

# HANDHELD NON-LINEAR JUNCTION DETECTOR

## «*LORNET*»

### USER MANUAL CERTIFICATE



# USER MANUAL

## 1. Introduction

The non-linear junction detector "LORNET" (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 an RF 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" automatically finds the best receiving frequency channel free of noise and distortion providing flawless operation even in the complicated electromagnetic environment. The frequency tuning algorithm implemented in "LORNET" automatically selects the RF probing signal frequency such that the noise level in 2d harmonic receiving channel is held minimal, while digital processing of a demodulated signal gives maximum sensitivity.

There are two types of radiated signals:

- continuous wave carrier (CW);
- pulse modulated carrier with a duty cycle of 1% (pulse).

This enables to combine wide detection range and reliable identification of the devices found.

Output power automatic control mode significantly simplifies operator's work. "LORNET" 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 click repetition rate reproduced through a built-in loudspeaker or wireless earphones.

## 1. Specifications:

**2.1.** Radiated signal types:

- continuous wave carrier;
- pulse modulated carrier with a duty cycle 1%.

**2.2.** Carrier frequency step 0.2MHz within a tuning range of (890 ... 891)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 the CW mode  $\leq 2W$

**2.4.** Peak radiated power in the pulse mode  $\leq 10W$ .

**2.5.** Manual or automatic control of the radiated power level.

Dynamic control range of 30dB down from the maximum output power value with 11 level gradations.

**2.6.** Receivers sensitivity better than  $-150dBW$  given a 10dB signal to noise ratio.

**2.7.** Receivers tuning frequencies equal to the transmitter double and triple frequencies.

**2.8.** Receiving path dynamic range  $\geq 70dB$ .

**2.9.** Time of continuous operation with a lithium-Ion battery at the maximum radiated power:

- $\geq 3$  hours in the pulse mode;
- $\geq 1,5$  hours in the CW mode.
- unlimited operation time from 220V mains with a power adapter connected

**2.10.** Equipped device weight  $\leq 1kg$ .

**2.11.** Operating conditions:

- ambient temperature 5...40°C.

- pressure  $\geq 450$ mm of mercury

## 2. Delivery set and accessories

No.	Description	Q-ty
1.	Transceiver antenna assembly with an arm and control panel and a built-in battery with a charger	1
2.	Power adapter	1
3.	Wireless phones including: receiving device and earphones	1
4.	User manual, certificate	1
5.	Package	1

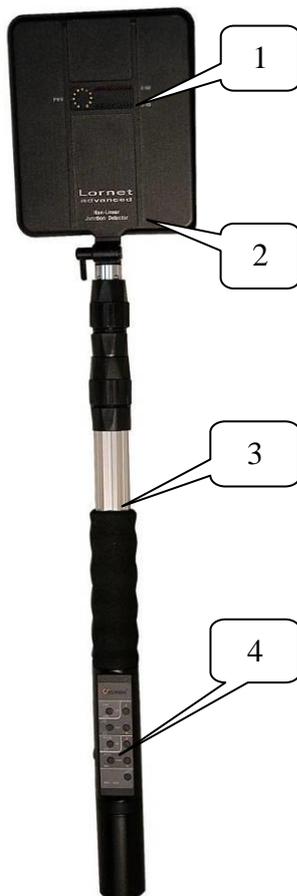


Fig. 1

The device appearance is shown in Fig. 1, where:

- 1- LED indicator;
- 2- Transceiver antenna unit combined with an indicator;
- 3- Telescopic arm;
- 4- Control panel with a power section and a battery (fixed underneath).

Wireless earphones, chargers and additional batteries are not shown in the figure.

## 4. Purpose of the Detector Basic Units

4.1. The transceiver antenna unit with built-in LED indicators (shown in Fig. 2) 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 the detector 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 of CW or pulsed RF signal.
- Reception and digital processing of the 2<sup>nd</sup> and the 3<sup>rd</sup> frequency harmonics. Simultaneous display of the 2<sup>nd</sup> and the 3<sup>rd</sup> 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<sup>nd</sup> and 3<sup>rd</sup> harmonics response, their amplification to the level required for tapping both to earphones and a built-in loudspeaker. The amplification is adjustable within a 20 dB range. The operator can listen to demodulated signals of the 2<sup>nd</sup> and 3<sup>rd</sup> harmonics in turn.
- Indication of the probing signal levels (1) as well as of the 2<sup>nd</sup> (2) and 3<sup>rd</sup> (3) harmonics levels (Fig. 2).

