# RO-400 2D
# Through Wall GPR-Detector

## Technical Description

### User Manual

Logical Systems LLC

**Moscow**
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# Contents

## 1. General safety rules and certification

To avoid injuries and damage to this product it is necessary to observe the following safety rules:

- Avoid strong shock impact and mechanical damage when using and transporting the device.
- Only users who have been trained or acquainted with the operation manual can operate the device.
- Only qualified personnel can perform servicing of the device.
- To avoid electric shock hazard do not disassemble device either partially or completely.
- Do not touch stripped parts of wiring. Do not touch non-insulated connections and live components.
- Do not repair this device yourself otherwise you can damage it.

Level of radiation power of the device is not hazardous for humans that is confirmed by Safety and Health Certificate
No. 50.99.04.431.ı .008785.07.07 dated 03.07.2007

## 2. Purpose

GPR detector is an instrument developed on the basis of the GPR technology and is designed for detection of various objects, including people buried in avalanches or under fragments of engineering structures as a result of man-made disasters. GPR detector is used for solving survey tasks ï to reveal hideouts, caches, saps, underground passes and utilities, criminal burials, hidden explosive devices and shells in engineering structures.

## 3. Principle of operation

The operation of GPR detector is based on the well-known principles of radiolocation. The property of radio waves to reflect from the media interface with different capacitive is the basis of the adopted method of detection.

Subsurface radiolocation employs short pulse signals. For these pulses to be formed, the use is made of broadband antenna excitation by voltage change with a leading edge of short duration. Direct processing of pulses of such short duration (hundreds of picoseconds) is quite difficult. Therefore the use is made of a method referred to in the literature as stroboscopic conversion.

The control unit generates commands, which are sent to receiving or transmitting units. The transmitting device generates signals, which are emitted by a transmitting antenna into medium being investigated. Echo signals are received by a receiving antenna, processed in receiving unit and forwarded to the processing and indication unit.

The processing and indication unit produces 2D image of received signals and displays them on a real time basis. If required, remote unit with LCD display can be connected by a cable of 50.0 m long to duplicate information from the monoblock screen.

To ensure connection with external PC, the device is furnished with a special connector to connect GPR detector and PC via Ethernet interface.

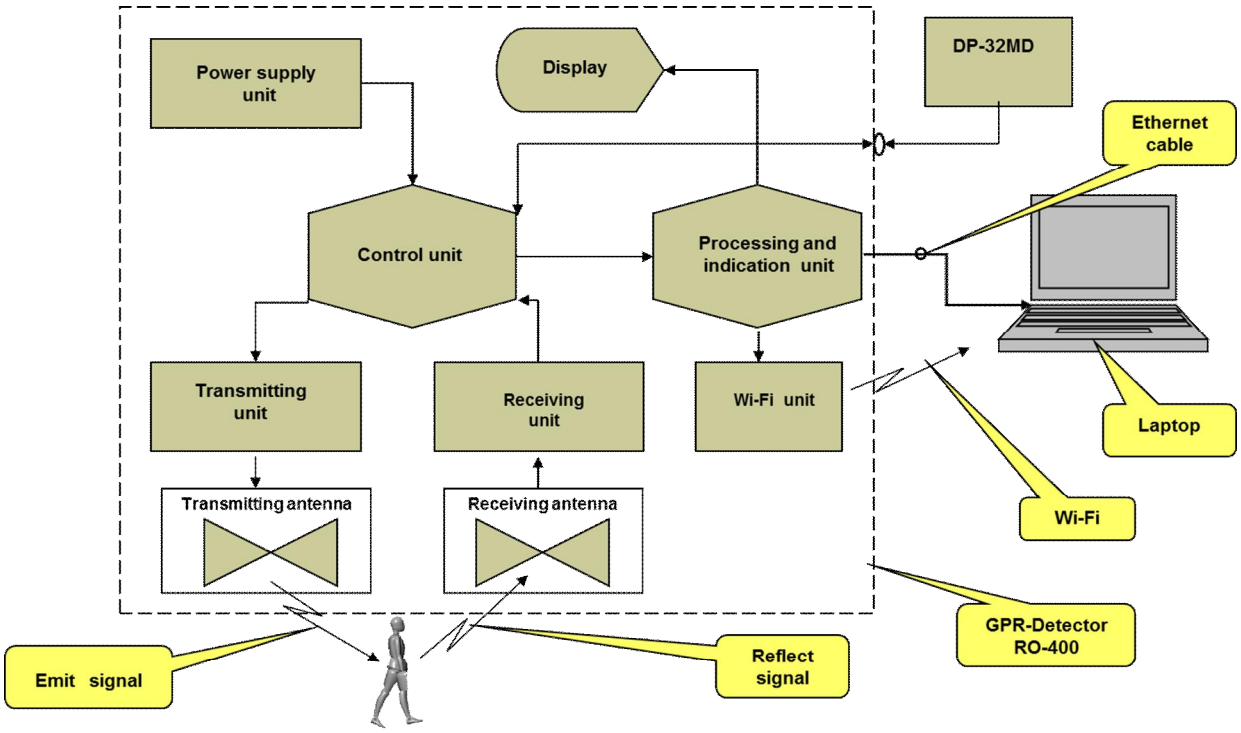


**Fig. 3.1 GPR detector function block diagram**

## 4. Components and technical specifications of GPR detector.

GPR detector consists of the following units*:

1. Monoblock with LCD display (Fig. 4.1).
2. Power supply unit.
3. Laptop.
4. Movement sensor DP-32J D (or DP-32).
5. Ethernet cable, 10.0 m.
6. Tripod.
7. Charger.
8. Bedplate.
9. Handle bar.
10. Documentation.
11. Transportation bag.

**Fig. 4.1 RJ -400 GPR Detector**

Software:

1. GeoScan32 software is designated for processing the files when copied to PC;
2. Detector software is designated to record sounding results to PC.

* ï GPR detector packaging is a choice of a Customer.

### 4.1 GPR detector monoblock RJ -400

Specifications:

- Center frequency ï 400 ʃ Hz
- Dimensions ï 396 ×286 ×155 (mm)
- Weight ï 4.3 kg
- Minimum continuous operation time ï 4 hrs
- Standard - Iţ 66
- Operating temperature range: from -20 to +45°ъ

Operating modes:

Ѳ). The moving object detection mode is set for:

- detection of moving people at a distance of minimum 7.0 m through a 0.6m width concrete wall or at a distance of minimum 12.0m through a 0.35m width brick wall;
- control of GPR detector via a 10m length cable by means of the software on PC;
- continuous self-contained monitoring and recording of survey results;

в). The search GPR mode is set for:

- surveying depth (for soil): min. 5.0 m;
- resolution: not worse than 0.15 m.

### 4.2 BP-3,8/12ъl Power Supply Unit

BP - 3,8/12ъl power supply unit is designed for power supply of GPR detector. BP - 3,8/12ъl power supply unit comprises storage batteries. Ni-MH batteries are used as storage batteries.

**Features:**

- The batteries are designed for at least 500 cycles of discharging/charging;
- Due to low self-discharge rate the batteries storage period with working parameters not being deteriorated is up to one year.

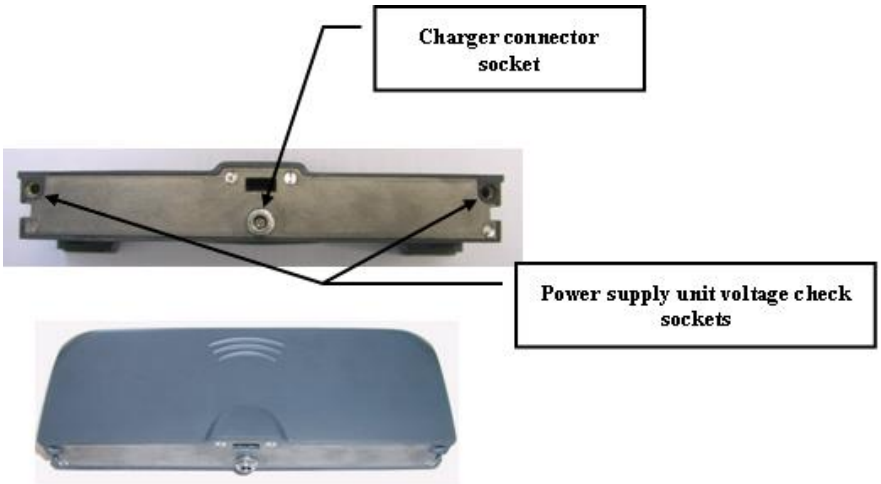


**Fig. 4.2. BP-3,8/12ъl Power Supply Unit**

In the course of Ni-MH batteries operation, so called memory effect occurs which results in actual memory reduction. To decrease the likelihood of such effect, the storage batteries training every six months or after lengthy downtime is essential, i.e. several cycles of full batteries

discharge with subsequent full charging. To recover the batteries capacity, it may take up to 3-5 such discharging/charging cycles.

### 4.3 ZU-9/12 Charger

Microcontroller automatic charger (fig. 4.3) with discharge function is meant to charge BP- 9/12 power supply unit.

**Fig. 4.3 ZU-9 Charger**

**Features:**

- Charging is controlled by ñæU methodò and stop watch;
- Testing phase before the charging process start enables to identify faulty batteries;
- Polarity reversal protection;
- Discharge function to train the storage batteries;
- Automatic switchover to trickle charge mode ï charging with low current once the battery is full;
- Charging process is indicated by built-in LEDs.

**Description of LEDs indications:**

**When the LED is lit:**

- red ï charging is ongoing;
- yellow ï discharging is ongoing;
- green ï battery is full and trickle charge mode is on.

### 4.4 DP-32 (DP-32ʃ D) Movement Sensor

DP-32ʃ D Movement Sensor (Fig. 4.4) is used during the travel of GPR detector in GPR mode along the surface being surveyed and is meant for precise referencing of the search results to surveyed terrain coordinates. DP-32ʃ D Movement Sensor is designed for operation in adverse weather conditions. The sensor is electrically connected to the monoblock by a cable, which links sockets between the monoblock and movement sensor.

**Fig. 4.4 DP-32ʃ D Movement Sensor**

### 4.4 Bedplate

Bedplate (fig. 4.5) is designed to accommodate GPR detector when sounding in GPR mode.

**Fig. 4.5 Bedplate**

### 4.5 Handle bar

Handle bar (fig. 4.6) is designed to move GPR detector installed on the bedplate when sounding in GPR mode.

**Fig. 4.6 Handle bar**

### 4.6 Tripod

Tripod (fig. 4.7) is designed to secure GPR detector monoblock when sounding in standalone mode or setting-up GPR detector next to the wall through which sounding is conducted.

**Fig. 4.7 GPR detector Tripod**

### 4.7 Tablet PC «Android»

Designed for connection the RO-4002D via Wi-Fi.


**Fig. 4.8 Tablet PC «Android»**

### 4.8 Wireless router

Designed for connection the RO-4002D via Wi-Fi with a laptop or tablet computer.

**Fig. 4.9 Wireless router**

### 4.9 Tripod for wireless router

Designed for fixing wireless router.

**Fig. 4.10 Tripod for wireless router**

### 4.10 Additional antenna

Designed to implement the detection in the 2D mode.

**Fig. 4.11 Additional antenna**

# 5. GPR Detector Operation.

## 5.1 GPR detector preparation

Remove Rʃ -400 GPR detector and BP-3,8/12ʁl power supply unit from the bag. Insert charged power supply unit into the GPR detector along the guides in the GPR detector body as shown in Fig. 5.1 until clamping lock operates (distinctive click). To remove the power supply unit, press the power supply unit clamping lock on the GPR detector body and pull the power supply unit out by moving along the guides.


**Fig. 5.1. Installation of the power supply unit into GPR detector**

There are the sockets in the bottom part of GPR detector (fig. 5.2) to connect cables available in the GPR detector set as well as the bracket to secure GPR detector on the tripod.

