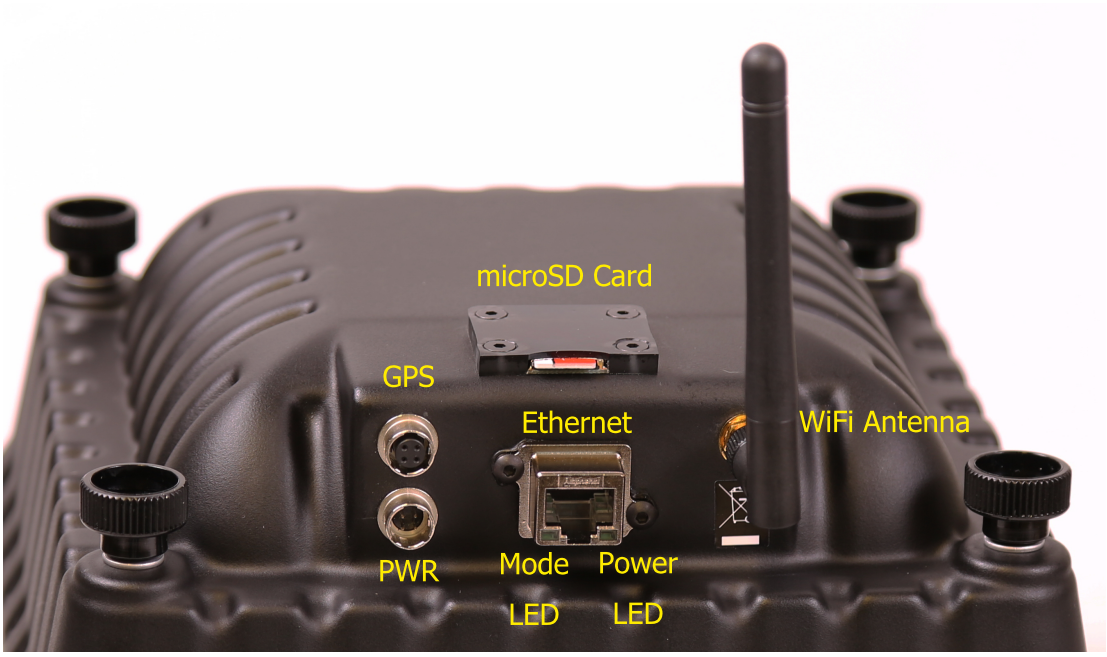
SPG-1700
User Manual



Ports and LED layout

Introduction

The SPG-1700 is an all in one Ground Penetrating Radar unit. This unit comprises the transducer, both transmitting and receiving ones, as well as the control electronics and power supplies needed for the operation of the unit. The control application runs in a Windows operating system and can establish communications with the unit via the Ethernet port of the computer or via WiFi where the SPG-1700 functions as an access point. The SPG-1700 also has the possibility to record the data to a local micro SD card for autonomous roving operation. The SPG-1700 counts with one port for connecting an external GPS receiver to be able to attach coordinates data to each and every collected radar trace.

This manual contains all the required technical information to successfully operate and maintain the unit. Please make sure to familiarize yourself with the operation of the unit and the different modes of operation before attempting to collect any useful data with the unit.

Technical Specifications

Center Frequency	608MHz
10dB Bandwidth	112.57%
Radiated Power	-55dBm
Receiver Sensitivity	4.02uV
Effective Dynamic Range (No Gain)	56.43dB
RF Sampling rate	8GSa/s
PRF	50kHz
Trace Range	32ns
Sample/Trace	256
Data Storage	16-bit
Supply Voltage	10.6 to 15.2VDC
Power Consumption @ 12VDC	2.64W
GPS Port	HCMOS Levels with 5VDC power output
Maximum Current on GPS port	500mA
GPS Baud rate	9600 bps
GPS Format	NMEA GGA or RMC Sentences available
GPS Trimble format (Extended Sentences)	Fully Supported
Wrong Polarity protection	up to 36A
Over voltage protection	Visual warning only
Weight	991g
Dimensions	200x200x130mm
Fastening points distance, M5 Screws	160mm square

Table 1 Technical specifications

Operation

Powering up the unit

The SPG-1700 unit is delivered without power supplies or batteries, therefore it is very important to consider the power requirements of the units as well as the connections to it.

The unit will accept any power source as long as it stays within the specified range, that is, from 10.6V and up to 15.2VDC. If the unit is supplied with a voltage below 10.6V the power LED will flash three times and will go off indicating that operation of the unit is not possible. If the unit is supplied with a voltage above 15.2VDC the power LED will flash constantly indicating possible power failure if the unit is not turned off immediately. If the unit is supplied with any voltage between the two specified limits the power LED will remain lit indicating everything is fine and you can carry on with the survey.

The SPG-1700 is fully protected against wrong polarity. In the case a wrong polarity is supplied to the unit the internal circuit will create a short circuit protecting the unit and activating a poly-fuse that will be open until the power has been removed and enough time has passed to allow it to cool down. Please note that this is a re-settable fuse and no replacement is required from your side.

Power Connector Pin Configuration

The chassis power connector mounted on the unit is a HR10-7R-4P(73) manufactured by Hirose, it mates with a HR10-7P-4S(73) type connector.

Fig. 1 HR10-7P-4S(73) Power Connector

The correct pin configuration is

Pin number 1	Positive Power Supply Lead
Pin number 2	Positive Power Supply Lead
Pin number 3	Negative Power Supply Lead (Common)
Pin number 4	Negative Power Supply Lead (Common)

Table 2 Power Connector Pin-out

Before proceeding with the next chapters make sure you have installed the application software as explained in Appendix 1, "Installing GeoView".

GPS Operation

The SPG-1700 is essentially a time mode unit and has no hardware input for defining the traveled distance or its direction in space. For this reason the only practical way it has to position the underground features is the GPS coordinates. There are many aspects of the GPS operation that will influence positively or negatively the location we acquire with the unit.

Please keep in mind that this is a HCMOS levels output and input unit. This means that connecting the unit to a GPS with TTL levels will most likely damage the processor in the unit. Likewise if the unit is fed with RS232 levels an irreparable damage will be made to the unit and the unit most likely will need to be repaired under non warranty conditions.

All of the GPS receivers that we at Geoscanners AB have tested to the date of writing of this manual have not satisfied the requirements for detecting targets below 20cm in diameter. But, location of targets can be done successfully if no 3D grids are required.

`GPS Port Connector Configuration`

The chassis GPS port connector mounted on the unit is a HR10-7R-4S(73) manufactured by Hirose, it mates with a HR10-7P-4P(73) type connector.

