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TECHNICAL DESCRIPTION
OPERATING INSTRUCTIONS

WATER LEAK DETECTOR
SUCCESS ATP-434N

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1. Design and principle of operation

Water leak detector «Success ATP-434N» is designed for:

- detection of water leak from metal or plastic pipelines underground up to 3 m depth
- detection of water leak from the pipes inside the house
- detection of energized cable lines underground up to 6 m depth by passive method.

Kit components are:

1–Receiver AP-027
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

Extra equipment:

! Always use ADM-227 sensor with extension rod If pipeline surface temperature is higher than 80°C

ADM is a mini sensor with magnetic base and extension rod, which is used for pipe diagnostics in hard-to-reach places and survey of valves. The method of operating the sensor ADM 227 is the same as with the sensor AD 227.

Operation conditions

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

2. Receiver AP-027

2.1 Appearance and Controls

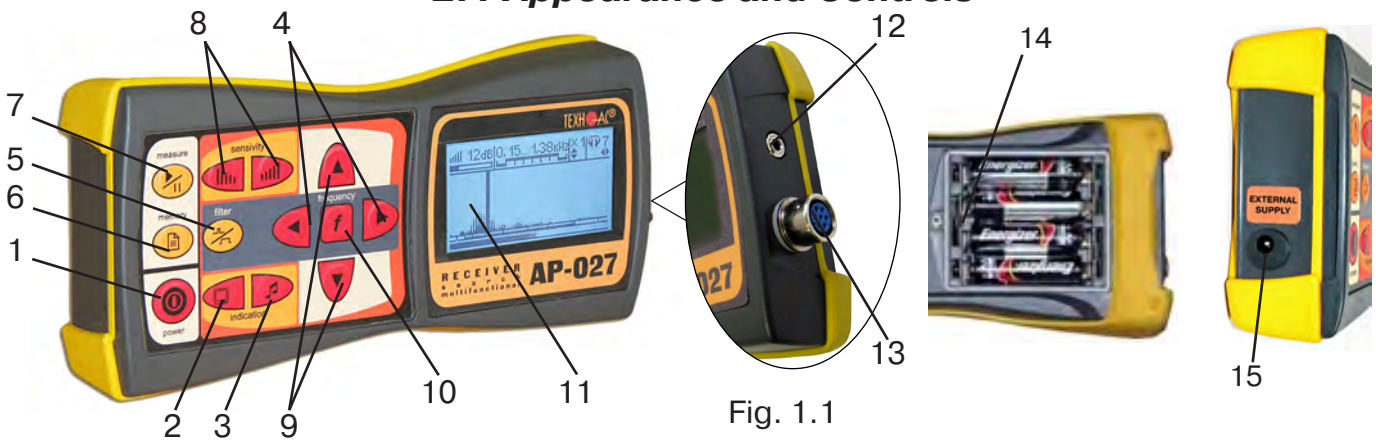


Fig. 1.1

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-027 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-027 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-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.

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).

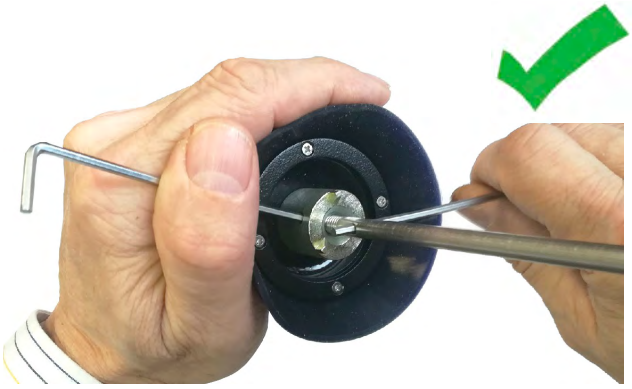
When working with sensor, the cuff is placed fully against the surface, and the base of sensor should touch the ground surface.

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.

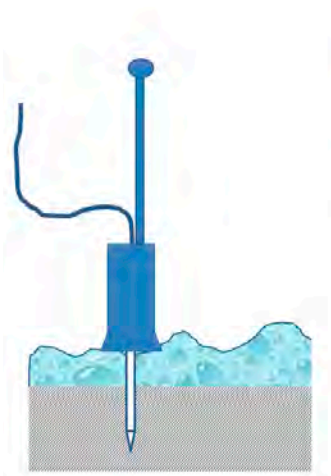
The rods are installed and removed manually. If necessary Allen keys (supplied) can be used to install and remove the rods. (one key is put into the hole of the rod, the second – into the hole in the base of sensor to prevent cranking of the base and damaging of the sensor)

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

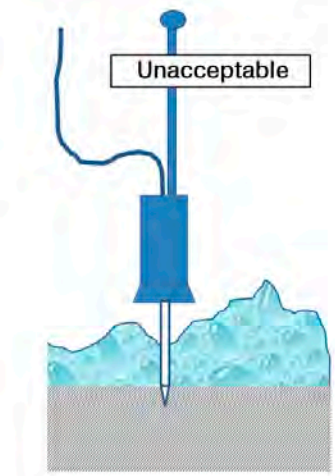


When using the rods, please, make sure that protective cuff fully touches the surface of the ground. This helps to exclude the influence of unwanted noise. (Pic. 3.1).

