LUX

Professional Non-Linear Junction Detector

Technical Description and User's Manual

Contents

1. Device purpose

1.1 The LUX non-linear junction detector, hereafter denoted as 'the device,' is designed for detection of devices containing semiconductor components or similar elements, as well as individual contact joints between two or more metallic objects.

1.2 Environmental conditions for the device operation:

- ambient temperature: 5 to 40°C;
- relative humidity up to 80% at 30°C;
- atmospheric pressure, at least 450 mm Hg.

2. Technical properties

2.1. General technical properties.

2.1.1. The device power supply is provided by a 7.2 V battery.

2.1.2. The device uninterrupted operation time with one battery is at least 4 hours.

2.1.3. The device provides two types of indication:

- audible signals submitted to headphones;
- light indication using two LED bars installed at the device handle. The left and right LED bars are connected to the outputs of 2^{nd} and 3^{rd} harmonic receivers, respectively.

2.1.4. The device allows to detect all types of radioelectronic devices containing semiconductor components, elements of such devices, or individual semiconductor devices.

Devices to be detected may be located on a human body under the clothes, in headwear, shoes, or personal items, be installed inside furniture, metallic cabinets, or inside brick or reinforced-concrete walls. Devices to be detected may be switched either on or off.

The LUX device allows to detect individual contact joints between two or more metallic objects if metal oxides are present at the contact location. Such contact joints can be produced in case of: low-quality armature welding, furniture springs, screw joints in wooden structures, clockwork mechanisms, bunches of keys, etc.

2.1.5. The device mass (without battery) does not exceed 950 gram.

2.2. Technical properties of the transmitter

2.2.1 The transmitter operates in a pulse mode at the 915 MHz range.

2.2.2 Frequency tuning step: 200 kHz.

2.2.3 Maximum output peak power: 16±1 dB.

2.2.4 Minimum output peak power: 1.6 dB.

2.3. Technical properties of receivers

2.3.1 Adjustment frequencies of the receivers are equal to twice and thrice the transmitter frequency, respectively.

2.3.2 The effective sensibility of each receiver: –136 dB/W at the signal/noise ratio of at least 6 dB.

Receivers dynamic range: at least 30 dB.

2.3.3 Receivers gain control: manual, in four (10±1) dB steps.

2.3.4 When operating in the **20k** mode, receivers emit signals used for amplitude modulation of radio-frequency pulses. The range width of the restituted (demodulated) signal: 500 to 2,000 Hz.

2.4. Technical properties of antennae

2.4.1 The device contains three antennae implemented as a single module.

2.4.2 Main lobe width of the directional characteristic for both receiving and transmitting antennae: within 90° at –3 dB.

2.4.3 Power level of side and back lobes of the directional characteristic for both receiving and transmitting antennae: up to 10% of the main lobe level.

2.4.4 Transmitting and receiving antennae have circular polarization with an ellipticity ratio up to 1.5.

2.4.5 Transmitting and receiving antennae have coaxial directional characteristics. Main lobe deflection of directional characteristics is within 5°.

3. Package contents: devices and accessories.

The following elements and accessories are included into the device package:

- LUX non-linearity locator	1;
- battery	1;
- battery recharger	1;
- headphones	1;
- simulator	2;
- packaging bag	1;
- Technical Description and User's Manual	1;
- device passport	1.

4. Device structure and operation

4.1. The device consists of a transmitter, two receivers, a processing and indication module, and an antenna module.

4.2. The transmitting antenna produces an electromagnetic field within the effective area of its directional characteristic. When any device containing semiconductor elements (diodes, transistors, or contact joints of two or more metallic objects if they contain oxides) enter this field, the receivers detect the appearing signals of second and third harmonics of the transmitter frequency.

Signals are transmitted from receiver outputs to the module, which processes the received information and carries out the appropriate indication. LED indicators denoted by numbers 2 and 3 allow to evaluate the levels of signals received at the 2^{nd} and 3^{rd} harmonic frequencies. Resolution of the indicators is 3 dB.

