NON-LINEAR JUNCTION DETECTOR

LORNET-36

USER MANUAL

2015

1. Introduction

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

NLJD operation is based on the property of semiconductor components to generate a response at the 2nd and 3rd harmonics when radiated by an UHF 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.

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

NLJD automatically finds the best receiving frequency channel free of noise and distortion providing flawless operation even in the complicated electromagnetic environment. The digital processing of a demodulated signal gives maximum sensitivity.

An embedded parabolic antenna with high gain (20 dB at 3600 MHz) enables highly precise detection of semiconductor components from a long distance. Laser pinpointing enhances localization accuracy of the found object.

There are two types of radiated signals:

- Pulse modulated carrier with a duty cycle of 0.6% (Pulse).
- Pulse modulated carrier with a duty cycle of 5.0% (CW).

CW mode is used to listen to the envelope of the signal received via a built-in loudspeaker or earphones to detect working analog radio microphones due to acoustic bonding.

Output power automatic control mode significantly simplifies operator's work.

NLJD simultaneously displays the 2nd and 3rd harmonics levels at its LED panel. Besides, the 2nd and 3rd harmonics levels can be estimated in turn aurally by click repetition rate reproduced through a built-in loudspeaker or connected to a pocket-size receiver.

2. Technical Parameters

2.1. Types of radiated signals:

- pulse modulated carrier with a duty cycle of 0.6% (Pulse).
- pulse modulated carrier with a duty cycle of 5.0% (CW).

2.2. Fixed carrier frequency. Step 13 MHz within range of (3581.5 … 3607.5) MHz.

Automatic frequency selection. Possibility of radiation at the carrier frequency with a minimum noise level in the 2nd harmonic receiver path.

2.3. Maximum power with duty cycle of 0.6% (Pulse) not less 18 W.

2.4. Maximum power with duty cycle of 5.0% (CW) not less 12 W.

2.5. Automatic or manual power control. Power control range 22 dB from maximum value, divided into 11 level gradations.

2.6. Transmittance antenna gain at 3600 MHz – not less 20 dB, beam width by -3 dB level not

more than 16 degrees.

2.7. Receiver sensitivity better than –110 dBm (the 1st LED lights up).

2.8. Receivers tuning frequencies equal to the transmitter double and triple frequencies, comprising 7163…7215 MHz and 10744.5…10822.5 MHz respectively.

2.9. Receiving path dynamic range – 30 dB (20 dB – LED indicator range, 10 dB – attenuator range at receiver input adjusting by ATT button).

2.10. Time of continuous operation with a Lithium-Ion battery at the maximum radiated power not less:

- 3 hours in Pulse mode;

- 2 hours in CW mode.

2.11. Weight not more 1.4 kg.

2.12. Operating conditions:

-ambient temperature - 5…40° C;

- pressure - 450 … 800 mm of mercury.

3. Delivery Set and Accessories.

The device includes units and accessories stated in the Table 1 below.

Table 1

No.	Name	Q-ty
1	A duplex antenna unit with a control panel and a built-in container for a battery	1
2	Changeable Li-Ion batteries	2
3	A container for battery charging	1
4	A charger for a duplex unit battery	1
5	A receiver with an adapter to charge its battery and earphones	
6	User Manual, Certificate	1
7	A package bag to keep and transport the device	1

Fig. 1 Appearance of NLJD and its charger

Fig. 2

Fig. 2 shows a receiver, an adapter for charging its battery and earphones.

4. Purpose of NLJD Basic Units

4.1. The duplex antenna unit with LED indicators is used for:

- Analysis of distortion and interference in the instrument receiving path, which is made each time the transmitter is switched on. Therefore, if an interfering signal appears during operation (in a complicated electromagnetic environment) it is necessary to turn NLJD transmitter off and on from time to time thus selecting an optimal frequency automatically, providing the best sensitivity and detection range of semiconductor components.

- Generation UHF signal, receipt and digital processing of the 2^{nd} and the 3^{rd} frequency harmonics. Simultaneous display of the 2^{nd} and the 3^{rd} 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 appear at oxidation of connecting points of various metals.

