

NON-LINEAR
JUNCTION DETECTOR
«LORNET-36»

USER MANUAL

CERTIFICATE

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1.Introduction

MW non-linear junction detector “LORNET-36” (further NLJD) is used for search and location of electronic devices both in active and switch-off state.

The detector operation is based on the property of semiconductor components to generate a response at the 2d and 3d harmonics when radiated by a microwave probing signal.

Semiconductor components of artificial origin will have a higher level second harmonic while semiconductor components of natural origin (e.g. oxide films) will have a higher level third harmonic respectively.

An NLJD analyzes the 2d and 3d harmonics response of the radiated objects, which enables a quick and reliable identification of electronic devices and natural oxide semiconductors.

The NLJD “LORNET-36” automatically finds the best receiving frequency channel free of noise and distortion providing flawless operation even in the complicated electromagnetic environment. Digital processing of a demodulated signal used gives maximum sensitivity.

A high gain parabolic antenna (20 dB gain at 3600 MHz) used in the device increases detection range of non-linear elements and provides their exact localization in space. For operator's convenience the detector is equipped with a laser pinpointing to indicate the place to which the maximum power of the probing signal is directed. There are two types of radiated signals: -pulse modulated carrier with a duty cycle 160 (Pulse).

-pulse modulated carrier with a duty cycle 20 (CW). The CW mode is used to tap the detected signal in the earphones to find active analog radio microphones and to use the effect of acoustic feedback to facilitate the search process. The output power automatic control mode significantly simplifies operator's work. "LORNET-36" simultaneously displays the 2d and 3d harmonics levels at its LED panel. Besides, the 2d and 3d harmonics levels can be estimated in turn aurally by the click repetition rate reproduced through a built-in loudspeaker or wireless earphones.

2. Specifications

2.1. Radiated signal types

- pulse modulated carrier with a duty cycle of 160 (pulse).
- pulse modulated carrier with a duty cycle of 20 (CW).

2.2. Carrier frequency step 13 MHz within a tuning range of (3581.5 ... 3607.5) MHz. Automatic frequency selection. Possibility of radiation at the carrier frequency with a minimum noise level in the 2d harmonic receiver path.

2.3. Maximum radiated power in 160 pulse mode ≥ 18 W

2.4. Maximum radiated power in 20 (CW) duty cycle mode ≥ 12 W

2.5. Manual or automatic control of the radiated power level. Power control range of 22 dB down from the maximum output power value with 11 level gradations

2.6. Transmitting antenna gain at 3600 MHz ≥ 20 dB with a directional pattern width at -3 dB level $\leq 16^\circ$.

2.7. Sensitivity of radio receivers better than -110 dBm (the first LED lights up).

2.8. Receivers tuning frequencies equal to the transmitter double and triple frequencies -

7163...7215 MHz and 10744.5...10822.5 MHz respectively.

2.9. Receiving path dynamic range ≥ 30 dB. 20 dB range of LED and 10 dB gain control using the ATT button.

2.10. Time of continuous operation with a lithium-ion battery at the maximum radiated power:

- ≥ 3 hours in the pulse duty cycle mode;
- ≥ 2 hours in the CW duty cycle mode.

2.11. Device weight ≤ 1.6 kg.

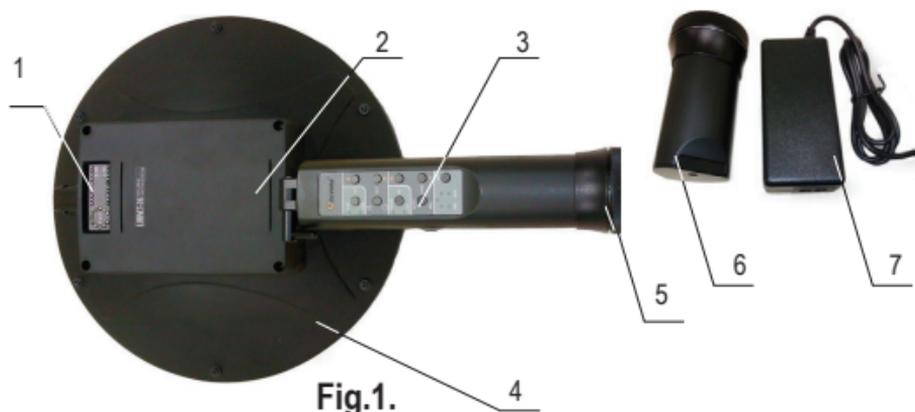
2.12. Operating conditions:

- ambient temperature 5...40°C.
- pressure ≥ 450 mm of mercury

3. Delivery set, design and accessories

3.1. The device includes units and accessories stated in the Table below:

Description	Q-ty
Receiver-transmitter unit with control unit and built-in battery container	1
Changeable Li-Ion batteries	2
Container for battery charging	1
Charger for receiver-transmitter unit (CH1)	1
Wireless accessories including: receiving device, earphones and charger (CH2)	1
Technical Description & User manual, Certificate (in one piece)	1
Package	1



- The appearance of the device and its charger are shown in Fig. 1, where:

1. LED indicator;
2. Transceiver antenna unit combined with the indicator ;
3. Control unit with an accumulator;
4. Parabolic antenna.
5. Screwed up cover of battery section
- 6.Container for battery charging;
- 7.Charger for receiver-transmitter unit (CH1);

Fig. 2 shows a receiver for wireless phones, its charger (CH2) and head phones.



4. Purpose of the Detector Basic Units

4.1. The transceiver antenna with built-in LED indicators is used for:

- Analysis of distortion and interference in the instrument receiving path, which is made each time the detector transmitter is switched on. Therefore, if an interfering signal appears during operation (in a complicated electromagnetic environment) it is necessary to turn the detector transmitter off and on from time to time thus selecting an optimal frequency automatically, which will provide the best sensitivity as well as detection range of semiconductor components.
- Generation of microwave probing signal, reception and digital processing of the 2nd and the 3rd frequency harmonics. Simultaneous display of the 2nd and the 3rd harmonics levels gives the opportunity to distinguish with a high reliability between signals of artificial semiconductors integrated in electronic devices and natural corrosive ones which may appear at oxidized junction points of various metals.

- Demodulation of the 2nd and 3rd harmonics response, their amplification to the level required for tapping both by earphones and a built-in loudspeaker. The amplification is adjustable within a 20 dB range. The operator can listen to demodulated signals of the 2nd and 3rd harmonics in turn.
- Indication of the transmitter power level (1) as well as of the 2nd (2) and 3rd (3) harmonics levels (Fig. 3).

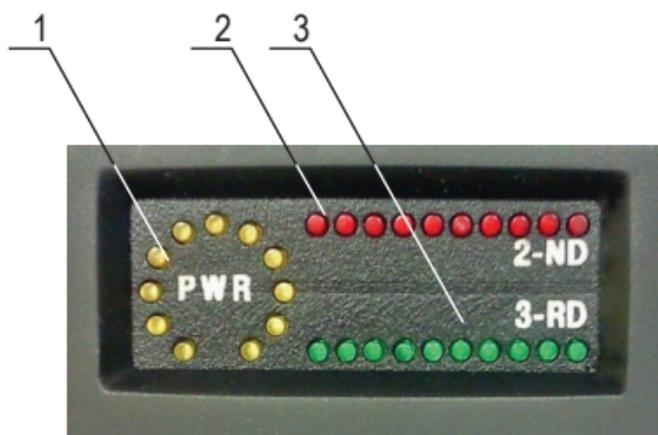


Fig. 3.

- 4.2.** Hinge joint of the transceiver antenna unit with a knob (see Fig.4) is designed to transform the unit into transportation position. Besides, it helps the operator to fix the antenna in a position convenient for search.
- Fig. 4: 1- Fixing device; 2- Hinge joint.



Fig. 4.

