M U L T I F U N C T I O N A L

NON-LINEAR JUNCTION DETECTOR

LORNET-STAR

USER MANUAL
& PASSPORT



1 · Introduction

The multifunctional non-linear junction detector “LORNET-STAR” (hereinafter referred to as the detector) is designed for the search and detection of electronic devices that are either active or switched off.

The operation of the detector is based on the property of semiconductor elements to re-radiate the second and third harmonics when irradiated by a probing microwave signal. The maximum response from semiconductor elements of artificial origin is observed at the second harmonic of the probing signal. When irradiating oxide films of natural origin, the maximum response falls on the third harmonic of the probing signal.

The detector allows analysis of the responses of irradiated objects both at the second and third harmonics of the probing signal, which makes it possible to identify electronic devices and natural oxide semiconductors.

The detector automatically finds the best frequency reception channel free from interference, which allows the instrument to operate even in a complex electromagnetic environment. The frequency tuning algorithm used in the detector automatically selects the probing signal frequency with the minimum interference level in the second-harmonic reception path.

The detector can be equipped with one to three Replaceable transmitter heads from the five available options:

- Transmitter head (option «08») of the 800 MHz range — allows operation in absorbing media with high humidity,
- Transmitter head (option «08s») of the 800 MHz range with a built-in spectrum analyzer — significantly improves identification of artificial and natural semiconductors,
- Transmitter head (option «24») of the 2400 MHz range — effective detection of small-sized (less than 1 cm^2) semiconductor elements,
- Transmitter head (option «24s») of the 2400 MHz range with a built-in spectrum analyzer — significantly improves identification of artificial and natural semiconductors,
- Transmitter head (option «36m») of the 3600 MHz range — remote detection with spatial target selection.

The detector has a removable telescopic pole that easily converts the instrument from an inspection device into a search device and back.

The applied digital processing of the demodulated signal provides high sensitivity.

The detector provides two types of radiated signals:

- Continuous radiation (or pulse modulation with a small duty cycle) of the carrier frequency (CW);
- Pulse modulation of the carrier frequency with a high duty cycle (Pulse).

This makes it possible to combine long detection range with reliable identification of detected devices.

The detector can simultaneously display the levels of the received second- and third-harmonic signals on the LED panel. In addition, the level of the second or third harmonic can be alternately evaluated by ear according to the click rate reproduced through the built-in loudspeaker or headphones.

The presence of an envelope detector of the re-radiated microwave signal allows, under continuous carrier-frequency radiation, acoustic detection of operating electronic devices that contain an acoustic transducer.

When option «24s» (or «08s») is used, it is possible to analyze signal spectrum of the 2nd and 3rd harmonics visually. In addition, option «24s» (or «08s») enables to evaluate reflecting level of the 1st harmonic increasing the possibility to detect shielding elements.

2 · Technical Parameters

Technical parameters depend on the type of Transmitter head used and are presented in the following table:

	Parameter	08	08s	24	24s	36м
2.1	Probing signal frequency range	788.5–790.5 MHz	—	2406–2414 MHz	2400.0–2415.2 MHz	3581.5–3607.5 MHz
2.2	Auto frequency step (min. interference criterion)	0.5 MHz	—	2 MHz	0.8 MHz	13 MHz
2.3	Max. probing power (peak)					
	Pulse mode (Pulse)	10 W	10 W	10 W	10 W	18 W
	Continuous mode	250 mW	250 mW	250 mW	250 mW	—
	Pulse mode, small duty cycle (CW)	—	—	—	—	6 W
2.4	Manual power adjustment range	(20 ± 5) dB	(20 ± 5) dB	(20 ± 5) dB	(20 ± 5) dB	(20 ± 5) dB
2.5	Receiver tuning frequencies = 2× and 3× transmitter frequency	Yes	Yes	Yes	Yes	Yes
2.6	Receiver sensitivity (not worse than)	−107 dBm	−107 dBm	−107 dBm	−107 dBm	−107 dBm
2.7	Battery life (pulse / continuous, max power)	3 h / 1.5 h	3 h / 1.5 h	3 h / 1.5 h	3 h / 1.5 h	2.5 h / 1.5 h
2.8	Weight (inspection version)	≤ 1.5 kg	≤ 1.5 kg	≤ 1.5 kg	≤ 1.5 kg	≤ 1.5 kg
2.9	Weight of telescopic pole	≤ 400 g	≤ 400 g	≤ 400 g	≤ 400 g	≤ 400 g
2.10	Operating temperature range	+5 … +40 °C	+5 … +40 °C	+5 … +40 °C	+5 … +40 °C	+5 … +40 °C