- Demodulation of the 2^{nd} and 3^{rd} harmonics response, their amplification to the level required for tapping both to earphones and a built-in loudspeaker. An operator can control sound volume. An operator can listen to demodulated signals of the 2^{nd} harmonic from lower or upper receiver ranges in turn.

- Indication of the receiver power level and levels of the 2^{nd} and 3^{rd} harmonics of the signals received (Fig. 3).

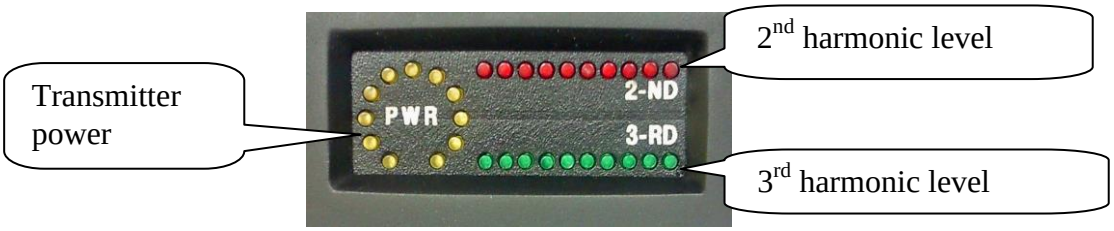

Fig. 3 LED indicators

4.2. Flexible joint of the duplex antenna unit with a handle is designed to transform the unit into transportation position (Fig.4). Besides, it helps the operator to fix the antenna in the position convenient for search.

Fig. 4 Flexible joint

4.3. The control panel is used to control operation of NLJD. It consists of a housing used as an arm into which a battery is integrated (changeable). A control board, buttons for operation modes control and display LEDs are placed in the housing. 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.

