



# **CABLE ROUTE LOCATOR ATHLETE AG-319N**

**TECHNICAL DESCRIPTION  
OPERATING INSTRUCTIONS**

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## Introduction

This Operation manual contains description of the cable route locator AP-019.1, its working modes, and information necessary for its proper use. AP-019.1 (hereinafter «the receiver») can be used individually, and with the transmitter. The receiver works at the networks frequencies 50(60) Hz, 100(120) Hz, and with route locating transmitters at frequencies 512Hz, 1024 Hz, 8192 Hz, 32768 Hz («33 kHz»).

### Intended use

- Power
- Public utilities
- Oil and gas industry
- Geodesy
- Communication
- Construction
- Other industries

### Operation conditions

- Ambient temperature, °C .....from -20C to +60
- Relative humidity, % .....up to 85 at t=35 °C
- Pressure, kPa,.....84 to 106
- Device protection class..... IP 54

### Receiver working principle

The cable route locator consists of the electromagnetic radiation receiver and transmitter providing for the electromagnetic radiation of the route being detected.

According to the signal of the embedded speaker or headphones and using the graphic display indications the operator determines the route location.

The receiver is capable of receiving a signal from industrial frequency radiation sources (50/60 Hz) and cathode protection systems (100/120 Hz). These modes are used for detecting the location of cable runs or routes carrying the voltage of the relevant frequency.

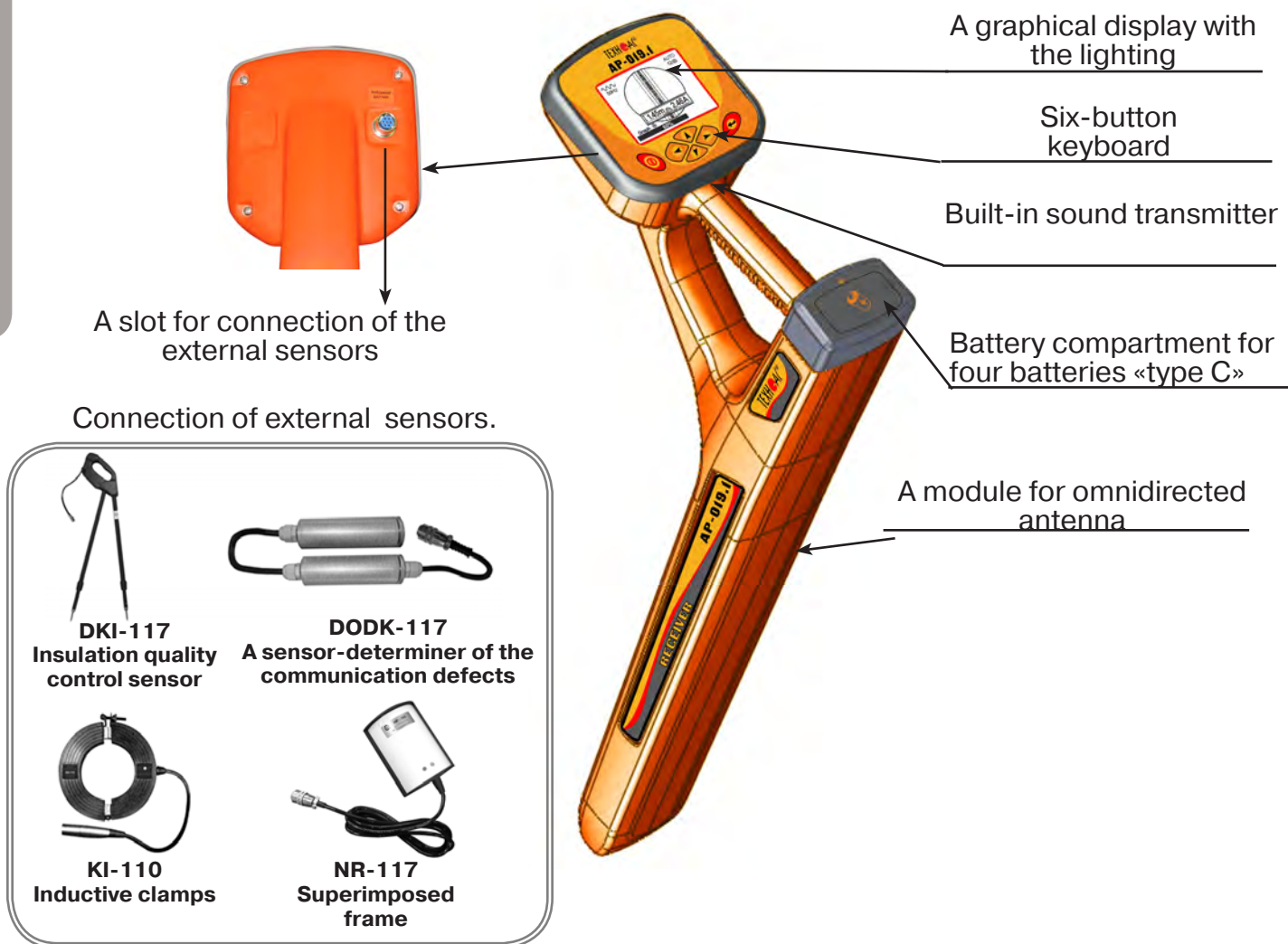
Cable or pipeline may be the load for generator. The transmitter can be connected to the load either directly (with connecting wires) or with the use of the inductive antenna or inductive clamp providing for contactless (inductive) connection of the utility under examination.

Use of the inductive antenna as a load is only possible at the 8,928 Hz frequency (selected automatically at antenna connection).

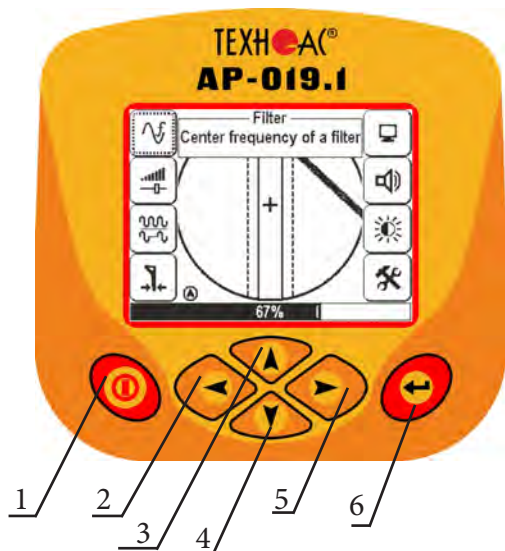


## 1. Appearance, AP-019.1 receiver controls

AP-019.1 receiver is made in the solid cast IP54 body, to the battery compartment the body provides the protection IP68, the device can be splitted in three components: the face panel with controls and displays, battery compartment and bottom part with the antenna block. On the back side of the face panel, there are two slots for connection of external sensors.



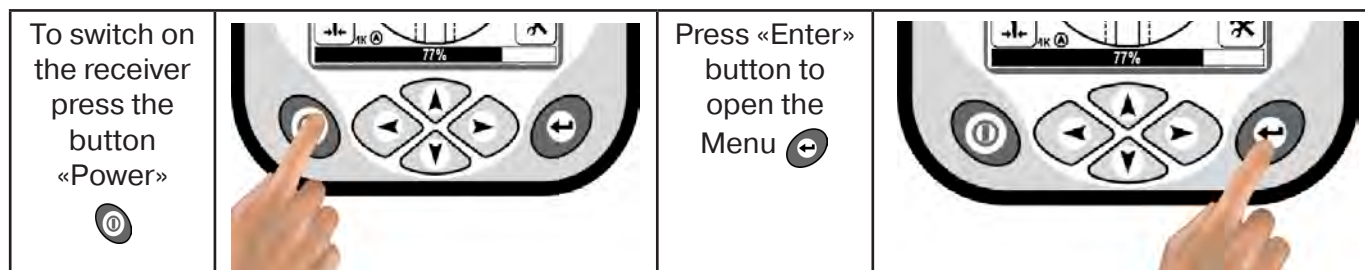
### Face panel, controls



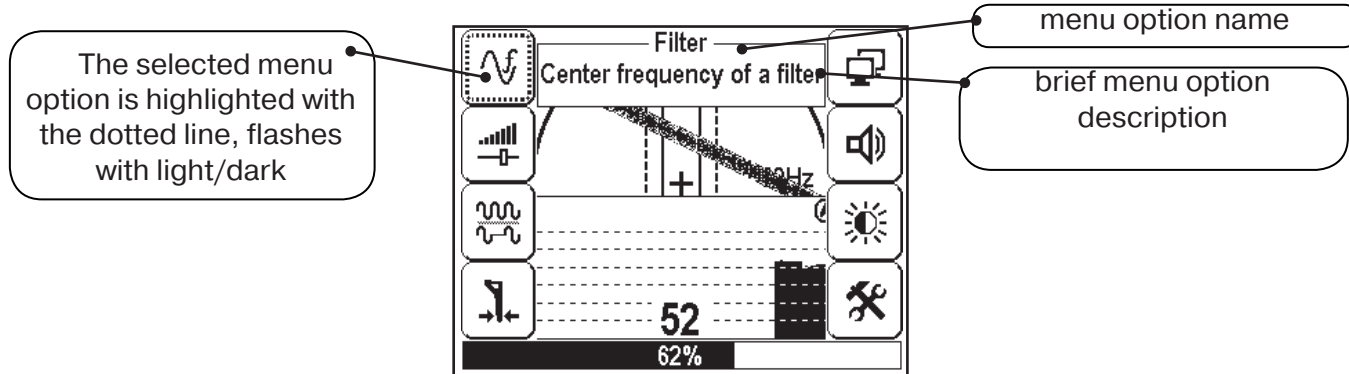
	«Power» button (1) Switching on/off the receiver
	«Enter» button (6) - calls out a menu, - enters into the editing mode of the selected menu option, - exit for the editing mode saving selected parameters.
	Buttons «Up» (3), «Down» (4), «Right» (5), «Left» (2). - selection of the menu option (icon), - selection or changing the parameter inside the menu, - operative change in the parameters

## 2. Receiver menu description

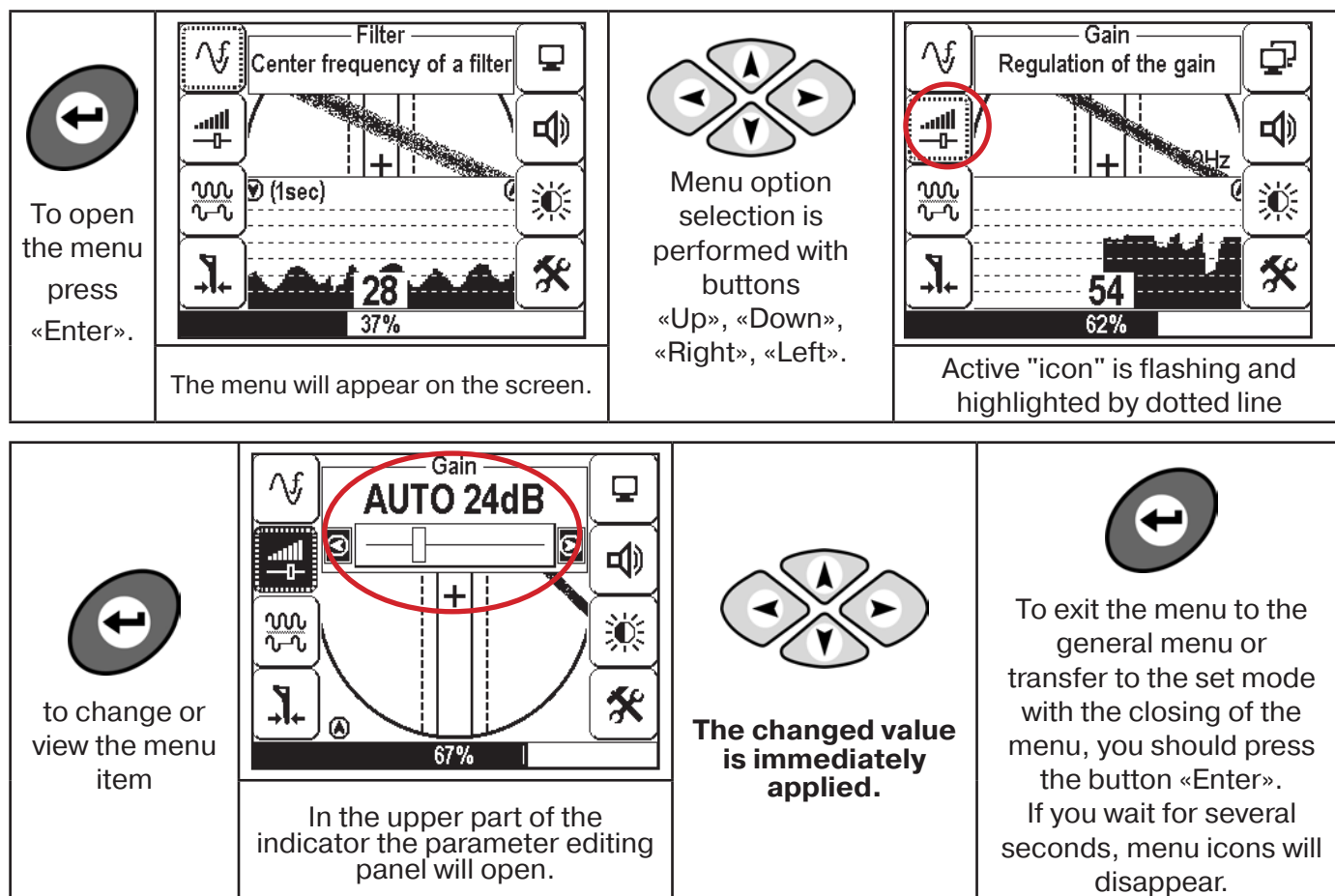
### 2.1 Receiver switching on and menu call



### 2.2 The general view of the menu screen



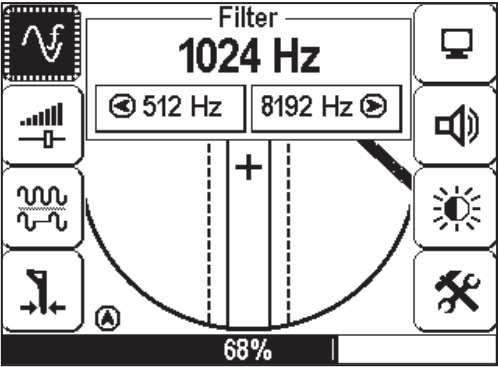
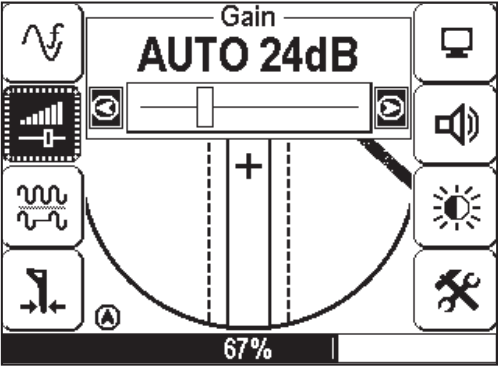
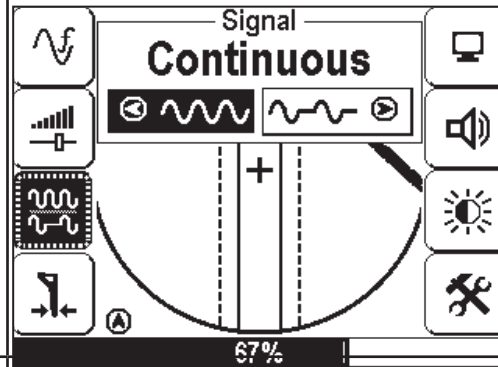
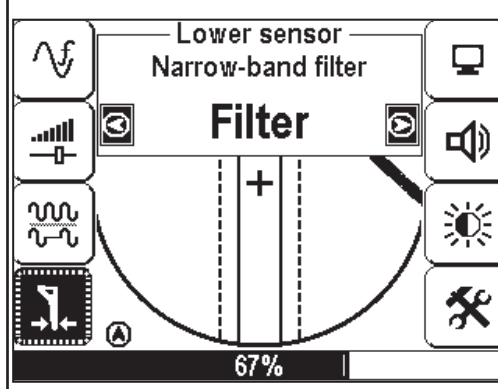
### 2.3 Menu parameter selection


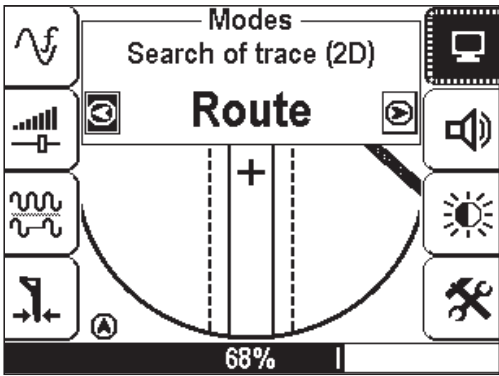

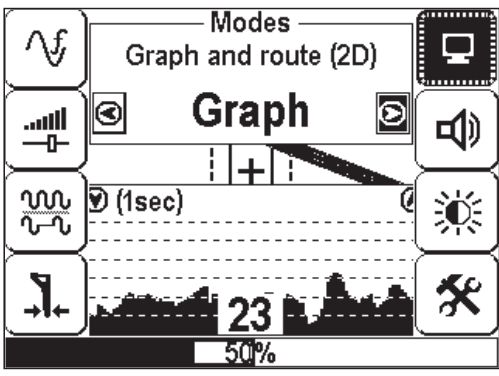

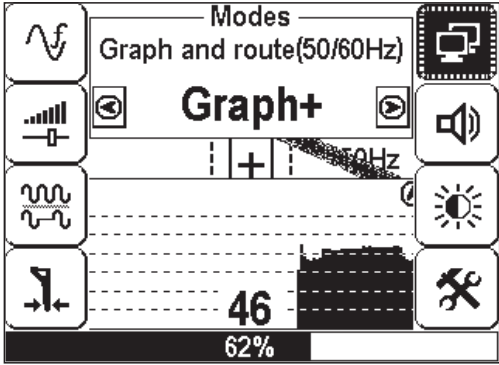



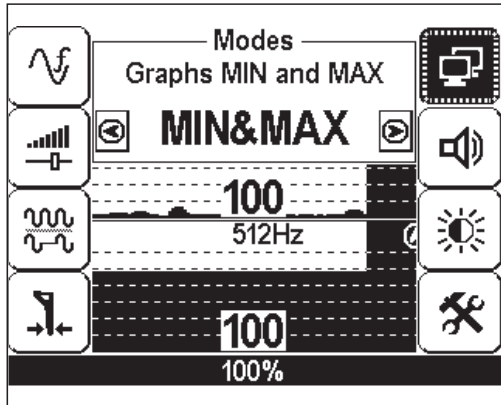

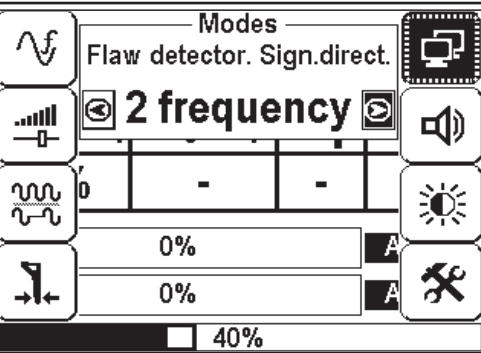

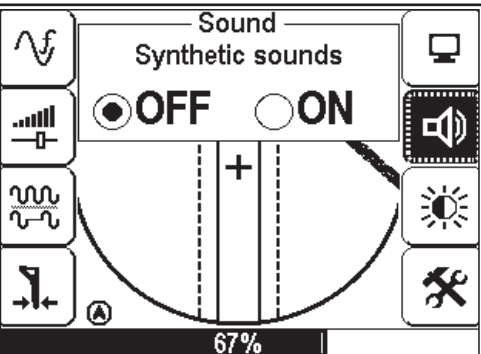

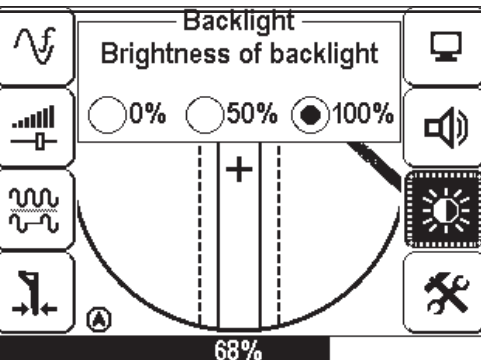
If you don't press any buttons for a period of time, the menu will disappear automatically. The length of this period is set in the corresponding menu option (see Table 1. p.6)

thirteen items of menu contain parameters of setting, which are opened in the panel located in the upper part of the indicator.


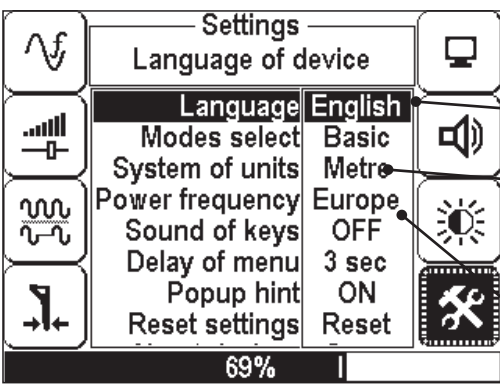
Table 1

№	Item of the menu	Display image	Parameter description
1	Filter		The working frequency of the receiver It is selected from the set: <b>50(60) Hz, 100(120) Hz, 512 Hz, 1024 Hz, 8192 Hz, 32768 Hz.</b>
2	Gain		The amplification coefficient of the scaling amplifier can be changed from <b>0 dB to 80 dB</b> with 2 dB step. The optimum coefficient of amplification can be selected: - <b>manually</b> , - <b>semiautomatically</b> (by a command), - <b>automatically</b> depending on the regime of the analysis and signal representation.
3	Signal		The type of signal received can be « <b>Continuous</b> » or « <b>Impulse</b> ».
4	Advanced bottom sensor setting		This option has several settings affecting the efficiency of bottom sensor. - « <b>Filter</b> » (all filters enabled) - « <b>WS</b> » (all filter disabled, sensor receives all frequencies below 8kHz). - « <b>Radio</b> » sensor receives all frequencies over 8kHz. 'Filter' setting is used only in 'Route mode', other settings are used in 'Graphic' mode.

5	<p>Base Mode</p> 		<p><b>Set of modes:</b></p> <ul style="list-style-type: none"> <li>- «<b>Route</b>» (2D display of the location of the route cable;</li> </ul>
6	<p>Base Mode</p> 		<ul style="list-style-type: none"> <li>- «<b>Graphic</b>» (visually represents the changes of signal level of surveyed cable);</li> </ul>
7	<p>Advanced Mode</p> 		<p><b>Advanced mode:</b></p> <ul style="list-style-type: none"> <li>- «<b>Graphic+</b>» (this mode combines two previous modes and allows to locate two cables simultaneously: one on 50Hz, and the other on frequency set by transmitter.z);</li> </ul>

8	<p><b>Advanced Modes</b></p> 		<p><b>Advanced of mode:</b></p> <p>- «<b>minimum maximum</b>» (graph representation of minimum and maximum signals)</p>
9	<p><b>Advanced Modes</b></p> 		<p><b>Advanced mode:</b></p> <p>«2 frequency» (simultaneous operation in two frequencies, also know as friend-or-foe mode).</p>
10	<p><b>Sound</b></p> 		<p>Switching on / switching off of sound notifications the created by the built-in speaker.</p>
11	<p><b>Backlight</b></p> 		<p>It sets the brightness of the LED display. It has following values::</p> <ul style="list-style-type: none"> <li>- 0%</li> <li>- 50%</li> <li>- 100%</li> </ul>



12			This menu is opened in the main field of an indicator	
			<b>Language</b>	<Russian/English>
			Locale of the device	
			<b>Measurement system</b>	<Meter/Foot>
			Measurement system: metrical or imperial	
			<b>Network frequency</b>	<Europe/USA>

The network frequency for passive search:  
«Europe» (50 и 100 Hz) / «USA» (60 and 120 Hz).