Fig. 2 HR10-7P-4P(73) Power Connector

The Pin configuration for the port is

Pin number 1	TX Output to GPS Receiver
Pin number 2	RX Input from GPS Receiver
Pin number 3	Positive Power Output, +5VDC
Pin number 4	Negative Power Output, GND

Table 3 GPS Connector Pin-out

WiFi Configuration

Before you can use your unit with the WiFi communications mode you need to connect your computer to the SPG-1700 WiFi module. Unlike previous models of the SPG series, the SPG-1700 works as an access point and this means that it is significantly easier to connect to any windows operating machine via the wireless network wizard. The only thing one should keep in mind is that for obvious reasons the network the computer will be joining does not have access to the Internet.

There are situations and places where your unit will most likely fail to connect, we strongly advise you to avoid these places or situations to avoid data loses or plain frustration because of malfunctioning of the unit. You should avoid:

- Heavily crowded WiFi areas with many active transmitters.
- Areas with strong transmitters such as airports or radio masts.
- Areas with many large metal objects creating multiple reflections in the line of communications.

Before proceeding make sure that the antenna is connected and pointing away from the unit. When intending to use the unit in WiFi mode please make sure that the Ethernet cable is unplugged from the host computer and preferably the unit as well.

The unit is shipped configured as WiFi mode type of operation and therefore both LED on the Ethernet connector are lit.

`Step 1`

Power up your unit and let it work for at least 1 minute until it boots up. Look in the wireless available device under your network connections. Your unit will appear as "Wifly-GSX-xx" where the last "xx" are the last two digits of the network card MAC address.

Fig. 3 SPG-1700 as Wifly-GSX-a4 on the local network

Step 2

Click on the name of the device and then on "Connect", please keep in mind that depending on the amount of available devices and the congestion of the network this can take from a few seconds to a few minutes.

Fig. 4 Connect to available unit by pressing "Connect"

Step 3

Even though the network shows "Connected" we are not connected yet, the unit has to negotiate a valid address and it is mandatory to wait until this process is finished.

Fig. 5 Wait until the computer has finished "Identifying ..."

Step 4

When Windows has finally been assigned a valid IP address the network will show that it is connected to a network with the same name as the unit, but that there is no Internet access. If the unit is on WiFi mode, that is the operation LED is ON, the system is set and ready to begin. However, if the unit is not on WiFi mode of operations and the operation LED is OFF, then the unit will not accept any commands via the established WiFi network even if it says that it is connected. In order to enter WiFi mode of operation you will need to connect via Ethernet and change the connection type.

Fig. 6 Now the SPG-1700 and the computer are connected and ready for operations

Step 5

Start the application now and the splash screen will offer you two options for connecting to the SPG-1700. Since we are connecting via the WiFi communications channel that is what we chose. Press the connect button with the WiFi symbol on it. Please note that as explained in step 4, for this to be successful the unit itself has to be in WiFi mode, that is, both LED's on the Ethernet connector must be lit. Also, note that the start button is grayed out at the moment not allowing for further operations.

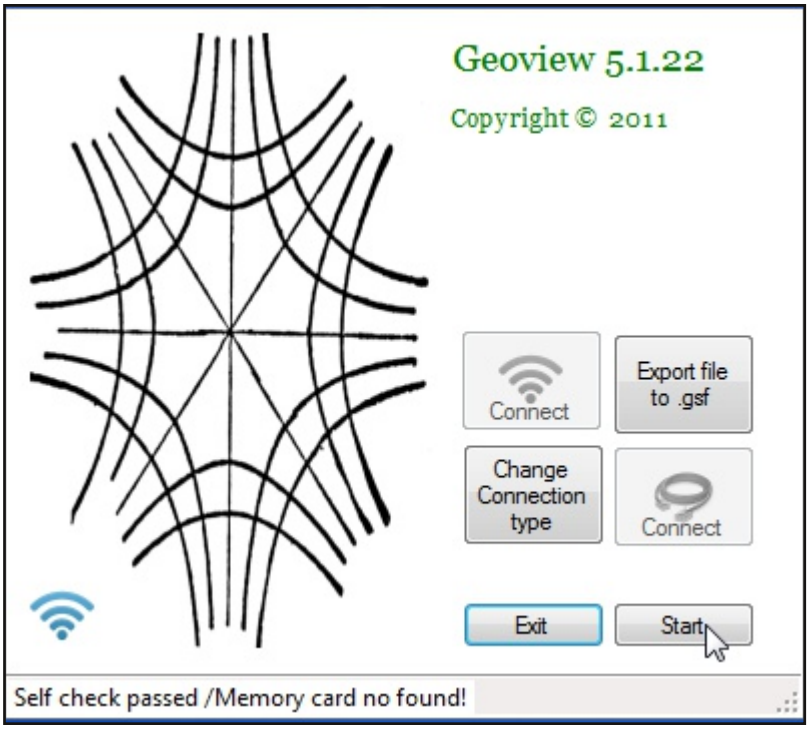


Fig. 7 Application splash screen

After pressing the "connect" button the host computer will try to establish communications with the unit.

Step 6

If everything was successful then a "Self-Check Passed/Memory card not found" or "Self-Check Passed/Memory Card Connected XX Files" will appear in the left lower corner of the splash screen and the start button will now be active. If the memory card inserted in the reader's slot is corrupted or the unit could not read it for any reasons then "Self-Check Passed/Corrupted Memory Card" will appear instead. In any case after the "Self-Check Passed/.." message is displayed you can press the start button to continue with the application.

Fig. 8 Self Check Passed the Start button becomes active now

If for any reasons the computer is not connected to the WiFi network or the self-check didn't pass then you may get the following message: "TCP Connection could not be established"

Once you have successfully connected your computer to the unit's network the operating system will remember your choices and new connections are carried on in a faster fashion.

Please keep in mind that connections between the control computer and the unit can deteriorate over distances and/or congestion on the wireless network in the area of survey. We ran a series of tests around our facilities to determine the connection at different distances. It must be noted that we are in a heavily saturated RF area and our findings may be somewhat pessimistic of the conditions you may encounter.

It is recommended and in most situations a necessity to ensure that all surrounding WiFi networks (where possible) are switched off e.g. mobile phones should be switched to flight mode and any other WiFi generating devices disabled. This will greatly improve the signal strength and quality of data.

Distance from the host to the unit	Observed data quality	Data losses
0 to 25 meters	Very good quality	Below 10%
25 to 50 meters	Good quality	~25%
50 to 75 meters	Low quality	~50%
75 to 100 meters	Poor quality	94%

Table 4 Distance vs Data losses

The rest of the operation is the same for the WiFi communications channel or the Ethernet port communications and therefore both will be explained as one, with the exception of the roving mode. The latter is available only in WiFi mode.

If you want to change the connection type to Ethernet then start the unit as explained above and wait for the splash screen to load. Connect to the unit using the WiFi button and wait for the successful connection message.

