Architectural & Engineering Specification for

OmniTrax ranging buried ported coaxial cable outdoor intrusion detection system

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Purpose of document

This document provides performance and functional specifications for the OmniTrax® intrusion detection system. It is written in a generic format without referring to the OmniTrax system by name or by specific identifiers. These specifications may be copied verbatim to form a generic procurement specification for a ranging buried, ported, coaxial cable intrusion detection system.

Classification of equipment

OmniTrax is a ranging buried ported coaxial cable electromagnetic field sensor system for outdoor perimeter intrusion detection. OmniTrax functions as a standalone system or as an integral component of a centralized control and maintenance facility.

Disclaimer

 The information in this document is subject to change without notice. Senstar reserves the right to make changes to product design or manufacturing methods, as engineering progresses, or as other circumstances warrant.

Contents

1.0 General performance specifications

1.1 System description

The system shall be a modular ranging buried coaxial cable outdoor intrusion detection sensor system based on ported coaxial cable technology. The detection field shall be formed by radio-frequency (RF) signals carried by sensor cables that are buried along the perimeter. The RF signals shall form an invisible electromagnetic detection field around the sensor cables that can locate and detect an intruder passing through the field.

A processor shall contain the electronics required to:

- Transmit and receive the RF signal without the use of an external antenna
- Monitor the detection fields of up to 2 sensor cable sets
- Determine the position of intruders to within +/- 1 meter with a 95% confidence factor
- Provide uniform detection performance along the length of the sensor cables regardless of the burial medium by using a unique detection threshold for each meter of cable
- Raise an alarm when an intruder enters the monitored zones
- Communicate alarm, status, and configuration information over a data network via an optional communications interface card
- Communicate alarm and status information via relay contacts

Field power modules shall be available for standalone systems and network systems. Standalone power modules shall supply 12 VDC power for one processor. Network power modules shall supply 48 VDC power for up to seven processors. It shall be possible to supply power to each processor through the sensor cables.

All processors shall provide the ability to adjust parameters using a laptop PC connected directly to the processor via a Universal Serial Bus (USB) cable.

The data network supported by the system shall communicate through a central network interface unit that provides standard communications interfaces for connection to computer equipment. Via the network interface unit and associated network management software, the system shall provide all the alarm and status information needed to implement the operator interface. In addition, configuration software shall be available so that all system calibration and adjustments can be done over the data network from a central location.

1.2 System technology

1.2.1 Ported coaxial cable

The system shall use ported (leaky) coaxial cables as the sensing elements. The size of the port (opening) shall change with cable length to optimize the strength of the receive signal. A detection field shall be created using pulse-coded RF signals that are generated by the processor and carried by the coaxial cables. Each system requires a transmit cable to transmit the RF signal, and a receive

cable to receive the signal and carry it back to the processor. Transmission and reception shall be accomplished without the use of antennae. The RF signal received on the receive cable shall be monitored and analyzed for any changes that would indicate the presence of an intruder. The system shall be available in three configurations that are suitable for different applications:

- a single-cable sensor system that includes both transmit and receive cables, for installation in a single narrow trench up to 400 m (1312 ft.) per processor; 200 m (656 ft.) per cable
- a two-cable sensor system that includes separate transmit and receive cables, for installation in two parallel trenches up to 400 m (1312 ft.) per processor; 200 m (656 ft.) per cable
- a two-cable sensor system that includes separate transmit and receive cables, for installation in two parallel trenches up to 800 m (2624 ft.) per processor; 400 m (1312 ft.) per cable

In all cases, the cable shall be capable of being used for power distribution (to power multiple processors from a single source) and for distribution and collection of alarm and other diagnostic information.

1.2.1.1 Single cable system

The single cable system shall use a single cable assembly consisting of two ported coaxial cables in one jacket. The outer jacket shall be made of abrasion and chemical resistant, high-density polyethylene. The cable assembly shall include a flooding compound to prevent the ingress of water if the outer jacket is nicked.

1.2.1.2 Two-cable system

The two-cable systems shall use two separate cable assemblies, each consisting of a single ported coaxial cable in its own jacket. The outer jacket shall be made of abrasion and chemical resistant, high-density polyethylene. The cable assembly shall include a flooding compound to prevent the ingress of water if the outer jacket is nicked.

1.2.2 Electromagnetic field

Detection shall rely on an electromagnetic field that is formed completely around the buried sensor cables.