13

Settings

**Sound of keys**

<ON/OFF>

Disables keys sound

**Delay of menu**

<1 sec/2 sec/ 3 sec/ 4 sec/5 sec>

Time-out before closing the menu when no buttons are pressed.

**• Popup hints**

<ON/OFF>

Disables pop-ups with useful hints.

**• Reset osettings**

<Reset>

Resets the receiver to factory settings

16

Settings

67%

90%

Modes select

basic / advanced

Available modes select

Basic

Advanced

About device

about device

<Open>

Information about the device will pop-up in a dialog window.

67%

### 3. Start of work

Before start of work, you should install the batteries into the corresponding compartment of the receiver in the following sequence:



Battery compartment will unsnap. Pull out the ring on the receiver handle



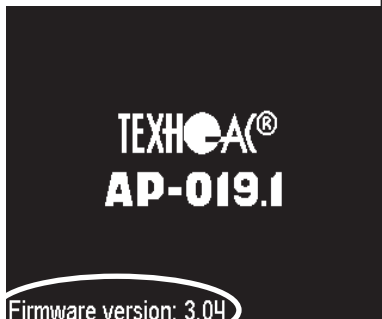
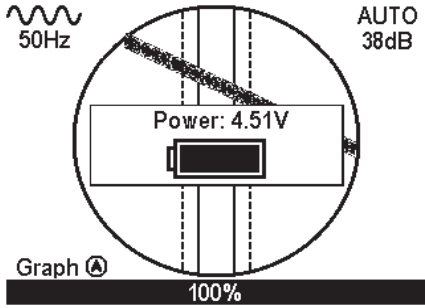
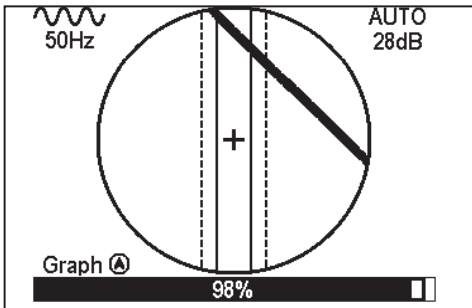
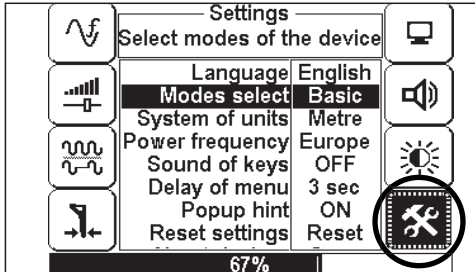
Remove the battery compartment from the receiver body

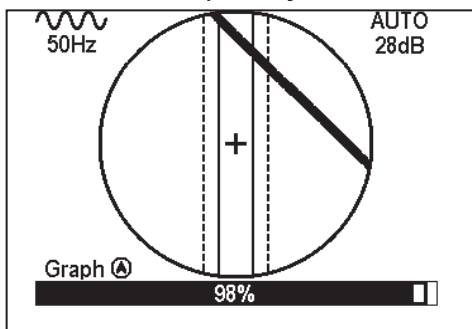















Install four new elements into the battery compartment of the device, minding polarity. Install the battery compartment into the body until it snaps.

### Receiver switching on

To switch on the receiver press the button «Power» 

<p>The screen saver will appear on the screen with the indication of the <b>Firmware version</b>, manufacturer and device name</p>		<p>The screensaver is followed by voltage and battery charge indicator..</p>	
<p>Then the receiver will automatically enter into the mode «Route» in 5 seconds. At the first switching the factory settings are set by default. The filter frequency is 50 Hz.</p>		<p>The description of factory settings can be found in the menu «Parameters». You can go back to factory settings by selecting the parameter «reset settings»</p>	



Settings		
	Select modes of the device	
	Language English	
	Modes select Basic	
	System of units Metre	
	Power frequency Europe	
	Sound of keys OFF	
	Delay of menu 3 sec	
	Popup hint ON	
	Reset settings Reset	
67%		

Note

**With factory settings enabled you can perform the cable location with network frequency 50 Hz in without transmitter.**

## 4. Search of cables in the mode «Route»

The Route mode is the main mode for route location of various communications (cables, pipelines) at all frequencies supported by the receiver, both a «passive» cable route location, and at the «active» (with the use of the route locating generator). In the passive mode the cable location is carried out at frequencies **50(60)100(120)Hz**, in the **active mode -512, 1024, 8192, 32768 Hz**.

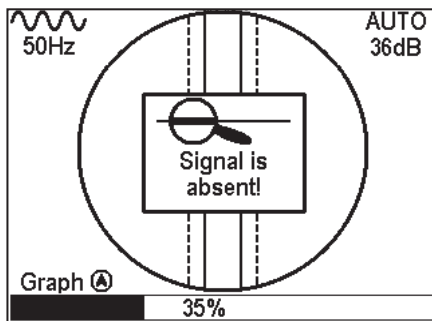
### 4.1. Cable location in the passive mode

This mode is used to search and locate a route of power cables under voltage with the frequency 50(60) Hz and other communications with the induced signal in frequency 50(60) Hz. The filter set on the receiver - 50(60) Hz. The external generator is not used.

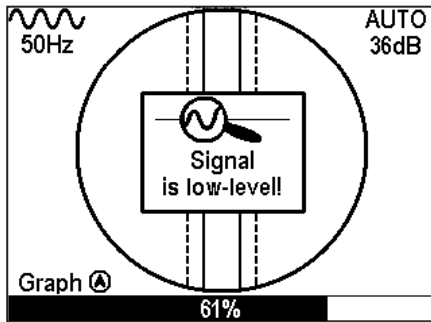
### 4.2 Search of a communication and measurement of its burial depth.

1. Come to the supposed place of the communication under the voltage or induced voltage in frequency 50(60) Hz.

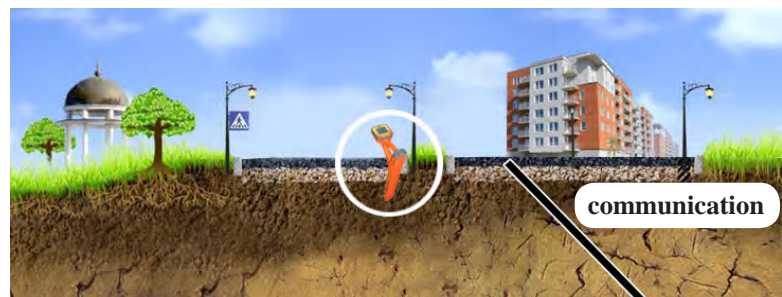
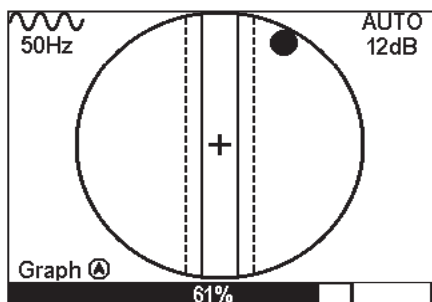
2. If the communication is far from the operator, you will see on the screen:



3. When moving towards the supposed place of the communication location, the «ball» will appear on the screen. It shows the presence of communication, and that it is on the significant distance from the operator.

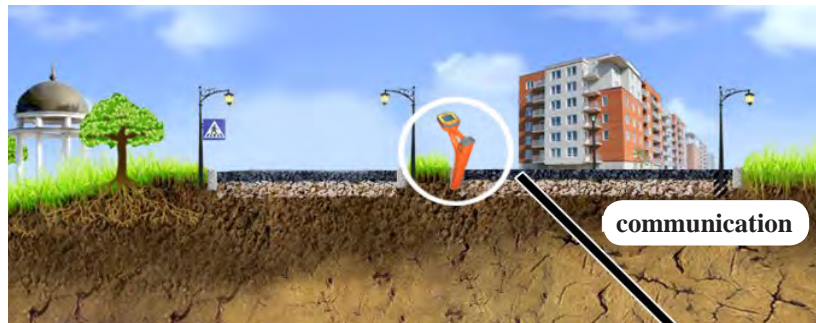
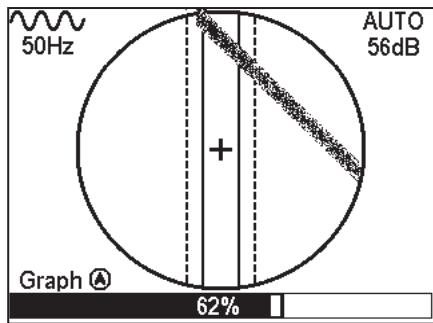


4. The «ball» position shows, in which direction from the operator the communication is located.

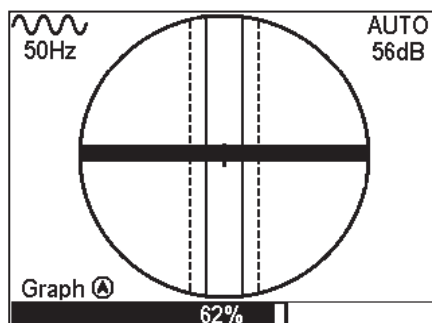




5. When approaching to the communication at distance less than the doubled burial depth, the blurred line of the axis pointer will appear.



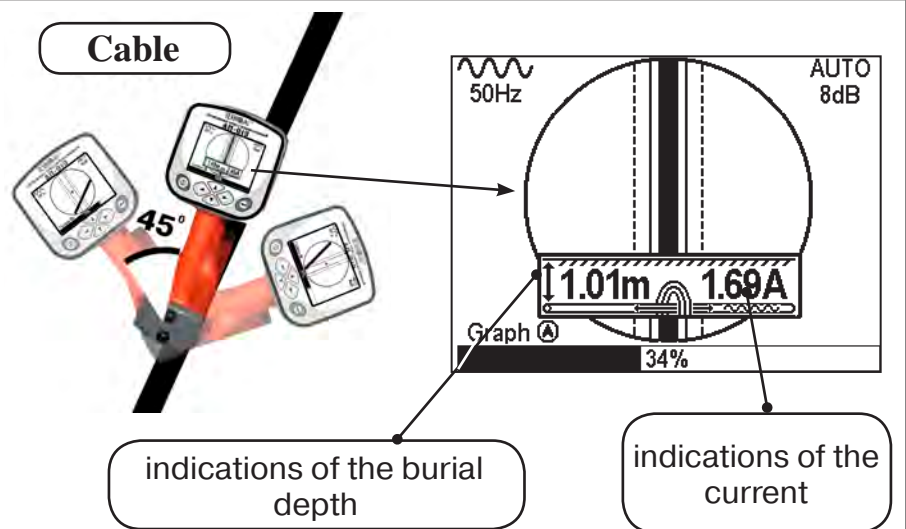
6. When operator moves closer to the communication, the axis will move to the circle center. This means that the operator is standing strictly over the communication.



### The measurement of the burial depth of communication

7. Further you should rotate the device, until the communication axis is aligned along the receiver axis. In this position and if the current in the cable is sufficient the window will appear displaying its burial depth and current. Now, the operator stands alongside the communication.

In this position, it is possible to move forward and trace whole cable.)

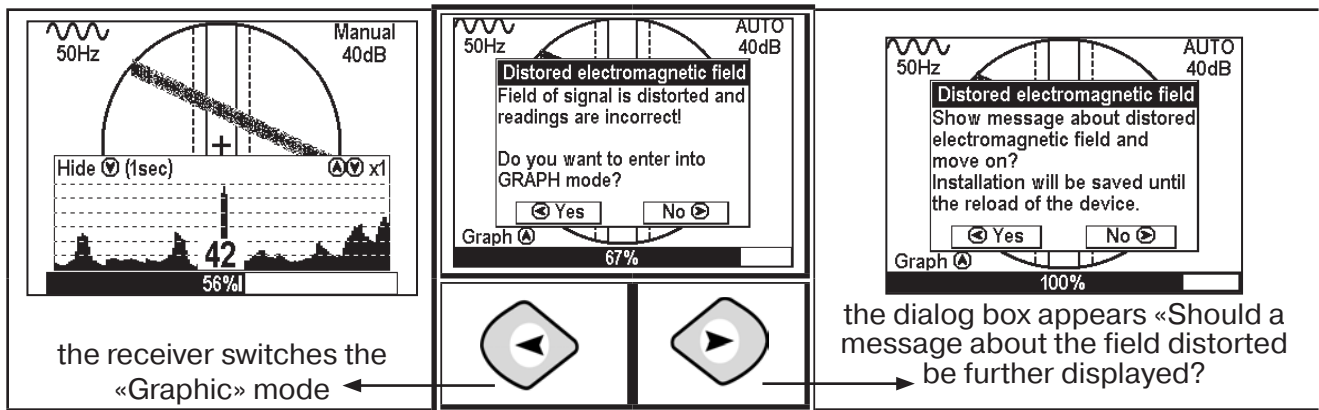


The power cables most frequently lay at the depth of 60-80 cm, allowing to differ them from pipelines. It is possible that cable lays in one channel with the pipeline, when the burial depth can be significantly exceed 1 meter.

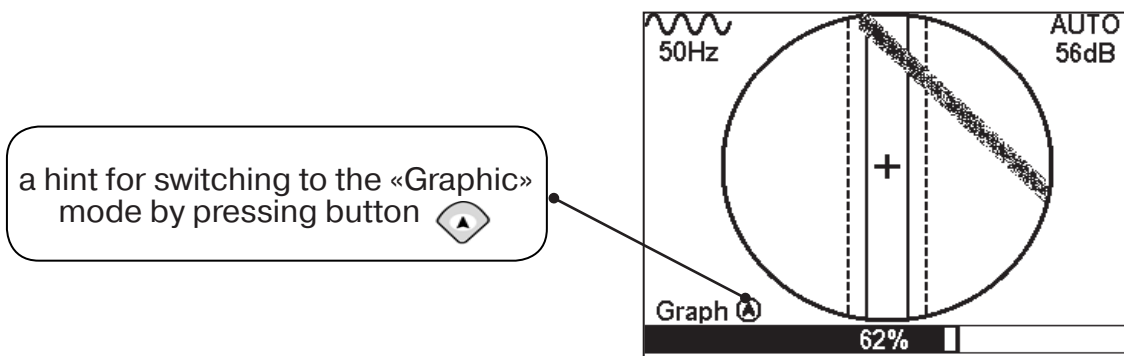
**Note**

If the communication axis cannot be located exactly in the limited area, and the periodical jumps are happening from the one border to the other, it tells about the presence of several cables under voltage with the 50 Hz frequency. You can specify number and position the cables in «Graphic» mode.

In the case when the signal is significantly distorted, the receiver automatically shows the notice about field distortion, offering switching the mode to 'Graph'



#### 4.3 Hot keys for work in the «Route» mode



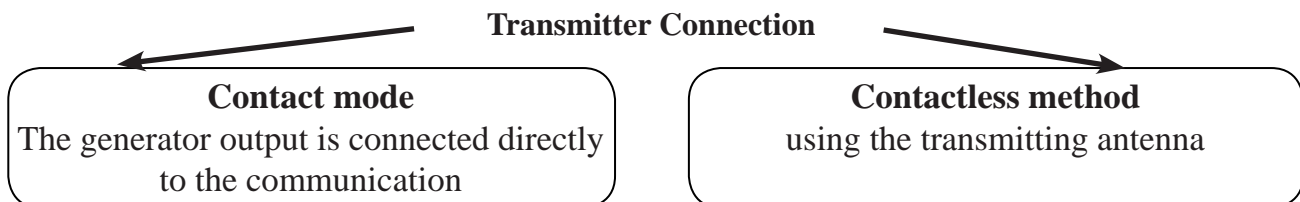
#### 4.4 Cable route location in the active mode

This mode is used to locate the power cables under voltage (and without voltage) and other current-conductive communications, using the external generator. The route location is possible at frequencies **512, 1024, 8192, 32768 Hz**.

The filter on the receiver is set manually in accordance with the selected generator frequency.

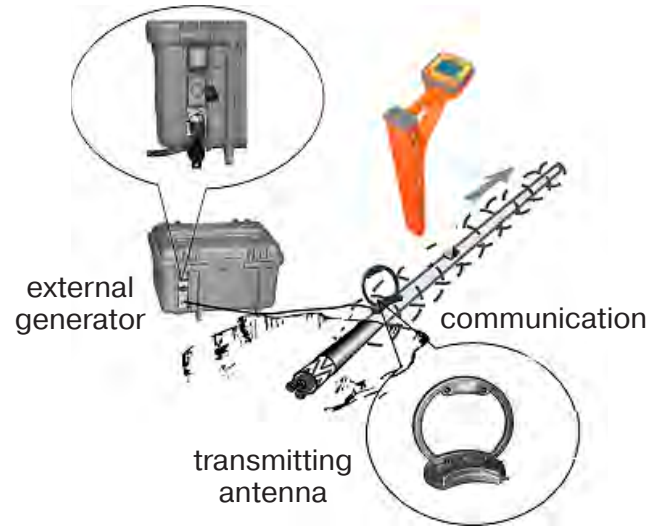
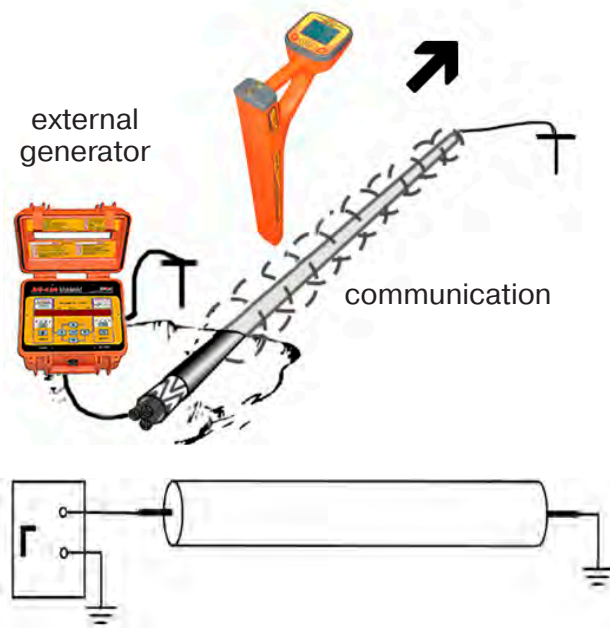
When locating the cable route in the conditions of the large number of surrounding utilities you should set the frequency **to 512 Hz**.

When it is impossible to ground communication, you should select higher frequencies. To perform the cable location with damage detection, you should select the higher frequencies.



**Note**


Note





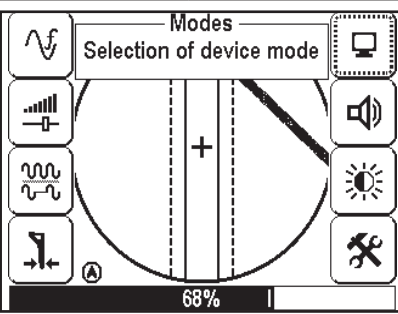
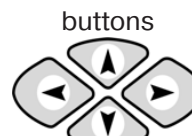

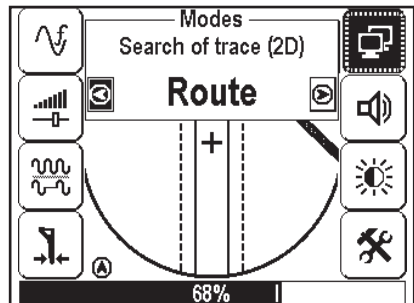


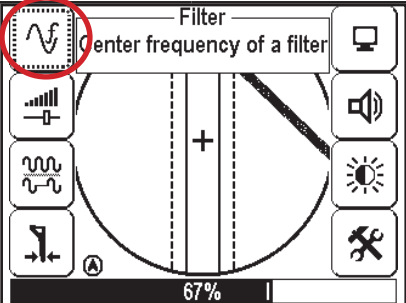


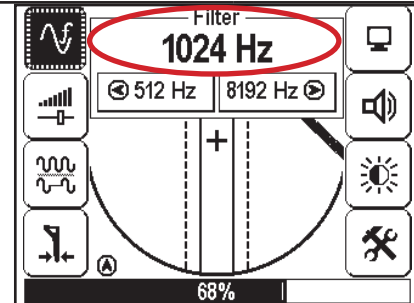
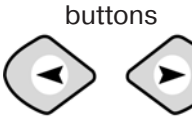
**Contactless method**  
using the induction clamps



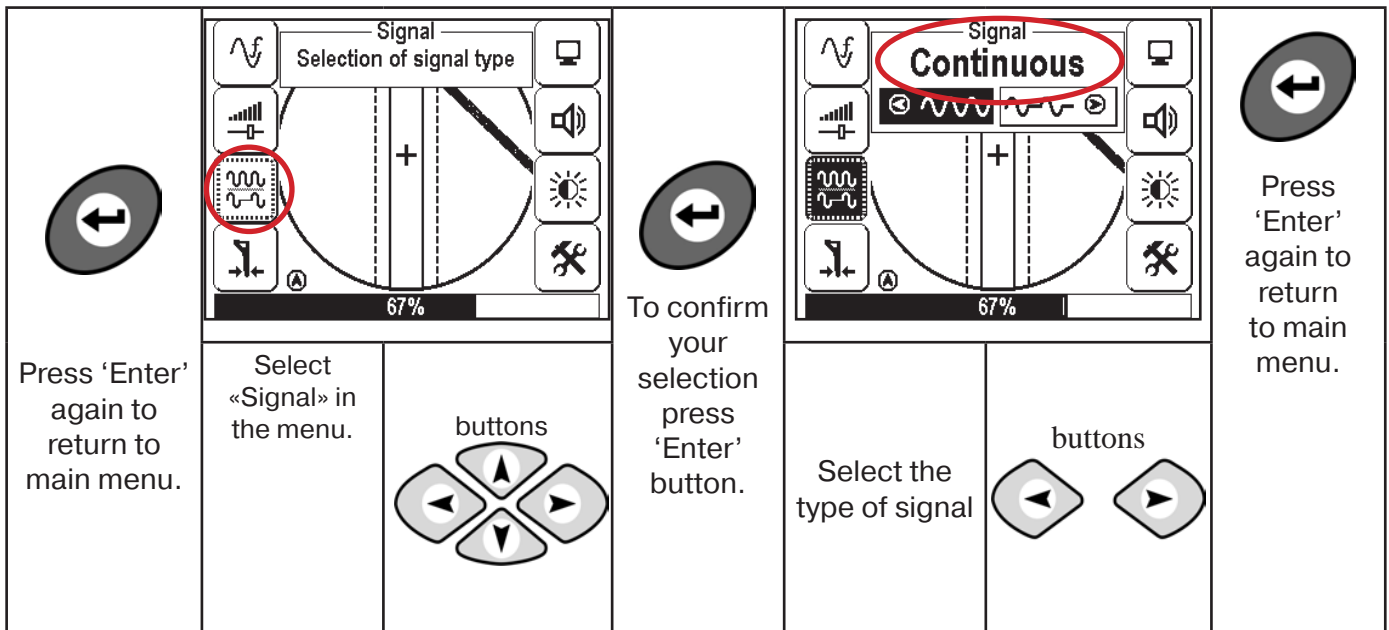
## Procedure for search of communication and conduction of cable route location

<p><b>Note</b></p> <p>1. Connect the generator to the communication by contact or contactless method.</p> <p>When possible, the preference should be given to the contact method of connection, which allows to perform the cable route location for more distantly.</p>	<p><b>Note</b></p> <p>2. Turn on the generator. Set the signal type - impulse «<b>IM</b>»/continuous «<b>CS</b>» The generation frequency on the generator - 512, 1024, 8192, 32768 Hz.</p> <p><b>Impulse mode (IM)</b> It is used to increase the time of work of generator.</p> <p><b>Continuous signal (CS)</b> allows to conduct simultaneously with the routing the diagnostic of the faults of the power cable</p>
 <p>The example of setting of parameters on the generator.</p>	<p><b>Example</b></p> <p>3. Start the generation, wait for the transmitter to power up.</p> <p>4. Proceed with the setting of the receiver AP-019.1.</p>

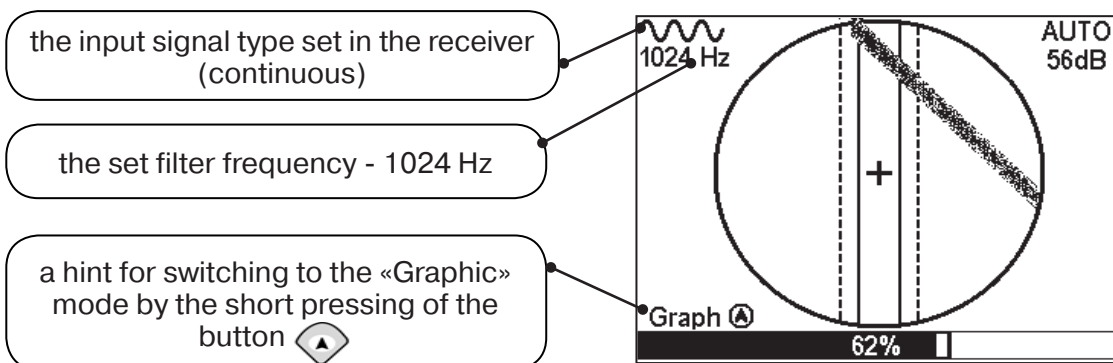
### Setting of the receiver for the active search. «Route» mode

 <p>Turn on the power</p>	 <p>Press 'Enter' button to open the menu</p>  <p>Select the icon «Modes» in the menu.</p>  <p>buttons</p>	 <p>To confirm your selection press 'Enter' button.</p>	 <p>Select the «Route» mode</p>  <p>buttons</p>
 <p>Press 'Enter' again to return to main menu.</p>	 <p>Select «Filter» in the menu.</p>  <p>buttons</p>	 <p>To confirm your selection press 'Enter' button.</p>	 <p>Set the filter frequency corresponding to the transmitter frequency, for example 1024 Hz.</p>  <p>buttons</p>





### View of the receiver screen for route location in the active mode



Having set up the receiver, you can start locating communication and determine its burial depth **similarly to p. 5.2 (page 17)**



When working in the Route mode, sometimes happens the following:

- the positioning of the communication axis into the centre is impossible
  - the presence of several near located communications
  - low signal in the cable
- in such cases you should switch to the «Graphic» mode.

