Double Probing Frequency Non-Linear Junction Detector

«LORNET-0836»

User

Manual

Certificate

2018

User Manual

1. Introduction

The double probing frequency non-linear junction detector «LORNET-0836» (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 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.

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.

The unique feature of the device in comparison with analogues is that it combines two detectors at different frequencies. The frequency of one transmitter is 790 MHz, and the other is 3600 MHz. The transmitters can operate separately or simultaneously. Therefore the device has undeniable advantage over single-frequency devices due to:

- it is better to detect small-sized and high-frequency semiconductor devices at high frequency (and vice versa);

- it is better to work in wet ground and concrete walls at low frequency;

- two antennas with wide (at low frequency) and narrow (at high frequency) direction diagrams enable to evaluate the situation first (at low frequency) and then to detect an object precisely using high frequency.

NLJD automatically finds the best receiving frequency channel free of noise and distortion providing flawless operation in the complicated electromagnetic environment.

An embedded parabolic antenna with high gain (20 dB at 3600 MHz) enable high precise detection of semiconductor components in space. To make operator's work easier NLJD is equipped with a laser pinpointing a place where an antenna is directed.

There are two types of radiated signals:

- pulse modulated carrier with a duty cycle of 0.3 % (Pulse).

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

CW mode is used to listen to the envelope detector output as well as to the received signal level 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. An operator can make search at both frequencies simultaneously or at one (high or low) frequency. Besides, the 2nd and 3rd harmonics levels can be estimated in turn aurally by click repetition rate reproduced through a built-in loudspeaker or earphones.

2. Technical Parameters

2.1. Types of radiated signals:

- pulse modulated carrier with a duty cycle of 0.3 % (Pulse);

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

Pulse width - 12 μs, pulse repetition rate - 300 Hz or 5 kHz.

2.2. Receiver and transmitter carriers are given in Table 1.

Carrier frequency (one of three) is chosen by minimum path interference of the corresponding 2nd harmonic receiver automatically.

Table 1

Frequency	Lower range			Upper range		
Transmitter, MHz	789.5	790.5	791.5	3581.5	3594.5	3607.5
2nd harmonic receiver, MHz	1579	1581	1583	7163	7189	7215
3rd harmonic receiver, MHz	2368.5	2371.5	2374.5	10744.5	10783.5	10822.5

2.3. Maximum power with duty cycle of 0.3% (Pulse) - not less 18 W in each range.

2.4. Maximum power with duty cycle of 5.0 % (CW) – not less 6 W in each range.

2.5. Automatic or manual power control. Power control range – 20 dB from maximum value, divided into 8 level gradations.

2.6. Transmittance antenna gain of upper range – not less 20 dB.

2.7. Transmittance antenna gain of lower range – not less 6 dB.

2.8. Receiver antenna gain of upper range – not less 24 dB, of lower range – not less 8 dB.

2.9. Receiver sensitivity better than –110 dBm (one LED lights up at the indicator scale).

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

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

- 2.5 hours in the pulse mode;

- 1.5 hours in the CW mode.

2.12. Weight of duplex antenna unit– not more 1.05 kg.

2.13. Operating conditions:

-ambient temperature - 5…40° C;

-pressure – 450 … 800 mm of mercury

3. Delivery Set And Accessories

3.1. The device includes units and accessories stated in the Table 2 below.

Table 2

No.	Name	Q-ty	Notes
1	A duplex antenna unit with a control panel and a built-in battery container	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	1	
6	Technical Description & User Manual, Certificate	1	
7	A package bag to keep and transport the device	1	