1.2.3 Sensor cable burial depth

The standard burial depth of the sensor cables shall be 23 cm (9 in.) in soil and 6 cm (2.5 in.) in hard surfaces such as asphalt or concrete.

1.3 Detection properties

1.3.1 Detection sensitivity

The system shall detect moving intruders that have a significant electromagnetic cross-section (e.g., humans, vehicles, and other large conductive objects) while rejecting other environmental stimuli (e.g., birds, small animals, weather).

1.3.2 Detection performance

1.3.2.1 Probability of detection

The probability of detecting a human intruder walking across the protected perimeter at random locations shall be 99% with a 95% confidence factor.

1.3.2.2 Intruder location

The system shall determine and display the location of intruders. For intruders crossing the sensor cable at any given location the declared position shall be repeatable within +/-1 meter with a 95% confidence. It is noted that the determination of absolute location along the cable can vary with installation conditions.

1.3.2.3 Velocity response

The system shall be capable of detecting upright human intruders moving through the detection field at speeds between 5 cm/s (2 in./s) and 8 m/s (26 ft./s) regardless of the direction of motion. The velocity response setting shall be programmable to optimize detection at low speed while reducing site nuisance alarms.

1.3.2.4 Intruder weight

The system shall detect human intruders weighing more than 35 kg (77 lb) at the specified probability of detection (PD) (section 1.3.2.1).

1.3.2.5 Crossing types

The system shall detect human intruders who walk, crawl, roll, jump, or run through the detection field.

1.3.3 False alarms

1.3.3.1 System-generated alarms

Alarms generated by internal electronic processes (cables excluded) shall not exceed one per zone per month. System generated alarms are averaged based on the total number of zones in the system.

1.3.3.2 Small animal alarm rejection

The probability of detecting a small animal, weighing less than 10 kg (22 lb), crossing the perimeter shall be less than 5% with a confidence factor greater than 90%.

1.3.3.3 Environmental alarms

When installed in accordance with the manufacturer's recommendations, the system shall operate within specifications in typical outdoor environments.

Specifically, the system shall maintain the full probability of detection for valid intruders while minimizing false alarms from the following stimuli:

- Vegetation up to 30 cm (1 ft.) high
- Rain
- Sunrise/sunset
- Wind
- Temperature changes
- Snow
- Hail
- Fog
- Sandstorms
- Seismic vibration
- Acoustic or magnetic effects

The supplier shall provide site planning information to enable site conditions (i.e., site grade, standing water, nearby objects) to be optimized for minimal nuisance alarms.

1.4 Sensor characteristics

1.4.1 Cable length

The system shall provide detection coverage to a maximum distance of 400 m (1312 ft.) per cable set. Sensor cables shall be available in standard lengths of 50 m (164 ft.), 100 m (328 ft.), 150 m (492 ft.), 200 m (656 ft.), 300 m (984 ft.), and 400 m (1312 ft.). Each sensor cable shall include a minimum of 4 m of detecting cable, in addition to the specified length, in which the detection field can build up to full strength.

1.4.2 Sensor segments and zones

It shall be possible to divide the perimeter protected by the sensor cable into multiple segments and zones. The supplier shall provide a software tool that runs on a Windows® PC for the creation of segments and zones.

1.4.2.1 Software functional segmentation

It shall be possible to create in software multiple functional segments in each sensor cable set. The segments can be declared as active or inactive, and can be set to unique detection parameters. It shall be possible to set up to 50 functional segments per sensor cable set. A segment shall have a minimum length of 1 m (3.3 ft.) and a maximum length of the combined length of the two sensor cable sets connected to one processor.

1.4.2.2 Software zoning

It shall be possible to combine one or more software functional segments into alarm reporting zones for operator control. It shall be possible to set up a reporting zone that bridges over the two sensor cables at their point of overlap. It shall be possible to set up to 50 alarm reporting zones per sensor processor.

1.4.3 Detection field dimensions

When the system is calibrated in accordance with the manufacturers' recommendations:

- The detection field shall be continuous and uniform over the protected site perimeter, excluding segments that are set to be inactive.
- The typical cross-section of the detection field shall meet the following dimensions:
  - Height – 1 m (3.3 ft.) above ground
  - Width – 2 m (6.6 ft.) for single-cable systems; up to 3 m (9.8 ft.) for two-cable systems, depending on cable separation
  - Depth – 0.5 m (1.5 ft.) below ground

1.4.4 Terrain-following characteristics

The detection field shall not be limited to flat terrain or line-of-sight operation. The system shall operate within specifications over uneven terrain with a maximum grade change of 30º within 4 m (13 ft.) and around corners with a minimum turn radius of 7.0 m (23 ft.).

