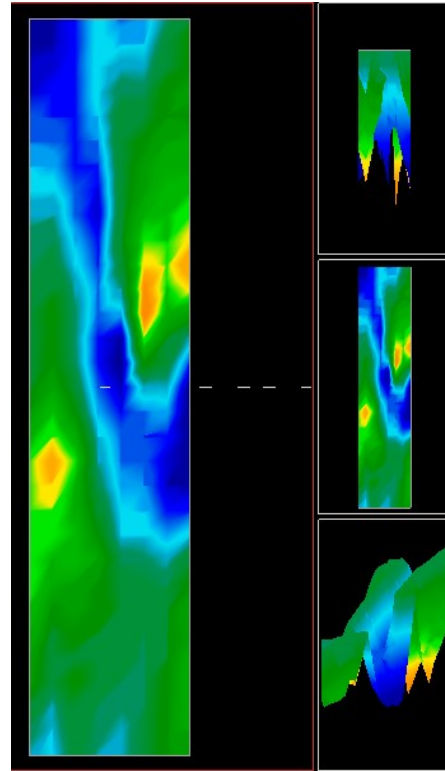
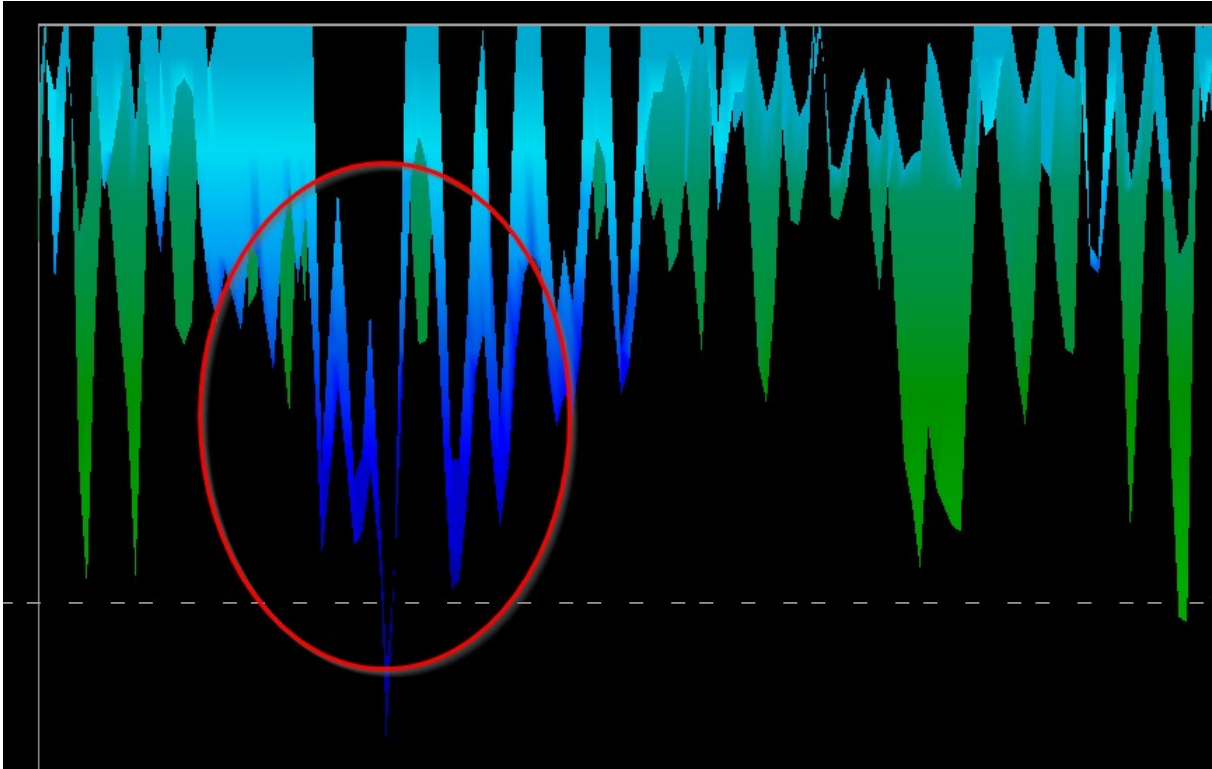


Figure 7.14: Tunnel scan in Turkey, submitted by a customer

The single line method is also a very accurate way of locating deeper voids and tunnels. When the single line method is used, the chances of making an error is greatly decreased. This method is used for an initial investigation of an area.



*Figure 7.15: Single line method used to locate tunnel*

In the example of figure 7.15, the void is circled to show the location. A scan like the one above will be repeated several times to ensure that the void is real and that it also does not move.

The repeating of the scans is also known as control scans.

A note to remember is that the bigger the tunnel opening or void is, the deeper the tunnel can be detected. If the tunnel is very small then the maximum depth will be decreased and may be difficult to find. The depth of a tunnel cannot be accurately determined. The Visualizer 3D software is designed to measure depth starting from the surface disturbance to the object itself.

## 7.5 Mineral Scan

The following procedures do not apply to those who are looking for buried treasures or a cache of items. This is only for the purpose of prospecting and locating naturally occurring mineral fields and their deposits with the OKM eXp 4500. If you are looking for buried items of great value or other man made objects that have been placed into the ground, then this function is not correct for your application. Please choose a different function that will give you the desired results.

The examples contained within this section are actual scans from actual locations and the data is derived from actual field experience. Results from your particular area may differ. As with all equipment, relevant data is dependent on the soil type in your area which may alter the final reading. Scan measurements and examples used in this supplement are derived from users located in different parts of Africa, Asia, South America and North America.

When prospecting for mineral deposits or other naturally occurring minerals or formations located in the ground, it is important to work in a clean environment, free of debris and obstacles. Debris may contaminate the area and lower the probability of success. The presence of debris may also lead to false or misleading signals. Obstacles will most likely have to be avoided. Create a path where unnecessary movement of the Super Sensor can be avoided. Additional movement of the Super Sensor may result in inaccurate data. Be sure to always work with data that can be repeated. More information under control scans at page 85.

The Visualizer 3D software or the OKM line of geophysical equipment can not identify element specific materials, minerals or items that occur naturally in the ground. It can identify and locate the presence of ferrous, non-ferrous, fracture zones and other naturally occurring anomalies. The actual detection of precious metals is based on results from various known mineral fields and mines. It is completely possible that other non-ferrous minerals may resemble or have a likeness similar to other naturally occurring minerals.

When conducting searches for fields of mineralization, it is important to identify areas of higher probability with the assistance or research of a geologist or a known geological location. Locating and prospecting in known fields or areas of higher probability will greatly increase your chances of success. Different geological formations may give different results in any particular area. If possible it is always best to start the training and/or field testing of the equipment in or on a known area to properly identify the mineral signature in the software. Different locations will have other geologic properties and may or may not be able to give an accurate reading or measurement. Varying ground features, mineralization and sub-strata may increase or decrease the receptibility of the Super Sensor.

The Visualizer 3D software will identify patches of mineralization. When conducting scans with the OKM eXp 4500, it is presumed that the user or operator is familiar with the proper operating technique.

The operating mode "Mineral Scan" should only be used with the Super Sensor. Using other antennas may result in not being able to see the finer or smaller mineral deposits.

### 7.5.1 New Mineral Scan

After activating this operating mode you have the possibility to adjust the impulse mode setting.

Please refer to section “New Ground Scan” on page 49 for further explanations concerning the impulse mode setting.

Then, go to your start position and start the measurement: A message will appear and ask if you want to start your measurement. Select “Yes” and press the knob to start the measurement. Please note: As soon as you press the knob, it is important to start walking immediately for the eXp 4500 is now recording data.