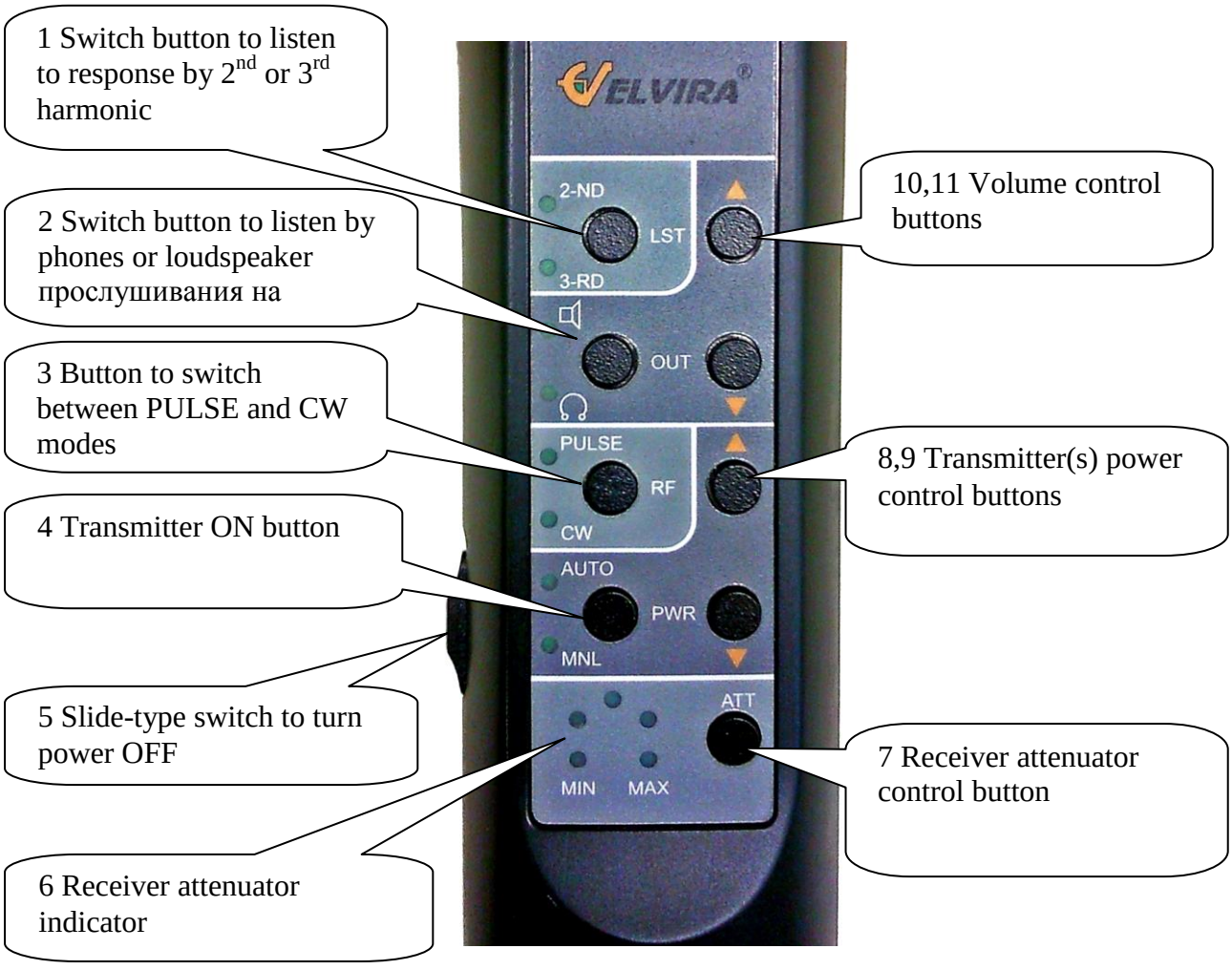

Fig. 5 Control panel

4.4. Functions of control panel indicators: Continuous lighting of any indicator corresponds to «ON» position, absence of lighting – to «OFF» position. Simultaneous flickering of all control panel indicators shows a built-in battery is discharged and needs to be charged.

4.5. Battery charging of the duplex antenna unit is to be made with the charger included to the delivery set only. Using other chargers is not allowed. For charging it is necessary to unscrew a cover at the edge of NLJD's arm, remove a battery and place it into the container for charging (Fig.1). Connect the container to the charger.

While a charger is connecting to the power mains a red LED is lightning at its housing. When a battery is completely charged, a red LED goes out, and a green LED lights up. Charging time of a fully discharged battery is about 6 hours.

4.6. Control elements of the receiver are shown in Fig. 6.

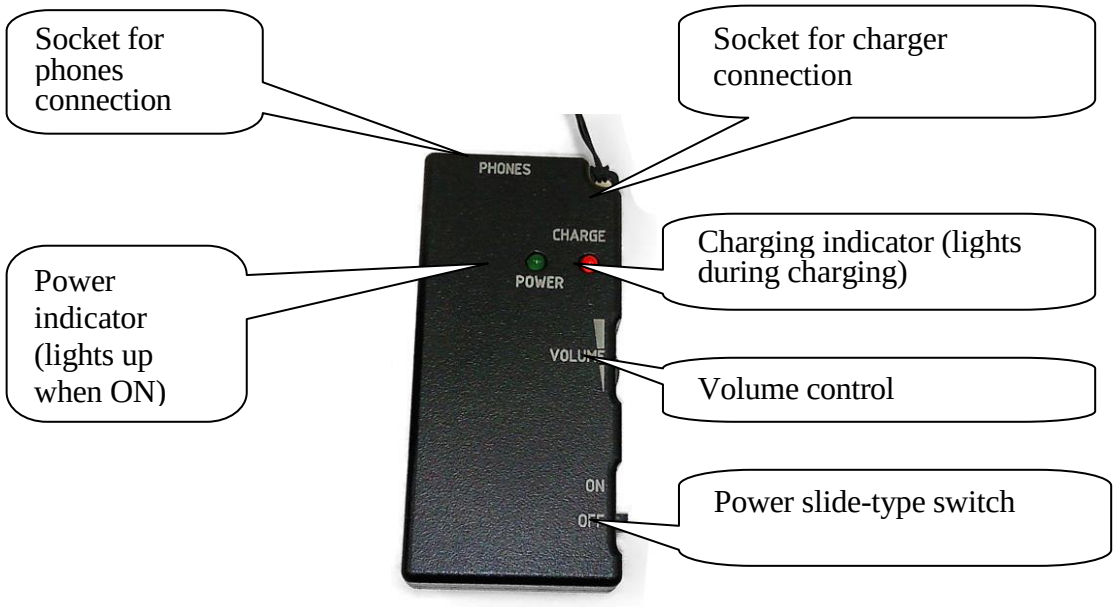

Fig. 6 Receiving Device

4.7. Receiver Operation Procedure

- Charge a built-in battery completely using the adapter included to the delivery set, here CHARGE indicator goes out.
- Connect earphones to the corresponding socket.
- Turn the receiver on by a slide-type switch, here POWER LED lights up.
- Set a comfortable volume level using volume control.
- If the receiver is turned on when NLJD is off, then there is a noise signal only in the earphones at higher volume. After turning on acoustic indicator signals corresponding to the operating mode of NLJD appear in the earphones.

