TRIBOELECTRIC FENCE
PROTECTION SYSTEM
“Quadrosense”

Operation Installation manual

2025.július

The Operation Installation Manual contains the information on the design and technical characteristics of the triboelectric fence protection system “Quadrosense” meant for perimeter areas (hereinafter referred to as protection system) as well as the information on its installation and use.

1. General information

1.1 Purpose

Triboelectric single-position passive and unmasked fence protection system “Quadrosense” with surface detection zone is designed for extended perimeter areas and is used as a stationary unit.
The protection system for perimeter fences mean to generate alarm signals after the local deformation/vibration of the fence and the sensitive element fastened to it in the case of an unauthorized penetration by climbing over the fence, without any facility, and as a result - deformation of the fence and the sensitive element over its fasteners.
The fence protection system ensures the monitoring of the sensitive element integrity (the element of triboelectric effect), the connecting element being checked as well. On their damage (short-circuit or broken element) the protection system generates an alarm signal on the fault.

1.2 Operating Conditions

The protection system is intended for continuous round-the-clock operation. Its performance is maintained within the set of normal values. The protection system does not generate the false “Alarm” signals on and after exposure to the outdoor environmental factors (OEF) given in Table 1.1.

Table 1.1

OEF	Description	Value
Acoustic noise	Is not regulated	
Elevated ambient temperature	Elevated operating temperature	+ 50 ºC
Low ambient temperature	Low operating temperature	- 40 ºC
Elevated humidity	Up to 98% at a temperature of +35 º C Is not regulated with a signal-processing unit (SPU) installed in the metal alarm cabinet	
Low humidity	Is not regulated	
Rain	Is not regulated	
Hoar-frost and ice-crusted ground	Thickness (at wind speed)	2 mm (10 m/s)
Dew	Is not regulated	
Blanket of snow	Is not regulated	
Fog	Of any intensity	
Saline (sea) fog	Of any intensity	
Dust (sand)	Particles circulation speed	10 m/s
	Dust (sand) flow density	5 kg/m2/s
Ultra-violet solar radiation	Is not regulated	
Wind	Mean wind speed	20 m/s
	Maximum wind speed value	30 m/s
Blizzards and sand-storms	Of any intensity	

Ground	Maximum sub grade slope for the fence		30 deg.
	Terrain irregularities along the fence axis		± 0,30
Herbage	Is not regulated		
Flood	For fence - depth	0.3 m	
One-man movement, movement of several people (from 3 to 5 men) and big animals	Distance to the guarded zone	0.5 m	
Driving of wheeled, full-track and electric-battery vehicles	Distance to the guarded zone (working on LF)		1.5 m
	Distance to the guarded zone (working on HF)		3 m
Railway freight and passenger	Distance to the guarded zone (working on LF)		10 m
	Distance to the guarded zone (working on HF)		20 m
Power lines (up to 500kV)	Distance to the guarded zone	5 m	
Exposure to the radar electromagnetic field	Is not regulated (with a signal-processing unit installed in the metal alarm cabinet)		
Exposure to the ultra-short pulses of the electromagnetic field	Is not regulated (with a signal-processing unit installed in the metal alarm cabinet)		
Exposure to the momentum neutron flux	Is not regulated		
Influence of birds and small animals over the fence components: - birds - small animals	Weight	5 kg up to 20 kg	

1.3 Technical characteristics

The maximum length of the sensitive element (TB cable) in a single zone up to 250 m;
The maximum length of the non-sensitive element (NON-SE) in a single zone up to 500 m;
Entrance areas 2 or 4 independent zones;
Relay outputs 2 or 4 independent outputs;
Integrity control cables, common Relay output;
Power source 10-28 V (DC);
With voltage drop below 9,5 V the protection system goes into the “Alarm” mod.;
Current consumption < 25 mA;
Operating temperature from -40 °C to +50 °C;
Alarm, control integrity, tamper output dry relay contact;
The duration of alarm signal is 1s minimum;
Fixed resistor value to control integrity of sensitive and non-sensitive elements;
Fixing on the fence with plastic ties;
Compatibility any alarm control panel;
IP class IP55;
Set up of equipment using a Windows software;
Integral remote control of the detector, suitable for any monitoring and control system;
It is recommended to install a separate switch on the power supply line.

1.4 Standard equipment

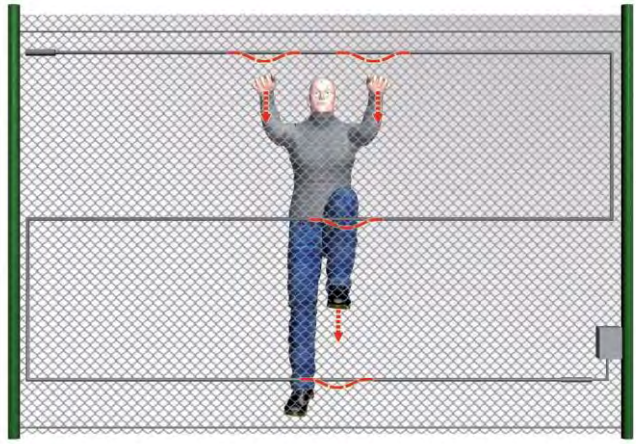
The following equipment is included in the guard alarm delivery set:
- Signal-processing unit;
- USB flash-drive with Software Manual
- Warranty

Optional: end sleeve, connection sleeve, RS485/USB converter, sensitive element, non-sensitive element, plastic ties can be included in the delivery set on the customer request.
The number of connection sleeves and end sleeves and the sensitive element length are to be agreed in ordering.

2. Principle of operation and design

2.1 Principle of operation

The basis for the protection system operation is generation of electrical signals in the sensitive element and at its stress centers (points of the sensitive element rigid fastening to the fence) under mechanical action on the fence components and their subsequent detection by the signal-processing unit.



2.2 Design

2.2.1 Sensitive element (TB cable)

The sensitive element mounted on the fence is meant for electrical signal generation under unauthorized mechanical actions on the fence. The sensitive element protection length depends on the guarded zone length, the fence height, number of supports, and the selected way of the sensitive element mounting on the fence.

2.2.2 Non-sensitive element (DC cable)

Element is used to connect Quadrosense unit with sensitive cable. The most commonly used version of the Quadrosense installation is at a distance from the protected fence.

2.2.3 Signal-Processing Unit (SPU)

The signal-processing unit Quadrosense (SPU) is used for the sensitive element signals detection and the alarm signal generation.
SPU is designed in the metal case with RS485 connection, with terminals for the external alignment using a Windows software connection and the protection system controls connection.
The SPU case is provided with fasteners meant for its installation.

2.2.4 Connection sleeve (CS)
The connection sleeve is meant for connecting the sensitive element together with its non-sensitive element which connected to the signal processing unit and for the connection point shielding and sealing.
In equipping gates and wickets should be made an extended connection sleeve permitting to fix a spiral wrap hose for the non-sensitive element protection.
The connection sleeve is used when it is needed to connect two separate parts of the sensitive or non-sensitive element and for the connection point shielding and sealing.
The coupling can be fastened to the fence with nylon ties.
2.2.5 End sleeve (ES)
The end sleeve provides a continuous monitoring of the sensitive element and the SPU connecting element integrity. It is also meant for the sensitive element's end point shielding and sealing (1 MΩ resistor).
2.2.6 Converter USB/RS485
Used to connect Quadrosense processing unit with Windows software to set up system parameters
2.2.7 Plastic ties
Plastic ties are used to fix sensitive element to the fence. Mounting claim is needed to transmit deformation or vibration from the fence to sensitive element.

3. Application

To ensure the required protection system stability (unauthorized actions detection), high noise immunity (actually an utter absence of false responses) and specified sabotage resistance.

THE FOLLOWING SHOULD BE PROVIDED:
• proper fence mounting (flexible fences should be stretched uniformly with specified tension force);
• combination of different-type fences with respective schemes of sensitive element laying and fastening;
• fence uniformity, i.e. the fence should be made of the same material because different-material sections generate signals of different strength when subjected to an unauthorized action;
• sensitive element proper installation and tightness;
• SPU detection zones optimal sensitivity setting.

Versions of Fence Equipping

Legend

— Sensitive element – TB cable
— Non-sensitive element – DC cable
● Sensitive element fixing point
Connection sleeve - CS
End sleeve - ES

Installation of sensitive element of Quadrosense triboelectric perimeter fence protection system:
1. Max. length TB cable per one input of signal processing unit (SPU)security detector – up to 300 m;
2. TB cable is to be laid in accordance with the draft layout;
3. TB cable is fixed to the fence by plastic ties 140*3,5 mm – every 20 cm. To make "fixing point" at the points of TB cable binding to the fence, binding should be performed in such a way to obtain visible cable sheath deformation not leading to cable damage;
4. When laying TB cable over the supports, TB cable contact with the support should be avoided;
5. Connection and end sleeves should be mounted on a fence horizontally and higher than TB cable lne.

Possible are the following versions of the guard alarm installation:

3.1 Sensitive element layout on light welded mesh fence.

Flexible fence is actually a fence made of metal element netting according, barbed element, element of rust-resistant steel, bimetallic element, reinforced barbed tape, etc.
The sensitive element is mounted directly on the fence's flexible elements. The supports enabling an intruder to get over the fence without touching its flexible elements being available, the sensitive element is mounted on the supports as well. "Alarm" signal is generated on the flexible fence under local deformation of the fence and the sensitive element fastened to it in the case of an unauthorized penetration by climbing over the fence, without any facility, and as a result - deformation of the fence and the sensitive element over its fasteners.
To obtain the required noise immunity, be sure to limit the flexible fence mobility under wind as much as possible.

NOTE:

1. Fence supports should be buried to the appropriate depth as conditioned by the ground type and climatic conditions, but not less than 1.5m of a 3-4m pitch.
2. The welded mesh must be evenly tensed between the supports with the min. force of 100 kg.
3. Recommended welded mesh parameters: mesh cell size: 250/50 mm; min. wire diameter 2.8 mm.

