Architectural & Engineering Specification for

Electrostatic field outdoor intrusion detection sensor

Purpose of document

This document is intended to provide performance specifications and operational requirements for the XField® Intrusion Detection Sensor. It is written in a generic format without referring to the system by name or by specific identifiers. These specifications may be copied verbatim to form a generic procurement specification for an electrostatic field intrusion detection system.

Classification of equipment

XField is a volumetric electrostatic field sensor employing electrostatic field technology for outdoor perimeter intrusion detection.

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Contents

1.0 General performance specifications

1.1 System description

The system shall be a modular electrostatic field outdoor intrusion detection sensor system based on very low frequency (VLF) electronics technology. An invisible volumetric electrostatic detection field shall be formed between sets of parallel wires. The detection field shall be capable of detecting the presence of a human intruder passing through it.

A field generator shall excite field wires to create an electrostatic field. Parallel sense wires shall pick up and carry the signals from the detection field back to the processor. The processor shall detect minute changes in the coupling that is caused by the presence of an intruder within the electrostatic field. The signal processor shall include both the generator and detector circuitry and shall be capable of monitoring either one or two detection zones as a standalone unit.

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 processor shall be capable of communicating alarm, status, and configuration information over a data network. The data network supported by the system shall be managed by 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 Electrostatic field

An AC signal that is generated along the field wires couples to the sense wires establishing an electrostatic field. The signal processor shall analyze the signals picked up by the individual sense wires to detect the presence of intruders within the field. The signal processor shall use digital processing and adaptive algorithms to nullify the effects of induced voltages from power lines, distant lightning, electromagnetic noise and environmental effects.

1.2.2 Field and sense wires

The field and sense wires shall be made of 316 stainless steel wire and shall be mounted on insulators. The insulators shall be mounted so that the wires are parallel and form a barrier. A typical installation shall employ 2 field wires and 2 sense wires (see Section 1.4.2). It shall be possible to add a fifth wire to increase the height of the 4-wire configuration. It shall be possible to create an 8-wire configuration by stacking two zones, one on top of the other, to achieve greater field heights. The insulators and wires shall be capable of being mounted on fences, and freestanding posts adjacent to, or between, physical barriers.

1.3 Detection properties

1.3.1 Detection sensitivity

The system shall detect intruders with a significant mass and velocity while rejecting other environmental stimuli.

1.3.2 Detection performance

1.3.2.1 Probability of detection (PD)

The probability of detecting an upright human intruder passing through the perimeter at random locations shall be 90% with a 95% confidence factor.

1.3.2.2 Velocity response

The system shall be capable of detecting human intruders moving through the detection field at speeds ranging from 5 cm/s (2.0 in./s) to 5 m/s (16.4 ft./s) regardless of the direction of motion.

1.3.2.3 Intruder weight

The system shall detect human intruders weighing 35 kg (77 lb.) or more at the specified PD.

1.3.2.4 Crossing types

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

1.3.3 False/nuisance alarms

False/nuisance alarms are divided into three categories: system-generated, small animal and environmental.

1.3.3.1 System-generated alarms (false alarms)

Alarms generated by internal electronic processes (wires excluded) shall occur at a rate of less than one per zone per month (averaged over 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 5 kg (11 lb.), crossing the perimeter shall be less than 10% with a confidence factor greater than 90%, provided the animal does not physically touch any field or sense wire.

1.3.3.3 Environmental alarms (nuisance alarms)

The system shall operate within specifications in typical outdoor environments. The system must be installed in accordance with the manufacturer's guidelines to minimize the possibility of nuisance alarms while maintaining the full PD for valid intruders. The following conditions shall not affect the system's PD:

- rain
- sunrise/sunset
- wind
- temperature changes
- snow
- hail
- fog
- sandstorms
- motion of nearby objects (vehicles, etc.)
- nearby radio-frequency sources
- seismic vibration
- acoustic or magnetic effects

The manufacturer shall provide system documentation, which includes detailed information on site planning, installation, operation and maintenance.

1.4 Sensor characteristics

1.4.1 Zone length

The maximum length of each individual detection zone shall be 152 m (500 ft.). The minimum zone length shall be 3.0 m (10 ft.).

