TECHNOAC
www.technoac.com

CABLE LOCATOR AND ACOUSTIC FAULT DETECTOR SUCCESS ATP - 434 E

TECHNICAL DESCRIPTION
OPERATING INSTRUCTIONS

Table Page of Contents

1. Design and principle of operation

Cable locator and acoustic fault detector is designed for:

- detection of energized cable lines underground up to 6 m depth by passive method.
- cable fault location by electromagnetic and acoustic methods (with high-voltage pulse transmitter, which is not included into the set)
- detection of insulation deterioration on cables by contact and non-contact methods

Kit components are:

1–Receiver AP-027M
2–Acoustic sensor AD-227
3–Electromagnetic sensorEMD-247
4–Headphones

1 – Acoustic sensor AD-227
2 – Magnet for AD-227
3 – Contact rod for AD-227, (70 mm)
4 – Contact rod for AD-227, (150 mm)
5 – Carrying rod for AD-227
6 – Extention carrying rod for AD-227
7 – Allen key, 2 pcs
8 – Key (attached to cable)
9 – Handle

Fig. 1.1

Operation conditions

- Ambient temperature, °C..... -20 to +50
- Relative humidity, % ....not more than 85 % at t = 35 ° C

2. Receiver AP-027M

2.1 Appearance and Controls

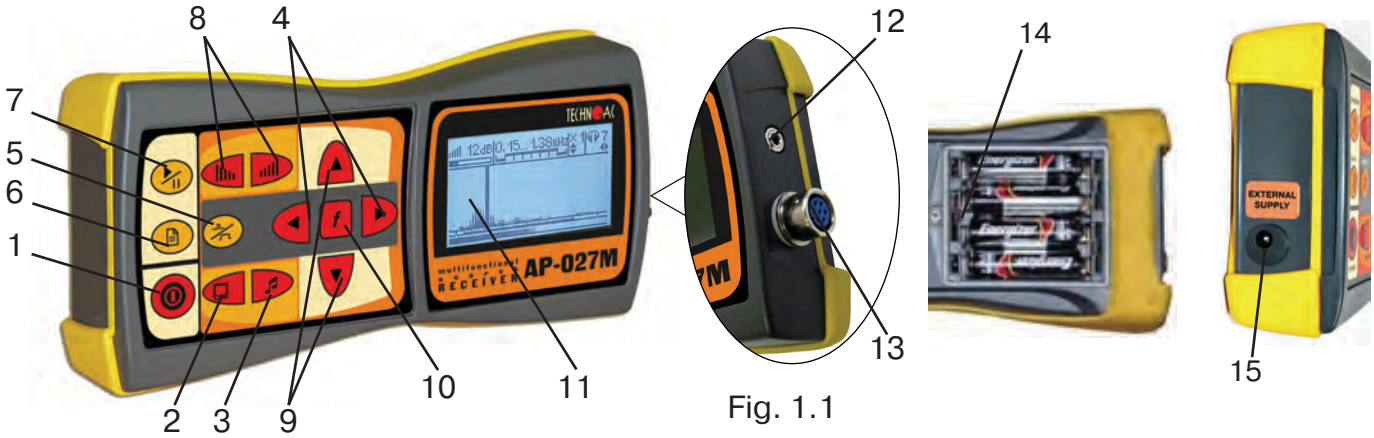


Fig. 1.1

1	⏻	power on/off button	9	▲/▼	selected parameter adjustment buttons (up/down)
2	🖵	visual indication type button	10	*f*	frequency button (filter frequency adjustment on/off)
3	♫	sound indication type button	11	LCD screen	
4	◀/▶	parameter selection buttons (left/ right)	12	headphones jack *	
5	⎍	filter button (broadband on/off)	13	sensors connector	
6	🗎	memory button	14	protective insert	
7	▶/⏸	start/pause button (measurement mode)	15	external power supply socket	
8	▁▂▃/▃▄▅	sensitivity buttons (higher/lower)			

* *AP-027M receiver uses 3,5mm port for headphones connection. It allows to use in-ear and on-ear headphones without microphone, with 3,5mm stereo (TRS) mini-jack.*

Technical specifications of the Receiver are listed in Appendix A.
Screen controls are listed in Appendix B.

2.2 Preparing Receiver AP-027M for operation

1. Insert 4 AA elements in battery compartment of the receiver, observing the polarity. Fig 1.1 p.14 If accumulators are used, they should be fully charged with charger, supplied separately.
Receiver cab also work from external PowerBank, supplied separately*.

*Set of external PowerBank (for example, Xiaomi Mi Power Bank 20000 mAh with protective case and power adaptor питания SAMSUNG ART-U90EWE 5.0 V/2.0 A)

NOTE

AP-027M automatically switches to external power supply, when connected to PowerBank. Some models of PowerBanks should be activated by pressing separate button on their body. When working at negative temperatures (to -20°C) place PowerBank under clothes.

2. Set the receiver on the holder

a) Place the receiver and holder as shown on the picture below:

b) Put one end of the holder below protective rubber of the receiver

c) Put other end of the holder below the second rubber

3. Put the strap of the holder around your neck. Connect required sensor to the receiver. Now it is ready for operation.

NOTE

It is recommended to adjust the length of the neck strap for more comfort during operation.

3. Acoustic sensor AD-227

3.1. Set content of acoustic sensor

1 – Acoustic sensor AD-227
2 – Magnet for AD-227
3 – Contact rod for AD-227, (70 mm)
4 – Contact rod for AD-227, (150 mm)
5 – Carrying rod for AD-227
6 – Extention carrying rod for AD-227
7 – Allen key, 2 pcs
8 – Key (attached to cable)
9 – Handle

threaded hole plug

Acoustic sensor AD-227 is made with threaded holes for installation of removable rods (magnet pos.2, rods pos.3 and pos.4) and extension handle pos.5. The set of sensor includes plastic plug-screws (for protection of threaded holes from dust and water) and a key (pos.8).

While working with acoustic sensor without removable elements for handling, use the handle on sensor cable to position the sensor (pos.9) .

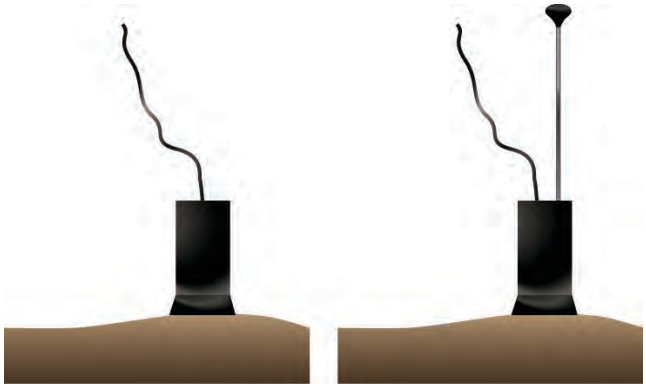
Using of magnet allows to attach the acoustic sensor to metal pipes and isolation valves. While preparing the sensor for the operation with removable handle and (or) rods, these plugs should be removed. After finishing the location the accessories should be removed and the plugs should be placed back.