Light welded mesh fence (Fig.1)

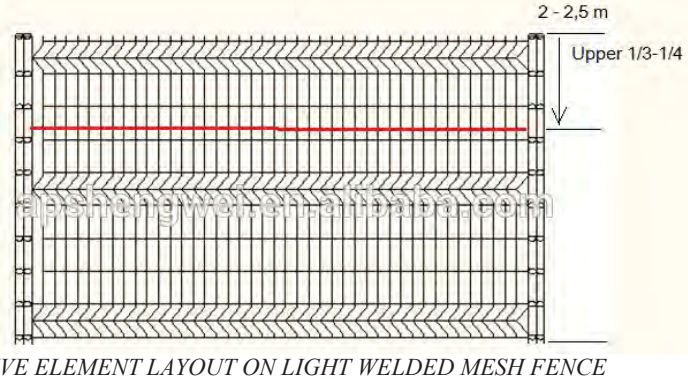


Fig.1 *SENSITIVE ELEMENT LAYOUT ON LIGHT WELDED MESH FENCE*

3.2 Sensitive element layout on nylofor mesh fence.

NOTE:

1. Fence supports should be buried to the appropriate depth as conditioned by the ground type and climatic conditions, but not less than 1.5m of a 3-4m pitch.
2. The welded mesh must be evenly tensed between the supports with the min. force of 100 kg.
3. Recommended welded mesh parameters: mesh cell size: 250/50 mm; min. wire diameter 2.8 mm.

Nylofor mesh fence (Fig.2)

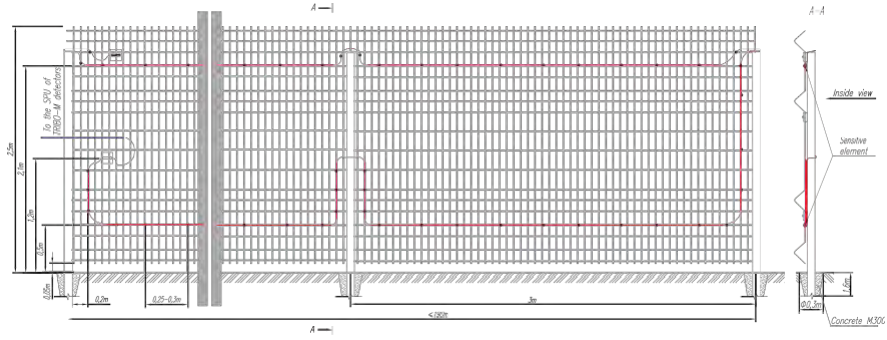


Fig.2 *SENSITIVE ELEMENT LAYOUT ON NYLOFOR MESH FENCE*

3.3 Sensitive element layout on Frameless Chain-Link fence

NOTE:

1. Fence supports should be buried to the appropriate depth as conditioned by the ground type and climatic conditions, but not less than 1.5 m at a 3-4 m pitch.
2. The chain-link mesh must be evenly tensed between the fence supports with the force of 100 kg or more, and fixed to the tension rope.
3. Steel ropes with the min. diameter of 3 mm should be used as the tension ropes.
4. The tension ropes should be stretched using turnbuckles and a winch to the force of 100 kg or more.

Frameless Chain-Link fence (Fig.3)

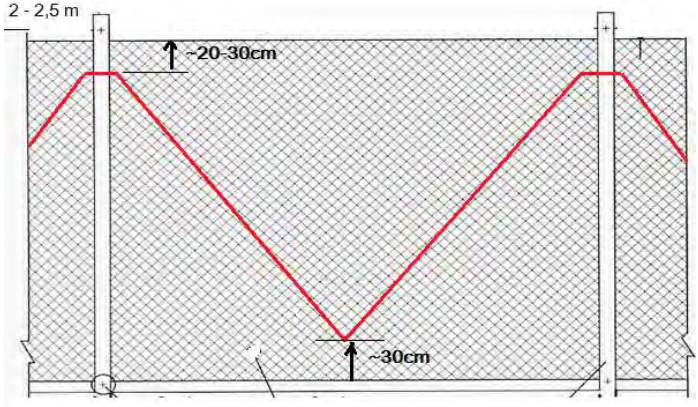


Fig.3 *SENSITIVE ELEMENT LAYOUT ON FRAMELESS CHAIN-LINK FENCE*

3.4 Sensitive element layout on Framed Chain-Link fence

NOTE:

1. Fence supports should be buried to the appropriate depth as conditioned by the ground type and climatic conditions, but not less than 1.5m at a 3m pitch.
2. The chain-link mesh must be evenly tensed with the force of 100kg or more, and fixed at each side of the frame.
3. Frame made of angle sections being used, make sure the netting is stretched uniformly and fastened to the all sides of the frame. In addition be sure to lay the sensitive element along the upper angle section of the frame and the fence supports (Fig.3).

Framed Chain-Link fence (Fig.4)

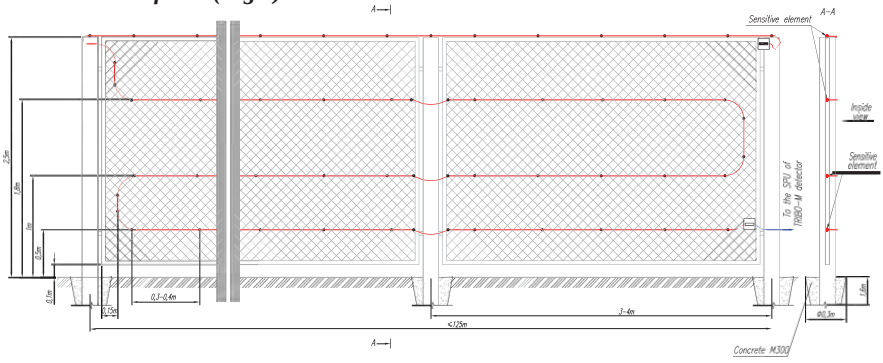


Fig.4 *SENSITIVE ELEMENT LAYOUT ON FRAMED CHAIN-LINK FENCE*

3.5 Sensitive element layout on barbed wire fence

NOTE:

1. Fence supports should be buried to the appropriate depth as conditioned by the ground type and climatic conditions, but not less than 1.5m at a 3m pitch.
2. Additional barbed wires should be diagonally stretched between the supports and fixed to every horizontal wire; each horizontal barbed wire must be well fixed on every support.
3. The barbed wire must be evenly tensed between the supports with the force of 100 kg or more.

Barbed wire fence (Fig.5)

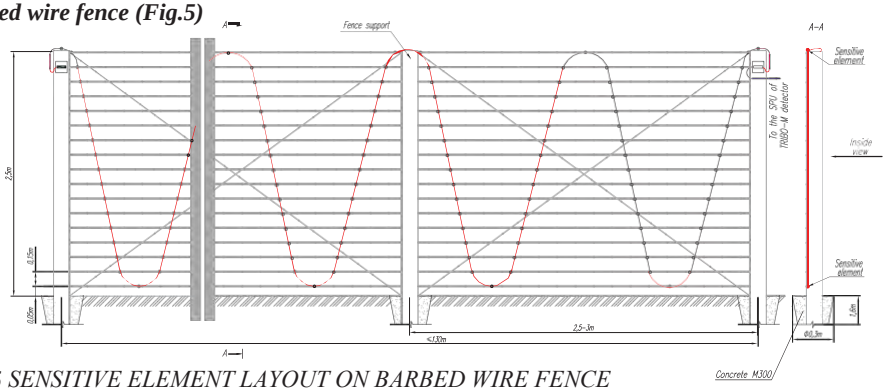


Fig.5 *SENSITIVE ELEMENT LAYOUT ON BARBED WIRE FENCE*

3.6 Sensitive element layout on razor wire fence

NOTE:

1. Fence supports should be buried to the appropriate depth as conditioned by the ground type and climatic conditions, but not less than 1.5m at a 3-4m pich.
2. Steel ropes with the min diameter of 3mm should be used as the tension ropes.
3. The tension ropes should be stretched using turnbuckles and a winch to the force of 100 kg or more.
4. Each flat spiral tum must be fixed to the tension cobles with 1.6 m galvanized binding wire, or appropriate brackets
5. Bending the bottom flat spiral line to the ground is allowed.

Razor wire fence (Fig.6)

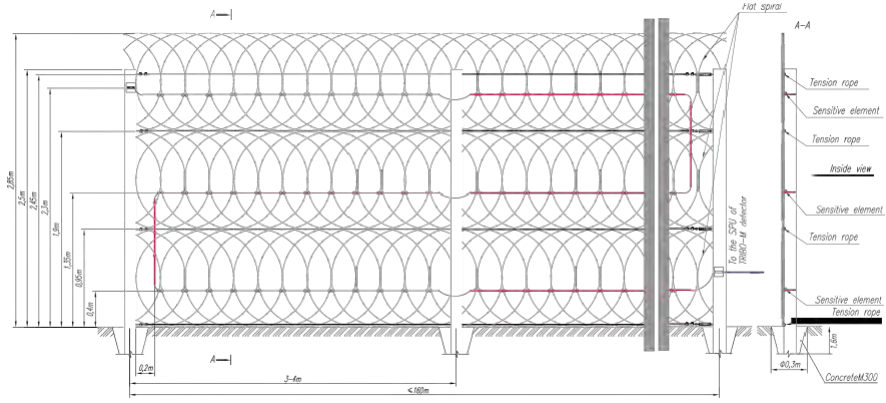


Fig.6 *SENSITIVE ELEMENT LAYOUT ON RAZOR WIRE FLAT SPIRAL FENCE*

3.7 Sensitive element layout on barbed wire fence extensions

NOTE:

1. The extension mounts should be installed on a fence with the max. step of 3 m.
2. The barbed wire must be evenly tensed between fence extension mounts with the force of 70 kg or more.
3. Max. distance between barbed wire fixing points is 0.15 m.

