

TRIBOELECTRIC PROTECTION SYSTEM SEL TERRA

OPERATION AND INSTALLATION MANUAL

CE

1. GENERAL INFORMATION

This operation and installation manual contains information on the design and technical data of the triboelectric **(underground)** protection system **SEL TERRA** (hereinafter referred to as the protection system) and information on its installation and operation.

The system is designed to detect an intruder:

- walking/running in the protection zone
- jumping off the fence into the protection zone

The system is used in objects characterized by an irregular shape of the perimeter, the absence of a fence or an increased requirement for the placement of a hidden protected zone.

The system can have up to four protection zones. In each zone a sensitive element is laid in the ground. The processor registers electric discharges generated by the sensitive element that detects an attempt to break into the territory. The processor activates an alarm if the number of received electric discharges exceeds the norm.

The protection system ensures monitoring of the integrity of the sensitive and connecting (non-sensitive) element. During operation the sensitive element is completely passive.

1.1 Operating conditions:

The protection system is intended for continuous twenty-four-hour operation. The security system does not generate false alarms under the exposure to outdoor environment (EOE) listed in Table 1.

Table 1.

EOE	DESCRIPTION	VALUE
Acoustic noise	Not regulated	
Elevated ambient temperature	Elevated operation temperature	+ 50ºC
Low ambient temperature	Low operation temperature	- 40ºC
Increased humidity	Up to 98% at + 35 °C temperature	
Low humidity	Not regulated	
Rain	Not regulated	
Frost and ground frost	Not regulated	

Roots of trees	Not closer than 50 cm from a sensitive element	
Snow cover	Not regulated	
Fog	Of any intensity	
Saline (sea) fog	Of any intensity	
Dust (sand)	Not regulated	
	Not regulated	
Ultraviolet solar radiation	Not regulated	
Wind	Not regulated	
Hail and sand storms	Of any intensity	
Laying depth of sensitive element	Min.	2 cm
	Max	15 cm
Grass	Not regulated	
Movement of one person, few persons (3 – 5 persons) and big animals	Distance to the protected zone	0.5 m
Freight and passenger trains	Distance to the protected zone	from 10 m to 20 m
Electric lines (up to 500 kV)	Distance to the protected zone	10 m

Exposure to the radar electromagnetic field	Not regulated (when processor is installed in the metal box)	
Exposure to the ultra-short pulses of the electromagnetic field	Not regulated (when processor is installed in the metal box)	
Exposure to the momentum neutron field	Not regulated	
Influence of birds and animals	Weight	Up to 20 kg

2. SYSTEM COMPONENTS

- Processor;
- User manual;
- Set of fastening materials;
- Set of tools and installation parts;

Optional: end sleeve, connection sleeve, RS-BL (light) converter, RS 485-USB converter, sensitive element, non-sensitive element. At user's request all of this can be included in the delivery kit. Their quantities are specified at the time of ordering.

3. TECHNICAL CHARACTERISTICS

- Length of the sensitive element in a single zone up to 500 m;
- Length of the non-sensitive element in a single zone up to 500 m;
- Inputs – 2 or 4 independent zones;
- Relay outputs – 2 or 4 independent outputs;
- Relay output – integrity control of sensitive and non-sensitive element;
- Relay output – unauthorized opening of the processor case.
- All relay outputs – dry contact of outbound relay;
- Power supply 10-30 V (DC); 
- When voltage drops below 9.5 V, the protection system goes into the Alarm mode; Current consumption < 25 mA;
- Operating temperature from -40°C to + 50°C;
- The duration of alarm signal is at least 1 s;
- Fixed resistance value, control of integrity of sensitive and non-sensitive elements;

INSTALLATION IN GROUND – sensitive element is laid in the depth from 2 cm to 15 cm; non-sensitive cable is laid in a plastic or metal pipe (laying depth is not regulated). Compatible with all security central lines;

System setting methods:

- Using RS-485/USB converter, wired connection (Windows software);
- Using RS-BL (light) converter, wireless connection (IOS/Android device);

4. PRINCIPLE OF OPERATION

The basis for the protection system operation is generation of electrical signals in the sensitive element which is caused by its deformation due to the mechanical impact of an offender on the ground above the sensitive element

4.1 SENSITIVE ELEMENT

A sensitive element is a special cable which is made in conformity with technical requirements.