3.2. Structural and operation features of acoustic sensor

Sensitive element of acoustic sensor is placed on steel sensing base (later on – base). The base is hanging at snap diaphragm made of sound-proof rubber and protected from external noise with safety cuff. Overall design of the sensor reduces the distortion of external noise and prevents mechanical damage of body.

Best protection from external noise is provided when cuff is placed fully on ground surface. (also when using rods).

When working with sensor, the cuff is placed fully against the surface, and the base of sensor should touch the ground surface.

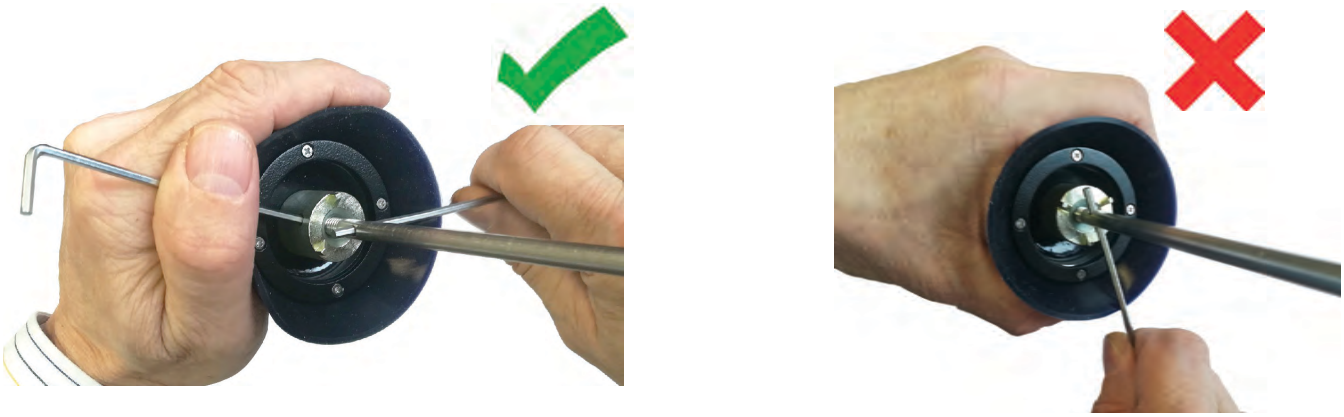


While working with sensor, please, make sure you are not pressing it too hard. The sensitive base may strike of vertical movement mechanical stopper. It may cause the unwanted noise in headphones and distorted signal. The distortion of signal may happen when sensitive base is placed incorrectly due to roughness of ground surface. When placing the sensor, choose as flat surface as possible.

When working on soft soil or in high grass or snow, use removable rods.

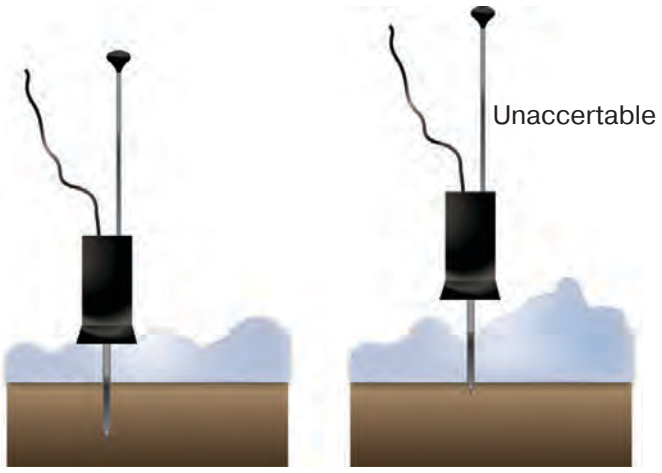
The rods are installed and removed manually. If necessary Allen keys (supplied) can be used to install and remove the rods. (one key is put into the hole of the rod, the second – into the hole in the base of sensor to prevent cranking of the base and damaging of the sensor)

WARNING! Using one key to install the rod is prohibited!



When using the rods, please, make sure that protective cuff fully touches the surface of the ground. This helps to exclude the influence of unwanted noise. (Pic. 3.1).

If it is impossible to place the cuff so it fully touched the ground, provide as much silence as possible. (Pic.3.2).



Pic. 3.1 **Pic. 3.2**

Indicated useful signal level fully depends on the position of the sensor. Comparison of signal levels can be done only when the sensor is placed in multiple points at similar conditions.. Moreover, the signal level in each point should be measured several times and average value should be considered as true.

Some elements of sensor are made of rubber, that is why it is restricted to clean the sensor with sharp tools. It is also restricted to bash the sensor over hard surfaces in order to clean it off the dirt. In order to clean the sensor rinse some water on it.

4. The sequence of operation in the search mode of the cable defect by acoustic method

To create periodic discharges in the hidden place of the cable defect, connect the output of the high-voltage pulses generator to the pins of the cable and apply the pulse voltage. In the location of the defect pulses of sound are created. The place of the defect is determined by the acoustic sensor (AS) on the maximum level of the signal.

Equipment used:

Receiver AP-027M | *Acoustic sensor AD-227* | *Headphones*

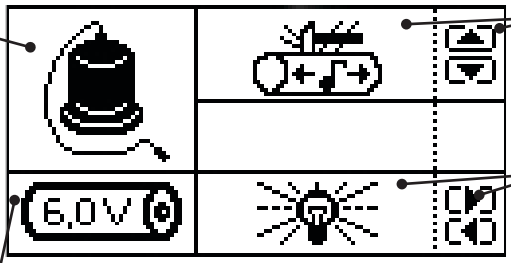
Fig. 4.1

4.1 Connecting sensors and test the functionality of the receiver

1. Connect acoustic sensor and headphones to the corresponding receiver connections

2. Turn on the Receiver AP-027M

3. In the «Start screen» on the display of the receiver:



Check the accuracy of sensor connection. If a «no sensor» symbol is lit on the display ,check if the sensor is connected

Choose the type of the received signal «hits» by any of ▲/▼buttons

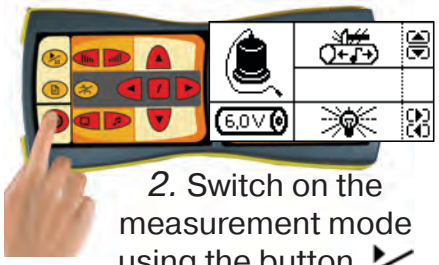
Set the desired back light level of indicator on the receiver using ◄/► buttons

Check the charge status of the batteries (***the charge should be no less than 4,0 V***). If the battery charge is low, replace the batteries

CAUTION!!
When working on finding defects of cable lines it is desirable to have a detailed map of underground communications. In the absence of the map a preliminary tracing of the cable should be conducted. On the accuracy of installation of the acoustic sensor above the axis of the cable depends on the level of the wanted signal and minimal interference.