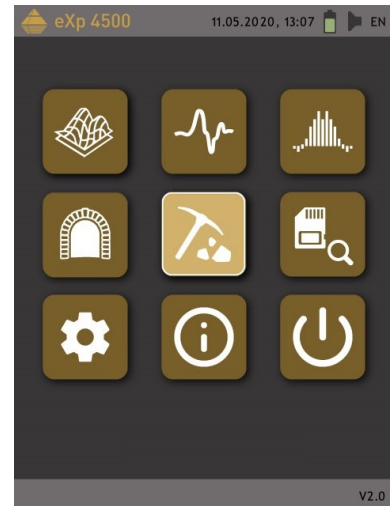


Figure 7.16: Mineral Scan

### 7.5.2 Scan Technique

The following technique applies only to the Mineral Scan mode with the Super Sensor

1. Ensure that all batteries and power packs have enough of a charge to complete the scan entirely.
2. Per the area to be prospected, ensure that you can travel the desired path without any interruptions, pauses or large obstacles (see explanation below).

The scan needs to be conducted in the following manner. Create a path where a single line can be traversed. This path needs to be a longer path, usually greater than 20 meters in length. The normal length for areas of prospection may be between 50 and 100 meters; up to 200 m long. Areas of very rough terrain will certainly be shorter.

This measurement needs to be a single line only!

Mark your starting and stopping points. Pull a line from the beginning point to the ending point to ensure that you are traveling a **STRAIGHT line!** Not walking a straight line **WILL** give you a false reading.

Use a WAAS/EGNOS/MSAS<sup>1</sup> enabled GPS with the appropriate hi-gain antenna (external or internal) to get better accuracy of your starting and stopping points. This is very important for locating the position after the data has been successfully analyzed.

3. Assemble the eXp 4500 and attach the Super Sensor.
4. Start the eXp 4500 and select “Mineral Scan” from the main menu (see figure 7.16).
5. Select either *Automatic* or *Manual* for the Impulse Mode depending on the terrain that is to be prospected. Push the multifunction control knob to verify your choice.
6. Ensure that your Super Sensor remains the SAME height above the ground and that it remains vertical during the duration of the scan. For areas of rough terrain or difficult to pass, be sure to use the Manual mode. Attempt to maintain the height between 5 cm and 10 cm (2” to 5”) above the ground with no more

<sup>1</sup> WAAS (Wide Area Augmentation System), EGNOS (European Geostationary Navigation Overlay Service) and MSAS (multifunctional Satellite Augmentation System)



than a  $\pm 5$  cm (2") variance during the scan to receive a good measurement (changing the height of the Super Sensor may give you a false reading).

7. At the end of the scan push the multifunction control knob to stop your scan (be careful to not shake the Super Sensor when pushing the button to start or stop for it can have a negative effect on the scan).
8. The dialog window "Do you want to save this scan now?" will appear. Select "Yes" to save the scan and "No" to end the scan without saving.

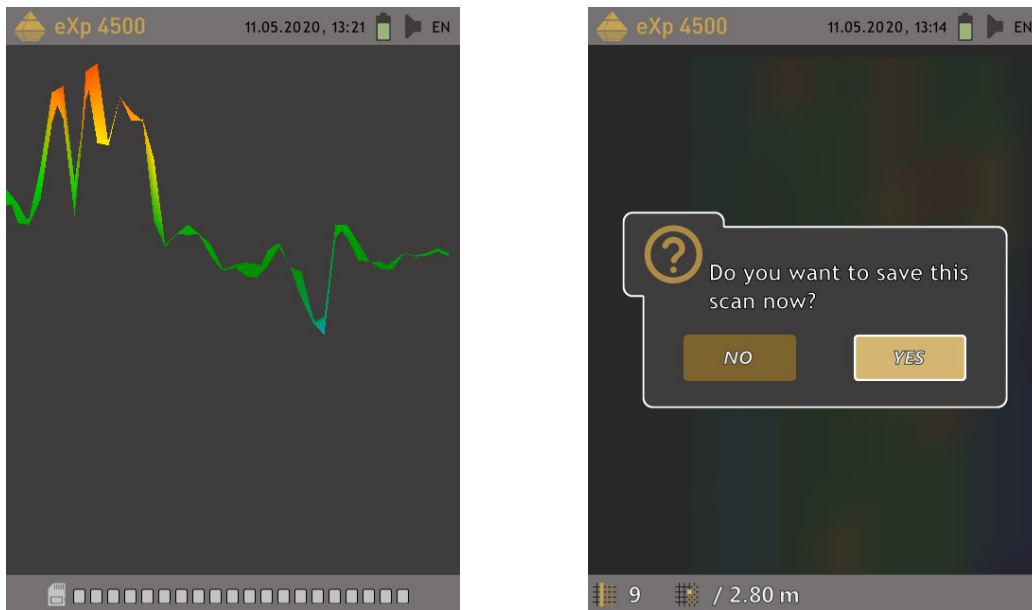


Figure 7.17: Save completed Mineral Scan

Though you will be able to see the scan on the eXp 4500 monitor, it is recommended to complete the analysis on the PC via Visualizer 3D. This software will give you more tools to identify mineral deposits in detail.

**It is very important to conduct Control Scans!**

### 7.5.3 Scan Analysis

After transferring the scan images to your computer, you will now see a scan that is a straight line. This scan is now ready to begin the analysis.

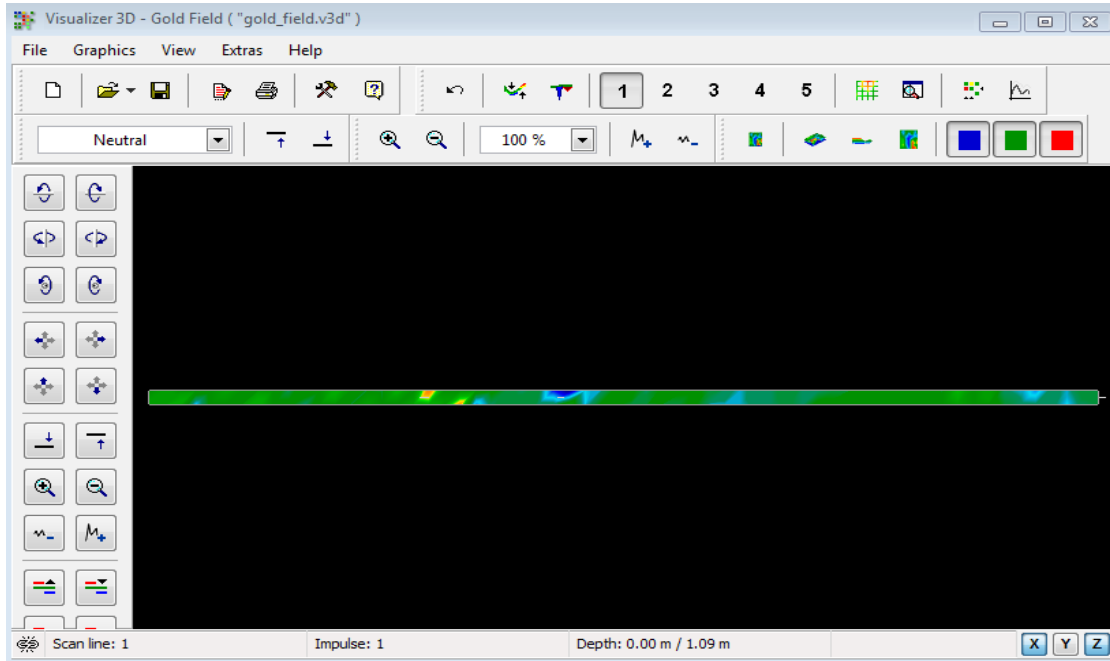


Figure 7.18: Visualizer 3D Screen shot

To see the differences within the scan rotate it to the side.