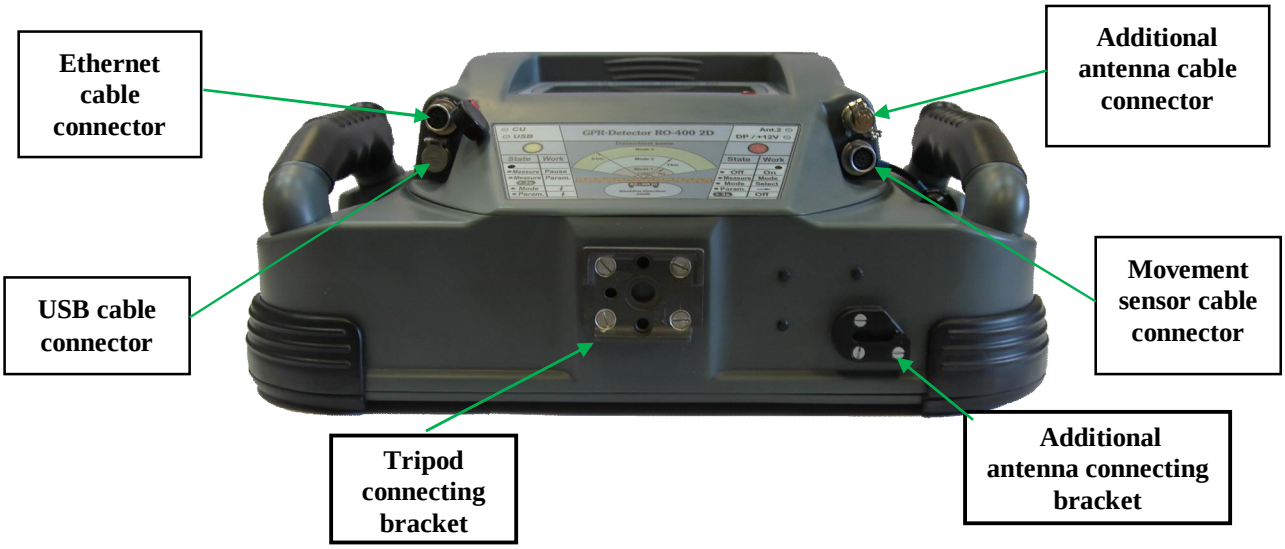


**Fig. 5.2. Arrangement of sockets to connect cables to GPR detector**

To carry out sounding by means of GPR detector in GPR mode, the following is required:

- install Rʃ -400 monoblock onto the bedplate (fig. 5.3);
- attach handle bar to the bedplate bracket, for which purpose retract spring-loaded bracket retainer, insert the handle bar into the bracket slot and release the retainer so that it enters into the handle bar bottom part hole;
- attach DP-32ʃ D movement sensor to the bedplate bracket found at the opposite side of the handle bar attachment bracket, for which purpose repeat the operations mentioned in the previous item. The handle bar attachment bedplate bracket and movement sensor attachment bracket are similar in design;
- connect electrical connectors on the movement sensor and GPR detector by DP cable.


**Fig. 5.3. Rʃ -400 set to carry out sounding in GPR mode**

In the course of sounding in the movement detection mode with application of the tripod (fig. 5.4), the following is required:

- draw off Rʃ -400 tripod attachment platform lever counterclockwise up to the stop (fig. 5.5) and retain it in this position;
- install GPR detector on the tripod platform so that the bracket configuration in Rʃ -400 bottom part matches the tripod platform configuration;
- by retaining the monoblock body, turn Rʃ -400 tripod attachment platform lever clockwise up to the stop.

**Fig. 5.4. GPR detector secured on the tripod**

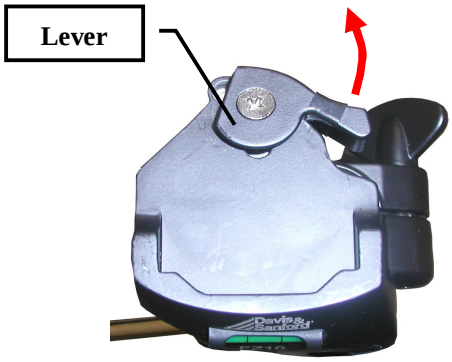


**Fig. 5.5. Tripod platform to accommodate GPR detector**

### 5.2 Charging of BP-3.8/12 Power Supply Unit

BP-3,8/12 ʁl power supply unit charging is performed in the following sequence:

- connect the charger and BP-3,8/12 power supply unit as shown in fig. 5.6;
- connect ZU-9 charger to electric main of 220V, 50 Hz;

**Fig. 5.6. ZU-9 charger assembly for BP-3,8/12 charger**

Once the charger is connected to the power supply unit, the charging process starts automatically. The storage battery testing phase goes in the first place and last for around 10 sec; at that, the red LED blinks on the charger body.

Upon completing the testing phase, BP-3,8/12 ʁl charging process begins, which is indicated by the permanently lit red LED. Charging of fully discharged power supply unit takes not more than 5 hours.

Once the charging process is over, the green LED lights up, while the red LED is not lit and the charger goes into trickle charge mode. The storage battery is now charged but may remain indefinitely connected to the charger.

### 5.3 Sounding techniques by GPR detector

Employment of the GPR detector for detection of moving objects depending on the surveying conditions and requirements (operational monitoring or long-term monitoring, the operator is located in the immediate vicinity or at some distance from the wall of the building being surveyed, etc.) is provided in the following modes

1. Monoblock surveying. Operator is holding the monoblock by the handles and presses it against the wall through which the limited access room is being surveyed. The results are shown to the operator on the monoblock display. Should there be any people next to the operator, they are expected not to move.
2. Tripod-mounted monoblock surveying. The monoblock is mounted on the tripod and positioned at a distance not exceeding 0.5 m from the wall through which surveying is performed or is pressed against the wall by adjusting the monoblock position on the tripod and by means of three adjustable legs of the tripod. The operator is viewing the results staying close to the monoblock or at some distance from it.
3. Surveying by means of a laptop connected to the monoblock by a cable. The monoblock is mounted on the tripod and positioned at a distance not

exceeding 0.5 m from wall or is pressed against the wall by adjusting the monoblock position on the tripod and by means of three adjustable legs of the tripod. The monoblock is connected to the laptop by a cable (up to 10.0 m long); the results may be viewed on the laptop display at some distance from wall depending on the cable length.

4. Scanning with application of laptop (Windows operational system) or tablet (Android operational system), connected to monoblock via Wi-Fi. The monoblok to be fixed on tripod, put at distance no more than 0.5 m from wall, through which sounding is being done, then by adjusting tripod bars put the monoblok close to the wall. There are two ways of the connection :
   There is built-in Wi-Fi module in the monoblock. To activate is necessary to select Wi-Fi mode in the monoblock menu. Outlet radio-modem is included to the set. To switch it on is necessary to join monoblock to the radio-modem thru cable line, place radio-modem separately in a distance from the monoblock. Outlet radio-modem application increases Wi-Fi network zone. It is possible to observe scanning collected data on laptop screen, same time the operator is in a distance from the wall. In running Radar Detector search survey operations in Geo Radar mode, scanning data can be seen on monoblockôs or tabletôs screen, the tablet in such case is to be connected to the monoblock via Fi-Fi line.

When carrying out survey operations by GPR detector in GPR mode, the sounding results may be observed on the monoblock screen or on the laptop screen connected to the monoblock via a cable.

### 5.4 Selection of GPR detector sounding modes and parameters

Switch on Rʃ -400 power supply by pressing the red button. Within 3 ï 5 sec automatic GPR detector software testing goes on following which the moving objects detection mode will automatically set off.

The GPS detector software controls the operation modes, enables to visualize and store sounding results both in the movement detection mode and GPS mode. Fig. 5.9 shows the program menu structure of the GPR detector, which allows the operator to make settings and modes switchover.

Pressing of the red button at the started mode of detection of moving objects causes main the menu (the Fig. 5.7) a GPR-detector, pressing of the yellow button gets out the necessary option, the chosen option becomes more active pressing of the red button.

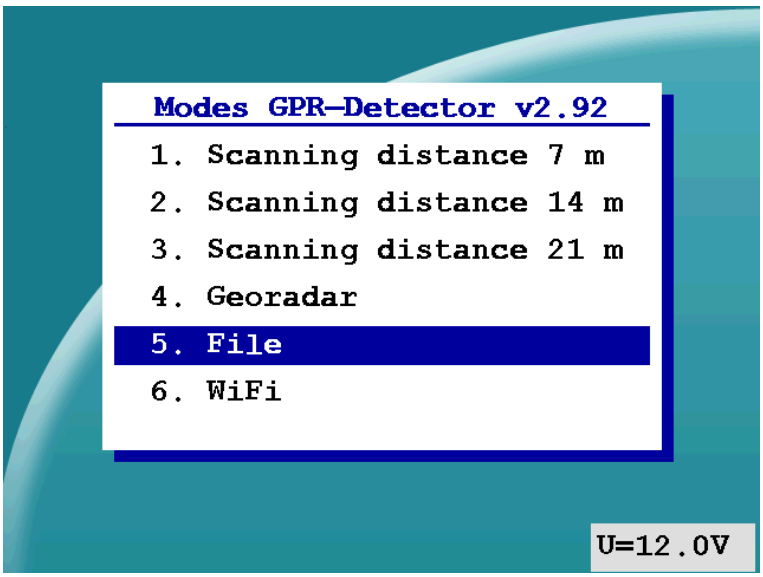


**Fig. 5.7 The main menu of a GPR-detector**

Points of the main menu of a GPR-detector designate following options:

1. «Detection to 7,0dʒ» ï the maximum distance of detection of moving object behind a barrier is equal to 7,0 meters;
2. «Detection to 14,0dʒ» - the maximum distance of detection of moving object behind a barrier is equal to 14,0 meters;
3. «Detection to 21,0dʒ» - the maximum distance of detection of moving object behind a barrier is equal to 21,0 meter;
4. "Georadar" - GPR-detector switching in a GPR mode;
5. "File" - is caused the menu "File" (a Fig. 5.8) with which help it is possible: to open for viewing the kept file (button click to "Open" the list of the kept files opens, the chosen file opens for viewing). To remove not the necessary kept file (button click to "Remove" the list of the kept files opens, the chosen file will be removed). The option to "Format" is applied in case of failure in the GPR-detector program when it is not possible to open kept files, after formatting there is a removal of all kept files.
6. «Wi ï Fi» - inclusion of a mode of transfer of search results on channel Wi-Fi from the antenna block on the block managements (laptop).

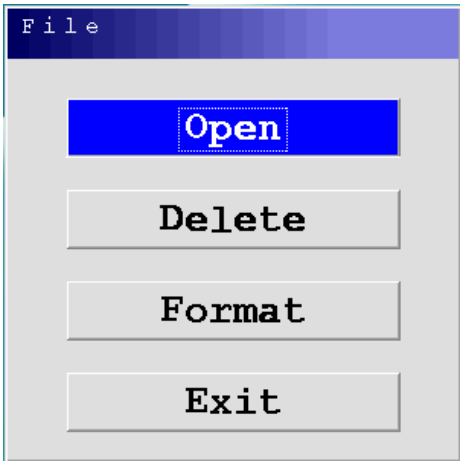


**Fig. 5.8 The menu «File» of a GPR-detector**

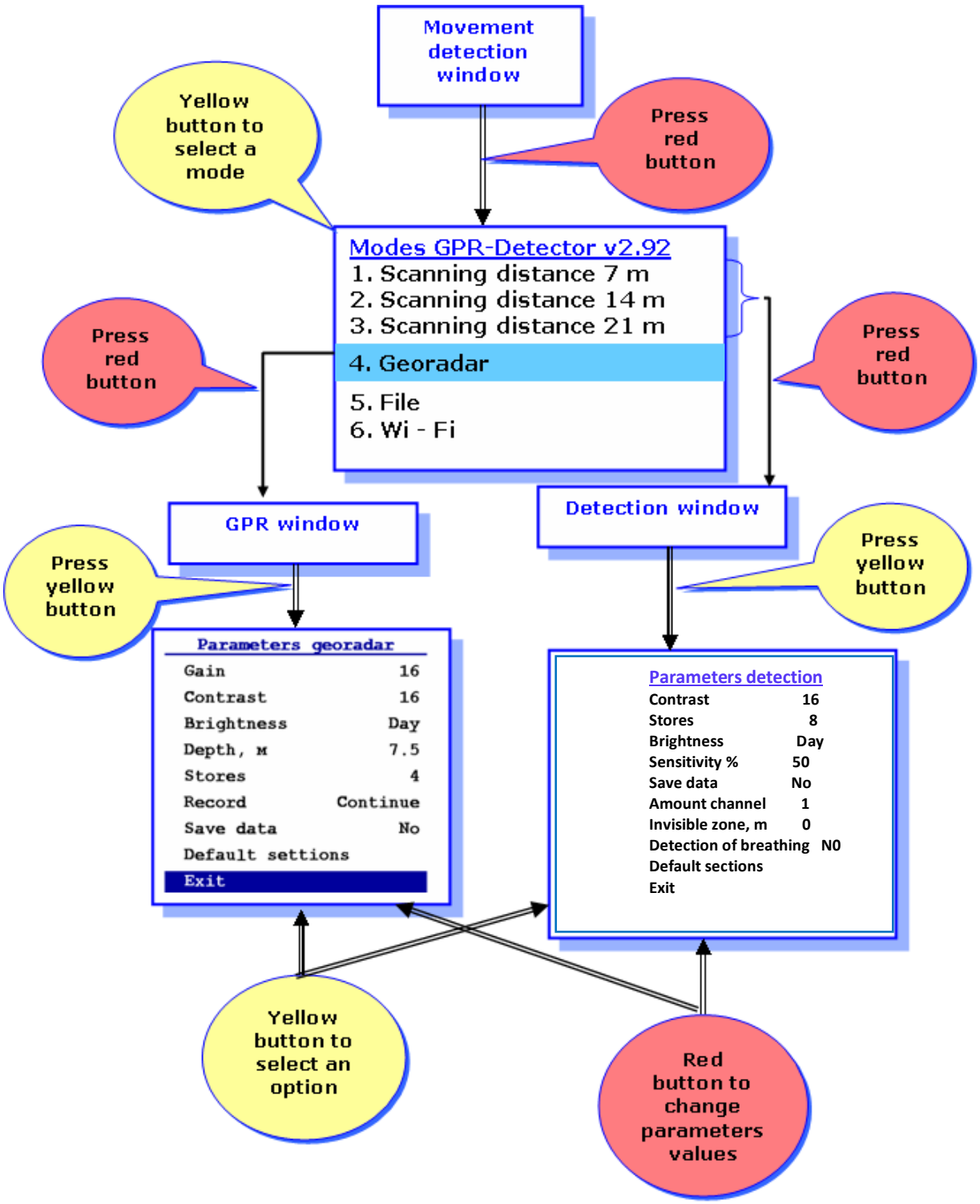


**Fig. 5.9 GPR detector program menu structure**

Table 5.1 and 5.2 show designations and functions of the parameters adjusted by an operator.