5. Safety Measures

5.1. 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.

5.2. An operator is not recommended to direct an antenna to people or to be himself towards radiation maximum.

5.3. An operator should not direct a laser beam to a person's eyes or face.

6. Operation Order

6.1. Remove NLJD from the package. After device transportation at negative temperatures it is necessary to keep the device in the switch-off state at room temperature at least for 30 minutes.

6.2. Turn NLJD on by the type-slide switch placed on the arm. The 2^{nd} and 3^{rd} indicators on the control panel will light up, indicating that NLJD has been powered on. One yellow LED should be lightning 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 2^{nd} and 3^{rd} harmonics indicators should not light (flashing of the first LEDs of the 2^{nd} and 3^{rd} 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 a signal level at the 2^{nd} harmonic receiver input. In the given mode sound information (clicks) of the 2^{nd} harmonic response is applied to the loudspeaker or earphones.

When switching on mode 3-RD by pressing LST button on the control unit, the output power of the transmitter is adjusted automatically depending on a signal level at the 3^{rd} harmonic receiver input. Acoustic information of the 3^{rd} harmonic response is applied to the loudspeaker or earphones.

To switch over to the manual mode of the probing signal power control (MNL indicator lights up) press one of power control buttons after the probing signal transmitter has been turned on.

Turn the probing signal transmitter off and then turn it on for a reverse switch over using PWR button.

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 it is normally recommended to work at decreased power of the probing signal.

The optimum level of the probing signal is reached experimentally.

6.4. Simultaneous flashing of all indicators on the control panel indicates that the battery is discharged. In this case turn off the power, unscrew a cover at the edge of the arm, remove a battery, place it into the container and charge using the charger.

6.5. If a response signal is to be tapped by earphones, press the corresponding button on the control panel and turn the receiver on.

Attention:

1) While operating NLJD constantly monitor battery state charging it in-time (by the indicators signal). NLJD must be kept with a battery charged.

2) Charging should be done with a charger included into the delivery set only, using of unauthorized chargers are strongly prohibited.

7. Search Recommendation

7.1. If possible remove electronic devices from the room examined. If it is impossible, examination should be done at a decreased radiated power.

7.2. Set maximum radiated power level and one of the operation modes of the receiver.

7.3. Direct the antenna to the surface under examination using a laser beam spot. Analyze behavior of the received signal of the 2^{nd} and 3^{rd} harmonics moving a laser beam spot over the surface under examination smoothly and changing the antenna orientation by an indicator visually.

7.4. Analysis of the received 2^{nd} and 3^{rd} harmonics levels is made both by number of LEDs lightning on the corresponding indicator scale and by clicks repetition rate in the loudspeaker or phones.

7.5. Remove the antenna unit from the surface examined or decrease output power and repeat measurements of the received signal level. For more accurate location as well as for protection of receiving devices from overload it is possible to decrease receiver sensitivity using ATT button.

7.6. When an artificial p-n transition is found you will normally see stable lightning of the 2^{nd} 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 stable lightning of the 3^{rd} harmonic indicator LEDs. While rapping at the examined surface intensively, readings of indicators by the 3^{rd} 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 study User Manual for «LORNET-36» thoroughly.
1.2. The warranty 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 warranty certificate is to be shipped with the instrument.

2. Delivery Set

Table 1

No.	Name	Q-ty
1	A duplex antenna unit with a control panel and a built-in container for a battery	1
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3. Warranty

3.1. Warranty period for «LORNET-36» is 12 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. Claims Data

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

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

If a defect appears during the warranty period, the customer is to send NLJD to the 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 2.

Table 2

Claim content	Reason, measures taken	Notes