- 4.3.** The control panel is used to control operation of the detector. It consists of the case combined with a battery and fixed on the arm. The control board, buttons for operation modes control and display LEDs are placed in the package. The control buttons are divided into two groups by their function: «AUDIO» placed in the upper half of the panel and «POWER RF» in the lower half. The control panel is shown in Fig.5

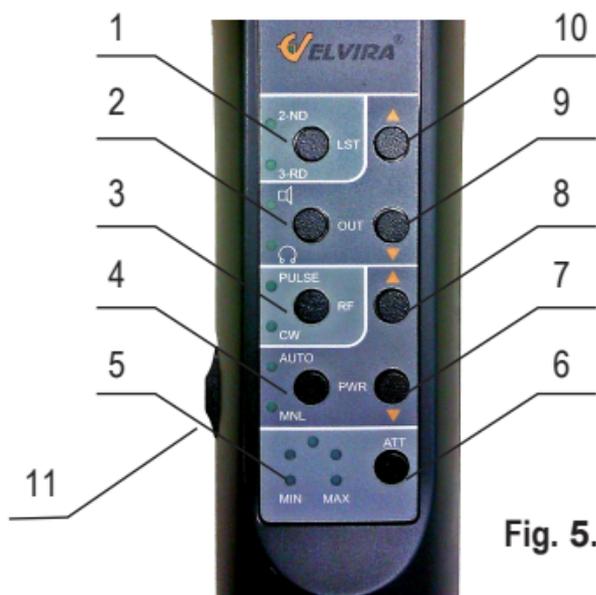


Fig. 5.

The following buttons refer to the «AUDIO» group:
 1 - LEDs and LSTN button for switching of acoustic indication to the output of the 2nd or 3rd harmonics.

2 - LEDs and OUT button for switching acoustic output to earphones or a built-in loudspeaker.

3 - LEDs and RF button for switching between transmitter operation modes – PULSE or CW

The following buttons refer to the «POWER RF» group:

4 - LEDs and PWR button for switching on/off the probing signal transmitter. When the NLJD is switched on the automatic mode of output power control (AUTO) is set by

default. To switch over to the manual mode of output power control (MNL) press one of the LEVEL buttons when a transmitter is turned on. To return to the automatic mode turn the transmitter off and then turn it on.

5, 6 - LED and ATT button for control sensitivity of the transmitters of the 2nd and 3rd harmonics. Lighting of each LED indicates decrease of the transmitters sensitivity for 4 dB. Hence, when ATT button is used the maximum sensitivity decrease can be 20 dB.

7, 8 - LEVEL buttons for control of radiated signal power in MNL mode. It is possible to set the required power level by pressing LEVEL button in AUTO mode before the probing signal transmitter is turned on.

9,10 - Volume buttons for volume control

11 - Slide-type power switch

Functions of control panel indicators: continuous light of any indicator corresponds to “on” position, absence of light – to “off” position. Simultaneous flickering of all indicators on the panel shows that the battery is discharged and needs to be replaced.

4.4. On the side surface of the control panel

a slide-type power switch is placed. A slide position corresponding to «ON» is marked by a contrast point.

4.5. Battery charging is to be made with a battery charger supplied with the instrument only. Using other chargers is not allowed. For charging it is necessary to connect a pin connector to the end surface of the detector arm.

A red LED on the charger case is lighting while charging. When a battery is completely charged, the red LED goes out, and a green LED lights up. Charging time of a fully discharged battery does not exceed 6 hours.

4.6. Wireless telephones consist of a receiving device and earphones. Appearance of the receiving device and positions of control units are shown in Fig.6

Using a power adapter supplied with the instrument make sure with a help of the charge indicator that the battery is completely charged. Using of other power adapters is forbidden.

Connect head phones to the corresponding socket of the receiving device.

Turn the receiving device on by a slide-type switch

(control by the turn-on indicator).

Using volume control set a comfortable volume level.

If the receiving device is turned on when the detector is off, then there is only a noise signal in the head phones at higher volume. After turning on the acoustic indicator signals corresponding to the operating mode of the detector appear in the earphones.