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| Sl. No. | Option | Function | Factory settings value |
|---|---|---|---|
| 1 | Brightness | Adjust the Gadget backlight level depending on the ambient lighting | 1 |
| 2 | Contrast | Modifies visualization contrast of signals reflected. | 16 |
| 3 | Stores | Defines measurement retrial value to accumulate reflected signals. Parameter increment increases detection sensitivity, however the screen redraw speed slows down. | 8 |
| 5 | Sensitivity general, % | Modifies sensitivity of moving objects detection algorithm throughout the range. | 20 |
| 6 | Invisible zone, m | The area, where moving objects cannot be found | 0 |
| 7 | Detection of breathing | Detection of breathing stationary object | No |
| 6 | Save data | Moving objects detection with results storing in RO-400 memory. | NONE |
| 7 | Amount channel | 1 - 1,5D; 2 ï 2D | 1 |
| 8 | Exit | Exit into the moving objects detection mode. | |

**Table 5.1. Designations and functions of GPR detector parameters in the movement detection mode**

Seen below is the sequence of the device powering up, its modes and parameters selection by the buttons located on the GPR detector handles:

1. brief pressing of the red button ï the device powers up and movement detection mode sets off;
2. short pressing of the red button in movement detection mode ï menu call-up to select either the movement detection distance or GPR mode by pressing the yellow button;
3. brief pressing of the red button after the detection distance selection ï entry into detection mode with selected detection distance;
4. yellow button hold down during 5 sec with initiated detection mode or GPR mode ï call up of ñDetection parametersò or ñGPR parametersò menu according to the running mode of the GPR detector;
5. yellow button pressing selects the parameter in ñDetection parametersò or ñGPR parametersò menu (according to the running mode), pressing of the red button modifies the selected parameter value;
6. to power off the device, the red button should be pressed and held down for 5 sec. In any running mode, the power off window calls up (fig. 5.10), pressing of the yellow button selects ñYESò item and brief pressing of the red button powers off the GPR detector.

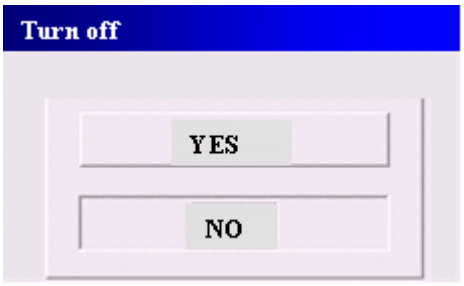



**Fig. 5.10. GPR detector power off window**

For the operatorôs convenience, there is a label under the monitor screen on the front panel of the GPR detector (Fig. 5.11), which indicates the procedure to select modes and parameters similarly to the one described in Items 1 ï 6 above.

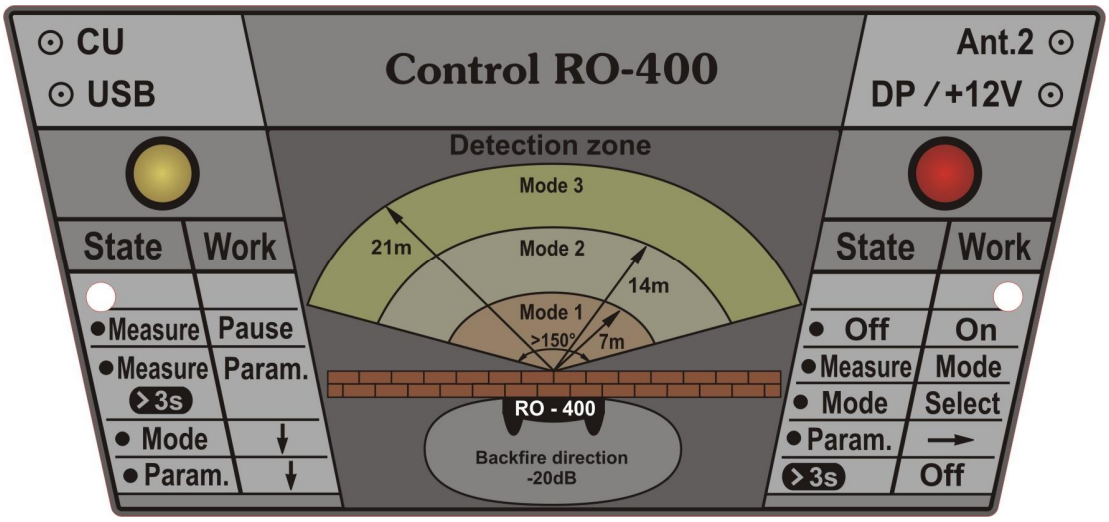



**Fig. 5.11 Table-scheme of the GPR detector modes control**

| Sl. No. | Option | Function | Factory settings value |
|---|---|---|---|
| 1 | Gain | Changes echo signal visualization brightness, reflected from long distances objects, Not affects detection quality | 16 |
| 2 | Depth | Requisite max sounding depth in the GPR mode is set to carry out survey operations. | 3.3 m (max 5,0m) |
| 3 | Brightness | Adjust the Gadget backlight level depending on the ambient lighting | 16 |
| 4 | Contrast | Modifies visualization contrast of signals reflected. | 16 |

| | | | |
|---|---|---|---|
| 5 | Stores | Defines amount of repeated reception of each track with their subsequent summing up. Increase of this parameter allows to reveal weaker signals, to increase actual sounding depth and enhance image quality, however at that the antenna unit traverse speed decreases during the profile recording. | 4 |
| 6 | Continuous recording | The mode during which survey operations are carried out w/o the use of the movement sensor, and the travel distance is not recorded. This mode is used when sounding out in the terrain where the use of the movement sensor is impracticable. | Continuously |
| 7 | Record by the wheel | The mode is used for sounding on relatively even surfaces. At that, by means of DP-32 movement sensor connected to ñDPò socket of GPR detector the sounding results are correlated with the distance covered by the operator. | |
| 8 | Save data | Sounding and storing of its results in the GPR detector memory. | Without storage |
| 9 | Default settings | Setting of the factory settings. | |
| 10 | Exit | Exit into the GPR mode with reset sounding parameters. | |

**Table 5.2. Designations and functions of GPR detector parameters in GPR mode**

### 5.5 Sounding results recording in a laptop

There is a provision in the GPR detector to record the sounding results both in detection mode and GPR mode to a laptop, which is connected to the GPR detector by means of a special 10 m long Ethernet cable. Schematic overview of the GPR detector connection to a laptop is shown in fig. 5.12.

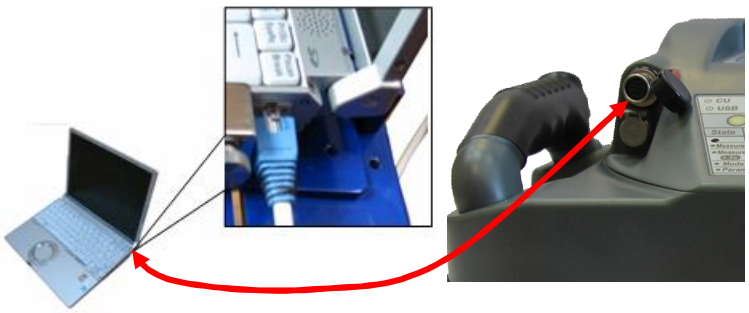


**Fig. 5.12 GPR detector connection to a laptop**

The procedure of the laptop recording of the sounding results is as follows:

- connect the laptop to the GPR detector by Ethernet cable as shown in fig. 5.12;

- depending on the desired sounding mode, install the GPR detector either on the tripod or on the bedplate (see Chapter ñSounding techniques by GPR detectorò);
- switch on the laptop power supply; once the computer is ready for operation, double click  tag (ñDetector.exeò) by the left mouse button on the desktop to enable monitoring of the sounding results on the computer screen both in the movement detection mode and GPR mode. After the program start, the computer screen will display the sounding radargram window (fig. 5.13) in the movement detection mode.

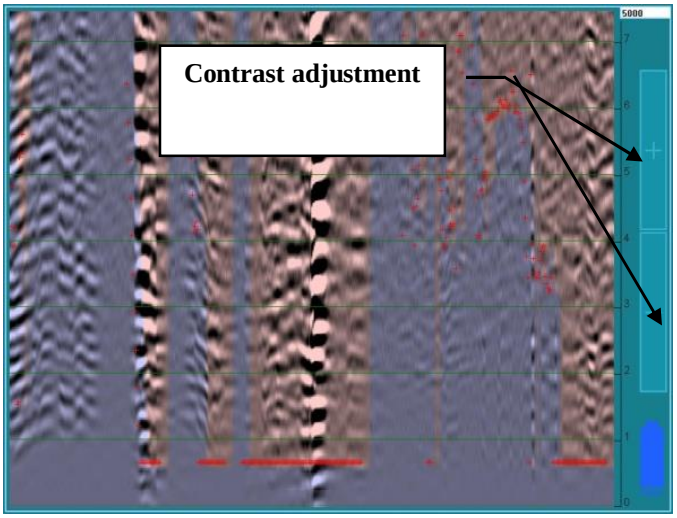



**Fig. 5.13 Detector program window after the program start**

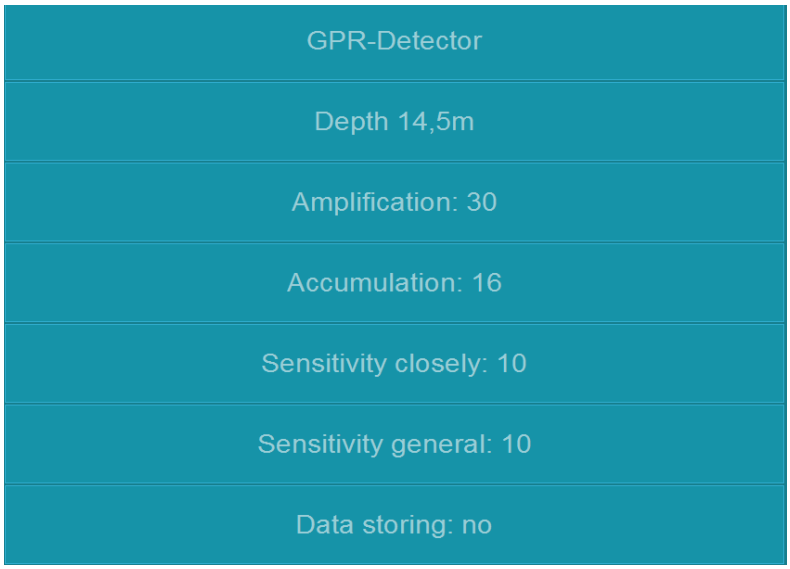



**Fig. 5.14 GPR-Detector menu Parameters**

In order to change the movement detection mode parameters, call up ñDetector Parametersò window (Fig. 5.14) in the running movement detection mode by the left mouse button (or stylus) double click in any laptop screen area. The ñDetector Parametersò menu of the movement detection mode is similar to the one integrated in the GPR detector. To switch over to GPR mode, press ñDetectionò button in ñDetector Parametersò menu, following which ñGPR ï Detectorò switchover menu appears on the screen (Fig. 5.15), where either the GPR mode or movement detection mode can be selected. ñGPR parametersò menu (Fig. 5.16) is called up by the left mouse button (or stylus) double click in any laptop screen area during the running GPR mode.