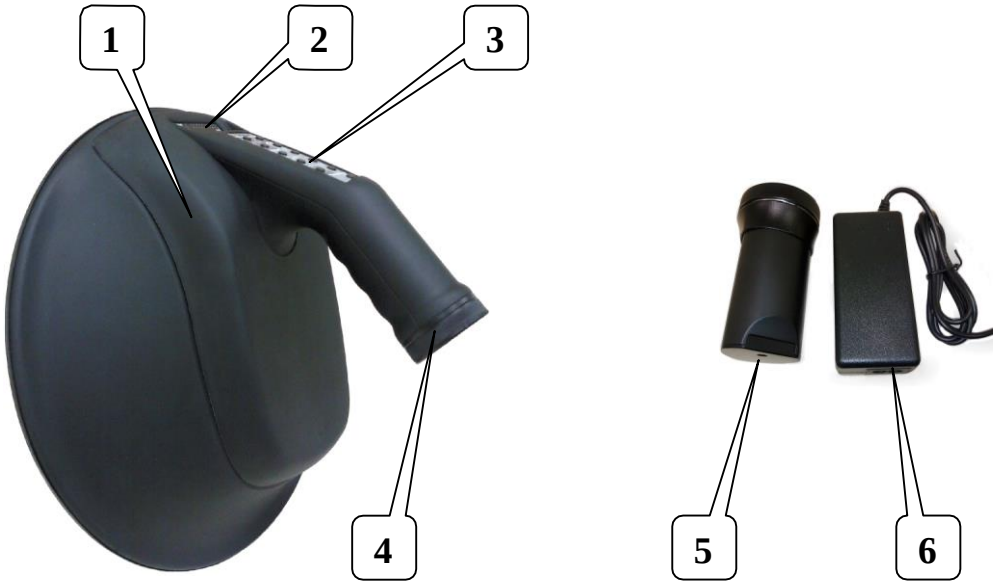

Fig. 1

Appearance of NLJD is given in Fig 1, where:

1- a duplex antenna unit
2- LED indicators
3- a control panel
4- a twisted cover of a battery section
5- a container for battery charging
6- a charger for a duplex antenna unit

Fig.2

Fig. 2 shows a receiver, an adapter for charging its battery and earphones.
Note: A type and appearance of the charging adapter and earphones can be different from the

shown ones.

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).

4.2. The control panel is used to control operation of NLJD. It is placed on the arm into which a battery is embedded. Control board, buttons for operation modes control and display LEDs are placed in the housing. Control panel and its buttons functions are given in Fig.3.

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 (replaced).