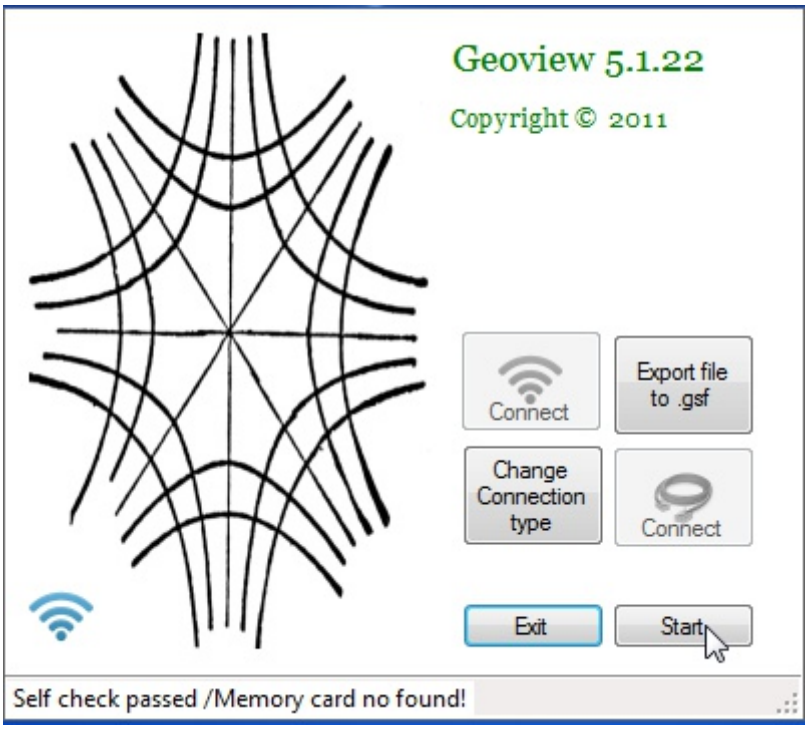


Fig. 9 WiFi connection success.

Now, instead of pressing the start button you need to press the "Change Connection Type" button.

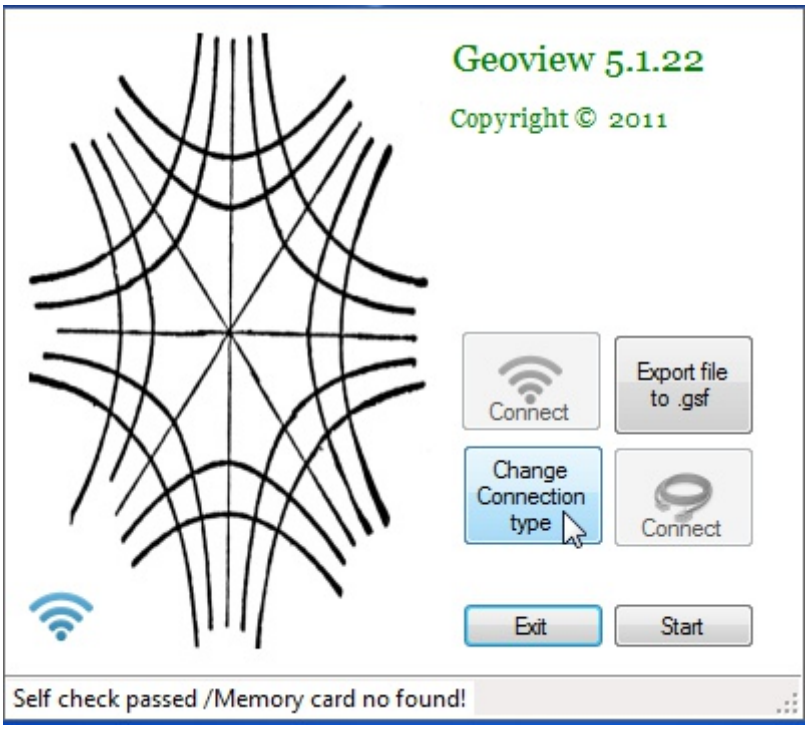


Fig. 10 Changing from WiFi mode to Ethernet mode of operation.

When everything is ready you will receive a confirmation message giving instructions on how to proceed further on. Please pay attention to these instructions since failing to do so can cause malfunctioning of the unit.

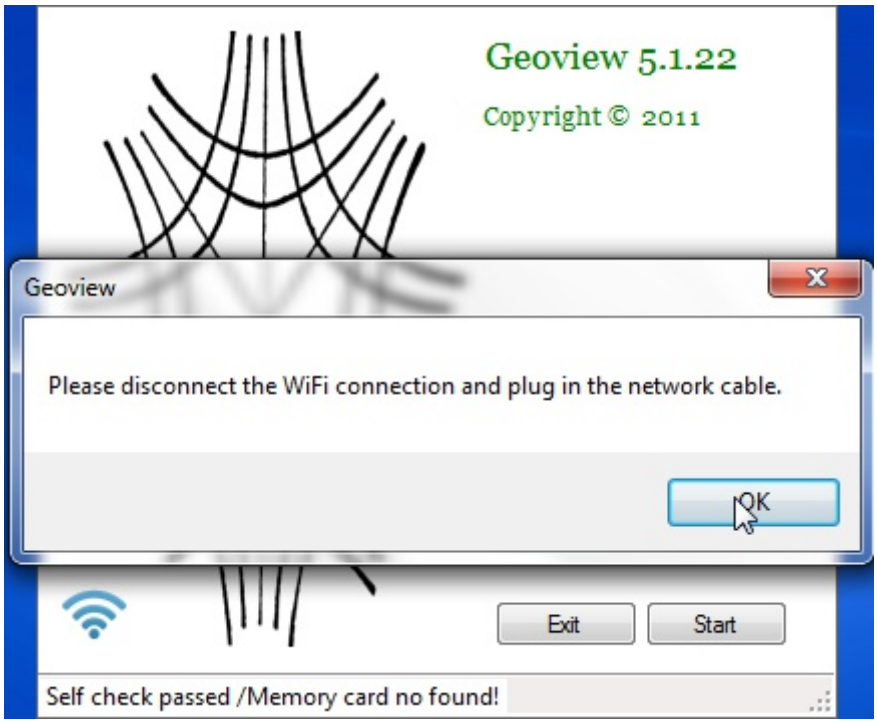


Fig. 11 The unit is now in Ethernet mode of operation.

The left LED on the Ethernet connector will be OFF now. Disconnect from the WiFi network and restart the unit, this time with the Ethernet cable connected. In some operating systems (Windows XP and Windows 7) it is beneficial sometimes to reboot your control computer as well.