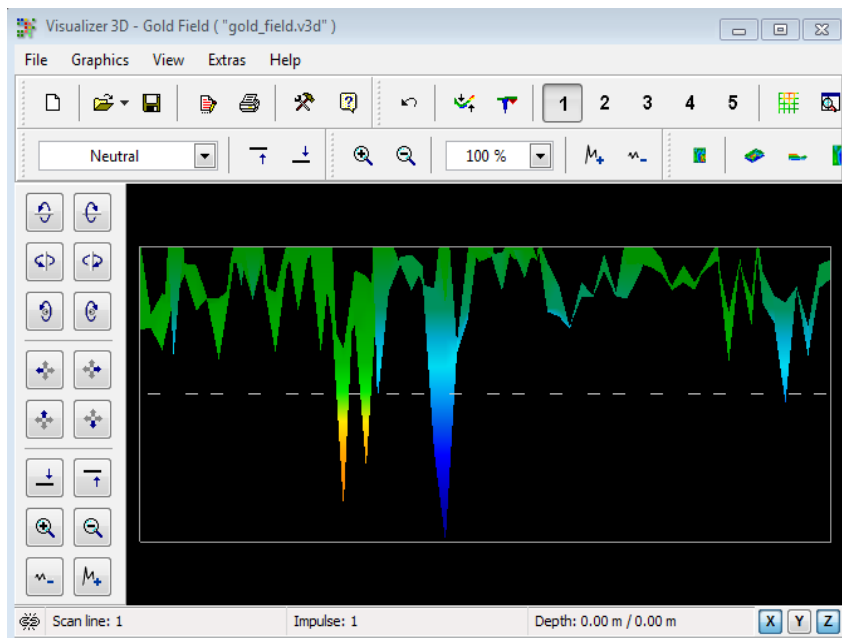
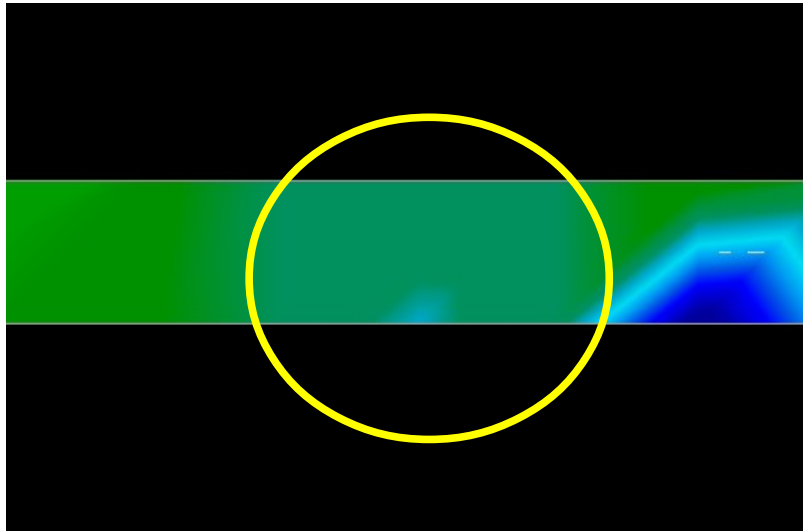
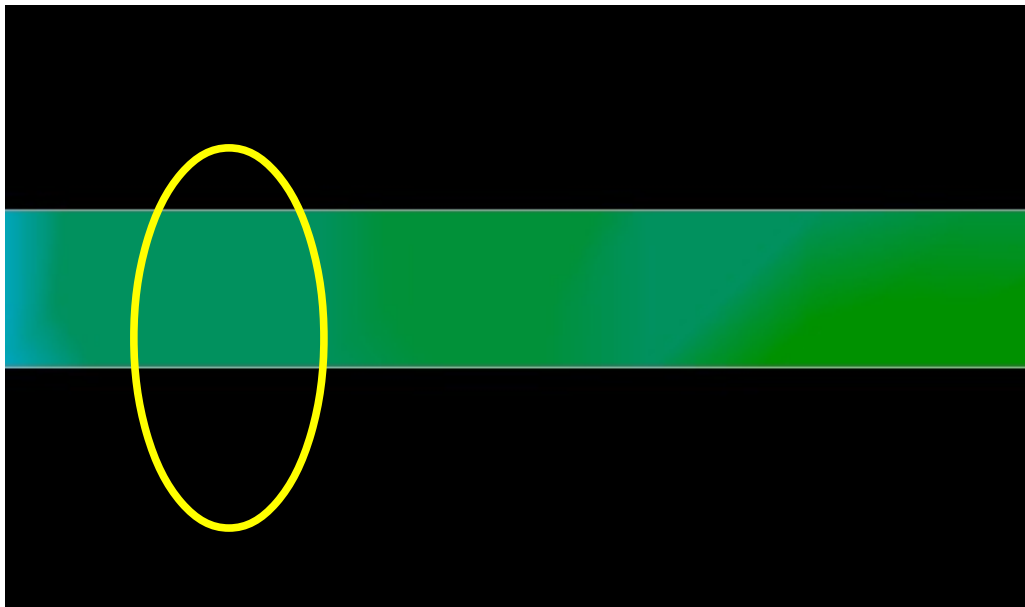


Figure 7.19: Side View of Scan Area



*Figure 7.20: Natural Mineral Field*

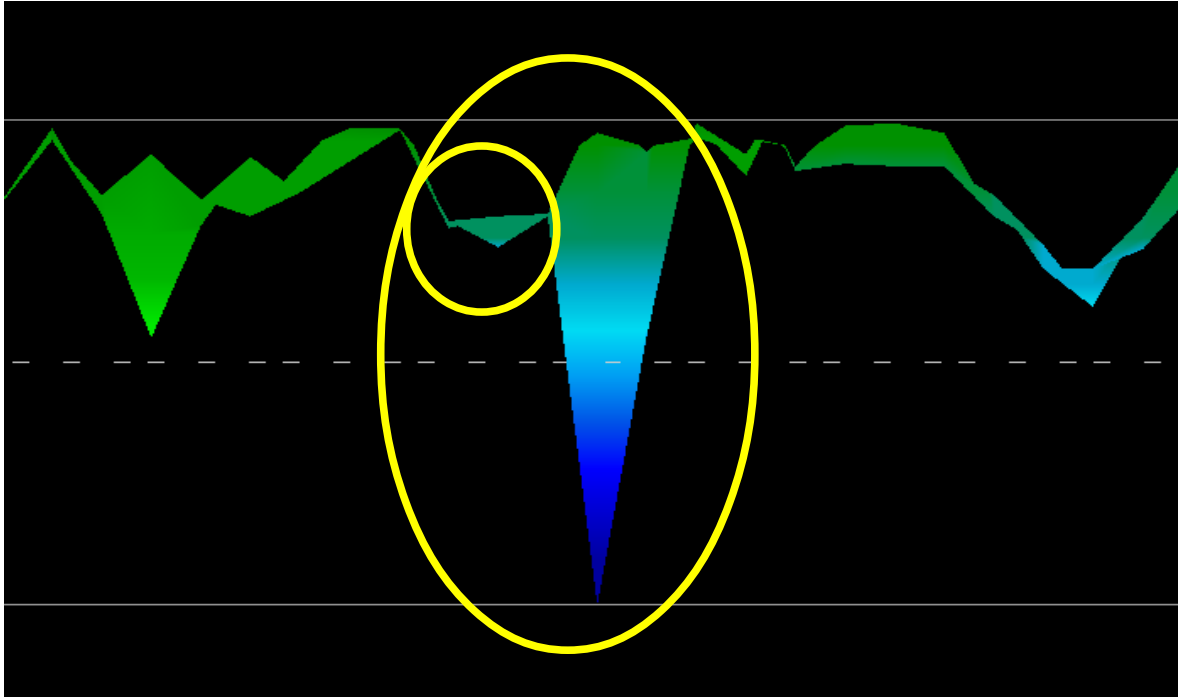
The above image (Figure 7.20: Natural Mineral Field) has the highlighted section of how a natural mineral field appears like. Please note the above colors, they are difficult to notice when in direct sun or bright light. Please do the analysis in an area where the computer can be shaded from most of the natural light to better recognize the colors. The image is from practical experience in the field.