## 5. Search of communications in the mode «Graphic»



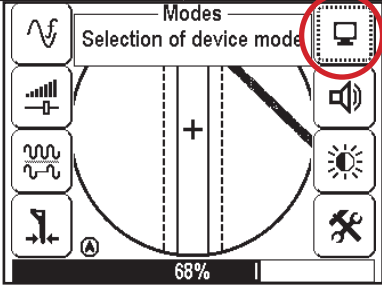

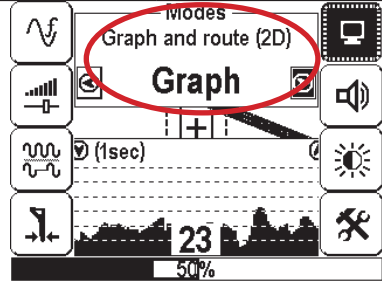
The «**Graphic**» mode of is the support mode and intended to locate various communications (cables, pipelines), both in the passive and active modes with the route locating transmitter. In the passive mode the cable location is carried out at frequencies **50(60), 100(120)Hz**, in the active mode - **512, 1024, 8192, 32768 Hz**.


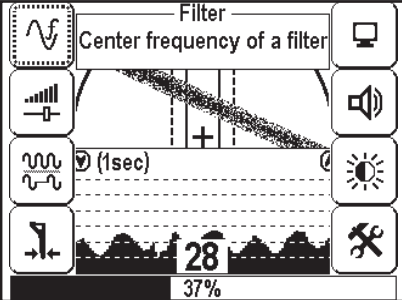

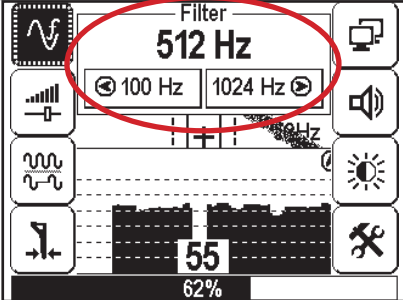
The «**Graphic**» mode is also intended to determine the number of the near located communications. The «**Graphic**» mode allows to perform the route location in the conditions of the low signal on the communication, when the route location in the «**Route**» mode is impossible.

The measurement of the burial depth and current is not available in this mode.

In the «**Graphic**» mode, the receiver screen displays the moving diagram of change in the signal level depending on the time by the 'maximum' method - when located over the communication the signal is maximum, when deviating from the axis - the signal decreases.


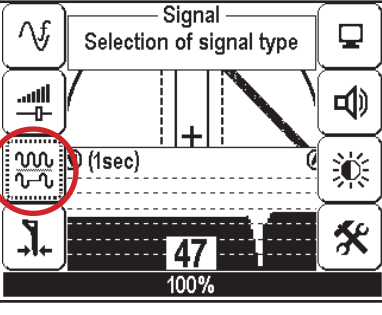

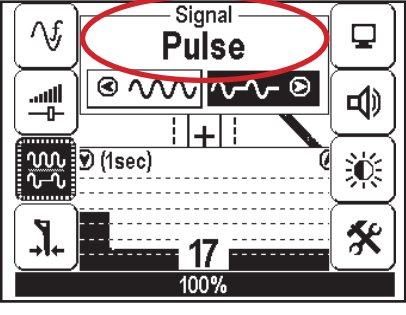

### 5.1 Setting of the receiver for work in the «Graphic» mode

 Turn on the power	 Press 'Enter' button to open the menu	 Select «Modes» in the menu.	 To confirm your selection press 'Enter' button.	 Select the mode «Graphic»
---	--	---	--	---

 Press 'Enter' again to return to main menu.	 Select the «Filter» in the menu.	 To confirm your selection press 'Enter' button.	 Set the filter frequency for the passive search 50(60) or 100(120) Hz, for active search 512, 1024, 8192 Hz, 33 kHz in accordance with the generator frequency
--	---	--	---

At the active search, the signal should be transmitted on the route from the generator with the same frequency as on the receiver (p.5.3).

In the «**Graphic**» mode the work is performed in the «**Continuous**» or «**Impulse**» signal. The difference at the work with the «**Impulse**» signal is in that the digit in the center of the analogous scale shows not the current value of the signal, but the maximum value (amplitude) of the transmissions of the interruptible signal from the route locating generator. The pitch of the tone of the sound synthesized also corresponds to the maximum value of the signal for the period of the impulse transmitted.


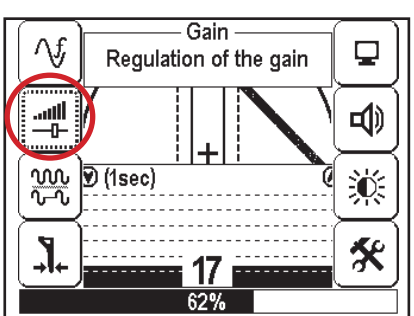
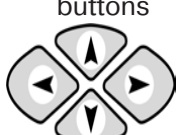
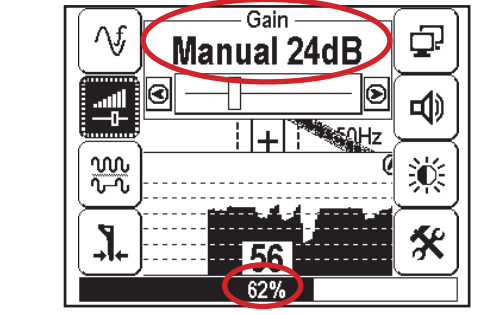

 Press 'Enter' again to return to main menu.	 Select «Signal» in the menu.	 buttons	 To confirm your selection press 'Enter' button.	 Press 'Enter' again to return to main menu.
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Note

When working in the passive mode **50(60) Hz, 100(120) Hz** - you should always select the **continuous type of the signal**.

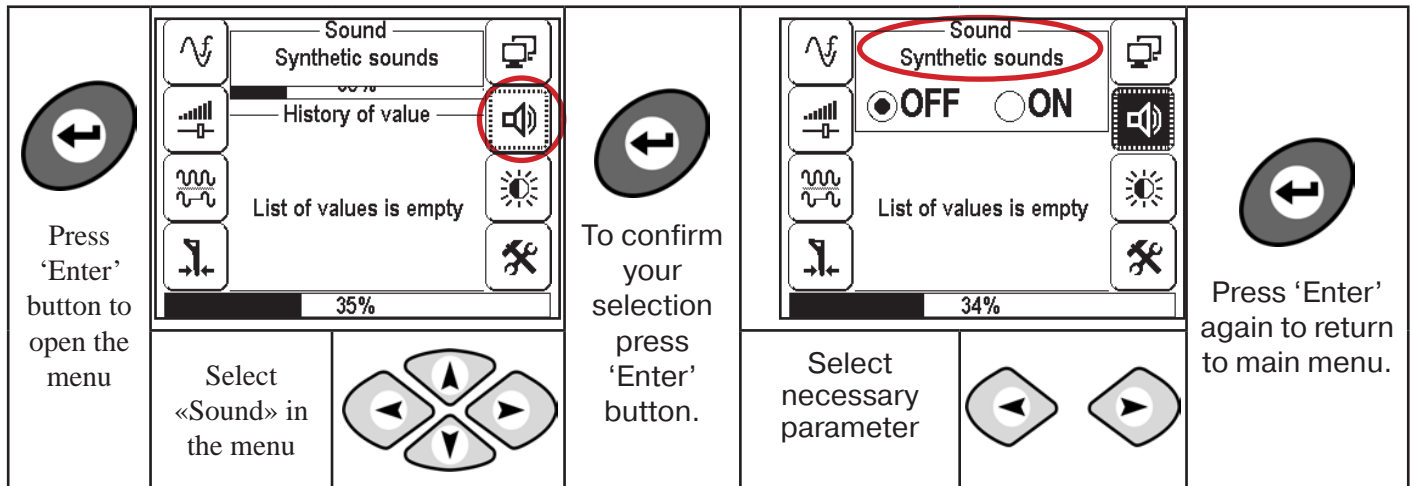
When working with the generator (in the **active mode**) **512, 1024, 8192 Hz, 33 kHz** - the type of the signal on the receiver is **continuous or impulse**, in accordance with the signal set on the transmitter.

During the route location, you can manually set the input signal amplification.

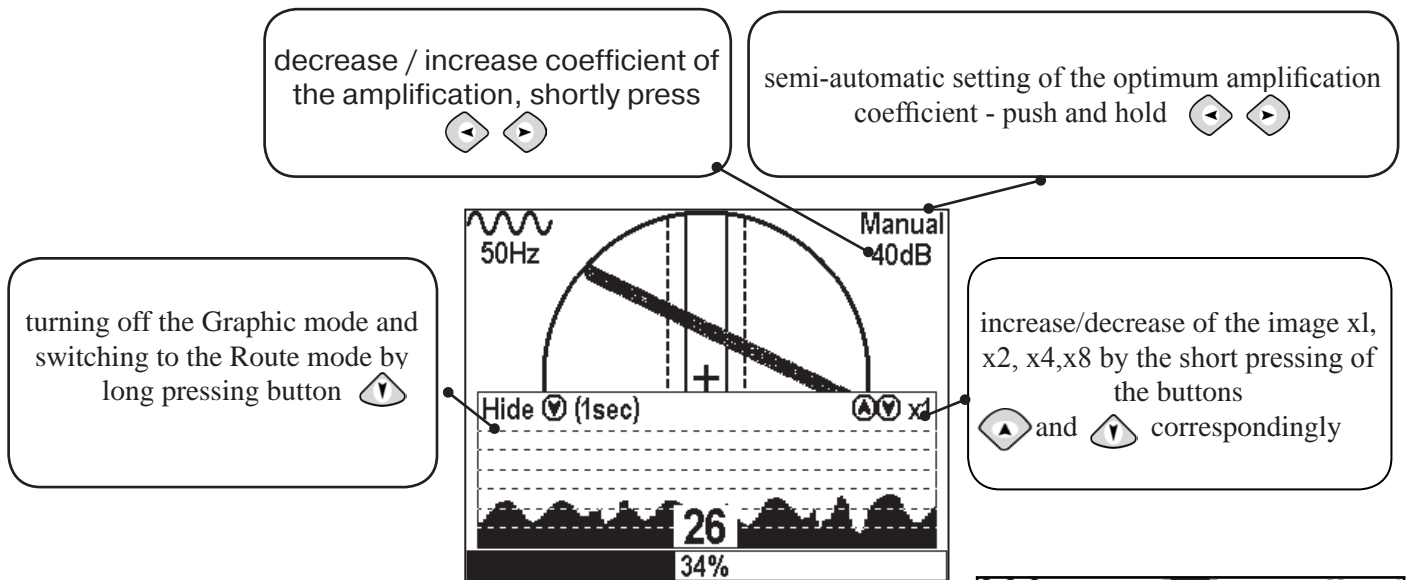
 Press 'Enter' button to open the menu	 Select «Amplification» in the menu.	 buttons	 To confirm your selection press 'Enter' button..	 Press 'Enter' again to return to main menu.
--	--	--	--	--

**The change of the input signal amplification coefficient should be performed manually by one of them**   **short pressing buttons or semi-automatically by holding pressed for 1 sec.**

In the «Graphic» mode it is possible to listen synthesized sound through the built-in speaker, The sound tone pitch changes depending on the signal level.

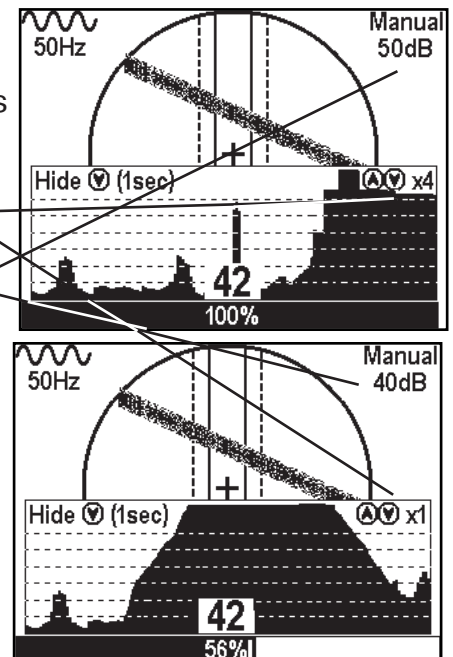


## 5.2 «Hot» keys for work in the «Graphic» mode



If the signal occupies the whole graphic (the black string) it is necessary to perform the following actions:

1. Decrease the graphic scale to the value x1 by pressing button
2. Decrease the signal amplification coefficient by pressing button till the appearance of the decrease of the input signal level will be less than 80%.
3. In case of low signal, increase the amplification coefficient by pressing button and the scale by pressing button.



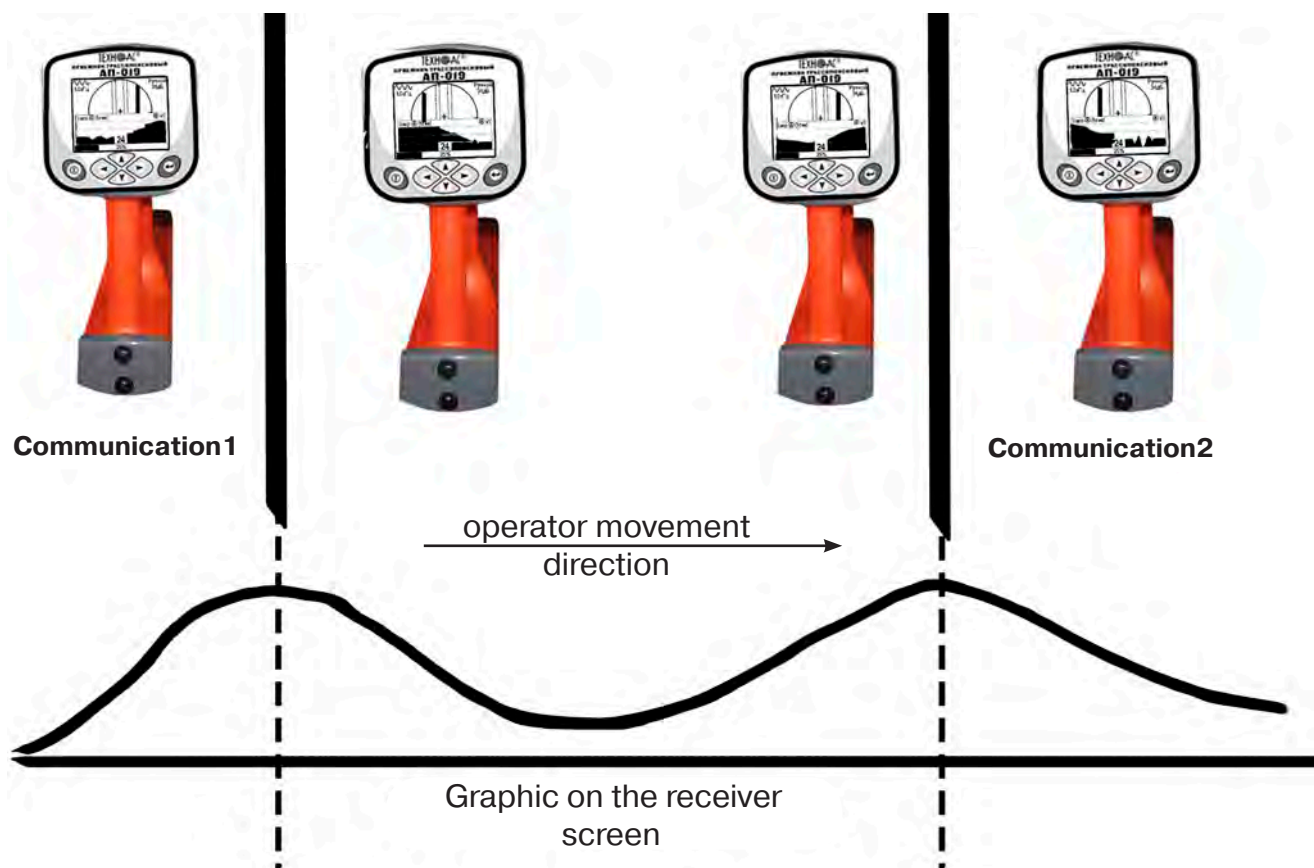


### 5.3 Search of communications in the mode «Graphic»

1. Perform the receiver setting - select the Graphic mode
2. Locate the receiver in parallel to the supposed axis of the communication, slowly move in direction as shown on the figure.



At presence of two communications, the approximate view of the graphic on the receiver screen is given on the figure:



4. You should locate the place of communication by the maximum signal level.

## 6. Search of the utilities in the mode « Graphic+»


The «Graphic+» mode is available in the advanced set of modes. The «Graphic+» is the auxiliary mode. This mode differs from the mode «Graphic», it shows «2D» image compatible with the graphic, not the relative position of the route, but automatically demonstrates the presence and provision of the near «power» cable under the voltage with the frequency 50(60) Hz.