1.4.2 Detection field dimensions

The effective detection field shall be continuous and uniform over the protected site perimeter. The typical cross-section of the detection field shall exhibit the following dimensions when the system is calibrated in accordance with the manufacturer's recommendations:

- Height – up to 2.5 m (8.0 ft.) above ground, based on a four wire configuration in a fence-mounted installation. Up to 3.65 m (12 ft.) above ground, based on a five wire configuration in a fence-mounted installation. Up to 5.65 m (18.5 ft.) above ground, based on an eight wire configuration in a fence-mounted installation
- Width – up to 1.0 m (3.3 ft.) centered on the plane of the wires

Note: The height and width dimensions are typical and depend upon the threshold setting and site conditions.

1.4.3 Terrain-following characteristics

The detection field shall not be limited to line-of-sight operation. The zone length, detection field dimensions and performance characteristics shall be valid over uneven terrain including grade changes and acute corners. Steep grade changes shall be possible with the installation of additional interim points.

1.4.4 Range of containment

When the system is adjusted to demonstrate sensitivity according to the manufacturers' recommendations, the detection field shall not detect a valid human target that is 1.5 m (5 ft.) or more from the plane of the wires.

2.0 Sensor processor specifications

2.1 Processor description

The signal processor shall contain the electronics necessary to perform the generation, reception and digital signal processing for one or two detection zones. The processor shall operate in either a standalone configuration or in a network configuration. The unit will be housed in a weatherproof NEMA 4 or equivalent enclosure, when installed outdoors.

2.2 Signal processor operation

2.2.1 Distributed processing

Signal processors distributed along the perimeter shall perform the generation, reception and digital signal processing of the electrostatic detection field. The failure of one processor shall not affect the other processors along the perimeter. Each processor shall provide coverage for up to 305 m (1000 ft.) of perimeter. The processor shall contain circuitry and firmware to prevent interference between adjacent fields.

2.2.2 Adaptive filter

The processor shall use an adaptive filter and signal analysis to identify and screen out environmental factors such as rainfall that could lead to nuisance alarms.

2.2.3 Total perimeter length

Total perimeter length shall be expandable from the 305 m (1000 ft.) maximum coverage of one processor to an unlimited length using multiple processors. There shall be uniform coverage and no gap in the detection field between individual zones.

2.2.4 Standalone mode

The signal processor shall identify, by type and zone, Intrusion, Supervision and Fail alarms locally via dry relay contacts (Form C) rated at 1.0 A, 30 VDC.

An alarm caused by intrusion into the detection zone shall be identified as an Intrusion alarm.

Alarms caused by tampering with the field and sense wires or by opening the enclosure shall be identified as Supervision alarms. Supervision alarms shall be distinctive from all other alarms and shall continue until the fault is corrected.

Alarms caused by power failure or internal electronic failure shall be identified as Fail alarms. Fail alarms shall be distinctive from all other alarms and shall continue until the fault is corrected.

The Fail and Supervision relays shall operate as failsafe. During normal operation, both relays shall latch in the non-alarm state. Upon total system failure both the Supervision and Fail relays shall switch to the alarm state to annunciate the system failure.

The processor shall be capable of performing an electronic self-test of either zone by local activation.

2.2.5 Network mode

In network mode, the processors shall be connected by 4-wire EIA-422 twisted pairs, or dual multimode fiber optic cables, or dual singlemode fiber optic cables for the transmission, reception and central display of Sensor alarms, Supervision alarms and Fail alarms, as described in 2.2.4. The system shall support redundant data paths. Network functionality shall be achieved by employing Auxiliary Interfaces as described in 2.2.6.

2.2.6 Auxiliary interfaces

In network mode, each processor shall be capable of supporting optional internal interfaces to collect or distribute data from auxiliary sensors, to provide power to auxiliary sensors, and to provide redundant data communication over EIA-422 or fiber optic data paths.

2.2.6.1 Optional data collection/distribution interfaces

The processor shall be capable of supporting either an auxiliary input card, or a relay output card. A plug-in input card shall be available to provide eight (8) supervised inputs for the collection of data from auxiliary sensors. A relay output card shall be available to provide eight (8) Form C dry contact relay outputs, rated at 1.0 A at 30 VAC/VDC. In addition, there shall be available on the processor itself, two supervised inputs and four relay outputs rated at 1.0 A at
30 V, non-inductive load.

