



**Predix  
Microwave Barrier Detection  
System**

**Installation Guide and  
Operating Manual**

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The current operating manual contains information on the purpose, construction, operating principle, technical features and composition of the “**Predix**” Microwave Barrier Detection System and its implementation versions (hereinafter referred to as ‘the detector’) as well as its deployment and operation.

The current manual uses the following abbreviations:

- PS - power supply;
- RC - remote control;
- DZ - detection zone;
- SAP - set of assembly parts;
- CPS - computer programme for set-up;
- DB - distribution box (optional, available separately);
- TU - transmitting unit;
- RU - receiving unit;
- RCD - receiving – controlling device;
- IA - interlocking apron;
- SA - signal apron.

# 1 Description and work

## 1.1 Purpose of product

1.1.1 The detector is destined for use as tool for protective alarm system and it ensures the detection of people crossing the DZ and is characterised by small width required for the exclusion zone.

1.1.2 The detector forms the release of the alarming signal by opening the outgoing contacts of the final control relay when:

- a person crosses the DZ either at full height or bending down.

1.1.3 The detector allows functioning in non-prepared sections (non-mowed grass or uneven surfaces up to the height of 0.5 metres under the conditions mentioned in point 2.1.2.4.

1.1.4 The detector has five basic implementation versions in accordance with table 1.1.

Table 1.1

Name	Model
“ <b>Predix-50</b> ”	PREDIX-50/24
“ <b>Predix-100</b> ”	PREDIX-100/24
“ <b>Predix-200</b> ”	PREDIX-200/24
“ <b>Predix-300</b> ”	PREDIX-300/24
“ <b>Predix-400</b> ”	PREDIX-400/24

The detector “**Predix**” meets the execution of GOST 15150-69 U1 climatic implementation at temperatures ranging from 233 through 338°K (from minus 40 through 65°C), and also meets the European ‘CE’ safety standard.

1.1.5 The detector provides information about the malfunction by disconnecting the outputs of the final control relay until the elimination of such malfunctioning when:

- the malfunction occurs at the RU;
- in case of sabotage attempts screening is done by radiation with radio reflecting (radio absorbing) materials.

1.1.6 The detector grants uninterrupted nonstop work and retains its ability to operate and does not release information about the alarm in case of:

- exposure to rain and snow up to the intensity of 40 mm/h;
- exposure to sunrays;
- exposure to wind with a velocity of 30 m/s;
- surface unevenness up to height of 0,3 m;
- grass cover up to the height of 0.3 m;
- snow cover without additional controls up to the height of 0.3 m (where the snow cover is higher than 0.3m, the DZ must be cleared).

1.1.7 The detector is able to operate and does not release false alarm in case of the separated effects of the following sources of disturbance:

a) movement of a person at the following distances from the DZ axis, not less than:

- 1.0 m for area length of 50 m;
- 1.2 m for area length of 100 m;
- 1.8 m for area length of 200 m;
- 2.0 m for area length of 300 m;
- 2.5 m for area length of 400 m;
- movement of motor vehicle at the following distances from the DZ axis,

not less than:

- 2.2 m for area length of 50 m;
- 2.5 for area length of 100 m;
- 2.8 m for area length of 200 m;
- 3.0 m for area length of 300 m;
- 3.5 m for area length of 400 m;

b) movement into the DZ of single small animals (birds) at a distance of more than 3 m from the TU or RU;

c) radiation of 433 MHz range radio stations and mobile telephones at a distance of more than 0.5 m from the TU or RU;

**Note – Here and hereinafter: DZ axis – straight line, connecting the TU and RU centres.**

1.1.8 The detector has the ability to select the parameters of the operating signal, specifically, of the frequency channel, in order to reduce the interaction of neighbouring detectors with the help of the tuning software (TS), working on a personal computer. It is possible to set up two detectors in parallel.

1.1.9 The detector provides the setting of all parameters and signals with the help of the tuning programme, working on a personal computer.

1.1.10 The detector is protected against the reversal of polarity of the supply voltage resulting from the faulty operations of staff and against spikes with voltage up to 1000 V for up to 1 ms, generated in the power lines during storms.

1.1.11 The electric supply of the detector comes from the source of constant current with a nominal voltage from 12 to 36 VDC at a fluctuation not higher than 0.1 V.