### 6.1 Setting of the receiver for work in the «Graphic+» mode

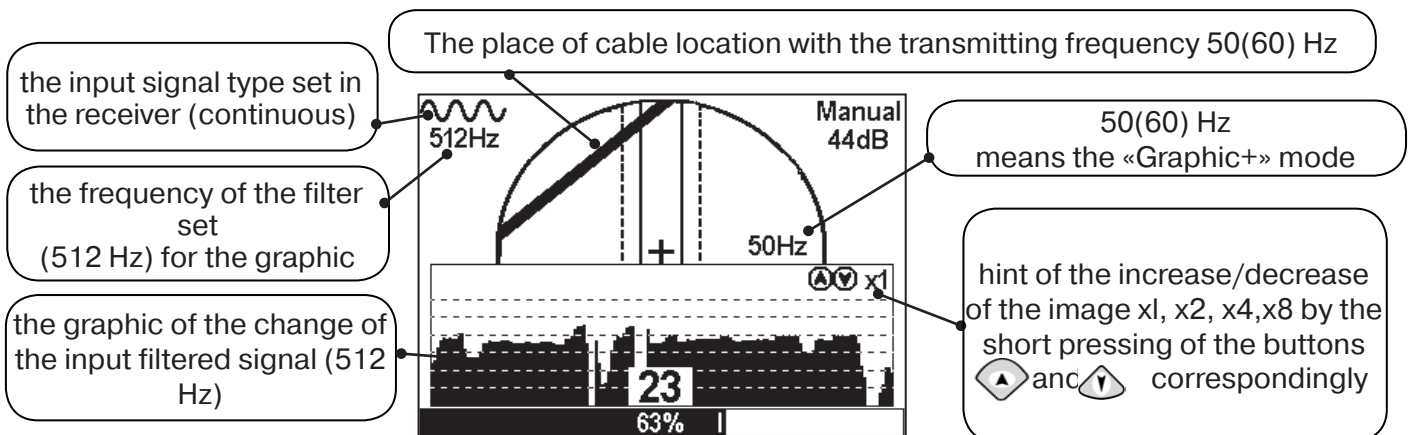
The setting of the receiver and use of the «hot keys» for work in the mode «Graphic+» is fully matches with the setting of the receiver for the «Graphic» mode, **section 6.1, section 6.2**

### 6.2 Search of communications in the mode «Graphic+»

<p><b>Note</b></p> <p>1. Connect the transmitter to the communication by contact or contactless method.</p> <p>When possible, the preference should be given to the contact method of connection, which allows to conduct the cable route location more distantly.</p>	<p><b>Note</b></p> <p>2. Turn on the transmitter. Set the signal type - impulse «IM»/continuous «CS» The generation frequency on the generator - 512, 1024, 8192, 32768 Hz.</p> <p>Impulse mode is used to increase the time of work of generator.</p> <p>Continuous signal allows to perform simultaneously with the routing the diagnostic of the faults of the power cable.</p>
--	--

 <p>The example of setting of parameters on the transmitter.</p>	<p>3. Set up the receiver for work in the «<b>Graphic+</b>» mode (section 6.1), set the frequency and type of the signal the same as on the transmitter.</p>	<p><b>Note</b></p> <p>4. Start the generation, wait for the transmitter to power up.</p>
---	--	--

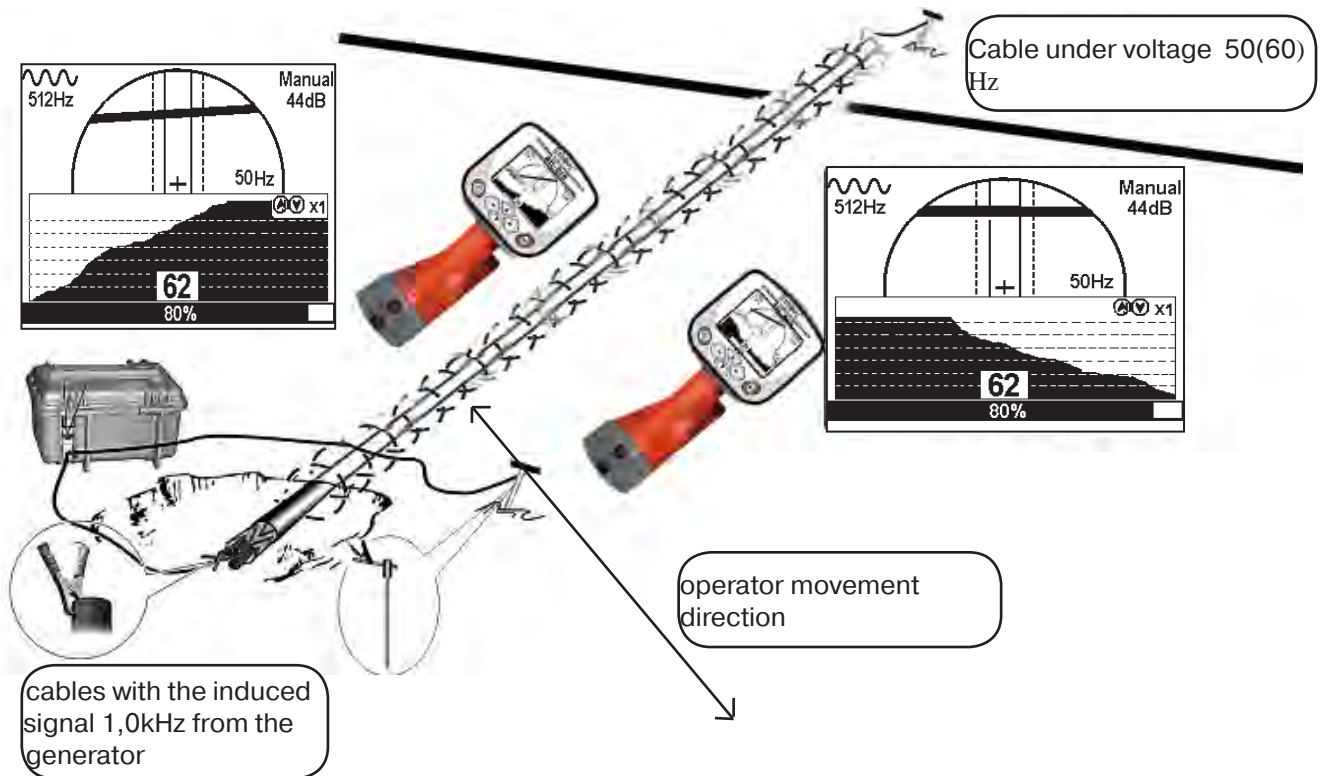
### View of the receiver screen for route location in the active mode



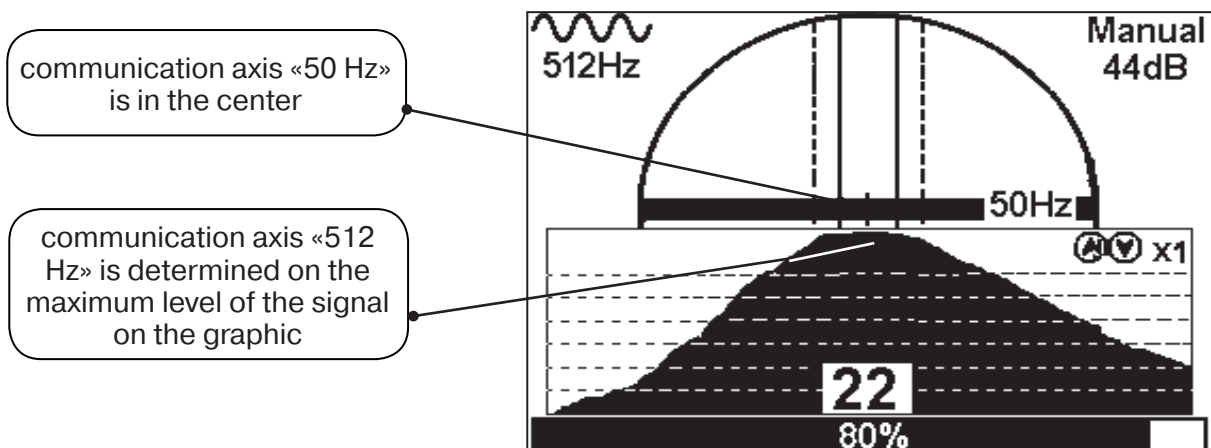
5. Approach to the supposed place of cable route, on which the signal from the generator was transmitted. Locate the receiver axis in parallel to the communication axis.

The graphic of change of the signal level will be displayed on the screen in frequency 512 Hz, on the 2D image of the route of the cable located near (if any) will be displayed under the voltage 50(60) Hz.

You should move the receiver as shown on the figure.



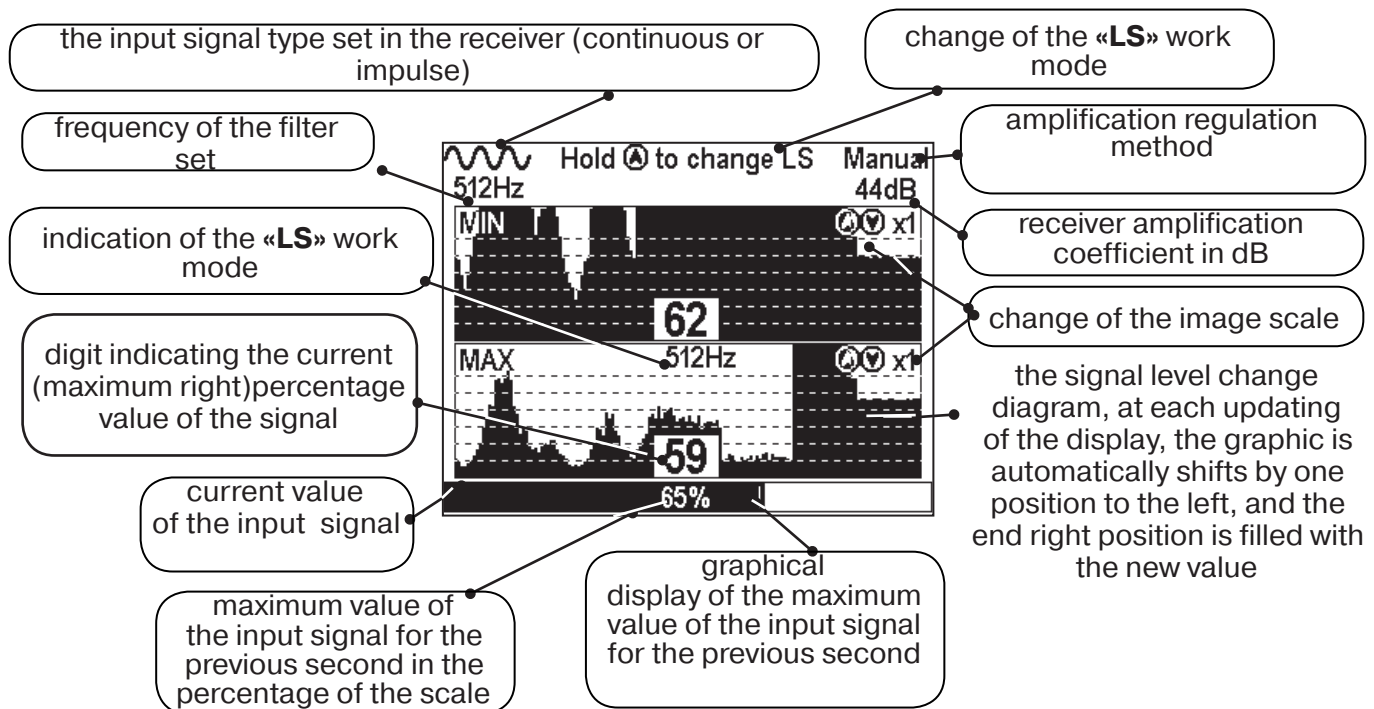
The place of crossing of cable corresponds to the setting of the pointer «50 Hz» onto the center of the circle at maximum value of the indication on the «Graphic» of the active frequency signal.



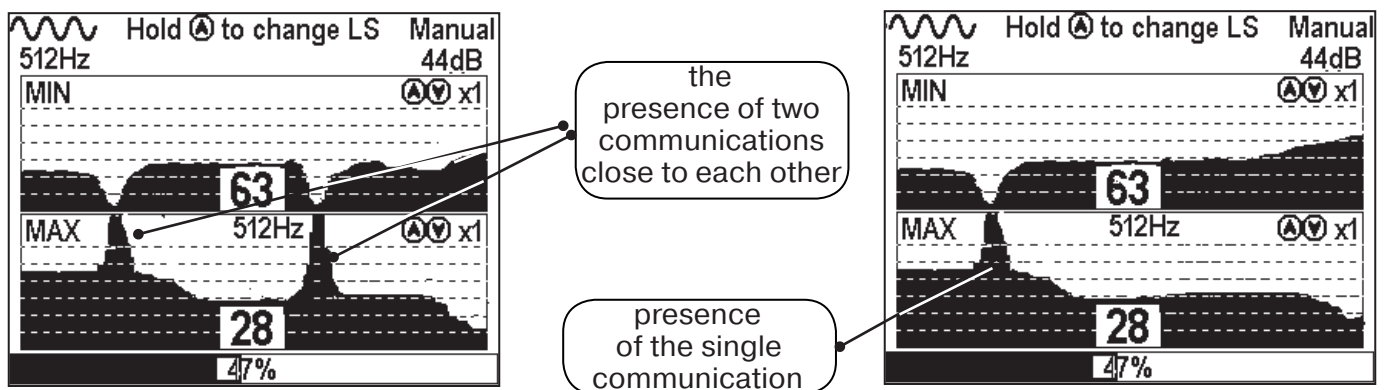
## 7. Performing the cable location in the mode «Minimum maximum»

In the mode «**Minimum maximum**», the device works simultaneously both on the method «maximum» and method «**minimum**». This mode is used in the conditions of the distorted field, in the presence of the nearby utilities, at the low induced signal. It allows to perform location, to determine presence and location of the utilities located nearby.

In the «**Minimum maximum**» mode the receiver display is divided in two halves. The moving diagram of the signal level change is displayed in the upper part by the «**minimum**» method - when located over the cable the signal is minimal, when deviating from the axis - the signal increases, in the bottom part - the moving diagram of the signal level change depending on the time by the «maximum» method - when you stand over the cable, the signal is maximum, when deviating from the axis - the signal decreases. In this mode the value of the depth and current in the communication are not displayed.



The cable route location shall be performed similarly to route location in the Graphic mode, orienting on the maximum level of the signal on the lower scale of the graphic and minimum level of the signal on the upper scale. To determine the number of the nearby communications, you should step aside from the axis of the located cable and go straight across to the communication axis to visualize the amount and place of the route of communications.





## 8. Performing cable route location in the mode «2 frequencies»

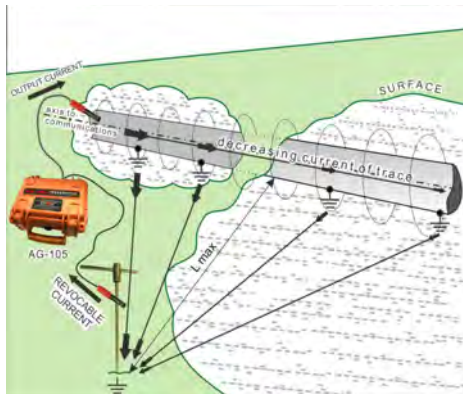
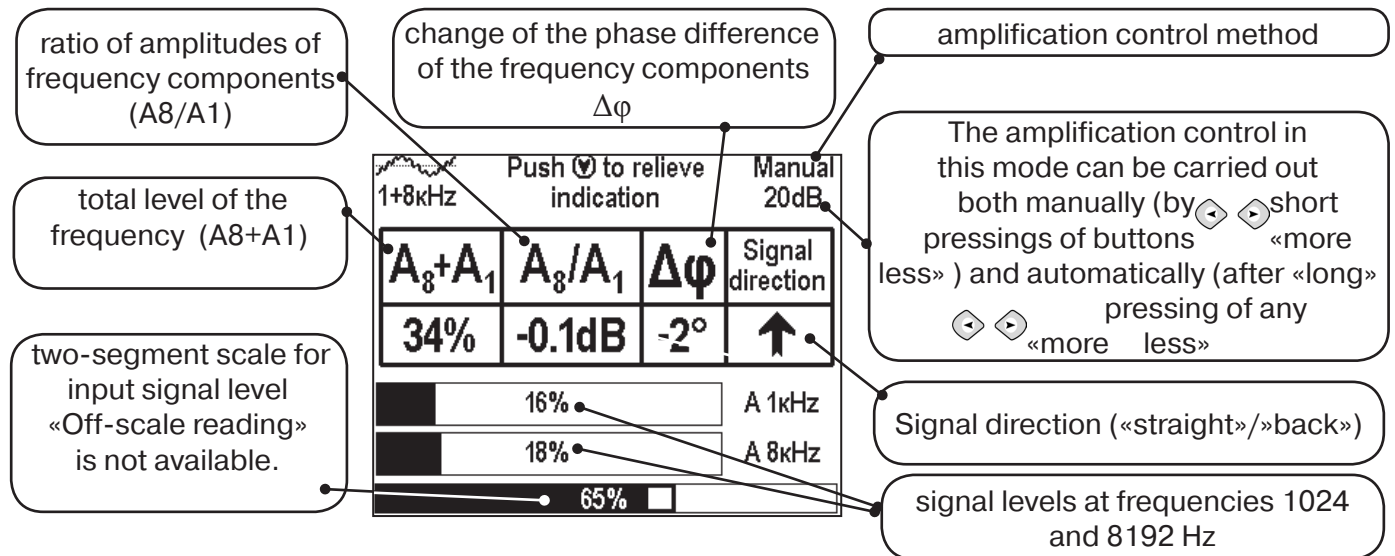
The mode «2 frequencies» was added for determination of the signal direction in cable.  
**Additional possibilities of the mode are described in App. 2:**

Append. 2 p.3 Amplitude «two-frequency» method « $\Delta A$ »;

Append. 2 i.4 Phase «two-frequency» « $\Delta\phi$ »



**The mode «2 frequencies» is realized only with the contact method of connection of the transmitter**

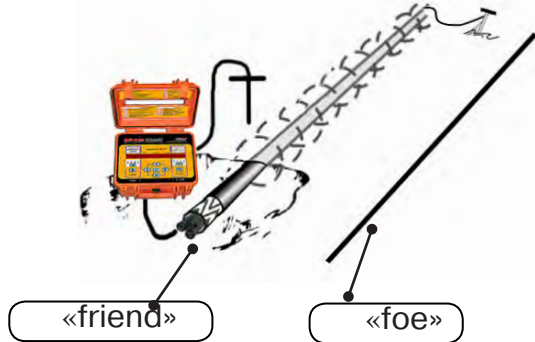


1. One output of the transmitter should be connected to the point of communication that more distant from the supposed place of the defect (start of the diagnostic site). The other output of the generator is grounded on the maximum possible distance from the communication. From the other side (end of the diagnostics site), the communication is grounded at the most possible distance from the communication.

2. The transmitter in the mode «2F» sends to the communication the signals of two frequencies (1024Hz and 8192Hz) simultaneously.



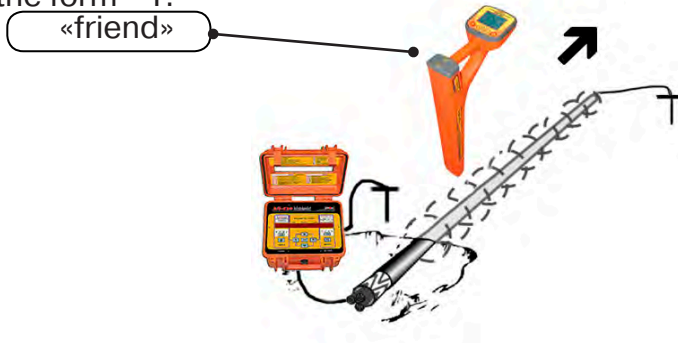
3. The signal from the communication, to which the route locating transmitter is directly connected, is conventionally named - «friend». The «parasitic» signal from the nearest communication, on which the generator signal is transferred, is conventionally named as «somebody else's».



4. Based on the direction of the «arrow» it is possible to distinct «friend» signal from «foe» one, since the current direction in «friend» communication is opposite the «transferred» currents flowing through «foe» communications.

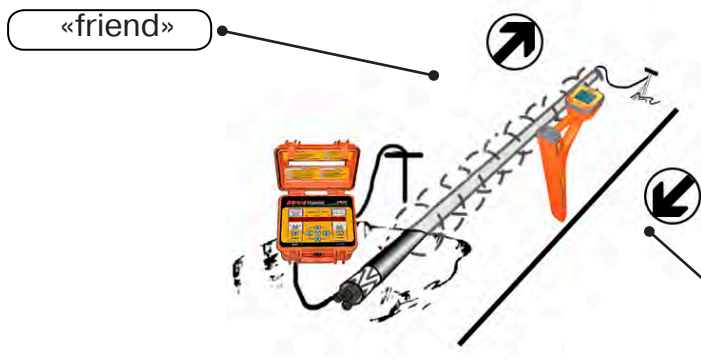
1+8kHz	Push  to relieve indication	Manual 20dB
$A_8 + A_1$	$A_8 / A_1$	$\Delta\varphi$
34%	-0.1dB	-2°
Signal direction		
↑		
16%		
A 1kHz		
18%		
A 8kHz		
65%		

5. «Signal direction - forward» is the conventional concept and «assigned» by the operator for this position of the sensor relative to the this route. The «assignment» is performed by the pressing of the button «», when the sensor is located exactly over the «allocated» communication, that is supposed to be «friend». After that, the pointer of the signal direction takes the form - 1.



1+8kHz	Push  to relieve indication	Manual 20dB
$A_8 + A_1$	$A_8 / A_1$	$\Delta\varphi$
34%	-0.1dB	-2°
Signal direction		
↑		
16%		
A 1kHz		
18%		
A 8kHz		
65%		

When switching to the «foe» communication with the other «signal direction» (or at the change of the sensor position to the «reverse») the sound will be emitted (if switched on) and the arrow will show the «signal direction - back 1».

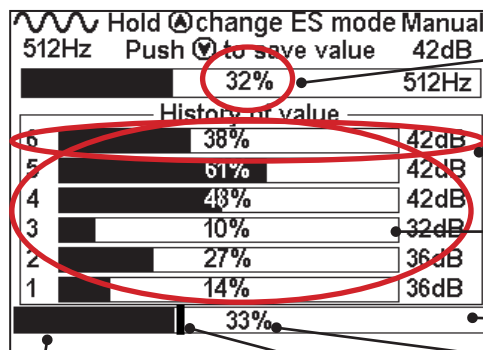


1+8kHz	Push  to relieve indication	Manual 20dB
$A_8 + A_1$	$A_8 / A_1$	$\Delta\varphi$
34%	-0.1dB	-2°
Signal direction		
↓		
16%		
A 1kHz		
18%		
A 8kHz		
65%		

## 9. The work mode «Cable selection from a bunch»

The mode «Cable selection from a bundle» is switched on and off automatically at the connection and disconnection of the external sensor **(ES) KI-110** (inductive clamps) or **NP-117** (superimposed frame).

The mode is intended for selection of the «allocated» cable from the bundle of cables on the characteristics (maximum) signal emitted by this cable. The selection can be carried out at all the frequencies supported by the receiver.



The level of the filtered signal from the sensor KI-110 or NP-11 in percentage

The current level of the signal and the amplification coefficient for the moment of measurement

Six lines for signal level and amplification coefficient values stored by the user. At each storage the content of all lines moves by one position down

the scale of the input signal level from the lower receiver sensor

current value of the input signal level.

the graphical display of the maximum value of the input signal for the previous second

the maximum value of the input signal for the previous second in percentage

### 9.1 The work with the receiver in the mode «Selection of the cable from a bunch»

**Attention!** In order to select the allocated cable from a bundle, you should provide the flowing of the current of the set frequency and form through it. To do this, it is necessary send into the searchable cable the signal from the route locating generator by the contact or contactless method and provide the «current return» to the generator (for example, through the ground). All output ends of cables of the bundle should be connected to the «return» circuit.



Fig.10.1

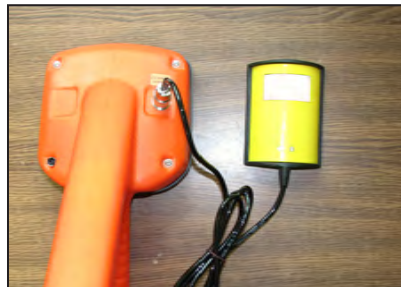
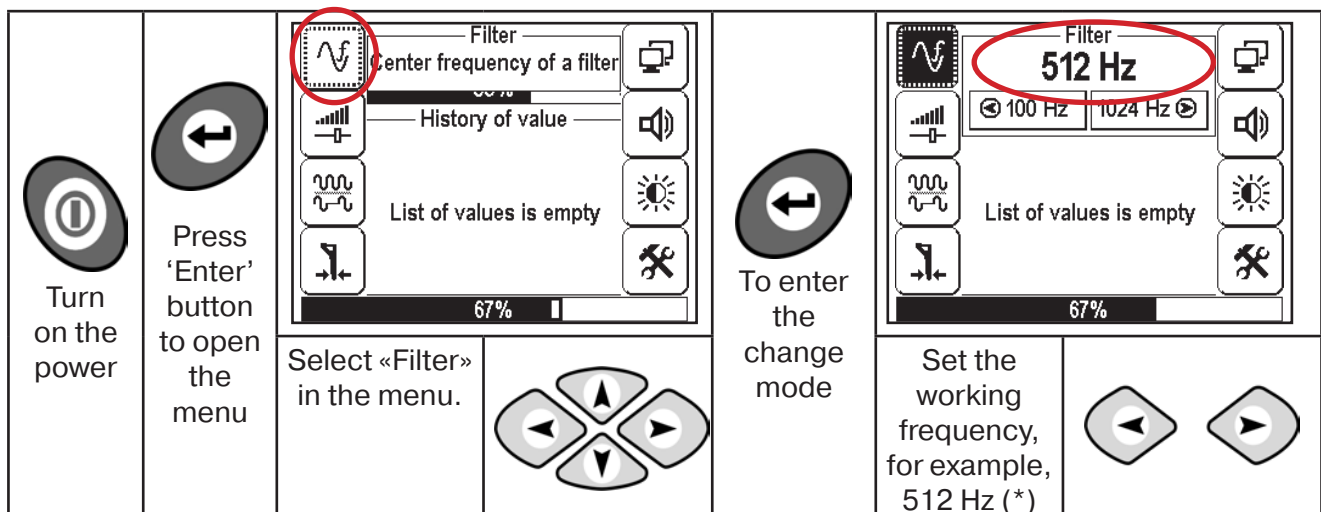

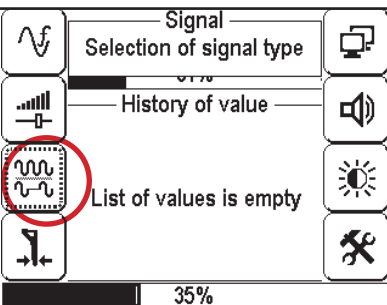

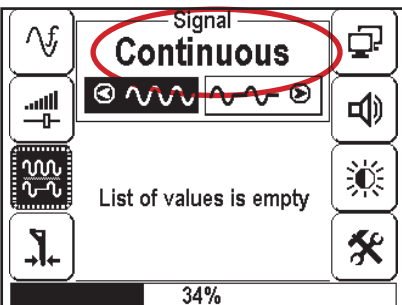


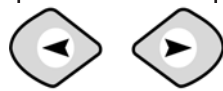


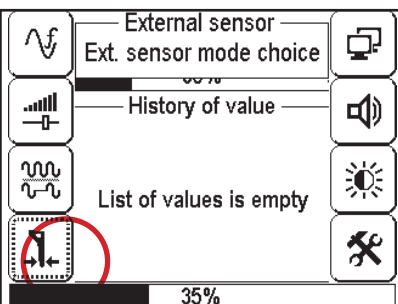

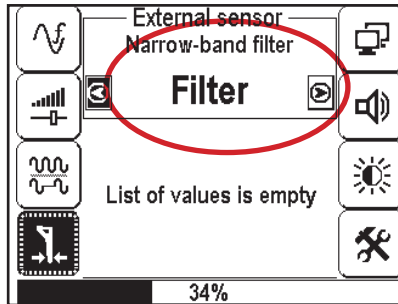



Fig.10.2

Connect inductive «clamps» KI-110 using the cable -adapter for pliers to the receiver (fig. 9.1) or NP-117 (fig. 9.2).