We assume here that the computer has already been configured properly to connect in peer to peer network. If not, please review the next chapter first before attempting to connect via Ethernet.

Ethernet Port Configuration

The SPG-1700 can be operated using the Ethernet port for communications. This is a simpler and faster way of communicating with the unit that requires the setup only once. The SPG-1700 does not require any drivers to operate via the Ethernet port, but the computer running the control software must be properly configured to successfully establish connection.

Fig. 12 Straight through Ethernet Cable to connect the unit to a host computer.

Open the control panel on your host computer. Select "Network and Internet" from the available options and then "Network and Sharing Center" from the new panel. Here we are going to change the adapter settings and that is why we click on the "Change adapter settings" link on the left side of the panel.

Fig. 13 Change adapter settings for your network card.

A new window with your network connections will appear. At this time you should have already disconnected from the wireless network or even better disable the adapter altogether to avoid confusion on Windows. Right click on it to choose the properties of it.

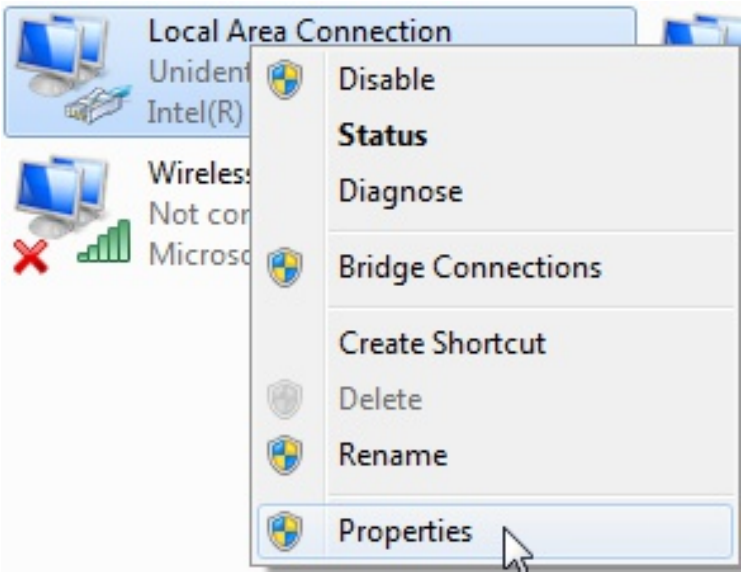


Fig. 14 Select the properties for the local area connection.

In the new window we need to select the Internet Protocol version 4 (TCP/IPv4) to change how it obtains its IP address. Click on it to select it and press properties.

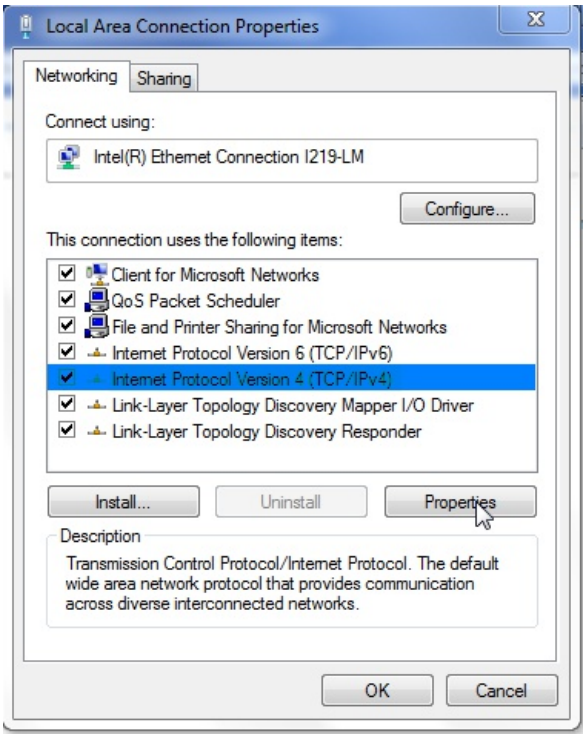


Fig. 15 Change the properties of the TCP/IPv4 protocol.

A new window with the properties of the protocol will open. In the General Tab select "Use the following IP address" and enter the address as shown in Figure 16. Check the radio button "Use the following IP address" so you can have access to the fields in the box. Enter the numbers as shown in Figure 16, please make sure the numbers are entered correctly so the communication channel can be established.

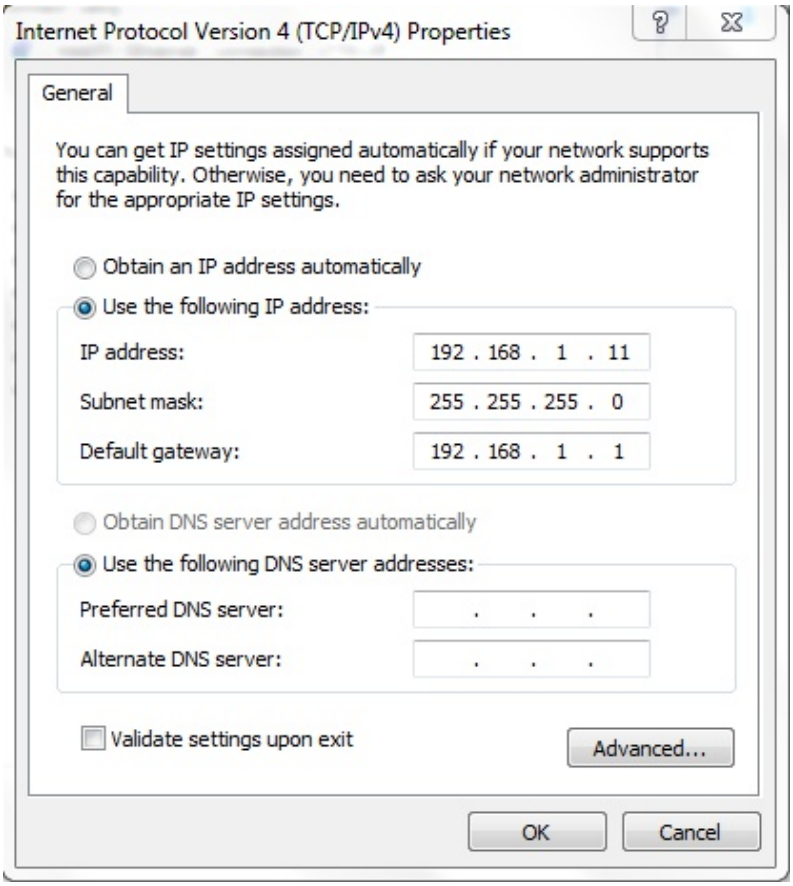


Fig. 16 Host Computer Ethernet Configuration Settings.