*Figure 7.21: Natural Mineral Field (additional example)*

Practical experience and the repeatability factor from several locations world-wide have made this color the one to watch for within the scans. As stated previously it is not an easy to recognize color.

Another signature to look for is the signature showing the presence of a non-ferromagnetic substance, like in the example below (Figure 7.22: Example showing the typical signal of non-ferrous metal). The scan image needs to be viewed from the side view. Click on the “Minimize the difference in height” in order to be able to fit the scan on the screen. If the values are too high then noticing the differences will not be possible.



*Figure 7.22: Example showing the typical signal of non-ferrous metal*

In the above example, the smaller area is attached to the larger area, this is very typical and occurs quite often when working with minerals located within hard rock.

After an initial area has been located, to determine the size of the field or potential mineral field then a conventional scan as stated in section Ground Scan on page 49 needs to be conducted. When conducting a conventional scan be very careful to not rotate the antenna. Rotational errors are very easily done and can be frustrating. By using the “Parallel” the rotational factor is greatly minimized and almost removed. Another key factor when conducting any of the scans is to absolutely maintain the same height as much as possible ( $\pm 3$  cm).

### 7.5.3.1 Additional Examples

In the following examples are other instances of naturally occurring gold that have been found. These particular examples are from a user in North Sudan.

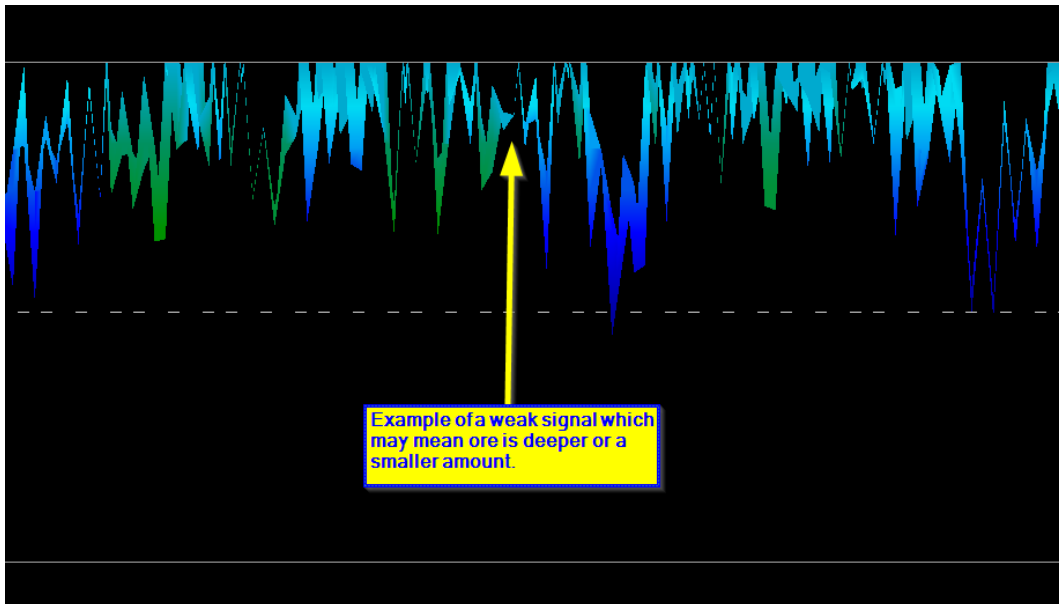


Figure 7.23: Shows a weak signal which can be smaller or deeper.

These additional examples yielded gold that was embedded in the rock alongside with quartz and black sand.

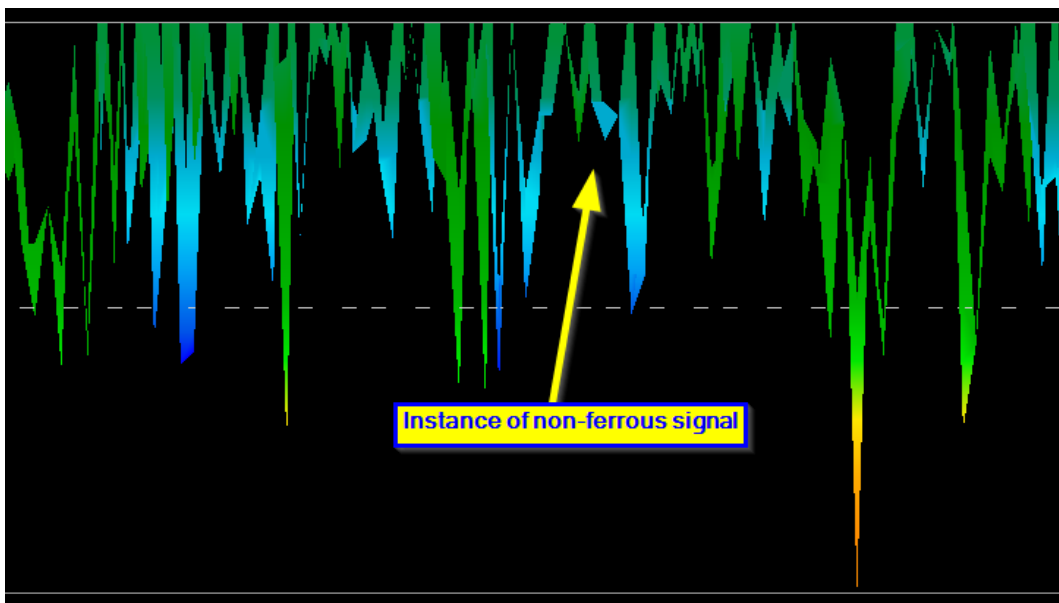


Figure 7.24: Measure value indicating a non-ferrous anomaly

### 7.5.4 Determining Position of Anomaly

After an anomaly has been found it is very important to know how to find the location. This is done very simply by entering in the field length into the "Characteristics" window (F9 key).

After the length has been entered into the system, you can navigate to the desired position using the arrow keys on the keyboard.