Barbed wire fence (Fig.7)

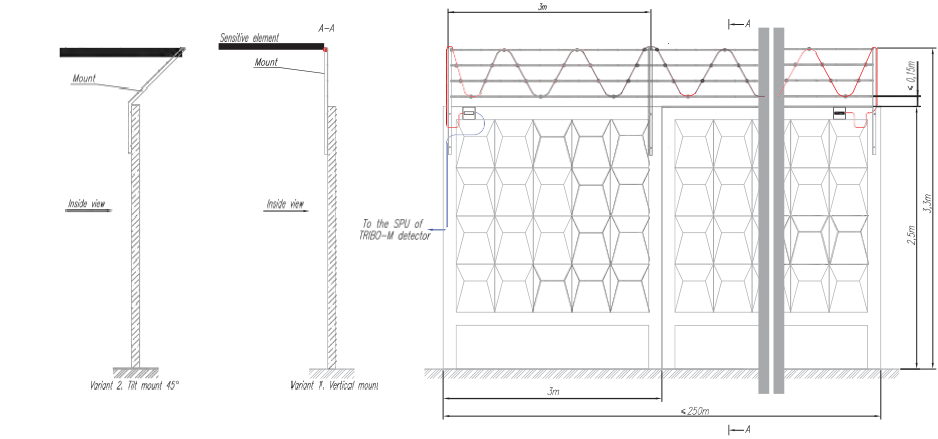


Fig.7 *SENSITIVE ELEMENT LAYOUT ON BARBED WIRE FENCE EXTENSIONS*

3.8 Sensitive element layout on light welded mesh fence extensions

NOTE:

1. 3 m distance between fence extension mounts is recommended.
2. The mesh must be evenly tensed between fence extension mounts with the force of 70 kg or more.

Light welded mesh fence (Fig. 8)

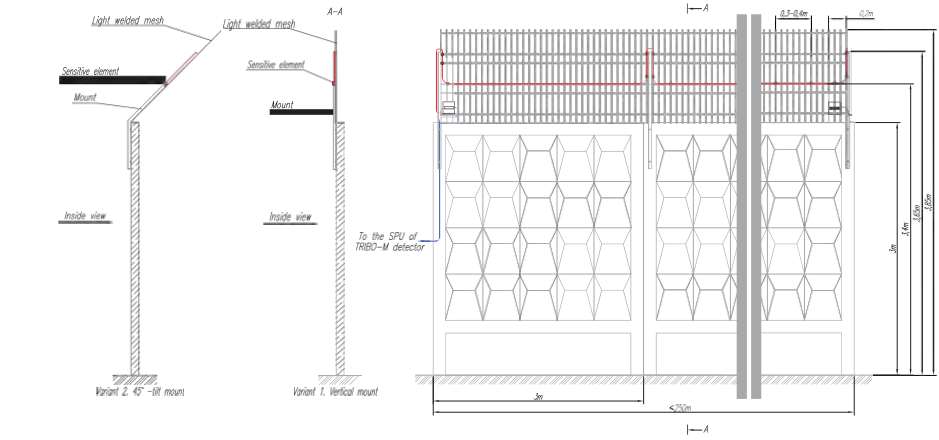


Fig.8 *SENSITIVE ELEMENT LAYOUT ON LIGHT WELDED MESH FENCE EXTENSIONS*

3.9 Sensitive element layout on razor wire flat spiral fence extension

NOTE:

1. 3-4m distance between fence extension mounts is recommended.
2. Steel ropes with min. diameter of 3mm or razor wire should be used as the tension ropes.
3. The tension ropes should be stretched using turnbuckles and a winch with the force of 70 kg or more.
4. Each flat spiral turn must be fixed to the tension ropes with 1.6 mm galvanized binding wire.

Razor wire flat spiral fence (Fig. 9)

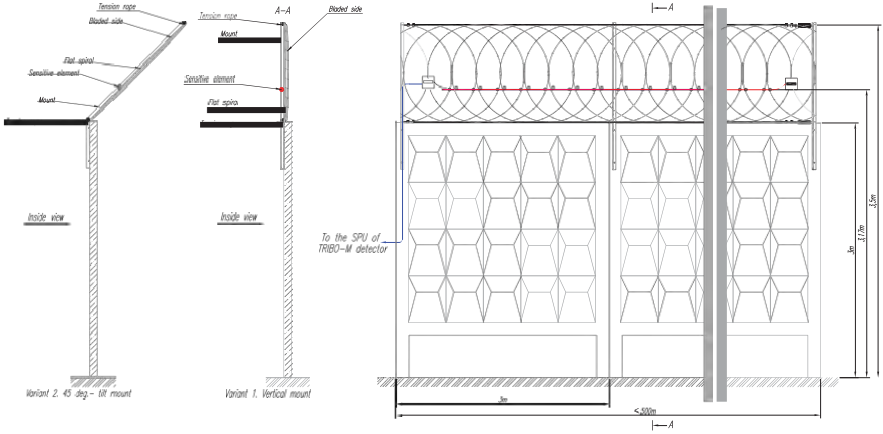


Fig.9 *SENSITIVE ELEMENT LAYOUT ON RAZOR WIRE FLAT SPIRAL FENCE EXTENSIONS*

3.10 Sensitive element layout on concertina fence extension

NOTE:

1. 3-4m distance between fence extension mounts is recommended.
2. Steel ropes with min. diameter of 3mm or razor wire should be used as the tension ropes.
3. The tension ropes should be stretched using turnbuckles and a winch with the force of 70 kg or more.
4. Each spiral tum must be fixed to file tension ropes with 1.6 mm galvanized binding wire or brackets.

Concertina fence (Fig. 10)

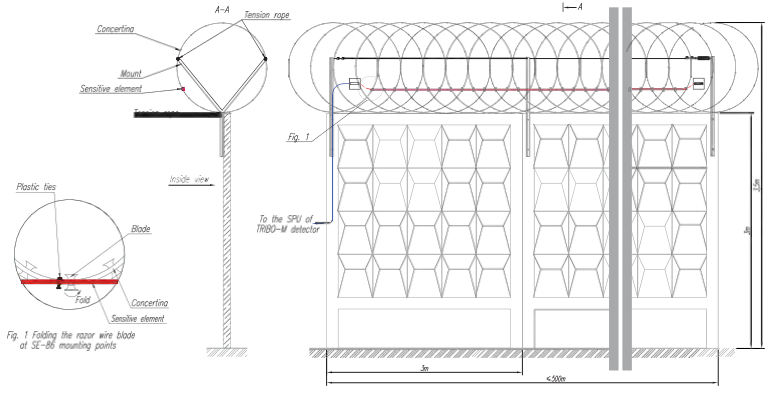


Fig. 10 *SENSITIVE ELEMENT LAYOUT ON CONCERTINA FENCE EXTENSIONS (Y-type mount)*

3.11 Sensitive element layout on push-top canopy over solid fence

NOTE:

1. To protect concrete fence from climb over be sure to lay the sensitive element TB cable along the fence upper crown under the visor made of deformable material, for example, metal or wooden plate.
2. In the middle of the strength points made to the fence, additional rubber bumper must be used as strength points.
3. Preliminary sensor pressure force 5 kg.

Push-top canopy over solid fence (Fig. 11)

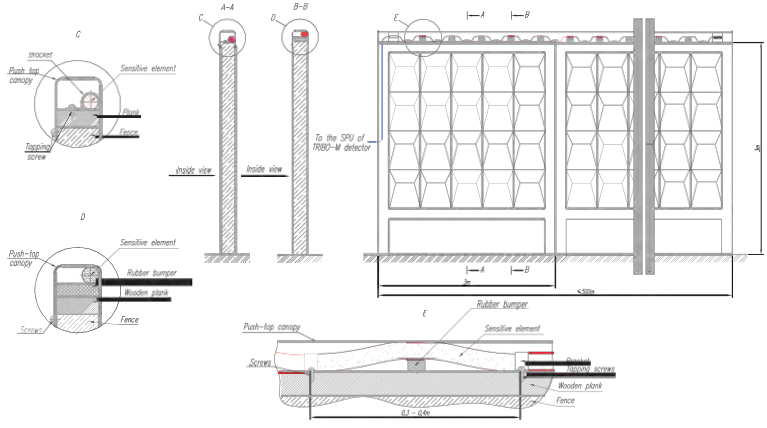


Fig. 11 *ELEMENT LAYOUT UNDER PUSH-TOP CANOPY OVER SOLID (CONCRETE) FENCE*

3.12 Sensitive element layout on corrugated metal fence

NOTE:

1. Fence supports set with a deep, based on soil and climatic conditions, but not less than 1.5 m in increments of 3-4 m
2. The sensitive element TB cable is to be laid in accordance with the draft layout and is to be fixed with Φ 6mm metal brackets using 4x6 pop-rivers.

Corrugated metal fence (Fig. 12)

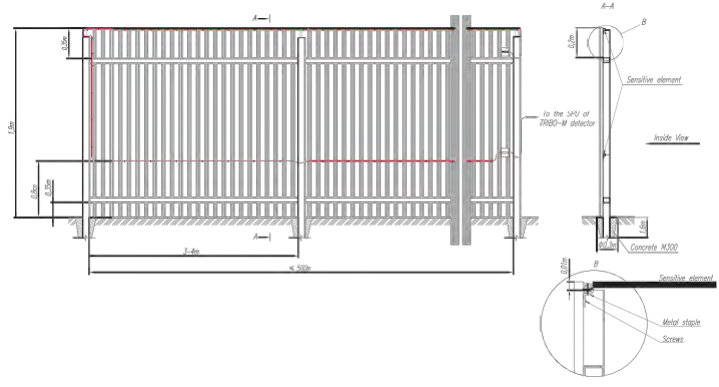


Fig. 12 *LAYOUT OF SENSITIVE ELEMENT ON CORRUGATED METAL FENCE HEIGHT -1.9m*

3.13 Sensitive element layout on wooden fence

NOTE:

1. Fence supports set with a deep, based on soil and climatic conditions, but not less than 1.5 m in increments of 3-4 m.
2. The sensitive element TB cable is to be laid in accordance with the draft layout and is to be fixed with Φ6mm metal brackets using wood screws.