4.2 Preliminary route inspection

1. Place the acoustic sensor over the supposed cable location



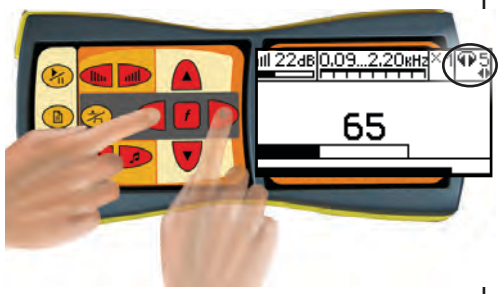
2. Switch on the measurement mode using the button

broadband mode 0.09...2.20кНz, by pressing the filter button.

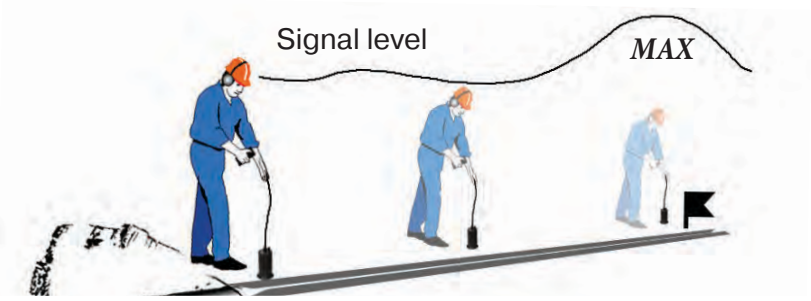
4. Set input signal level using sensitivity buttons и

! Overload on input (full filling the bottom of the scale) leads to distortion of sound in the head phones and information about the signal level

5. Set the headphones to required volume using buttons ◄/►



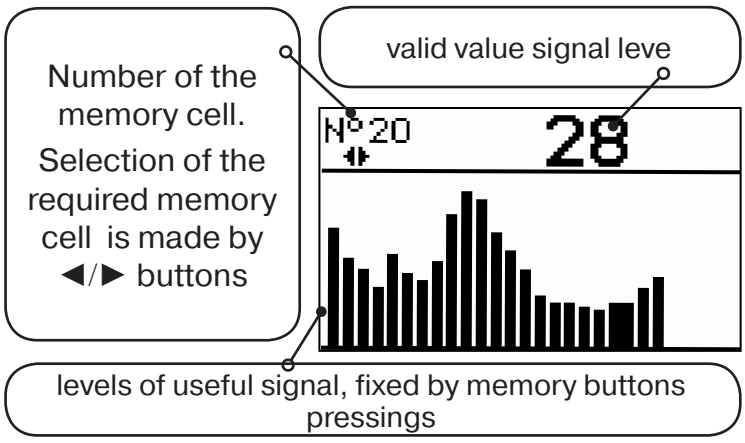
6. As you move along the route, move the acoustic sensor in increments of approx.1 m. and place markers in the spots where the signal level is the highest



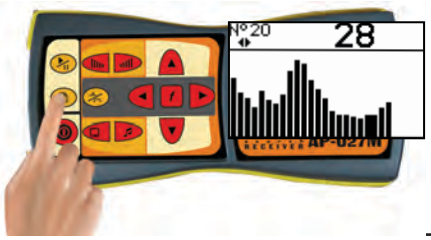
7. We recommend you to record the points where signal level is the highest into the memory of the device by pressing the memory button

The receiver has an ability to record/view 30 saved signal levels Output signal level values are recorded every time by pressing the memory button

7.1. Browse the saved memory (Appendix B), select the areas with the highest signal and search for leaks in the marked spots If on the extraneous background sounds you can hear the distinctive sound of the leak, ***set the filter (p.3.3)***. If not - move the sensor to another proposed location



In order to enter the review mode:

1. Turn off measurement mode by pressing	***2.*** Press the memory button	***3.*** Review memorized fields using the ◄/► buttons
		

In order to leave memory mode press button - you enter the launch window, and then to return to the measurement mode press «start»

When the receiver is powered off, the recorded data is not saved!

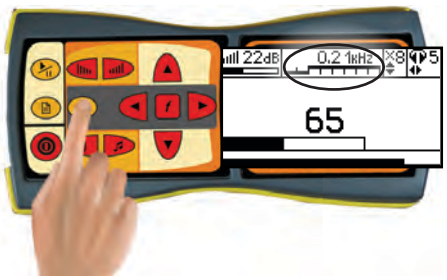
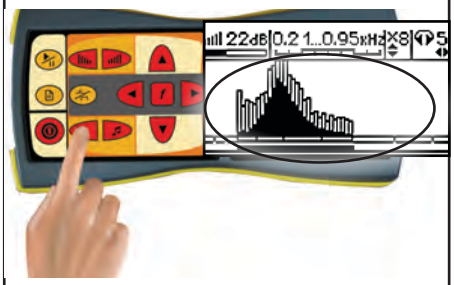
NOTES:

-Before moving the sensor to stop the «measuring» mode by the button for saving last readings of the indicator on the screen and removing unpleasant sounds from the head phones.

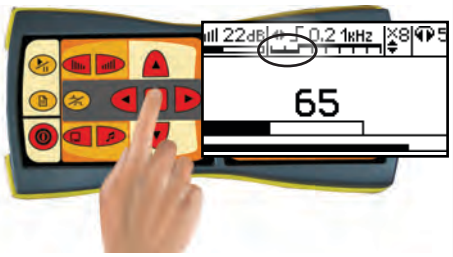
-Do not change the settings of the management bodies when moving the sensor in the process of passing along the route, to preserve the relative magnitude of the signal level.