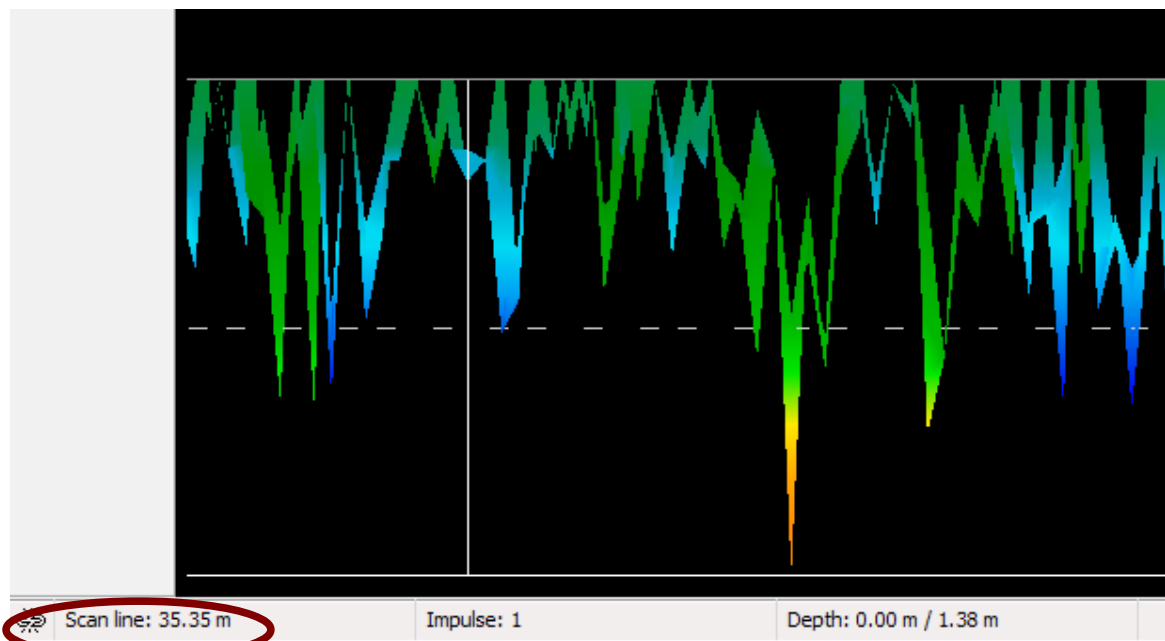


Figure 7.25: Position of anomaly with distance

In Figure 7.25: Position of anomaly with distance you can see in the bottom left hand corner the distance is being shown. The beginning of a scan is normally always on the bottom right hand side of the software window. The positioning line was put into place using the arrow keys. Afterward the signal position can be found using simple distance measuring tools.

## 7.6 Browse Scans

After selecting the menu item "Browse Scans" (see figure 7.26, left) you are asked to select a type of scan mode (only available for Ground Scan, Tunnel Scan and Mineral Scan). "Browse Scan" is also available when the sensors are not connected to the control unit.

After choosing the scan mode, you see a list of the stored scans from which you can select your desired scan file (see figure 7.26, right). The file names show date and time of the scan and the sensor used for the measurement.



Figure 7.26: Menu: Browse scans and select stored measurement

Select the measurement which you like to view by rotating the multifunction control knob. Press the knob to select the desired measurement.

For the selected measurement the following options are available:

- **View Ground Scan (Detail)**



The selected measurement will be displayed and built line for line as the scan was taken.  
To speed up the viewing process, rotate the multifunction control knob.

- **View Ground Scan (Quick View)**



The selected measurement will be displayed immediately and will not show the building of the data line for line.

- **View Tunnel Scan | View Mineral Scan**



Displays the selected measurement.

- **Delete Ground Scan | Delete Tunnel Scan | Delete Mineral Scan**



The current selected measurement will be deleted, if you confirm the following message with “Yes”. Afterwards, you return to the main menu.

- **Empty Memory**



The measurements of the selected scan mode will be deleted, if you confirm the following message with “Yes”. Afterwards, you return to the main menu.



## 7.7 Settings

Within the eXp 4500 there are several settings which can be configured. The following options are available.

- **Language**

Here you can set the desired language. The following languages are available:

- German, English, French, Spanish, Arabic, Farsi, Russian, Bulgarian, Turkish, Greek, Dutch, Chinese



Figure 7.27: Language Icon

- **Date**

Here you can set the day, month and year.



Figure 7.29: Date icon

- **Time – Set Time**



Figure 7.30: Time Icon

- **Volume – Set Volume**



Figure 7.31: Volume Icon

- **Restore Factory Defaults**



Figure 7.32: Reset to Factory Default Icon

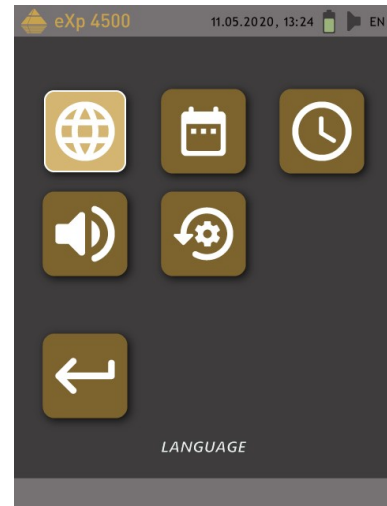


Figure 7.28: Settings Menu

## 7.8 Exit

Whenever you wish to shut down your device. It is important to use the “Exit” function.

Do not power off the eXp 4500 by turning off the power pack, select only the exit icon! Powering off the Power Pack may cause damage to the unit.

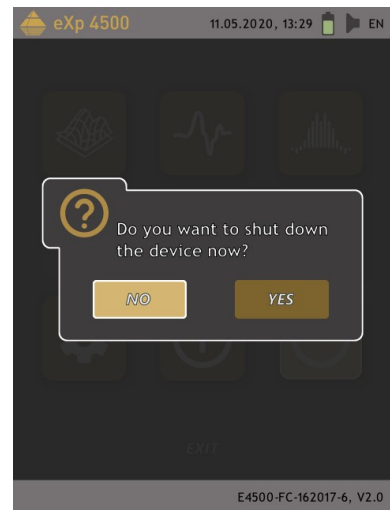


Figure 7.33: Exit Icon

# CHAPTER 8

## Field procedure

This chapter gives practical instructions about the general procedure of scanning an area. The different scanning methods and procedures will be explained in detail.

## 8.1 6 Major Rules to Follow

Following the 6 PRIMARY RULES below will greatly increase your chances of success with the OKM line of equipment. Failure to follow the major rules will most likely result with errors.

1. Do not turn or rotate the antenna or Super Sensor - this means that when the antenna is facing one direction, it must remain in that direction. If a vertical antenna like the Super Sensor is used then it must remain vertical, not tilted to the side. A horizontal must be horizontal and not tilted.
2. Do not change the height of an antenna during a scan. The antenna should always stay at the same relative height throughout the scan (between 5 cm to 10 cm above the ground is recommended).
3. Move the antenna at the same speed! When in Automatic mode, the speed of the antenna during a scan line must remain the same. When in Manual mode the distance between the impulses must be the same.
4. Keep each scan line Straight! Walk straight, not in a curve. This is done very easily by NOT looking at the antenna or the unit and looking at a target that is further away. Constantly watching the antenna or unit will make you walk in circles.
5. Be sure that your scans are large enough to see the potential target or field of targets (initial scans should not be smaller than 4 m x 4 m). When a scan is too small then the overall size of the target can not be seen and errors in the analysis may happen due to the lack of size.
6. Be sure to conduct the "Control Scans"!!! When you pass over a field it is important to repeat the process at least 2 or more times to ensure that the field does have a target or does not have a target. Failure to complete the control scans has made many users dig in areas where there was no target.

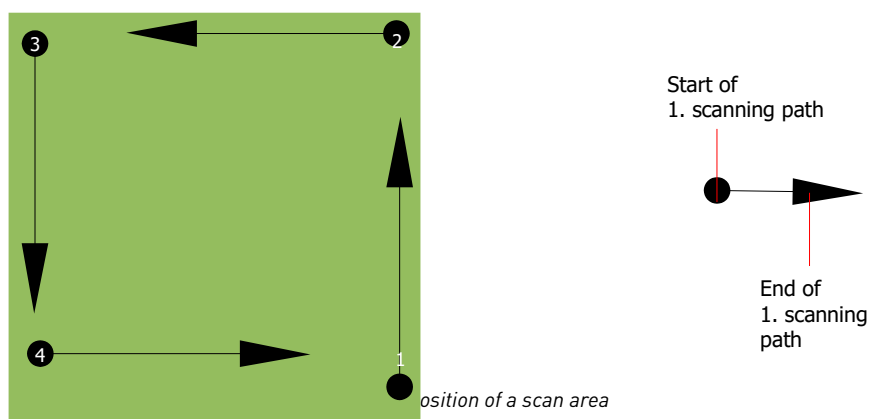
Remember: **REAL TARGETS DON'T MOVE!**

## 8.2 General scanning procedure

In general every scan always starts on the bottom right corner of your scan area. Starting from this point, you should walk scan path by scan path, whereby every following path is situated on the left side of its previous path. During walking these lines, the measurement values will be recorded and depending on the selected operating mode either transferred directly to a computer or saved into the memory of the device.