1.4.5 Range of containment

When system sensitivity is calibrated according to the manufacturer's recommendations, the detection field shall not detect a human intruder that is 2 m (6.5 ft.) or more away from the nearest sensor cable.

1.4.6 Operation in frozen soil

The freezing of the burial medium during cold weather operation shall not cause degradation in the performance of the system or damage to the system's components. The only adjustment required after freezing or thawing is recalibration of thresholds.

1.4.7 Operation in areas of high moisture content

The sensor cables and underground connections shall be impervious to water ingress and degradation for a minimum of 10 years. The system shall operate within specifications in soil saturated with fresh water.

1.4.8 Burial-mediums

The system shall operate within specifications when installed in burial mediums with conductivity ranging from 10 mS/m to 200 mS/m, including, but not limited to, sand, clay, soil, asphalt and concrete.

1.4.9 Snow cover

The sensor system shall operate within specifications when covered by snow up to 30 cm (1 ft.) deep.

2.0 Processor specifications

2.1 Processor description

Each processor shall contain the electronics required to handle the signal processing for 100 software-defined functional segments on two sets of sensor cables, including the calculations necessary to determine the location of intruders. The processor shall operate in either a standalone configuration, or in a network configuration. The processor shall be provided in a weatherproof enclosure providing the protection level of CSA Type 4 (equivalent to NEMA 4).

2.2 Processor operation

2.2.1 Distributed processing

Each processor shall transmit, receive and process the electromagnetic detection fields for two cable sets, independently from other processors. Each processor shall provide coverage for up to 800 m (2,624 ft.) of perimeter.

2.2.2 Adaptive filter

The processor shall use an adaptive filter that adjusts the signal processing to reduce nuisance alarms caused by environmental factors such as rainfall or slow-running water.

2.2.3 Total perimeter length

The total perimeter shall be expandable to an unlimited length by using multiple processors. There shall be no gap in the detection field between the individual zones or cables.

The system shall be able to protect a continuous perimeter of up to 5.6 km (3.5 miles) while having power supplied at only one processor location.

The integrated data network shall provide data networking capability for perimeters of up to 25.6 km (15.9 miles) while requiring that the network interface unit be attached to the network at only one processor location. To provide communications redundancy it shall be possible to attach the network interface unit to the data network at two different processors.

2.2.4 Alarm outputs

In standalone mode, the processor shall output alarms to four on-board Form C relays, (Alarm A, Alarm B, Supervision, Fail). The relays shall be rated at 1.0 A at 30 VAC/VDC.

In network mode, the buried sensor cables shall support a data network that communicates sensor alarms, supervision alarms, fail alarms, and status and configuration information. The network interface unit shall be able to connect to the data network at processors equipped with a communications interface module. To provide network redundancy it shall be possible to connect the network interface unit to the data network at two different processors. The following options shall be available for the physical media between the network interface unit and the processor(s) where the network attachment is made: EIA-422, dual multimode fiber, dual singlemode fiber.

2.2.4.1 Sensor alarm

In standalone mode, intrusion into any zones that are supervised by the processor shall be identified by a contact closure, Alarm A for cable set A, and Alarm B for cable set B. With the addition of a plug-in auxiliary relay output card to the processor, it shall be possible to output an intrusion alarm to one of 10 auxiliary relays (2 on processor 8 on auxiliary relay card). These auxiliary relays shall be rated at 1.0 A at 30 VAC/VDC.

In network mode, intrusion into any zones that are supervised by a processor shall be identified by alarm type (sensor) and location (zone ID) and distance in meters from a calibrated reference point. This information shall be transmitted over the data network and made available via the network interface unit to the security management system.

2.2.4.2 Supervision alarm

A Supervision alarm caused by opening the processor enclosure or cable fault shall be identified by alarm type (Supervision) and location (Processor ID). A Supervision alarm shall not reset until the cause of the alarm is corrected.

2.2.4.3 Fail alarm

A Fail alarm caused by power failure or internal electronic fault shall be identified by alarm type (Fail) and location (Processor). A Fail alarm shall not be reset until the cause of the alarm is corrected.