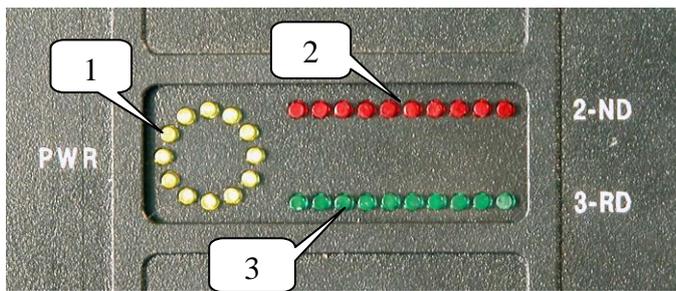


Fig.2

operation modes control and display LEDs are placed in the package. 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. Control panel is shown in Fig.4 The following buttons refer to «AUDIO» group:

1- LEDs and **LSTN** button for switching of acoustic indication to the output of the 2<sup>nd</sup> or 3<sup>rd</sup> 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 types of the radiated signal (CW – continuous, PULSE – pulsed).

The following buttons are referred to «POWER RF» group:

4- LEDs and **PWR** button to switch on/off the probing signal transmitter.

When the instrument is switched on the automatic mode of output power

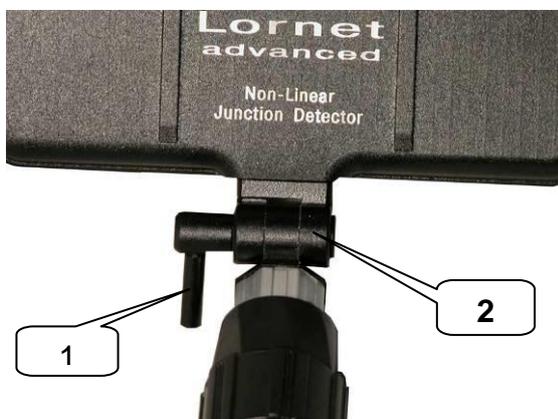


Fig. 3

control (AUTO) is set by default. To switch over to 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 a button for receiving unit attenuator control.

7,8 - **LEVEL** buttons for control of radiated signal power in MNL and AUTO modes (↑ - high, ↓ - low). It is possible to set the maximum power level by pressing **LEVEL** button (↑ - high, ↓ - low) in AUTO mode before the probing signal transmitter is turned on.

9,10 - **Volume** buttons for volume control (↑ - high, ↓ - low). 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.

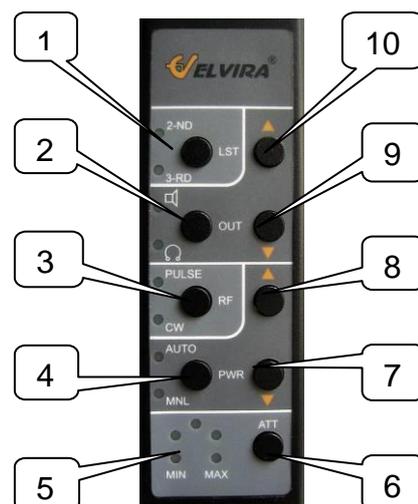


Fig. 4

**4.4.** On the side surface of the control panel (see 1 in Fig. 5) a slide-type power switch is placed. A slide position corresponding to «ON» is marked by a contrast point. The device operates only when a charged battery is connected to it. A battery is

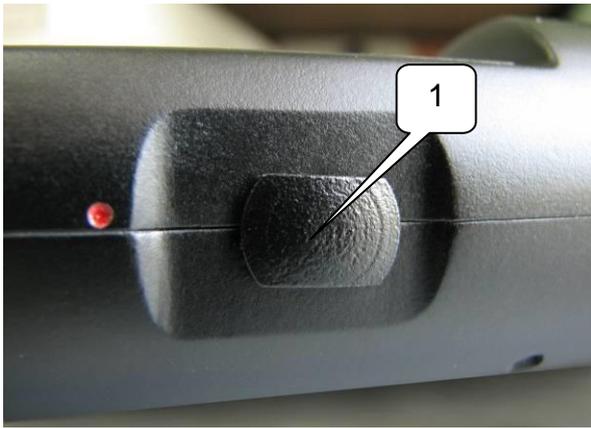


Fig. 5

screwed on the back side of the control panel. The appearance of a battery is shown in Fig.6. While a battery is being screwed on, the positive battery lead must not be short-circuited with a case (see 1 in Fig.5).