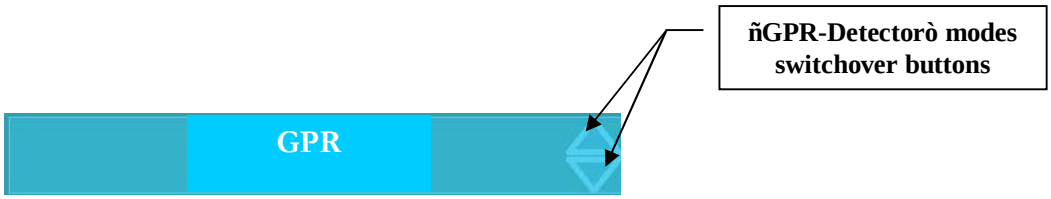



**Fig. 5.15 Menu ñGPR-Detectorò modes switchover**

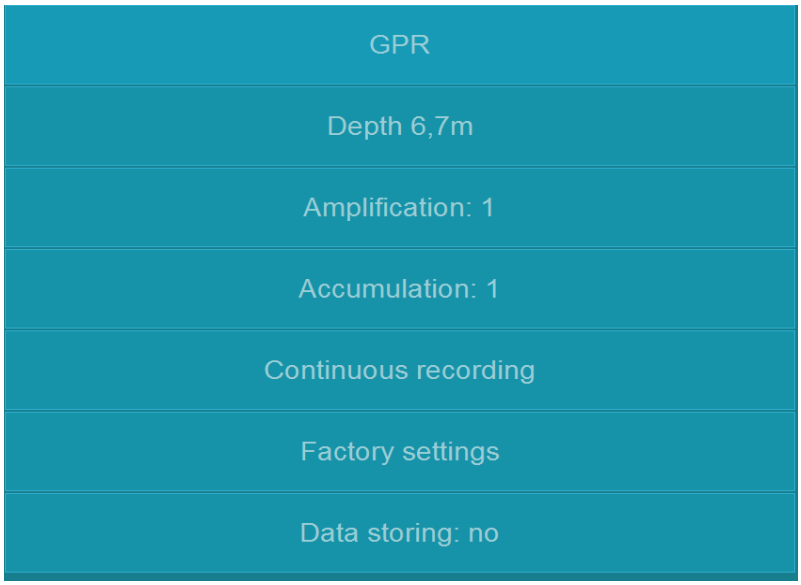



**Fig. 5.16 Menu ñGPR Parametersò**

For registration of results of sounding on the laptop with channel Wi-Fi application it is necessary:

- In the GPR-detector main menu to choose point «Wi-Fi», after activation of this point the screen of the monitor of the antenna block dies away;
- On the laptop which is included into the complete set, it is necessary to include channel Wi-Fi. For this purpose it is necessary to press the button laptop task bars,

on the monitor screen the list of accessible networks of wireless connection (a Fig. 5.17) will be displayed.

- To choose from the list an access point under a name «Logis», to press button "Disconnect" then the laptop should establish connection on channel Wi-Fi with a GPR-detector. Thus it is necessarily necessary to disconnect connections on a local network, having used «the Command control centre networks and the general access» the laptop;
- To start on the laptop program Detector;

On the screen of the monitor of the laptop there will be a picture similar described at GPR-detector a connection to the laptop by means of an Ethernet-cable.

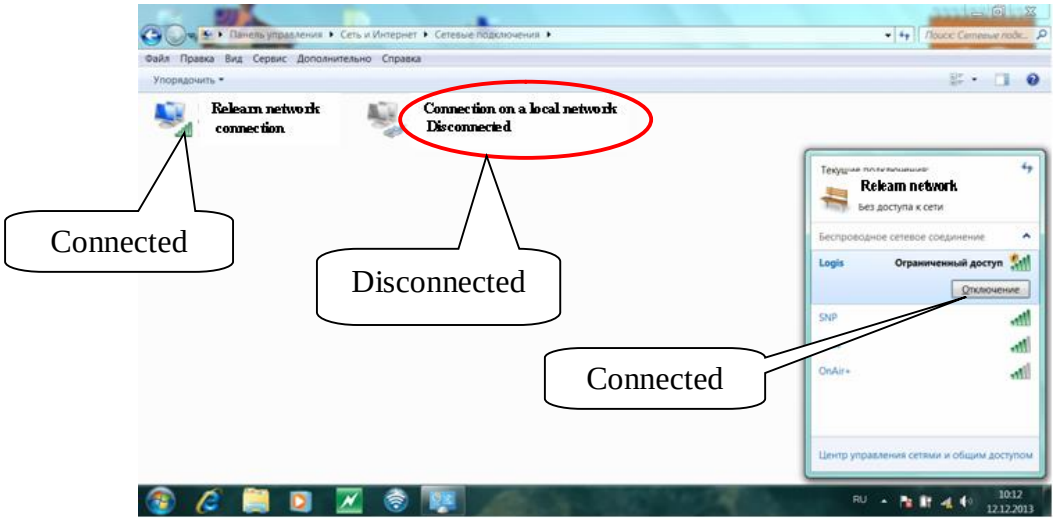



**Fig.17 The menu of the laptop for GPR-detector connection to the laptop by Wi-Fi**

### 5.6 Sounding results copying to a laptop

There is a provision made by the GPR detector software to save the sounding results both in moving objects detection mode and GPR mode. Saved files can be copied to a laptop as well, the files with .gpr extension available in the laptop memory can be copied to the GPR detector memory. To copy the saved files from the GPR detector to a laptop, do the following:

- switch on the laptop;
- connect your laptop to the GPR detector by USB cable available in the GPR detector as shown in Fig. 5.18;

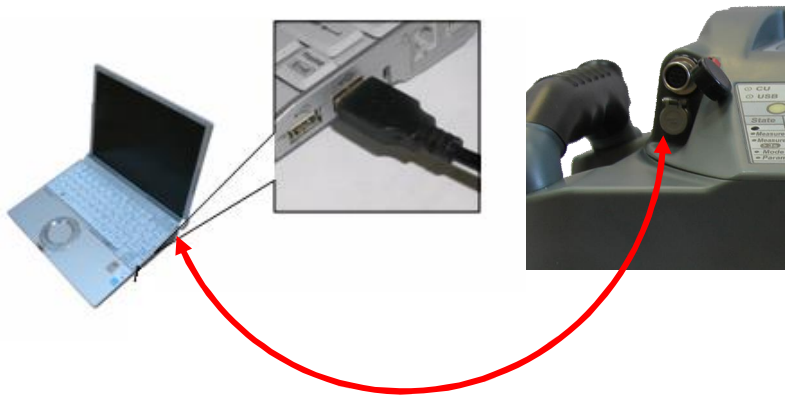


**Fig. 5.18 GPR detector and laptop connection diagram to copy the saved files**

- open ñMy computerò folder in your PC where the GPR detector is found as a removable disk. Then the files copy process is similar to that for any USB storage device.

Copied files are viewed and processed with the help of GeoScan32 program, which description is available in the supply package of the GPR detector.

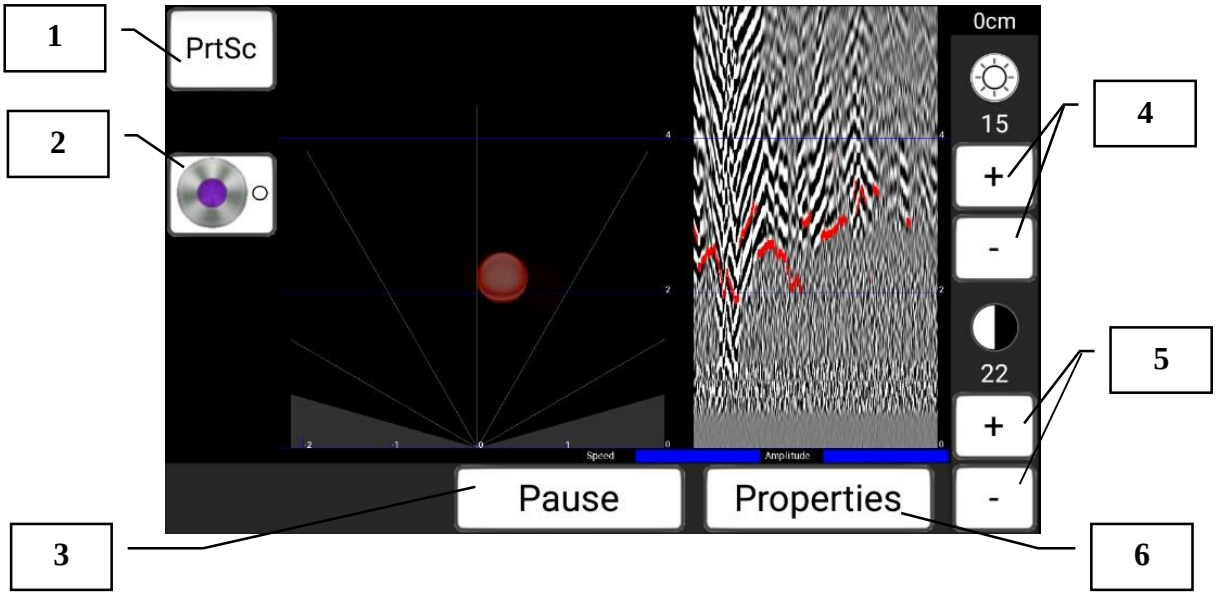
### 5.7 Scan data register to Tablet PC

There is possibility in the GPR detector to make survey as in detector mode, as in GPR mode, data will be transmitted to reinforced tablet PC, which is connected with GPR detector via Wi-Fi channel (built-in the GPR detector). The tablet PC is govern by finger touch to screen (touch screen).

For scanning data register to tablet PC via Wi-Fi channel by GPR Detector built-in Wi-Fi module is necessary :

- turn on GPR detector and tablet PC power supply ;
- select in gpr detector main menu ñWi-Fiò opion ;
- initiate the software by double click  («Detector.exe) icon on the working table ;
- after the software on the tablet has been initiated, Wi-Fi connection between GPR-detector and the tablet is to be built automatically .

after the software has been started up, on the tablet monitor is to be displayed GPR detector window in 2D mode (Pic.5.19).

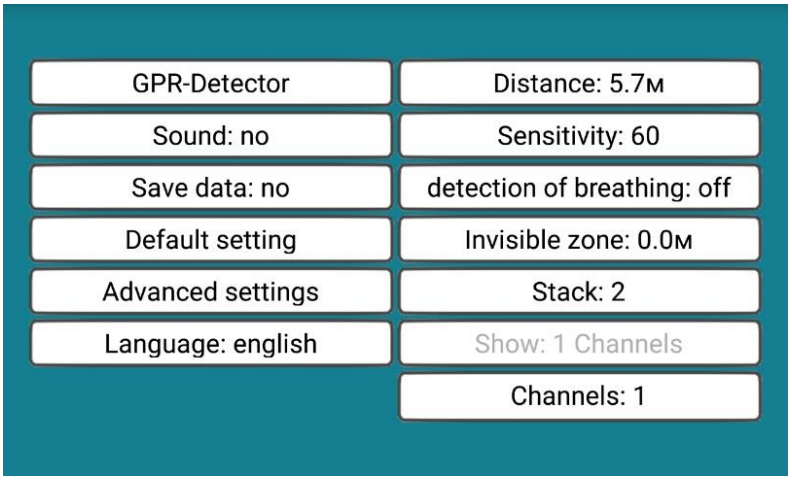



**Pic.5.19 The software window in 2D mode**

Software window control buttonsôapplication :

1. Record screen picture.
2. Record scan data .
3. Pause current screen picture.
4. Adjust the screen brightness.
5. Adjust the screen contrast.
6. Recall ñPropertiesòmenu .

In order to change sounding parameters, «Properties» button is to be pressed, after that window (see Pic.5.20) will be displayed on screen.



