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CABLE LOCATOR
SUCCESS CBI-116N

TECHNICAL DESCRIPTION
OPERATING INSTRUCTIONS

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Introduction

The Cable locator «Success CBI-116N» is the detective-diagnostic set, intended to survey a terrain before digging or excavation, locating electrical cables and electrically conductive underground utilities, determination of depth of their occurrence.

Benefits of the set

- Possibility to use in conditions of low temperatures,
- Wide Range of frequencies of band-pass filters (50/100/512/1024/8192/32768 Hz),

The application field

- Housing and public utilities
- Electricity networks
- Heating systems
- Water utilities
- Organizations conducting earthworks, etc.

Operating conditions

Ambient air temperature, °C ....from -30 до +50
Relative humidity, % ....up to 85 at t=35 °C
Atmospheric pressure, кPa.....from 84 up to106
Degree of protection against external influences..... IP 54

1 The general description
1.1 Composition of the set

1 - Receiver AP-014

2 -Head phones

3 - The electromagnetic sensor EMD-247

1.2 The principle of operation

The principle of operation of the cable locator is based on phenomenon of electromagnetic induction. The electromagnetic «EMD-247» sensor records variable electromagnetic field which is being produced around a cable under research of it or a pipeline and converts an electromagnetic signal into a power signal. An electrical signal enters the receiver, where it is passing amplification and filtering (the selection signal of the given frequency. The location of the maximum of electromagnetic field intensity measured above the ground, corresponds to the axis of the desired communication. The operator on the signal in the head phones and the LED indicator determines the location of the alignment and possible defects of communication.