The type of the detected element with non-linear characteristics can be estimated by the relative level of the harmonics. Semiconductors such as diodes or transistors produce reflected signals with maxima at the 2^{nd} harmonic. A non-linear element made up by a mechanical contact between two or more metallic objects produces a reflected signal with a maximum at the third harmonic. A correct determination of relative signal levels at different harmonics is not possible if the indicators are overloaded. Provided controls of transmitter output power and receivers sensibility located under the indicator LEDs should be used when operating the device.

The Non-Linear Junction Detector supplied in the delivery package should be used to check that the device is in working order.

4.3. The **20k** operation mode allows to listen to low-frequency signals of operating devices (such as tape recorders, radio transmitters, microphone amplifiers, etc.). In this mode, signals received by the device at the harmonic frequencies are modulated with a low-frequency signal present in electronic circuits of the detected or investigated device.

This operation mode is a powerful tool allowing to obtain a better-quality information on the type of the detected non-linear element. A non-linear element made by the contact of metallic objects produces an unstably received signal. Tapping the area under investigation would in this case make a characteristic sound appear in the headphones synchronously to the

tapping. To obtain this effect while using the LUX device, it is sufficient to tap a 15-cm thick reinforced concrete wall lightly with one's hand.

4.4 The LUX device use a battery as a power supply. The battery lifetime is sufficient for 4 hours of the device continuous operation. Battery discharge is indicated by the **Batt** LED installed at the device handle: when the battery is discharged, the LED starts blinking. The device operation with the LED blinking is only allowed for up to 10 minutes.

5. Device design

The Non-Linear Junction Detector is implemented as a non-demountable device consisting of an antenna module and a handle rod, connected with a pivot joint. The battery module is attached to the device body with a threaded joint.

Control buttons and LED indicators are arranged at the device front panel as shown in Fig. 1.

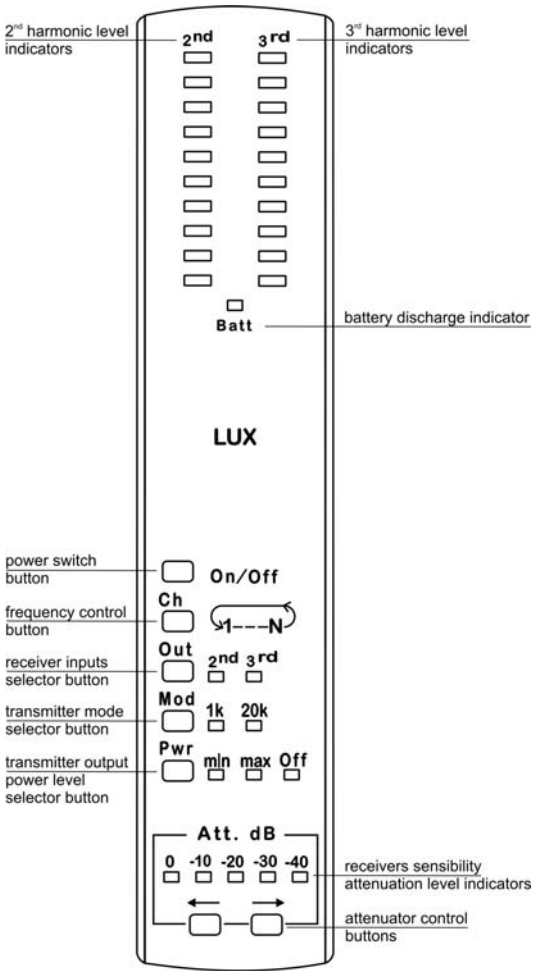

Fig. 1

The following connectors are provided at the end face of the battery module:

- battery charger connector;
- headphones connector.

6. Marking and seals

6.1. A marking **LUX** is present at the device control panel.

7. Packaging

7.1. The device and its accessories are packed in a dedicated back made of high-strength material.

8. General operation guidelines

8.1. The present Manual states the main operation rules for the LUX device and constitutes a set of official guidelines for all personnel directly related to the device operation.

8.2. All personnel admitted to the device operation must read and understand the Technical Description and User's Manual prior to the use of the device.

8.3. The LUX device is a complex electronic apparatus requiring careful handling while operated.

9. Safety measures

9.1 During the device operation, observe safety rules applicable to devices containing open radio-frequency radiation sources.

