

Non-linear Junction Detector



USER MANUAL

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This Manual is intended for explanation "NR-2000" Non-linear Junction Detector design & principle of operation as well as directions for its use.

For proper equipment use study this Manual in depth.

APPLICATION

NR-2000 Non-linear Junction Detector is intended for searching concealed electronics like eavesdropping installations, Remote Controlled Improvised Explosive Devices (RC IED) and etc. as well as other items that contain semi-conductor elements.

NOTE: **NR-2000** can detect typical targets in every operational mode: active, stand-by or even switched-off.



NR-2000 typical targets:

- Radio-mikes
- Microphone amplifiers
- Wired mikes
- Video & audio recorders
- SIM cards
- Electronic timing devices
- Devices with infrared (IR) or ultrasonic data & control channel
- Remote Controlled Improvised Explosive Devices (RC IED)

NR-2000 possible application fields

- Crime scene investigation for hard evidence of explosive terrorism that contains any electronic components and its remains: triggers, communication facilities and etc.).

- Searching for Improvised Explosive Device (IED) that contains electronic components in typical urban environment.

NOTE 1: In practice NR-2000 is immune to interfering signals typical to urban conditions.

NOTE 2: The IED detection range is comparable with that of an 'Eagle' NLJD – Russian standard tool for field operations: 7-10 meters.

NOTE 3: Fortunate combination of significant detection range with low radiation level and practical immunity to unban interference guarantees NR-2000 operator from spontaneous IED triggering.

- Various premises investigation for mobile phones and SIM-cards hidden in domestic articles.

NOTE: NR-2000 ensures mobile phones and SIM-cards detection in moist environment and light construction materials up to the distance of 1m and 0.5m respectively.

- Searching for eavesdropping devices concealed in light building structures, furniture and various home appliances as well as their reliable localization.

NOTE 1: NR-2000 can easily detect targets in building structures behind their reinforcement elements (steel grid and etc.)

NOTE2: NR-2000 provides its operator with an opportunity to discriminate between industrial electronic elements and metal-to-metal contacts, so called 'corrosion diodes'.

NR-2000 NLJD represents a comprehensive multi-purpose tool with mid-power output and an outstanding searching ability and rate. User Manual

DESCRIPTION Complete set

NR-2000 is supplied as a complete set (see fig. 2 and Table 1).



Fig. 2 NR-2000 complete set

		Table 1
1	Main Unit (transceiver)	1
	with Antenna module and Control unit	
2	Headphones receiver	1
3	AAA cells	3
4	Standard packing	1
5	Soshine 18650 rechargeable cells	5*
6	Soshine SC-S1 max charger	1
7	Headphones	1
8	AC power adapter	1
9	Car power adapter	1
10	Imitator (test unit)	1
11	Electric torch	1
12	Electric torch sheath	1
13	Forearm support	1
14	Shoulder belt	1
15	User Manual (not shown)	1

*- 2 x 2 cells set for NLJD + 1 for an electric torch.

Table 2

TECHNICAL DATA

 Scale '2' readings under following conditions: standard test unit detection range - 1±0.05m probing signal min output & minus 20dB received signal attenuation 	4 LEDs are glowing (at least 10dB)
Probing signal output attenuation	2 steps 0 dB & - 6dB
Receiver input signal attenuation	5 steps: 0dB, -10dB, -20dB, -30dB, and -40dB
Indication	Audio & LED display
Operational condition:	
- operational temperature range	-20°C+40°C
 relative humidity (under +25°C) 	Not more 80%
Power supply	2x18650 Li-ion rechargeable cells
Continuous operation time - searching mode - 20K	Not less 4h* Not less 1.5h*
Weight:Main unit (transceiver) with batteryComplete set in carry bag	3.0 kg 10.0 kg

*- with 2800mAh cells

PRINCIPLE OF OPERATION

NR-2000 detector represents a portable device that consists of antenna system, probing signal transmitter and 2 receivers tuned to the double & triple frequencies of the emitted signal.

Mono-harmonic probing signal emitted by transmitter is converted by non-linear elements (industrial semi-conductor or corrosion metaloxide-metal structure) to poly-harmonic one and re-radiated into an ambient space.



The re-radiated 2-nd & 3-rd harmonic of the probing signal are received and processed by above-mentioned receivers (see fig. 3).

The received signals levels are displayed by two bar-graph scales: '2' (red) & '3' (green) respectively.

Furthermore, at the same time tonal acoustic signal is reproduced by the headphones. The tonal signal level corresponds to that of the received electric signals.

Volume control is adjusted by (+ VOL -) buttons of the Control unit. At that a corresponding bar-graph scale is switched over for sound level indication for one sec.

The received signal level can be adjusted by Control unit with appropriate LED confirmation.

20K-mode activated by Control unit is used for revealed target identification. This auxiliary mode allows operator to evaluate probable probing signal amplitude modulation.