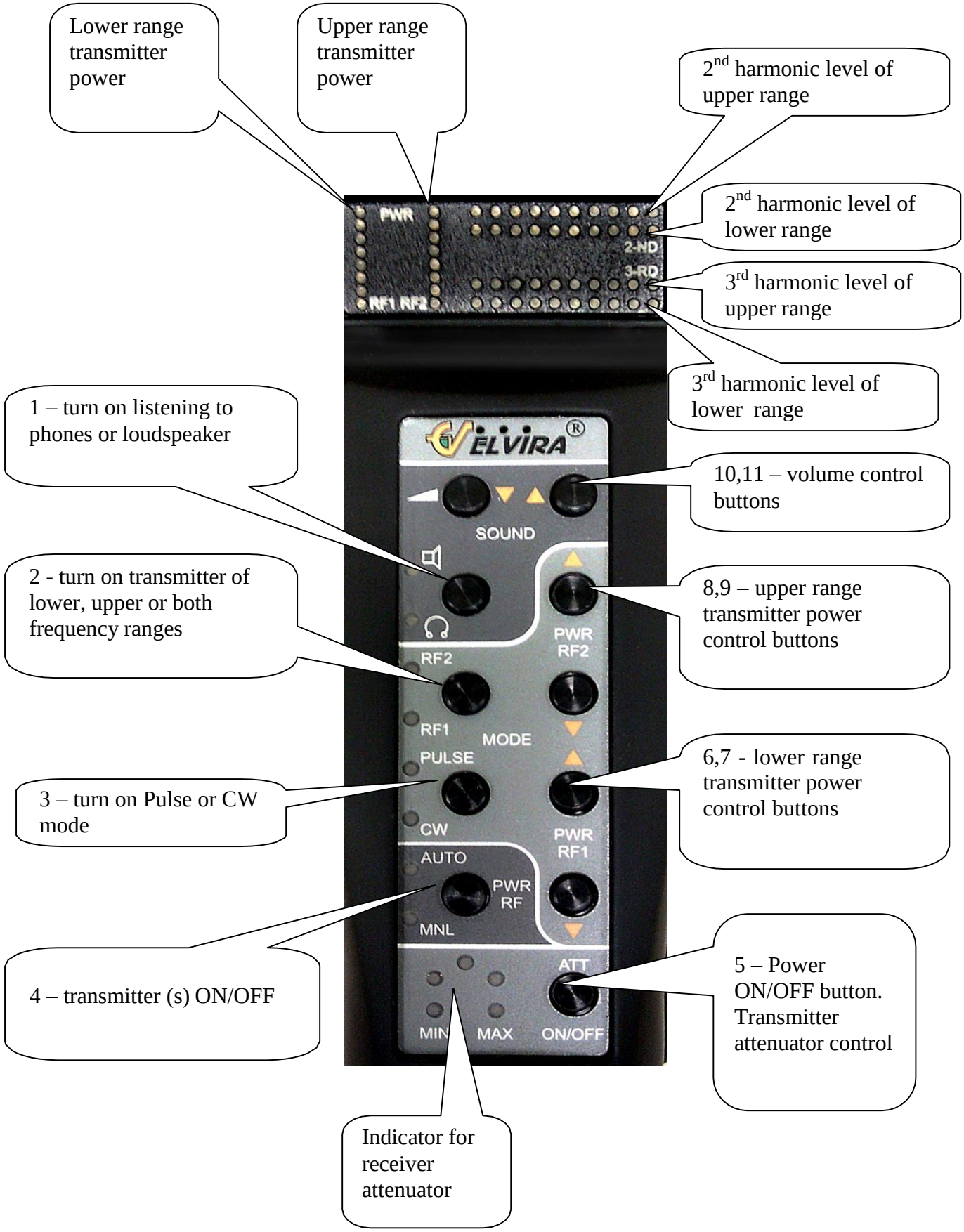
Lower range transmitter power
Upper range transmitter power
2nd harmonic level of upper range
2nd harmonic level of lower range
3rd harmonic level of upper range
3rd harmonic level of lower range
1 – turn on listening to phones or loudspeaker
10,11 – volume control buttons
2 - turn on transmitter of lower, upper or both frequency ranges
8,9 – upper range transmitter power control buttons
3 – turn on Pulse or CW mode
6,7 - lower range transmitter power control buttons
4 – transmitter (s) ON/OFF
5 – Power ON/OFF button. Transmitter attenuator control
Indicator for receiver attenuator
PWR
RF1 RF2
2-ND
3-RD
ELVIRA
SOUND
PWR RF2
RF2
RF1
MODE
PULSE
CW
PWR RF1
AUTO
PWR RF
MNL
ATT
MIN
MAX
ON/OFF

Fig.3

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. 4.