2.2.4.4 Fail-safe relay operation

Both the Fail and Supervision relays shall operate in fail-safe mode, whereby the relays shall latch in the non-alarm state during normal operation. Upon the loss of the DC power input the Fail relay shall change to the alarm state to indicate the power failure. Upon the loss of DC power and the loss of battery back-up power the Supervision relay shall change to the alarm state to indicate a complete loss of power.

2.2.4.5 Self-test

The processor shall be capable of performing a diagnostic self-test of either sensor cable set by either local or remote activation. The self-test feature shall cause an internal electronic test of the processor.

2.3 Optional transponder modules

In network mode, the base processor, without the aid of any auxiliary cards, shall have available two supervised input points to capture the alarm data from auxiliary sensors and four output relays for the control of auxiliary equipment. The four relay outputs shall be rated at 1.0 A at 30 VAC/VDC, non-inductive load.

Further, in network mode, the processor shall be able to accept one optional plug-in transponder module to expand the input or output capacity.

2.3.1 Optional 8-input transponder module

The optional 8-input transponder module shall provide eight supervised inputs while allowing normal operation of the two supervised inputs and four relay outputs that are integral to the processor.

2.3.2 Optional relay output module

The optional relay output module shall provide eight Form C dry contact relay outputs, rated at 1.0 A at 30 VAC/VDC. This module shall allow normal operation of the two supervised inputs and four relay outputs that are integral to the processor.

2.4 Optional communications modules

It shall be possible to equip the processors with communications modules to enable them to support data networking. Communications modules shall be available in five configurations: EIA-422/EIA-422, Multimode Fiber Optic/Multimode Fiber Optic, Singlemode Fiber Optic/Singlemode fiber Optic, EIA-422/Multimode Fiber Optic and EIA-422/Singlemode Fiber Optic, A data communication interface card shall be mandatory for each processor using network communications including when data is networked over the cables.

2.5 Optional auxiliary power supply module

An auxiliary power supply shall be available for installation inside the processor enclosure. The auxiliary power supply shall convert 48 VDC supplied from the sensor cables to 12 VDC to power external devices. It shall be capable of supplying up to 150 mA at 12 VDC.

2.6 Environmental operating range

2.6.1 Temperature

The processor shall operate within specifications at temperatures between –40º and 70º C (–40º and 158º F).

2.6.2 Humidity

The processor shall operate within specifications at humidity levels ranging from 0 to 95% relative humidity, non-condensing.

2.7 Powering Requirements

2.7.1 Input power

Processors shall function with input power in the range of 10 to 48 VDC. Maximum power consumption shall be 9W.

2.7.2 Network power capability

The network field power module shall be capable of supplying power to up to seven processors over the sensor cable.

2.7.3 Power cable redundancy

In a network configuration where power is supplied redundantly via the sensor cables, the processors shall operate within specifications when power is removed from either of the two sensor cables.

2.7.4 Backup battery

Each processor shall be equipped with an internal backup battery with a minimum capacity of 5Ah. In the event of loss of the prime input power the processor shall switch over automatically to the backup battery without any disruption in performance and annunciate the power loss either to the local Fail relay or over the data network if so configured. The processor shall have charging circuitry to maintain the battery at full charge when prime power is available.

2.8 Reliability/maintainability

The processor shall have a calculated Mean Time Between Failure (MTBF) of greater than 40,000 hours. The Mean Time to Replace (MTTR) a processor shall be less than 15 minutes.

2.9 Physical installation criteria

2.9.1 Processor enclosures

The processor shall be provided in a weatherproof enclosure providing the protection level of CSA Type 4 (equivalent to NEMA 4).

2.9.2 Covert installation

The processor enclosure shall be capable of covert installation within a telecom enclosure.

2.9.3 Location of processor

A non-sensing section of cable shall be included as an integral part of the cable set to allow the processor to be located away from the detection field. The standard length of non-sensing cable shall be 20 m (66 ft.). The non-sensing cable shall not reduce the 400 m (1312 ft.) maximum length of the active cable.

2.9.4 Lead-in/sensing cable junction

The junction between the non-sensing section of lead-in and the sensor cable shall be integral to the cable assembly and shall require no connectors or breaks in the outer jacket of the cable. The lead-in section of the sensor cable shall be 20 m (66 ft.) in length and shall be adjustable by either cutting out or splicing in additional sections of non-sensing cable.

2.9.5 Lightning protection

The processor shall include internal components to protect circuitry from power supply transients and lightning. Optional external protection devices shall be available for use in areas with a high incidence of lightning.