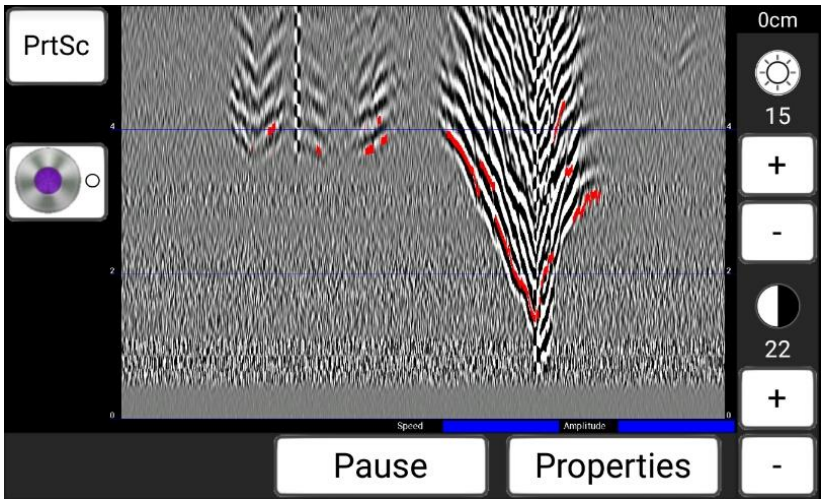

Pic.5.20 ñPropertiesòwindow menu

ñPropertiesòmenu parametersôapplications while operation tablet software are shown in table 5.3.

| Sl. No. | Option | Function | Factory settings value |
|---|---|---|---|
| 1 | GPR-Detector | Mode Switch to detection or GPR | GPR-Detector |
| 2 | Sound | Turn on sound signalization for detection | No |
| 3 | Save data | Save scan data | No |
| 4 | Default setting | Cancel early made set up parameters | |
| 5 | Advanced settings | Factory reset | |
| 6 | Distance | select detecting distance | |
| 7 | Sensitivity, % | Modifies sensitivity of moving objects detection algorithm throughout the range. | 20 |
| 8 | Invisible zone, m | The area, where moving objects cannot be found | 0 |
| 9 | Detection of breathing | Detection of breathing stationary object | No |
| 10 | Stack | Defines measurement retrial value to accumulate reflected signals. Parameter increment increases detection sensitivity, however the screen redraw speed slows down. | 8 |
| 11 | Channel | 1 - 1,5D; 2 ï 2D | 2 |

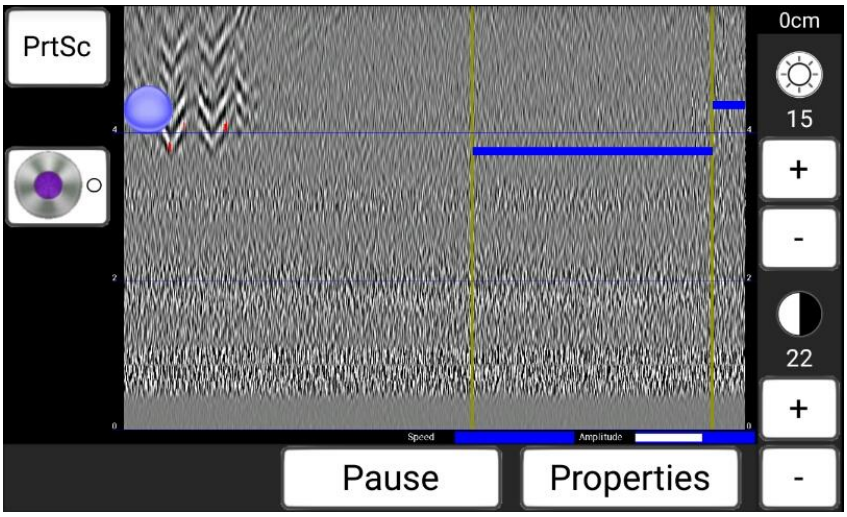
**Table 5.3 Designations and functions of GPR detector parameters in the movement detection mode**

To change the mode the GPR detector to 1.5D, channel number is selected equal to 1, after that picture on screen looks as per Pic.5.21..



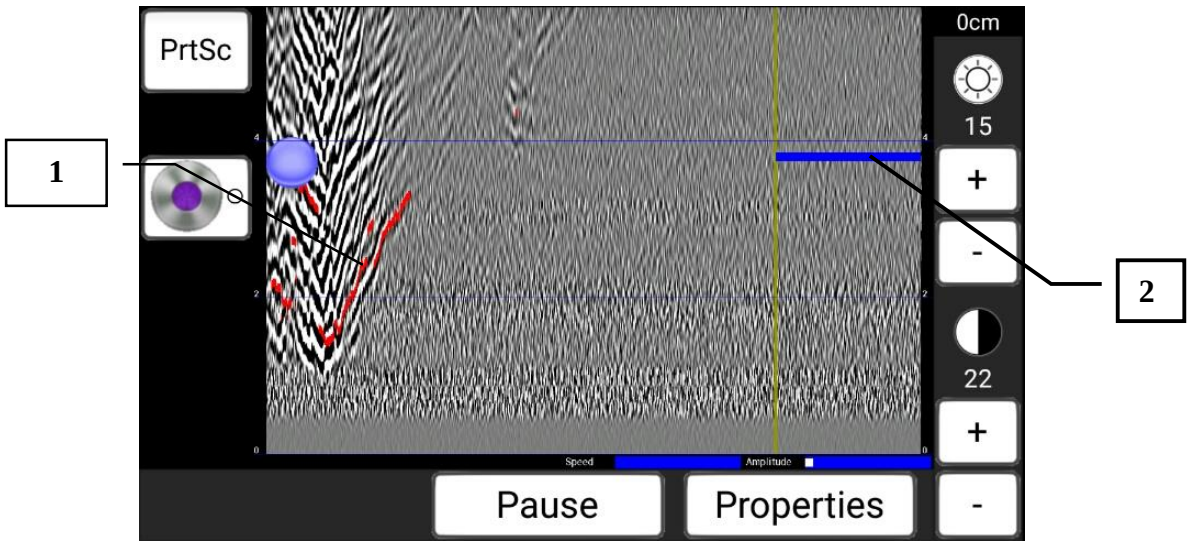

**Pic.5.21. Software window in 1.5D mode, detection for moving objects.**

Only in 1.5D mode possible to detect for alive object by breath, screen picture looks like Pic.5.22.



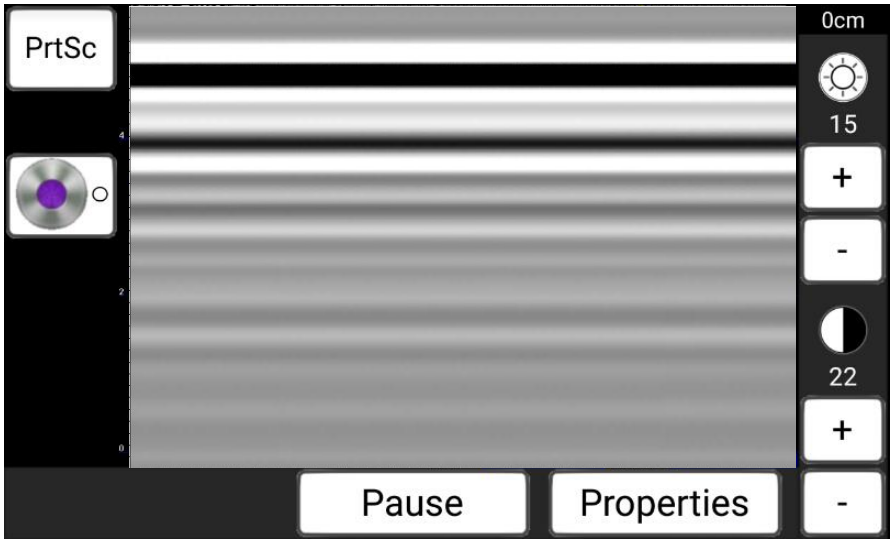

**Pic.5.22 The software window 1.5D mode, detection for alive and not moving object by breath**

If the found object has moved, then stopped ï the screen picture will be as per Pic.5.23.



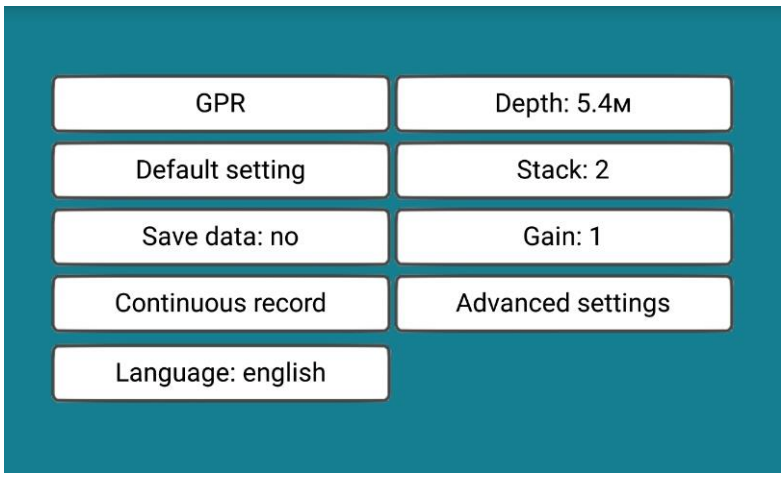

**Pic.5.23 Software window 1.5D mode, 1 ï detection an object by move, 2 ï detection not moving alive object by breath**

In order to change the mode the GPR detector to GPR mode, is necessary in menu (Pic.5.20) press button ñGPR-detectorò, re-calling by that modes switcher and select ñGPRò, radar gram in GPR mode(Pic.5.24) will be displayed on screen




**Pic5.24 Software window in GPR mode**

GPR detector scan parameter in GPR mode is made via Properties menu, which is re-called by pressing button ñPropertiesò, while GPR mode is on




**Pic.5.25** Properties menu in GPR mode

GPR detector in GPR mode operationñPropertiesò parameter menu applications are given in table 5.4.

| Sl. No. | Option | Function | Factory settings value |
|---|---|---|---|
| 1 | Default setting | Cancel early made set up parameters | |
| 2 | Save data | Save the results of sounding | Without storage |
| 3 | Continuous recording | The mode during which survey operations are carried out w/o the use of the movement sensor, and the travel distance is not recorded. This mode is used when sounding out in the terrain where the use of the movement sensor is impracticable. | Continuously |
| 2 | Depth | Requisite max sounding depth in the GPR mode is set to carry out survey operations. | 3.3 m (max 5,0m) |
| 5 | Stack | Defines amount of repeated reception of each track with their subsequent summing up. Increase of this parameter allows to reveal weaker signals, to increase actual sounding depth and enhance image quality, however at that the antenna unit traverse speed decreases during the profile recording. | 4 |
| 7 | Gain | Changes echo signal visualization brightness, reflected from long distances objects, Not affects detection quality | 16 |
| 9 | Advanced settings | Setting of the factory settings. | |

## 6. Antenna Unit RO-4002D operation with additional antenna unit

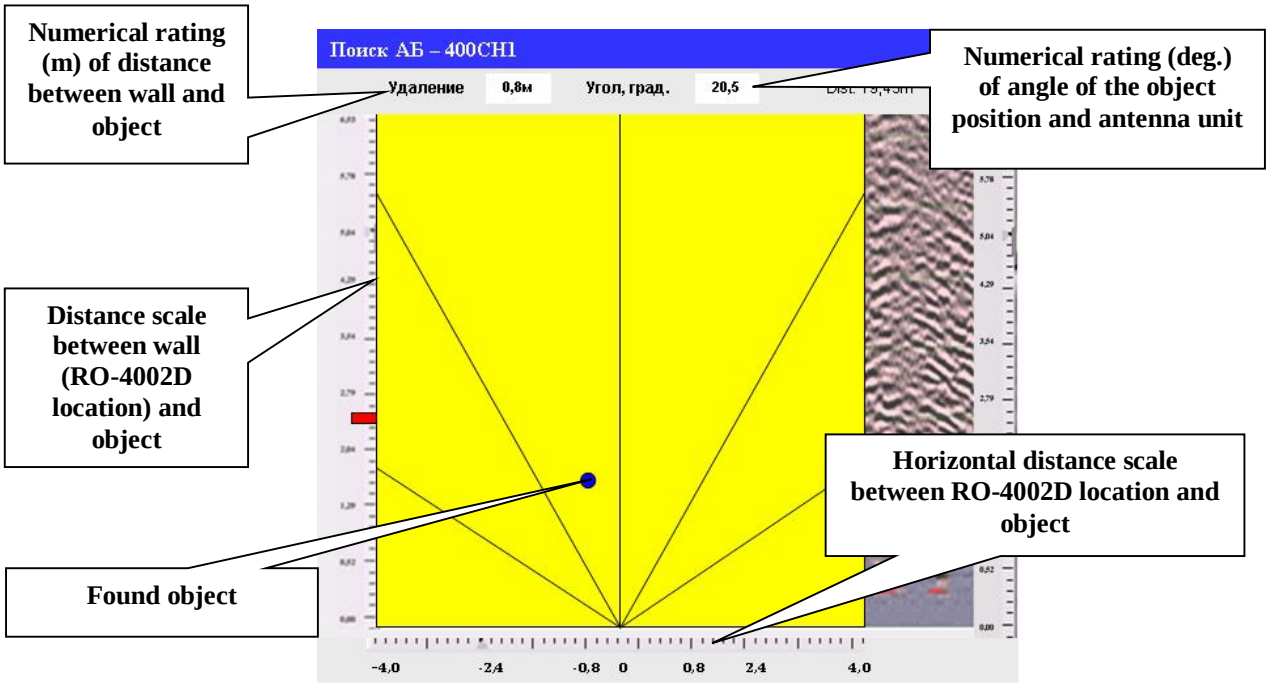
GPR Detector includes additional antenna unit is applied for detection moving objects through barriers, it assists to display received data in 2D mode.