Wooden fence (Fig. 13)

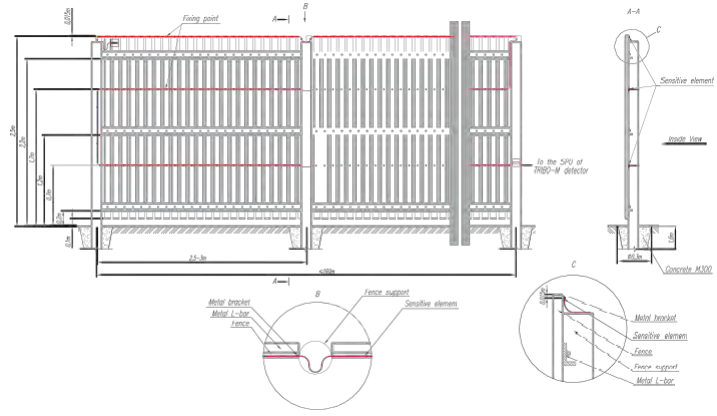
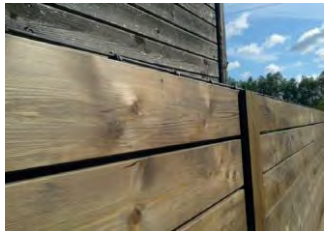


Fig. 13 *SENSITIVE ELEMENT LAYOUT ON WOODEN FENCE*

3.14 Sensitive element layout on wooden fence with push-top canopy



NOTE:

1. To protect wooden fence from climb over be sure to lay the sensitive element TB cable along the fence upper crown under the visor made of deformable material, for example, metal or wooden plate.
2. In the middle of the strength points made to the fence, additional rubber bumper must be used as strength points.
3. Preliminary sensor pressure force 5 kg.
4. The top edge of the fence must not be higher that the rubber bumper.

Wooden fence with push-top canopy (Fig. 14)

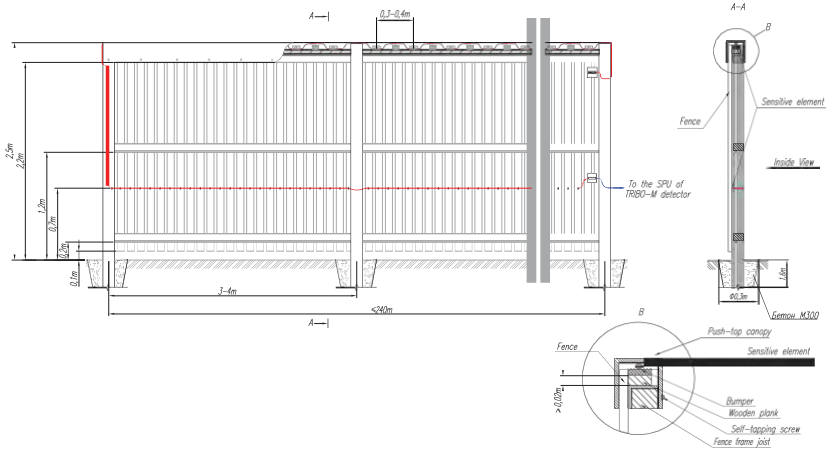


***Fig. 14** SENSITIVE ELEMENT LAYOUT ON WOODEN FENCE (WITH PUSH-TOP CANOPY)*

3.15 Wooden fence with brick pillars

NOTE:

1. The sensitive element TB cable is to be laid in accordance with the draft layout and is to be fixed with Φ6mm metal brackets using wood screws..
2. Metal caps are recommended for installation on the fence supports (brick pillars) in such a way that the TB cable would be tightly pressed between rubber bumpers and the cap, with the pressing force of 5 kg or more.

Wooden fence with brick pillars (Fig. 15)

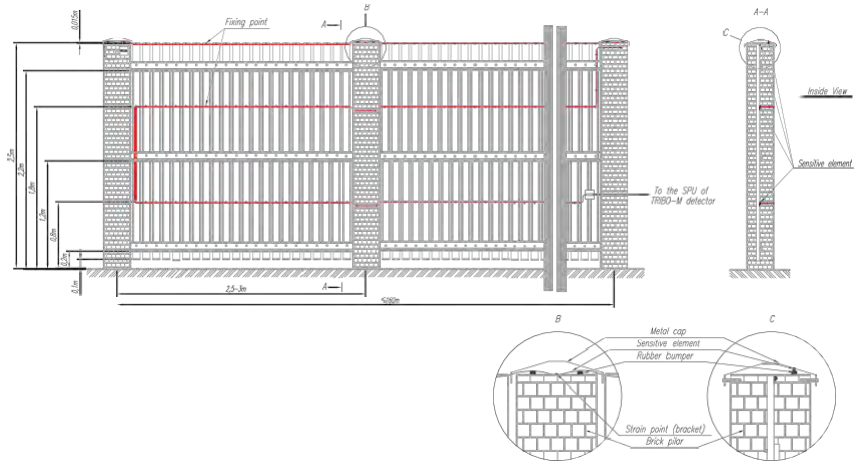
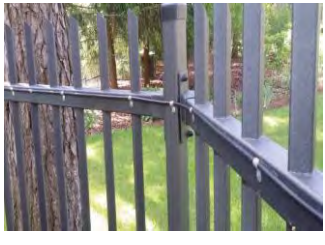


Fig. 15 *SENSITIVE ELEMENT LAYOUT WOODEN FENCE WITH BRICK PILLARS*

3.16 Sensitive element layout on wrought iron fence



NOTE:

1. Fence supports should be buried to the appropriate depth as conditioned by the ground type and climatic conditions, but not less then 1.5m of a 3-4m pitch.
2. Sufficient tension of the TB cable must be assured when laying the bottom TB cable line.
3. Variant 2 of fence support solution is recommended to complicate possible climbing attempts.

Wrought iron fence (Fig. 16)

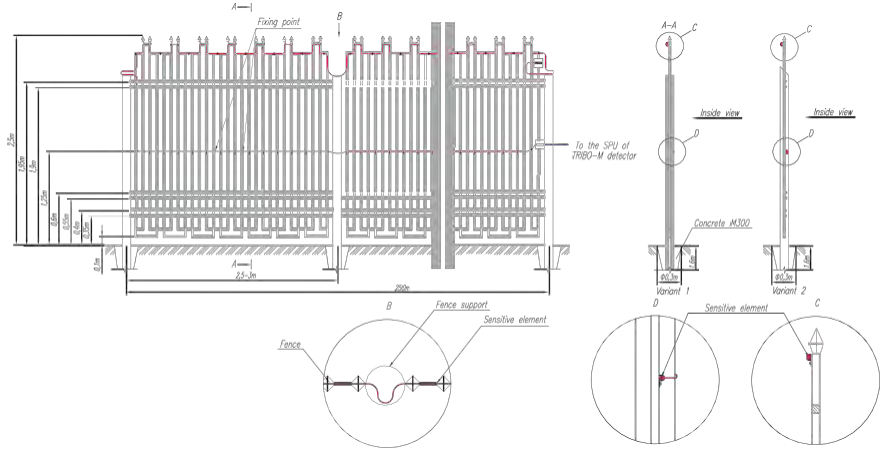


Fig. 16 *SENSITIVE ELEMENT LAYOUT ON WROUGHT IRON FENCE*

3.17 Sensitive element layout on bar fence

NOTE:

1. Fence supports should be buried to the appropriate depth as conditioned by the ground type and climatic conditions, but not less than 1.5m at a 2.5-3m pitch.

Bar fence (Fig. 17)

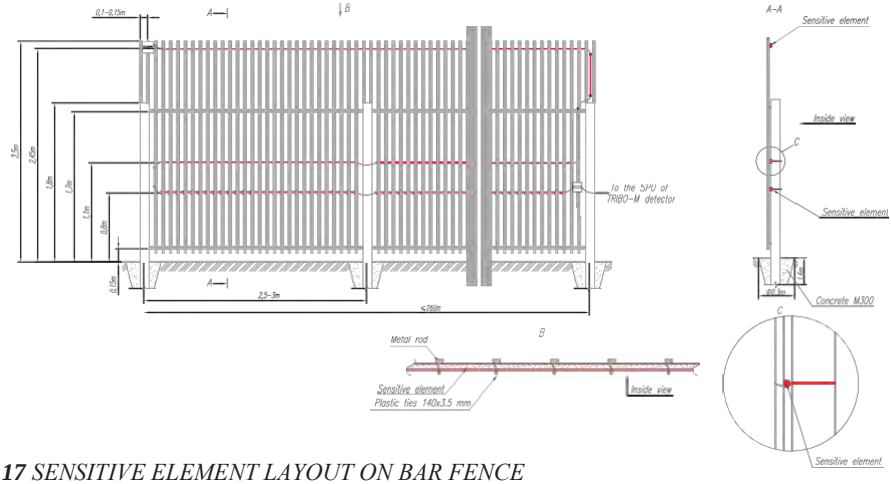


***Fig. 17** SENSITIVE ELEMENT LAYOUT ON BAR FENCE*

3.18 Sensitive element layout with exclusion of gates from the detection zone

NOTE:

1. The gates are passed by with NON-SE connection cable.
2. NON-SE cable under the gates is to be laid in a metal pipe ≥50 mm.
3. Installation of transfer boxes or cabinets is recommended.
4. NON-SE cable lengths from adapter joint to transfer box are to be laid in a pipe diameter 8 mm

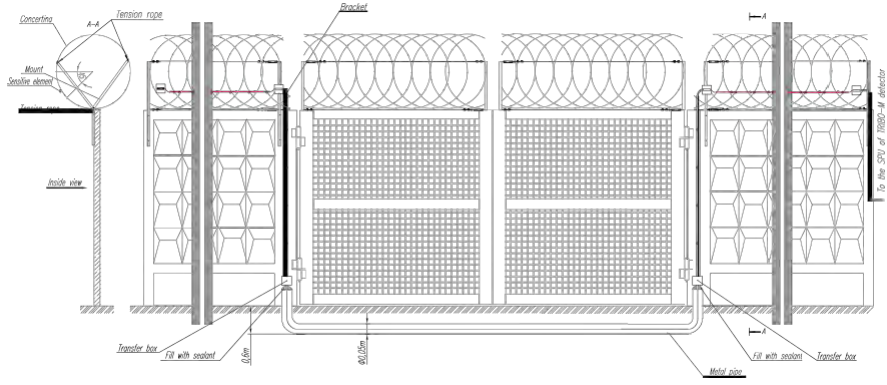


***Fig.18** SENSITIVE ELEMENT LAYOUT WITH EXCLUSION OF GATES FROM THE DETECTION ZONE*

3.19 Sensitive element layout with inclusion of gates in the detection zone
NOTE:
1. The gates are passed by with NON-SE DC connection cable.
2. NON-SE DC cable under the gates is to be laid in a pipe diameter ≥50 mm.
3. Installation of transfer boxes or cabinets is recommended.
4. NON-SE DC cable lengths from adapter joint to transfer box are to be laid in a pipe diameter 8 mm.
5. The fence and the gate being of the same material, just one sensitive element can be used.
If so the sensitive element is laid on supports between the fence and the gate through special stretch-out boxes, extended connection sleeves and a spiral wrap hose. Be sure to lay the sensitive element from one gate leaf to another in a metal bypass pipe buried at a depth of 0.3 m, minimum.

