



WATER LEAK DETECTOR SUCCESS AT - 407N

**TECHNICAL DESCRIPTION
OPERATING INSTRUCTIONS**

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1. Receiver AP-027M

1.1 Appearance and Controls

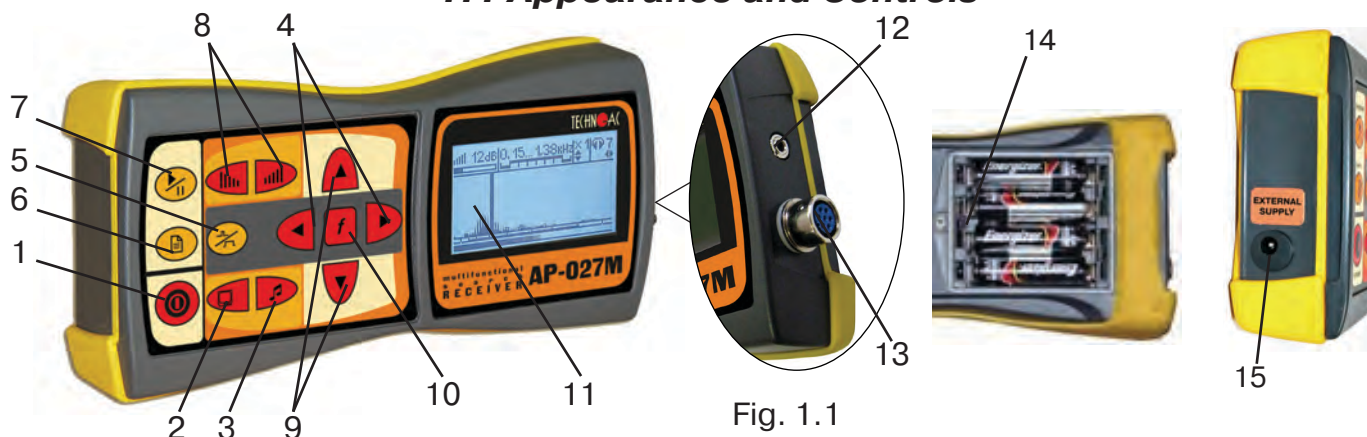


Fig. 1.1

1		power on/off button	9		selected parameter adjustment buttons (up/down)
2		visual indication type button	10		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.

1.2 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 can 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-027 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.

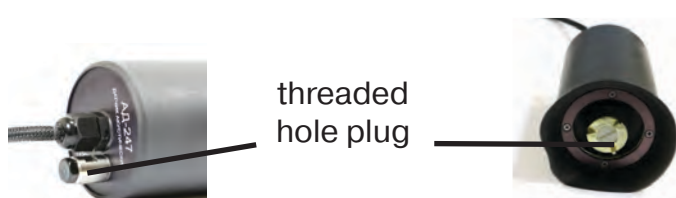


2. Acoustic sensor AD-227

2.1. 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 – Extension 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) .

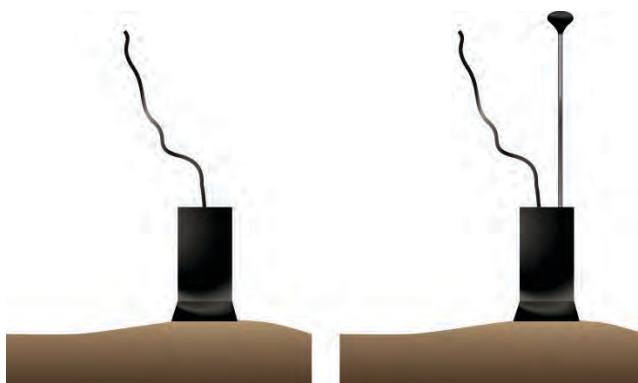
Using of magnet allows to attach the acoustic sensor to metal pipes and isolation valves. While preparing the sensor for the operation with removable handle and (or) rods, these plugs should be removed. After finishing the location the accessories should be removed and the plugs should be placed back.

2.2. 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.

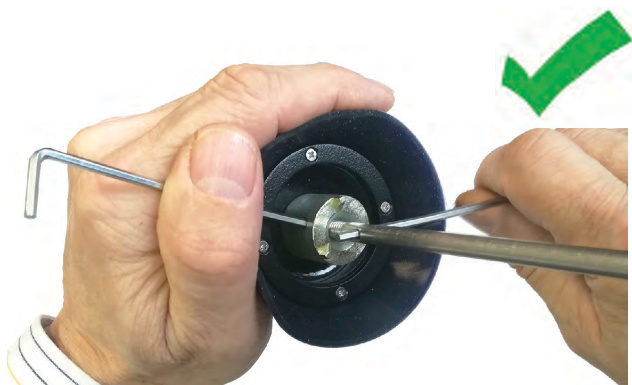


While working with sensor, please, make sure you are not pressing it too hard. The sensitive base may strike of vertical movement mechanical stopper. It may cause the unwanted noise in headphones and distorted signal. The distortion of signal may happen when sensitive base is placed incorrectly due to 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. (Fig.2.1).

If it is impossible to place the cuff so it fully touched the ground, provide as much silence as possible. (Fig.2.2).