The device stops at the end of each finished scan line, so that the user can find the starting position of the next line. In this way, all paths will be recorded and the area will be measured.

Figure 8.1 shows all 4 possible starting positions and the corresponding first scanning path. Depending on the composition of your terrain you can determine the optimal starting point for your measurement by yourself.



The scanning paths may be referred as “Zig-Zag” or “Parallel” traverses. Also the number of impulses (measure points), which are recorded during one scanning path can be adjusted individually depending on the size of your scan area (length of scanning path).

### 8.2.1 Scan Mode

There are two general techniques to surveying an area with the eXp 4500:

- **Zig-Zag**

The starting position of two scanning paths next to each other is on the opposite side of the measured area. You will record data on your scanning path and on the return path as well.

- **Parallel (recommended)**

The starting position of two scanning paths is always on the same side of the measured area. You will only record data in one way and in one direction, while you should return and walk back to the starting position of the next scanning path without recording data.

Figure 8.2 represents both techniques schematically.

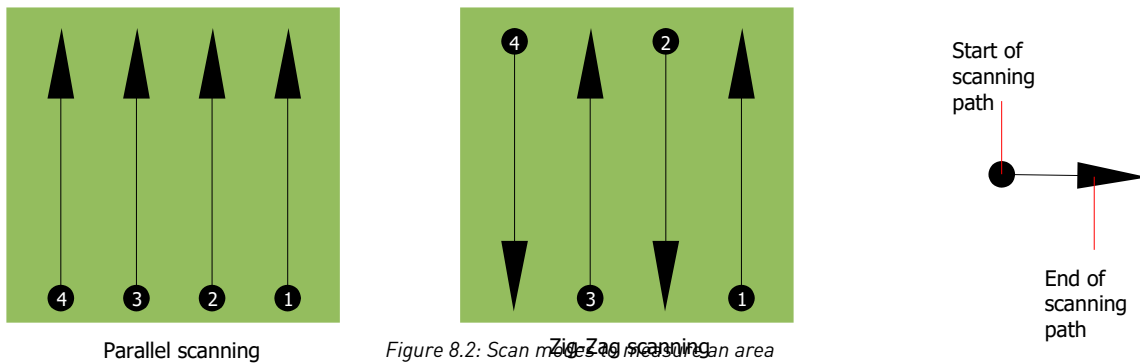


Figure 8.2: Scan modes to measure an area

Doing the scan in “Parallel” mode you will start on the bottom right corner of your scan area (point ❶) to walk and record a scan path towards the upper right corner of the area. After recording the first line, you should walk back to the starting point and move to the left of the first scan line to start the scan path 2 (point ❷), to start there the second scanning path. In this way all other paths will be scanned, until you have reached the left side of your measure area.

Doing the scan in “Zig-Zag” mode you will start also from the bottom right side of your measure area (point ❶) to walk and record a scanning path towards the right upper corner of the measure area. Different from the parallel measurement, you should continue recording data while walking back the second scanning path. So you go to the starting point of the second scanning path (point ❷) and scan in the opposite direction. In this way, all other paths will be scanned in the scan mode “Zig-Zag” until you have reached the left side of your measure area.

The distance between the scanning paths should be consistent during one measurement but can vary from measure area to measure area. If you mostly look for smaller targets than you should also select a smaller distance between the lines. A standard rule is: The smaller the distance between the paths, the more accurate your scans will be. When you are conducting your first scans the lines should not be too close together to locate possible targets.

## 8.2.2 Regulation of the number of impulses per scanning path

It is possible to select the distance (number of impulses) before starting the measurement or selecting the automatic mode (“Auto”) to adjust the number of measure points after finishing the first scanning path.

When the distance has been configured, the device will stop automatically when this number has been reached and waits for the start of the new scanning path.

In the automatic mode you should stop the measurement of the first scanning path by yourself, by pressing the appropriate button, as soon as you have reached the end of the first scanning path. This effective amount of measure points will be used for all further scanning paths of this measurement. Starting from the second scanning path, the device now stops automatically after the assumed number of impulses has been reached.

Keep in mind the number of impulses which you have recorded per scanning path. This amount should be entered later in the software program, when transferring the data to a PC, to receive all measured data

correctly from your measuring instrument!

There is no special rule for selecting the right number of impulses. But there are different aspects which should be considered. These are some considerations

- the length of your measured area and
- the size of the objects you are searching for.

A preferable distance between two impulses is about 15 cm to 30 cm. The smaller the distance between two impulses is, the more exact the graphical representation will be. If you are looking for small objects you have to select a smaller distance, for big objects you can increase the distance between the impulses.

Figure 8.3 shows the effects of the distance and the number of impulses per scanning path for some objects.

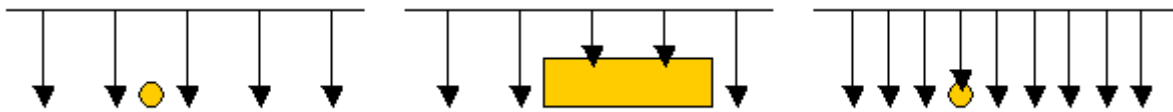


Figure 8.3: Effects of changing the number of impulses and their distance

Figure 8.4 shows the difference between very few impulses (left side) and much more impulses (right side) on the same length of scanning path. Therefore the second record (right side) shows much more details and also smaller objects can be seen.

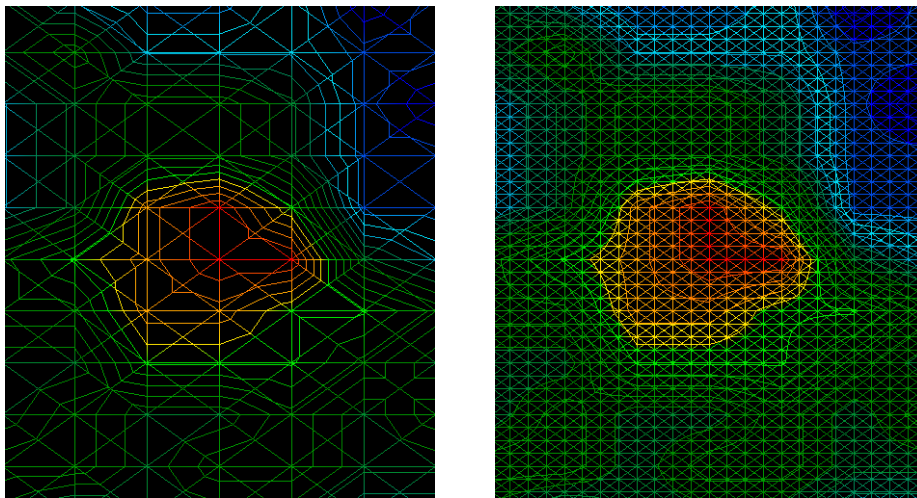


Figure 8.4: Comparison of low and high number of impulses

Do not hesitate to record more measurements with different numbers of impulses. For example you can scan a large area before doing a second detailed precision measurement. Especially if searching for bigger objects you can proceed like this. With this manner you can measure a larger area very quickly and afterward you make new scans localizing the suspect targets.

When conducting a scan it is important to not only make note of how many impulses are being used but to get a clear picture of what you are scanning, it is very important to watch your speed. Every scan line should be measured at the same speed as the previous line.

Figure 8.5 shows what can happen, if you walk at different speeds during your scan.