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. Operation sequence in liquids leak detection mode

Equipment used:

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

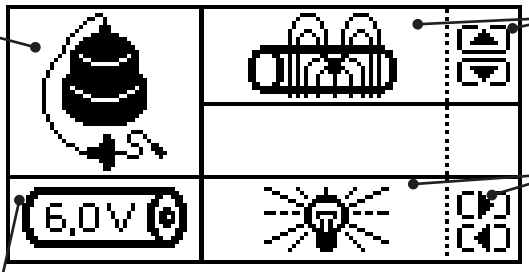
Fig. 4.1

4.1 Connection of sensors and check the receiver operability

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

2. Turn on the Receiver AP-027

3. In the start window on the receiver display:



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

Select the received signal type «leak» by any of ▲/▼buttons

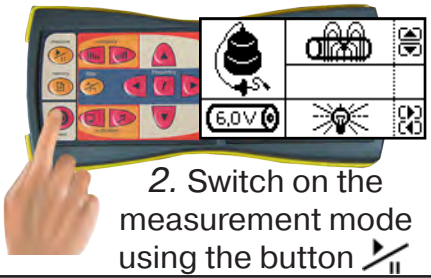
Set the necessary level of receiver display backlighting, using ◄/► buttons

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

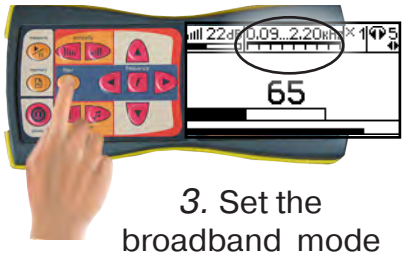
CAUTION!!
During leak detection works one should have a detailed diagram of underground utilities. If there is no diagram, a preliminary pipeline route location should be conducted. The level of valid signal and signal interference depends on the accuracy of acoustic sensor placement over the pipeline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

4.2 Preliminary route inspection

1. Place the acoustic sensor over the supposed pipeline location

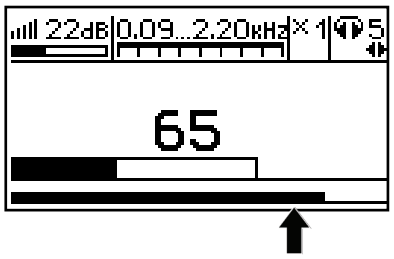


2. Switch on the measurement mode using the button ▶/❚❚



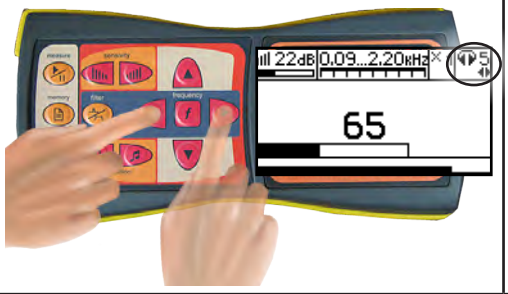
3. Set the broadband mode 0.09...2.20кНz, by pressing the filter button.

4. Set input signal level using sensitivity buttons ▁▃▅ и ▁▃▅▇

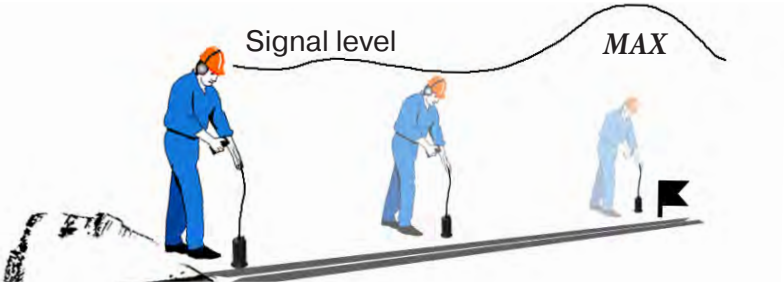


Narrow scale indicator readings should be preferably at 50...90% of maximum value

5. Set the headphones to required volume 🎧5 using buttons ◀/▶



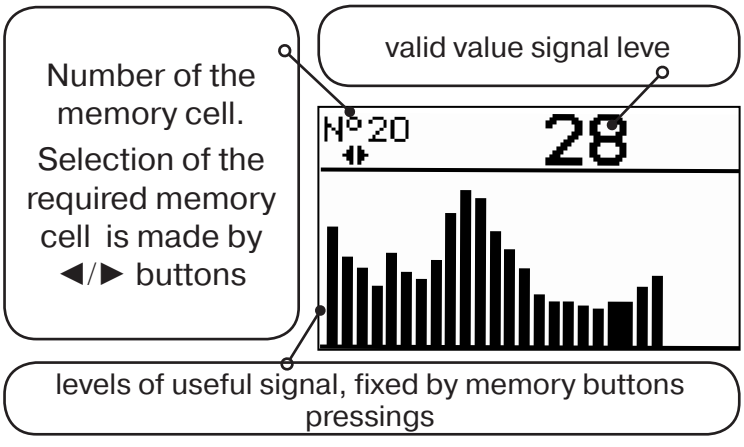
6. As you move along the route, move the acoustic sensor in increments of approx.1 m. and place markers in the spots where the signal level is the highest



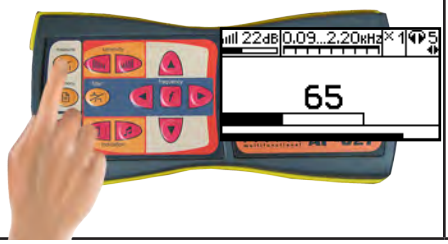
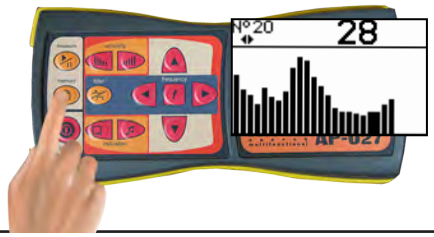
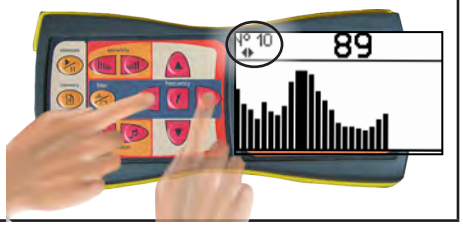
7. We recommend you to record the points where signal level is the highest into the memory of the device by pressing the memory button 💾