Fig.2.1



Fig.2.2

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.

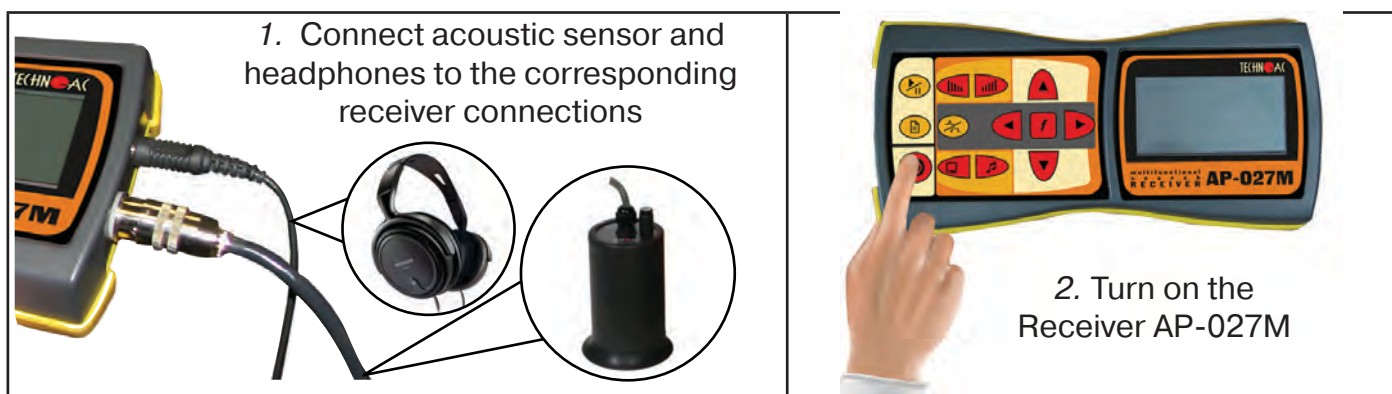
3. Operation sequence in liquids leak detection mode

Equipment used:

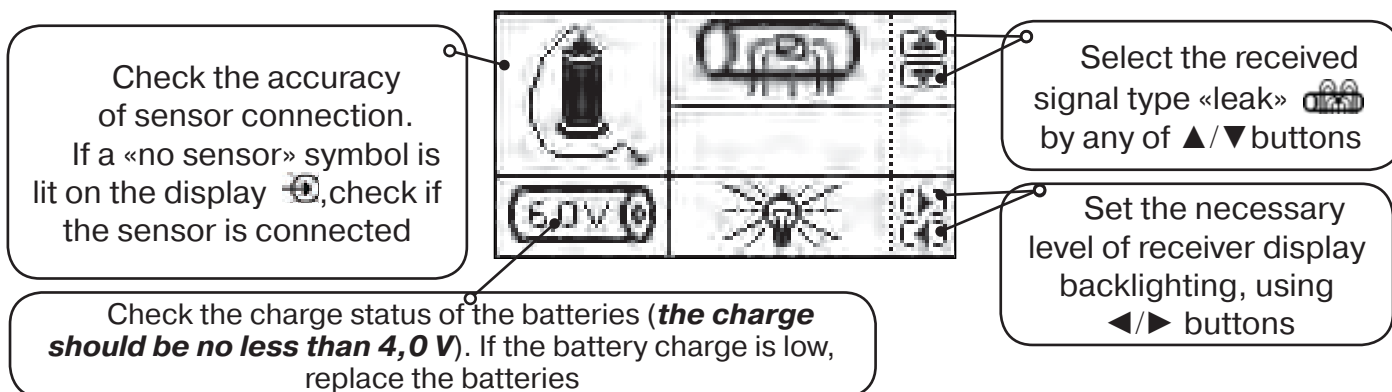


Fig. 3.1

3.1 Connection of sensors and check the receiver operability




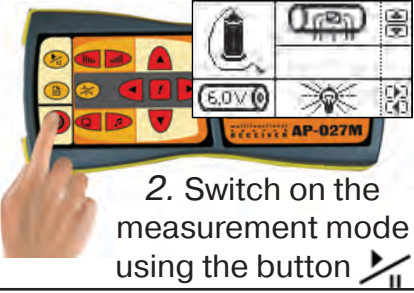
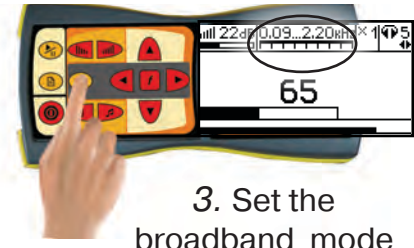