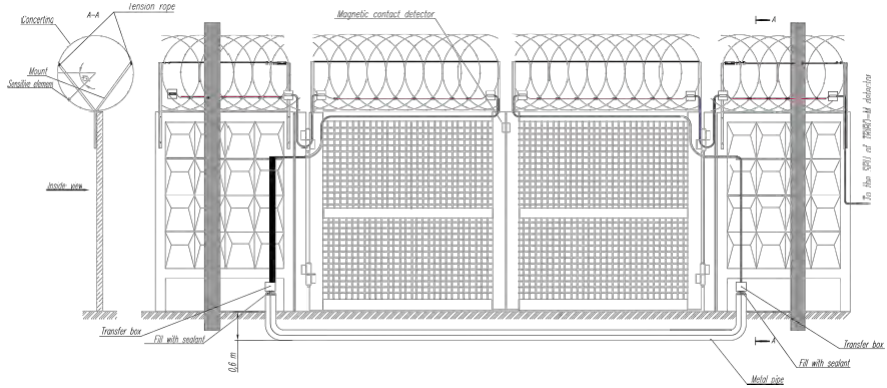
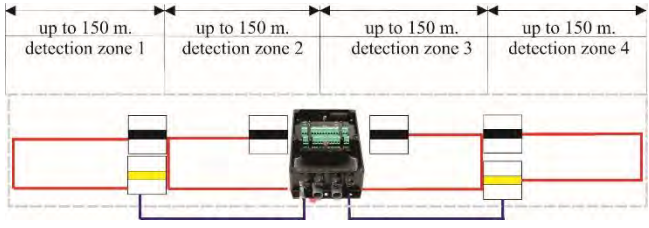


Fig.19 *SENSITIVE ELEMENT LAYOUT WITH INCLUSION OF GATES IN THE DETECTION ZONE*

4. Detection zones creation variants with sensitive element.

4.1 Detection zones creation variants with sensitive element.
Quadrosense system is very flexible and can be integrated with different security and automatization systems. Depending from client/object requirements we can offer different detection zones lengths, installation variants.

Fig.20 *Quadrosense UNIT INSTALLED NEAR THE FENCE. FENCE HEIGHT 2 METERS, NEEDED DETECTION ZONE LENGTH 600 METERS.*



Example:

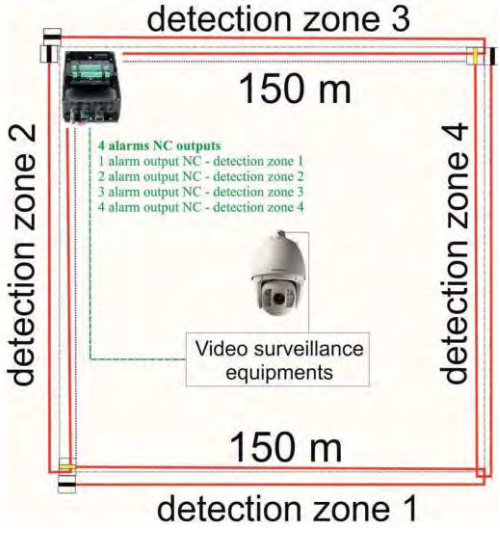
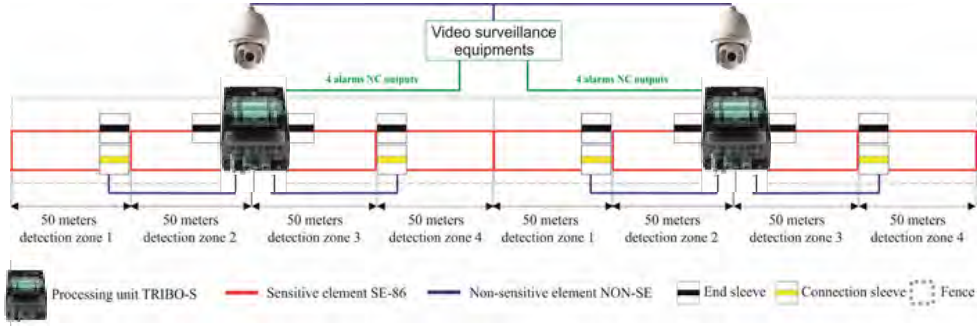


Fig.21 *Quadrosense UNIT IS INSTALLED ON THE FENCE. FENCE HEIGHT 2 METERS, EACH DETECTION ZONE IS 150 METERS.*



Example:

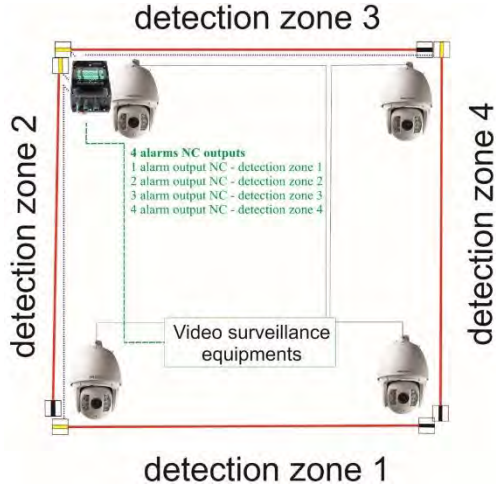


Fig.22 *Quadrosense UNIT IS INSTALLED NEAR THE FENCE OR IN THE BUILDING; FENCE HEIGHT IS 1.5 METERS; EACH DETECTION ZONE IS 50 METERS.*

If Quadrosense system is connected with CCTV system there is an option to install detection zone up to 50 m.

This variant is most successful used for perimeter protection, where Quadrosense connected with CCTV system were after alarm camera made the photo and send it to security post.

4.2 Detection zones creation variants with non-sensitive element.

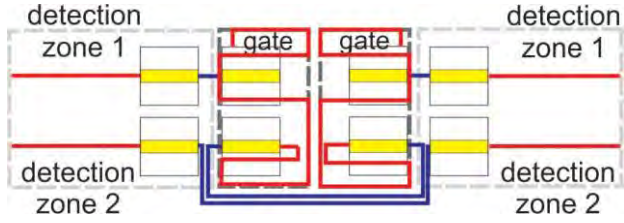


Fig.24 *GATE PROTECTION NON-SENSITIVE ELEMENT TO PASS FROM FENCE TO GATES.*

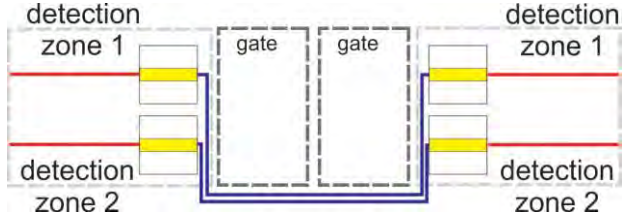


Fig.25 *PASS GATES. NON-SENSITIVE ELEMENT TO PASS GATES.*

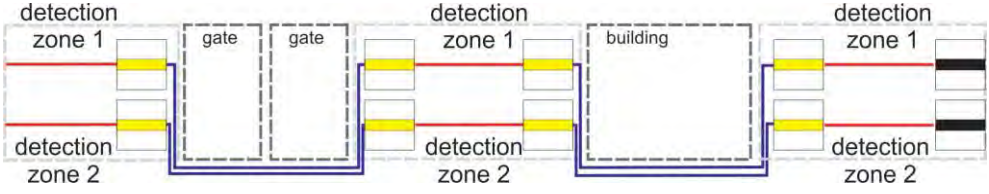


Fig.26 *NON-SENSETIVE ELEMENT TO PASS GATES AND BUILDING.*

4.3 Service ability check

Safety Precautions

Only a skilled electrician, familiar with the present Manual is entitled to perform the protection system installation, operation and maintenance.

Service ability Check

The guard alarm is to be inspected for external defects on its receipt from the manufacturer. Check the protection system for serviceability in compliance with Table 4.1.

Table 4.1

Description and procedure of check	Technical requirements
Check of completeness	Correspondence with the warranty
Check for appearance Visual inspection	Absence of mechanical damages and corrosion. Availability of intact Manufacturer seal on the cover of the SPU case

5. Installation and preparation for use

5.1 General

Be sure to observe all norms and regulations for assembling and wiring work in the protection system installation.

The fence protection system being powered from the remote power source, select the type of element and the conductor cross-section so that the voltage across the SPU terminals is from 10 to 28 V with the output power supply voltage changing within permissible limits.

IMPORTANT. To ensure the protection system trouble-free operation provision should be made for the standby DC power supply.

Use non-sensitive element to connect the sensitive element to the signal-processing unit.

Make sure non-sensitive element is hidden and the possibility of its damage is eliminated when laying the element from the signal-processing unit to the sensitive element end.

5.2 SPU Quadrosense installation

In perimeter protection it is a good practice to install the signal-processing unit in the metal splash-proof cabinet to improve the protection system sabotage resistance and to allow for the additional equipment location (an alarm button, a network controller of the data acquisition and processing system, etc). Be sure to locate the cabinet and the signal-processing unit in it so, that the connecting elements of the sensitive elements, alarm stub, RS-485 stub and power leads are conveniently connected and the possibility of SPU periodic inspection and adjustment is provided.

Prior to the SPU installation, do holes layout work for the SPU fastening and fasten it with screws and screw nails.