**Pic.6.1. Antenna Unit RO-4002D with additional antenna unit**


**Pic.6.2. There is bracket on RO-4002D enclosure for additional antenna fixation and plug for the additional antenna connection**

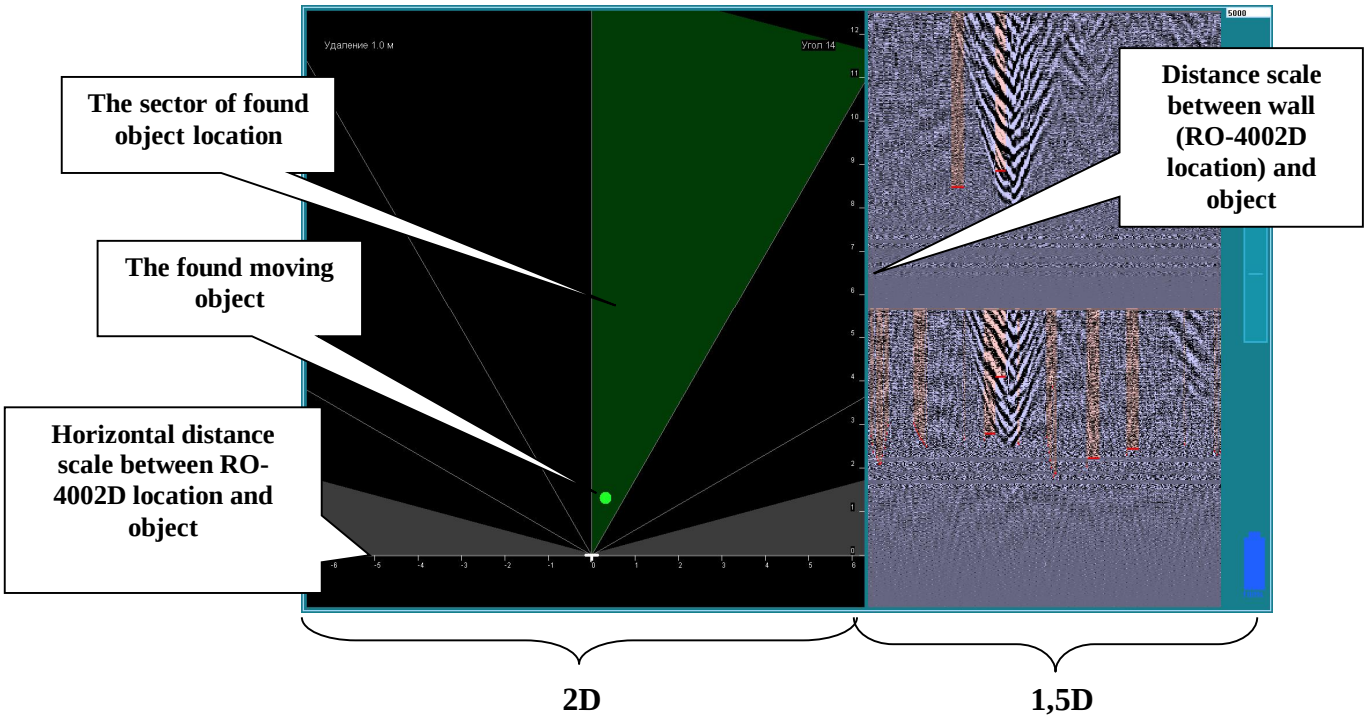
In order to run operation with additional antenna unit is necessary : to fix additional antenna unit on the RO-4002D enclosure bracket (Pic.6.2. pos.1) and connect cable to plug (Pic.6.2. pos.2). The operation to be followed the following order :

1) to fix additional antenna unit on the AB-400CH1 enclosure ;
2) connect additional antenna unit cable to plug (Pic.6.2. pos.2) on RO-4002D enclosure ;
3) to place power supply unit into RO-4002D enclosure ;
4) pressing red button ï switch on GPR-Detector ;
5) on the first switch on of the GPR-Detector with additional antenna unit, moving objects detection mode 1,5D format will be displayed ;
6) in order to transfer the GPR-Detector data scan into 2D format display, it is necessary while movement detection is in progress call set-up menu and in ñChannel numberò clause point ñ2ò (two channel scanning mode), and return to detection mode ;
7) data will be shown on RO-4002D screen (as per Pic.6.3) ; the screen left side ï for 2D mode, right side ï 1,5D mode.




**Pic.6.3 RO-4002D screen (working with additional antenna unit) displays in moving objects detection mode**

In order to change detection distance, it is necessary to skip out moving object detection mode to GPR Detector main menu, chose required distance, after that again turn on detection mode. In connection of GPR Detector to Control Unit (Notebook) or via Wi-Fi channel, received data will be displayed on the computer screen as per shown on Pic.6.4.. The Control Unit screen display specificity will be : in case founding moving object, the sector where it has been found, is colored green, balance data ï as per displayed on antenna RO-4002D screen.




**Pic.6.4. Moving object detection mode display on Notebook (cable connected to antenna unit RO-4002D with additional antenna) screen**

# 7. Interpretation of the GPR detector sounding results.

## 7.1 Interpretation of the GPR detector sounding results in the GPR mode

Local object on the radargrams obtained during the sounding in the GPR mode can be detected based on their echo signals both on a real time basis and in the postprocessing of the saved files. Signals reflected from the detected objects are imaged in the radargrams depending on how the antenna unit travels against the object axis during the sounding. When the antenna unit travels either normal to the object axis or at an acute angle, the object is imaged as an isolated hyperbola (fig. 7.1). When the antenna unit travels along the object axis, the image of echo signals on the processing and indicating unit screen will be as shown in fig. 7.2. If the antenna unit travels along the axis of extended object (pipe, cable), there is a good likelihood that that the operator can skip or overlook the object.

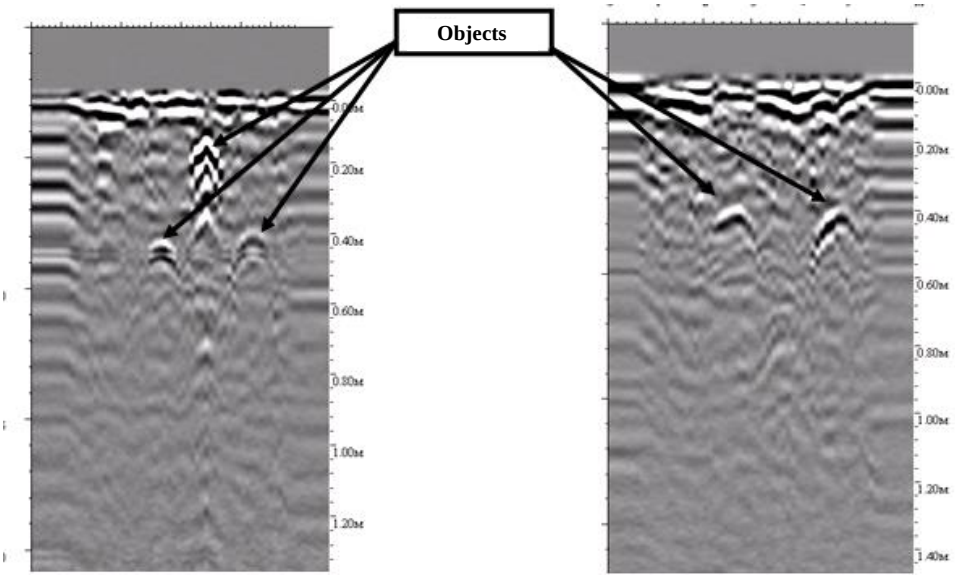



**Fig.7.1 Radargrams of the objects detection by the GPR detector in the GPR mode when moving the monoblock square with the object axes**

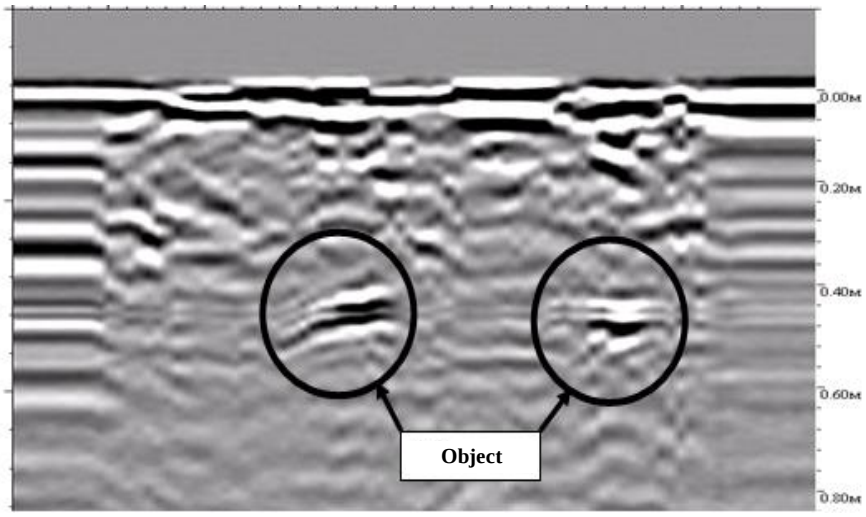



**Fig.7.2 Radargrams of the objects detection when the monoblock passing along the object axis**

The GPR detector in the GPR mode allows detecting not only the objects but also voids and hideouts. Fig. 7.3 shows radargrams of voids (hideouts) detection:

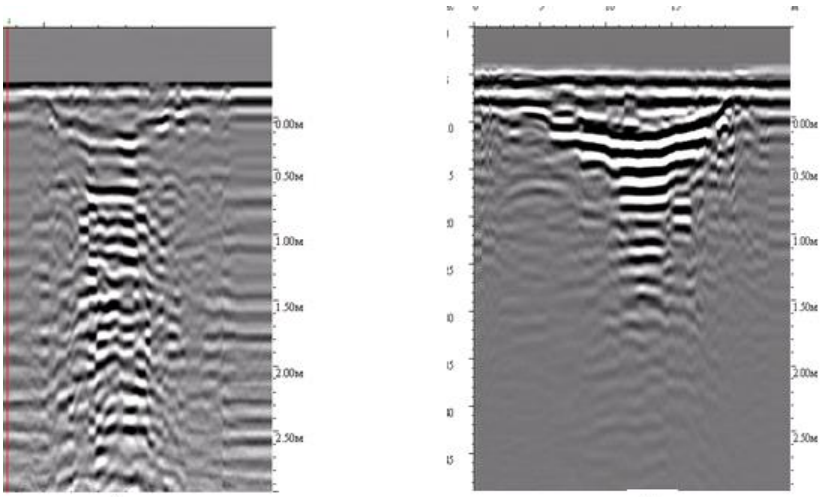



**Fig.7.3 Radargrams of the concrete tunnel (ф) and ʃ forest ground hideout (В) detection**

## 7.2. Interpretation of the GPR detector sounding results in the moving objects detection mode

The GPR sounding results are displayed on the monitor of monoblock of laptop on-line. Imaging of the sounding results on the monitor screens is right to left. For convenience of visual perception of the sounding results, the moving objects echo signals are filled with red markers. The distance of monoblock to object moving behind the wall can be determined against the distances scale on the monitor. The operator can evaluate the object movement direction (whether the object is moving away or approaching the monoblock location) against the filling sequence of reflected signals and determine the number of moving objects.
Fig. 7.4 ï 7.9 shows variants of the displayed image of the GPR detector sounding results for various cases of the moving objects detection.