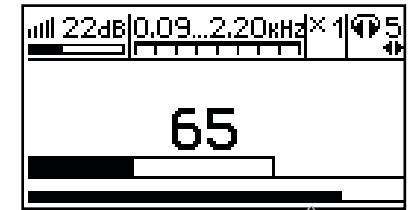

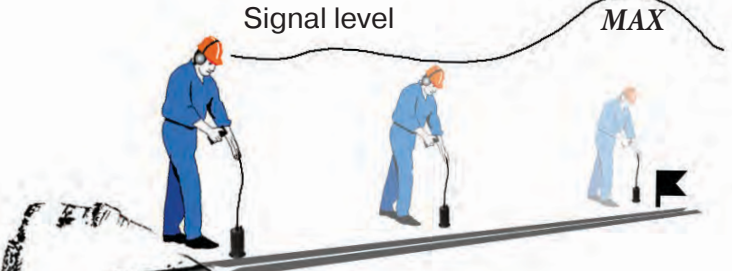
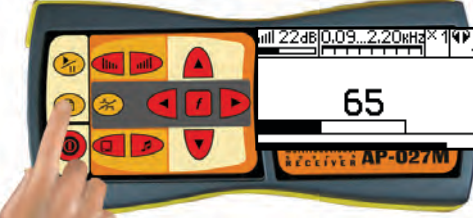

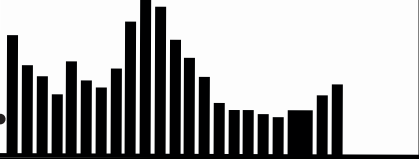
3. In the start window on the receiver display:






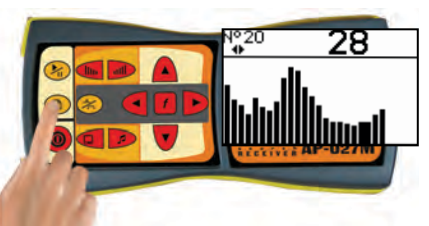



CAUTION!!

During leak detection works one should have a detailed diagram of underground utilities. If there is no diagram, a preliminary pipeline route location should be conducted. The level of valid signal and signal interference depends on the accuracy of acoustic sensor placement over the pipeline axis.

3.2 Preliminary route inspection

 <p>1. Place the acoustic sensor over the supposed pipeline location</p>	 <p>2. Switch on the measurement mode using the button</p>  <p>3. Set the broadband mode</p> <p>0.09...2.20kHz, by pressing the filter button</p>	<p>4. Set input signal level using sensitivity buttons</p>   <p>65</p> <p>Narrow scale indicator readings should be preferably at 50...90% of maximum value</p>
<p>5. Set the headphones to required volume using buttons</p>  <p>65</p>	<p>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</p>  <p>Signal level</p> <p>MAX</p>	
<p>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</p>  <p>65</p> <p> 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</p>	<p>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</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="671 1675 970 2011"> <p>Number of the memory cell. Selection of the required memory cell is made by </> buttons</p> </div> <div data-bbox="986 1675 1417 2101"> <p>valid value signal level</p> <p>Nº 20</p> <p>28</p>  <p>levels of useful signal, fixed by memory buttons pressings</p> </div> </div>	


In order to enter the review mode:

<p>1. Turn off measurement mode by pressing </p> 	<p>2. Press the memory button </p> 	<p>3. Review memorized fields using the   buttons</p> 
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In order to leave memory mode press button  **- you enter the launch window, and then to return to the measurement mode press «start»** 



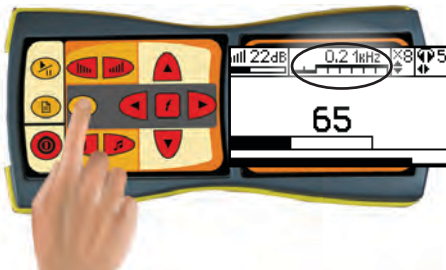

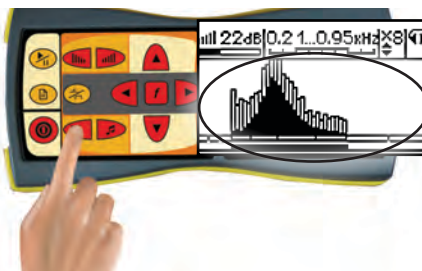
When the receiver is powered off, the recorded data is not saved!

NOTES:

- It is recommended to turn off the measurement mode by pressing the button  before moving the sensor, in order to save the receiver settings and eliminate unpleasant noise in the headphones.
- During leak detection it is not recommended to move the sensor and use the memory functionary earlier than 10 seconds after placing the sensor on the ground and turning on the measurement mode
- Do not change control settings as you move along the route, in order to save the relative value of signal level.

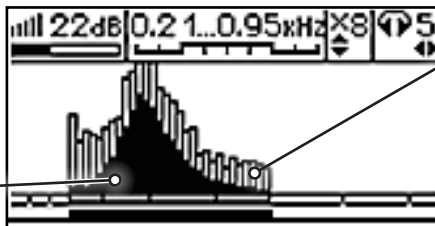
3.3 Conduct fine tuning of receiver filter

General principle of the filter setting is the gradual narrowing of band pass in order to isolate the sound of leakage and maximum suppression of all other sounds.