At this moment the host computer is successfully configured to connect to the unit in a peer to peer network fashion. If you need to use your computer to connect to the Internet or for any reasons have an IP address automatically assigned to it, then please do not forget to configure it back to operation with the SPG-1700.

Now when you start the software you can connect using the button with an Ethernet cable depicted on it.

If you need to return to WiFi mode of operation then you will start the software and in the splash screen click on the "Change Connection Type", the operation mode LED should lit and a message with instructions will appear.

It is worth noting that the first time you connect your unit to the host computer using the Ethernet communications channel it may take a while until Windows accepts the network as valid one

Fig. 17 It can take a few minutes for the Ethernet network to be identified.

Please be patient and wait for the network to be recognized by the operating system.

Fig. 18 The unit is now recognized as a public network.

Roving Mode of Operation

The SPG-1700 has a new mode of operation, roving mode. In this mode the unit will collect the radar data internally in the on board micro SD card. For this mode of operation to be available the unit has to be in WiFi mode. A properly formatted micro SD card must be present in the card bay and the unit has already recognized it as a working memory card. We recommend Samsung EvoPlus 16 or 32GB cards to be used with the SPG-1700.

Each profile will be saved with an increasing number from 00 to 99. When 99 files are stored in the memory card it is necessary to change the card for a new one or to remove the files from it.

To activate this mode one needs to go to "Settings" and check the check-box "Save to SD" and press "OK".

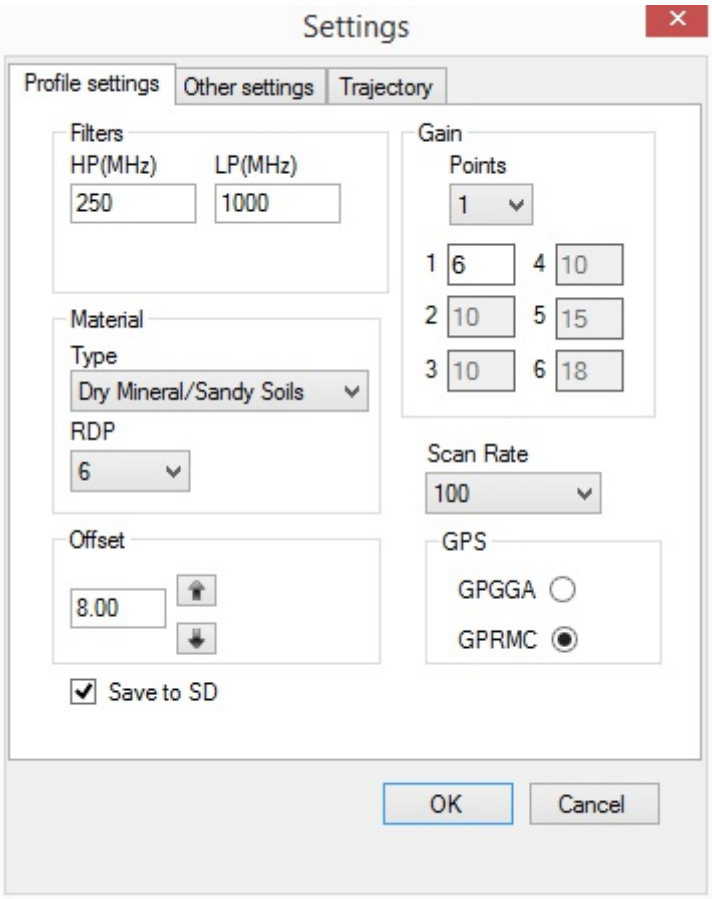


Fig. 19 The "Save to SD" check-box is available only in WiFi mode.

Now wen you return to the main application's window and press "Run" instead of showing the current data being collected a blank white screen is presented with a green lamp showing that the unit is within range and everything is OK. If the unit for any reasons will go off range then the green lamp will turn red.

It is important to know that even if the unit loses connection with the host computer the data will continue to be collected and when the unit enters the WiFi network range the lamp will change back to green and the file can be closed without loosing data.

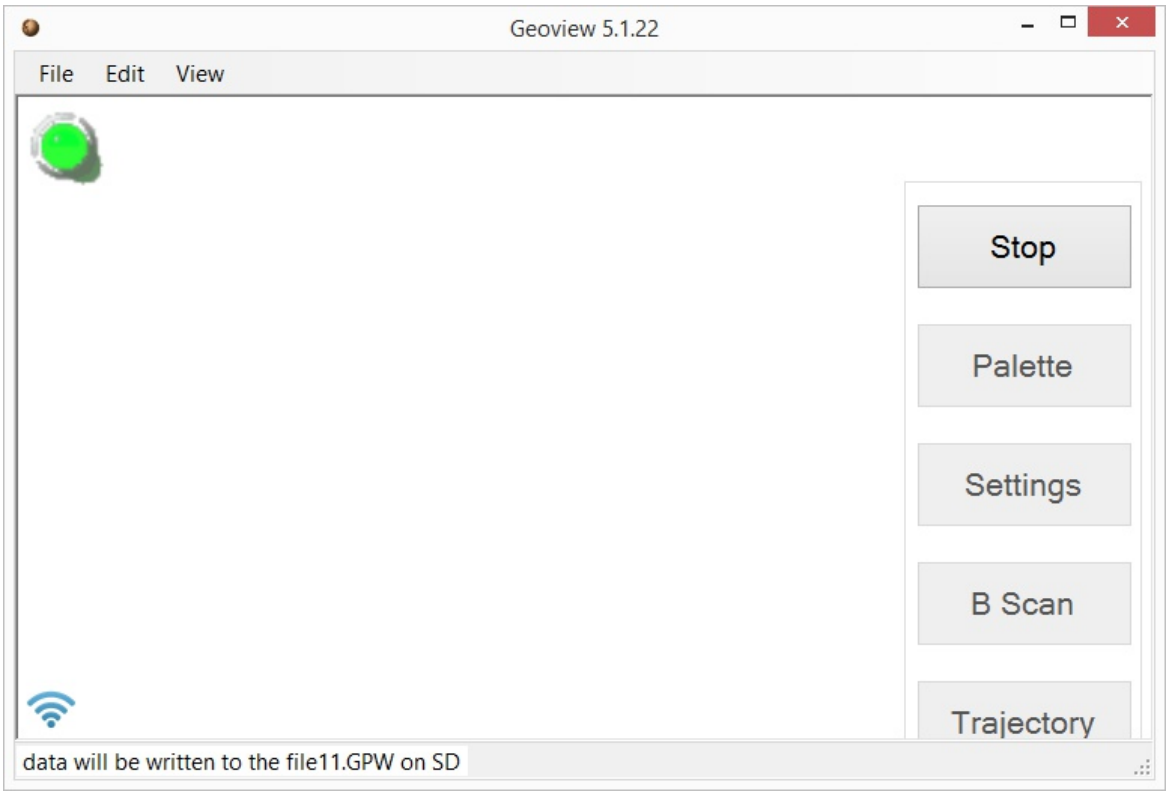


Fig. 20 Roving mode of operation.