3 · Detector set, Design and Accessories

3.1 Delivery Variants

Depending on the number and type of required Replaceable transmitter heads (RTH), the detector can have 17 delivery variants:

#	Delivery Set Name	Contents
1	LORNET-STAR (08)	One RTH at 800 MHz
2	LORNET-STAR (08s)	One RTH at 800 MHz with spectrum analyzer
3	LORNET-STAR (24)	One RTH at 2400 MHz
4	LORNET-STAR (24s)	One RTH at 2400 MHz with spectrum analyzer
5	LORNET-STAR (36m)	One RTH at 3600 MHz
6	LORNET-STAR (08s/24)	Two RTHs at 800 and 2400 MHz
7	LORNET-STAR (08/24s)	Two RTHs at 800 and 2400 MHz with spectrum analyzer
8	LORNET-STAR (08/36m)	Two RTHs at 800 and 3600 MHz
9	LORNET-STAR (08s/24)	Two RTHs at 2400 and 800 MHz with spectrum analyzer
10	LORNET-STAR (08s/24s)	Two RTHs at 800 and 2400 MHz with spectrum analyzers
11	LORNET-STAR (08s/36m)	Two RTHs at 3600 and 800 MHz with spectrum analyzer
12	LORNET-STAR (24/36m)	Two RTHs at 2400 and 3600 MHz
13	LORNET-STAR (24s/36m)	Two RTHs at 3600 and 2400 MHz with spectrum analyzer
14	LORNET-STAR (08/24/36m)	Three RTHs at 800, 2400 and 3600 MHz
15	LORNET-STAR (08/24s/36m)	Three RTHs at 800, 3600 and 2400 MHz with spectrum analyzer
16	LORNET-STAR (08s/24/36m)	Three RTHs at 2400, 3600 and 800 MHz with spectrum analyzer
17	LORNET-STAR (08s/24s/36m)	Three RTHs at 800, 2400 with spectrum analyzers and 3600 MHz

3.2 Set of the Detector

The detector consists of the units, devices and accessories listed below:

#	Item	Qty	Note
1	Replaceable transmitter head (RTH)	1–3	According to delivery set 3.1
2	Control unit	1	
3	Removable telescopic pole	1	
4	Li-ion battery packs (12 V) BAT series (411, 412, 414)	2	
5	Battery charger AL 1115 CV	1	
6	Headphones	1	
7	User manual, passport	1	
8	Packaging	1	“Lornet Star 24” hard case (sets 1–4) or “Lornet 36” backpack (sets 5–17)



3.3 Appearance of Components

The appearance of the detector components is shown in Figure 1.



Fig. 1 — Component overview

1. Replaceable transmitter head AM//08 at 800 MHz
2. Replaceable transmitter head AM//08s at 800 MHz with spectrum analyzer
3. Replaceable transmitter head AM//24 at 2400 MHz

4 Replaceable transmitter head AM//24s at 2400 MHz with spectrum analyzer

5 Replaceable transmitter head AM//36м at 3600 MHz

6 LED indicators

7 Graphic LCD indicator

8 Detachable connection

9 Control unit

10 Control panel

11 Li-ion battery pack (12 V, 2.5 Ah) BAT series (411, 412, 414)

12 Battery charger (AL 1210 CV)

13 Telescopic pole

14 Headphones

15 Built-in speaker

16 Headphone jack

4 · Purpose of the Main Units and Blocks

4.1 Any Replaceable transmitter head performs:

- Analysis of the interference load of the radio-receiving path (performed each time the transmitter is switched on) and automatic selection of the optimal operating channel. In a complex electromagnetic environment it is recommended to periodically switch the transmitter off and on again to re-select the optimal frequency.
- Generation of the microwave signal, reception and digital processing of the second- and third-harmonic signals. Simultaneous indication of both harmonic levels makes it possible to reliably distinguish artificial semiconductors (electronic devices) from natural corrosion junctions.
- Demodulation of the second- and third-harmonic responses and amplification to a level suitable for headphones or the internal speaker. Volume is adjustable; the operator listens to the two harmonics alternately.