<p>1. Place the acoustic sensor over the suspected leak point and commence filter setup.</p>  <p><i>Suspected leak point</i></p>	<p>2. On hearing a sound like the sound of fluid leakage turn on the band pass filter by the button </p> 	<p>3. Switch to Spectrum window by pressing visual indication type button twice </p> 
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4. Conduct an analysis of the generated spectrum

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



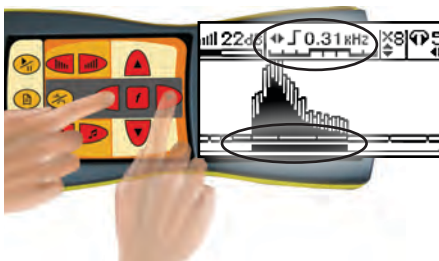
light to the frequency components of accidental interference

Frequencies where light segments prevail over the dark ones, are the most likely the interference frequencies that should be suppressed by pass band filter

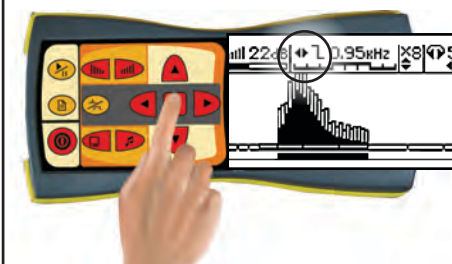
5. Turn on the filter by pressing the frequency button **f**. A symbol of low frequencies suppressing will appear on the display **LF**



6. Using the buttons **◀/▶** increase the frequency of the lower «cut-off» **0.2 1kHz** as long as it is not detrimental to the intelligibility of the sound in the headphones



7. Press the frequency button **f**. A symbol of higher frequencies will appear on the display **HF**

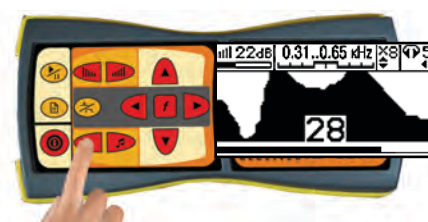


8. Using the buttons **◀/▶** decrease the frequency of the «cut-off» **0.95 kHz** as long as it is not detrimental to the intelligibility of the sound in the headphones.



9. Check the filtered signal quality shown in the Spectrum graph (**see p. 4**). Highest number of black stripes (valid signal) and lowest number of light stripes (interference) signifies correct choice of filter

10. Switch to Scale mode by pressing visual indication button **□**. Without changing the settings, examine the suspected leak area **as described above in sections 3.2 paragraphs 5-8**

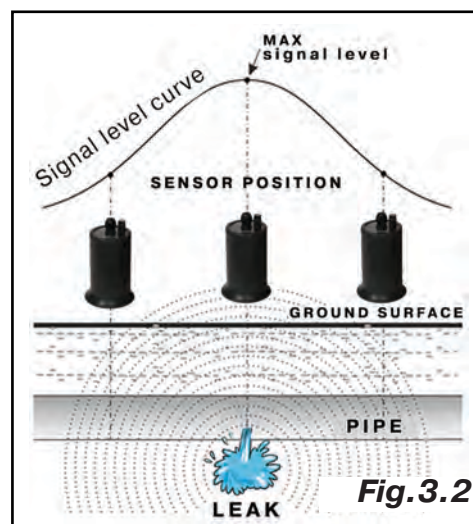


Leak point usually corresponds to a point where valid signal level is the highest. (fig.3.2).

If the same intensity of the signal level is observed at a distance of 2 to 5 m, then the leak point is located in the middle of such a segment.

11. Mark the suspected leak location.

12. Turn off the device



5 Portable acoustic sensor ADM-227 (with magnetic connection feature)



Sensor

Rod

SPECIFICATIONS:

1. Weight, kg:

sensor - (0,225 +/- 0,02)

rod - (0,115 +/- 0,02)

2. Dimensions, mm

Sensor (without wire) - (105 + 2) x width (31 + 1)

rod - (190 + 2) x width (29 + 1)

Portable acoustic sensor ADM-227 is used for acoustic water leak detection in combination with AP-027M receiver.

BRIEF DESCRIPTION:

Portable acoustic sensor has magnet base and extension rod. It allows to inspect pipelines in order to locate water leakages in hard reachable places, and also inspect if pipe valves were closed properly.

OPERATION METHOD:

High-quality microphone allows to detect smallest noises, caused by running water. Data, acquired by the sensor, is indicated on receiver screen. Magnet base allows to install the sensor directly on the pipe if usage of bigger sensor – AD-227 is not possible. ADM-227 allows to inspect smaller pipes.