## 1.2 Technical features

1.2.1 The technical features of the detector are presented in table 1.2.

Table 1.2

Parameter	Value
DZ length, m	1-400
Minimum required level of the signal received at the maximum length of the DZ, dB	8
Minimum DZ height along an area of 300 metres, m	1.5
Range of detection speeds, m/s	from 0.1 to 10.0
Range of working supply voltage, VDC	from 12 to 36
Maximum current required at the working supply voltage of 24V, mA:	
a) "Predix" TU	80
б) "Predix" RU	100
Maximum operable time after the supply is switched on, s	10
Maximum recovery time of the stand-by system after notification of an alarm, s	10
Parameters of signal, switched with the contacts of the output circuit:	
- maximum current, constant or alternate, mA;	30
- maximum amplitude voltage, V	72
RC signal parameters:	
- maximum input resistance of the circuit, kOhm;	5
- impulse voltage, V;	10-30
- maximum impulse duration, s	0.5
Minimum signal duration, s	5
Operating frequency, GHz	24.00 ... 24.25
Overall dimensions of RU (TU) with bracket, mm	165x165x100
Maximum weight of the packaged detector, kg	1.5
Minimum average service life of the detector, years (warrantied)	2

### 1.3 Package contents

1.3.1 Package contents are presented in table 1.3.

Table 1.3

Item	Quantity
TU kit	1
RU kit	1
Brackets kit for placing the RU and TU on stands	2
Protective cable housing	2 (X 1m.)
Operating manual	1

## **1.4 Installation and operation**

### **1.4.1 The principle of operation of the detector.**

TU and RU are placed at the opposite ends of the guarded area. TU emits electromagnetic waves in the direction of RU. RU receives these waves, processes them into an electric signal and analyses this signal.

The person who crosses the DZ, triggers the modulation of the signal at the entry of the RU. The depth of the modulation and the form of signal depend on the size and mass of the person, the place where the area is crossed, the relief of the land and the speed of movement.

If the person moves close to the antenna (closer than 15 ... 20 m), the signal comes with the release of a one-off, unpleasant emission of very deep modulation.

If the person moves on to a distance of more than 15 ... 20 m from the antenna, the signal comes with several sequentially alternating positive and negative emission of low depth modulation and with this the interval between the neighbouring positive and negative emissions and the duration thereof depend on the speed of the person's movement. The analysis of the temporary and amplitude characteristics of the signal is contained in the algorithm of processing.

The evaluation of the modulation level of the input signal is made according to three threshold levels:

- basic threshold – is surpassed when the signal is increased;
- low threshold – the first control level, overcome when the signal is decreased;
- high threshold – the second control level, overcome when the signal is decreased.

When a person crosses the area near the antenna, the high threshold is overcome, generating a signal about the alarm.

When a person crosses the area far from the antenna, the depth of the negative modulation is decreased and the high threshold is not overcome but then the basic and low thresholds are continually overcome. If the temporary intervals between these events correspond to the calculated temporary thresholds, an alarm signal is generated, too.

The detector has two systems for the regulation of thresholds: “automatic” and “manual”. In the automatic system, the processor provides the optimal characteristics for the detection of persons, crossing the DZ on the ground surface. In the manual system the negative threshold as it becomes more and more significant is set up by the operator. As a rule, the need for manual regulation arises in case of change in the operating conditions specified by this manual.

It is worth mentioning that in the automatic system the threshold is determined in dB in relation to the average level of the radio signal received. To this end, the detector adapts itself to the slow changes in the level as determined by the weather conditions.

An important feature of the detecting algorithm of the detector is the facility to set up the upper detecting speed at which the trespasser overcomes the border.



The selection of the particular parameter is made by the user depending on the usage conditions of the detector.

Three values for the highest speed can be set up in the alarm system: 0.5 m/s; 2 m/s; 10 m/s. Recommendations for the selection of the particular parameter are presented in the table.

Table 1.9

Usage conditions of the detector	Recommended value for the upper detecting speed
Open space without any engineering facilities, hindering the movement of the trespasser	“high” (~10 m/s)
Inadequately guarded border (small fence, space near the buildings and walls, shrubby obstructions and so on)	“average” (~2m/s)
Properly guarded border (the top or the wall of a high fence where the movement speed of the trespasser is limited significantly)	low” (~0.5 m/s)

Selecting the right value allows to reduce substantially the probability of false responses of the alarm system, generated by flying birds and other disturbing factors.

The detector has 251 independent frequency channels (from 0 through 250). The difference in frequency between two neighbouring channels makes up 1 MHz. The complete range of all channels extends from 24.00 to 24.25 GHz. The released frequency of channel 0 is 24.000 GHz, and that of channel 10 is 24,010 GHz and that of channel 250 is 24.250 GHz. The selection of the frequency channel is made with the help of tuning software. It is essential for the normal operation of the detector to set up the same frequency channels in the TU and in the RU.