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.4.3)***. 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:

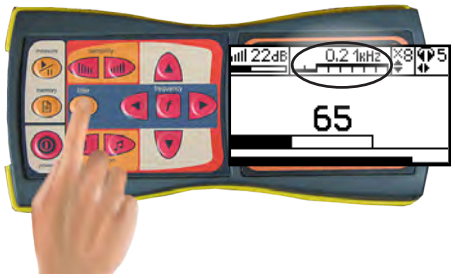
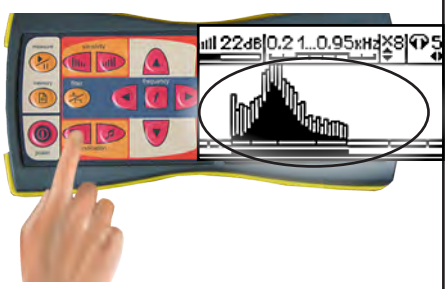
- It is recommended to turn off the measurement mode by pressing the button before moving the sensor, in order to save the receiver settings and eliminate unpleasant noise in the headphones.

- 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.

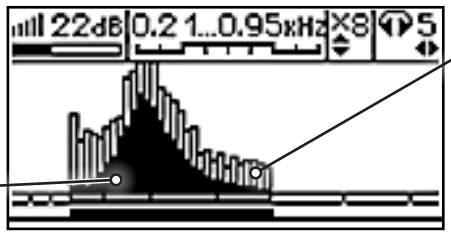
4.3 Conduct fine tuning of receiver filter

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.

1. Place the acoustic sensor over the suspected leak point and commence filter setup.	*2.* On hearing a sound like the sound of fluid leakage turn on the band pass filter by the button	*3.* Switch to Spectrum window by pressing visual indication type button twice
 *Suspected leak point*		

4. Conduct an analysis of the generated spectrum

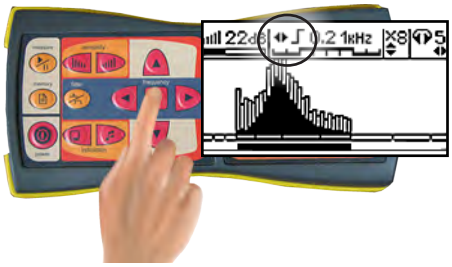
dark segments correspond to the frequency components of valid (continuous) signal



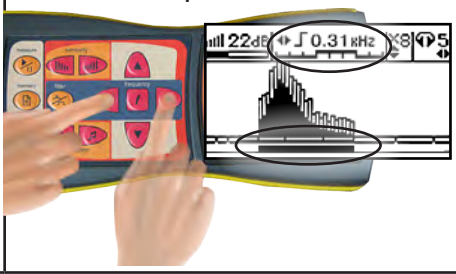
light to the frequency components of accidental interference

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

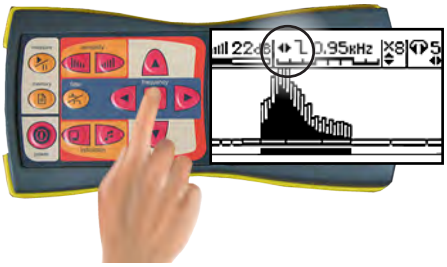
5. Turn on the filter by pressing the frequency button **f**. A symbol of low frequencies suppressing will appear on the display



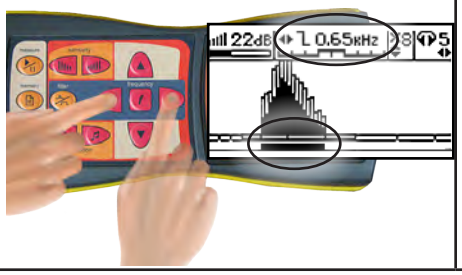
6. Using the buttons ◄/► increase the frequency of the lower «cut-off» 0.2 1kHz as long as it is not detrimental to the intelligibility of the sound in the headphones



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

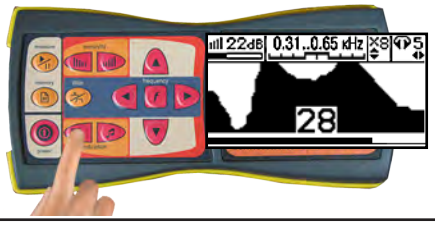


8. Using the buttons ◄/► decrease the frequency of the «cut-off» 0.95kHz as long as it is not detrimental to the intelligibility of the sound in the headphones.



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.4.2).