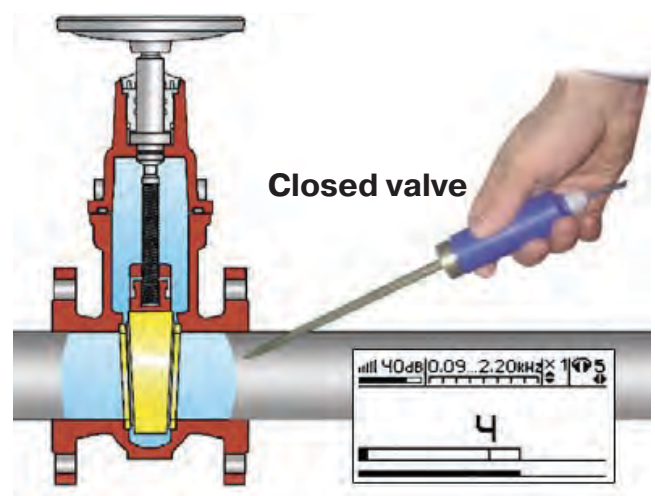
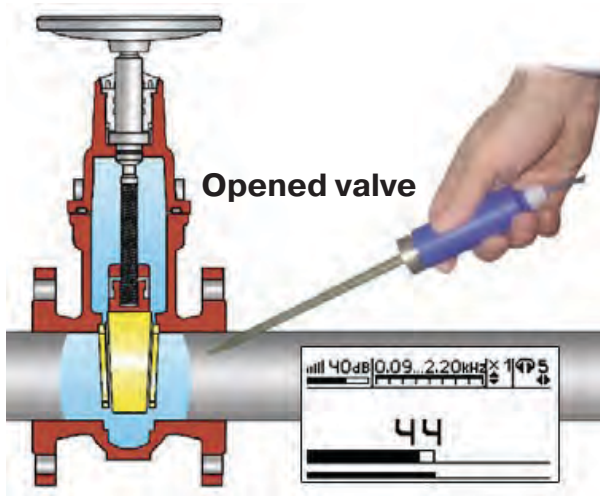
SENSOR HAS TWO MAIN APPLICATIONS:

1. Installation of the sensor to a pipe for water leak detection.
2. Usage with extension rod as hand sonde for pipe valving inspection.

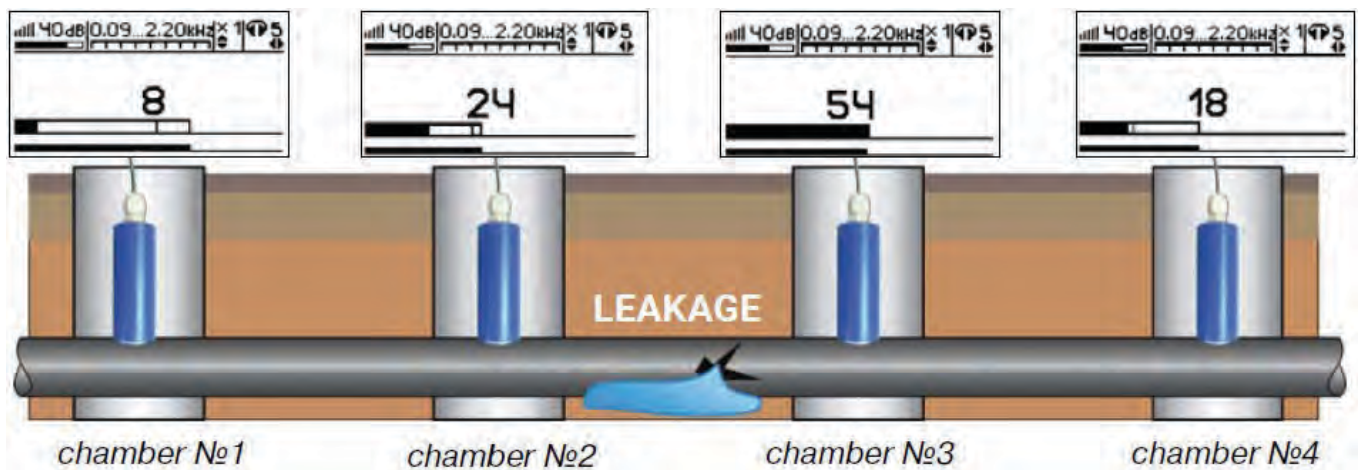
Method of operation is the same as described for AD-227 (described in corresponding section of user manual).

SPHERE OF APPLICATION:

Inspection of isolation valve



Location of water leakage from underground pipeline with ADM Sensor



Appendix A

Receiver AP-027M Technical specifications

Parameter	Tracing	Leak detection
Type of accepted signal	Uninterrupted /pulse	Uninterrupted signal
Frequencies of the receiver's filter	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	Range limitation "below" 0,1/0,15/0,21/0,31/0,45/0,65/0,95/1,38 kHz
	two-frequency mode 1024 Гц + 2048 Гц, 1024 Гц + 8192 Гц	Range limitation "above" 2,00/1,38/0,95/0,65/0,45/0,31/0,21/0,15kHz
«Broadband», (operating mode)	0,05 ...8,6 kHz	0,09....2,20 kHz / 0,03...0,50 kHz
Gain factor	100 dB	
Visual indication	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".	
Sound indication	<u>Headphones</u> natural broadband or filtered signal	
	<u>Headphones-synthesized sound.</u> <u>Frequency modulation</u>	-
	<u>Built-in emitter - synthesized sound.</u> <u>Frequency modulation</u>	-
Supply	Voltage 4...7 V. - alkaline batteries AA type 1,5 V (4 pcs.).	
Time of continuous operation not less than	20 hours	
Ambient temperature, C	minus 20C...to +50C	
Ingress protection rating	IP54	
Receiver AP-027M dimensions	220 × 102 × 42 (mm)	
Weight of the electronic unit, kg	0,46 kg	

Appendix B Receiver AP-027M. Indication

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 AP-027M (fig.B.1) and the Start window (fig.B.2).