The following equipment is to be connected to the signal-processing unit:

- ground connection (uninsulated copper element of cross-section 1.0 mm2, minimum);
- sensitive element(can be connected directly or using non-sensitive element);
- alarm stub;
- supply line.

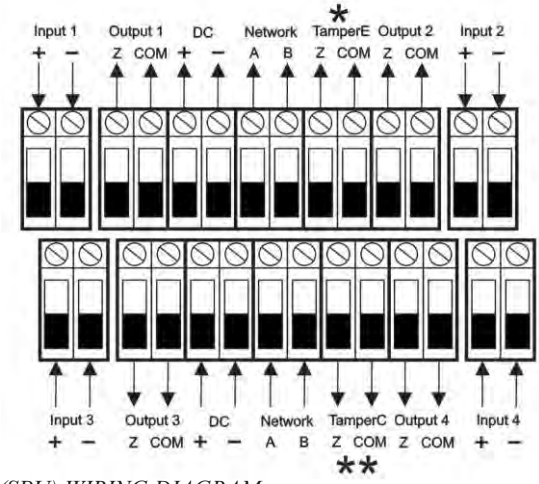


Fig.27 *Quadrosense (SPU) WIRING DIAGRAM*

(*) TamperE – Tamper of sensitive element control all inputs loops.

(**) TamperC – Tamper of the opening of QuadroSense (SPU) cover.

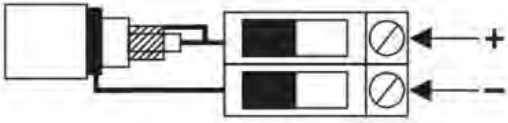


Fig.28 *SENSITIVE ELEMENT CONNECTION TO INPUT*

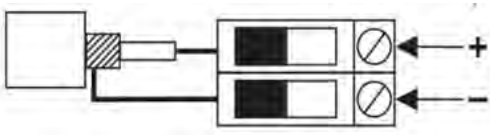


Fig.29 *NON-SENSITIVE ELEMENT CONNECTION TO INPUT*

CAUTION.
Be sure to ground the protection system only at one point - by a fastener on the SPU case.
In mounting the connecting element, sensitive element and end sleeve, be sure to eliminate the possibility of grounding at other points of electric circuit.
Check the conductors' polarity in connecting the supply line.

5.3 Sensitive element laying

QuadroSense OFFER
The kind of laying depends from the fence type. If Quadrosense is used for non-standard fences we offer first to try it working with this kind of fence. Prepare a sensitive element about 10 meters and install it on the fence (1 or 2 segments) in your chosen way.
1) Connect to Quadrosense unit and set up it'ssensitivity.
2) Test Quadrosense sensitivity.
4) If Quadrosense detects an intruder and don't give alarms from noises - this variant of laying can be used on all segments of this fence. Sensitivity will be the same for all distance.

Prior to laying, proceed as follows:
Arrange the sensitive element along the fence inside without bights; make sure it is free of mechanical damages and the sensitive element ends are protected from moisture ingress.
To lay the sensitive element, proceed as follows:
- proceed according to the design documents;
- make sure the ambient temperature is not less than minus 10 ºC;
- laying the sensitive element along the fence, make sure, that the radius of its bend is 120 mm minimum;
- stress points should be made with plastic ties (140x 3.5 mm) Nylon 6.6 self-extinguishing V2 UL94. Temperature range -40/+100, distance between stress point is from 20 up to 45 cm, depends from a fence type;
- the parts of sensitive element must be connected over a connection sleeve only.

CAUTION. The sensitive element fastening should be rigid enough to prevent its ANY lengthwise movement relative to the attaching point and the fastener movement relative to the fence.
Creating fixing points on the sensitive element, BE SURE, that you provide visible deformation of the sensitive element without its integrity breaking.

5.4 Connection of sensitive element with non-sensitive element.
Splice the ends of the sensitive element and non-sensitive element.

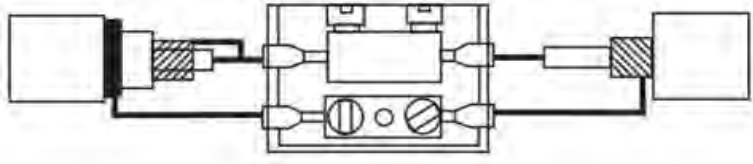


Fig.30 *SENSITIVE ELEMENT (TB cable) CONNECTION WITH NON-SENSITIVE CABLE (DC cable)*

1) Connect sensitive element with non-sensitive element.

2) Seal the contact.

3) Close the connection sleeve.

To ensure against moisture running down from the element towards the coupling, install the coupling horizontally on the fence.

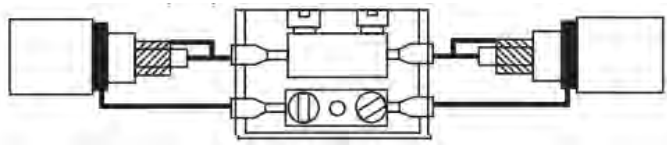


Fig.31 *SENSITIVE ELEMENT (TB cable) CONNECTION WITH SENSITIVE ELEMENT (TB cable)*

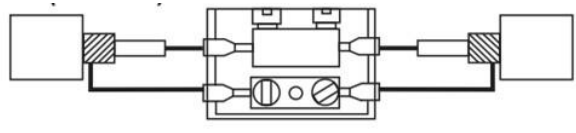


Fig.32 *NON-SENSITIVE CABLE (DC cable) CONNECTION WITH NON-SENSITIVE CABLE (DC cable)*

5.5 End sleeve connection

With all electrical connections completed according to the schematic diagram, use nylon ties to fasten it to the fence.

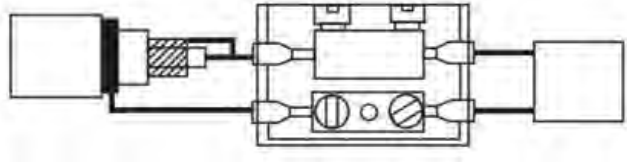


Fig.33 *END SLEEVE CONNECTION*

1) Connect Sensitive element with end resistance.

2) Seal the contact.
Seal the contact (N) and end resistance with seal tape.

3) Close end sleeve.

To ensure against moisture running down from the element towards the end sleeve, install the end sleeve horizontally on the fence.

6. QUADROSENSE Software

QuadroSense hardware and software package is designed for monitoring the condition and setting of Quadrosense triboelectric fence protection system using the Windows software.

6.1 Main Provisions

QuadroSense Software can be started on devices with operating system Windows 7 or higher.
Connecting USB/RS485 adapter to the Quadrosense SPU is performed by RS-485 double-wire interface to RS-485 socket at the control panel.
Default network address on the terminal: 1
Default network address on the jack socket: 253

6.2 Preliminary Configurations

Before using the package it is necessary to install QuadroSense Software.

6.3 Program Start-up, GENERAL Tab

After connecting the software to the detector, the main window with active GENERAL tab (Figure 38), which displays the detector parameters and the status of each all its inputs (sensing elements), appears. Before starting work, it is recommended to go to the "LOGS" tab and synchronize the time and date. (unit 7.5 Work with Log). This action is necessary for the further adequate display of information in the LOGS journal.

Inputs status show the tab header background color at the screen top:

- Normal — green;
- Alarm — red;
- Failure (Break, Closed, Noice) —yellow.

If the sensing element is faulty, the corresponding SE STATUS line will be highlighted in red, indicating the fault reason (open circuit, short circuit, increased noise level and power-supply noise). *Unused detector inputs should be shunted with the attached EOL units.*

If the supply voltage is insufficient, the POWER inscription in the left column will be highlighted in a similar manner.

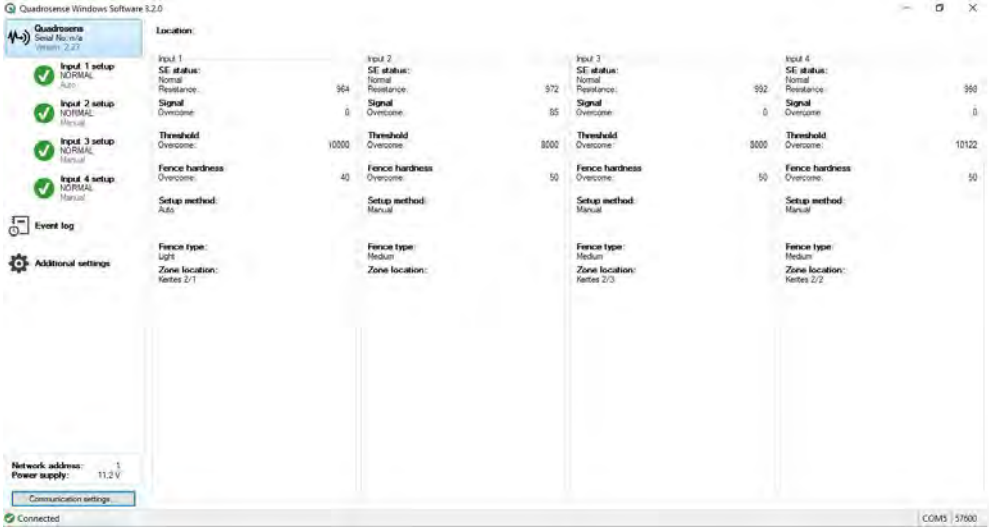


Fig.38

After pressing ADDITIONAL SETTINGS button (Figure 39) it will be possible to enter the information about detector location (DETECTOR LOCATION), change its network address (NETWORK ADDRESS), output relay contact type (ALARM TYPE) and duration of alarm notification duration (ALARM TIME), as well as sound management (ALARM SOUND). Acceptable number of characters to enter and the number bounds are displayed in the pop-up window tips.