2.10 Sensor calibration

It shall be possible to perform all calibration and configuration of the processors using supplier-furnished software running on a Windows® PC. It shall be possible to perform this locally at the processor with a direct USB connection or remotely via the data network.

Access to the processor USB connection shall require removal of the enclosure's cover and shall cause a Supervision alarm to be generated.

2.10.1 Calibration walk

It shall be possible to calibrate the system by having a person walk along the length of the protected perimeter, over the center of the detection zone. During the calibration walk the processor shall be connected to a Windows® PC running the configuration software. The configuration software shall measure and record the sensor cable response and set the threshold for each meter (3.3 ft) of the cable. The configuration software shall use the results of the calibration walk to determine the appropriate setting for the processor's transmitter power level.

2.10.2 Sensitivity adjustment

It shall be possible to adjust detection sensitivity for each zone with a Windows® PC. It shall be possible to perform this locally at the processor with a USB connection or remotely via the data network.

2.10.2.1 Local sensitivity measurement

It shall be possible to view and record the processor's response on a Windows® PC. It shall be possible to perform this locally at the processor with a USB connection or remotely via the data network. The PC shall display the alarm trip-point, thereby showing the processor's degree of detection above or below the level required to cause an alarm.

2.10.2.2 Functional segmentation

It shall be possible to use a Windows® PC to define up to 50 functional segments per sensor cable. A functional segment shall be subject to further sensitivity adjustments for optimum performance or it can be defined as non-reporting. A non-reporting functional segment shall not report intrusion alarms that occur within its defined length.

2.10.2.3 Reporting zones

It shall be possible to use a Windows® PC to combine one or more functional segments into alarm reporting zones. It shall be possible to define up to 50 alarm zones per processor.

3.0 Centralized control & maintenance

The sensor shall provide an integrated data networking capability to allow it to be integrated into a centralized control and maintenance facility.

3.1 Network characteristics

The data network shall be capable of communicating all alarm, status, and configuration information between the processors and a network interface unit. The data network shall use a loop topology with separate Transmit and Receive point-to-point links between processors, or between a processor and other compatible equipment such as the network interface unit. The following physical media options shall be available for the point-to-point links:

- EIA-422
- singlemode or multimode fiber
- the sensor cables

It shall be possible to link up to 32 processors together into one network.

The data network shall communicate through a central network interface unit that provides standard communications interfaces for connection to computer equipment. The standard interfaces available from the network interface unit shall be EIA-232, USB, and Ethernet. Via the network interface unit and associated network management software the system shall provide all the alarm and status information needed to implement an operator interface. It shall be possible to attach a network interface unit to one processor, or to two processors, to provide redundant data paths to the processor network.

The supplier's configuration software shall be capable of using the data network so that all system calibration and adjustments can be done from a central location.

It shall be possible to have multiple networks, each with up to 32 processors, managed by multiple instances of the network interface unit and associated software, all reporting to one control and maintenance display system.

3.2 Network management software

The supplier shall make available network management software that runs on a Windows® PC to control the flow of information on the data network. The network management software shall control the network via the network interface unit and provide a software interface that gives access to all alarm, status, and configuration information. The software interface shall be implemented via TCP/IP.

The supplier shall make available complete documentation of the software interface provided by the network manager software to enable integration with third-party Security Management Systems.

4.0 System installation and commissioning

The supplier shall make available a complete documentation package to enable successful site planning and design, installation, and commissioning of the system.

The supplier shall make available a training course or courses to cover the following:

- site planning and design
- system installation
- system commissioning
- system integration with Security Management Systems

5.0 System maintenance and repair

5.1 Recalibration requirements

The system shall not require recalibration after initial calibration, with the exception of systems that are installed where seasonal changes cause freezing and thawing of the burial medium. These systems may require minor seasonal recalibration to maintain ideal sensitivity levels.

5.2 Sensor cable repair

If the sensor cable is cut or damaged, it shall be capable of being repaired.

5.3 Product support

The supplier shall provide technical support and shall warrant that spare parts and assemblies shall be available for a minimum of 10 years after installation.

6.0 Product certifications

The system shall comply with FCC and IC regulations for the operation of a radio-frequency radiating device.

The system shall comply with European CE regulations and carry the CE mark.

The manufacturer’s quality management system shall have ISO 9001-2000 certification.

The product shall comply with safety standard IEC 60950-1:2001 and the supplier shall make available upon request a CB Test Certificate confirming such compliance.

7.0 System availability

A product that meets or exceeds this specification is the OmniTrax outdoor intrusion detection system, available from:

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