Fig. B.1

2. The start window

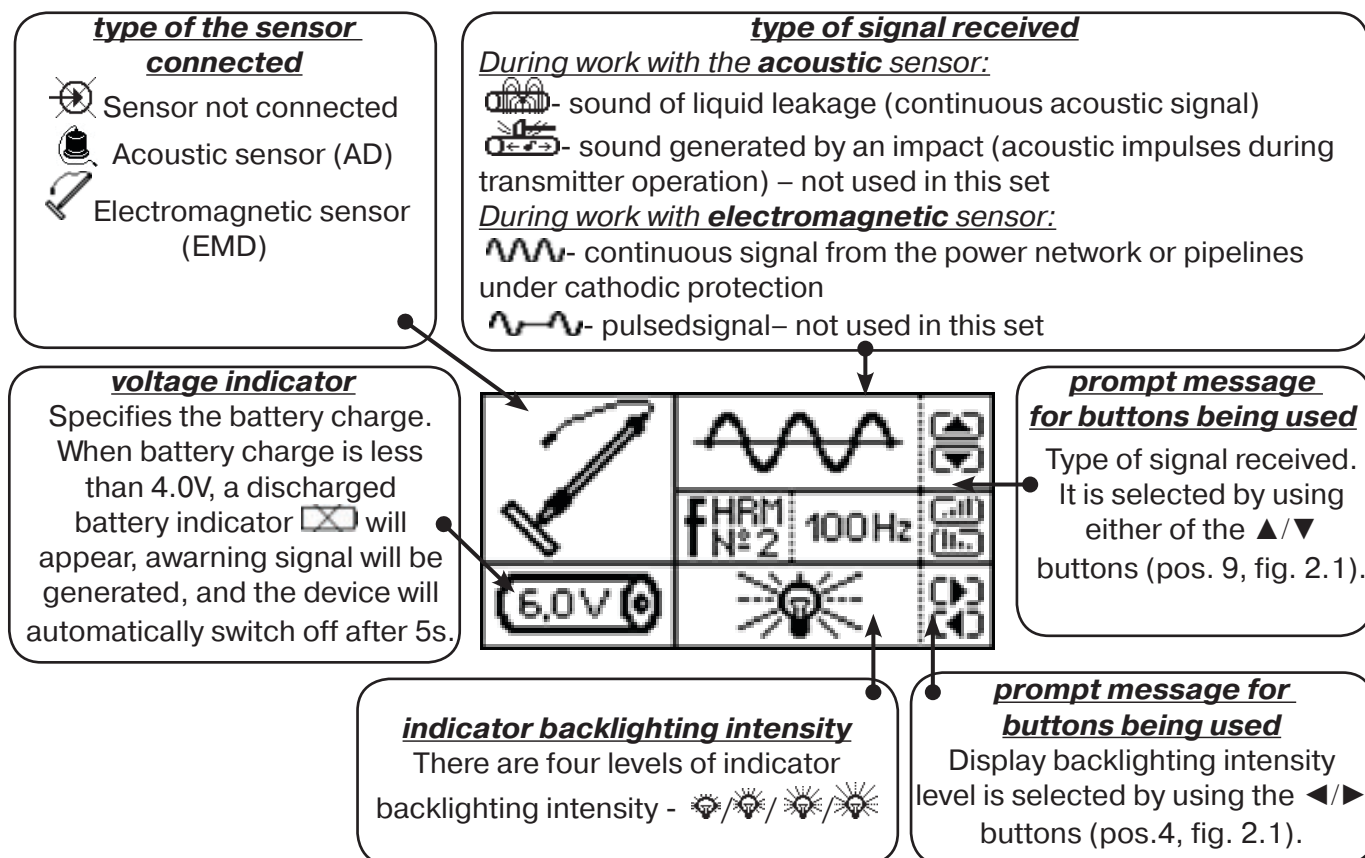
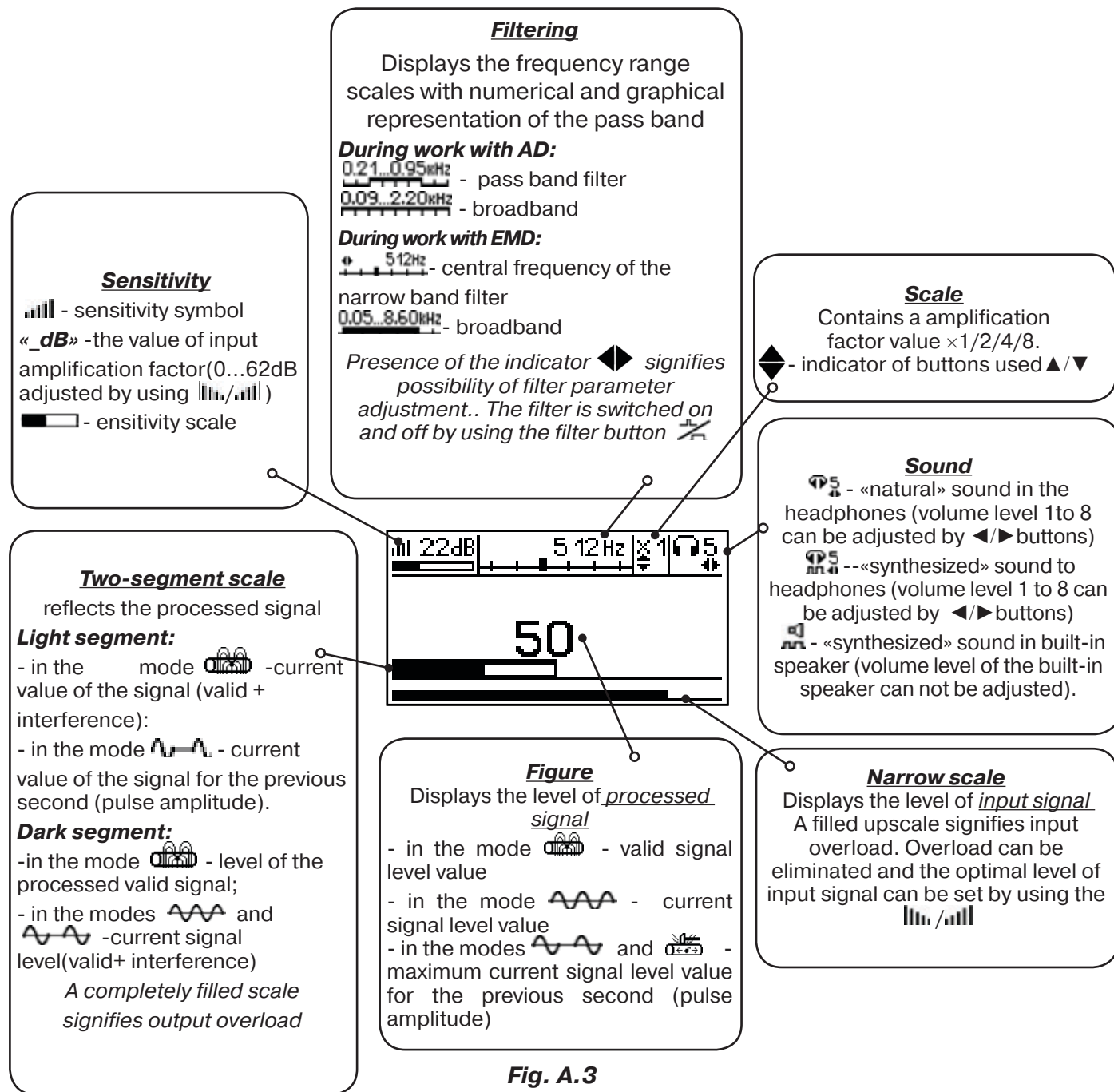