(\*) at that the signal should be sent into the cable from the transmitter with the same frequency 1024 Hz

 <p>Press 'Enter' again to return to main menu.</p>	 <p>Signal Selection of signal type History of value List of values is empty 35%</p>	 <p>To confirm your selection press 'Enter' button.</p>	 <p>Signal <b>Continuous</b> History of value List of values is empty 34%</p>	 <p>Press 'Enter' again to return to main menu.</p>
<p>Select «Signal» in the menu.</p> 		<p>Select the signal type corresponding to the signal type from the transmitter, for example, continuous.</p> 		

 <p>External sensor Ext. sensor mode choice History of value List of values is empty 35%</p>	 <p>To enter the selection</p>	 <p>External sensor Narrow-band filter <b>Filter</b> History of value List of values is empty 34%</p>	 <p>To exit from the menu you should press the button «Enter». If you will wait for several seconds, menu icons will disappear.</p>
<p>Select the icon «Mode of the lower sensor» in the window.</p> 	<p>Select the mode of the bottom sensor «Filter»</p> 		

Install on «induction pliers» KI-110 (fig. 10.3) or apply NP-117 (fig.10.4) onto the one of cables.



Fig. 9.3

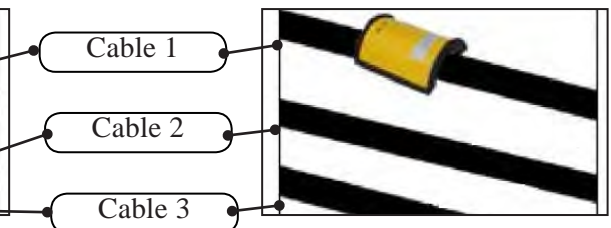

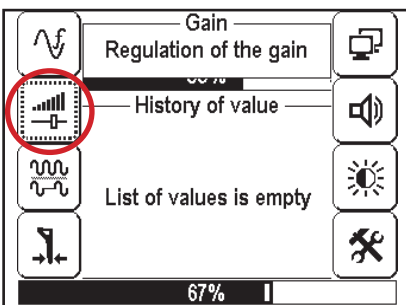

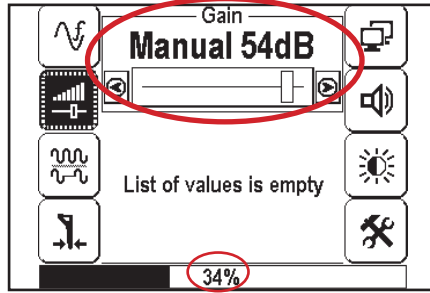



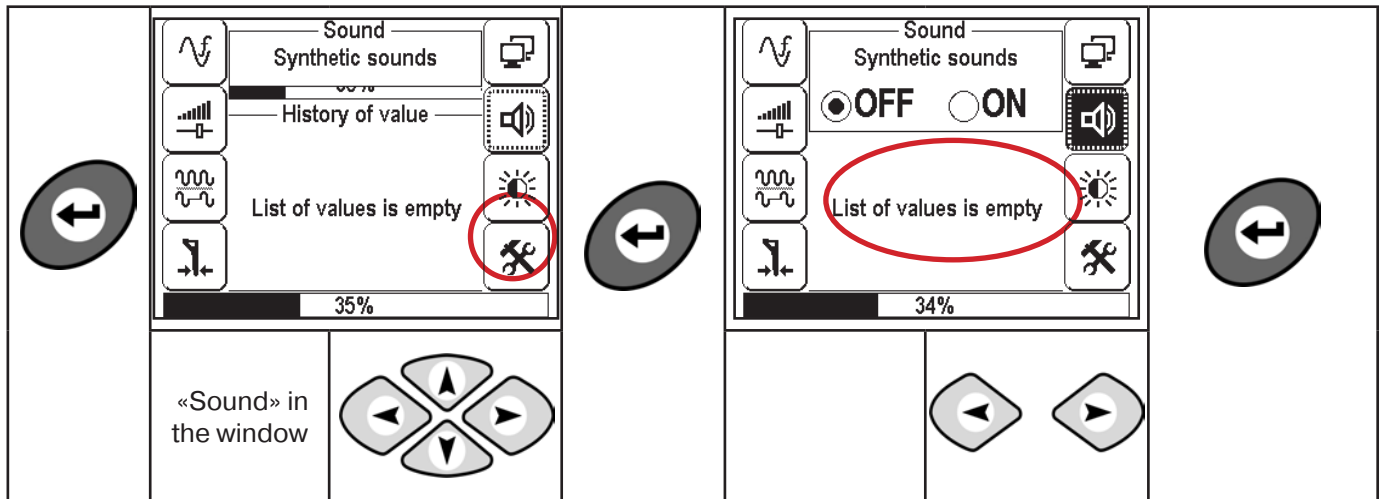


Fig. 9.4

 <p>Press 'Enter' again to return to main menu.</p>	 <p>Gain Regulation of the gain History of value List of values is empty 67%</p>	 <p>To confirm your selection press 'Enter' button.</p>	 <p>Gain <b>Manual 54dB</b> History of value List of values is empty 34%</p>	 <p>Press 'Enter' again to return to main menu</p>
<p>Select «Amplification» in the menu.</p> 		<p>Set the amplification coefficient, for example, 54 dB</p> 		



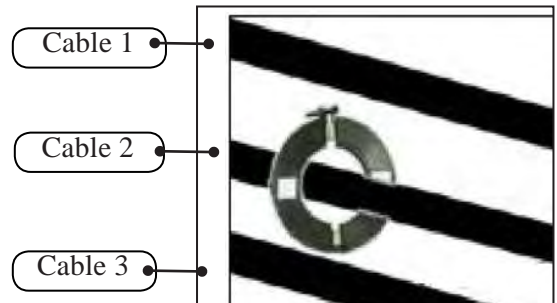


**Save parameters of measurement into the memory by pressing the button**



Alternately putting on «Inductive clamps» or applying a attachable frame to the cables bundle, find «isolated» cable by the higher level of the signal (Fig. 9.5).

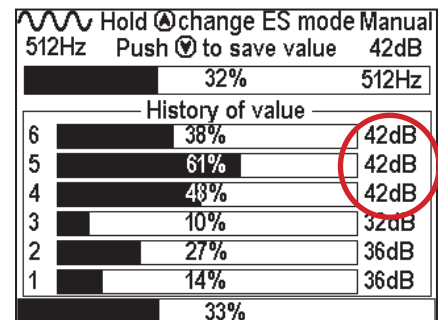
The tone pitch of the synthesised sound correspond to the signal value (including and «impulse» amplitude)



**To compare the signals, you should perform measurements at the equal amplification coefficient.**

**In the example (fig. 9.5) it is possible to compare values only with the amplification 42 dB. The maximum of them is the value under the number 5.**

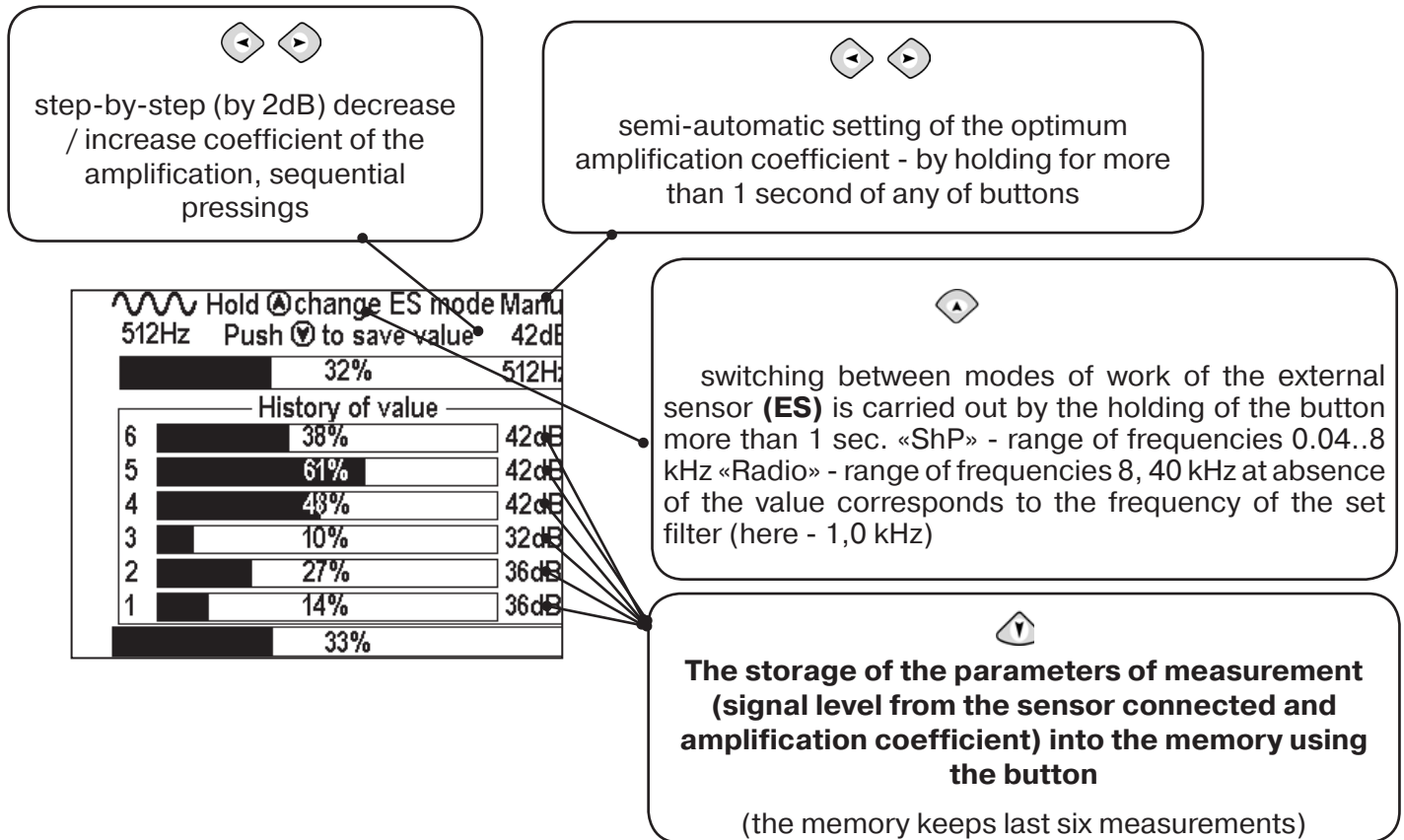
The maximum signal 80% (42 dB) corresponds to the cable No.2



**Fig. 9.5**



## 9.2 «Hot» keys for the work in the mode «Selection of the cable from the bunch»



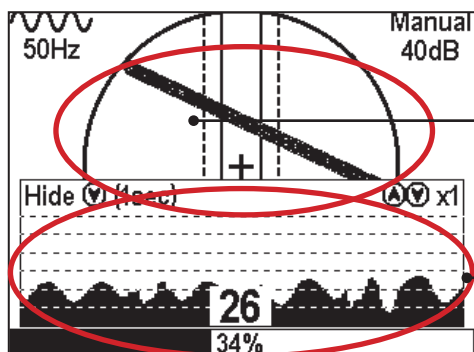
### Note

In the mode «Cable selection from a bunch» using the external sensor, the work with the continues and impulse signal is supported (menu option «signal», table 1 p.3). The difference at the work with the «Impulse» signal is in that the digit in the centre of the analogous scale shows not the current value of the signal, but the maximum value (amplitude) of the transmissions of the interruptible signal from the route locating transmitter made by TECHNO-AC.

## 10. Mode «Search of defects» using external sensors



The mode «Search of defects» is switched on and off automatically, when connecting and disconnecting external sensors DKI-117, DOLK-117. The mode «Search for defects» with external sensors DKI-117/DODK-117 was added for search of insulation defects.

The search of defects of cable defects can be carried out at all frequencies both in an active, and passive modes.



2D display of the route location

2 The graphic of time change of the external sensor signal level

The graphic can be hidden by long pressing of the button  and appears at the short holding of the button. 

### The work with the receiver in the mode «Search for defects»



**Fig.10.1**



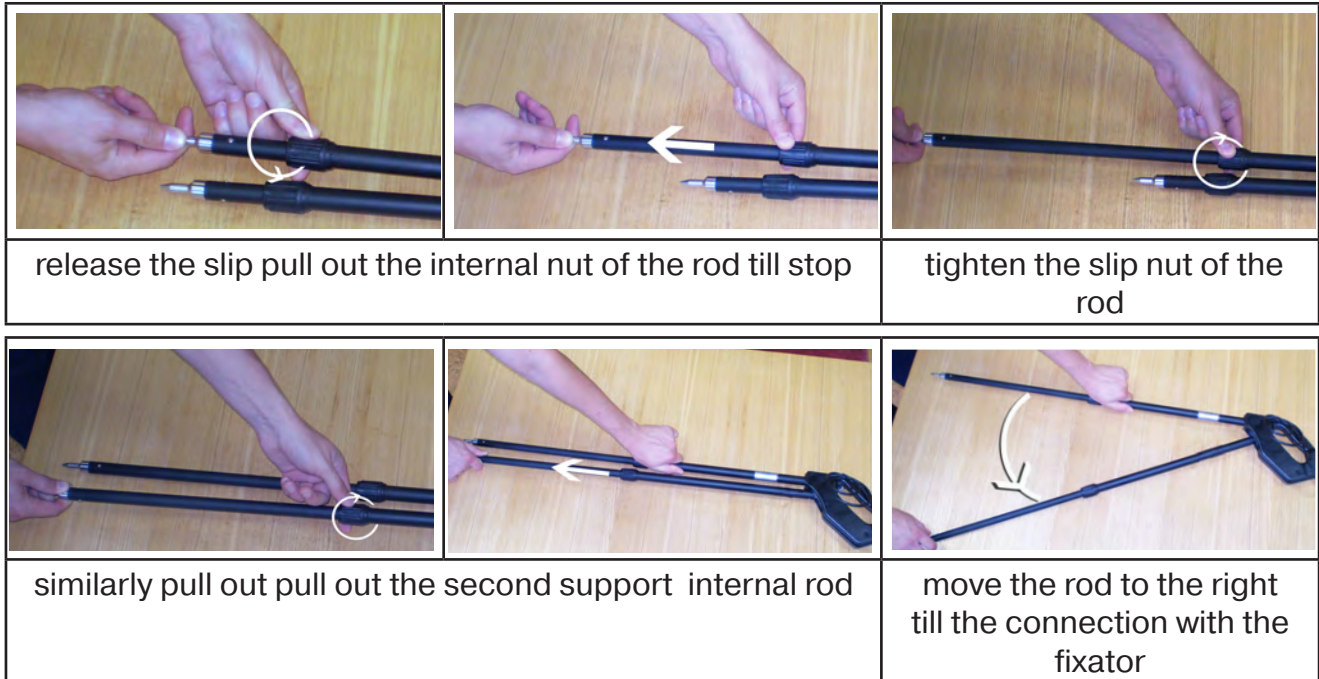
**Fig.10.2**

- - Connect to the sensor to the receiver of the insulation control DKI-117 (fig. 11.1) or DODK-117 -117 (fig. 11.2).

## Preparation of the sensors for work

### DKI-117

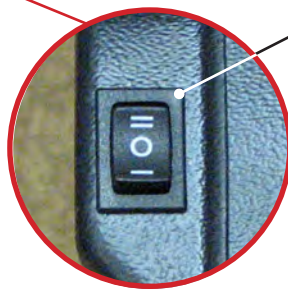
Prepare the sensor for operation.



The average position of the fixator corresponds to the angle 30, end - angle 60 (fig. 10.3). Maximum distance between electrodes corresponds to the maximum sensibility.



(fig. 10. 3.)



- 3-position switch of the signal level
- in the position «O» - signal 100%
  - in the position «I» - the signal is weakened in 5 times
  - in the position «II» - the signal is weakened in 25 times

**Before starting the operation you should set the switch into the position «O».** If during the search process, with the amplification coefficient 0 dB, the input signal level is greater than 70%, you should switch the sensor regulator to «I» position and with a further increase of the signal to the position «II», and then perform the adjustment of the coefficient of amplification of the receiver to the level of the input signal 50 to 80%. (**Fig. 10.4**)

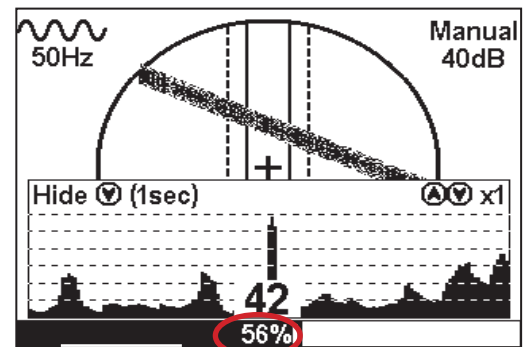


Fig. 10.4

## DODK-117

The survey shall be performed by two operators, the one operator has the measuring electrode, and the second one has the measuring electrode and receiver (**fig. 10.5**). Based on the receiver indications, you can locate the damaged cable (**by methods described in the application 2 p. 1-2**).

### NOTICE!

**When working with the sensor DODK, the electrodes should be used without gloves, providing the contact of the sensor with a skin (fig. 10.6)**




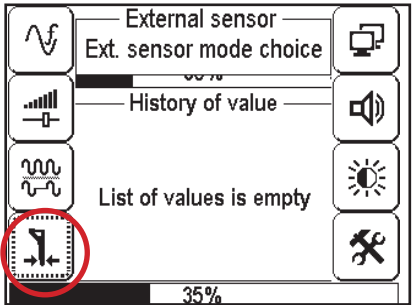


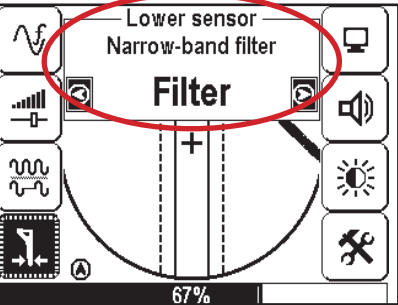


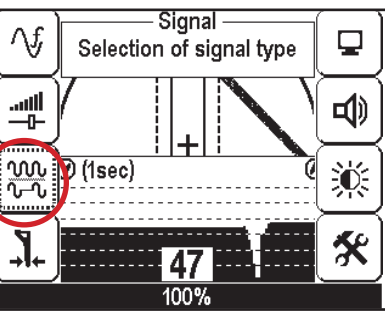


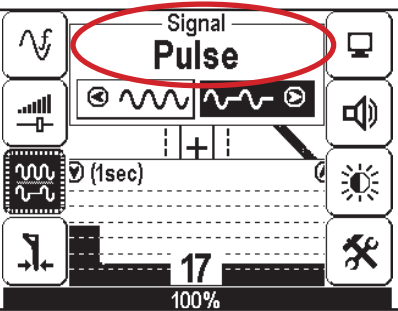

Fig. 10.5










Fig. 10.6

### Receiver setting

1. Turn on the receiver
2. Set the work mode of the lower sensor to the value «Filter»
3. Set the working frequency and type of the signal:

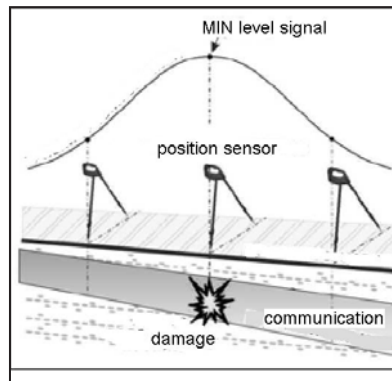
 To call out of the menu press the button «Enter»	 <p>Select the icon «Mode of the lower sensor» in the window.</p> 	 To change of the parameter selected, press the «Enter» button.	 <p>Set the value signal «Filter»</p> 
 To exit the change mode	 <p>Select the icon «Signal» in the window.</p> 	 To enter the change the parameter selected, press the «Enter» button.	 <p>Select the signal type,</p> 



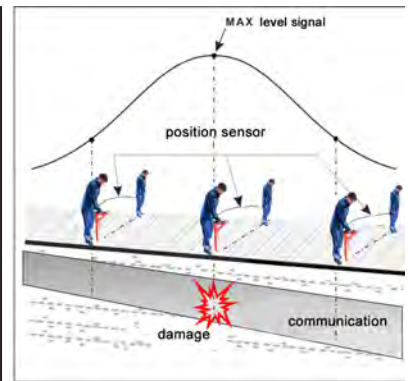
	<p>To call out of the menu press the button «Enter»</p>	 <p>Filter Center frequency of a filter</p>	 <p>To change the parameter selected, press the Enter button.</p>	 <p>Filter 512 Hz</p>	 
		<p>Select the icon «Filter» in the window.</p> 		<p>Set the working frequency, for example, 512 Hz (*)</p>	

**Wait for several seconds till menu icons disappear**

The search of insulation damage should be started by the method «MAX» (fig. 10.7, 10.8) (see. appendix 2). Move along the cable axis, mark the place cable signal (start of the signal rise, place of the maximum detection).









(fig. 10.7.)