4.3 Accurate location of the defect

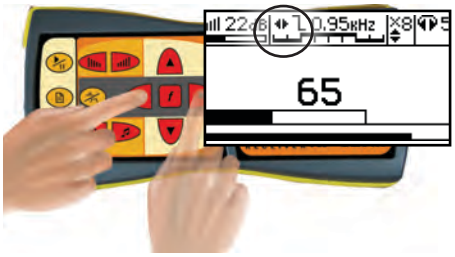
To accurately determine the location of the defect of the cable line by the maximum sound level, information is needed on the level of useful component of the signal received. Tunable bandpass filter lets to eliminate sound frequencies outside a strip occupied by the sound of the defect. **The general principle of filter settings is to gradually narrow the bandpass width to select the sound of defect (the characteristic «clicks») and the greatest suppression of all other sounds.**

1. Install acoustic sensor above the intended new location of the defect and begin configuring the filter.	*2.* Hearing the sound like «clicks» of electromagnetic discharges, include the bandpass filter button	*3.* Put on the adjustment of the filter frequency by pressing the «frequency» button.
 *estimated place of the defect*		

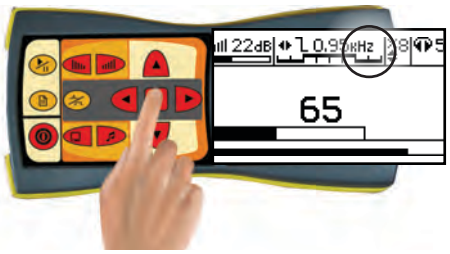
4. Using the buttons ◄/► increase the frequency of the lower «cut-off» 0.2 kHz as long as it is not detrimental to the intelligibility of the sound in the headphones



5. Turn on the filter by pressing the frequency button ***f***. A symbol of low frequencies suppressing will appear on the display



6. Using the buttons ◄/► increase the frequency of the lower «cut-off» 0.95 kHz as long as it is not detrimental to the intelligibility of the sound in the headphones



The location of the defect corresponds to the point with the maximum level of «useful» signal (Fig.4.2). If the same intensity of the signal observed at site 2…5 m, the location of the defect is determined in the center of that gap.

7. Note the alleged defect.

8. Switch off the equipment

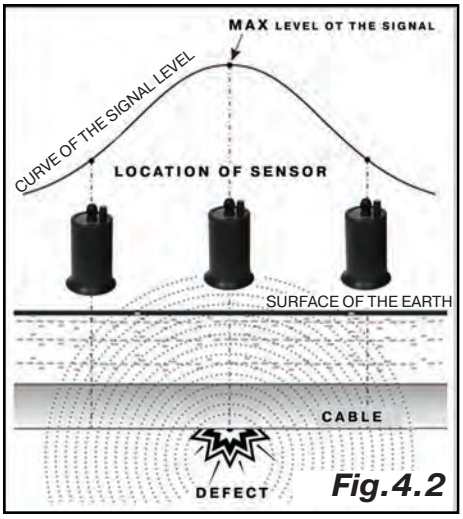
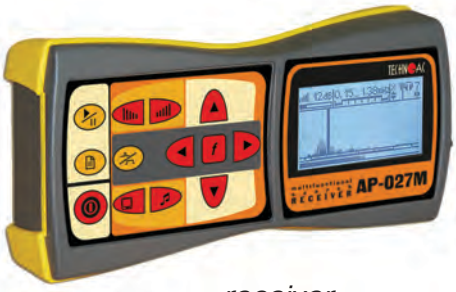


Fig.4.2

5. Operation sequence in passive cable route detection mode

Used equipment:



receiver AP-027M

electromagnetic sensor EMD-247

headphones

Fig. 5.1

5.1 Connection of sensors and check of the receiver operability

1. Connect the electromagnetic sensor and headphones to the corresponding receiver connections headphones (if necessary)

2.1 To set the electromagnetic sensor from transport to operating position. In order to do that: loosen the locking nut (1), extend the bar (2) to a required length and fix with the locking nut

1.

2.

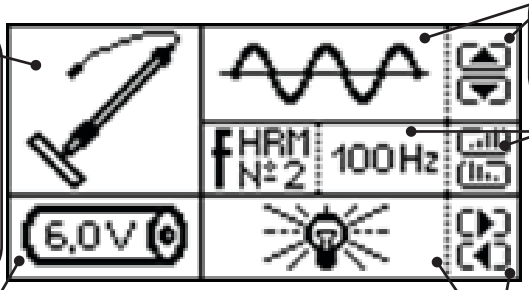
2.2 Loosen the locking nut (3) and install the electromagnetic sensor (4) in a position used in route detection. Fix the position with the locking nut. Horizontal position – is used for route detection by maximum method, and transport position for route detection by minimum method

3.

4.

3. Turn on the receiver AP-027M

4. In the start window of the receiver display:



Check accuracy of the sensor connection. If a «no sensor» symbol , is lit on the display, check if the sensor is connected correctly.

Check the received signal type as «continuous» (by any of buttons ▲/▼)

If it necessary, change the frequency ***of the second filter***

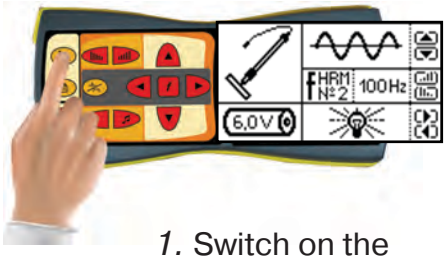
by changing the number of harmonic component «HRM №2» to another by buttons or.

Check the charge status of the batteries the charge should be no less than 4,0 V). If the battery charge is low, replace the batteries.

Set the necessary level of receiver display backlighting, using ◄/► buttons

Fig.5.2

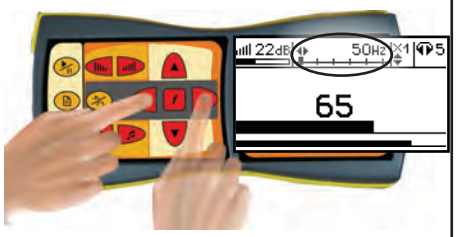
5.2 Conduct receiver setup



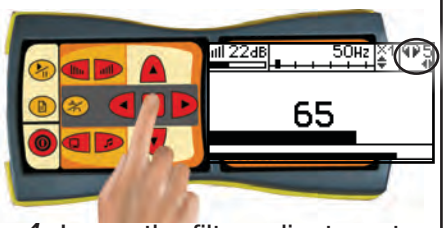
1. Switch on the measurement mode using the button

2. To select the necessary frequency press the frequency button *f*. symbol will appear ◄►

For tracing of energized cables please set frequency 50 Hz.