Fig. B.2

3. Scale window

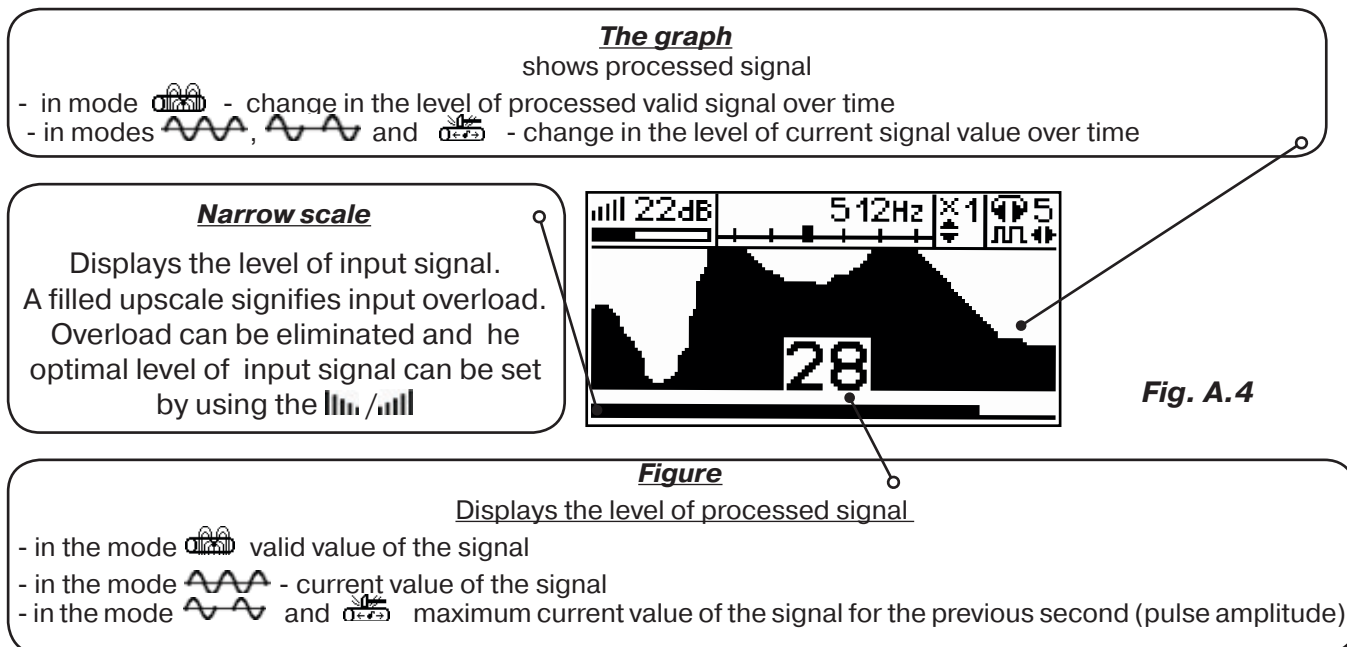
When measurement mode is selected (except the two-frequency), Scale working window appears first fig.A.3.