**It is worth taking into account that there are exceptions from the general rules. Specifically, it is possible to organise the normal working of the detector in case the number of the frequency channel of the transmitter is by 6 numbers more than the frequency channel of the receiver. It means that if 10 channels are used in the TU, its signals will be detected by the RU with 10 as well as 4 channels. The particular circumstance must be considered in case of parallel connection of several detectors.**

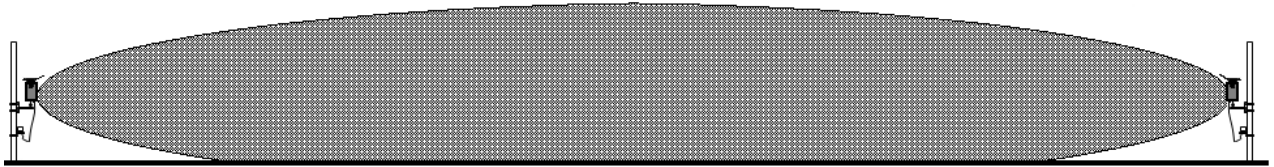
Apart from this, the RU indicator indicates in the initial and constantly switched on system of the **indications of the detector**:

- alarm signal for 5 seconds;
- signal about the fault, namely: lack of signal at the entry of the RU, outage of the TU or RU, flashing of the RU by powerful sources of radio noise and in several other cases for more than 30 s;

The order of using these controls is described additionally in the corresponding points of subsection “Regulating and testing of the operation of the detector”.

Special feature of the construction, ensuring the original functional properties of the detector is the very narrow diagram of the direction of the antennas. This feature ensures increased resistance to the moving objects within the direct vicinity of the DZ axis. The relatively high working frequency also determines a small width of the DZ.

A sample view of the DZ form for a 300 m long land is shown on drawing 1.1.



Drawing 1.1 – Sample view of the DZ form

#### 1.4.2 The construction of the detector

In terms of construction, the detector is executed in the form of two separate units, which are identical in size and appearance.

The appearance of the RU (TU) and the optional DBs, set up on the stand is shown on drawing 1.2.

To fulfil the adjustment it is necessary to preliminarily loosen the fixing nut and to tighten it upon the end of the operation. The RU (TU) on the pipe is set up with the help of the SAP. The recommended diameter of the pipe is 50 to 90 mm.



Drawing 1.2 – Setting up the RU (TU) and the optional DB on the stand

## **1.5 Marking and sealing**

1.5.1 The marking of the RU and TU of the detector contains:

- the trade mark of the manufacturing company,
- name of the detector
- conditional destination of the units (TU or RU),
- factory serial number,
- year and quarter of manufacturing.

1.5.2 The marking of the optional distribution box contains:

- conditional destination (KP-Y1 or KP-Y1-C),
- factory serial number,
- year and quarter of manufacturing.

1.5.3 The marking of the consumer package of the detector contains:

- name of the detector;
- TY number;
- the trade mark of the manufacturing company;
- factory number of the detector;
- year and month of packaging;
- OTK stamp.

## **1.6 Packaging**

1.6.1 Detector units (RU and TU), DB are packed in boxes from corrugated card-board.

1.6.2 The SAP-1 is placed into the box with the detector units.

1.6.3 The SAP-3 is packed using wrapping paper, corrugated card-board and polyethylene film.

1.6.4 The documentation about operation of the alarm is placed in the box with the units of the detector.

## 2 Proper use

### 2.1 Preparing the product for use

#### 2.1.1 Safety measures in preparing the product

When carrying out the work for preparing the detector for use as well as in using it, the current rules on technical safety have to be observed in the use of electric installations with a voltage up to 1000 V.

The emission level of the TU of the detector, in accordance with the effective norms for personal safety of those, who are professionally not connected with CBЧ, allows non-stop working, contemplated by this manual (without limitation of time).