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

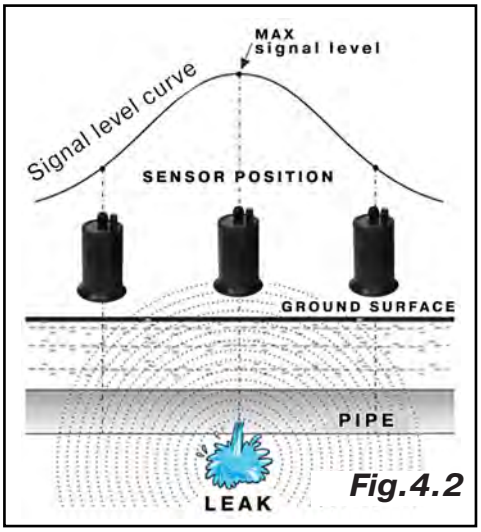


Fig.4.2

5. Operation sequence in passive cable route detection mode

Used equipment:

receiver AP-027 *electromagnetic sensor EMD-247* *headphones*

Fig. 5.1

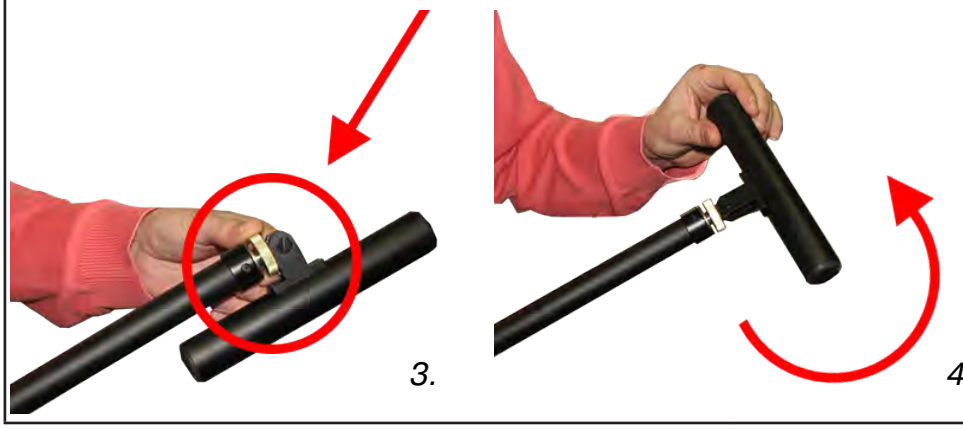
5.1 Connection of sensors and check of the receiver operability

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 (1) and install the electromagnetic sensor (2) 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-027

4. In the start window of the receiver display:

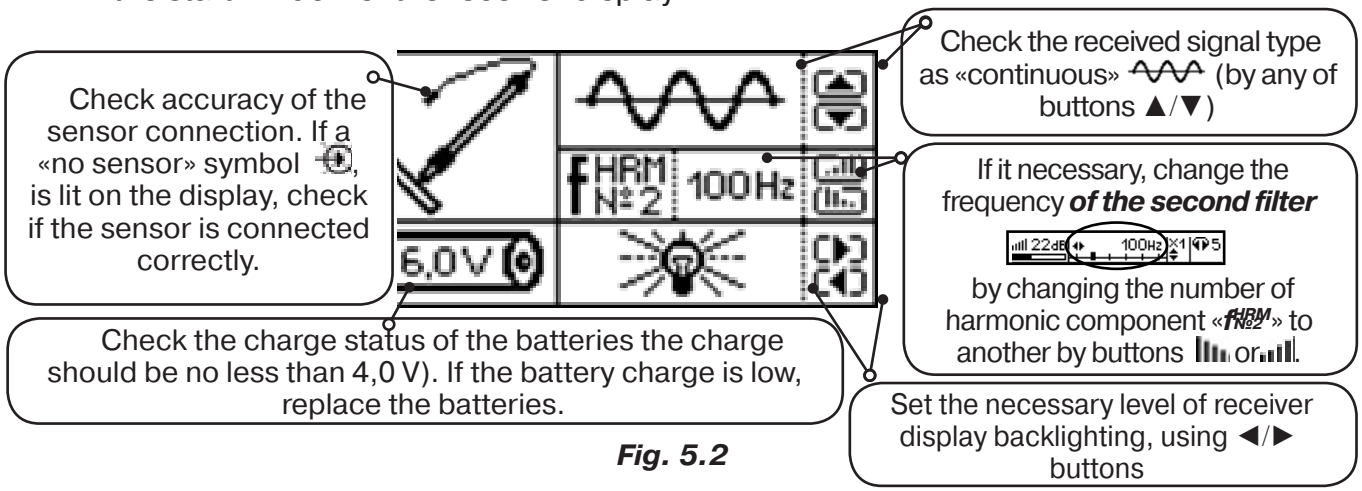
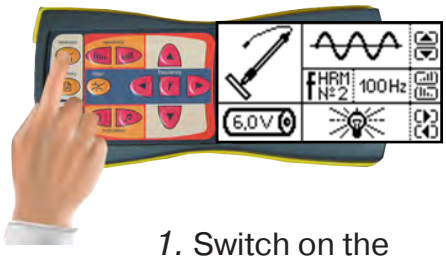


Fig. 5.2

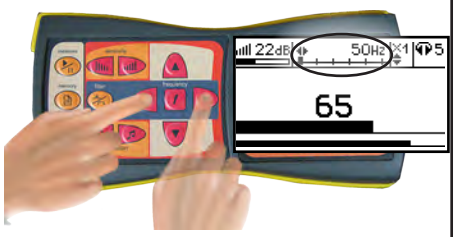
5.2 Conduct receiver setup



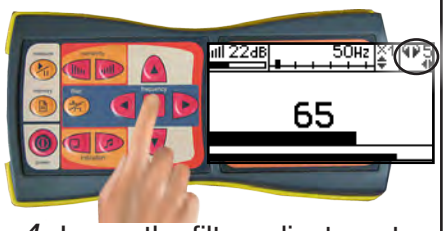
1. Switch on the measurement mode using the button

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

For tracing of energized cables please set frequency 50 Hz.