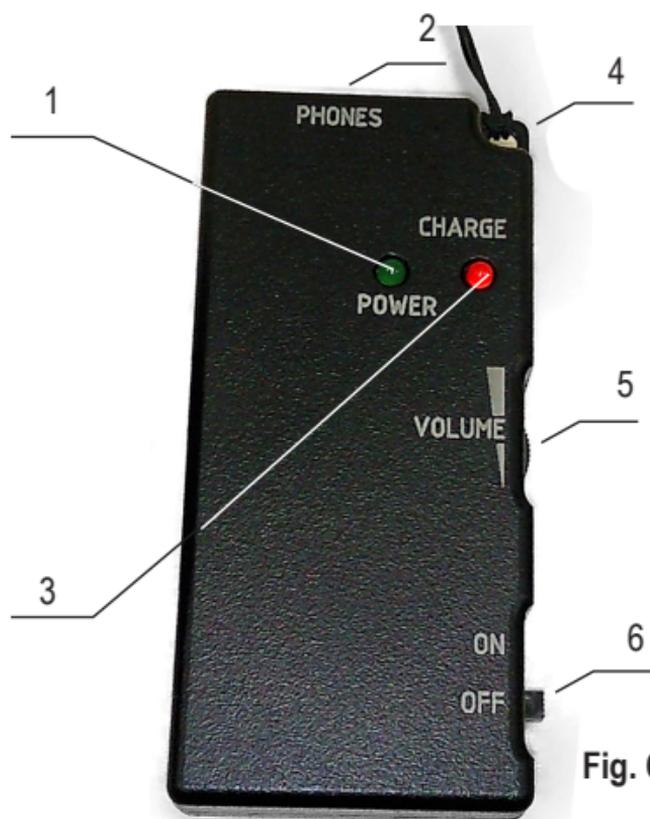


Fig. 6.

- 1- "ON" indicator (lights at turn-on)
- 2 - Socket for phones connection
- 3 - Charge indicator (is lighting during charging)
- 4 - Socket for power adaptor
- 5 - Volume control
- 6 - Slide-type switch

5. Safety Measures

- 5.1.** By requirements of electric safety the detector corresponds to protection class 1 (according to the Russian standard).
- 5.2.** The instrument is to be operated only by persons who have been duly instructed for safety measures while working with electric and measuring devices with open RF energy radiators.
- 5.3.** The microwave radiation power density level from the detector transmitter is shown in the Table below.

Measurements	Mode	P aver, μW/cm ²	P max, μW/cm ²
In the direction of maximum radiation	Duty cycle 0,6%	3.6	9.36
	Duty cycle 5%	44.1	77.8
In the rear semi-sphere; 0.3m.	Duty cycle 0,6%	0.19	1.7
	Duty cycle 5%	1.88	7.7

5.4. It is not recommended to direct the antenna towards people. And it is not recommended for an operator to stay in the direction of the maximum radiation.

6. Operation Order.

6.1. Remove the detector from the package. If necessary charge a battery. After the device transportation at temperatures below 0°C it is necessary to keep the device in the switch-off state at room temperature for at least 30 minutes.

6.2. Turn «LORNET-36» on by the power switch placed on the arm. The 2nd and 3rd indicators on the control panel will light up, indicating

that the detector has been powered on. One yellow LED should be lighting on the antenna unit (a circle scale of the probing signal power indicator). Its initial position corresponds to the maximum power of the probing signal. The probing signal transmitter is off (it is turned on after pressing PWR button only). The 2nd and 3rd harmonics indicators should not light (flashing of the first LEDs of the 2nd and 3rd scales is permitted).

- 6.3.** Turn the probing signal transmitter on pressing PWR button. This will switch on the transmitter pulse mode and the automatic mode of signal power control. The radiated signal power will change depending on the signal level at the 2nd harmonic receiver input. In the given mode the sound information of the 2nd harmonic response is applied to the loudspeaker or head phones. When switching on mode 3-RD by pressing LST on the control unit, the output power of the transmitter is adjusted automatically depending on the signal level at the 3rd harmonic receiver input. Sound information of the 3rd harmonic response is applied to the loudspeaker or head phones.