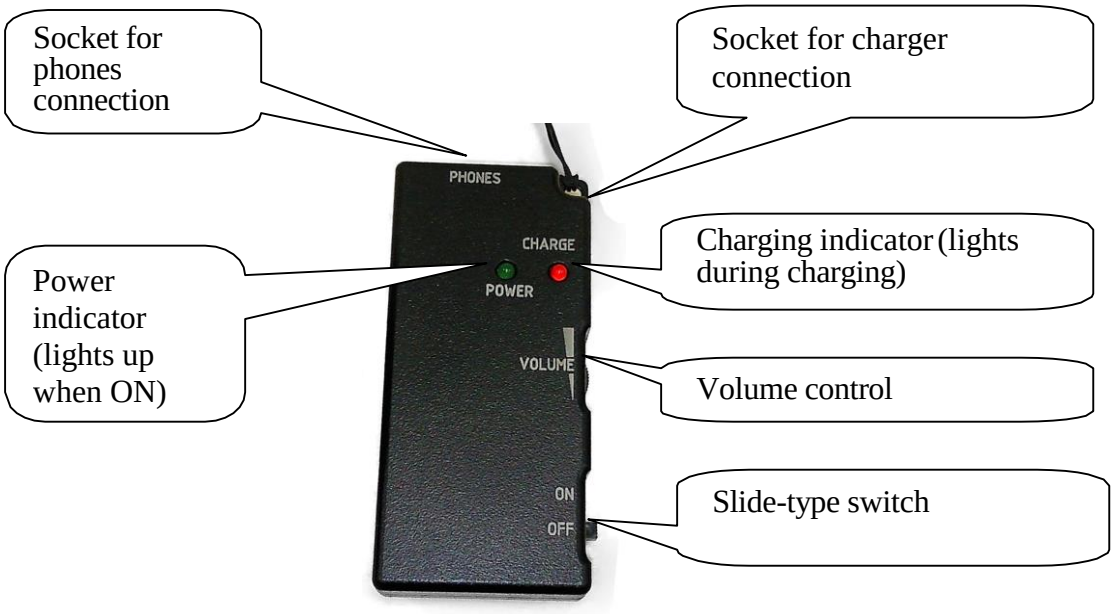

Fig. 4 Receiver

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.

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 button 5 (Fig.3) on the control panel. Four indicators: RF1, RF2, PULSE and a loudspeaker LED will light up. One yellow LED should light on each scale of the probing signal power indicator. Here the probing signal transmitters are off. The 2^{nd} and 3^{rd} harmonics indicators should not light. If button 5 is pressed again and kept within 5 seconds, NLJD is off.

6.3. Turn on the probing signal transmitter pressing PWR RF button 4. By default both transmitters (RF1 and RF2), PULSE (duty cycle 0.4%) mode and AUTO mode of automatic power control are turned on.

Acoustic information is applied to the loudspeaker or earphones when semiconductor elements are detected. Click repetition rate is proportional to the signal level at the 2^{nd} harmonic receiver output. The clicks are referred to the receiver level of that range where the 2^{nd} harmonic signal is higher.

The 2^{nd} and 3^{rd} harmonic signal levels from the upper and lower ranges of the receivers are displayed on LED indicators simultaneously.

6.4. Before turning on probing signal transmitters RF1 and RF2 one can select one of the following operation modes: both transmitters are on or only one of them. For this purpose press button 2 (Fig.3) consequently. RF1, RF2 or both LEDs light at each pressing. An operator can control power of RF1 and RF2 probing signals pressing the corresponding buttons ▲▼(more, less) (buttons 8,9 and 6,7 (Fig.3)). Here AUTO indicator goes out, and MNL indicator lights up.

It is recommended to use lower probing signal power in the rooms where a lot of electronic devices are placed.

Turn the transmitters off and then turn them on use PWR button 4 to switch over to automatic mode of power control.

6.5. If Pulse/CW button 3 is pressed NLJD is switched over to the 2^{nd} harmonic envelope listening mode. In this mode only one of the two transmitters is on. Here duty cycle of pulses is 6% and the frequency repetition rate is 5 kHz, and the signal obtained from the 2^{nd} harmonic receiver output passes via low-pass filter with cutoff frequency of 3 kHz and is applied to the built-in loudspeaker and wireless phones.

The given mode can be used for search of analog radio microphones. In this case acoustic bonding must appear when listening to the built-in loudspeaker.

There can be places with unstable electric contact between metallic objects with corrosion in a room under detecting, which can generate false response by the 2^{nd} harmonic. In this case one can knock strongly (by a hammer, for example) in the place of the supposed position, here a crack must appear in the loudspeaker (earphones).

6.6. Simultaneous flickering of all indicators on the control panel indicates that the battery is discharged. Turn NLJD power off, unscrew a cover at the edge of the arm, remove a battery, place it into a container and charge it using charger.

6.7. If a response signal is to be listened via phones press the corresponding button 2 (Fig.3) and turn a receiving device on (cl.4.4).

Attention:

1) Do not direct the antenna towards the operator and people nearby.

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

3) 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-0836» thoroughly.
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

Table 1

No	Name	Q-ty	Serial No	Notes
1	A duplex antenna unit with a control panel and a built-in battery container	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	1		
6	Technical Description & User manual, Certificate	1		
7	A package bag to keep and transport the device	1		

3. Warranty

3.1. Warranty period for «LORNET-0836» 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.