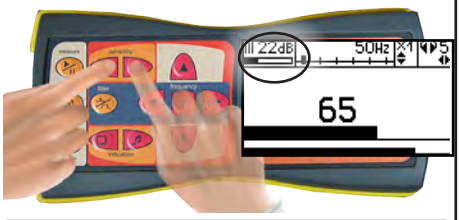


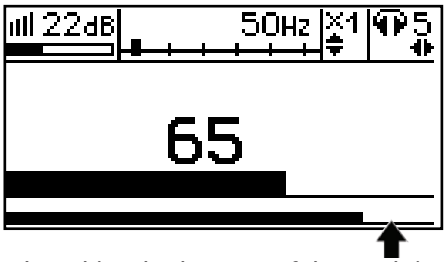
3. Using buttons ◄/►, set the desired frequency in the filtration zone for example, 50 Hz



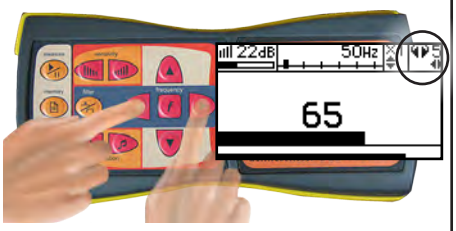
4. Leave the filter adjustment mode by pressing the frequency button *f*. Indicator ◆ will appear in the volume adjustment zone

5. Set input signal level using sensitivity buttons and



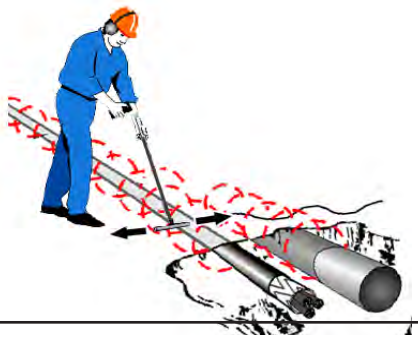


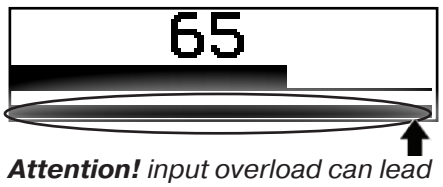
Level (at the bottom of the scale) must be within 50 ... 90% of the maximum



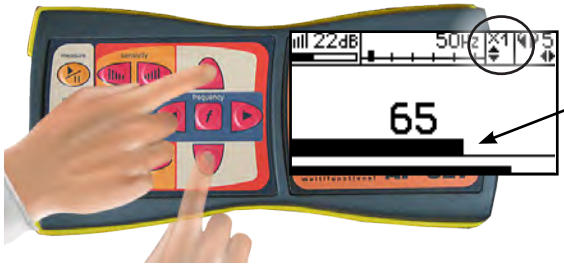
6. Set an acceptable volume level volume using ◄/► buttons

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*



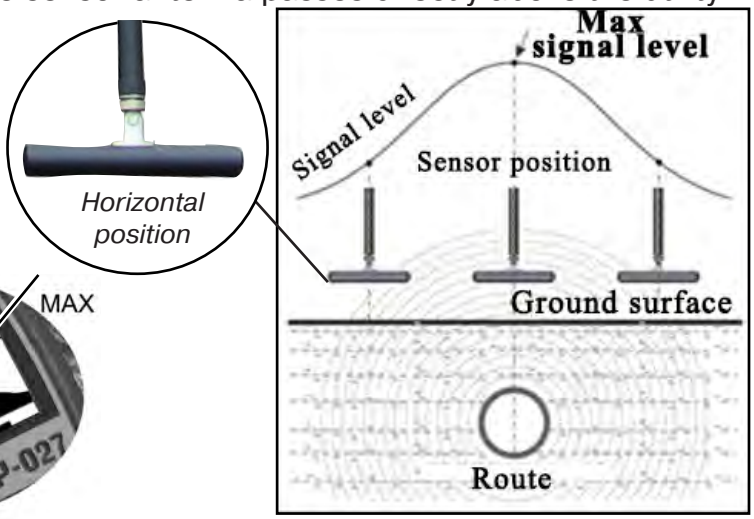
8. Set the required gain factor of filtered signal to «×1/2/4/8», by pressing buttons ▲/▼

9. Commence detection or tracing according to the method set in ***p.4.3****, 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.4.3). 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.

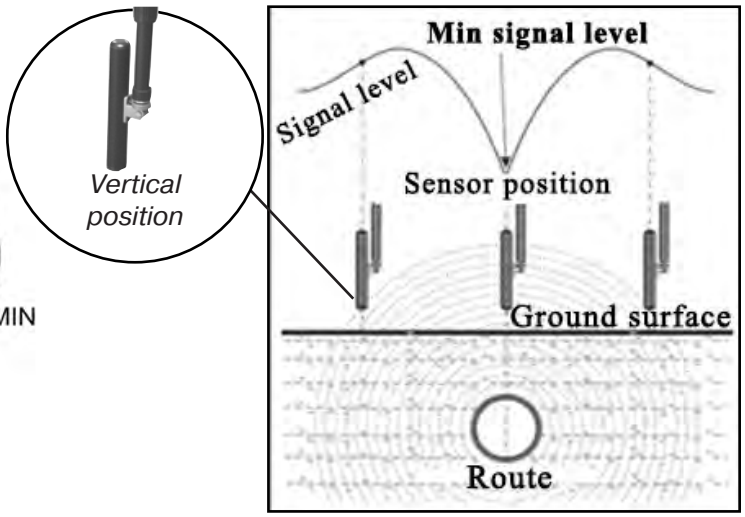


The Maximum method

Fig. 5.3

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. 4.4. 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.