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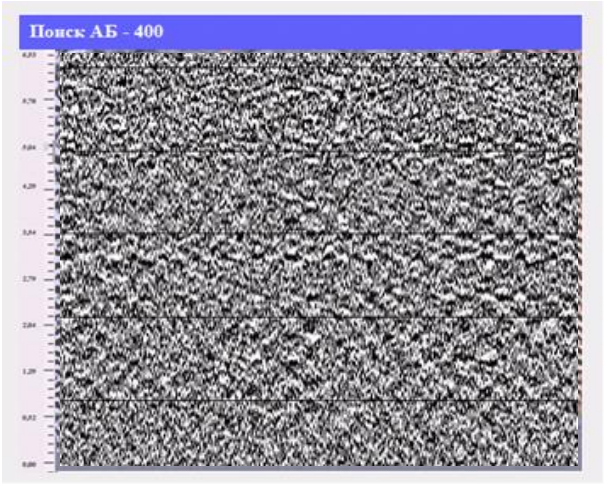



**Fig.7.4. Sounding results of the room with no moving objects available**

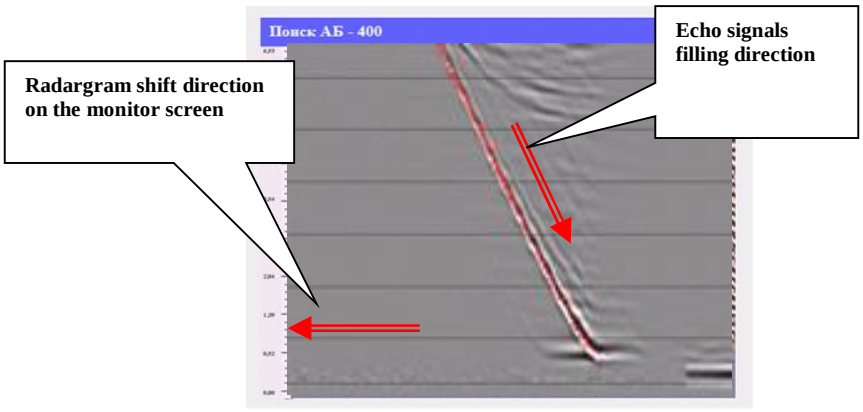



**Fig.7.5 Sounding results ï the object drew closer at a distance of 0.6 m to the wall behind which is the monoblock**

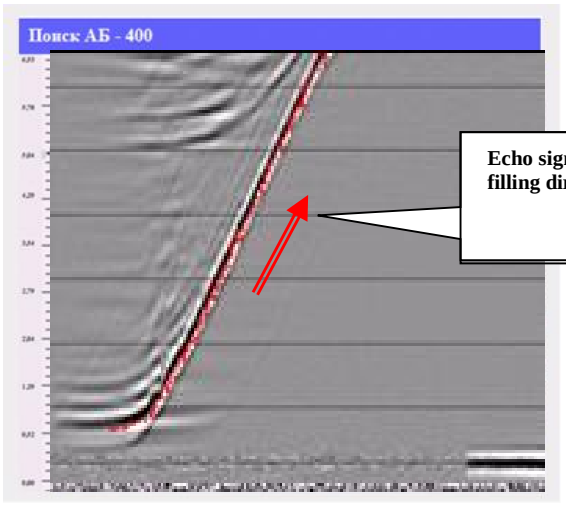



**Fig.7.6. Sounding results ï the object withdrew from the wall behind which is the monoblock**

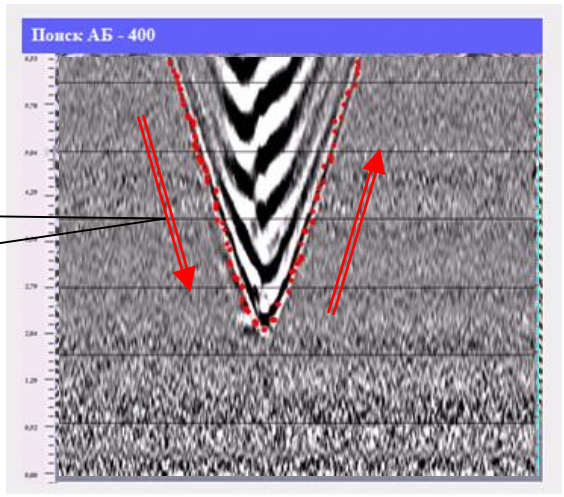



**Fig 7.7. Sounding results ï the object drew closer at a distance of 2.0 m and then withdrew from the wall behind which is the monoblock**

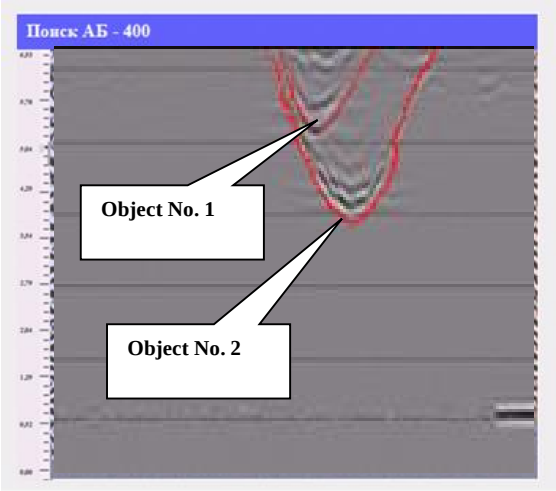



**Fig.7.8 Sounding results ï 2 objects are detected. Objects Nos. 1 and 2 were simultaneously approaching the monoblock location. Object No. 1 drew closer to the monoblock at a distance of 50 m and then withdrew from the detection zone. Object No. 2 drew closer to the monoblock at a distance of 3.0 m and then withdrew from the detection zone..**

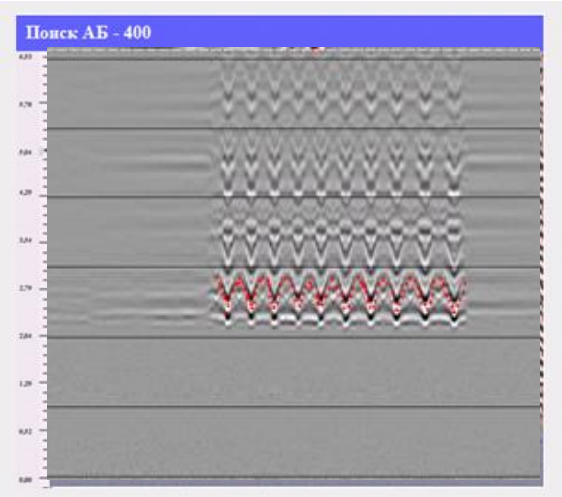



**Fig.7.9. Sounding results ï a man stood still and swung one's arms in front of himself**

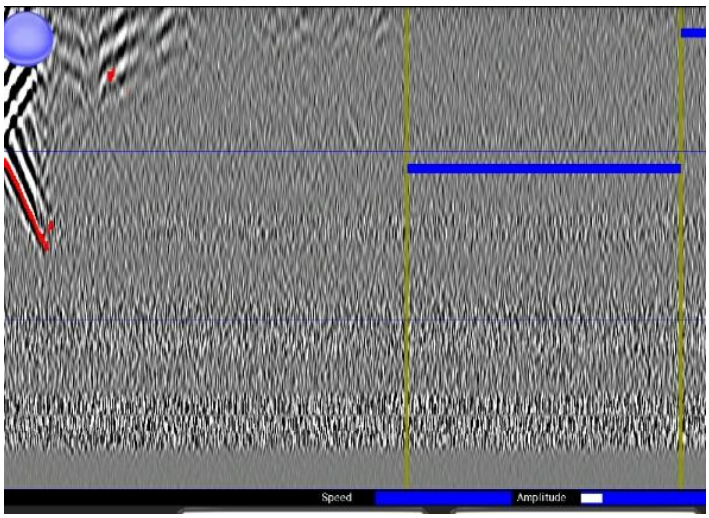



**Fig.7.10 Sounding results ï visualization of respiration detecting stationary object on the laptop (tablet) screen**

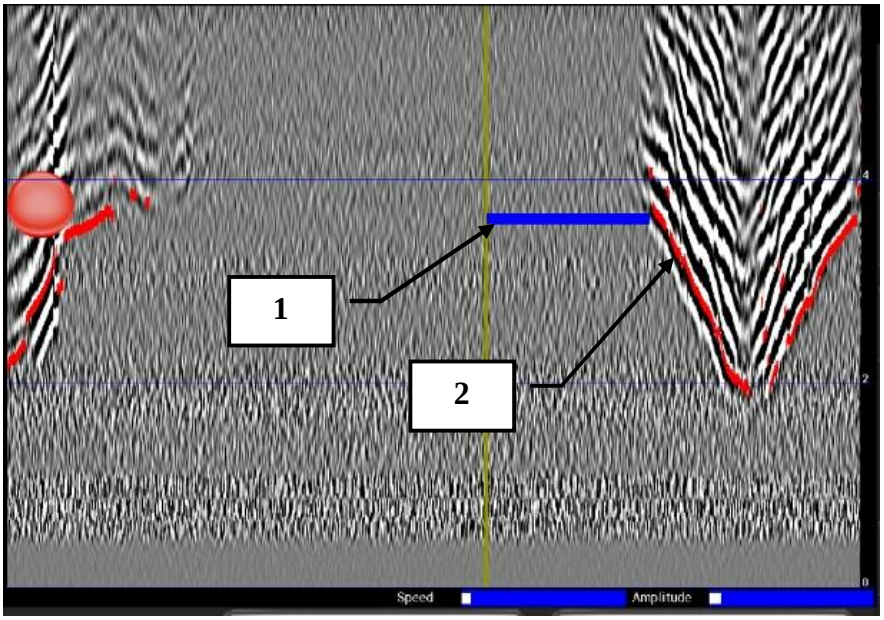



**Fig.7.11 Sounding results ï object stationary (breathing - 1), move object (2)**

## 8. General guidelines

The technical maintenance of the device includes preventive operations with the aim to keep it in working order and provide normal operation within its service life (7 years).

Recommended periodicity and types of preventive operations (scheduled maintenance):

External examination ï prior to every operation ï there should not be any damages beyond repair on device body and connection cables, i.e. insulation faults, cracks etc;

External cleaning ï quarterly ï removal of soil from the device surface and detachable connections;

Charging of BP- 3,8/12 storage batteries from accessories set ï at least quarterly, inclusive of the power supply from SPTA-0 set which is put to operation when the need arises.

## 9. Requirements on safe operation and electromagnetic compatibility

It is prohibited to immerse antenna units into water or any other liquids.

During the device operation and transportation, strong impacts and mechanical damages should be avoided.

This device creates no electromagnetic interference above the allowed level.

## 10. Technical maintenance

During the device external condition examination, there should be a check of paint coating condition, absence of chipping and cracks on fiberglass and plastic items and panted parts.

Charging of BP- 3,8/12 storage batteries should be carried out in case of voltage reduction to 10½ V at least quarterly.

**Safety directions:**

- Use the charger for BP- 3,8/12 power supply units storage batteries charging only.
- Use the device indoors only.
- Do not plug in if the device body or plug is damaged.
- Disconnect the device when not in use.
- After charging the power supply sources, do not leave the charger plugged in as this may result in its failure.

To avoid failure of the power supply sources and to increase their service life, strictly observe their connecting order when charging.

## 11. Running repairs

The running repairs are done by the manufacturer. To carry out running repair, the faulty device unit should be sent to the manufacturer with detailed description of revealed faults. If the faulty unit cannot be isolated, the whole device should be sent to repair.

## 12. Transportation

The device transportation is performed by any transport means at any distance in the original manufacturerôs packaging and subject to observance the following rules:

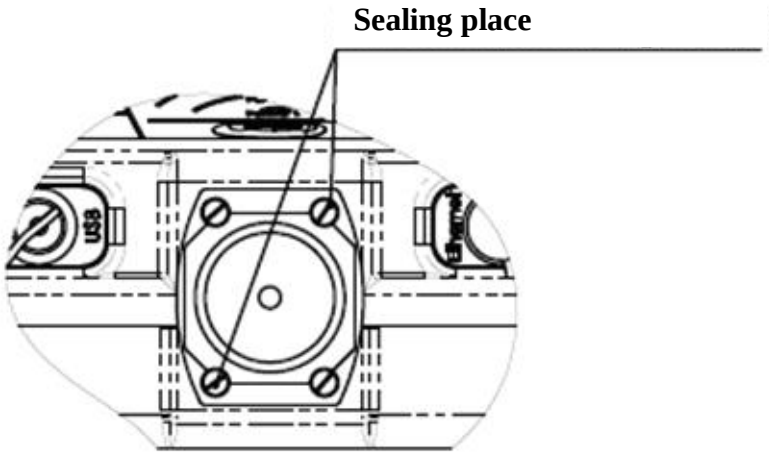
1. the device transportation should be performed in closed transport: railway cars, containers, closed motor cars, if no traces of cement, chemicals etc found in it. When transporting by plane, the devices should be located in pressurized compartment.