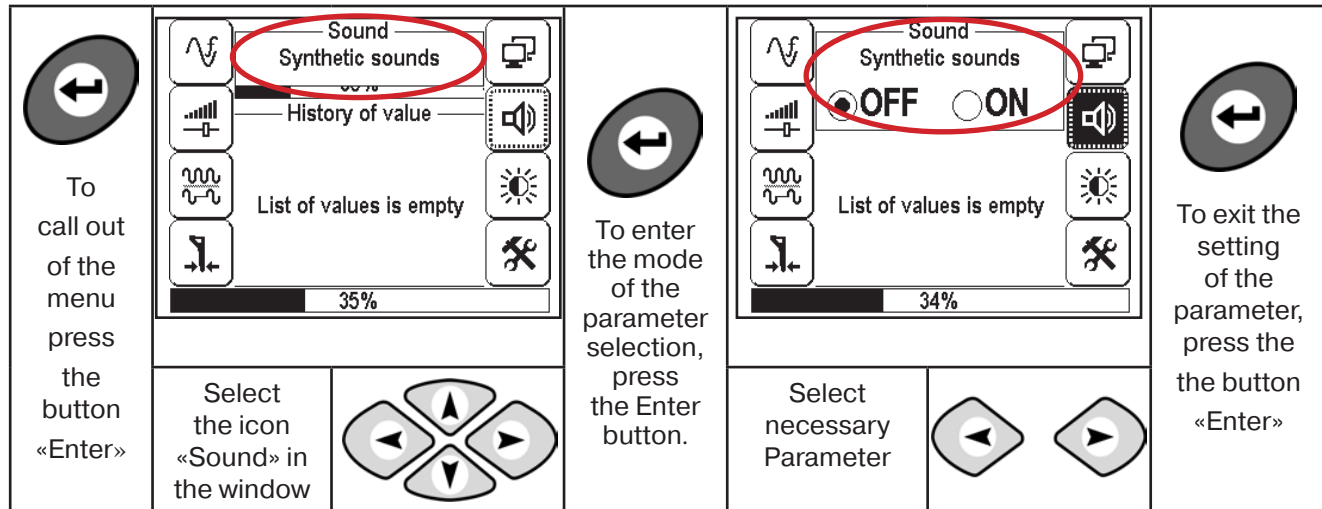
(fig. 10.8.)

When working with sensors you should regulate the receiver amplification coefficient so that the signal level was in the rang 50 to 90 %.

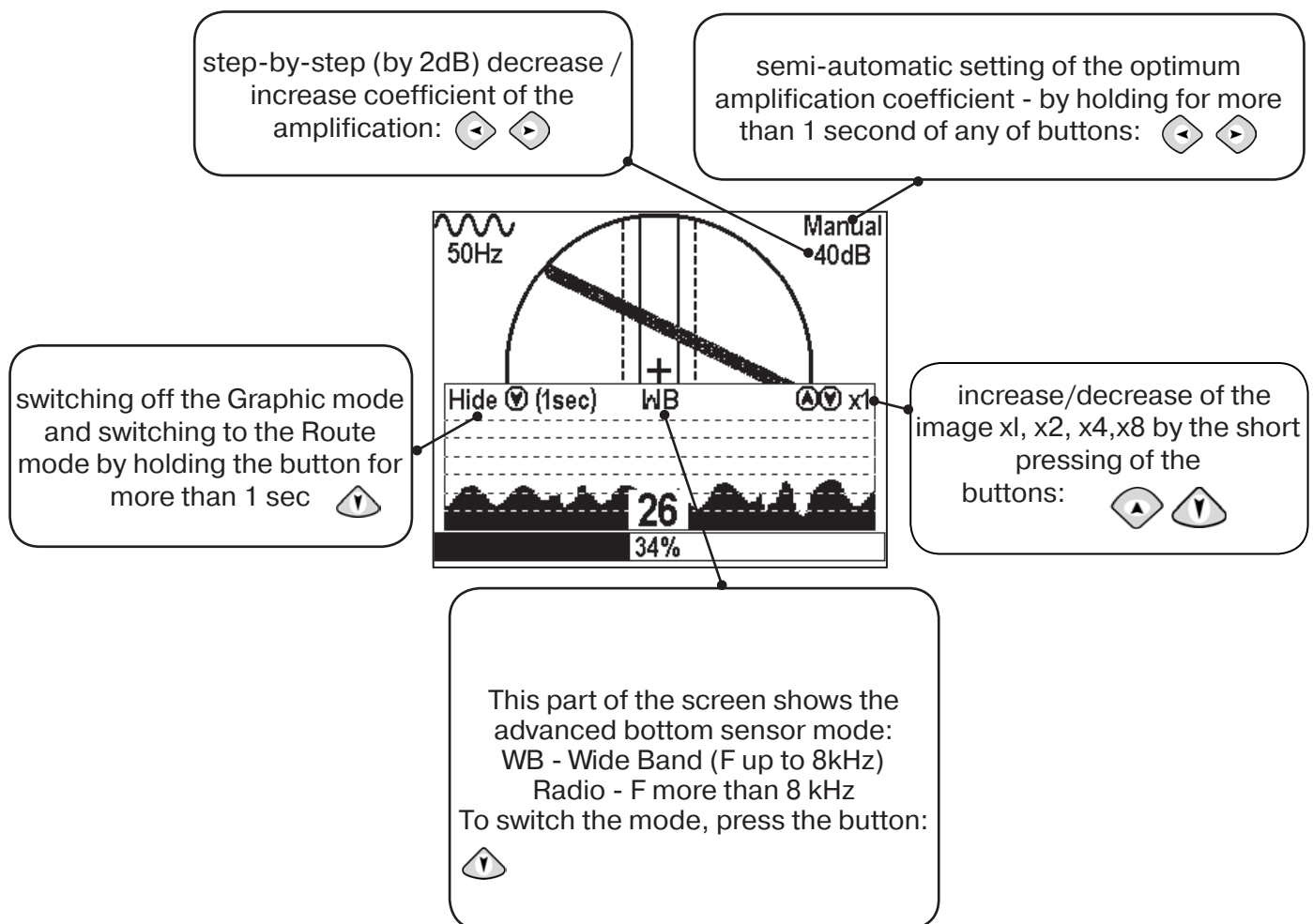
 <p>To call out of the menu press the button «Enter»</p>	 <p>Gain Regulation of the gain</p>	 <p>To enter the mode of the arameter selection, press the «Enter» button.</p>	 <p>Gain Manual 14dB</p>	 <p>To exit the setting of the parameter, press the «Enter» button.</p>
	<p>Select the icon «Amplification» in the window.</p> 		<p>Set the amplification coefficient, for example, 14 dB</p>	



The user can listen synthesized sound through the built-in sound speaker. The sound tone pitch changes depending on the signal level. The synthesized sound can be switched on in the menu «**Sound**».



## 10.2 «Hot» keys for work in the «Graphic» mode with DODK and DKI





**Thank you for choosing Techno-AC equipment!!**

- If you have suggestions of improving the device's operation to your needs,
- you have proposals to improve technical documentation,
- You have any questions about device operation - email us to: [marketing@technoac.ru](mailto:marketing@technoac.ru)  
or call:

+7 (496) 615-16-90

**We will to solve your in no time.**

## Appendix 1

### Receiver AP-019.1 Specifications

Parameter	Value
Quasi-resonant frequencies of the filter	50(60)/ 100(120)/ 512/ 1024/ 8192 / 32768 Hz
Quasiresonant filter quality factor (Q)	Not less than 100
Frequency range "Broad band"	0,04...8 kHz
Frequency range "Radio"	8...40 kHz
The maximum gain of the electric path	>100 dB
Number of built-in sensors	4
Connected external sensors	KI-110, HP-117, DODK-117, DKI-117 (made by «TECHNO-AC»)
Sensitivity control	Auto - for 2D display «Route». Semi-automatic or manual (optional) - for the «Graphics». Automatic or manual (optional) - for the «2F» mode.
Determination the burial depth of the route	Automatically in the mode Route 0...9,99 m
The accuracy of determining of the depth	±5%
Measurement of the current of the signal received	Automatically in the mode Route 0,01...9,99 A
Accuracy of the measurement of the current of the signal received	±5%
Support of energy saving (intermittent) modes of the route locating generators	At combined work with the route locating generators made by "TECHNO-AC" ("Pulse" mode)
Visual indication	LCD display, 320x240 pix., LED lighting
Induced parameters	-parameters of setting and control - 2D visualization of the route location relative to the device -graphics of the signal level from sensors - route burial depth - signal current
Audio indication	Built-in transmitter - synthesized sound HM- sound indication of buttons pressing
Power supply source	4...7 V (4 elements of C type)
Time of continuous work from the one complete of the alkaline batteries	Not less than 20 hours
Temperature range for storage / operation	-30...60 / -20...60°C
House protection degree	IP54
Dimensions	330x140x700 mm
Weight	2,1 kg

## Appendix 2 Searching methods by AP-019.1

### 1. MAX method when searching the place of insulation damage with sensors DKI-117 and DODK-117

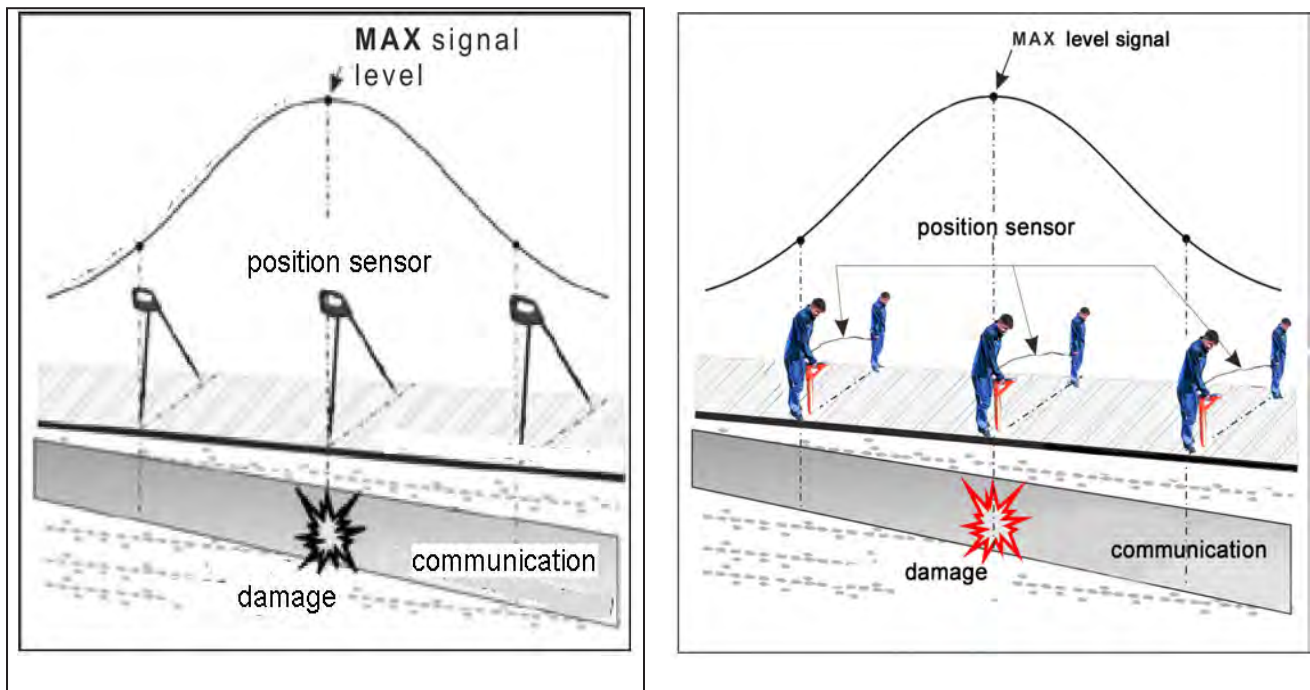
When searching for insulation damage by «**MAX**» method, the one of the input terminals (contact pins of DKI or electrodes of DODK) should be placed over the route, and the second one - at a maximum distance from the route, in the direction straight across its axis.

While moving along the route, the operator dips the contact pins in of DKI sensor in the ground. The measurements will be correct while the contact pins are firmly dipped into the soil.

DODK electrodes are transported by the two operators located from each other at the distance equal to the length of the connecting wire. In this case, measurements can be made continuously in motion.

The signal gradually increases when approaching the spot of damage, reaches it's maximum when one of the contact electrodes is above the damage spot and then gradually decreases (**fig.A. 1**).

The MAX method can reliably detect the existence of damage, however, has a low accuracy of localization of the exact place due to the blurred indication of signal curve maximum.



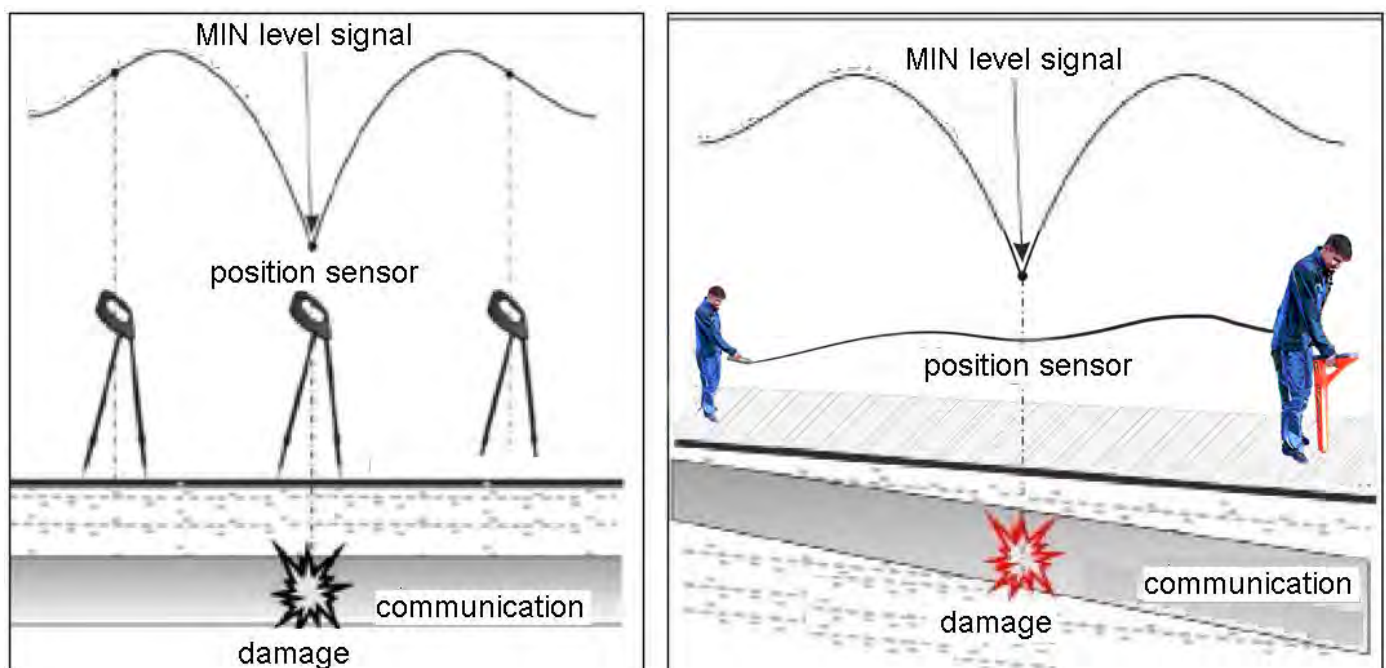
**Fig. A.1**

## 2. Method MIN when searching the place of damage location using sensors DKI-117 or DODK-117

When searching for insulation damages by «**MIN**» method, the contact pins of DKI-117 or DODK-117 electrodes should be placed over the route, along the axis of the route. When you use the MIN method, the signal increases smoothly at first, then rapidly decreases to a certain minimum value, then as the distance from the damage place increases, it rises sharply again and then gradually decreases.

The place of damage will be located midway between the electrodes, at a time when the signal reaches the minimum value (**fig. A.2**).

The sensor DODK-117 provides a «fast» method of damage location, which is especially important for the extensive communications, and the sensor DKI-117 provides a higher sensitivity and accuracy of damage location and needs only one operator for work with it.



**Fig. A.2**



### 3. Amplitude «two-frequency» method «ΔA»

This method was added for contactless search of insulation defects of city cables with resistance less than 5 kOhm. The smaller the distance to the end of the cable, the higher the sensitivity of the method on this site.

**The method description:** the two-frequency signal is transmitted from the generator. The ratio of two-frequency signal amplitudes remains stable, if there is no damages in cable. At presence of damage, the ratio of amplitudes in the place of damage is changed.

**Table 8**

1. Exit output of the generator should be connected to the «start» of communication (more distant from the supposed place of the defect). The other output of the generator is grounded on the maximum possible distance from the communication. The «end» of the communication is not grounded.

2. The transmitter in the mode «2F» sends to the communication the signals of two frequencies (1024Hz and 8192Hz) simultaneously.

3. The defect localisation is performed in direction «from generator».

4. The value «A8/A1» is sharply changes, when operator passes the place of leakage of the signal current into the ground.

1+8kHz	Push  to relieve indication	Manual 20dB	
$A_8+A_1$	$A_8/A_1$	$\Delta\varphi$	Signal direction
34%	-0.1dB	-2°	↑
16%		A 1kHz	
18%		A 8kHz	
65%			

#### Note

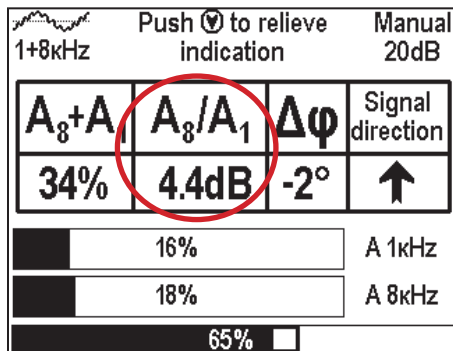
A8/A1 indication can have negative value. In such cases it recommended to reset indication periodically, using the button .


1+8kHz	Push  to relieve indication	Manual 20dB	
$A_8+A_1$	$A_8/A_1$	$\Delta\varphi$	Signal direction
34%	-0.1dB	-2°	↑
16%		A 1kHz	
18%		A 8kHz	
65%			

5. The «double» scale shows levels (amplitudes) of the frequency components of the signal. At bottom - «A8kHz», at top - «A1kHz». When levels of the frequency components are insufficient for determination «A8/A1», the inscriptions «A8kHz» and «A1kHz» are correspondingly «darkening», and the value «X.XdB» disappears.

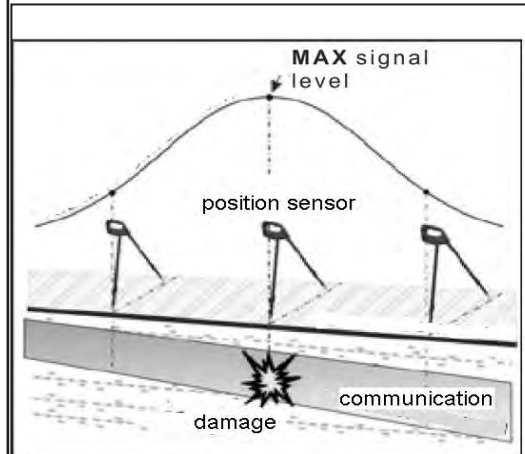
6. There is no need to continuously move along the route, controlling the signal. You can walk around the place which is hard to reach. If, while returning to the route, A8/A1 did not changed, it means that there are no damages on the surveyed site.

7. The sharp positive overfall of the «A8/A1» value by 3dB and more indicates the possibility of defect existence (the resistance is less than 5 kOhm). The sensor should be located straight across the communication.



If you go through the same site in the opposite direction (towards the generator), holding the receiver the same as before with reset of the indication (using the button «»), negative value of the reading (more than minus 3dB) will mean that there is damage in the cable.

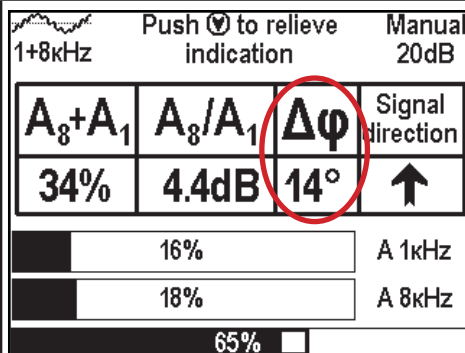
8. To validate the existence of the damage, use 2contact method, using. (the methodology in app. 2 of p.1.2)



#### 4. Phase «two-frequency» method « $\Delta\varphi$ »


The contactless method of search for insulation defects of city cables with resistance less than 10 kOhm. The smaller the distance till the end of the cable, the higher the sensitivity of the method on this site. This method cannot be used in city because of high distortion of the signal.

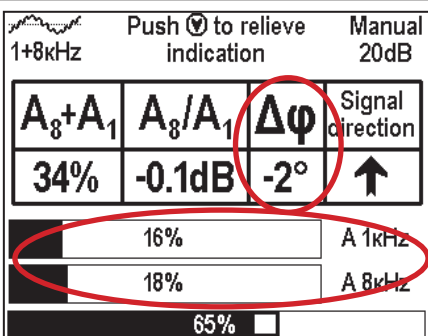
Steps 1-3 are similar to those in p.3.



4. « $\Delta\varphi$ » shows - the change of the phase difference « $\varphi_{1024} - \varphi_{8192}$ », after the resetting (in degrees reduced to the frequency 1024 Hz). The value « $\Delta\varphi$ » is sharply changes, when operator passes the place of leakage of the signaling current into the ground.

##### Note

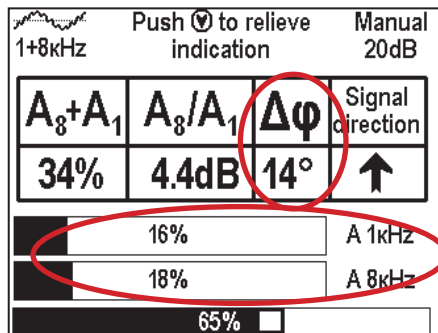
$\Delta\varphi$  indication can be negative, «running» in the process of increase of distance from the generator. It is recommended to periodically reset such indications (exactly over the route), using the button «».




5. The «doubled» scale shows levels (amplitudes) of the frequency components of the signal. At bottom - A8kHz, at top - A1kHz. When levels of the frequency components are insufficient for determination A8/A1, the inscriptions A8kHz and A1kHz are correspondingly «darkening», and the value «X0» disappears.

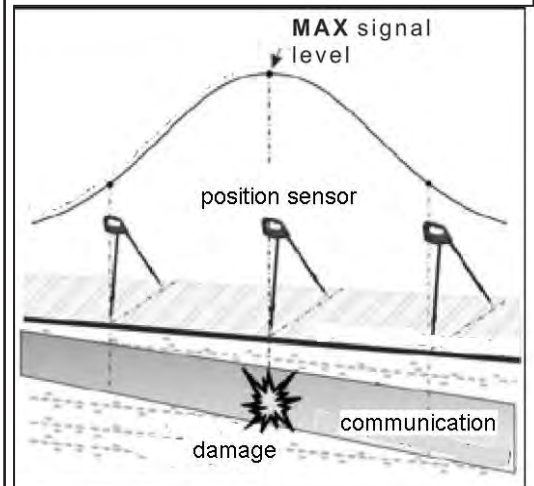
6. There is no need to continuously move along the route, controlling the signal. You can walk around the place which is hard to reach. If, while returning to the route, A8/A1 did not changed, it means that there are no damages on the surveyed site.

The sharp positive overfall of the  $A_8/A_1$  value by 3dB and more indicates the possibility of defect existence (the resistance is less than 10 kOhm). The sensor should be located straight across the communication.



If you go through the same site in the opposite direction (towards the generator), holding the receiver the same as before with reset of the indication (using the button «»), negative value of the reading (more than minus 50) will mean that there is damage in the cable.