4.2 Transmitter head with LED Indicators (//08, //24, //36м)

Indicates the probing-signal power level and the levels of the received second- and third-harmonic signals (see Fig. 2).

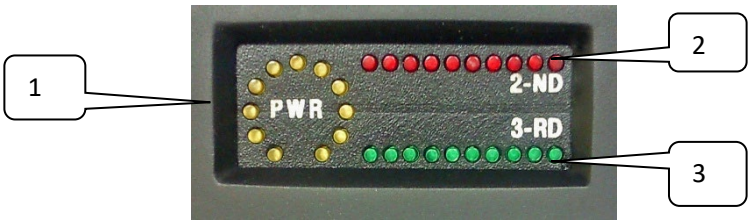


Fig. 2 — LED indicator scales

1 Probing-signal power level

2 Received 2nd-harmonic level

3 Received 3rd-harmonic level

4.3 Transmitter head with Spectrum Analyzer (//08s, //24s)

Provides indication on a graphic display. Fig. 3 shows the possible presentation forms of transmitter power, harmonic levels, spectra and reflected first-harmonic level.

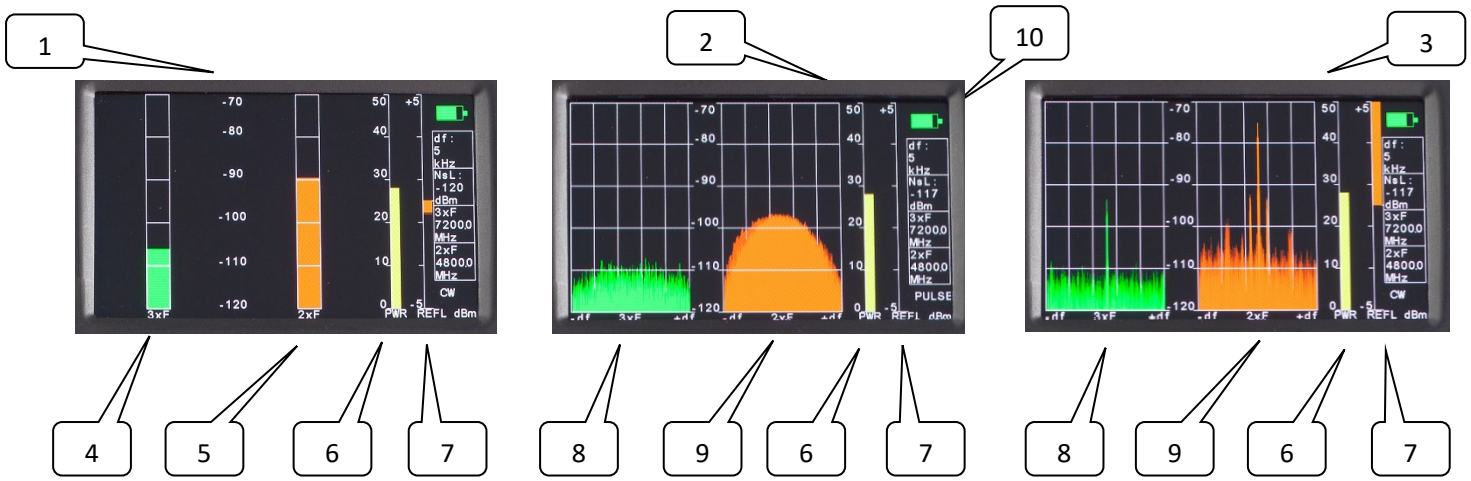


Fig. 3 — Display modes

1. Bar-graph indication of 2nd and 3rd harmonics
2. Spectrum analysis of 2nd & 3rd harmonics (pulse mode)
3. Spectrum analysis of 2nd & 3rd harmonics (continuous mode)
4. 3rd-harmonic level scale (green)
5. 2nd-harmonic level scale (red)
6. Probing-signal power scale (yellow)
7. Reflected 1st-harmonic level scale (red)
8. 3rd-harmonic spectrum (green)
9. 2nd-harmonic spectrum (red)
10. Battery charge level indication

4.4 Articulated Connection

The articulated connection of the Transmitter head with the detachable joint (Fig. 4) allows convenient positioning of the antenna for inspection and search work.