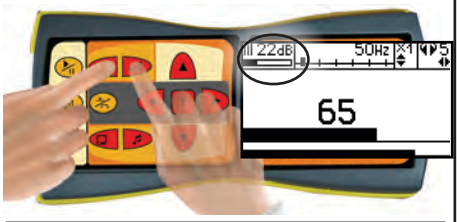


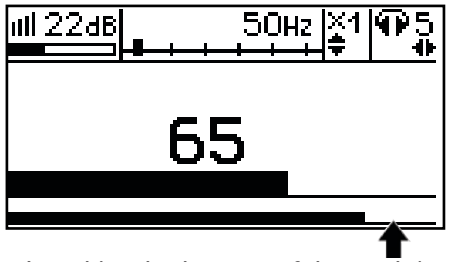
3. Using buttons ◄/►, set the desired frequency in the filtration zone for example, 50 Hz



4. Leave the filter adjustment mode by pressing the frequency button *f*. Indicator ◄► will appear in the volume adjustment zone

5. Set input signal level using sensitivity buttons and

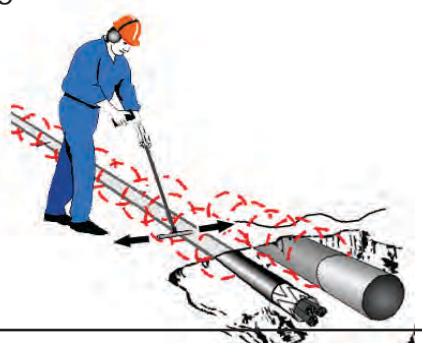


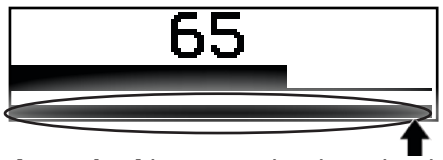


Level (at the bottom of the scale) must be within 50 ... 90% of the maximum

6. Set an acceptable volume level volume using ◄/► buttons

7. Moving along the route, it is necessary to move the electromagnetic sensor across the route in one and the other side to maintain a maximal level of the signal.





Attention! *input overload can lead to the wrong interpretation of data*

8. Set the required gain factor of filtered signal to «×1/2/4/8», by pressing buttons ▲/▼

9. Commence detection or tracing according to the method set in ***p.5.3****, avoiding prolonged input/output overloads*

5.3 Route location methods

1. The Maximum method

This method consists of positioning the electromagnetic sensor in the direction of the magnetic field created by the utility radiation (fig.5.3). EMD antenna must be positioned horizontally and the sensor placed in a plane perpendicular to the cable route. In this case the maximum signal level is observed when the sensor antenna passes directly above the utility line. The maximum method is intended for a quick route location. Flat peaks of the signal level curve do not allow for high location accuracy, but enables a quick route location.

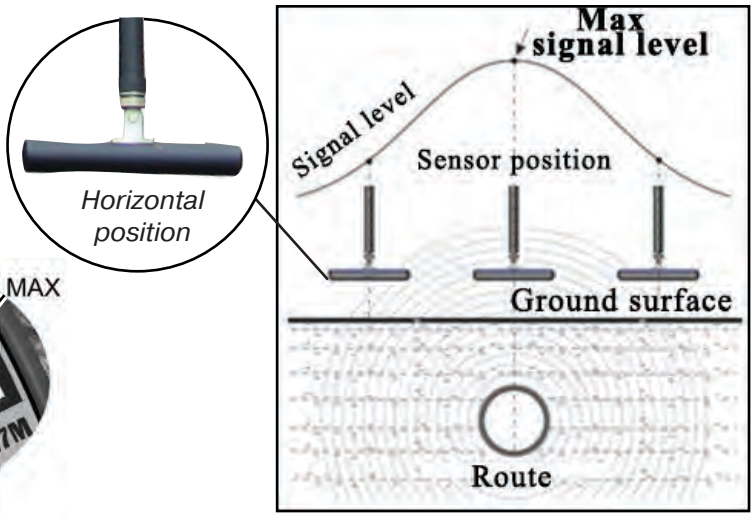


Fig. 5.3

The Maximum method

2. The Minimum method

When the EMD antenna in a vertical (transport) position is placed directly above the route the signal is at its lowest level fig. 5.4. As the distance from the point directly above the pipeline increases, the signal level first rises sharply then slowly decreases. This is the minimum method, which is used to determine a more precise route location (after quick route tracing using maximum method.

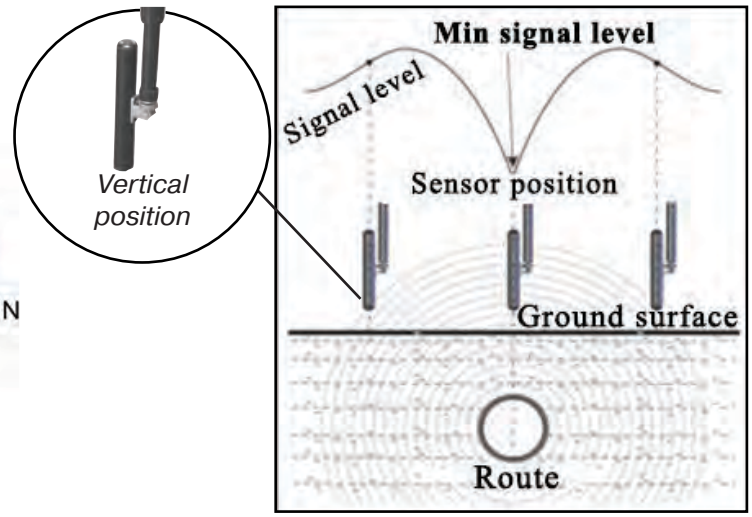


Fig. 5.4

The Minimum method

6. Additional features

6.1 Task: ***Indirect electromagnetic mode of depth measuring***

Equipment used: *receiver AP-027M, electromagnetic sensor EMD*

Tip: When determining the depth, one should take into account the terrain. In order to obtain precise results, select flat surface areas.

Method: 1. Find the precise pipeline route location (preferably using the minimum method). Mark the spot.

2. Fix the sensor antenna at a 45 angle to the ground surface, minimum of the signal is observed at a distance from the point «above the route», equal to the depth of the utilities, when the antenna axis intersects the axis of the route. This is the indirect method of measuring the depth of utility (***fig. 6.1***)

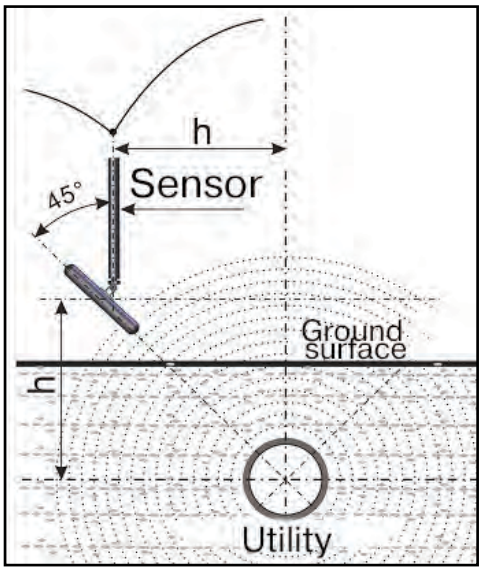


Fig.6.1

6.2 Task: Detecting the pipeline and utility lines intersection point.

Equipment used: *receiver AP-027M, electromagnetic sensor EMD, headphones.*

Method: 1. Perform preliminary pipeline route location.