To validate the existence of the damage, use contact method, using. Append. 2 p.1,2)



**%%The transmitter AG-120  
%%%%Appearance. Controls**

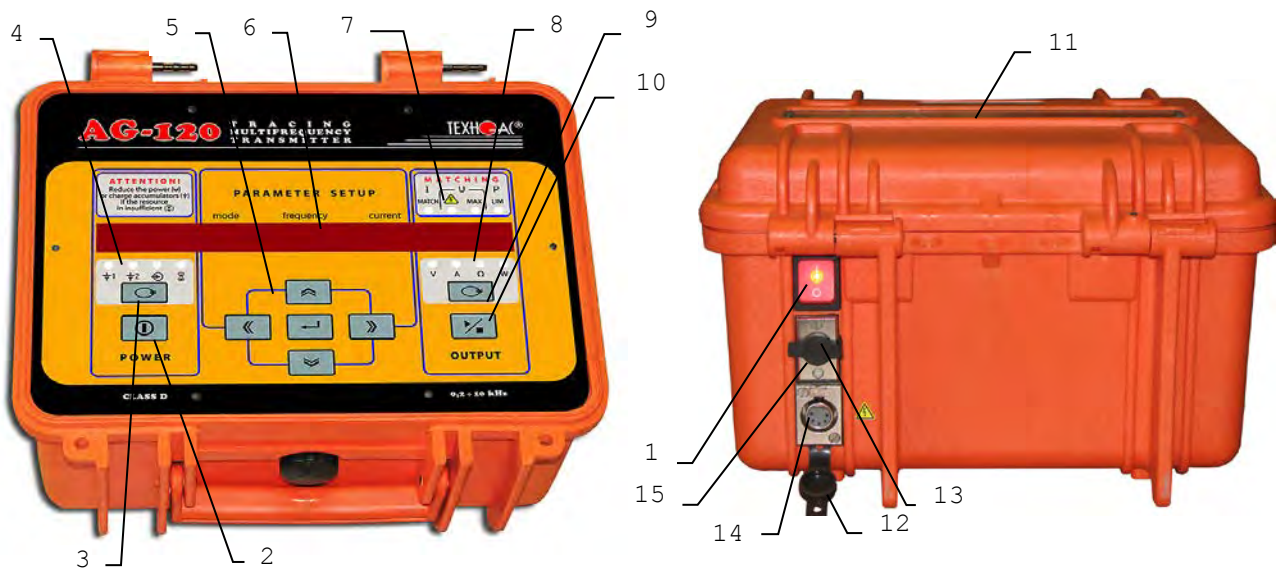


Fig.11.1

1	<b>External power switch</b> (mechanical waterproof) with generation indicator
2	<b>Button «0»</b> control of internal electronic <b>power switch</b>
3	<b>Button of power supply parameter indication</b>
4	<b>Indicated power supply parameter:</b> voltage acc.1/acc.2/ext. power. (V), life time (hour) or charging time (hour, min)
5	<b>Menu control buttons</b> «⏪» - selection of parameter to be set in the left direction by the indicator «⏩» - increase of value or «up» in the list «⏴» - reduction of value or «down» in the list «⏴⏩» - selection of parameter to be set in the right direction by the indicator «⏴⏩⏴»: in the «stop» condition – entering to the parameter setting / exit from parameter setting with saving of settings - in the «generation» condition – input of current value of output current as setup value
6	<b>Indicator of power supply parameters</b> (V, hours), <b>work mode</b> , <b>generation frequency</b> (Hz), <b>set current</b> (A), <b>output parameters</b> (V/A/Ω/W)
7	<b>«MATCHING»</b> (results): set current is achieved «Imatch», mode of unlimited voltage «U⚡», maximum voltage «Umax», power limited at the optimal level «P lim»
8	<b>Parameter indicated by «output multimeter»:</b> U «V», I «A», R «Ω», P«W»
9	<b>Button of selection of parameter indicated by «output multimeter»</b>
10	<b>Button «⏴» «START/STOP»</b> of generation, matching or charging
11	<b>Transparent window</b> for indication reading with closed cover
12	<b>Plug</b> sealing the output connector (opened)
13	<b>Plug</b> sealing the external power supply connector (closed)
14	<b>Output connector</b> to connect the buried utility, transmitting antenna or “clamp”
15	<b>Input connector</b> to connect <b>external accumulator</b> or <b>mains power supply adapter</b> (operation/charging)

## %%2 Procedure of work with the transmitter

### **SAFETY REQUIREMENTS**

**The dangerous voltage (from 24 to 400 V) may exist on the generator output (including the clamps). The route detection procedure is based on the grounding of one of the transmitter output clamps.**

**NEVER!** Touch the output connecting cables clamps and elements of the monitored buried utility when the transmitter is in operation.

**NEVER!** Connect and disconnect the connecting cables when the transmitter is in operation.

The persons properly instructed and having no medical restrictions are admitted for instrument operation.

*Personnel safe procedure for work with the transmitter when connecting to the route:*

- make sure on the monitored buried utility and near it no activities are conducted or planned which can result in deliberate or accidental touching of the current-conducting part under voltage;
- make sure the generator is switched off;
- ground the cable conductor opposite to the transmitter connection point and put the table «Grounded» («High voltage»);
- if the paragraphs a), c) can not be fulfilled use the contact-free mode of connection with inductive antenna or transmitting clamps;
- make sure the instrument can not be activated accidentally by another person during connection of the output cable;
- connect the output cable clamp to the monitored buried utility (cable wire, pipeline, link cable);
- connect the second clamp of the output cable to the grounding, cable armor or to the grounded rod;
- connect the output cable connector to the output socket of the deactivated transmitter;
- if there are other persons near current conductive parts alert them about voltage supply by saying «Applying voltage ».

### **ATTENTION!!**

**When connecting the transmitter the latter itself shall be  
TURNED OFF!!**

*Personnel safe procedure for work with the transmitter when disconnecting from the route*

- turn off the transmitter power;
- disconnect the output cable from the transmitter and close the connector with rubber plug;
- conduct the troubleshooting activities (cable digging out, placing the clamp, etc.) only AFTER the transmitter is turned off and disconnected from the buried utility



### 3 Transmitter connection

#### 1) Contact mode of transmitter connection

This mode guarantees transmission of signal without interference and allows use of low frequencies.

The connection to buried utility is done by mating of the output connector of the transmitter to the buried utility and grounding rod figure 11.2.

The grounding is carried out in any convenient place, which should be cleaned from the dirt with file or sand paper to the metal. This ensures more reliable contact of the clamp and buried utility.

##### Rules for grounding:

- To achieve the maximum tracing distance when the transmitter is connected to the buried utility the grounding shall be arranged at an angle close to  $90^\circ$  and **as far as possible** from the route in the assumed search direction
- The grounding rod shall be inserted for at least  $2/3$  of its height.
- To achieve better grounding effect the following methods shall be used in the place of grounding rod installation: cleaning of contact in the place of contact wire connection to the ground rod, pressing of the ground, moistening of the ground using salt solution

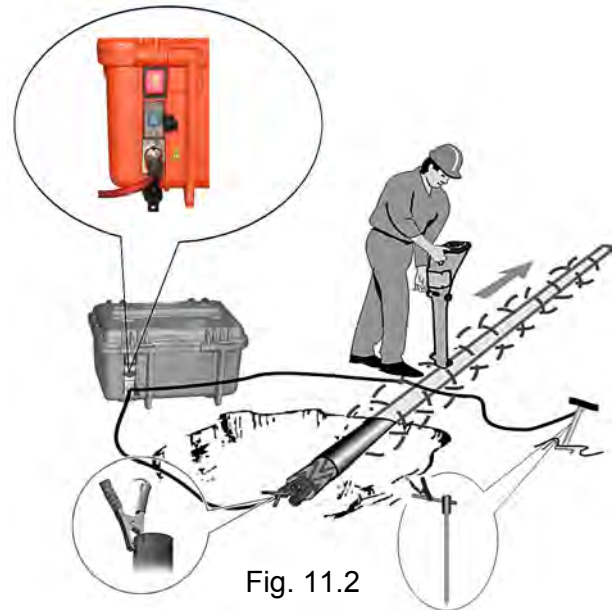


Fig. 11.2

#### Methods of transmitter connection to the route

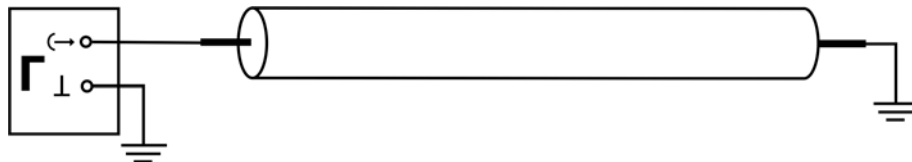
To achieve quality in route position detection the following rules should be observed:

The direct connection of the transmitter to the load provides the longest tracing distance.

Several ways can be used to define the underground cable (or pipeline) route when directly connected to the buried utility. They are as follows:

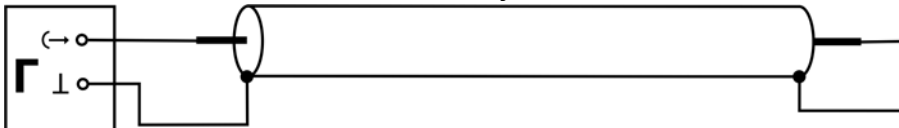
##### 1) The ground is a return conductor

Connect the transmitter to one end of the cable, ground the other end of the cable.



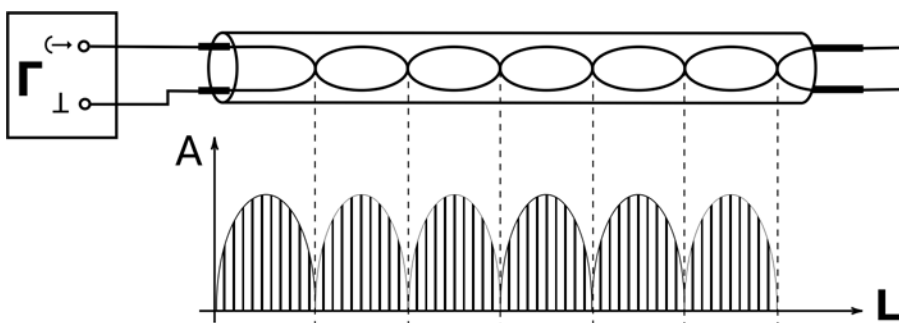
##### 2) The cable armor is a return conductor

Connect the transmitter to ends of the cable; join the other ends of the cable.



##### 3) The cable cord is a return conductor

Connect the transmitter to two cords from one end of the cable, join the cords from the opposite side.



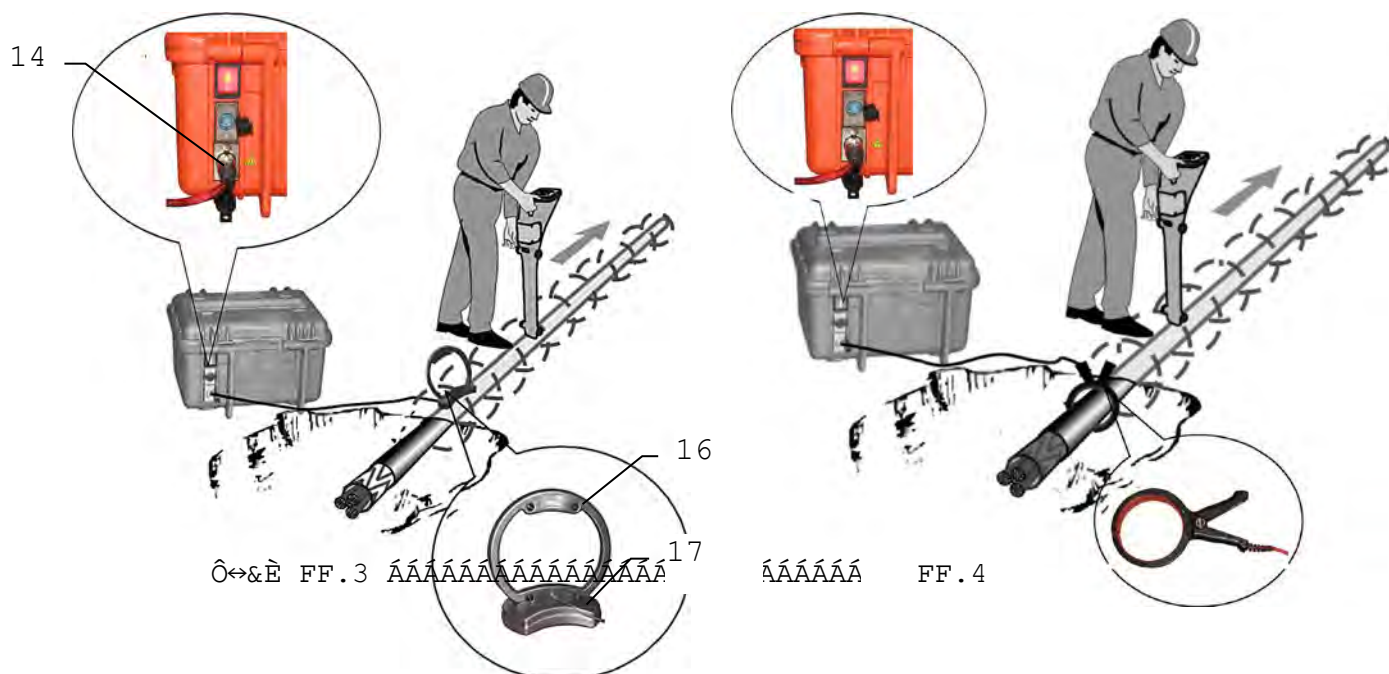
## 2) **Contact free mode** using the **inductive** antenna – IEM -301.2

Connecting to the utility is carried out by induction method.

To do this: remove the antenna from its package and insert active part of the antenna in the foundation body. Connect the antenna to the transmitter output connector (pos. 14 figure 11.3) and install over assumed place of route. The antenna and route must lay in the same plane.

## 3) **Contact-free mode** using the **transmitting** clamp.

Allows tracing of the selected buried utilities, energized and de-energized cables. The clamp shall be put around the conductor to be traced figure 11.4

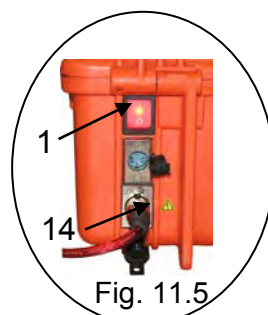


**EVER! Touch the clamps of connecting cables and parts of monitored buried utility while the transmitter is working.**

**NEVER! Mate and disconnect the connecting cables while the transmitter is working.**

## 4) Turning on the transmitter power

Connect the load to the lowest connector on the transmitter rear panel in accordance with the tracing procedure (pos.14 figure 11.5). The examined route (pipeline, cable), inductive antenna or transmitting clamp can be used as a load.



To ensure safety it is strongly recommended to complete all connection works before the generation is started.

Turn on the power with external mechanical switch «I/O» on the rear panel by setting it into the «I» position pos.1. Open the cover. Turn on the power with the button pos.2 figure 11.6. The indicators on fields «POWER» and «PARAMETER SETUP» will start indicating.

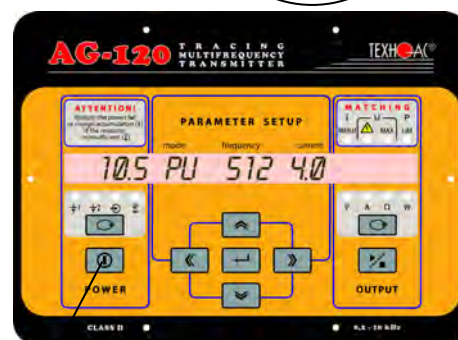
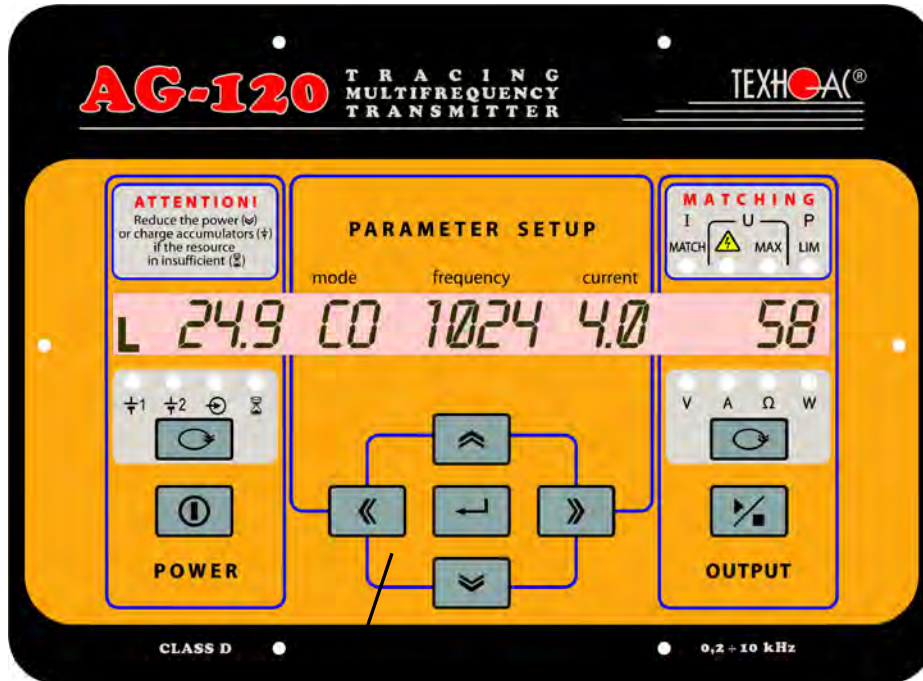


Fig. 11.6

## 5 Parameter setup

The field «PARAMETER SETUP» figure 11.7 is used for selection of one of three generation frequencies  $f_1$ ,  $f_2$ ,  $f_3$ , one of three modes of sine generation (continuous «CO», one frequency transmission «PU», three frequencies transmission «3F» or charging mode «CH») and of four current loads. If necessary the “banks” of currents and frequencies can be modified quickly. The use of the transmitting antenna as a load is possible only if a generation frequency of 8928 Hz which is set automatically when the antenna is connected to the output.



5 Fig. 11.7

1) To enter the setup mode depress the button of entering into parameters setup «←» pos.5 while staying in the “stop” mode (no generation, yellow LEDs on the “OUTPUT” field figure 4.7. are not on). Will begin to blink field of the indicator «MODE».

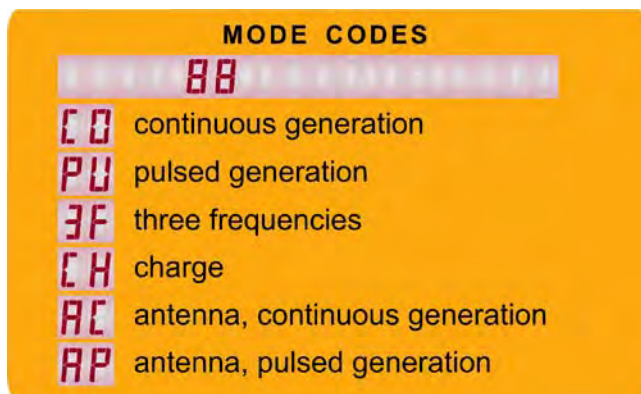


Fig. 11.8

2) Depending on the task, to set the mode the buttons «↵» or «⇓» (cycle) pos.5 figure 11.7 are used to select on the field “MODE” the symbol depicting the required generation mode or mode of internal accumulators charging. The mode codes are shown on figure 11.8. If the transmitting antenna is connected to the output, the signal «AC» is indicated (mode «antenna, continuous»). The selection in this case is possible only between modes «AC» and «AP» (mode «antenna, pulsed») directly by the buttons «⇓» or «↵».

3) To set the operation frequency or current, use the button «↵» until the indicator «FREQUENCY» or «CURRENT» appears on the indicator screen. In the modes «CO» and «PU» the blinking value (figure) can be modified.

*REMARK- In the stable three-frequency mode («3F») the lowest frequency used during automatic matching appears on the indicator «FREQUENCY».*

To input another value of frequency instead of the blinking one press the button «←» so that only first digit of the figure would be blinking (the highest digit). To select another digit use the buttons «↵» or «⇓». The blinking figure can be modified with buttons «↵» or «⇓» (0...9). To save the new value in the «bank» of frequencies (instead of the previous one), press the button «←».

It is possible to work with the specified frequency temporarily before power is switched off, if the generation (automatic matching) is activated immediately with the button «↵» pos.10 figure 11.9.



4) The setting of the specified current is conducted similarly to the work frequency specification. The range of specified current is 0,1...9,9 A with a step of 0,1 A. The «bank» of currents may contain up to four preset values. If necessary, the current of pulsed transmission («PU») in the stable mode of transmission can be increased up to 15A (if there is enough power). The values of current exceeding 9,9A may not be saved in the «bank» of currents.

The high output current (up to 15 A) allows tracing of buried utility with extremely low resistance (for example, to pass the output current between grounded pipeline and grounding circuit bus). In this case the small,

but still sufficient, part of the output current is branched into the remote areas of buried utility. The serviceability is maintained till full short-circuit of the output clamp.

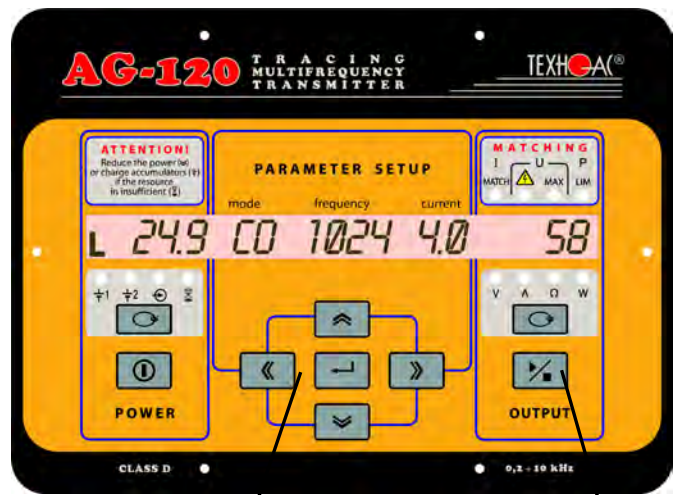
















Fig. 11.9

When selecting the load current (or power) and frequency of the transmission the following guidelines are to be followed:

- the lower is the power – the higher is power supply life
- the lower is the current, the lower is the frequency – the lower «induction» on the neighboring elements
- the higher is the frequency – the higher is sensitivity of receiver, the less current (power) is enough, energy saving is possible, recommended for high-resistance buried utilities, on the other hand, the higher level of signal penetration into the neighboring objects and, as a result of higher attenuation, the signal is spread at the less distance.
- the higher is the current, the lower is the frequency – the range of transmission and route detection is higher, but the power required is higher.


## %%6 Modification of the set parameters


To modify the set parameters, stop the generation with the button «» pos.10 figure 11.9 at the field «OUTPUT» by one or two depressions and proceed to the parameters setup. The first depression of the button «» pos.10 results in stop of the automatic matching process at the achieved level (the indicator readings are «frozen», no generation, yellow LEDs on the field «OUTPUT» are not on), second depression on the button «» results in the stop of generation (the indicator is off).