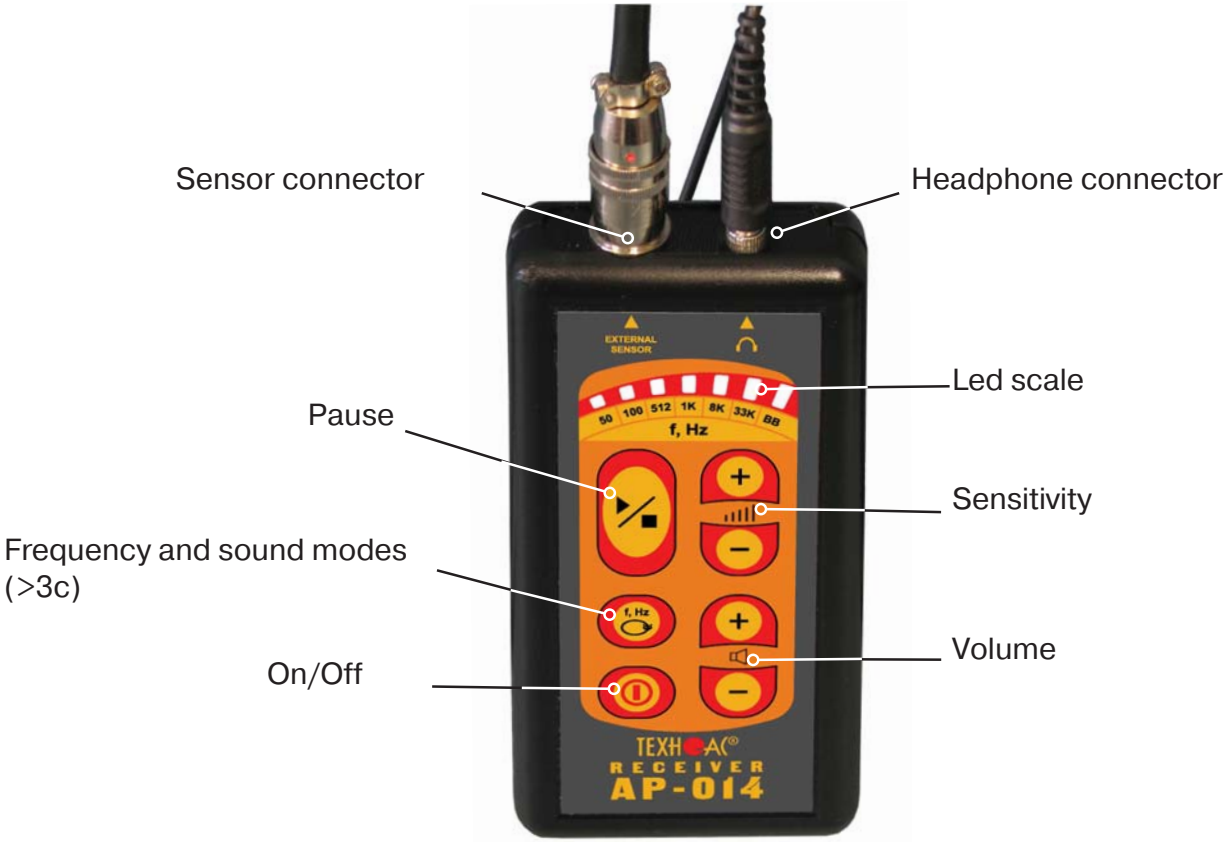
Specification AP-014

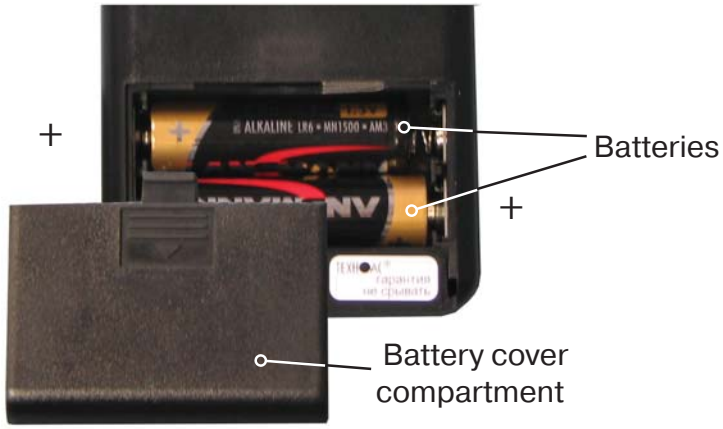
AP-014 receiver	
Frequencies of the receiver's filter	Main filter frequency 50 Hz /100 Hz /512 Hz / 1024 Hz 8192 Hz / 32768 Hz.
«Broadband», (frequency range)	0.05...8.2 KHz
Gain factor	100 dB
Visual indication	LED scale – 7 values.
Gain factor	Headphones - natural, filtered and synthesized signal. Built-in emitter - synthesized signal.
Visual indication	Voltage 1.8 to 4V. - alkaline batteries AA type 1.5 V (2 pcs.).
Time of continuous operation not less than	10 hours
Operation temperature	-30^{0}C...+50^{0}C
Location precision , m	± 0,3
Ingress protection rating	IP54
AP-014 receiver dimensions	145x70x24 mm
Weight of the electronic unit	0,15 kg
Electromagnetic sensor EMD-247	
Type of transducer	Resonant ferrite magnetic antenna
The center frequencies of filter	50 Hz /100 Hz / 512 Hz / 1024 Hz / 8192 Hz / 33 kHz
Type power	From the receiver
Switching filters	Forced (by a receiver)

2. Receiver AP-014

Reciever «AP-014» is made in the dimensions of the cell phone, has a built-in micro processor

2.1 General view and buttons mapping.





2.2 Receiver control and indication modes

The receiver can work with acoustics or electromagnetism sensors. The type of the sensor is determined automatically. For an electromagnet sensor there are several reception frequencies.

The light emitting diode scale executes indication of several functions:

a) this is an indication of a power battery condition,

b) a frequency of the received signal is switched in a circle,

c) a sensitivity is more-less,

d) a volume is more-less.