2. ambient air temperature during the transportation should be between -30°ъ to + 50°ъ, pressure 84 to 106.7 ʕPѲ(630-800 mm of mercury).

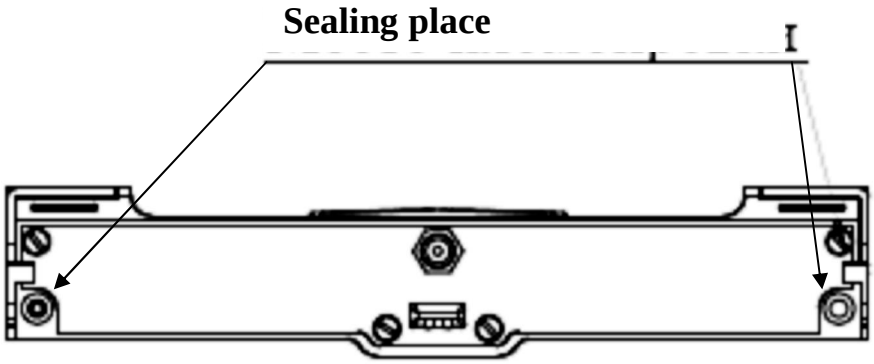
3. Layout and anchoring of the boxes with the devices on the transport means should ensure stable position during the travel, absence of dislocation and mutual impacts.

4. When handling, the tare inscription requirements should be observed.

## Annex 1. GPR detector sealing places



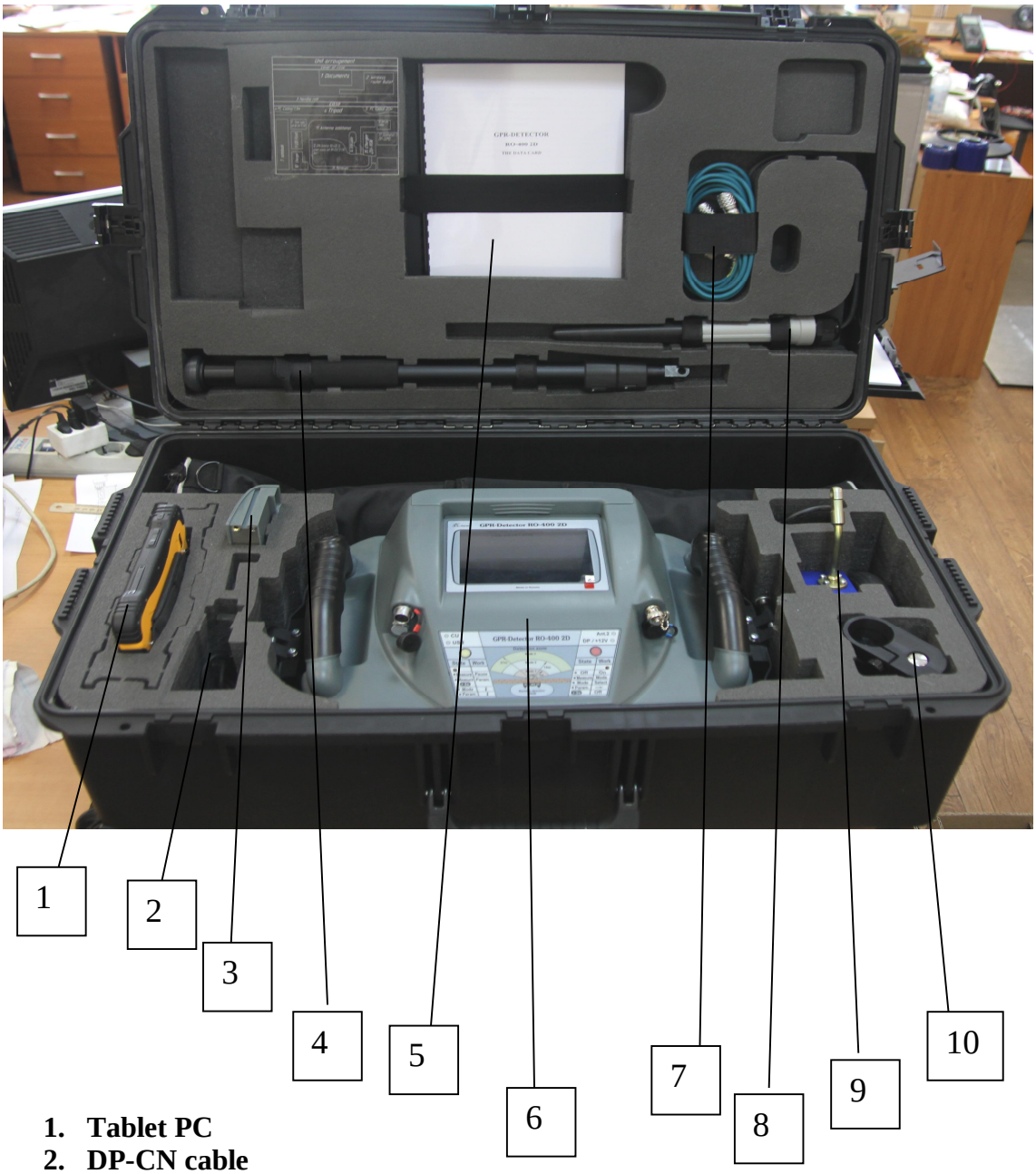

**GPR detector sealing place**




**BP 3,8/12 power supply unit sealing place**

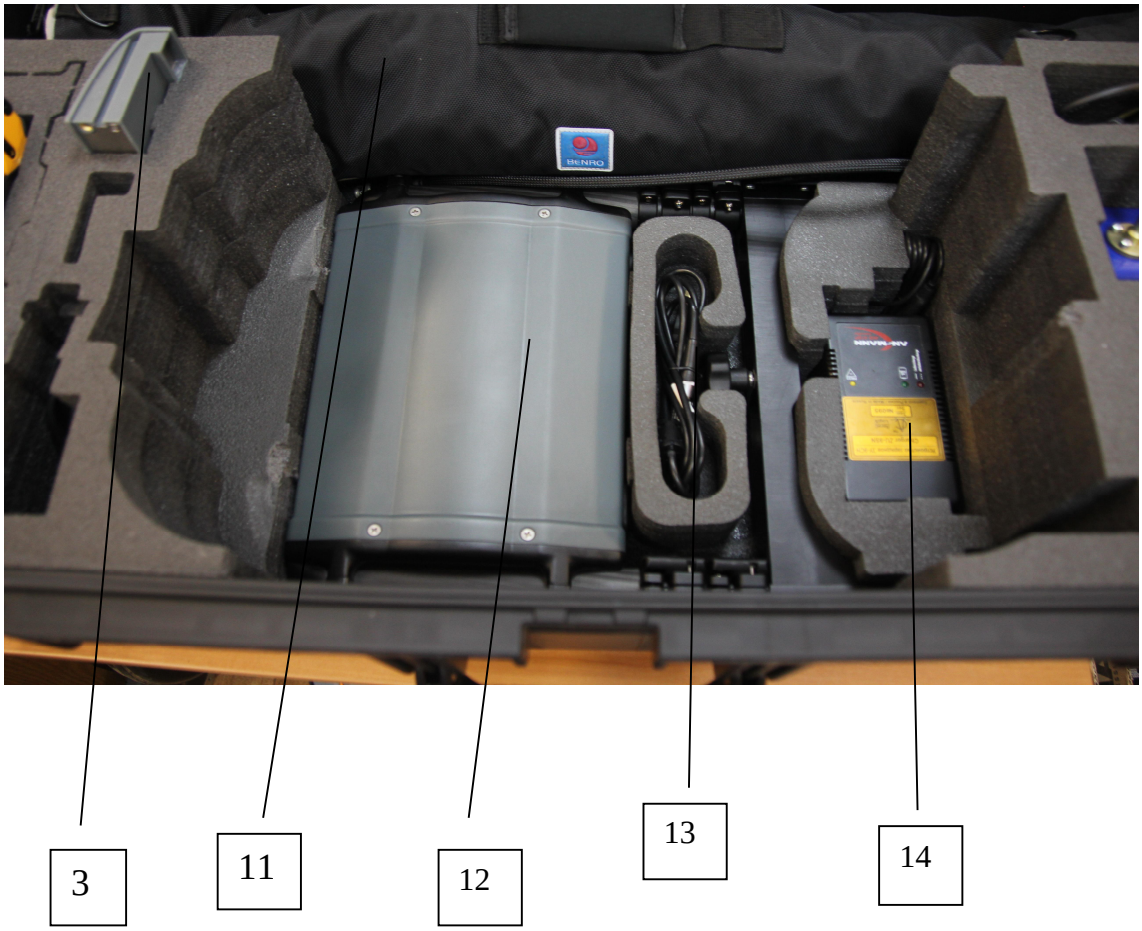
# Annex 2. Placing of the complete set of the GPR-detector in a special case

**View 1**




1. **Tablet PC**
2. **DP-CN cable**
3. **BP-3,8/12**
4. **Handle bar**
5. **User' s Manual**
6. **GPR - Detector**
7. **Extension cable**
8. **Wireless router**
9. **DP-32ʃ D movement sensor**
10. **Tripod for wireless router**

**View 2**




**11. Tripod**
**12. Additional antenna**
**13. USB Cable**
**14. ZU-9 charger**

# Annex 3. Two options for sending results of detection by Wi-Fi

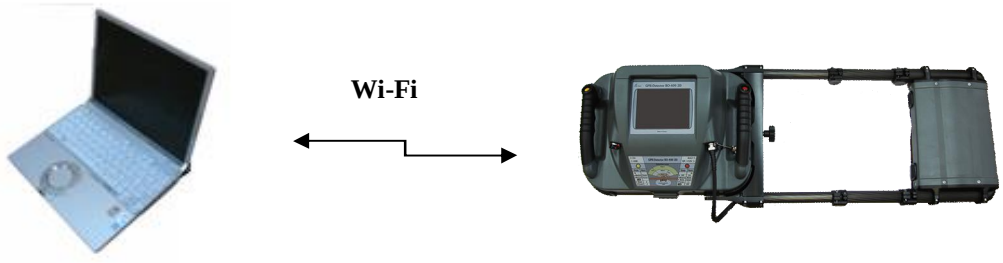



**Fig.3.1** In the GPR-detector main menu to choose point «Wi-Fi», on the laptop, which is included into the complete set, it is necessary to include channel Wi-Fi.

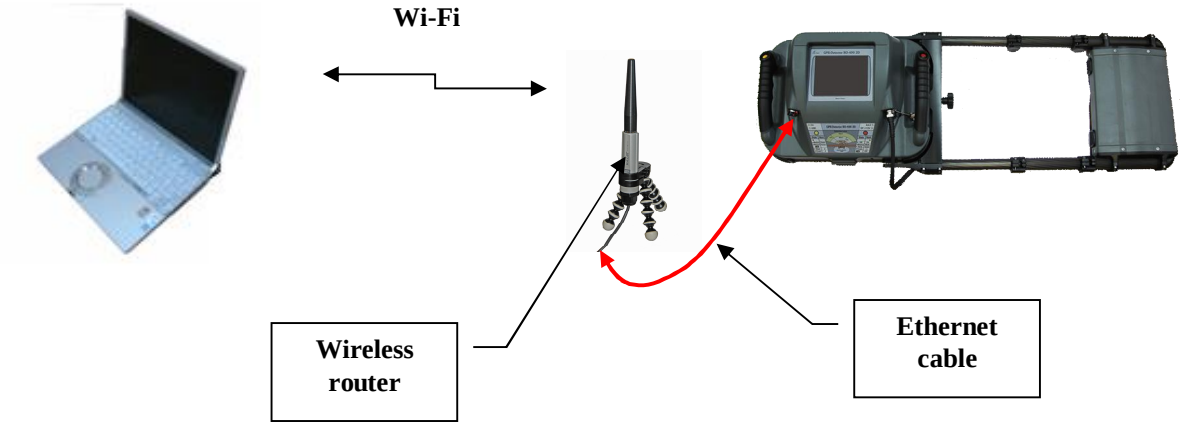



**Fig.3.2** Wireless router connect Ethernet cable to GPR-Detector, on the laptop, which is included into the complete set, it is necessary to include channel Wi-Fi.