To enter the parameters modification mode depress the parameters setup button «» pos.5 while staying in the «stop» mode. The indicator field «MODE» will start blinking, to change the mode use the buttons «» or «» (by cycle) pos.5 to select the required generation mode symbol and go to modification of other parameter (frequency, current) with buttons «» or «». The blinking value of parameters from the databank can be selected with buttons «» or «» (0...9). To modify the parameter value when the required value is not in the databank (the selected parameter blinks) depress the parameter setup button «», after that the blinking figure can be modified with buttons «» or «» (0...9). To save the new value in the data «bank» (instead of the previous one) depress the button «».


## 7 Indication of parameters


1) Indication on the field «POWER» figure 11.10.

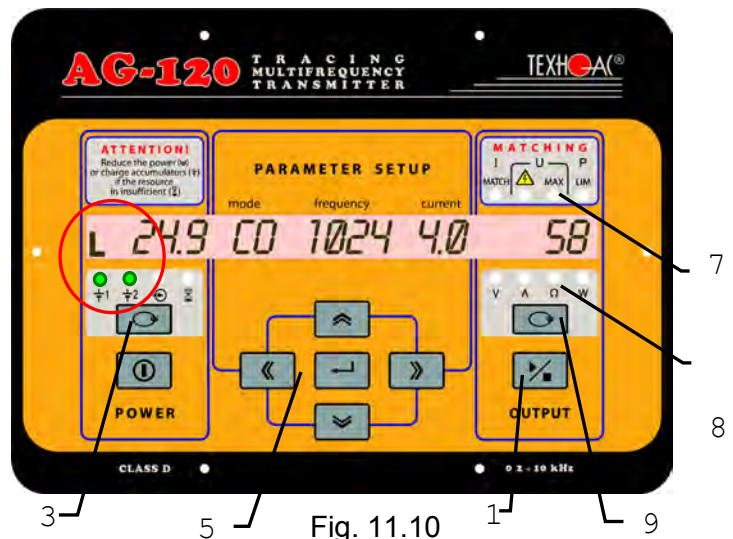
One of the digital indicator readings is selected by the corresponding button  pos.3 by the green LEDs.

 1 - voltage on the “base” internal accumulator No1

 2 - voltage on the «superstructure» internal accumulator No2

 - voltage on the external power supply input

 - in the generation mode – estimated power supply life meaning: «for this level of energy consumption it will work for N hours» (on base the family of discrete discharge curves for new accumulator for  $t = 0^{\circ}\text{C}$ ). The reading «20» means «very high life time which is difficult to estimate». The reading «0,1» means: «the instrument may switch off at any moment».



- in the «charging» mode - time of charging by the stable current (counting up) and time of charging by the stable voltage (counting down), hours/min

If two or three first LEDs are illuminated at the same time, that means that the digital field «POWER» indicates the resulting voltage, supplying the terminal power amplifier. In this the first (left) seven-segment indicator on the field «POWER» symbolically depicts the configuration of mutual connection of the power supplies. The list of possible power supply configurations and codes is given on the transmitter cover (figure 11.11).







POWER SUPPLY CONFIGURATION CODES	
	internal in parallel (12V)
	internal serial (24V)
	internal in parallel, external serial (24V)
	internal and external in parallel (12V)
	internal and external serial (36V)
	only external (accumul 24V or network power 15V)


Fig.11.11


2) Indication on the field «PARAMETER SETUP»

Indication on the field «PARAMETER SETUP» is described in the sections parameters setup and parameters modifications.

3) Indication on the field «OUTPUT»


When the **power is applied** to the transmitter two situations are possible:





- If the LEDs on the field «OUTPUT» **are not illuminated**– the transmitter is in the standby mode («stop»). The parameter setup can be conducted or the generation (automatic matching) may be initiated immediately by depressing of the button  pos.10. The mode «stop» will last for 1 minute. If no button is depressed the internal electronic power switch will switch the power off automatically.

- If one of the yellow LEDs **is illuminated** on the field «OUTPUT» (and the external switch pos.1 is highlighted), the power has been turned off during generation and the same mode with the previous settings is restored. The automatics tries to recover the situation through the automatic matching. If it is necessary to change the set parameters, stop the generation with the button «» pos.10 on the field «OUTPUT» («turn off» the yellow LED and illumination of the external switch with one or two pressing) and proceed to the parameters setup.

During the generation the estimated values of output parameters are indicated on the digital field «OUTPUT»: load voltage «V», load current «A», load resistance «Ω», load power «W». The accuracy of measurement ( $\pm 5\%$  for «V» and «A» and  $\pm 10\%$  for «Ω» and «W») is sufficient for




situation evaluation and decision making. The indicated parameter is selected by the button «» pos.9 the LED corresponding to the selected parameter is illuminated pos.8 figure 11.10.

The power is selected automatically according to the principle: «sufficient (or maximum possible) for achieving of the specified output current (or closest possible value)». When the automatic matching is finished (or interrupted with button “START/STOP ”) manual control of voltage (current, power) with buttons «» and «» is possible. During this the indicator «» always indicates the remaining life of the internal power supply (hours) depending on the accumulator discharge level and current energy consumption.

The high output voltage (above 330 V with the use of additional accumulator 12 V) and high reserve of power (up to 270 W with additional 12V accumulator) provide sufficient tracing current for long buried utilities with high resistance.


After complete attempt of automatic matching (not aborted) the field «MATCHING» pos.7 figure 11.10 reveals the result:


- «Imatch» - completed successfully, specified current achieved. After generation is turned off from this condition the set parameters of generation and selected parameters of indication becomes default values, that means loaded after power interruption.
- «Umax» - the voltage is not enough to achieve the specified current for this load (the load resistance is too high or the contact between output clamps with the load is broken)
- «P lim» - not enough power to achieve the specified current for this load.

The potentially «dangerous» unlimited mode of generation is depicted with a special «alert» indicator «». The «default» increase of the output voltage is limited by level safe for a human (24V). If necessary (for tracing the cables) it is possible to operatively remove the limitation (temporarily) if the appropriate precautions are taken.

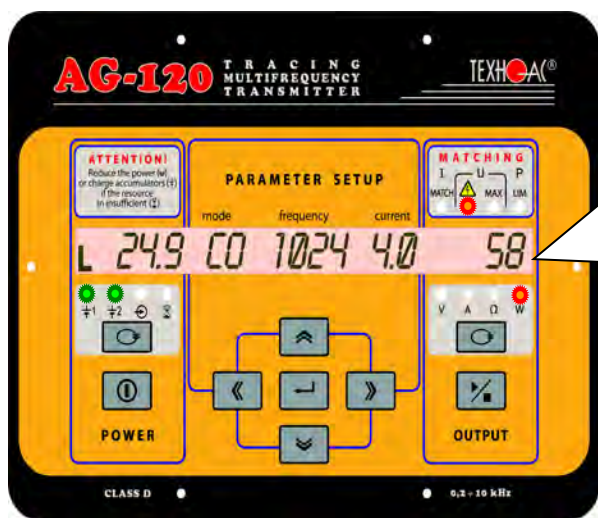
Here the decision should be made about necessity to correct the parameters of output current. For this purpose the test tracing is recommended.

#### 4.8 Start and stop of generation



If after power is turned on the button «» pos.10 is depressed **shortly** in the standby mode («stop»), the generation and automatic matching – step-by-step increase of voltage at the output until the specified current is reached shall be started. It is recommended to monitor the power life indicator

(«» on the field «POWER»). If the output voltage («V») exceeds «24.0» the automatic matching shall stop anyway. If the specified current is not reached, the indicator “Umax” shall be on in the field «MATCHING». This is a **safe mode** set by default when the power is on.

If higher output voltage is required to achieve the necessary current during tracing of the cables (AND APPROPRIATE SAFETY MEASURES ARE TAKEN!),



Direct connection to buried utility  
24.9 - supply voltage  
(2 acc in series), V  
CO - continue generation  
1024 - frequency, Hz  
4,0 - current, A  
58 - power, W

the automatic matching can be started in the «**unlimited**» mode. For this purpose press the button «» in the standby mode (“stop”) and keep it **depressed** until the “alerting” indicator «» is on. That means the potentially dangerous “unlimited” mode is activated, the output voltage may exceed 200 V with internal power supply and 300 V with added 12V external power supply. The «unlimited» mode shall exist until the power is off.

The current in load is selected or input from the keyboard in the indicator field «CURRENT». In the course of automatic matching the voltage on the load is increased step by step till the current in the load exceeds the value stated in the setter («CURRENT»). In this case the voltage increase is

stopped and the “Imatch” sign appears in the field «MATCHING». If the load resistance is changed in the stable mode of generation, the power selection program shall maintain the specified current within  $\pm 2\text{dB}$  by repeated automatic matching with appropriate adjustment of power.

The incomplete automatic matching procedure can be stopped at any point by depressing of the button « $\frac{1}{2}$ ». The first pressing in the course of automatic matching – «stop» of matching, second – «stop» of generation. Depression in the stable mode of generation results in «stop» of generation.

### ATTENTION! ENERGY SAVING!

All manipulations with output current (power) lead to energy consumption (power supply life time) change. Observe the life time indicator « $\frac{1}{2}$ » on the filed «POWER» to make sure there is enough time to complete the tracing. To save the energy, work with the minimum sufficient power in the load. Use the mode of short-time transmission if possible. The breaks in operation help in partial replenishment of capacity. Charge the accumulators if the situation allows. Do not bring to automatic switch off through insufficient power.

Long-term storage of accumulators in discharged condition results in complete loss of their serviceability. Before long term storage charge the accumulators and recharge them at least every 6 months. The temperature during storage shall be  $+20...25^{\circ}\text{C}$ .

### 9 Operation with inductive frame antenna

To achieve the maximum intensity of the «induction», the buried utility line and antenna frame must be located as close as possible to each other and in **a single plane**. Prior to connection of the frame to the output turn off the power in the “stop” mode with power button pos.2 « $\text{I}$ » figure 11.13 or with external mechanical switch.

If the antenna is connected to the output when the power is on, the instrument switches to

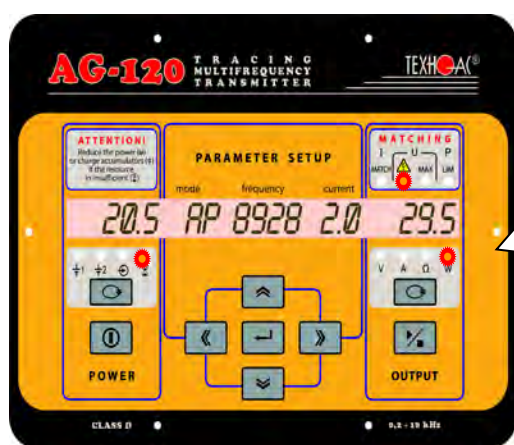


Fig. 11.13

Inductive connection to buried utility with antenna  
20 - time, h  
AP - pulsed generation  
8926 - frequency, Hz  
2,0 - current, A  
29,5 - power, W

“antenna” mode characterized by permanent parameters setup. The following is indicated: mode «AC», frequency «8928», current «0,2». After transmission is activated with the button « $\frac{1}{2}$ » pos.10 the automatic matching results in automatic setting with optimum specified parameters. After that if necessary the output voltage can be reduced or increased with the buttons « $\nabla$ » and « $\wedge$ ». To continue transmission after power interruption restart with the button « $\frac{1}{2}$ » is required.

### 10 Operation with the transmitting «clamp»

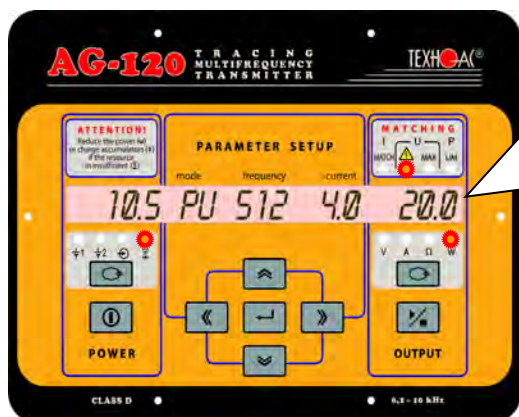


Fig. 11.14

Inductive connection to buried utility with clamp  
10.5 - time, h  
PU - pulsed generation  
512 - frequency, Hz  
4,0 - current, A  
20,0 - power, W

If there are several closely located buried utilities it is recommended to use the transmitting clamp figure 11.14 to induce the current specifically in one of them contact-free. The power consumed by the clamp is reverse proportional to the signal frequency if the voltage is constant. It is not recommended to apply the power more than 60W in the continuous generation mode (CO).

The waterproof instrument (**IP54**) allows operation under precipitations when the cover is closed providing the on-line adjustment of parameters is not required. The power is turned on/off with external waterproof power switch «I/O» pos. 1 figure 11.15. The readings are monitored through the transparent window in the cover pos. 11 figure 11.15. Make sure the required mode is selected and start the transmission before closing the cover. Every time the power is turned on with the closed cover the system shall restart this mode (except for «AC» and «AP») with automatic matching. The transmission is indicated by highlighting of the external switch. The free connectors on the rear panel are protected by rubber plugs.

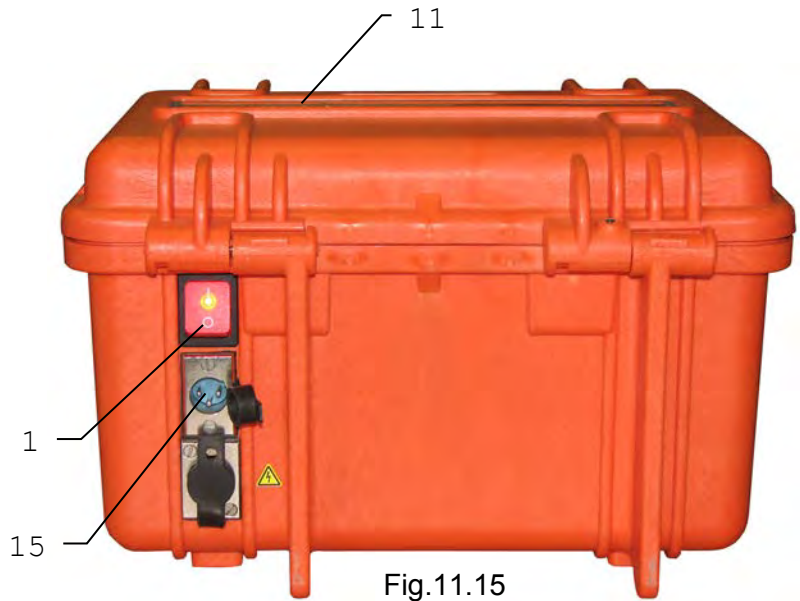


Fig.11.15




The additional accumulator (12/24V) or power adapter output (15 V) can be connected to the upper connector of the rear panel pos.15 figure 11.15.

**ATTENTION!**


**The external source output may have no galvanic link except for with the transmitter output. Prior to connection make sure there is no grounding, zeroing or link to the vehicle body for any of the external source outputs.**

Depending on the task the instrument uses the external power for increase of the life time or increase of power or for charging.

### 13 Internal accumulators charging

It is strongly recommended to conduct the internal accumulators charging under ambient air temperature of 20...25°C. To charge the internal accumulators connect the power adapter to the mains and to the external power input (upper connector on the rear panel). Turn on the mains power and «1» of the transmitter. Select the mode «CH» on the «MODE» indicator. Press the button «». Observe the time counting on the indicator «» and “animated picture” of the charging procedure on the digital field «OUTPUT». When the picture becomes static, the charging can be aborted with the button «». The instrument is ready for operation (charging at least 90%). If the time allows, it is recommended to continue charging with the stable voltage **14,7-14,9V**. Time of full charging is 8 hours, after that the automatic switching off happens.

#### NOTE.

*In the course of charging it is recommended to periodically monitor: « $\frac{+}{-}1$ » or « $\frac{+}{-}2$ » - voltage on the charged internal accumulator and «» - voltage on the power adapter output. If « $\frac{+}{-}1$ » or « $\frac{+}{-}2$ » exceeds the maximum allowed «14,9», one should “specify” the output voltage POWER ADAPTER (optimal value «15.0...15.2») using its adjustment resistor output “under flat screwdriver”. The readings « $\frac{+}{-}1$ » or « $\frac{+}{-}2$ » above «14,9» correspond to the start of “overcharging” and increased internal gas output. The continuous stable readings below «14,7» indicate lowered output voltage of power adapter.*

### The joint operation of transmitter and receiver during active route detection

The inductive (active) search method is now most widespread for detection of underground buried utilities. The basis of the method is the fact that there is an electromagnetic field around the conductor with current.

The transmitter connected to one end of the monitored buried utility serves as a source of test current of special frequency. For flowing of the current it is necessary to have a special electric conductive circuit with monitored buried utility as one branch and grounding as another branch for return of current through the ground.

The maximum strength of the electromagnetic field measured above the ground surface corresponds to the axis of searched buried utility.

To properly operate the kit the following rules are to be observed:

- Transmitter grounding selection (refer to p.11.3);
- Definition of transmitter connection type (refer to p.11.3);
- Setting of transmitter parameters (refer to p.11.5);
- Adjustment of receiver (refer to p).



After performing the above items you can start buried utility tracing.

## Specifications of AG-120

<i>Frequency of generated signal</i>	
<b>Frequencies f1, f2, f3 (three frequencies fixed in memory), Hz</b>	<b>Range 200...9999</b> (selected in the range with a resolution of 1 Hz and accuracy of $\pm 0,05\%$ Hz and input in the power-independent memory)
<b>Frequency f4 (one «temporary»), Hz</b>	<b>Range 200...9999</b> (selected instead of one of the «fixed», not input to the memory, exists while the power is on)
<i>Generation modes</i>	
<b>Mode 1</b>	Continuous «CO»
<b>Mode 2</b> pulse duration, ms pulse rate, Hz	Short pulses transmission «PU» 350 0,7
<b>Mode 3</b>  Pulse duration, ms Pulse rate, Hz	Three frequencies (sent with alternation of frequencies f1, f2, f3) «3F» 350 1,4
<i>Output parameters</i>	
<b>Output current</b>	
Maximum in manual mode: - continuous and three frequencies generation, A - pulse generation, A	<b>10</b> <b>15</b>
Specified for auto matching	Four values (I1, I2, I3, I4) Selected in the range 0,1...9,9 A with a resolution of 0,1A and kept in power-independent memory
<b>Maximum output voltage</b>	
- when working in safe mode, V - under internal power supply, V - with added external accumulator 12V, V - when supplied from power adapter, V	<b>24</b> <b>220</b> <b>330</b> <b>140</b>

<b>Maximum output power when accumulators are fully charged</b>	
- under internal power supply or from external accumulator 24V, W	<b>120</b> continuous and «3F» at a load of 1,2...300 Ohm / <b>180</b> pulsed at a load of 0,8...200 Ohm
- with added external accumulator 12V, W	<b>180</b> continuous and «3F» at a load of 1,8...450 Ohm / <b>270</b> pulsed at a load of 1,2...300 Ohm
- from power adapter, W	<b>70</b> at a load of 0,7...200 Ohm
<b>NOTE.</b> <i>When incompletely charged or (and) frequencies above the "logarithmic middle point" of the range (1,4kHz) the reduction of the maximum power with an increase of frequency and load resistance is possible at no more than 3dB.</i>	
<b>Allowed load resistance</b>	
	Any (0... $\infty$ ) Current limit at "low-ohm" loads, «Umax» at "high-ohm" loads
<b>Resistance range for matched loads, broader than</b>	
For minimum specified current ( <b>0,1A</b> ) - for internal power, Ohm -with external accumulator 12V added, Ohm	<b>4...2200</b> <b>4...3300</b>
For maximum continuous current ( <b>10A</b> ) - for internal power, Ohm -with external accumulator 12V added, Ohm	<b>0...1,2</b> <b>0...1,8</b>



For maximum pulsed current ( <b>15A</b> ) - for internal power, Ohm -with external accumulator 12V added, Ohm	<b>0...0,8</b> <b>0...1,2</b>
<b>Matching with the load</b>	
	- automatic, providing achieving of the specified current in the load - manual (buttons «  » or «  »)
<b>Design parameters</b>	
Output <b>power amplifier</b>	Pulsed, technology <b>CLASS D(BD)</b> , <b>Efficiency factor &gt; 80%</b>
LED-based superbright digital indicators of high temperature range	- all supply voltages - modes and settings - power resource - «OUTPUT MULTIMETER»: «output voltage», «current in load», «load resistance», «power in load»
Control	Nine-button keyboard and external power switch with generation indicator providing work under rain with closed cover (due to parameter setup “memorizing”). Intuitive interface
<b>Dimensions</b> of electronic block (case), maximum, mm	<b>305x270x194</b>
<b>Weight</b> of electronic block, maximum, kg	<b>12</b>
Operating temperature range, °C	<b>-30 ...+60</b>

### Appendix 3

#### ***Symbols displaying the power supply configuration of the AG-120 transmitter***



accumulator No2 is connected **in parallel** with the base accumulator No1 (12V)



accumulator No2 is connected **in series** with the base accumulator No1 (24V)



the external accumulator (12V) is connected **in series** to the internal accumulators No1 and No2 connected in parallel (24V).



the external accumulator (12V) is connected **in parallel** to the internal accumulators No1 and No2 connected in parallel (24V) .







the external accumulator (12V) is connected **in series** to the internal accumulators No1 and No2 connected in series (36V)



the power amplifier is supplied only from external source with an elevated voltage (external accumulator 24B or power adapter 15V). The internal (accumulators No1 and No2) supply the rest of the circuit.

The horizontal segments designate the power supplies with «-» output connected to the common wire of the circuit. The base internal accumulator No1 is always connected to the common ground and is designated by the lowest horizontal segment (if participates in the power amplifier supply). The vertical segments designate the power supplies with «-» output connected to the «+» of the other sources («superstructure sources»).

#### ***Dependency of power supply life time of the AG-120 transmitter from the configuration of different kind of used power sources***

External supply type	Power source connection configuration			
	 External only	 All in parallel	 External in series with mutually parallel internal ones	 All in series
Accumulator 12 V / $\geq 24$ Ah	-	Increase depends from external accumulator capacity	<b>Life time <math>\times 2</math></b>	<b>Either life time or <math>P_{max} \times 1,5</math></b>
Accumulator 24 V / 15 A	The life time is fully defined by the external accumulator capacity	—		
Power adapter 15 V / 15 A	The life time is fully defined by 220 V AC mains availability.	—		

### ***Symbolic depiction of the AG-120 multifrequency transmitter operation modes***



continuous generation



pulsed generation (short transmissions)



three frequencies (frequencies sent in turn)



charging of internal accumulators





transmitting antenna connected, continuous generation



transmitting antenna connected, pulsed generation

### ***Indication of emergency situations during the AG-120 multifrequency transmitter operation***

<b>Indication</b>	<b>Reason</b>	<b>Implication</b>
Er 10	Signal reached minimum	Incorrect actions of the operators when the level of output signal is changed manually with the buttons «  » or «  ». The transmission is not stopped
Er 11	Signal reached maximum	
Er 12	Power reached maximum	
Er 14	Current in load reached maximum	
Er 20	Encountered external power voltage not allowed for charging	Indication of emergency situations resulting in automatic switching the transmission off
Er 21	External power voltage during generation has been too low	
Er 22	Voltage of one of internal accumulators has been too low	
Er 23	Voltage of external power has been too high	
Er 30	Current mode did not match to “presence/absence” of transmitting antenna due to incorrect connection	
Er 40	Highest allowed current in output cascade has been exceeded	
Er 41	Highest allowed consumption current has been exceeded	