To understand where you are, one needs to know the following: at startup the scale is checked, i.e. consistently included 4 cycles of running lights, then a slight pause, then highlighted the level of battery power state for 5 seconds, then the signal strength is displayed.

- **Activation/deactivation of the receiver.** The receiver turns on when one-time pressing the *«Activation/deactivation of the power»* button. When you turn on, the device consistently:

1. Enable animation plays («running lights» on the LED display);
2. About 4 seconds indicates battery charge (if all the LEDs are lit, than the charge is maximum, if the first led light blinks, the device is turned off or the batteries are low):

Weak battery charge

Maximum battery charge

3. Sound plays when the instrument turns on;
4. If the «EMD-247» sensor is attached for around 2 seconds, one light emitting diode of the light emitting indicator diodes displays the operating filter frequency (for example, 1024 Hz – «1k»).

5. It is turning into the operating mode, the LED display is indicated by the input signal level at a selected frequency:

Low input level

High input level

and a synthesized audio signal is given on headphones.

Turning off the receiver is performing by briefly pressing the button «Power On / Off».

- The choice of the operating frequency. The LED indicators of the receiver on the front panel have inscriptions, corresponding to certain frequencies of the receiver:«50» 50 Hz, «100»: 100 Hz, «512»: 512 Hz, «1k» – 1024 Hz, «8k» – 8192 Hz, «33k» - –32768 Hz, «WB» «Wide band» (0,05…8,60 kHz). Operating frequency is selected by consistent briefly pressing the button «Switching frequencies and operating modes» and is displayed on the display corresponding flashing led for two seconds.

-Adjustment of the **receiver sensitivity and volume** levels is being made by the corresponding buttons «more» and «less».

During adjustment and for 2 seconds afterwards the sensitivity level is displayed on the scale by the blinking light emitting diode.

Change of the level is occurring step by step. When you change the level on five steps, there is switching of the indication to the adjacent LED (at increasing increasing on the first, at reducing on the left.)

Change of the sensitivity level can be made by a short press of the «more» and «less» buttons, as well as by their retention for achievement of the required level.

- Change of the way of audio indication. During long retention of the button «*Frequency switch*» the device switches the mode of audio indication. Three audio indication modes are implemented in the receiver:

-The **sound generation mode.** The sound being fed to headphones is generated by the device and modulates at frequency depending on the selected filtering frequency signal level. This mode is selected by default during activation of the device.

- The **natural sound mode**. The sound is fed to headphones through the filter on the chosen one frequency in straightness off the sensor.

- The **mode of the built-in speaker.** The sound signal is generated by the device and modulates at frequency, depending on the selected filtration frequency signal level, and is fed into the built-in speaker. In this mode a natural sound feds to headphones as in the «Natural sound mode».

- **Increase and reduction of headphones volume level.** The volume in headphones level is changing with the corresponding «Change of volume" on headphones buttons. The volume level is displayed on the light emitting diode indicator with help of the blinking light emitting diode.

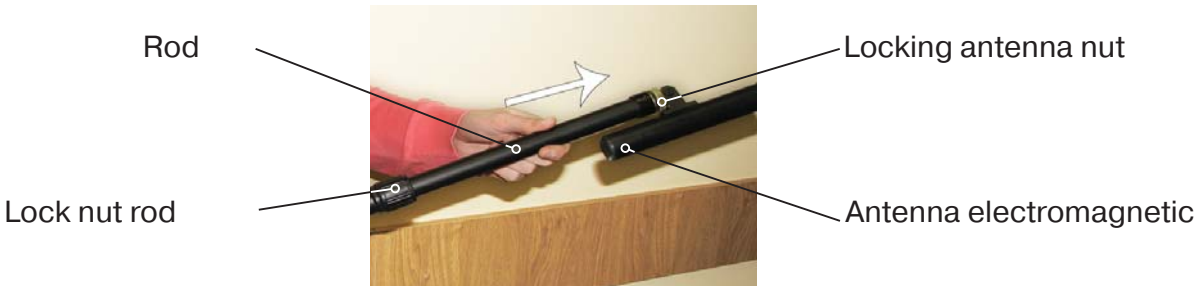
Increase and reduction of headphones volume level. The volume in headphones level is changing with the corresponding «Change of volume" on headphones buttons. The volume level is displayed on the light emitting diode indicator with help of the blinking light emitting diode.