Attention! If the instrument has not been in operation for a long period, it is recommended to remove the battery from the device and keep it separately.

**4.5.** Battery charging is to be made with a power adapter and a battery charger supplied with the instrument

only. Using other chargers is not allowed.

For charging it is necessary to connect a low-voltage connector of the power adapter to the socket placed underneath the front side of the control panel. (see 1 in Fig.6).

A red LED (see 2 in Fig.6) is lighting while charging (see 2 in Fig.6). When a battery is completely charged, a red LED goes out, and a green LED lights up (see 3 in Fig.6).

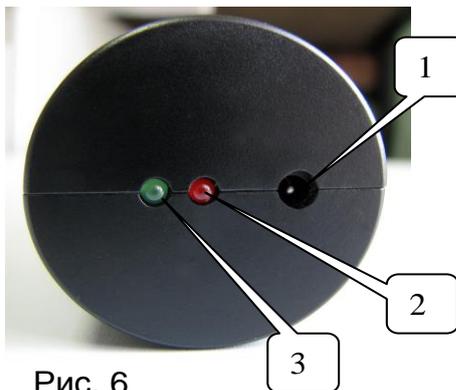


Рис. 6

Charging time of a fully discharged battery does not exceed 5 hours (typical value is 3.5 h). In case of a failure (charging is not complete within five hours) a charger switches off automatically, both LEDs will go out.

**4.6.** Wireless telephones consist of a receiving device and earphones. Appearance of the receiving device and position of control units are shown in Fig.7

Fig. 6

Receiving device operation order:

- Using a power adapter supplied with the instrument make sure with a help of the charge indicator that the battery is completely charged.
- Connect head phones to a corresponding socket of a 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 acoustic indicator signals corresponding to the operating mode of the detector appear in the earphones.

**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

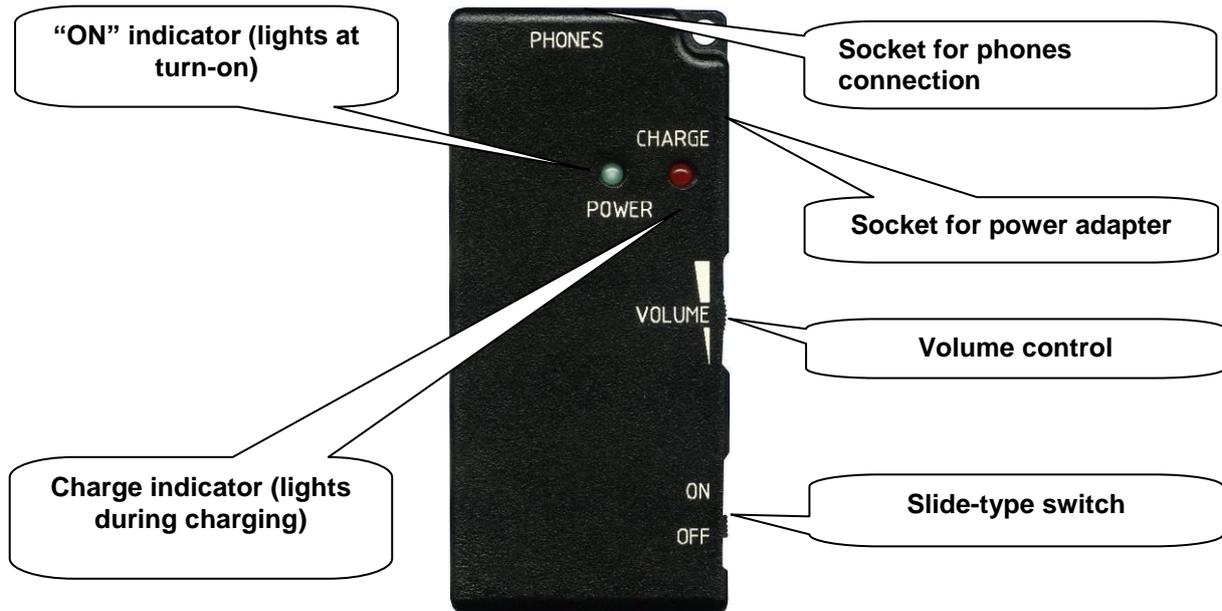


Fig. 7

for safety measures while working with electric and measuring devices with open RF energy radiators.