The sensitive element installed underground is designed for electrical signal generation when an offender mechanically or vibrationally affects the ground above the sensitive element at a distance of 2-15 cm from it.

The sensitive element protection length depends on the length and width of the protected zone. The sensitive element can be laid in any ground, including sand, clay, stone, etc.

4.2 NON-SENSITIVE ELEMENT

The non-sensitive element is a part of the SEL TERRA protection system. It is insensitive to deformation and vibration. The non-sensitive element is used for transferring signals between the SEL TERRA processor and the sensitive element or for connection of two sensitive elements using connection sleeves (e.g., bypassing gates, asphalted passages etc.). A non-sensitive cable in a plastic/metal pipe is ALWAYS used to connect the processor to the sensitive element.

4.3 PROCESSOR SEL TERRA

Processor SEL TERRA is used for detection, processing and alarm generation of the sensitive element signals.

4.4 CONNECTION SLEEVE (CS)

Designed to connect the sensitive element to the non-sensitive element or to restore the system after cable damage and for shielding

and sealing the connection point. Installation of sleeve in the ground is allowed with additional sealing means, except the places where the ground may be flooded for a long time. It is recommended to use as small number of connection sleeves as possible.

4.5 END SLEEVE (ES)

End sleeve provides a continuous integrity of input lines. It is also designed for shielding and sealing the sensitive element's end point (499 kΩ RESISTANCE). Installation of sleeve in the ground is allowed with additional sealing means, except the places where the ground may be flooded for a long time.

4.6 RS-485/USB CONVERTER

Used to connect SEL TERRA processor with Windows device to set up and control system parameters.

5. APPLICATION

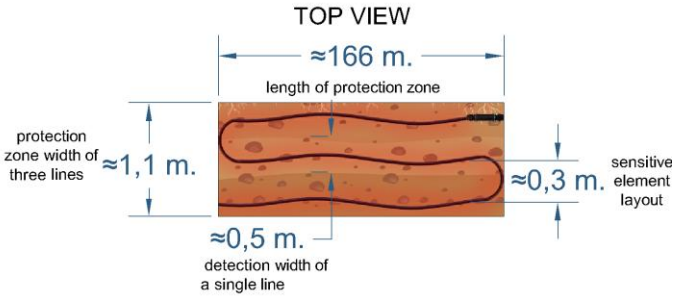
In order to ensure the required protection system stability, high noise immunity and specified sabotage resistance, THE FOLLOWING SHOULD BE PROVIDED:

- When laying sensitive cable in any ground, it is important to maintain its natural structure. This means that you cannot remove small stones or pour sand, or gravel.
- If there are different types of ground in the protection zone, then it is necessary to check the strength of the signal from an offender along the entire length of the zone and set the trigger threshold for the minimum signal.
- When choosing the correct width of the protection zone (the number of lines of the sensitive element), it is necessary to take into account the task that is assigned to the protection system.
- Pay special attention to the installation of end and connection sleeves, if necessary, install them above the ground or use additional sealing means.
- Optimum selection of the sensitivity of the processor detection zones.

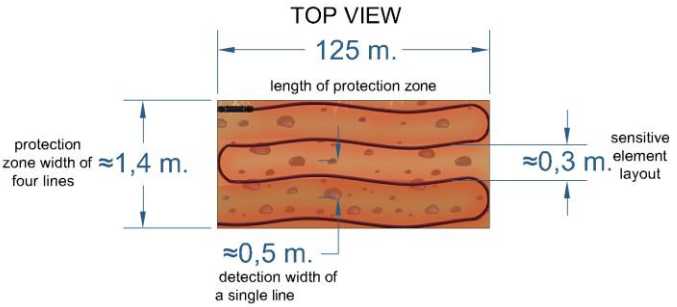
SENSITIVE ELEMENT LAYOUT RECOMMENDATIONS IN THE GROUND

The number of Sensitive Element lines per single input depends on the set requirements for the protection zone