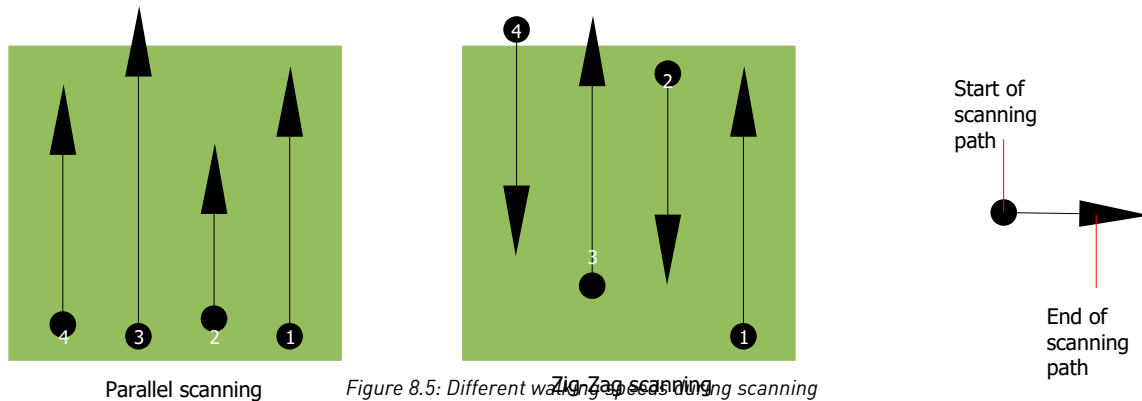


Figure 8.5: Different walking speeds during scanning

Using a different walking speed in the scanning paths, will cause displacements in the scanning path. As a matter of fact, a target can get cut into several smaller items or completely lost because it was missed. Later when the data is downloaded for further analysis, speed errors can make a target completely unidentifiable and may be discarded.

In general, the following rule is valid: Keep scans at practical sizes where you can see the beginning and stop lines and can comfortably traverse an area to keep your speed and the distances reasonable.

### 8.3 Special notes for field procedure

There are some aspects which you should take note of when conducting scans. In principle, a scan is only as good as the path that was taken. Making errors while scanning will show up in the final graphical representation also as an error. This will cause frustration and lost time.

Before you start with a measurement in the field, you should think of what you are looking for and if the selected area is suitable. Measuring without a plan will usually produce unacceptable results. Please consider the following advice:

- What are you looking for (graves, tunnel, buried objects, ...)? This question has direct effects on how a scan is conducted. If you are looking for larger targets, the distance between the single measure points and scanning paths can be larger, as if you are looking for small targets.
- Inform yourself about the area, where you are searching. Does it make sense to detect here? Are there historical references which confirms your speculation? What type of soil is on this area? Are there good conditions for data recording? Is it allowed to search at this place (eg. private property)?
- Your first measurement in an unknown area has to be large enough to get representative values. All further control measurements should be adjusted individually.
- What is the form of the object you search? If you are looking for an angular metal box, the identified object in your graphic should have a form according to this.
- To get better values concerning depth measurements, the object has to be in the center of the graphic, which means it has to be framed by normal reference values (normal ground). If the object is on the side of the graphic and not totally visible an estimated depth measurement is not possible and also measurement of size and form are limited. In this case, repeat the scan and change the position of your scan area, to receive an optimal position of the anomaly inside of the graphic.



- There should not be more than one object in a scan. This will influence the depth measurement. It is useful to scan partial areas over such targets.
- You should do at least two controlled scans to be more sure about your results. This is also important to recognize areas of mineralization.
- Most important rule when dealing with mineralization. **REAL TARGETS DON'T MOVE!** If your target moves then it is most likely mineralization.

### 8.3.1 Orientation of probe

During one measurement the probe should have always the same distance to the ground. Generally we recommend a height of about 5 – 10 cm from the surface of the ground if possible.

In the event that you are going to go over stones, wood or high grass that is higher, start your scan with the sensor higher right from the beginning. In circumstances like these, then perhaps you will need to start the scan with the probe at a height of 2 feet (50 cm) and keep it at that level for the entire scan. It is important to maintain the height, this will eradicate many errors. As a rule, do not change the height during a scan for it may create unnecessary errors.

Another important aspect is the physical orientation of the probe. During the “Parallel” scan mode the orientation of the probe does not change because you are always measuring in the same direction. Even in the “Zig-Zag” scan mode the orientation of the probe must not be changed. That means you are not allowed to turn yourself with the device and the probe at the end of the scanning path. Instead you should walk backwards and continue scanning. Otherwise your obtained graphic includes red or blue stripes. These stripes throughout a scan are commonly referred to as “Rotational Errors”.

### 8.3.2 Parallel or Zig-Zag?

For skilled users of the eXp 4500 both scan modes are suitable. According to experience the best graphics has been received in the “Parallel” mode, because you are starting at the same point and traveling in the same direction. It is also easier to control your walking speed and direction.

Especially in uneven terrain like mountain sides or other inclines, the parallel mode is preferred. When it comes to speed, the experienced user will very often use the Zig-Zag mode only for the initial scan to determine if there are anomalies in the area worth further research.

### 8.3.3 Manual or automatic impulse mode?

Large even or passable surfaces are commonly measured in the automatic mode. The manual impulse mode is mostly used for difficult uneven terrain, areas where there is quite a bit of growth and if the measurement result needs to be very accurate.

In terrains with difficult access like mountain cliffs and sides, slippery surfaces or overgrown areas, it is wise to use the manual impulse mode. Because each impulse will be released manually, you have enough time to position the probe in the correct way and record the measured value. In this way, you can also measure accurately previously marked dots of a predefined grid.

### 8.3.4 Tips from the trainers themselves

When conducting scans, there are some extremely important items that need to be noted. First of all it is crucial that you relax. When you are tense, you are putting too much pressure on yourself to do the scan correctly; often resulting in errors.

- Newly buried targets are difficult to see. Many users receive the equipment and the first thing they do is go out and bury an object. When an object goes into the ground it changes the natural signature of the soil and creates some kind of noise. Usually the buried object has a weaker signature than the unnatural noise and therefore is not detectable. Initial scan images will not show the buried item but visualize the noisy area in blue or green colors. After the item has been seasoned, meaning it has been in the ground for a complete cycle of seasons (usually a year), the noise is reduced and the signature of the buried object becomes visible again.
- Train on known targets. In the training course at the factory we have several objects that have been buried for years, just like real targets in the field. These targets can be quickly and easily identified because they are not natural to the soil. Other targets that you can use in your own area are buried utilities. Pipes, tanks, electrical, sewers, graveyards, etc... Most of these items can be found in every community, town or city. This is where you need to begin your training if you are going to self-train.
- Get professional training. When you take advantage of receiving the training, either from the factory or a qualified dealer, you will understand not only the use and operation of the OKM detector but also the software so much easier and be able to identify targets as well as errors.
- Do not rely on just one scan measurement. So many users go out into the field and they make a measurement and see a target. Instead of repeating the scan and reproducing it several times, they go out and get a shovel and dig. On very rare occasion will the first scan be perfect. Even the trainers do multiple scans to ensure that they are not looking at areas of mineralization or an error.
- Soil Mineralization – Oh! Very frustrating! We will all experience it. When you are in an area that is known to have pockets of high ground mineralization, be prepared to conduct more scans than normal.
  - Clay is probably the number one foe. Depending on the iron content of the clay will determine how strong the attenuation will be. A quick analysis of the iron content is how dark it is, it can vary from a light gray up to a dark orange. The darker the clay, the more iron it has.
  - Sand is usually very clear and easy to hunt in. There are two factors of sand that need to be noted. Sand where the ground water is very shallow, meaning that the ground water is usually just a couple of meters from the surface or desert sand where it is very arid. In desert sand, the targets can be situated 3x deeper than indicated.
  - Farmland is another area to take note of. In modern farms, so many nutrients and fertilizers are introduced creating an unnatural area of mineralization.
  - Rocky mountainous areas. Areas with many mountains are also riddled with patches of mineralization. Mountainous areas are created from faults in the earth and this is probably the biggest area for natural treasures as well as mineralization.
- All scans have a red ... and a blue. When you view the scans in the Visualizer 3D software every scan has a red spot. The scans represent the strongest signals (red) as well as the weakest signals (blue).