#### 2.1.2 Requirements as to the place of assembly of the detector.

**Attention! The reliability of the operation of the detector depends on the fulfilment of the following requirements.**

##### 2.1.2.1 General requirements as to the place of assembly:

- no water flow from the roofs is allowed in the direct vicinity of the detector units (in the direction of the emission at a distance up to 5 m and up to 0.25 m from sideways);

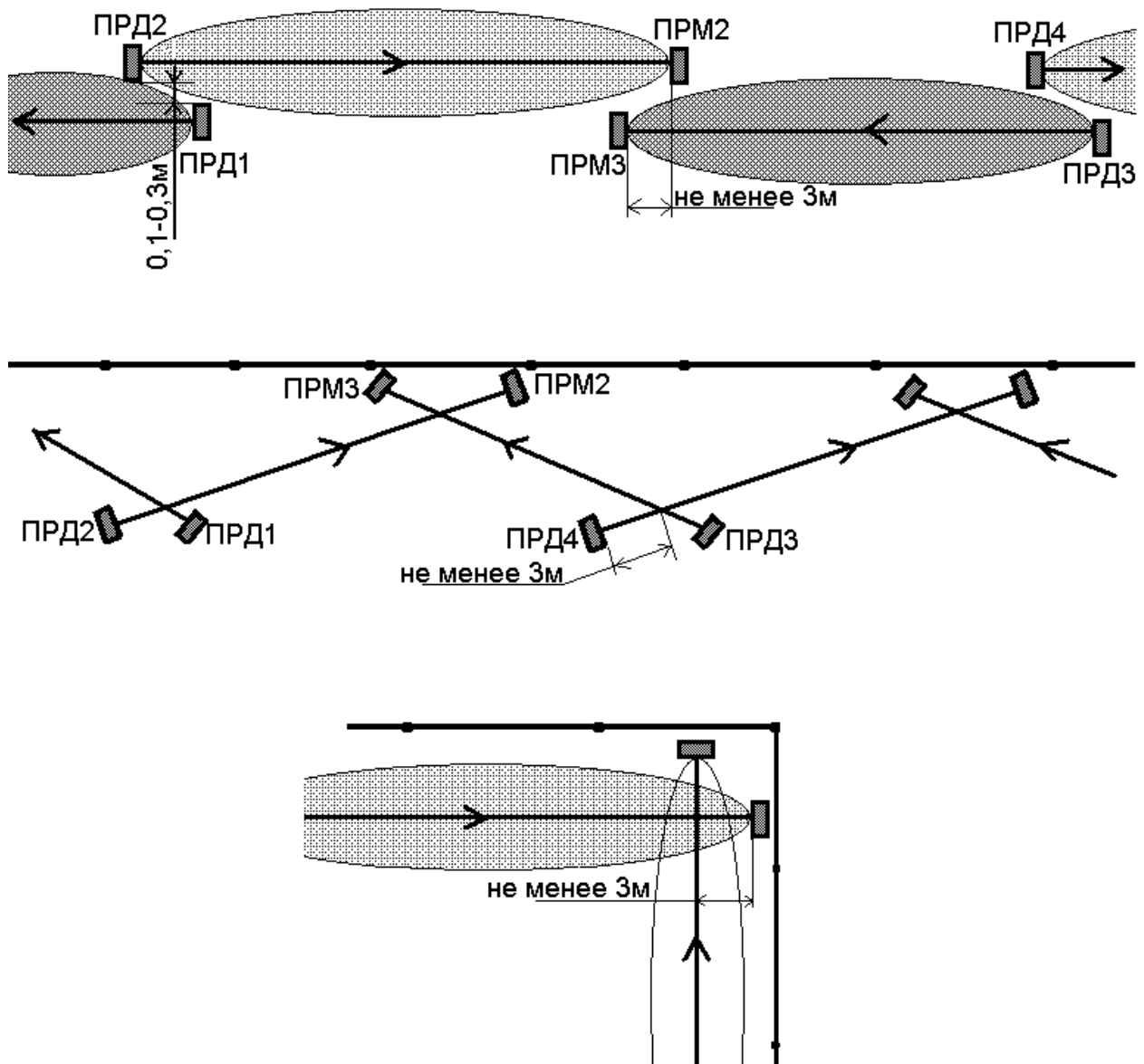
- it is necessary to provide an exclusion zone where the presence of bushes and branches of trees as well as of big, immovable objects and building structures is not allowed. Movement of tractors, people and animals is not allowed. The width of the exclusion zone for various application versions is shown below;

- the borders of car roads and railways, big, immovable objects and structures, forest sections have to be outside of the zone at a distance twice as big as the exclusion zone. In the event the detector units or the adjacent structures are exposed to the vibrations of passing traffic, the indicated distance has to be specified accurately by way of experimenting.

Comment – No requirements are shown in respect of the area for the limits of non-radio transparent (metal, ferroconcrete and so on) walls and barriers.