DESIGN

NR-2000 **Main unit** consist of antenna module, probing signal transmitter unit, two receivers, telescopic bar and control unit with LED display (fig. 4). The unique 'Bullpup' design provides NR-2000 ergonomic advantages in any possible application.



UHF cables pass through the telescopic bar. They are permanently fixed to the antenna module and transceiver unit.

NR-2000 **Antenna module** is fasten to the tip of 3-elbou telescopic bar (fig. 5). **Telescopic bar** length can be adjusted by means of 2 levellocks.



Fig.5a Antenna system adjustment

Moreover, antenna system position can be adjusted in two planes i.e. - two-dimensional motion is available (see fig. 5 & 5a).

Step 1

- Loosen antenna elevation holder screw.
- Adjust antenna elevation rotating it relative to antenna module axis.
- Tighten the antenna elevation holder screw.

Step 2

- Unfasten level-lock responsible for antenna rotation.
- Adjust antenna position rotating it relative to the telescopic bar axis.
- Fasten antenna rotation level-lock.

Forearm support is attached to the Main unit body with a latch.

(fig. 6).



NR-2000

NR-2000 control unit (fig. 7) is placed on top of the telescopic bar (see also fig. 4) and in essence consists of LED display for representing an acting operational mode and received signals level as well as control board with 10 non-fastening buttons that are used for adjusting and altering operational mode.

Control unit are permanently coupled to the Main unit

- 1. Power ON/OFF button
- 2. 20K mode activation button with LED confirmation
- 3. CH button for radiochannel activation with blue LED confirmation
- 4. 2-nd & 3-rd harmonic switch-over button with LED confirmation
- 5. Headphone volume control
- Probing signal output indication (min max)
- 7. Output level adjustment button
- 8. Received signal attenuation
- 9. Attenuator scale with 10dB step
- 10. Received signal 2-nd (red) & 3-rd (green) harmonics LED bargraph indicator (each step - 2.5dB)



Fig. 7 NR-2000 Control unit

NR-2000

User Manual

NR-2000 power supply

is provided by the battery of two Li-Ion rechargeable cells.

Battery compartment is located under Control unit module in Detector handgrip (fig. 8).

NOTE: For better operator convenient NR-2000 main unit is supplied with a shoulder belt



ACCESSORIES

Headphones (fig. 9) can be connected directly to the Main unit via corresponding jack at a back side of the housing.

Fig.8 NR-2000 power supply installation



Fig. 9 Headphones connection

Otherwise they can be coupled by means of a dedicated **receiver** (see fig.2, item 2 & fig. 10). An audio-signal transmitter is incorporated into the main unit.



Fig.10 Radio-channel receiver connection At the Operator's option headphone receiver can be placed in his pocket

The receiver power supply is obtained by two AAA cells (supplied).

Use the ON/OFF button on the receiver front panel for its activation. Press CH button to activate built-in audio signal transmitter that is confirmed by corresponding blue LED.

The headphones volume control is available from Control unit

NOTE 1: For correct operation switch-on the receiver after the Main unit activation.



Fig. 10 Soshine 18650 cell set of two

For battery charging **Soshine SC-S1 max** charger (supplied) is used (see fig.11).



charger package

Imitator (test unit) is intended for NR-2000 workability control (fig.12). It represents HF semi-conductor diode (2D521A - in accordance with Russian classification) in a solid plastic body Æ14 x 165 mm.



Fig. 12 NR-2000 Imitator (test unit)

Electric torch (fig. 13) is intended for illuminating dark places under control. The torch is powered by one Li-Ion Soshine 18650 rechargeable cell and (for operator convenience) supplied by a sheath and a belt



Fig. 13 Electric torch set

PACKING

Complete set of NR-2000 NLJD is packed into a dedicated shockproof metallic case (fig.13). The case is equipped with soft inserts.



Fig. 13 NR-2000 Detector packing chart

	-		Table 3
1	Main Unit	8	Soshine 18650 rechargeable cells (4 pcs)
2	Imitator (test unit)	9	AAA cells (3 pcs)
3	Headphones	10	Headphones receiver
4	Shoulder belt & electric torch sheath	11	Soshine SC-S1 max charger
5	Electric torch	12	Car power adapter
6	Soshine 18650 rechargeable cell (1 pc)	13	User Manual (under cover)
7	AC power adapter	14	Forearm support

NR-2000 APPLICATION CONDITION

After long-term exposure to a low temperature keep Detector packed in a standard packing at least 2 hours for evening up its temperature with the environment.

NR-2000 SAFETY PRECAUTIONS

- Operating NR-2000 keeps corresponding safety measures.
- Do not direct NR-2000 antenna to the human from a distance less than one meter.
- Avoid prolonged presence of personnel in a main lobe of NR2000 antenna diagram.