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

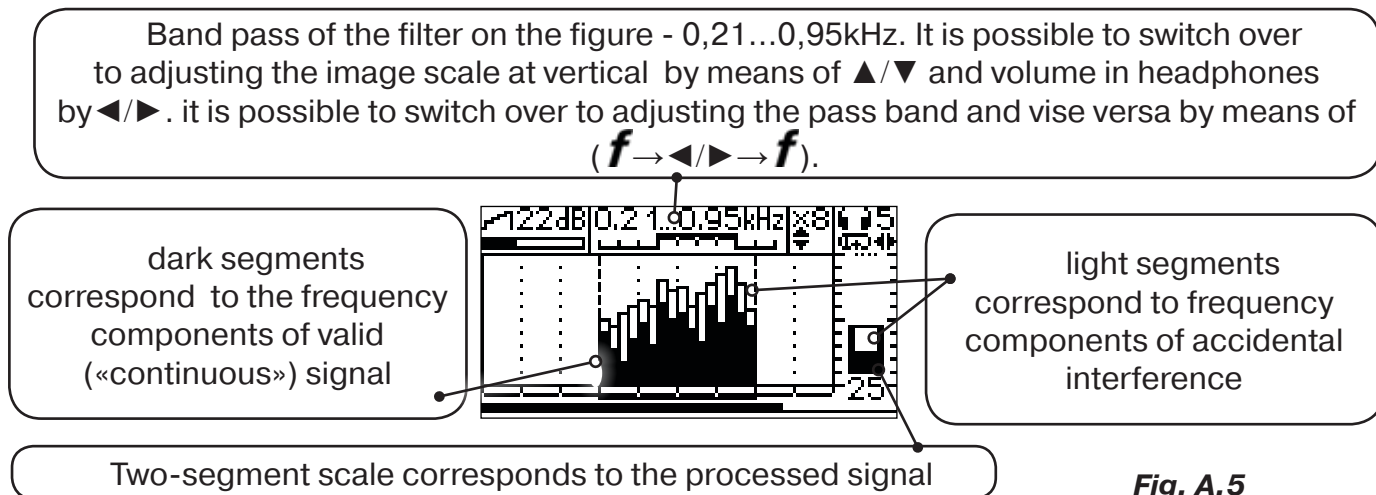
The graph displays the changes in processed signal levels over time and moves at constant speed from right to left.



5. Acoustic signal spectrum window

It displays the spectrum of the filtered signal.

When working with EMD switching the window can have the following view :



The frequencies at which light segments significantly predominate over dark probably are the interference frequencies to be suppressed by the band pass filter.

6. Power range spectrum window

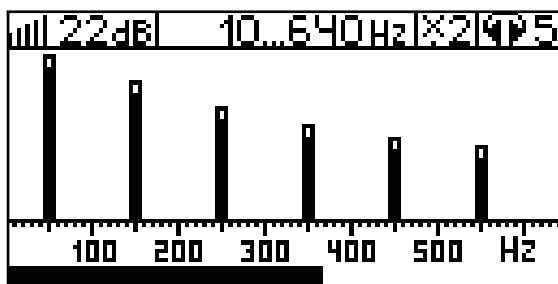


Fig. A.6

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

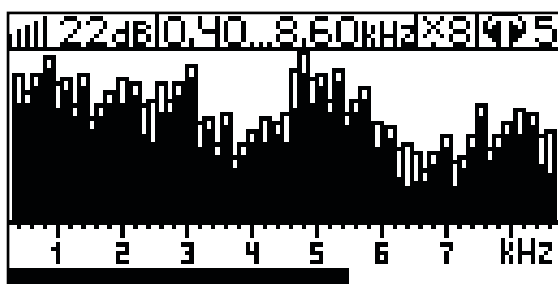


Fig. A.7

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

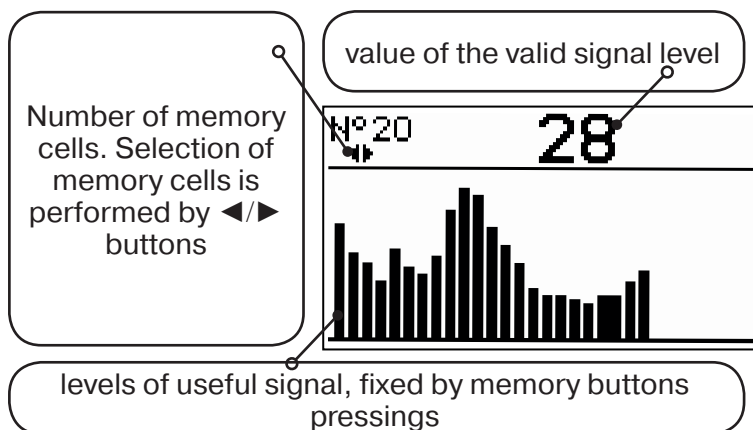


Fig. A.8

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 .

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

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.