In case of installation near electric wires, the installation places of the units have to be moved to a distance of at least 5 m from the wires up to 35 kV and 10 m at voltages up to 500 kV. It is recommended to build the trace lines of the external connection in a subterranean way where they are located close to the electric wire.

Where several detectors are set up consecutively to exclude trespassing of the DZ under or above the places of the units, it is recommended to ensure the overlapping of adjacent sections at a distance of at least 3 m. In this case the units of the same name (TU or RU) have to be placed side by side. Set up examples are presented on drawing 2.1.



<sup>1</sup> ПРД= TU; ПРМ=RU; не менее = not less than

Drawing 2.1 – Set up examples in adjacent sections

The horizontal distance from the DZ axis to the border of the exclusion zone has to make up:

- at least 1.2 m for a section with a length up to 50 m,
- at least 1.5 m for a section with a length from 50 to 100 m,
- at least 2.0 m for a section with a length from 100 to 200 m,
- at least 2.5 m for a section with a length from 200 to 300 m,
- at least 3.0 m for a section with a length from 300 to 400 m.

In the exclusion zone the maximum height of the unevenness of the ground and the snow and grass cover shall not exceed 0.3 m.

Comment – The use of the detector is allowed in case the snow cover exceeds the indicated value where it has to be taken into account that the detector

may not detect a person moving within the snow cover. In such a case it is necessary to change the height of the set up of the units.

2.1.2.2 In case the abovementioned requirements are not complied with, the tactical characteristics of the detector may deteriorate. In such cases the question about the permissibility of the use of the detector under the particular conditions is determined by the usage experienced.

### 2.1.3 Assembly of the detector

#### 2.1.3.1 General recommendations

The installation of the detector must provide free access to the controls and the fastening elements. It is recommended to establish the connecting cables under the ground.

#### 2.1.3.2 Setting up the detector

In places where the height of the snow cover may exceed 0.5 m, the length of such parts of the posts (supports) for the fastening of the detector units as are above the ground shall not be less than 1.5 m. In areas with little snow it is allowed to reduce to 1.1 m the length of such parts as are above the ground.

There has to be provided the facility to shift the detector units along the support simply in case of seasonal adjustments. The initial height at which the units of the detector are set up is 0.8 m from the ground surface to the centre of the unit. The bracket has to be oriented on the support so that the directions of the emissions of the units were set one at the other.

It is recommended to use a metal pipe for support, with diameter from 50 to 90 mm. Where pipes of asbestos cement are applied, it is necessary to replace the regular collars. On soft soils, the support has to be set up on a foundation. The type and dimensions of the foundation are determined in view of the type of the soil and the weather conditions for the given region in order to prevent damage to the adjustment in carrying out the subsequent application.

Each unit of the detector on the chosen round support is produced with the help of two collars. The optional DB is fastened to the pipe with the help of the collar. The fastening of the RU and the optional DB to the support is shown on drawing 1.2.

- a) Prepare the well for setting up the box.
- b) Establish and strengthen the stand. Before laying the stand in concrete, place the pin in the hole in the lower part of the stand.
- c) Create and strengthen the box.
- d) Set up and fix the TU.

#### 2.1.3.3 Connecting

To connect the TU in the optional DB, the cable has to be entered through the hole in the foundation and the cable has to be fixed. The object cable is entered in the optional DB through the cable entry.

Separate the end of the object cable and connect it to the optional DB terminal. The RU and TU of the external circuits are connected to the optional DB in accordance with table 2.1 and 2.2.

Table 2.1 – Connecting the RU to the optional DB.

No.	Color of the output	Purpose of output
1	<b>Brawn</b>	Plus supply
2	<b>White</b>	Minus supply
3	<b>Shield of the cable (gen)</b>	RS-485
4	<b>Green (A)</b>	
5	<b>Yellow (B)</b>	
6	<b>Grey</b>	SA (output circuit)
7	<b>Pink</b>	SA (output circuit)

Table 2.2 – Connecting the TU to the optional DB.

No.	Color of the output	Purpose of output
1	<b>Brawn</b>	Plus supply
2	<b>White</b>	Minus supply
3	<b>Shield of the cable (Gen)</b>	RS-485
4	<b>Green (A)</b>	
5	<b>Yellow (B)</b>	

**Attention! The measuring (control) of the resistance of the circuits and the isolation of the current-carrying cores of the connecting cables can only be performed after the switching off of the voltage of the power supply of the detector and the disconnection of the circuits controlled.**

#### 2.1.4 Regulating and testing of the operation of the detector

2.1.4.1 Switch on the supply of the detector and check its voltage at the corresponding outputs of the units. The voltage can be checked by any measuring device that provides such measuring. The value measured, taking into account the required reserve for usage must be between 11.0 through 28 V.