9.2. Radiation emission levels were evaluated by measurements of power flux density produced by the device at the operator location. Measurements were carried out according to methods approved by Russian Sanitary and Epidemiological Service (SES) using dedicated apparatus for checking electromagnetic field levels at the workplaces of personnel operating radioelectronic devices. The electromagnetic power flux density at 0.5 m from the antenna back face at the maximum transmitter output power (average power of 200 mW) was found to be equal to 4.2 μW/cm. At the minimum transmitter output power (average power of 20 mW), the power flux value did not exceed the level existing noise level (about 0.5 μW/cm).

According to the Sanitary Standard 2.24/2.1.8.055–96 (*Radio-Frequency Range Electromagnetic Radiation. Sanitary Standards and Guidelines*), power flux density must not exceed 10 μW/cm at residential development areas, public rest areas, and other locations open for people unrelated to the operation of radioelectronic devices. For personnel operating radioelectronic devices, the allowed duration of stay in the hazardous area at the power flux density of 25 μW/cm must not exceed 8 hours a day.

Note: According to GOST 12.1.006–84 standard, the maximum permissible value of electromagnetic radiation flux in the area of possible operator location is equal to 200 μW·h/cm.

10. Getting ready for operation

10.1. After the unpacking or a long-time storage of the device, inspect it visually in order to make sure it has not sustained any mechanical damage.

10.2. If the device has been brought from outdoors in frosty weather, keep it indoors for at least 2 hours before unpacking.

10.3. Check the device package completeness. If necessary, recharge the batteries. Battery recharging should be performed according to the manual provided with the battery charger.

10.4. Attach the battery module to the device using the screw(s) provided.

11. Operation sequence

11.1. Direct the device antenna away from the operator and other persons. Switch the device on by pressing the **On / Off** button. Red LED indicators will light.

11.2. Tune the device to eliminate the interference produced by cellular communication systems. To do so:

- switch the device transmitter off by pressing the **Pwr** button and holding it for 2 seconds; the **Off** LED indicator will light;

- press the **Ch** button until you find an interference-free channel (where the presence of the 2nd harmonic is not indicated);

- switch the device transmitter on by pressing the **Pwr** button and holding it for 2 seconds.

11.3. Check that the device is in working order. To do so:

- press the left (**–**) control button of receivers attenuators; the **0** LED indicator will light;

- set the transmitter output power control to **min**;

- select the orientation of the device antenna so that the low-frequency signal is not heard in the headphones, and LED indicators of harmonic levels do not light;

- without changing the antenna orientation, bring the 2nd harmonic imitator to the distance of 30–50 cm from the antenna. An audible signal will appear in the headphones, and one or more LEDs will light in the left-hand LED bar marked **2nd**;

- without changing the antenna orientation, bring the 3rd harmonic imitator to the distance of 30–50 cm from the antenna. An audible signal will appear in the headphones, and one or more LEDs will light in the right-hand LED bar marked **3rd**;

- set the output power level control to **max**, position the simulator(s) at the distance of 80–100 cm from the antenna, and repeat the testing sequence. An audible signal will appear in the headphones, and one or more LEDs will light in the indicator LED bar(s).

If all LEDs in both indicator LED bars light, it means that the indicator is overloaded; adjust the receiver sensibility levels by varying the positions of input attenuators. At lower receiver sensibility levels, the simulator detection distance may become shorter.

The device is now considered ready for operation. The transmitter output power level is selected by operator at will.

12. Recharging the battery

- Disconnect the battery from the device.

- Connect the charger to the **Rapid Charge** socket. The red LED will light at the charger indicator. The device battery is recharged for 1.5 hours, until the green LED lights.

13. Transportation and storage

13.1. The device can be transported in all passenger transportation vehicles.

13.2. The device should be stored in storage rooms providing the device protection from atmospheric precipitation. It should be stored in racks or kept in its packaging. Storage room atmosphere must be free from vapors of acids, alkalis and other aggressive substances.

13.3.Ambient air temperature in storage rooms where the device is kept should be in the range from –50 °C to +40°C with relative air humidity of 80% at 30°C.