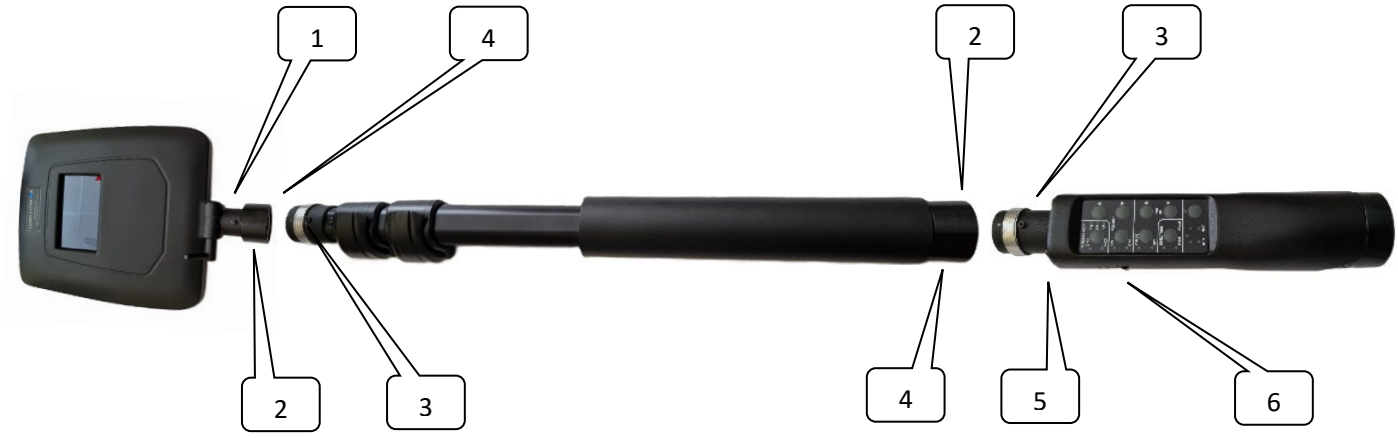


Fig. 4 — Articulated joint

1. Articulated connection
2. Connector (fixed-contact side)
3. Connector (spring-contact side)
4. Clamping nut
5. Built-in speaker

6 Headphone jack

4.5 Detachable Connections

The detachable connections between the Transmitter heads, the control-unit handle and the telescopic pole allow the operator to convert the detector quickly from an inspection instrument into a search instrument and back.

4.6 Control Unit

The control unit houses the control board, mode buttons and indication LEDs. It also serves as the handle and contains the interchangeable battery pack. The control panel is shown in Fig. 5.



Fig. 5 — Control panel

1 2nd-harmonic listening indicator

2 2nd / 3rd harmonic listening switch

3 3rd-harmonic listening indicator

4 Built-in speaker listening indicator

5 Speaker / headphones switch

6 Headphones listening indicator

7 Pulse-mode indicator

8 Mode cycle button: Pulse → Continuous (AM) → Continuous (FM) → Pulse

9 Continuous-mode indicator

10 Spectrum-analysis mode indicator

11 Bar-graph indication mode indicator

12 Transmitter on/off button

13 Receiver attenuator indicator

14 Pulse-mode listening indicator

15 Volume up

16 FM-demodulator listening indicator

17 AM-demodulator listening indicator

18 Volume down

19 Transmitter power up

20 Transmitter power down

21 Power on/off & attenuator control

4.7 Indicator Functions

Continuous lighting of any indicator = “on”; absence of lighting = “off”. Simultaneous flashing of all control-unit indicators signals that the battery is discharged and must be charged.

4.8 Battery Charging

Charging is performed with the supplied charger (or any charger intended for BAT 411 batteries). A red LED on the charger lights during charging; it turns green when the battery is fully charged. Typical charge time for a fully discharged pack is approximately 1.5 hours.

4.9 Headphones

Headphones are connected to the jack on the control unit.

5 · Safety Instructions

5.1 The detector is classified as Class I equipment under IEC 61140 (protection against electric shock is provided by basic insulation and a protective earth connection).

5.2 Only persons who have been instructed in safety rules when working with electrical appliances and radio-measuring instruments that have open radio-frequency energy radiators are allowed to work with the instrument.

6 · Operating Procedure

6.1 Remove the detector from the packaging. Charge the battery if necessary. If the product was transported at a negative temperature, keep it at room temperature for at least 30 minutes before switching on.