NOTE: Probing signal power density at the distance of 1 meter along the maximum of NR-2000 antenna directional radiation pattern does not exceed Russian State Standard 12.1.006-84 (Russian State Sanitary Norm) for UHF-equipment serviceman under continuous 8-hours operation.

NR-2000 OPERATION

WARNING: NR-2000 detector is a high-sensitive radio-electronic device. Before operation, please, make sure to remove any semiconductor-containing items from your clothing and munitions.

GETTING STARTED

Unpack NR-2000 detecting set.

Connect Headphones to a corresponding jack on the Main unit body or use wireless headphones facilities (see pp. 12-13 for reference).

Install two fully charged Li-Ion Soshine 18650 cells into Detector's battery compartment (see fig. 8). Pay attention to their polarity referring the label on the battery holder sidewall.

Close the battery compartment hatch.

Press O button to switch on NR-2000 Detector.

At that the following mode is activated:

- Transmitter is OFF: probing signal output LED indication (min max) is dead.
- Receivers are ON to control noise environment.
- Headphones are coupled to the 2-nd harmonic receiver output. Input signals attenuation is in 0 dB state;
- Volume control is in the **Mid**-position.

Use ATT button to adjust maximum receiver sensitivity.

Point Antenna module to various directions switching over 2-nd & 3-rd harmonic receivers outputs to evaluate the interference environments. In case of a certain noise chose the antenna direction with no noise in the headphones.

NR-2000 WORKABILITY TEST

Press **PWR** button to activate probing signal transmitter - LED **min** will confirm the minimum probing signal output power.

Point out NR-2000 antenna module to standard imitator (test unit) from 0.3...0.5m distance (fig. 14) - a tonal audio signal will be head in the headphones confirmed by 2-nd harmonic bar-graph LED indication.

Move imitator in various directions noting LED bar-graph indication obtaining a full scale indication for the 2-nd harmonic.

Then use **ATT+** button to engage successive step of input attenuator. Make sure that every stroke corresponds to an adequate attenuator activation and 2-nd harmonic indication declination.

Press PWR+ button to boost probing signal output level.



Make sure that every stroke corresponds to an adequate PWR scale increment and 2-nd harmonic indication gain.

Switch off the Detector

NR-2000 detector is ready for operation

USERFUL HINT: In case of battery discharge 2-nd & 3-rd LED bar-graph scales are lit by turns

NR-2000 SEARCHING TECHNIQUE



Carry out a target search under maximum (if possible) probing signal output and highest receiver sensitivity. That will ensure the maximum detection range. Acting transmitter output and receiver sensitivity level are defined by existing interference environment right on spot of a searching operation.

In general, the noise surroundings are formed by UHF external signals and non-linear targets that could not be eliminated or removed from the area.

Scan antenna module along the examined surface (fig. 15). Once the tone signal becomes audible in the headphones, localize the response signal based on the maximum audio level in headphones.

To do this alter antenna module position and orientation, variate the probing signal emitted power with PWR (+,-) buttons, and change the receiver sensitivity with ATT (+,-) buttons.

Use SND button to switch over receiver outputs to compare second and third harmonic levels and to identify the source of the response signal.

USEFUL HINT:

If the second harmonic signal level is considerably higher than that of the third one, it is highly probable that there are certain industrial semi-conductor components within the detection area.

If the third harmonic signal level substantially exceeds the second harmonic level, a corrosive nonlinear scatterer is the most likely to be the source of the response signal.

20K mode is used to identify a detected object. Natural corrosive nonlinear scatterer (two metal items divided by an oxide layer) has an unstable junction.

Under mechanical impact (tap) in close vicinity of detected nonlinear junction Operator will hear a wheeze and cracks in the headphones that corresponds to above mentioned impact.

A man-made target (electronic device, gear and etc.) has more stable junctions and produces a weak respond to mechanical impact. Active device like clockwork produces a regular signal without any external impact.

NOTE: its highly recommended to switch Detector over to 20K mode when receiver signal level achieves 20 dB according to the 2-nd & 3rd harmonics scales because of this mode lower detection capacity.

OPERATION TERMINATION AND PACKING

By the of practical operation – press ON/OFF button to switch off Detector.

Remove rechargeable cells from battery compartment, fold the telescopic bar and disconnect headphones.

Put Detector and its accessories into the carrying case referring fig.13.

BATTERY CHARGING

Soshine SC-S1 max Charger is intended for rechargeable cells charging.

Charging order

Insert 2 or 4 cells into **Soshine** Charger chamber (fig. 18), if necessary slide 'minus' spring contact. Pay special attention to cell polarity referring indication on the Charger chamber.



Couple AC or DC 12V Car adapter to the socket (item 2, fig. 18).

Connect AC power adapter to the mains (100-240V, 50/60 Hz) or Car adapter to a corresponding cigarette lighter socket.