2.2.6.2 Optional Power interface

A DC-DC power converter shall optionally be located in the processor enclosure to convert 24 or 48 VDC from the power network to 12 VDC, 150 mA maximum, to power external devices.

2.2.6.3 Optional Communications interface

Separate plug-in communication interfaces shall be available for EIA-422, multimode fiber optic, and singlemode fiber optic bi-directional data communications.

2.3 Environmental conditions

The signal processor shall operate within specifications in the following range of conditions:

Temperature: –40ºC to 70ºC (–40ºF to158ºF)

Humidity: 10 to 95%, non-condensing

2.4 Powering Requirements

The signal processor shall be capable of being powered at 10 to 52 VDC at 6 W maximum.

2.4.1 Backup battery

It shall be possible to equip the processor with an optional internal 6 VDC, 5 Ah (nominal) battery to provide emergency backup power in the event of a power failure. The processor shall include charging circuitry to maintain the battery at full charge.

2.5 Physical installation criteria

2.5.1 Physical installation

The field and sense wires shall be tensioned at the start of the zone, at the end of the zone, and at 50 m intervals throughout the zone, and shall be supported every 6 m (20 ft.) or less, depending on the environmental conditions (strong wind). The wires shall be capable of being mounted in the following configurations:

- Fence-mounted - on an existing, or new, perimeter fence
- Freestanding - on freestanding poles either in an open area within a controlled perimeter, or in the area between two barriers along a perimeter

2.5.2 Determination of zone length

The length of each zone shall be determined by the physical boundaries of the site to a maximum length of 152 m (500 ft.).

2.5.3 Location of signal processor

The signal processor shall be mounted inside the protected perimeter, away from the fence, within 150 m (492 ft.) of the start of the zone.

2.5.4 Enclosures

For outdoor installations, the signal processor shall be housed in a weatherproof NEMA 4 (or equivalent) enclosure. The enclosure shall be capable of being mounted on walls and posts.

2.5.5 Lightning protection

The signal processor shall include internal components to protect circuitry from electrostatic discharge (ESD) and lightning. This protection shall include, but not be limited to, relay contacts, input power, sensor input and field output. The installer shall provide an approved, low resistance earth ground at each processor that is properly connected to the enclosure, in accordance with local regulations.

2.6 Sensor calibration

Each detection zone shall be capable of being calibrated from its respective signal processor. All calibration adjustments shall be performed using Windows® based software on a laptop PC connected directly into the processor via Universal Serial Bus (USB) cable. During calibration, the PC shall display information about each parameter as it is adjusted.

Access to the USB connector on the processor shall require opening the enclosure's cover. This action shall cause a Supervision alarm to be generated.

2.6.1 Network transponder/device calibration (optional)

In a networked system, there shall be a single point interface between the networked processors and the operator interface.

When the processor is configured as a network transponder/device, it shall be capable of being calibrated remotely from the central control and display system.

The central control and display system shall also monitor and control the entire perimeter security system from a central location. It shall also be able to display sensor system diagnostic test results.

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
- multi-mode fiber
- single-mode fiber

It shall be possible to link up to 60 processors together into one network.

The data network shall be managed by 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 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 provides 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 system shall be installed and commissioned in accordance with the manufacturer's recommended procedures, as defined in the Product Guide.

The manufacturer shall make available training programs for site planning, installation, operation and maintenance of the system. Prior to installation, the installer shall have completed a training program and be certified by the manufacturer. Alternatively, the manufacturer shall make available to the installer, qualified technical support for the installation and commissioning of the system.

The manufacturer shall make available standard acceptance test procedures to demonstrate that the system meets the specified probability of detection when installed and calibrated according to the manufacturer's directions.

5.0 System maintenance and repair

System maintenance shall include periodic visual inspections of the site, tension measurement of the sensor wire and operational checks of the effectiveness of the detection zones.

Outdoor mechanical assembles such as wires, mounting hardware and insulators shall be self-cleaning and shall be constructed of materials not prone to decay when exposed to the elements.

5.1 Product support

The product shall be under warranty for a minimum of three years from the date of purchase.

The end-user shall have the option of extending the warranty to five years without additional fees.

6.0 Product certifications

The quality management system of the product's manufacturer shall have current ISO 9001-2015 certification.

The system shall comply with the limits for a Class A digital device pursuant to Part 15 of the FCC rules.

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

7.0 System availability

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

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