6.2 Power-on (Options «08s» and «24s»).

Press button (5-21). Four indicators light (5-1, 5-4, 5-7, 5-14), showing that the detector is ready for pulse mode with speaker listening of the 2nd-harmonic response. These initial conditions can be changed:

- Button (5-2) — switch between 2nd and 3rd harmonic listening,
- Button (5-5) — switch between built-in speaker and headphones,
- Button (5-8) — cycle modes: Pulse → Continuous (AM) → Continuous (FM) → Pulse.

6.3 Transmitter on (Options «08s» and «24s»). — bar-graph mode

Press button (5-12). Pulse mode with bar-graph indication starts. On the display the operator can monitor transmitter power, 2nd- and 3rd-harmonic levels. Power is adjusted with buttons (5-19)/(5-20); volume with (5-15)/(5-18).

Button (5-8) switches to continuous mode (AM demodulator). Scale (3-7) now shows the reflected 1st-harmonic level (useful for detecting reflecting materials). A second press of (5-8) selects the FM demodulator; a third press returns to pulse mode.

6.4 Transmitter on 6.3. (Options «08s» and «24s»). — spectrum mode

A second press of (5-12) keeps pulse mode but switches the display to spectrum analysis of the 2nd and 3rd harmonics. Button (5-8) again cycles through continuous modes with spectrum display. A further press of (5-12) switches the transmitter off and triggers automatic noise analysis / frequency selection for the next activation.

6.5 Power-on (Options «24» and «36m».)

Press button (5-21). Indicator (5-13) briefly shows battery state; three indicators (5-1, 5-4, 5-7) remain lit. On the antenna unit one yellow LED (maximum power) lights. Initial conditions can be changed with the same buttons as above; power can be pre-set with (5-20).

6.6 Transmitter on 6.6. (Options «24» and «36m»).

Press button (5-12). Pulse mode with automatic power adjustment starts. The radiated power follows the 2nd-harmonic (or 3rd-harmonic if selected) response level. Manual power control is available via (5-19)/(5-20). Button (5-8) toggles continuous (CW) mode. A further press of (5-12) switches the transmitter off and re-selects the quietest frequency.

6.7–6.8 Transmitter head «08»

Operation is analogous to the «08s» sequence, but indication is performed on the LED scales of the antenna unit instead of a graphic display. The same mode-cycling and listening options are available.

6.9 In rooms containing many electronic devices it is recommended to work at reduced probing-signal power. Optimal level is selected experimentally.

6.10 Simultaneous flashing of all indicators (or a colour change of the battery icon on the display) signals a discharged battery. Switch the unit off, remove the pack and charge it.

6.11 To listen via headphones insert the plug into the jack on the control unit.

6.12 Switch the product off by a long (2–3 s) press of button (5-21).

Attention!

1) Always monitor battery state and charge it in good time. Store the detector with a charged battery.

2) Charge only with the supplied (or approved BAT-411) charger; non-standard chargers are strictly prohibited.

7 · Search Recommendations

7.1 If possible, remove existing electronic devices from the controlled room. Otherwise conduct the inspection at reduced radiation power.

7.2 Set maximum output power and select a receiver mode.

7.3 Evaluate response levels both by the number of illuminated LEDs / bar-graph / spectral density and by the click rate in the speaker or headphones.

7.4 For precise localisation reduce transmitter power or receiver sensitivity (ATT button).

7.5 An artificial p-n junction typically produces a stable response predominantly at the second harmonic; tapping the location does not change the reading.

7.6 A natural (corrosion) p-n junction produces a stable response predominantly at the third harmonic; intensive tapping usually changes the reading.

The proposed method is recommendatory and does not cover every practical nuance.

CERTIFICATE

1 · General Instructions

1.1 Before operation carefully read the user manual of the multifunctional non-linear junction detector “LORNET-STAR”.

1.2 The passport is part of the delivery set and must always accompany the product.

1.3 When the product is sent for repair or transferred, the passport must travel with it.

1.4 Entries in the passport must be made promptly.

1.5 All entries must be made in ink, clearly and neatly. Erasures, blots and uncertified corrections are not permitted.

1.6 Notes or entries on the margins or cover of the passport are forbidden.

2 · Delivery Set

2.1 Delivery Variants

#	Item	Qty	Note
1	Replaceable transmitter head (RTH)	1–3	According to delivery set 3.1
2	Control unit	1	
3	Removable telescopic pole	1	
4	Li-ion battery packs (12 V) BAT series (411, 412, 414)	2	
5	Battery charger AL 1115 CV	1	
6	Headphones	1	
7	User manual, passport	1	
8	Packaging	1	“Lornet Star 24” hard case (sets 1–4) or “Lornet 36” backpack (sets 5–17)