## 6. Operation Order

6.1. Remove the detector from the package, and the battery from a protective case, connect the battery to the detector. 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. To start operation set the battery and turn «LORNET» on by the power switch placed on the control panel (Fig.5). The 2<sup>nd</sup> and 3<sup>rd</sup> 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 2<sup>nd</sup> and 3<sup>rd</sup> harmonics indicators should not light (flashing of the first LEDs of the 2<sup>nd</sup> and 3<sup>rd</sup> scales is permitted).

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

**6.3.** Simultaneous flashing of all indicators on the control panel indicates that the battery is discharged and needs to be replaced urgently. In this case the power should be turned off and the battery - replaced.

**6.4.** 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 (see 2 in Fig.4) and turning wireless phones on (according to their User Manual).

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.
- 4) Self – assembling or - disassembling and use of undue chargers is forbidden.
- 5) When the operation is finished, or during long operation breaks, it is recommended to remove the battery from the detector.
- 6) To avoid short-circuiting of leads (see 1 in Fig.6) batteries are to be kept in an isolated case when not used.

## **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.** In the CW mode it is recommended to use manual operation mode “Man” only.

**7.4.** Place the antenna unit parallel to the surface examined at the distance not exceeding 10cm.

**7.5.** Slowly moving the antenna unit parallel to the surface examined and changing orientation of antennas, analyze changes in the signal received at the 2<sup>nd</sup> and 3<sup>rd</sup> harmonics visually by the indicator (aurally the click repetition rate should be maximum).

**7.6.** Analysis of the received 2<sup>nd</sup> and 3<sup>rd</sup> harmonics levels is made by number of LEDs lighting on the corresponding indicator scale.

**7.7.** Remove the antenna unit from the surface examined or decrease output power and repeat measurements stated in 7.5. of the present manual. For a more accurate location as well as for protection of receiving devices from overload it is possible to decrease the signal level using attenuators.

**7.8.** When an artificial p-n transition is found you will normally see stable lighting of the 2<sup>nd</sup> harmonic indicator LEDs. While rapping at the suspected place of a p-n transition, readings of LEDs do not change.

**7.9.** When a natural p-n transition is found, you will observe stable lighting of the 3<sup>rd</sup> harmonic indicator LEDs. While rapping at the examined surface intensively, readings of indicators by the 3<sup>rd</sup> 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».
- 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

Name	Q-ty	Serial No	Notes
Transceiver antenna assembly with an arm and control panel and a built-in battery with a charger	1		
Power adapter	1		
Wireless phones included: a receiver and earphones	1		
User manual	1		In one piece
Certificate	1		
Package	1		
Option			

## 3. Warranty

- 3.1. Warranty period for «LORNET» 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. Acceptance Certificate

<b>A C C E P T A N C E   C E R T I F I C A T E</b>			
Non-linear Junction Detector «LORNET» <small>name</small>		No _____ <small>serial number</small>	
is manufactured and accepted according to obligatory requirements of state standards, current technical documentation and is fit for service.			
Technical inspection			
_____	_____	_____	_____
<small>stamp</small>	<small>signature</small>	<small>name</small>	<small>date, month, year</small>

#### 5. Package Certificate

<b>P A C K A G E   C E R T I F I C A T E</b>			
Non-linear Junction Detector «LORNET» <small>name</small>		No _____ <small>serial number</small>	
Packaged by: <u>JSC SELCOM SECURITY.</u>			
according to the requirements stated in the given technical documentation.			
_____	_____	_____	_____
<small>title</small>	<small>signature</small>	<small>name</small>	<small>date, month, year</small>

**6. 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 the 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 the 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 1.

Table 1

Claim content	Reason, measures taken	Notes