2.1.4.2 After the power supply is switched on, it is necessary to carry out the regulation of the detector.

**Attention! In the settings schemes the detector generates signal about the malfunction (output circuit is disconnected)**



### 2.1.4.3 Selecting the settings scheme

To adjust the detector, loosen the fixing nuts of the TU and RU units. To reach the maximal indication of the signal level, turn consecutively the TU and the RU slowly and gradually, inspecting visually the direction of the emissions of the units.

#### Comments:

**1 In certain cases where the level of the received signal is insufficient (basically where the length of the section is close to the maximum), it is recommended to change sequentially the height of the settings of the TU and (or) RU in the range 0.7 to 1 m with 0.1 m steps with the subsequent adjustment of units (cm higher).**

**2 It has to be taken into account that in certain cases the maximum level of the signal received is achieved during the adjustment when the units are directed towards the nearest reflecting surfaces (fencing, ground surface and so on). In such cases it is not allowed to orient the units in the given direction.**

a) Upon the finishing of the adjustment, the fixing nuts of the units have to be tightened, not allowing to change the position (controlling the level of the signal received).

b) One of the causes of frequent false responses of the detector may be the impact on the RU of the emission of the TU of the neighbouring sections. Such impacts can be detected by switching off the power supply of the neighbouring TUs. In detecting the impacts it is necessary to change the frequency band of the detector. The change of the frequency band is performed **simultaneously in the RU and the TU** with the help of ПИ.

c) To realize the control of the functioning of the detector, the detector has to be set to “Work” scheme and the generation of alarm signals has to be controlled. To this end, it is necessary to perform controlling trespassing of the DZ along the entire section, selecting the places of passage in cavities and on elevations. In the event no signal is made when the DZ is trespassed, it is necessary to correct the threshold level with the method described below.

Comment – In setting the product, excluding the possibility of trespassing the section by the operator in the indicated ways, the trespassing of the section has to be carried out in ways and groups that are more likely for the penetration of the violator into the guarded zone (at the discretion of the service operation). In these cases it is allowed to use the imitator of the violator in the form of a square of non-radio transparent material with dimensions 0.6 x 0.6 m, transferring him horizontally, perpendicularly to the DZ axis.

**ATTENTION! To increase the noiseproof feature of the detector, it is necessary to establish the highest possible absolute value for the operating threshold.**

If the ПИ indicates noises (changes of the signal, not brought about by the movement of the person in the DZ), it is necessary to take measures to eliminate the sources thereof and if it is not possible, to change the place of setup, reducing the length of the section. Noises, carrying eventual, non-periodic character, may be

generated by the movement of objects, the vegetation swinging in the wind. The probable causes of noises with systematic, periodical character may be the impact on the RU of the emissions of the TU of the neighbouring sections. Such impacts may be indicated by switching off the power supply of the neighbouring TUs.

The setting of the detection threshold is done by determining its value, which is exceeded in each controlling instances of trespassing by the operator of the section. Each controlling instances of trespassing has to be performed with intervals not less than 20 s with a velocity of 0.5 through 3 m/s along the axis of the DZ, moving away from it to a distance of at least 4 m. The mass of the operator, performing the trespassing, has to be 50 to 80 kg and the height in the group, when bent, has to be 0.8 through 1 m. Herewith it is compulsory to perform the trespassing at the following places:

- in the middle of the section in both positions; at a distance of 15 through 20 m from the TU and the RU in both positions;
- in a bent position in cavities.

**ATTENTION! To increase the noiseproof feature of the detector, it is necessary to establish the highest possible absolute value for the operating threshold.**

2.1.4.4 After performing the regulation of the detector, put on its place the optional DB lid. Enable the RC (in case this function is used), giving a voltage of 10-30 V at the output “RC”, at which the detector has to release a signal about the alarm. In the utilisation process of the detector it is recommended to perform RC every 8 hours.

2.1.4.5 Carry out the testing of the work of the detector by non-stop test usage of the detector during a period not less than 3 days with the registration of all signals and by the subsequent analysis thereof. Perform the checking at least twice in 24 hours of the working ability of the detector by making controlling trespassing of the DZ.

In case false signals are indicated in the passing or in case of omissions in the controlling trespassing, it is necessary to eliminate the violations by using the instructions in subsection 2.2.2.