Change of the volume in headphones level does not affect the input level.

- **The mode «Pause»**. When pressing the «Pause» button, any audio indication stops and in pressing the light emitting diode indicator displays input level measured at the moment of the «Pause» button pressing. The exit from the mode is being carried by a repeat press of the button.

3. Electromagnetic sensor EMD-247

The set uses electromagnetic sensors «EMD-247» on the basis of resonance ferrite magnetic antenna. Resonance frequencies of the antenna: 50 Hz, 100 Hz, 512 Hz, 1024 Hz , 8192 Hz and 32768 kHz. Switching of resonance is forced (controlled by the receiver).



The EMD Rod for easy transportation is sliding. Antenna of the electricitymagnetic sensor can take three positions relative to the boom: at 0^0, 45^0, 90^0 degrees.

To bring the electromagnetic sensor from the vehicle into working position, it's necessary: to loosen the lock nut rod, to slide the rod to the desired length and to fix the locking nut.

To change the electromagnetic sensor position relative to the rod, it's necessary to loosen the fixing nut, mount the antenna to the desired position, to fix the position by the locking nut

4. Search the route in passive mode

The source of the electromagnetic field in this case are frequency currents 50 Hz in cables under mains voltage and 100 Hz in pipelines with cathodic protection mode, the route search is performed without using the trace generator. Equipment used: Receiver «AP-014», Electromagnetic sensor «EMD-247», headphones.

Preparing Receiver AP-014 for operation

1. Insert two batteries into the battery compartment of the receiver «AP-014», observing polarity.
2. Connect the electromagnetic sensor, headphones to the corresponding connectors of the receiver.
3. Turn on the power of the receiver.

When switching on, the device revert to the settings used in previous work - the level of input gain, volume levels and frequency filtering.

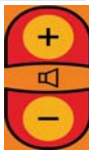
4. Select the work «passive» frequency (50 Hz for tracing cable under voltage or 100 Hz for the tracing of the pipeline with cathodic protection.

5. Place the electromagnetic sensor «EMD-247» exactly on the track and so, that it will be at the point of maximum signal strength. For this you need to have the sensor perpendicular to the desired track at that distance from it, where you want to search;

6. Press the «Change receiver sensitivity» buttons to adjust the input level, so the level filled led scale as much as possible, but to the last led isn't flashing.

If while working full scale led filled, and the last led is flashing (there is an overload of the input), the receiver sensitivity should be reduced.

If the maximum of the sensitivity scale isn't filled, and the first led flashes, it means that the device cannot recognize the signal at the selected frequency, because its level is too low or signal is missing.

7. Establish a comfortable level of headphone volume with «Headphone volume Changes» buttons. 

8. *Move along the path by moving the electromagnet sensor across tracks in one or the other way to determine the point with the strongest signal. Points with the utmost level of the signal correspond to the position of the communication axis.*

4.1 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 sensor 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.