2. Turn on the receiver and set it up for broadband.

3. Position the electromagnetic antenna over the pipeline, parallel to the pipeline route (signal level displayed on the receiver screen will be close to zero) (***fig. 6.2***). Perform route location in accordance with the maximum method. When following the route, the intersection points with utility lines can be identified by the maximum signal.

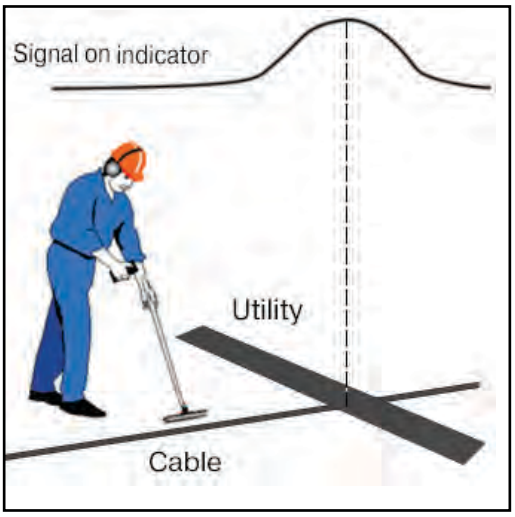


Fig.6.2

Appendix A
Receiver AP-027M Technical specifications

<table>
<tr><th>Parameter</th><th>Tracing</th><th>Leak detection</th></tr>
<tr><td>Type of accepted signal</td><td>Uninterrupted /pulse</td><td>Uninterrupted signal</td></tr>
<tr><td rowspan="2">Frequencies of the receiver's filter</td><td>Central frequency of quasi-resonant filter 50..60 Hz,
100….450 Hz through 50 Hz,
120…540 Hz through 60 Hz,
512 Hz / 1024 Hz / 8192 Hz/ 33kHz</td><td rowspan="2">Range limitation
“below”
0,1/0,15/0,21/0,31/0,45/0,65/0,95/
1,38 kHz

Range limitation “above”
2,00/1,38/0,95/0,65/0,45/0,31/0,21/
0,15kHz</td></tr>
<tr><td>two-frequency mode
1024 Гц + 2048 Гц,
1024 Гц + 8192 Гц</td></tr>
<tr><td>«Broadband», (operating mode)</td><td>0,05 …8,6 kHz</td><td>0,09….2,20 kHz / 0,03…0,50 kHz</td></tr>
<tr><td>Gain factor</td><td colspan="2">100 dB</td></tr>
<tr><td>Visual indication</td><td colspan="2">Liquid-crystal display- symbols and meaning of the chosen modes and parameters.
-animated (moving) scale of the output signal level
- digital value and animated (moving) scale of the output signal level
-graphic (moving diagram) of the output signal level
- frequency content of the output signal level
-digital and graphic display of output signal levels kept in the “memory’.</td></tr>
<tr><td rowspan="3">Sound indication</td><td colspan="2">Headphones natural broadband or filtered signal</td></tr>
<tr><td>Headphones-synthesized sound. Frequency modulation</td><td>-</td></tr>
<tr><td>Built-in emitter - synthesized sound. Frequency modulation</td><td>-</td></tr>
<tr><td>Supply</td><td colspan="2">Voltage 4…7 V.
- alkaline batteries AA type 1,5 V (4 pcs.).</td></tr>
<tr><td>Time of continuous operation not less than</td><td colspan="2">20 hours</td></tr>
<tr><td>Ambient temperature, C</td><td colspan="2">minus 20C…to +50C</td></tr>
<tr><td>Ingress protection rating</td><td colspan="2">IP54</td></tr>
<tr><td>Receiver AP-027M dimensions</td><td colspan="2">220 × 102 × 42 (mm)</td></tr>
<tr><td>Weight of the electronic unit, kg</td><td colspan="2">0,46 kg</td></tr>
<tr><td></td><td colspan="2"></td></tr>
</table>

Appendix B
Switching-on the receiver

1. Switching-on the receiver

When the receiver is switched on, the display shows the following sequence: manufacturer's trademark (logo) «TECHNO-AC», Business card of the Receiver with the Software version number and the Start window (fig.A.1).

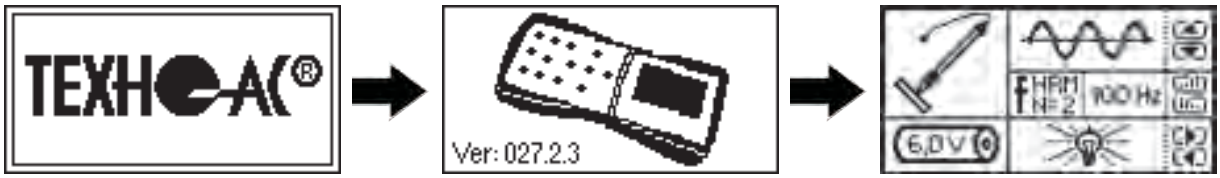
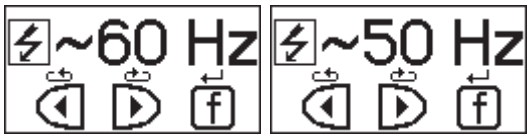


Fig. A.1

When switching the receiver with the button ⏻ ***while holding*** button **f**, after Business card Window of network frequency selection will appear. Frequency of 50 Hz or 60 Hz is selected by any of button ◄/►, and «input» with transfer to Start window is performed by pressing the button again **f**.



2. The start window

The start window displays the following information:

type of signal received

when working with AD

- «sound of liquid leakage (continuous acoustic signal)
- «sound generated by an impact (acoustic impulses during transmitter operation)

During work with electromagnetic sensor

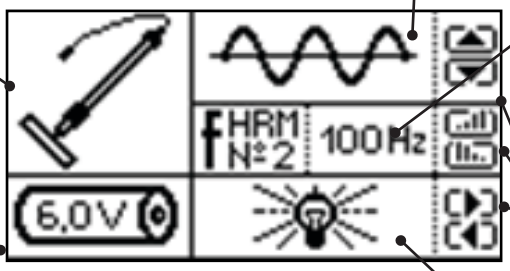
- -continuous signal from the power network, cathode protection of trace generator
- pulsed signal of trace generator
- Dual-frequency signal of the trace generator

type of the sensor connected

- Sensor not connected
- Acoustic sensor(AD)
- Electromagnetic sensor(EMD)

parameters of detector of harmonic component with net frequency

№ and frequency of harmonic component of net frequency (for the second filter)



voltage indicator

When power voltage ≤4.0V after switching on the warning signal is heard, when power voltage ≤ 3.8V there is the image of fully discharged battery ⌧ and the device will automatically switch off after

indicator backlighting intensity

There are four levels of indicator backlighting intensity

indicators of used buttons

Type of signal received, available for this of the sensor is selected by ▲/▼ buttons

№ of harmonic component of the net frequency (for the second filter) is selected by buttons /

Indicator backlighting intensity is selected by the buttons ◄/►

Fig. A.2

Return to the Start Window from measurement mode is performed by pressing ⏯ ((pause mode) and **f**.