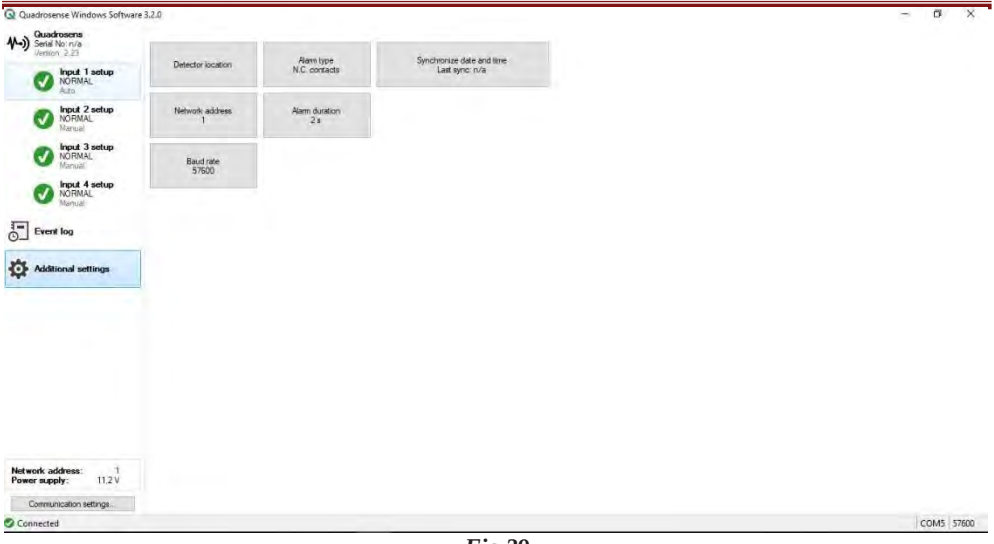


Fig.39

6.4 INPUT Tab and Assigning its Individual Fields and Tabs

To obtain detailed information on any input status it is necessary click the appropriate INPUT button. After that, the selected tab will become active, and the selected modes and detected detection parameters will be displayed on the screen (Figure 40).

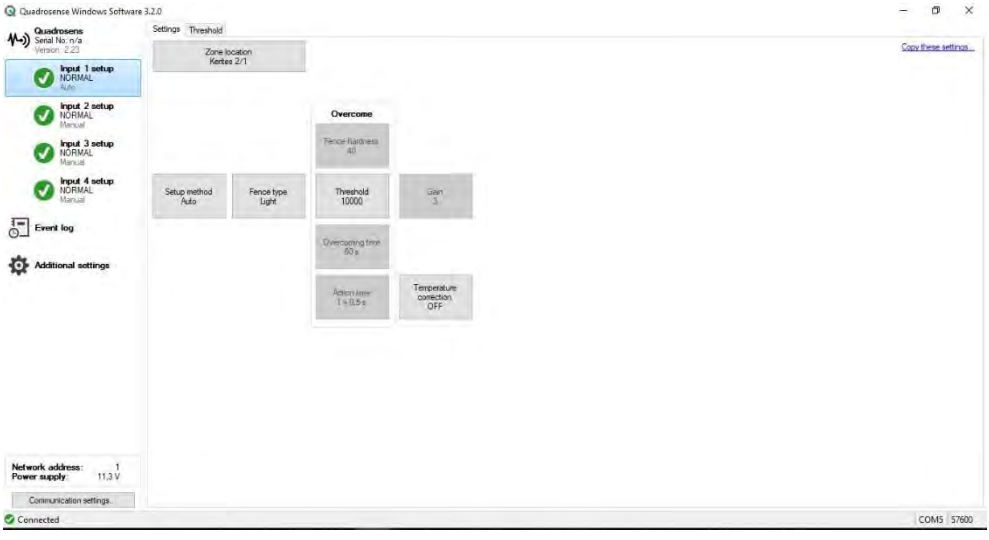


Fig.40

It is possible to enter information on the features of sensing element location (INPUT LOCATION), selection of a fence used, configuration method and operating threshold.
Enabling temperature correction (TEMPERATURE CORRECTION button) allows to compensate the change of the sensor cable characteristics, when there are the ambient temperature drops. When there are insignificant temperature fluctuations (from minus 20 to plus 30 degrees), use of temperature correction is unpractical.

6.4.1 AUTO Method

In delivery state the detector has an automatic setting method (AUTO) and averaged detection parameters typical for medium-hardness fences (MEDIUM) for welded 3D panels.
In most cases, it is sufficient to monitor alarm signals generation, when simulating the boundary overcome for such fences.
In case of using other fence types the closest fence type should be selected in the FENCE TYPE tab (Figure 41), after which the detection parameters that are most suitable for the selected fence type will be automatically set.

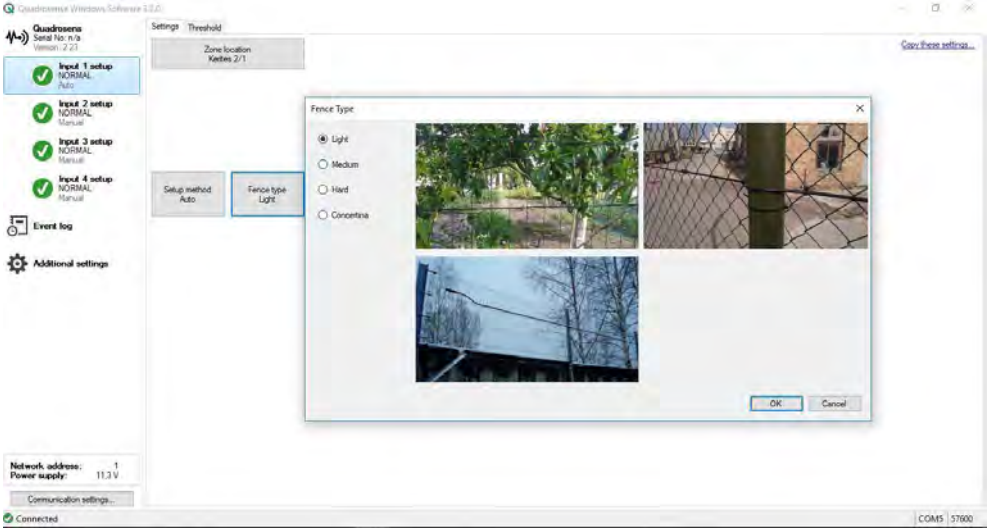


Fig.41

After that, it is necessary to monitor the formation of alarms when performing control overcomes and their absence under the influence of outside interference factors.
It may be necessary to adjust the operating threshold if there are no alarms (when simulating the boundary overcome) or false alarms (on outside interference factors) generated, **only**.
To do it, select THRESHOLD tab in the left column.
Selected tab will become active and the current signal waveform will be displayed on the screen, that allows to estimate the noise and signal level from the intruder, when crossing the boundary in real time (Figure 42).
Observing the signal behavior during overcome simulation, it is necessary to select and set the operating threshold that is most appropriate to these conditions (sensing element cable type, fence type, attachment method and etc.).

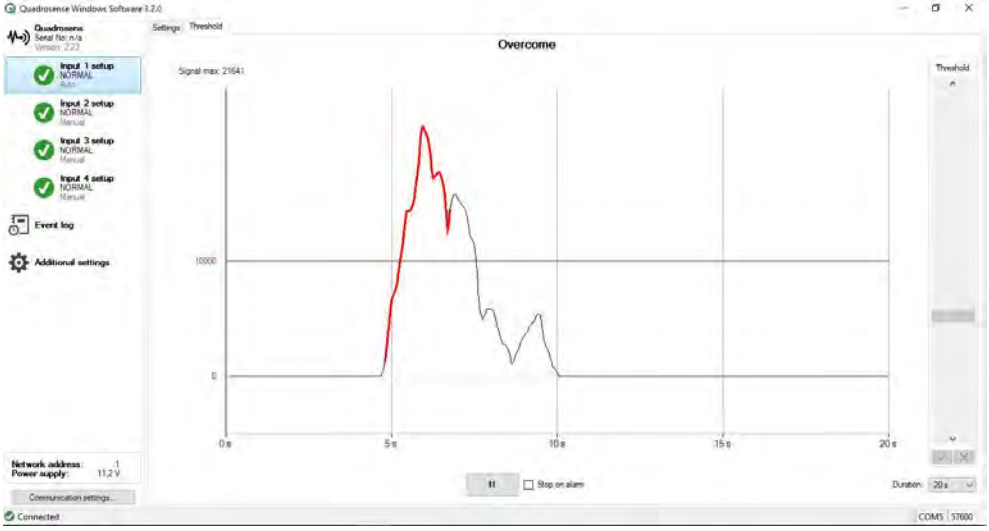


Fig.42

It is recommended to set operating threshold at 80% level from the maximum signal value.
The threshold is set by moving the threshold line with button pressed.
At the screen top there are buttons of stop, fixation upon and diagram expansion .
There is the possibility of alarms counting (ALARM COUNTER button) and screenshots of the screen during alarms (EVENTS RECORDER).

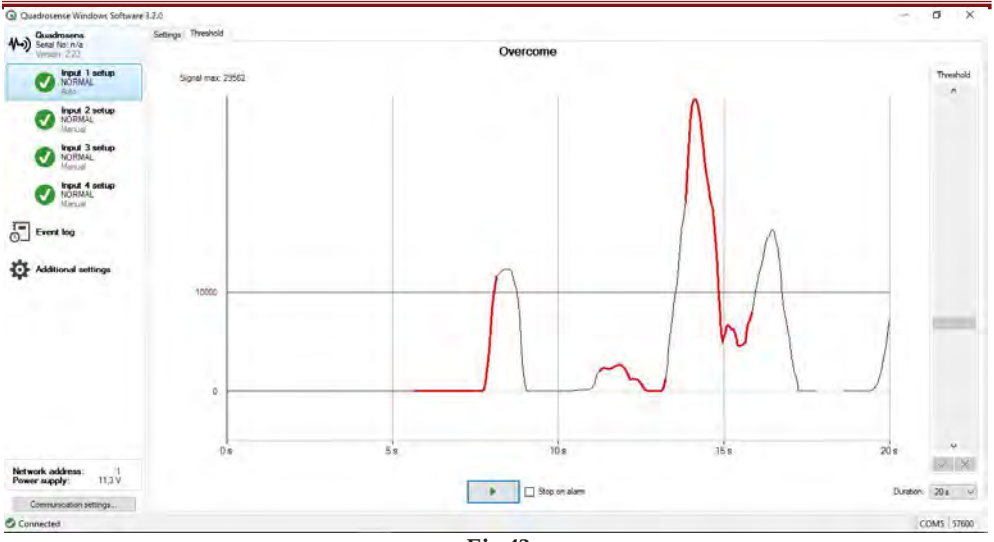


Fig.43

6.4.2 MANUAL Method

For more precise detector adjustment, when fence characteristics deviate from the standard ones, if the signal from the intruder is insufficient or too large, in the presence of interference, and etc. it is necessary to open SETTINGS tab and select MANUAL configuration method (Figure 44).