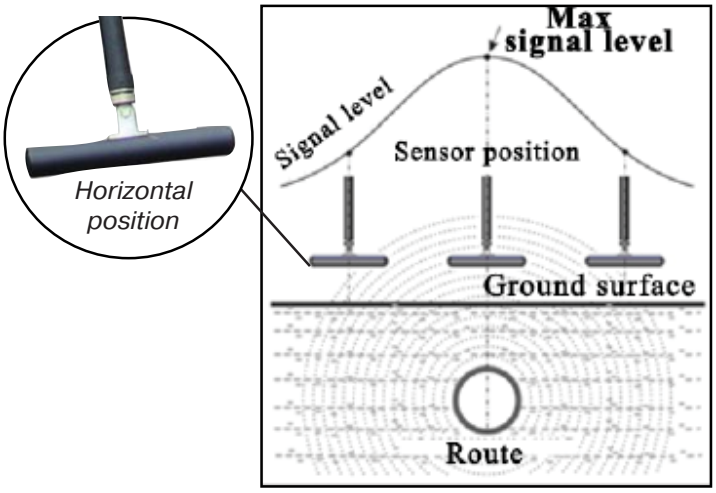


Fig. 4.3

2. The Minimum method

When the EMD sensor 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.

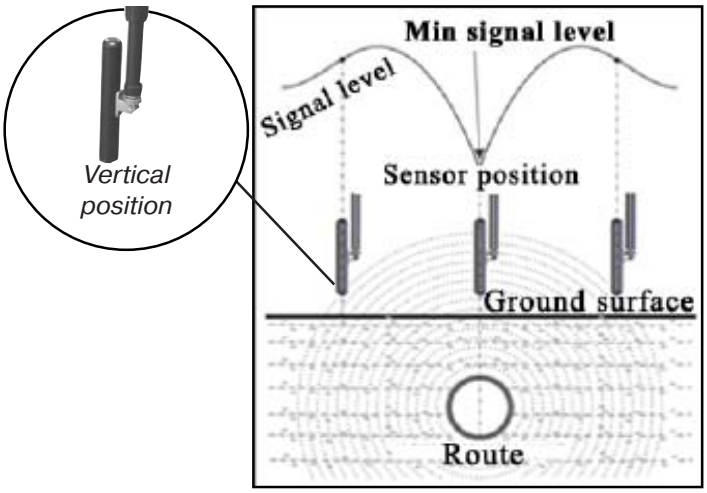


Fig. 4.4

5. Additional features

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

Equipment used: *receiver AP-014, 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. 5.1***)

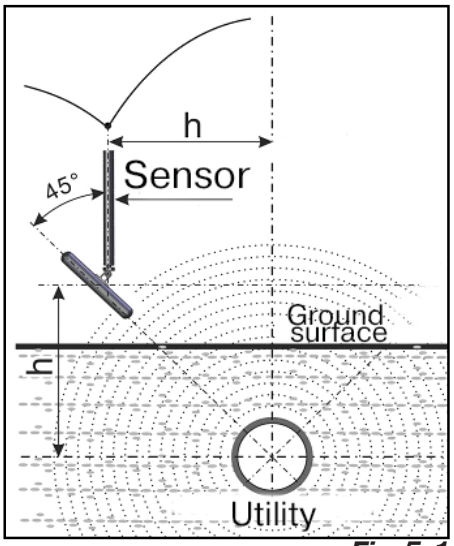


Fig.5.1

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

Equipment used: *receiver AP-014, 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 sensor over the pipeline, parallel to the pipeline route (signal level displayed on the receiver screen will be close to zero)(***fig. 5.2***). 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.

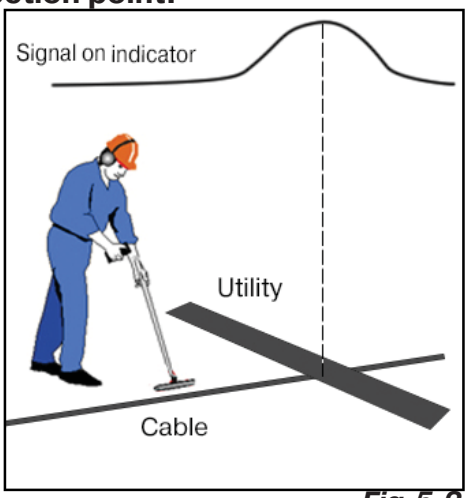


Fig.5.2