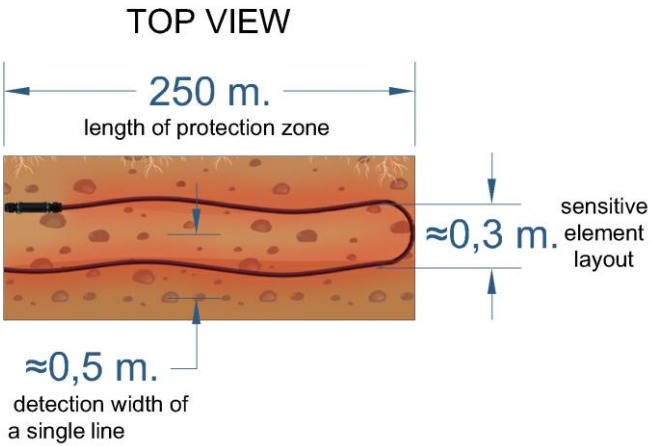
EXAMPLE 1. The figure (Fig. 1) shows max. length – 500 m of the sensitive element in one input. In this case protection zone consists of 2 lines (length – 250 m, width – 1 m).



EXAMPLE 2. The figure (Fig. 2) shows max. length – 500 m of the sensitive element in one input. In this case protection zone consists of 3 lines (length – 166 m, width – 1 m).



EXAMPLE 3. The figure (Fig. 3) shows max. length – 500 m of the sensitive element in one input. In this case protection zone consists of 4 lines (length – 125 m, width – 1.5 m).



6. SERVICEABILITY CHECK

Precautions

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

Serviceability check

The security alarm must be checked for defects on its receipt from the manufacturer. Check the serviceability of the protection system according to Table 2.

Table 2.

Checking action	Technical requirement
Check of complete set	Conformity to the assembly list (page 36)
Visual inspection	Absence of mechanical damage and corrosion. If the manufacturer's control sticker on the processor housing cover is intact.

7. INSTALLATION AND PREPARATION FOR USE

GENERAL INFORMATION (Tips)

All assembly and wiring norms and regulations shall be complied for the installation of the security system.

Underground SEL TERRA protection system is powered from the remote power source, select the type of element and the conductor cross-section that the voltage across the processor terminals is from 10 to 30 V when the output power supply voltage changing within permissible limits.

IMPORTANT! In order to ensure the protection system trouble-free operation, care should be taken of the standby power supply.



7.1 PROCESSOR SEL TERRA INSTALLATION

Arrange the processor in such a way that connectors, signalling components, RS-485 components and power cables are conveniently connected and that the processor settings can be checked and adjusted periodically.

The following equipment must be connected to the processor:

- ground connection (uninsulated copper element of cross-section at least 1.0 mm^2) (not indicated);
- sensitive element (can be connected directly or using a non-sensitive element) (input 1, input 2, input 3, input 4);
- alarm outputs (output 1, output 2, output 3, output 4);
- power supply line (DC);
- RS 485 interface for connecting several processors (Network);
- Sensitive Element and Non-Sensitive Element sabotage alarm output (TamperE);

- alarm output of processor sabotage (lid opening) (TamperC);