After switching on Charger will check every charging channel operability and initiate the charging action (see table 4 for reference).

Charging time for **Soshine 18650** 2800 mAh Li-Ion rechargeable cells with **Soshine SC-S1 max** Charger is as follows:

- 4 hours for 2 cells;
- 8 hours for 4 cells.

After battery charging completion unplug AC adapter from the mains and then from the charger.

NOTE: The battery (cells) can be unplugged from the charger during any charging stage without any failure to the battery or the charger itself.

Charging mode LED indication (see table 4)

Table 4

Charging process status	LED light mode
Charger workability self -test	2 or 4 LEDs light up 'red' then switch over to 'green'
Defective cells or cells of a wrong	Alter 'green' to 'red'
type were installed (Ni-Mh, Ni-Cd and etc.)	back and forth
Charging mode start	Red
80%-90% charge is obtained	Blinking green
Fully charged	Green
Cell's wrong polarity	Dead

Charger operation precautionary measures

- Do not try to charge primary cells! That can initiate an explosion and provoke the fire.
- Refer inscription on a cell body.
- Do not block vent holes on the bottom of the charger housing.
 Don't place it on a soft surface like carpet, blanket, automobile seat covering and etc.
- Charger is intended for indoor use only.
- Protect it from moisture and perspiration water.
- Do not switch on the charger and/or power adapters with the obvious presence of moisture inside the device.
- Do not try to disassemble or modify the device.
- Do not use it as a surrogate power source for a certain gadget.
- The device terminals are intended for charging appropriate cells only.
- Charger is an electronic device with high frequency circuits and a violent operating current.
- The wrong operation could cause an electrical shock.
- Do not leave the charger and/or AC power adapter coupled to the mains unattended for a long time. In spite of several protection circuits used in a Charger scheme there is a certain probability of abnormal mode that will cause the fire.

NR-2000

10. MAINTENANCE

ATTENTION! IT IS FORBIDDEN TO DISASSEMBLE DETECTOR! GENERAL INSTRUCTIONS

The NR-CHP Maintenance should be carried out by the personnel who studied the Operation Manual and have practical experience of NLJD usage.

To keep NLJD in fault-free and ready-to-use condition the following Maintenance are provided:

- Check inspection performed at the detector acceptance procedure, preparation for transportation, storage as well as at periodic testing of serviceability, removal from storage and after transportation;
- Daily Maintenance performed after each Detector usage, transportation or placing in storage;
- Scheduled Maintenance performed once a year during longterm storage.

MAINTENANCE ORDER

Check inspection:

- take **NR-CHP** components, accessories and supporting documentation from the carry bag;
- check NR-CHP set packaging referring the device packing list; verify the seals integrity;
- check **NR-CHP** components exterior;
- verify labels, signs & marking condition on the device component housings;
- carry out the device workability test;
- remove the batteries;
- pack **NR-CHP** components into the carry bag.
- Daily Maintenance
- use clean rag to remove dirt and dust from external surfaces of the device components;
- use brush and soup water to clean the carry bag;
- dry the carry bag;
- correct minor paint coating defects (scratches and chipping) of the device components; – charge the batteries;
- perform the device workability test;
- remove the batteries;
- pack **NR-CHP** components into the carry bag.

Scheduled Maintenance

charge the batteries.

Routine repaire

The defective device repair, adjustment and setting-up should be carried out **ONLY** by authorized personal at the Manufacturer's factory.

NR-2000

SHIPPING AND STORAGE

NR-2000 can be shipped in a standard packing in a passenger cabin by any kind of transport.

Prevent the device in standard packing from shock and vibration.

Store packed device under the temperature from +5 up to +40°C and relative humidity no more than 80 % under +25°C

NOTE: Rechargeable cells should be stored in a charged state

CERTIFICATE OF ACCEPTANCE

Non-linear Junction Detector NR-2000 works No ______ is in conformity with main technical parameters and is accepted for use.

Vendor _____

Date _____

WARRANTY

Warranty period for NR-2000 is 12 months from the date of sale.

Manufacturer guarantees normal functioning of the device on the assumption of the following all requirements of this Manual by the

User and in case of malfunction within the Warranty period

Manufacturer will repair the device free of charge or even replace it.

Dedicated operating life till writing off -5 years

NOTE: The repair for a device with an expired operating life term is not available. Meanwhile, the device examination can be carried out under separate agreement.

Customer complaints are not accepted and warranty maintenance do not cover the following cases:

1. Mechanical damage of the device's units or parts.

2. Traces of independent unauthorized repair and/or warranty sealing damage.

3. The device's Works number mismatches to that mentioned in a Certificate of Acceptance

NOTE 1: Warranty period does not cover the battery and the wireless headphones set.

NOTE 2: Post-warranty service is accomplished under separate order

FOR NOTES