3. Scale window

When measurement mode is selected (except the two-frequency), Scale working window appears first fig.A.3.

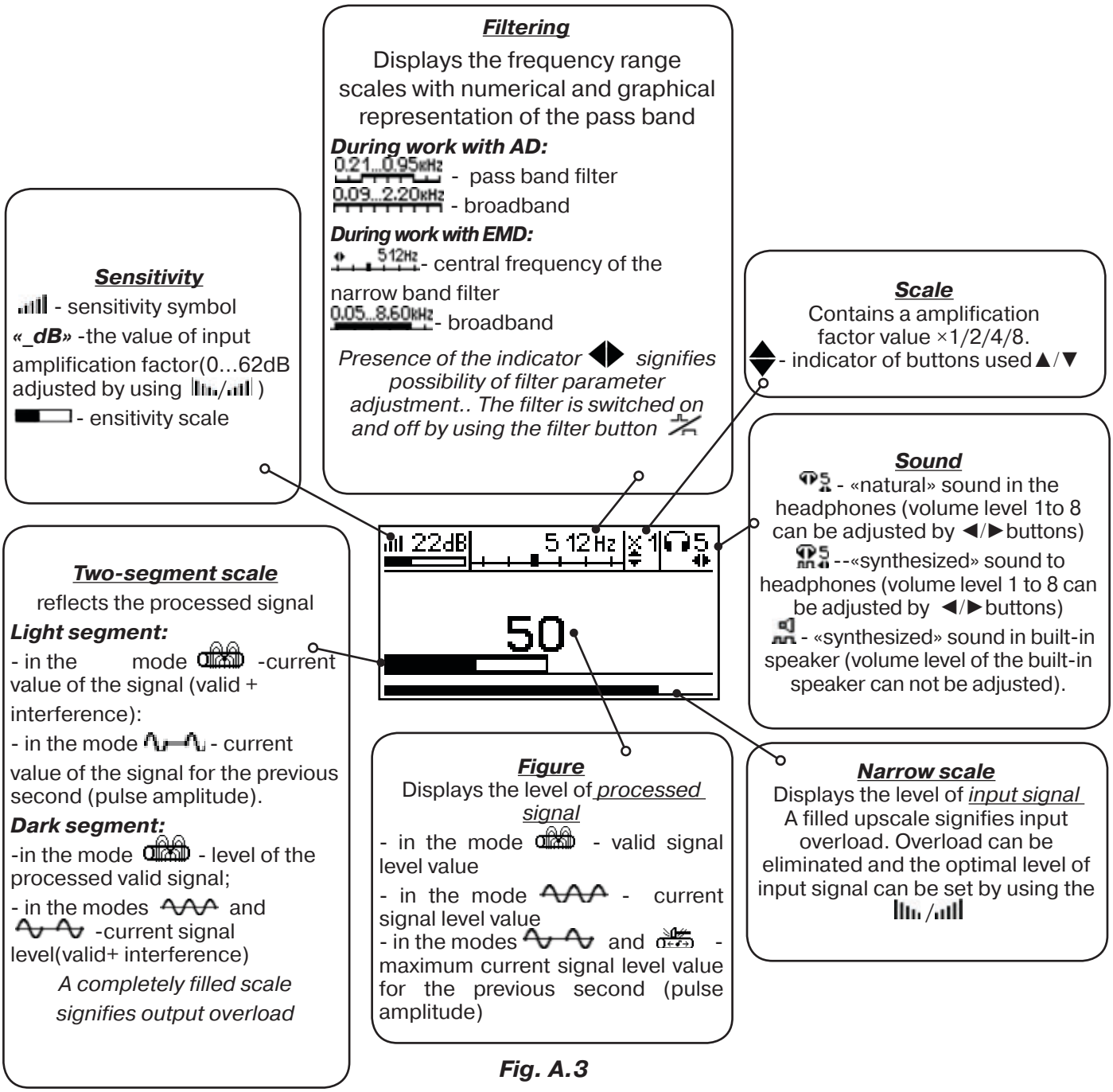


Fig. A.3

Visual indication button can lead to the indication modes of Graph (fig.A.4) and Acoustic signal spectrum(fig.A.5) or Power range spectrum (fig.A.6) and Broadband electromagnetic range (fig.A.7).

4. Graph window

The graph displays the changes in processed signal levels over time and moves at constant speed from right to left.

The graph
shows processed signal
- in mode - change in the level of processed valid signal over time
- in modes , and - change in the level of current signal value over time

Narrow scale
Displays the level of input signal. A filled upscale signifies input overload. Overload can be eliminated and he optimal level of input signal can be set by using the /

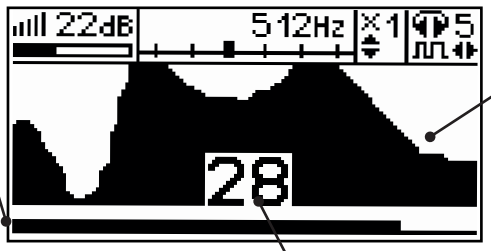


Fig. A.4

Figure
Displays the level of processed signal
- in the mode valid value of the signal
- in the mode - current value of the signal
- in the mode and maximum current value of the signal for the previous second (pulse amplitude)

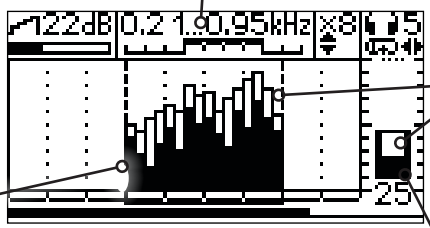
5. Acoustic signal spectrum window

«Spectrum Analyzer» is an auxiliary tool for signal visualization. It does not replace audio analysis and subjective evaluation by the operator. The mode is used when adjusting the band pass filter. The spectrum of the filtered signal is displayed on the screen. In broadband mode, the entire range of this mode is displayed. To adjust the filter, you need to exit the «broadband» mode.