The Minimum method

Fig. 5.4

6. Additional features

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

Equipment used: *receiver AP-027, 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***)

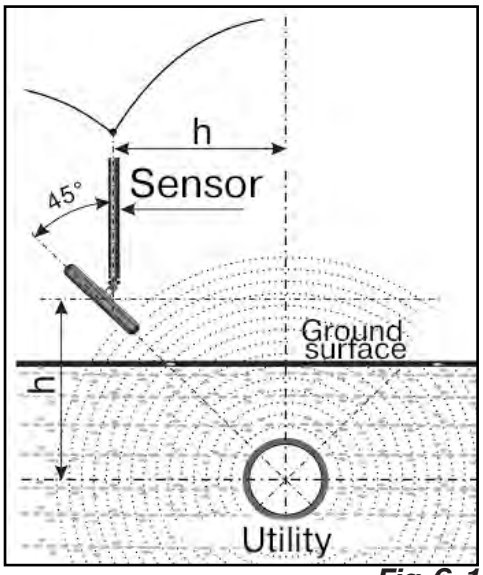


Fig.6.1

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

Equipment used: *receiver AP-027, 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.

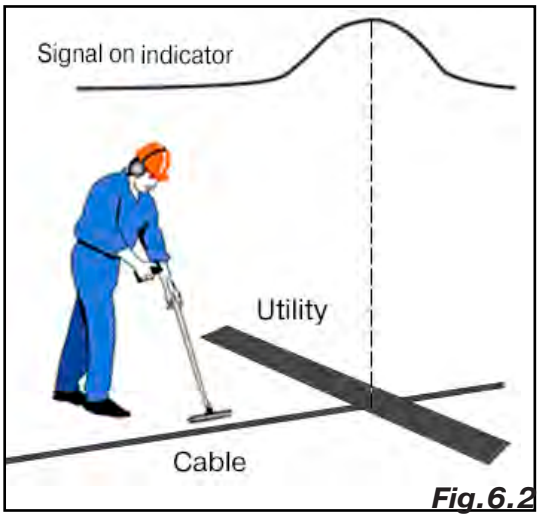


Fig.6.2

7 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-027 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.

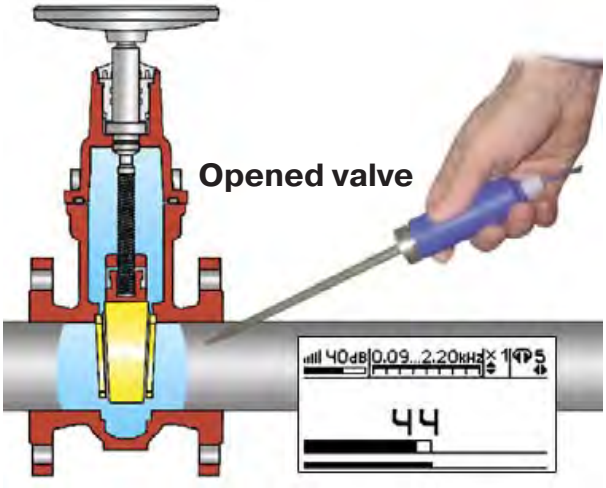
SENSOR HAS TWO MAIN APPLICATIONS:

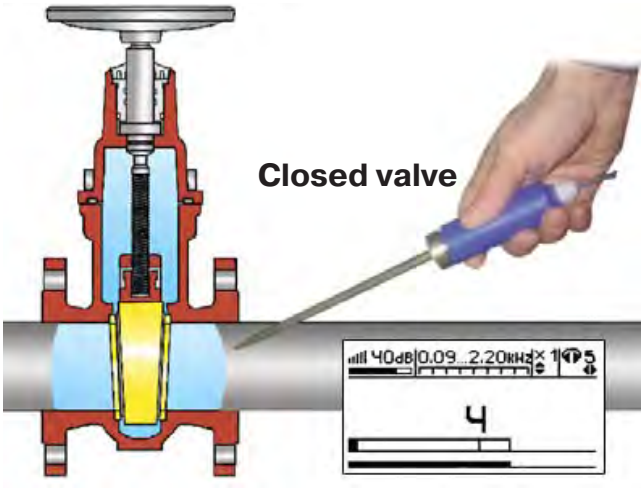
1. Installation of the sensor to a pipe for water leak detection.
2. Usage with extension rod as hand sonde for pipe valving inspection.

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

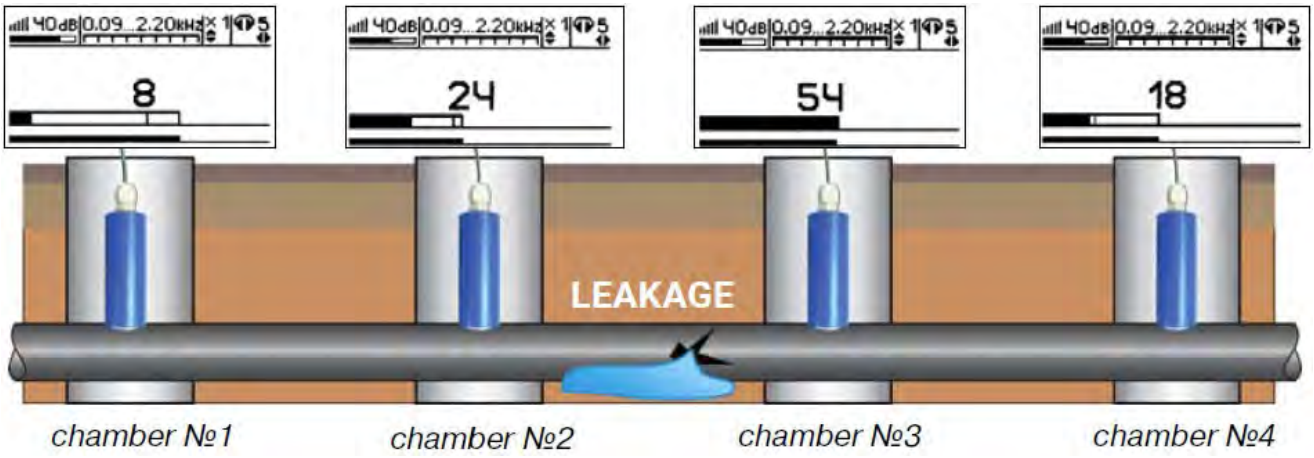
SPHERE OF APPLICATION:

Inspection of isolation valve





Location of water leakage from underground pipeline with ADM Sensor



Appendix A
Receiver AP-027 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 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
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	Headphones natural broadband or filtered signal	
	Headphones-synthesized sound. Frequency modulation	-
	Built-in emitter - synthesized sound. Frequency modulation	-
Supply	Voltage 4…7 V. - alkaline batteries AA type 1,5 V (4 pcs.).	
Time of continuous operation not less than	20 hours	
Automatic shutdown when the device is not active	After 30 minutes of inactivity	
Ambient temperature, C	minus 20C…to +50C	
Ingress protection rating	IP54	
Receiver AP-027 dimensions	220 × 102 × 42 (mm)	
Weight of the electronic unit, kg	0,46 kg	

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).

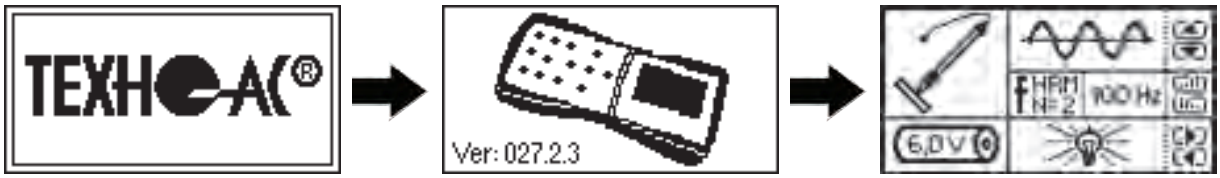
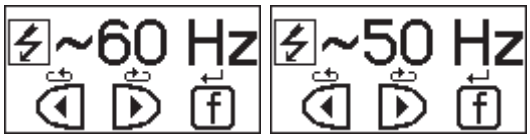


Fig. A.1

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

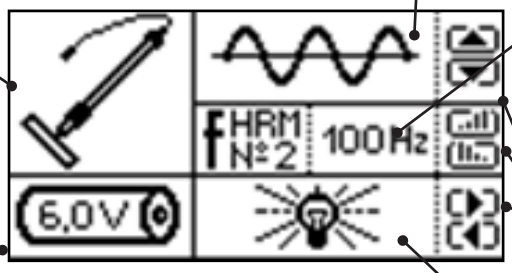
- continuous signal from the power network, cathode protection of trace generator
- pulsed signal of trace generator
- Dual-frequency signal of the trace generator

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.