The collected data files can be retrieved using the Geoview software splash screen. Click the button "Export File to .gsf". The unit doesn't have to be connected to the host computer for this operation to take place, but the memory card has to be connected to the host computer using any kind of memory reader. However, it is possible to remove the card from the unit while the unit is powered up and then use the main toolbar file drop down list and select "Export to .gsf" option.

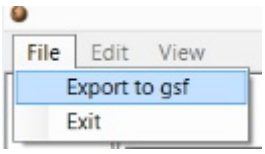


Fig. 20 Roving mode of operation.

A Windows browser will open and then you need to navigate to the location of your micro SD memory card and select the file you want to export and press "Open" to start the export operation. When the file has been successfully exported the first 500 traces will be shown and a message informing what the file name is will appear. The exported files are stored in My Documents/Geoscanners/Geoview500/FilesGSF/.

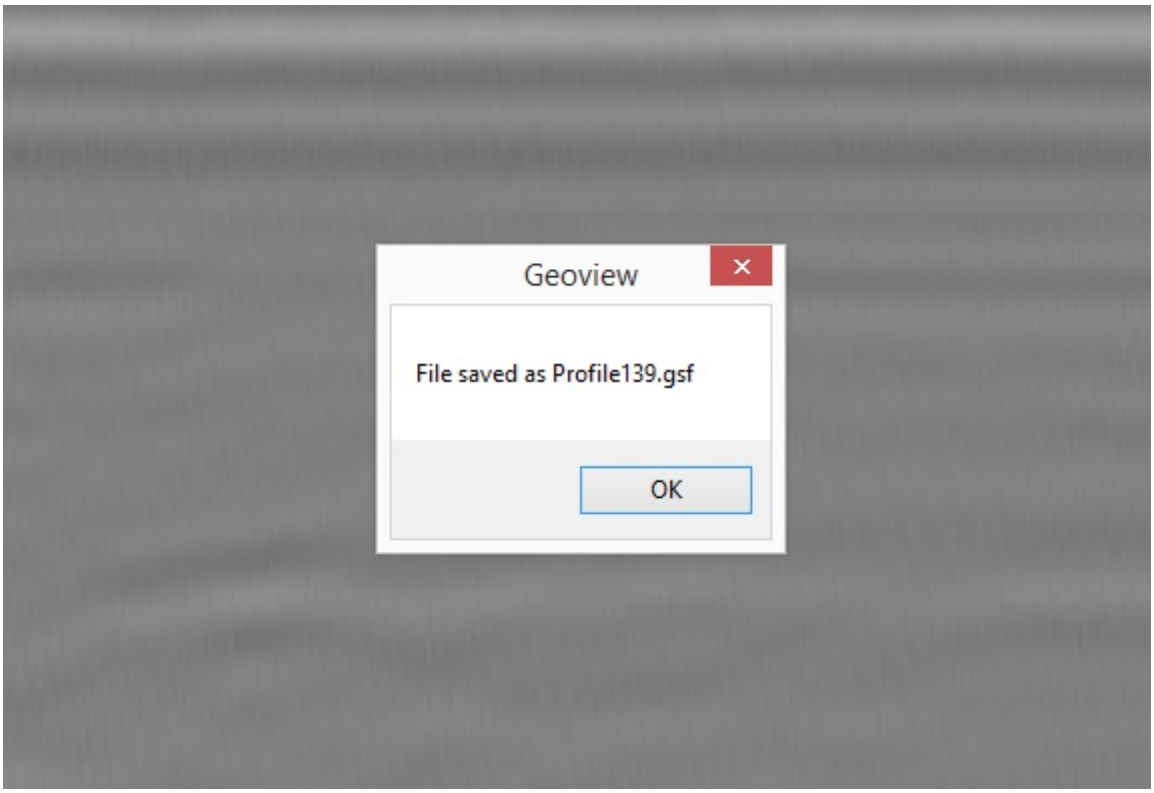


Fig. 22 Export operation completed successfully.

After the data has been exported into geoscanners file format it can be viewed or processed using our award winning software GPRSoft©. The data in the memory card is compressed and therefore not suitable for exporting into any other software.

Setting up the unit

Independently on the communications channel you have previously selected the work of the unit is similar from now on with a few exceptions that will be mentioned accordingly.

When the application loads you will have the main data window, the control panel on the right side and the status bar showing you relevant messages when the unit is working.