To switch over to the manual mode of the probing signal power control (MNL indicator lights up) press one of LEVEL buttons after the probing signal transmitter has been turned on. Using PWR button turn the probing signal transmitter off and then turn it on for a reverse switch over. If it is necessary to tap the third harmonic response turn on mode 3-RD using LST button on the control panel. During operation in premises with a lot of electronic devices, you will normally have to decrease the level of the probing signal by 2-4 points counterclockwise from the initial position. The optimum level of the probing signal is determined experimentally.

- 6.4.** Simultaneous flashing of all indicators on the control panel indicates that the battery is discharged. In this case the power should be turned off and the battery - replaced.
- 6.5.** If a response signal is to be tapped by phones, switch over acoustic indication to the head phones mode pressing the corresponding button on the control panel and turning the wireless phones on.

Attention:

- 1) Do not direct the antenna towards the operator and people nearby.
- 2) While operating the device constantly monitor batteries state replacing them in-time (by the indicators signal). The batteries must be kept fully charged.
- 3) Charging should be done with a charger supplied with the instrument only. Use of undue chargers is strictly forbidden.

7. Search Recommendation

- 7.1. If possible remove electronic devices from the room examined. If it is impossible, the examination should be done at a decreased radiated power.
- 7.2. Set the maximum radiated power level and one of the operation modes of the receiver.
- 7.3. Using laser pointer direct the antenna to the surface examined. Slowly moving the laser spot along the surface under examination and changing the orientation of antenna, analyze changes in the signal received at the 2nd and 3rd harmonics visually by the indicator (aurally the click repetition rate should be maximum).

- 7.4. The received 2nd and 3rd harmonics levels are analyzed by the number of LEDs lighting on the corresponding indicator scale.
- 7.5. For a more accurate location as well as for protection of receiving devices from interference it is possible to decrease the receivers sensitivity using ATT button.
- 7.6. When an artificial p-n transition is found you will normally see a stable lighting of the 2nd harmonic indicator LEDs. While rapping at the suspected place of a p-n transition, readings of LEDs do not change.
- 7.7. When a natural p-n transition is found, you will observe a stable lighting of the 3rd harmonic indicator LEDs. While rapping at the examined surface intensively, readings of indicators by the 3rd harmonic will change, as a rule.

The search technique offered does not reflect all nuances which may appear in each exact case, and represents a recommendation only.

CERTIFICATE

1. General

- 1.1. Before operation thoroughly study User Manual for «LORNET-36».
- 1.2. The Certificate is included in the delivery set and should be always kept with the instrument.
- 1.3. If the device is sent for repair or to a different place during operation the Certificate is to be shipped with the instrument.
- 1.4. Marks in the Certificate should be done in-time.
- 1.5. All records in the Certificate should be made by ink only, distinctly and carefully. All unauthorized erasures, blots and corrections are not permissible.
- 1.6. It is forbidden to make any notes or records in the fields and on the cover of the Certificate.

2. Delivery Set

Description	Q-ty
Receiver-transmitter unit with control unit and built-in battery container	1
Changeable Li-Ion batteries	2
Container for battery charging	1
Charger for receiver-transmitter unit (CH1)	1
Wireless accessories including: receiving device, earphones and charger (CH2)	1
Technical Description & User manual, Certificate (in one piece)	1
Package	1

3.Warranty

3.1.Warranty period for «LORNET-36» is 18 months upon supply to the customer.

3.2. Life time is 6 years.

3.3. If the device fails during warranty period provided the customer has followed all the operation, transportation and storage rules, the manufacturer is to make the repair free of charge or replace the device.

3.4.Warranty does not cover power elements.

4. Contact Details

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6. Claims Data

In case of a package damage during transportation claims are applied to the transportation organization complying to the valid regulations.

If the delivery set is not complete or the NLJD is damaged, provided the package is not damaged, an Act is made together with a representative of the manufacturer.

If a defect appears during warranty period, the customer is to send the NLJD to manufacturer with an accompanying letter, stating the reason of the claim.

All claims with a brief description of encountered problems and measures taken are recorded in Table 1.

Table 1.

Claim content	Reason, measures taken	Notes