At the same time, the window may look like this (axelerometer leakage, 0.21...0.95kHz):

Band pass of the filter on the figure - 0,21...0,95kHz. It is possible to switch over to adjusting the image scale at vertical by means of ▲/▼ and volume in headphones by◄/►. it is possible to switch over to adjusting the pass band and vise versa by means of (f →◄/►→ f).

dark segments correspond to the frequency components of valid («continuous») signal



light segments correspond to frequency components of accidental interference

Two-segment scale corresponds to the processed signal

Fig. A.5

«Bright segments» of the columns in the analyzer represent the maximum level of the signal in a certain frequency range for a certain period of time.

In leak detection mode, this is the level of brief! signal variations ("irrelevant" background noise).

In impact mode, this is the maximum level of the signal for 2 seconds! («useful» impact or "spark discharge").

«Dark segments» of the columns in the analyzer display:
- the level of continuous «useful» component of the signal in leak detection mode;
- animation of changes in real time in impact mode.

Thus, bright segments are essential in impact mode and supplementary in leak detection mode, while dark segments are vice versa, essential in leak detection mode and supplementary in impact mode.

In the leak detection mode «» ():

Frequencies with the highest dark segments are likely to be «useful». Other frequencies (especially those with the highest bright segments) are recommended to be suppressed by a band pass filter. The final decision here is made by the operator based on subjective experience in recognizing various sounds of leaks.

By repeatedly pressing the button « *f* » (not in the «broadband» mode!), you change the mode to the lower range limitation mode of the band pass filter «» or upper range limitation mode «»or headphones volume regulation. Adjustments are made using the buttons «◄/►».

In the acoustic pipe location mode (or cable spark discharge sound location) «» ():

Frequencies with the highest bright segments are likely to be spectral components of the sound of impacts (spark discharges). The rest (especially those with high but barely moving dark segments) are recommended to be suppressed. The final decision here is made by the operator based on subjective experience in recognizing various «impact» sounds.

6. Power range spectrum window

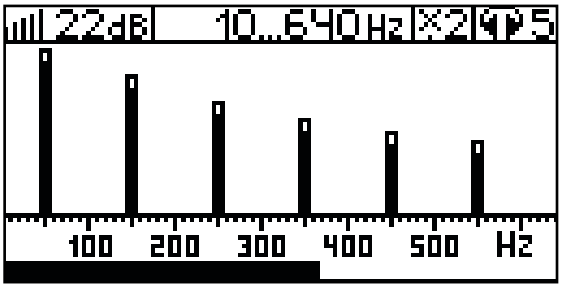


Fig. A.6

The window is available in the electromagnetic mode of broadband 0.05...8.60kHz and can be called for by the additional touch of a button . The display shows the industrial frequency spectrum of «10 ... 640 Hz». Maximum of emission spectrum of the power cable falls to 50/60 Hz.

Two-segment columns show the current and minimum values of the frequency components of the signal. Typically, the spectrum contains harmonic components which are dependent on the form of voltage and current in the load. There can be often present strong odd harmonic components at frequencies of 150/180, 250/300 (Hz), etc.

7. Broadband electromagnetic spectrum window

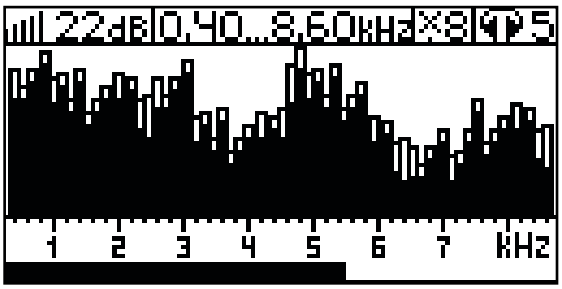
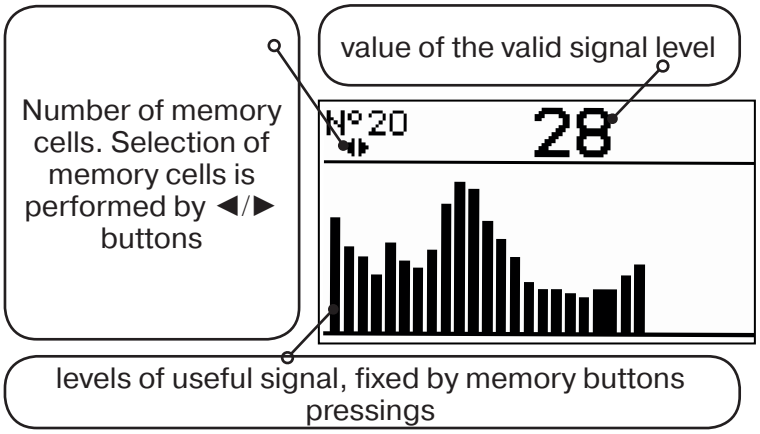


Fig. A.7

The window is available in the electromagnetic mode of broadband 0.05...8.60kHz and can be called for by pressing the button . The display shows the industrial frequency spectrum of «0.50...8.60 kHz».

Two-segment columns display the current and minimum values of the frequency components of the signal.

8. Memory window



The receiver has an ability to record/view 30 saved signal levels (fig.A.8). Output signal level values are recorded every time the memory button pos. 6.fig.2.1 is pressed in the measurement mode.

The memory of the receiver provides 30 cells for filling, any subsequent record is the last one.

The review mode is called up by the memory button .

Fig. A.8

In order to do that: turn off measurement mode by pressing , the start/pause button , review memorized fields using ◄/► buttons.

Leaving Memory window for the previous measurement mode occurs by sequentially pressing memory button and measurement buttons.

When the receiver is powered off, the recorded data is not saved.

9. Audio indication

The sound is output to the headphones or the built-in sound transmitter. Three categories of sound are used:

- «Natural» without filtering (broadband) to the phones;
- «Natural» filtered (narrowband) to the phones;
- «Synthetic» (modulation of sound frequency by the level of the filtered signal) to the phones or to the built-in transmitter.

When working with AD only «natural» sound is used.

When working with EMD in the mode «natural sound to the phones» the adopted «high active» frequency 8192Hz and 33kHz, before playing, are converted into a well-acceptable «low» frequencies of 838Hz and 1574Hz respectively.

«Synthesized» sound is created by a principle: «Frequency of the audible sound signal (pitch) is directly proportional to the signal level,» and the volume does not depend on the level of the received signal. «Synthesized» sound is played while values «figure≥2».

The volume of the headphones is set by the operator using buttons ◄/►. Two pressings correspond to the one change of figure on the display «8 … 1/1…8».

Volume of the «synthesized» sound on the built-in transmitter can not be regulated.