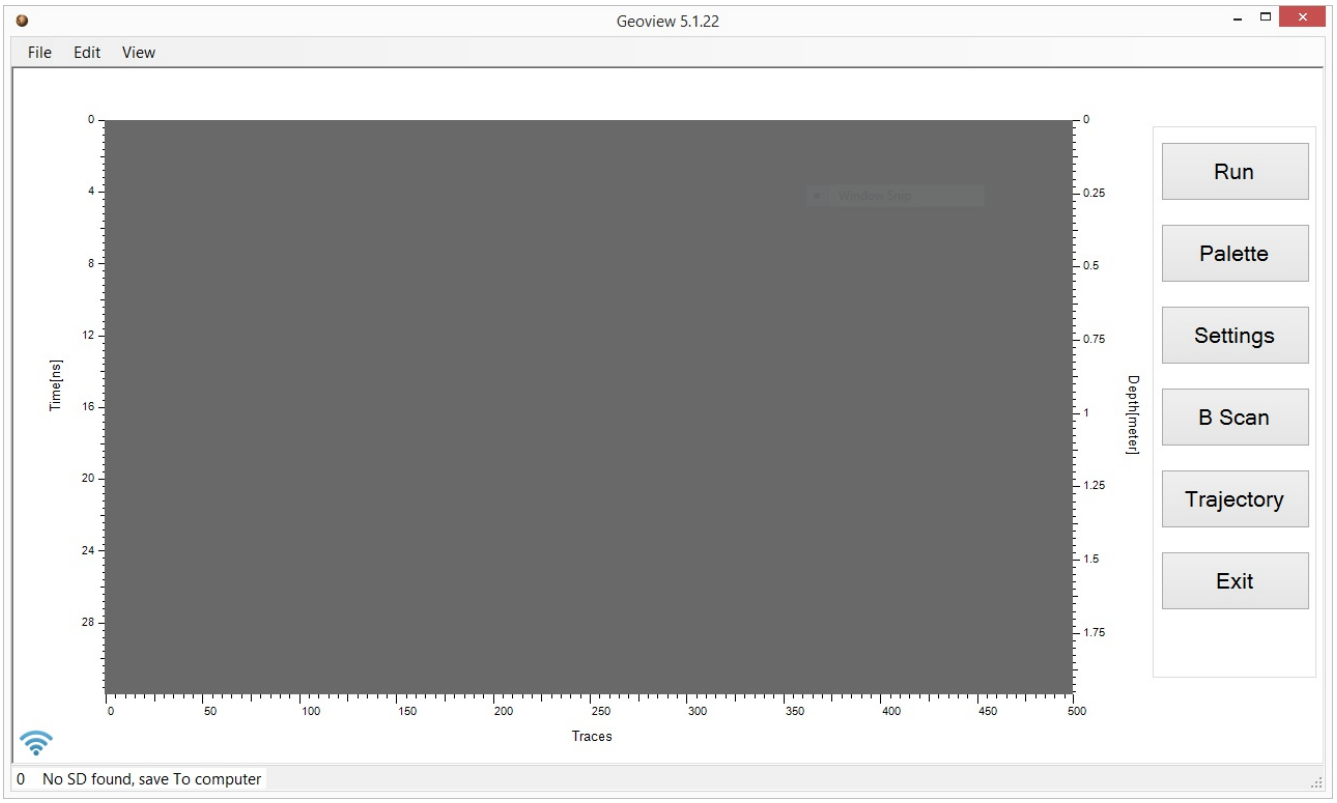


Fig. 23 Application Window

The buttons on the control panel have very intuitive functions as described by their names:

1. Run/Stop, starts or stops the collection of data
2. Palette, opens the palette selector window
3. Settings, opens the settings dialog box
4. B-Scan, switches between B-Scan view or Slice View. SliceView activates only if GPS precision allows it.
5. Trajectory, switches the main view between B-Scan/Slice and trajectory from GPS
6. Exit, closes the application

The menu bar has the same functions as the control panel if you prefer to navigate that way.

The data window shows the profile view of the data being collected with time range on the left, depth information on the right and trace numbers in the horizontal scale.

The status bar shows the connection actual status together with the NMEA sentence being gathered at the moment and the GPS coordinates if available. The current trace number is also being displayed in the status bar.

The software remembers all the settings you had during your last session, so if you are happy with the settings the only thing you need to do for each and every new survey is press the "Run/Stop" button and nothing else.

Profile Settings

The profile settings tab in the Settings dialog box can be summoned by pressing the "Settings" button in the control panel or by selecting it from the main menu bar.

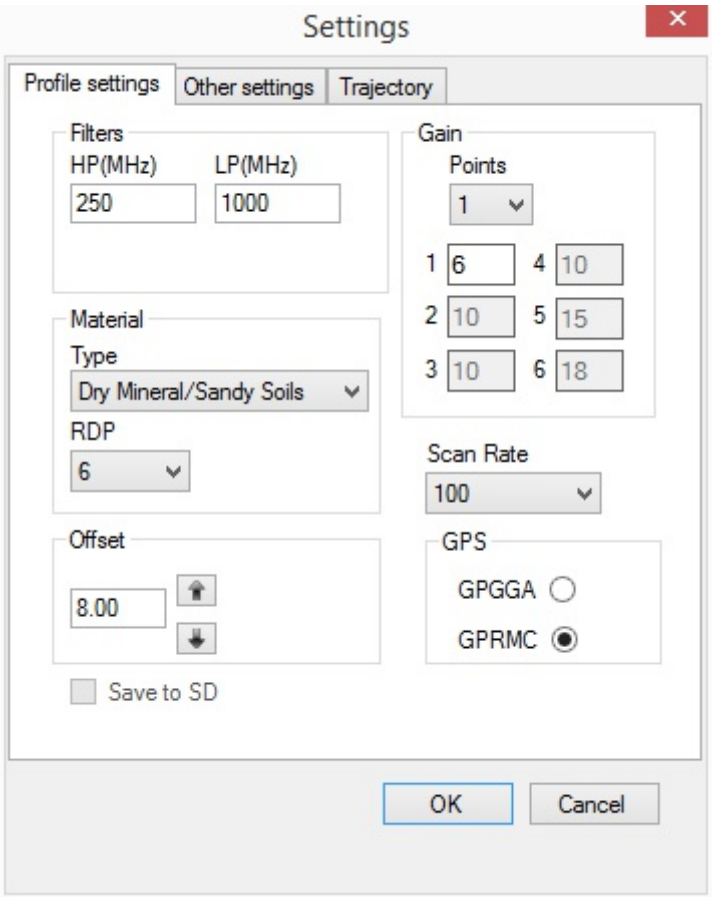


Fig. 24 Profile settings tab in the Settings Window

Again, all the settings here are straight forward if you are familiar with other ground penetrating radar units, but we will explain each one to avoid confusion and to aid those starting with this technology now.

The "Filters" box has two settings, the "HP(MHz)" or High Pass Filter which allows frequencies starting with the values selected here and above to be collected and the frequencies below the value to be heavily attenuated. The second setting, the "LP(MHz)" or Low Pass Filter allows frequencies below the value selected here to be collected and the frequencies above this value to be attenuated. This two settings together will create a "zone" of frequencies starting with the value in the high pass filter and ending with the value in the low pass filter to be collected. All frequencies outside this "zone" we created will be attenuated. The default values are most of the time adequate, but you may try adjusting them a little to get better data quality.

The "Gain" box has two settings, the "Points" and the points values, this is a gain curve compensating for the losses of the signal as it enters the material. Be careful when using these settings since it is very easy to distort the data beyond repair and the only way to get it back is to collect it again. A rule of thumb to follow is that every subsequent gain value has to be higher or equal to the preceding one. Adjust the settings so the data never becomes absolute white or absolute black anywhere in the profile window, that would be a good indication of signal saturation or "clipping" which should be avoided at all costs.

The "Material" box governs the "RDP" Relative Dielectric Permittivity value used for the depth calculation. Please keep in mind that this value will severely affect your readings so choose carefully. A rule of thumb is that soils or materials containing moisture will normally have higher values of the RDP.

The "Offset" button puts the starting of the signal on the profile. This setting is normally set by the hardware and should not be changed unless you don't see the transmitted or direct pulse in your data. Please note that if you don't have a starting point in your data as the reference you will have trouble finding out the correct depth information of your targets.

The "Scan Rate" drop down box allows you to select how many traces, or soundings per second you want to have collected. There is a selection between 10, 50 and 100 independently of the operation mode.

The "NMEA" box has a radio button allowing you to select the "GGA" or the "RMC" NMEA sentence from the stream coming from the GPS data channel.

Finally there is the "Save to SD" check-box. If the unit is operating in Ethernet mode this check-box is greyed out and the user has no access to it. If the unit is operating in WiFi mode then checking this check-box will eliminate data transfers to the host computer and the data will be stored locally allowing for roving mode.