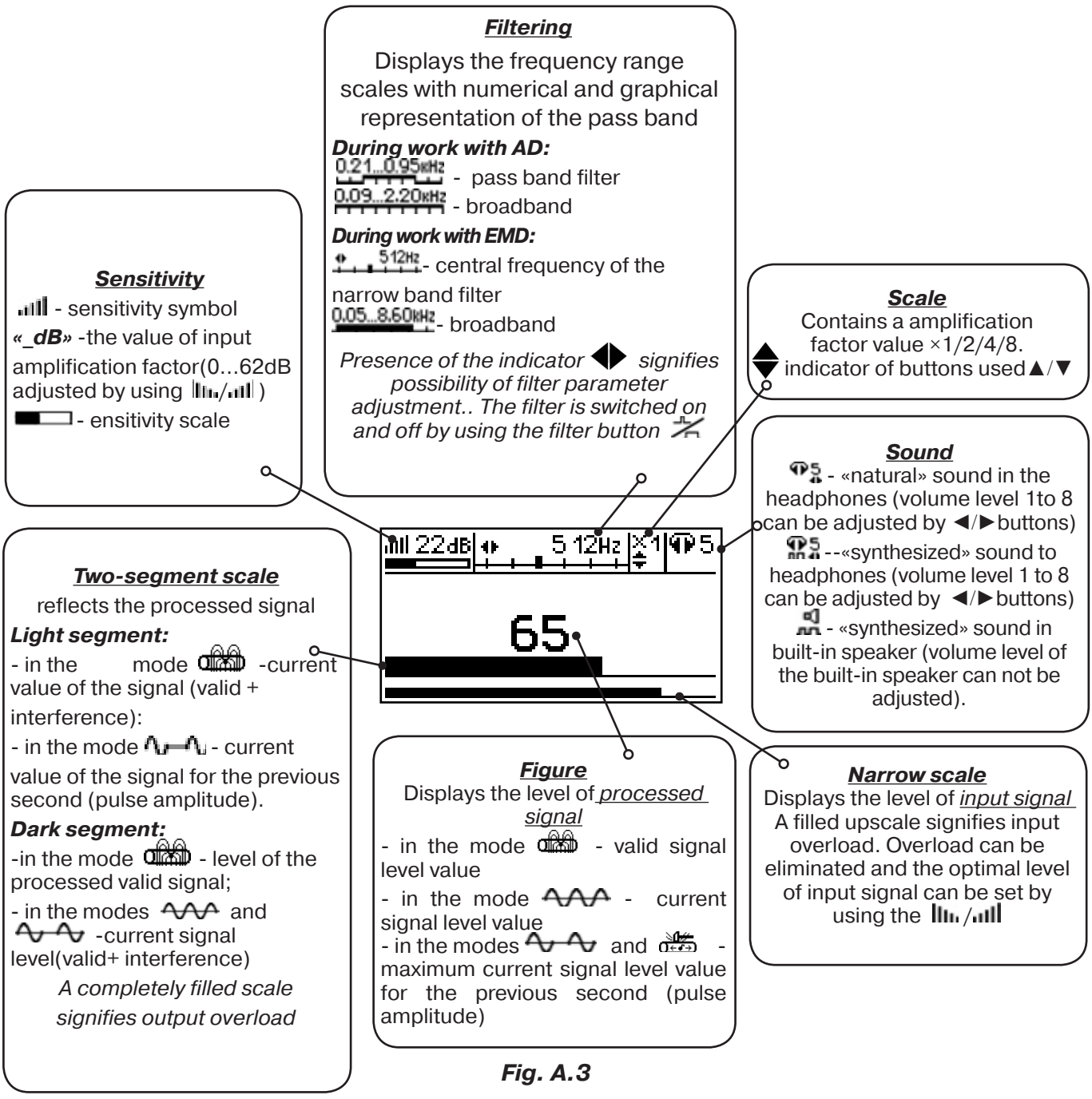


Fig. A.3

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 /

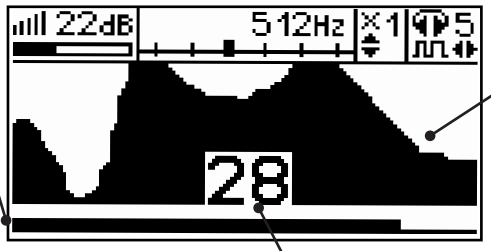


Fig. A.4

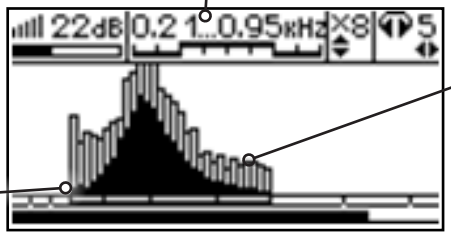
Figure
Displays the level of processed signal
- in the mode valid value of the signal
- in the mode - current value of the signal
- in the mode and maximum current value of the signal for the previous second (pulse amplitude)

5. Acoustic signal spectrum window

It displays the spectrum of the filtered signal.
When working with EMD switching the window can have the following view :

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

Fig. A.5

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

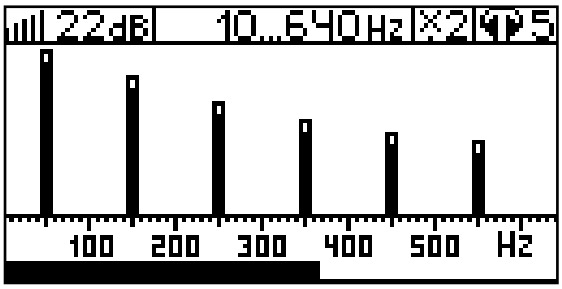


Fig. A.6

The window is available in the electromagnetic mode of broadband 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.

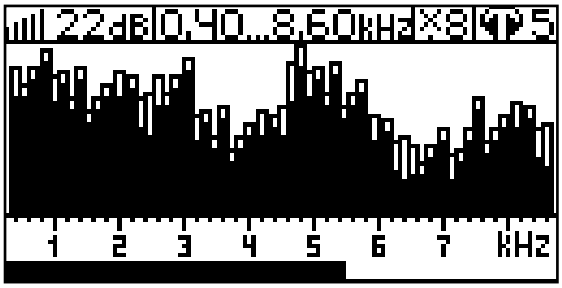


Fig. A.7

7. Broadband electromagnetic spectrum window

The window is available in the electromagnetic mode of broadband and can be called for by pressing the button . The display shows the industrial frequency spectrum of «0.40...8.60 kHz».

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

8. Memory window

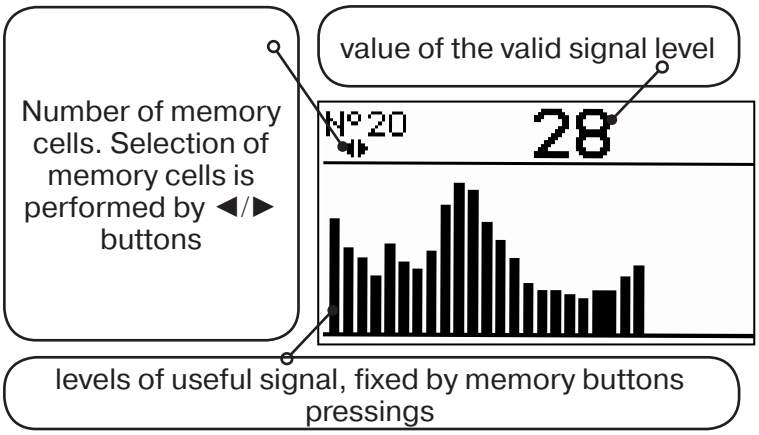


Fig. A.8

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 ◄/► 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.