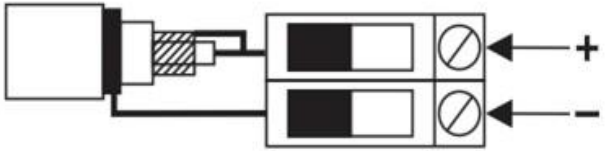


Fig. 4 Sensitive element connection to input

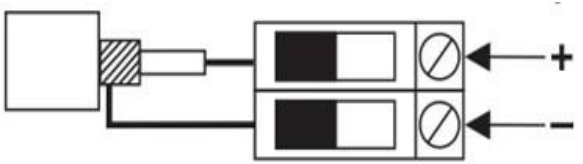


Fig. 5 Non-sensitive element connection to input

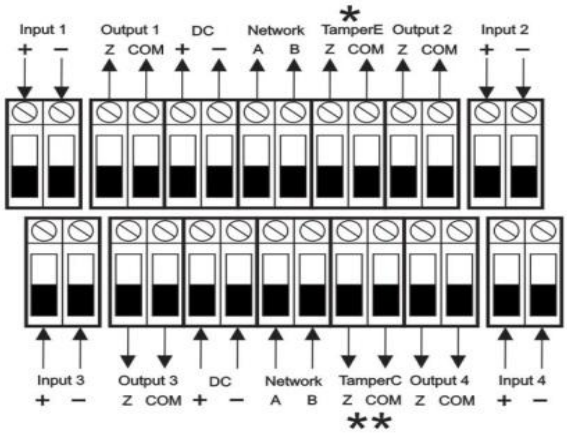


Fig. 6 SEL TERRA processor wiring diagram

7.2 LAYOUT OF SENSITIVE ELEMENT

RECOMMENDATIONS

1. Before starting the installation, it is necessary to mark the area where the sensitive cable will be laid. Please note that one line of sensitive cable protects from 20 cm to 30 cm of the ground's surface along the entire length of the line, so the number of lines must correspond to the task.
2. If the ground is soft (humus, sand, etc.), it is necessary to "remove" the ground with a shovel and gradually lay the cable at a depth of 2-15 cm. After laying, the cable must be tamped down into the ground.
3. If the ground is gravelly, in order to lay the cable, it is necessary to to dig a trench with a depth of 2-15 cm and a minimum width. After laying, fill it with already excavated soil and tamp down.

Before laying the sensitive element, the following steps shall be done:

- proceed according to the project documents;
- make sure that the ambient temperature is not less than minus 10ºC;
- make sure that its turning radius is not less than 120 mm;
- the parts of the sensitive element must be connected using a connection sleeve only.
- For more convenient installation of the sensitive cable, in some places (for example, in turns) the sensitive cable can be fixed to the ground (with a weight or a clip).

7.3 CONNECTION OF SENSITIVE AND NON-SENSITIVE ELEMENTS

Prepare the wire ends of the sensitive and non-sensitive elements.

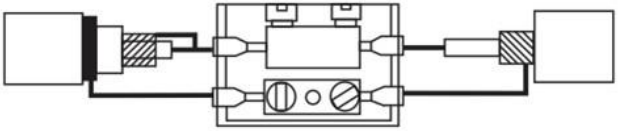


Fig. 7 connecting the sensitive element with the non-sensitive cable

1) Connect sensitive and non-sensitive elements;



2) Isolate the contact;



3) Use the foil to shield the connection;



4) Collect the connection sleeve;

7.4 END SLEEVE CONNECTION

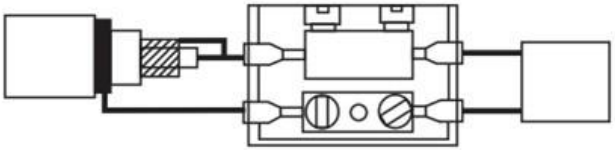


Fig. 8. END SLEEVE CONNECTION

1) Connect the sensitive element with the end resistance;



2) Seal the contact and the end resistance with seal tape;



3) Use the foil to shield the end sleeve;



4) Collect the connection sleeve;

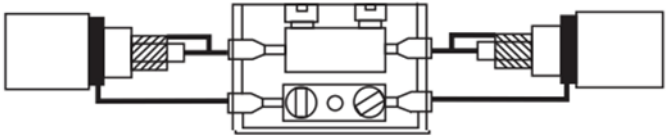


Fig. 9 sensitive element connected to sensitive element

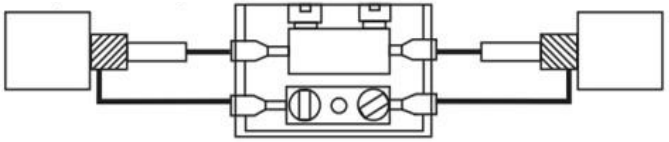


Fig. 10 non-sensitive cable connected to non-sensitive cable