Other Settings

The other settings tab in the Settings dialog box contains information about the unit system used and what kind of units. The system default is metric and meters, but you can select imperial system and feet or inches if necessary.

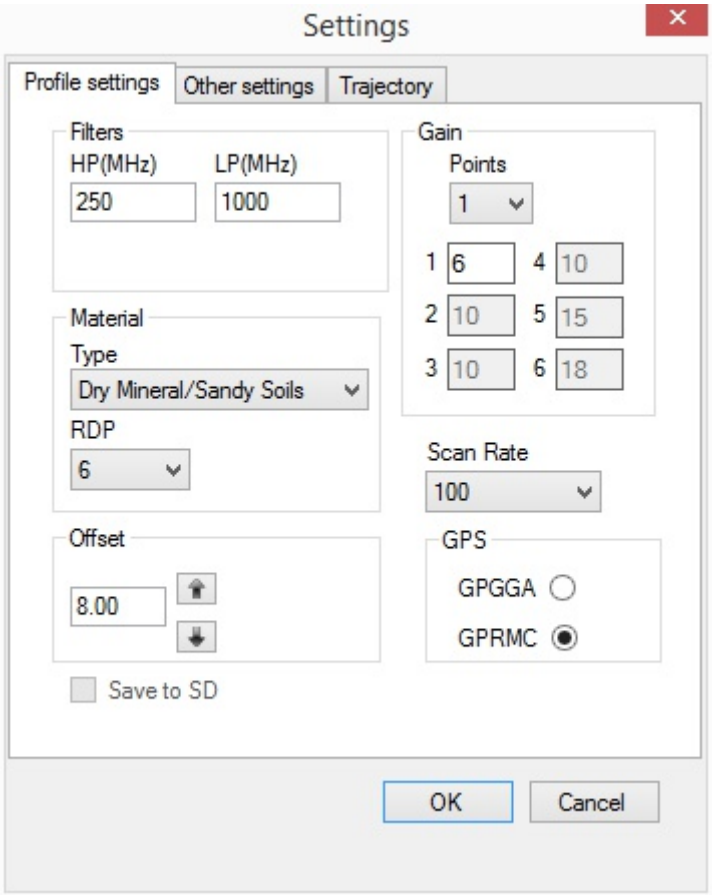


Fig. 25 Other settings tab in the Settings dialog box

The amount of slices is used to generate the 3D "bird view" slices when activated. Please note that this will not have effect if the resolution of the GPS is not enough for creating the 3D grid.

The check box for saving the files automatically can be unchecked if you prefer to be prompted every time the stop button is pressed after collecting a file.

Trajectory

The final tab in the Settings dialog box is the trajectory one. Here we setup the size of the grid we want to collect and the cell size for the grid. This is very important since this will define the actual size of the objects you can map.

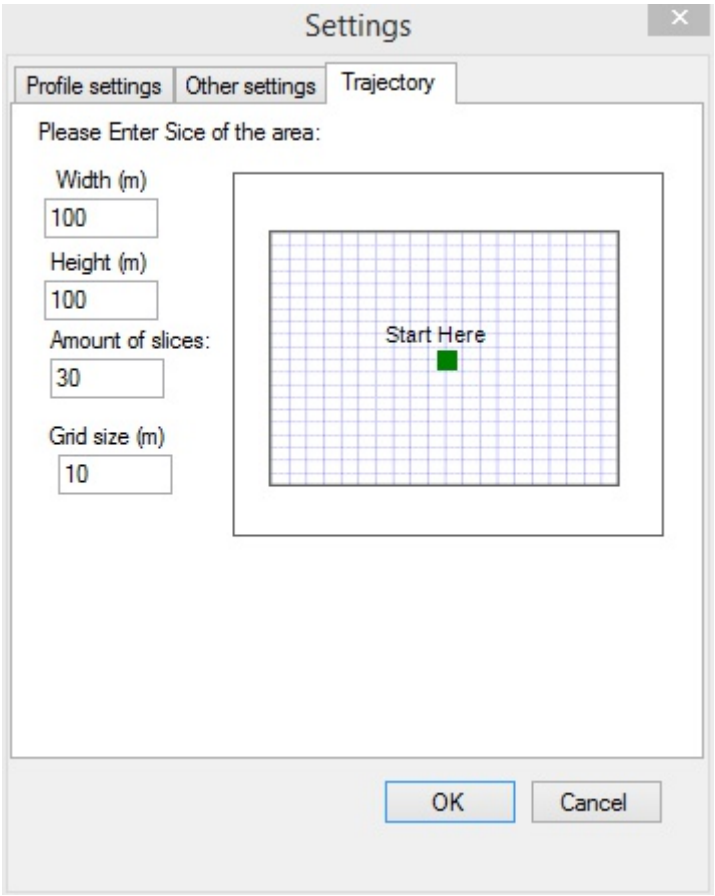


Fig. 26 Trajectory tab in the Settings dialog box

The grid size has to be one quarter of the object size you are trying to map. For instance, if you are trying to locate small objects with a diameter of 20cm you need to collect your data with 5 cm cells to be able to produce reliable data. Obviously, your GPS receiver has to provide you with that kind of accuracy otherwise this will not work. For larger objects from 0.5 meters and up more manageable grids can be built, please keep always in mind that the accuracy of your receiver will determine if you can use this feature or not. The first step would be to pass over the area of interest and let the GPS gather the coordinates, if the resolution is enough you will be informed that the grid was collected if not no "bird view" or 3D slices will be generated.

Palette

The palette button in the control panel summons the palette dialog box. This is a simple selection of palettes, no editing features are available here. To select a palette from the choices in the window simply press on it with your mouse and it will be active next time you start collecting data. Press "OK" to exit this dialog box. Please note that no palettes will be applied to the already collected data though.

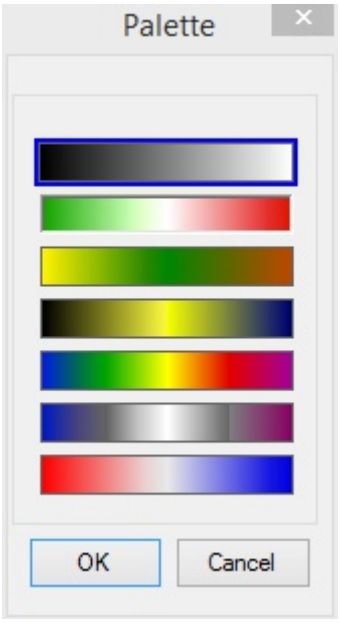


Fig. 27 Palette dialog box

Appendix 1

Installing GeoView

Installing the application software is straight forward. Start the GeoView program you got from Geoscanners AB.