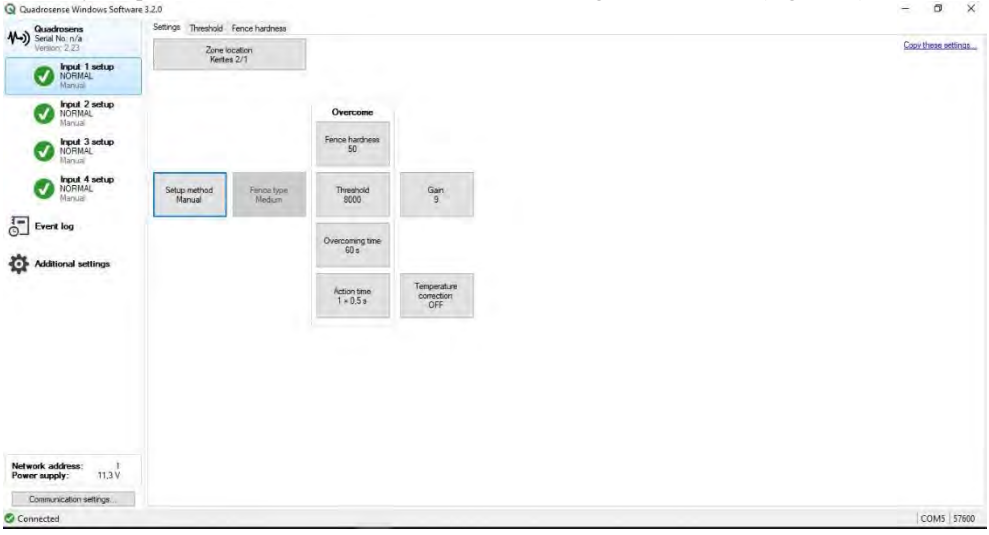


Fig.44

Wherein the possibility for more precise adjustment of operating parameters depending on the fence hardness (FENCE HARDNESS), the possibility to set the total time to overcome the boundary (OVERCOME TIME), time of single action and number of actions, when overcoming (ACTION TIME), appear.

To configure the listed parameters select FENCE HARDNESS tab in the left column.

After that, the selected tab will become active, and fence hardness histogram will be displayed on the screen. It helps to estimate the noises during fence oscillating (Figure 45).

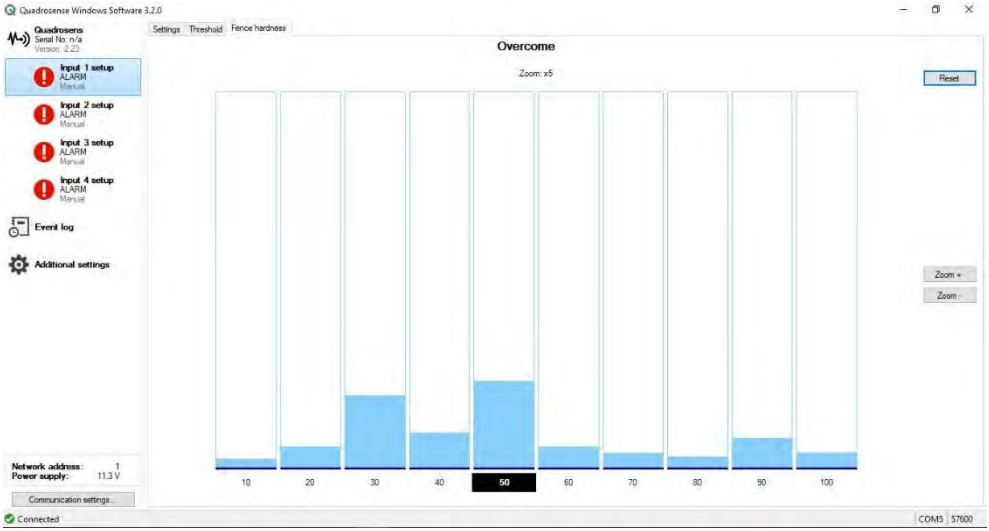


Fig.45

To select the hardness, simulate **wind effects** on the fence and select the column with the largest interference amplitude pressing the corresponding numeric key at the bottom of the screen.
In this case, interference from fence parasitic oscillations will not be considered, when generating alarms.
When necessary, it is possible to use zoom histogram function (ZOOM).
After configuring the fence hardness select THRESHOLD tab (Figure 42), simulate overcoming the boundary and estimate the typical time for overcoming, duration, amplitude and number of recorded impacts.
Having set the appropriate parameters in SETTING tab, it is necessary to check alarms generation, when performing control boundary overcoming.

6.4.3 SPECIAL Method

When there is the threat of penetration by destroying the fence portion or transferring the sensor cable, it is possible to connect the additional processing algorithm that provides alarm generation under the specified impacts.
To connect this function, open SETTINGS tab and select SPECIAL configuration method (Figure 46).

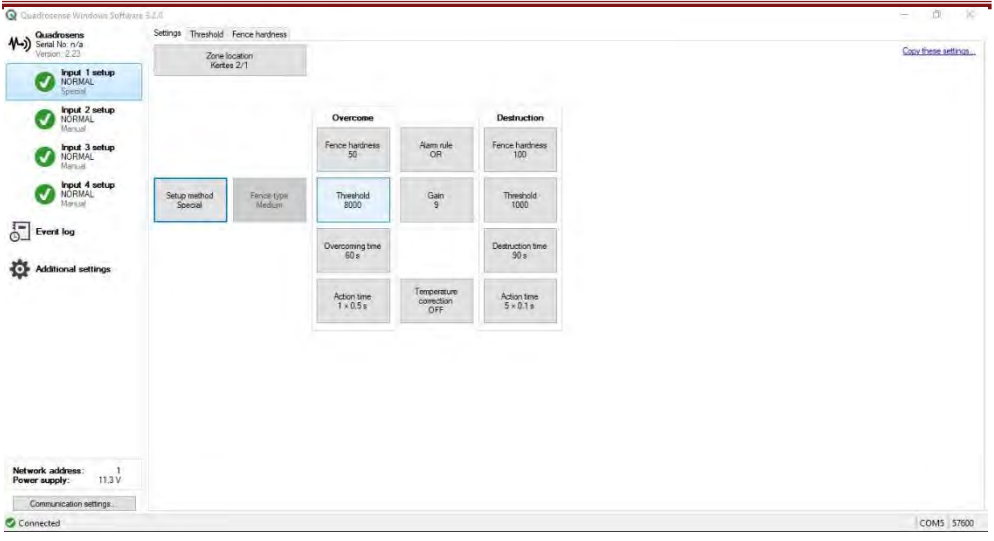


Fig.46

In this case, the additional DESTRUCTION column appears on the right side of the screen with detection parameters, which configuration is performed in sequence similar to unit 7.4.2.
When determining the rigidity of the fence, perform an imitation of penetration by cutting the fastening elements of the sensitive cable, BUT not by imitation of outside interference factors.

6.5 Work with Log

During operation, the detector records all occurring events and writes them to non-volatile memory. To view the events history it is necessary to open LOGS tab (Figure 47).

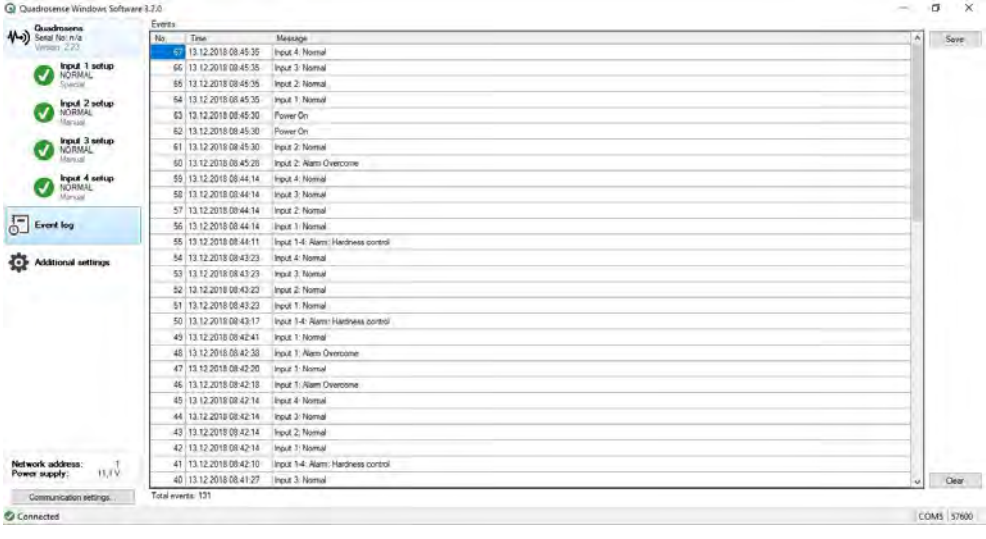


Fig.47

LOGS contain the history of statuses of each detector input (Normal, Alarm, Break, Closed) and duty personnel actions history (changing the detector settings).
Log can be used for the detailed analysis of the events that occurred during operation.
For convenience, after switching on the detector it is recommended to set the date and time. For that it is necessary to press TIME AND DATE SYNCRONIZATION button. Time and date are used to generate entries in the event log.
If the detector power fails, time and date are not saved. Therefore, after each power failure, time and date should be set again.
Maximum number of records that can be stored in the detector's memory is 1,000. When 1,001-st event occurs, the oldest record is deleted. Thus, up to 1,000 recent event records can be stored in the detector's memory.
It is possible to save the log into a text file. To do this, press SAVE LOGS button.
The log can be cleared by pressing CLEAR button.