- 
- A real target will usually have a much stronger signal than that of a mineralized field. It will also not move. If you think that a red spot in the software is a real target, conduct a set of control scans and see if the target remains in the same place, or moves. If it moves, then it is not real.

# CHAPTER 9

## Scanning Techniques

Here you can find additional information on accessories that can compliment the basic unit. Keep in mind that the mentioned accessories are not included in the normal scope of delivery.

## 9.1 Super Sensor

The Super Sensor is a high resolution antenna, which is specially adjusted to detect metals. Yet it is also possible to recognize larger voids with this antenna. A particular characteristic is to distinguish ferrous metals from non-ferrous metals. This discrimination is possible in the operating mode Pin Pointer. Compared to the standard Horizontal GPR antennas the Super Sensor can find much smaller and deeper situated metal objects.

The Super Sensor can be used in the following operating modes:

- Ground Scan
- Pin Pointer
- Magnetometer
- Mineral Scan

To use the Super Sensor with the eXp 4500, simply connect it to the main unit. Always hold the antenna vertical to the ground in your hand, whereby the cable should come out at the upper end of the antenna. The figure 9.1 shows how the Super Sensor has to be correctly held.



*Figure 9.1: Position of Super Sensor*

The Super Sensor should not be swung nor change height, either up or down, during the measurement. The smoother the antenna is held, the better your scan results will be. The distance between the ground and lower part of the antenna should be about 10 cm, but can be enlarged depending on the terrain conditions.

### 9.1.1 Super Sensor Training Marks

With the Super Sensor it is very important to make sure that it is not rotated during the scan. A useful training tool is to put additional marks on the Super Sensor. This will allow others who are watching the operator better recognize a twist while it is in motion.



*Figure 9.2: Add additional marks to the Super Sensor aids in the scan.*

By putting several lines or marks on the Super Sensor (a colored electrical tape as example), others can easily see if the unit is being rotated. The user has the arrow on the top of the Super Sensor to support you in keeping the unit straight.

### 9.1.2 Super Sensor Orientation

The grip on the Super Sensor is very important. The best grip is a very loose and comfortable grip that does not put any strain on the body. With a weight of approximately 770 g, it does not take much force to hold the antenna. On windy days, there is more force necessary to hold the antenna still.



*Figure 9.3: Super Sensor Wrong Orientation*

Picture 9.3 shows an example of how the Super Sensor should NOT be held.

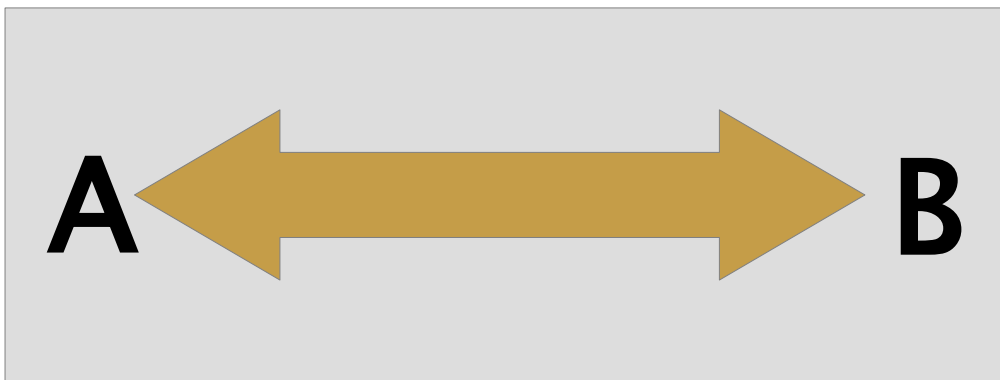
Hold the Super Sensor very straight and with a grip that is not too strong. When holding it at the top it will automatically find the correct vertical position. When the grip is too strong then the Super Sensor will not be vertical and it can be uneven like shown in the picture.

The orientation of the antenna should not be changed during the complete measurement!

## 9.2 Control Scans

Always conduct a set of control scans on any area prior to excavation. A control scan is a very accurate measurement to ensure that the area being prospected is a viable area and to verify that the target is real. This is done by doing additional scans.

To ensure consistency of the scans the same person should do the scans, they should be done using the same starting and the same stopping points. The control scans have the same amount of impulses and the same amount of scan lines in every scan. Both methods, single line and conventional, need to be conducted to ensure that the field of mineralization is correct. This is important for it is easier to conduct an additional set of scans rather than dig a hole with nothing in it.



*Figure 9.4: Control Scan the same line in both directions.*

In the example (figure 9.4) the easiest way to conduct an initial control scan is to scan the exact same line in both directions. This method is used when prospecting for naturally occurring mineral fields.

This is done by doing the first scan completely. At the end of the line, either download the existing data to the laptop or change to another control chip (only for certain detectors available). Many users will have multiple control chips for their unit to conduct more scans over a given area without having to download the data after measurement.

There is a couple of very important reasons, one, if the target moves then it is most likely an area without a valid target and two, you can get a much better perception of the actual size or area of the target.

Having the same person perform the measurements is important. This way the scans will be done exactly the same, with the same speed and the same amount of impulses. It is important that others watch the operator as the scans are being performed to ensure that no mistakes are being made and the scan lines are straight. The other users need to ensure that the Super Sensor is not rotating or tilting and that it is remaining the same height over the ground.

If multiple operators are going to conduct scans, then it should be noted in the Characteristics window of the Visualizer 3D software as to which operator performed the scan. This way subtle differences between the operators can be noted.

When working an area that is encompassing a traditional scan, the control scans need to be done in sets of 3.



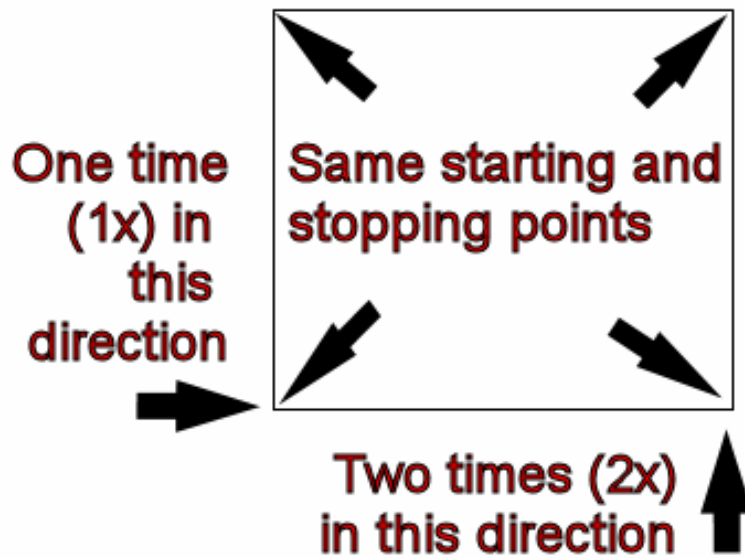


Figure 9.5: Traditional control scan procedure

Per figure 9.5 above, the procedures are laid out to conduct the traditional control scan. It is imperative that the **EXACT SAME STARTING POINTS** and the **EXACT SAME STOPPING POINTS** are used. If the same points are not used then the scans will potentially have errors from the beginning. When looking for naturally occurring mineralization and deposits thereof, the slightest variable can make the difference in an accurate detection.

When looking for traditional buried objects this method is also used to ensure that the item is actual. The only difference is that with a traditionally buried object that the signal values will be greatly increased for the actual object(s).

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