2.2 Composition of the Product

#	Delivery Set Name	Contents
1	LORNET-STAR (08)	One RTH at 800 MHz
2	LORNET-STAR (08s)	One RTH at 800 MHz with spectrum analyzer
3	LORNET-STAR (24)	One RTH at 2400 MHz
4	LORNET-STAR (24s)	One RTH at 2400 MHz with spectrum analyzer
5	LORNET-STAR (36m)	One RTH at 3600 MHz
6	LORNET-STAR (08s/24)	Two RTHs at 800 and 2400 MHz
7	LORNET-STAR (08/24s)	Two RTHs at 800 and 2400 MHz with spectrum analyzer
8	LORNET-STAR (08/36m)	Two RTHs at 800 and 3600 MHz
9	LORNET-STAR (08s/24)	Two RTHs at 2400 and 800 MHz with spectrum analyzer
10	LORNET-STAR (08s/24s)	Two RTHs at 800 and 2400 MHz with spectrum analyzers
11	LORNET-STAR (08s/36m)	Two RTHs at 3600 and 800 MHz with spectrum analyzer
12	LORNET-STAR (24/36m)	Two RTHs at 2400 and 3600 MHz
13	LORNET-STAR (24s/36m)	Two RTHs at 3600 and 2400 MHz with spectrum analyzer
14	LORNET-STAR (08/24/36m)	Three RTHs at 800, 2400 and 3600 MHz
15	LORNET-STAR (08/24s/36m)	Three RTHs at 800, 3600 and 2400 MHz with spectrum analyzer
16	LORNET-STAR (08s/24/36m)	Three RTHs at 2400, 3600 and 800 MHz with spectrum analyzer
17	LORNET-STAR (08s/24s/36m)	Three RTHs at 800, 2400 with spectrum analyzers and 3600 MHz

3 · Warranty Obligations

3.1 Warranty period — 12 months from the date of transfer to the Customer.

3.2 Life time is 6 years.

3.3 Within the warranty period, provided the rules of operation, transportation and storage have been observed, the manufacturer shall perform free repair or replacement.

3.4 Warranty obligations do not cover power-supply elements.

4 · Certificate of Acceptance

Multifunction Non-Linear Junction Detector

LORNET-STAR

Serial numbera:

Control panel (CP) № 10 _____
Transmitter head (TH «08») № 5 _____
Transmitter head (TH «08s») № 6 _____
Transmitter head (TH «24») № 7 _____
Transmitter head (TH «24s») № 8 _____
Transmitter head (TH «36m») № 9 _____

Is manufactured and accepted according to obligatory requirements of state standards, current technical documentation and is fit for service.

Technical Inspection

Stamp Signature Name Date

№	Option	
1	08	
2	08s	
3	24	
4	24s	
5	36m	
6	08/24	
7	08/24s	
8	08/36m	
9	08s/24	
10	08s/24s	
11	08s/36m	
12	24/36m	
13	24s/36m	
14	08/24/36m	
15	08/24s/36m	
16	08s/24/36m	
17	08s/24s/36m	

5 · Certificate of Packaging

Multifunction Non-Linear Junction Detector № _____
Serial number

LORNET - STAR

Packaged by: "ELVIRA" Production JSC

according to the requirements stated in the given technical documentation.

Title Signature Name Date

№	Option	
1	08	
2	08s	
3	24	
4	24s	
5	36m	
6	0824	
7	08/24s	
8	08/36m	
9	08s/24	
10	08s/24s	
11	08s/36m	
12	24/36m	
13	24s/36m	
14	08/24/36m	
15	08/24s/36m	
16	08s/24/36m	
17	08s/24s/36m	

6 · Information on Claims

In the event of damage to the packaging during transportation, claims shall be submitted to the organization performing the transportation.

In the event of incomplete delivery or damage to the detector with intact packaging, an act is drawn up jointly with a representative of the manufacturer.

If a defect appears within the warranty period, the consumer must send the detector to the manufacturer with a covering letter stating the reason for the claim. All claims are recorded in the table below.

Content of the claim	Reason / measures taken	Note