FPS System

Fence Protection System

Fence Protection System Design Guide

G2DA0109-001, Rev A
First edition
September 11, 2009

SENSTAR™

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CONTENTS

LIST OF FIGURES

INTRODUCTION

This guide has been developed to help you design a Magal-Senstar, inc. FPS Fence Protection System. The FPS provides professional and reliable, yet inexpensive, perimeter protection. System design and installation are not difficult. This guide provides straightforward procedures that will help answer important questions and provide a complete perimeter protection system.

HOW TO USE THIS GUIDE

This design guide provides a step-by-step procedure for designing a Magal-Senstar, inc. FPS Fence Protection System. The design process takes you through logical steps beginning with the requirements of the fence and proceeding through all the important elements of perimeter security design. Each element of the design is presented in a question and answer format.

Begin by reviewing the Theory of Operation. This will give you a good understanding of the FPS system operation and the reasons why certain information is required. Following the Theory, proceed through the design questions step-by-step. While answering the questions, you can develop an equipment list . When you are finished, use the material listing to order appropriate materials. If you have any remaining questions, send the completed material list to the factory for a double check of the system requirements.

THEORY OF OPERATION

The MSI FPS system is a "Strain Sensitive Cable Sensor System," meaning that a mechanical disturbance in the fence causes a small strain on the sensor cable that is converted to an electrical signal.

Figure 2 shows a simplified FPS system block diagram. The sensor cable is a small coaxial cable specially manufactured with a permanent electrical charge throughout its entire length. Any movement in the fence causes a small voltage to appear at the sensor cable output. Magal-Senstar tests every foot of the sensor cable to verify that the alarm sensitivity will be uniform over the entire length.

The sensor cable connects to an FPS processor (or in the case of the FPS-3 system, a Pre-Amp) mounted on or near the fence at the beginning of the detection zone. The mechanical disturbance detected by the sensor cable is sent to the FPS Processor. See Figure 2. Each FPS-2-2 processor or FPS-3 Pre-Amp connects to two zones of perimeter protection. An FPS-2-2 or FPS-3 Pre-Amp can have up to a 1000-foot alarm zone running in each direction from the processor unit. The processor contains the circuitry that analyzes the disturbance detected by the sensor cable. The electronics are designed to match the characteristics of the sensor cable and only report as events those signals that are similar to the disturbances caused by climbing, cutting, or lifting the fence fabric.

The detected signals are sent by the processor to the alarm monitoring and control point. See Figures 3 and 4. Alarm monitoring can be accomplished in a number of ways.

FPS MODELS

MSI has developed numerous models of the FPS system to accomodate all of the variables that can be involved in a properly designed system. We have broken down the various model families based on the method of communicating the alarm information.

FPS-2 Series (Relay Output Sensor)

Model	Description
FPS-EX	Single zone alarm processor
FPS-EXH	Single zone alarm processor, utilizes Helisensor armored sensor cable
FPS-2-2R	Two zone alarm processor
FPS-2-2RH	FPS-2-2R two zone alarm processor for use with Helisensor armored cable

FPS-2 Series (Integrated Copper or Fiber Optic Multiplex) For Use With MX-5000, MX-5400 or MSI DCU - Data Collections Unit

FPS-2-2M	Two zone alarm processor
FPS-2-2MH	Two zone alarm processor, utilizes Helisensor armored sensor cable
FPS-2-2M/AP	Two zone alarm processor with Advanced Processing for alarms
FPS-2-2MH/AP	Two zone alarm processor with Advanced Processing for alarms with Helisensor armored cable
FPS-2-2M/FOC	Two zone alarm processor with Advanced Processing communicates via fiber optic multiplex cable to MX-5400
FPS-2-2MH/FOC	Two zone alarm processor with Advanced Processing communicates via fiber optic multiplex cable to MX-5400, utilizing Helisensor armored cable

Note: See MSI MX Feature Guide for more details

FPS-3 Series

2-PAK	Two zone Perimeter Alarm Kit with Controller/Display
2-PAK/H	Two zone Perimeter Alarm Kit with Controller/Display, utilizing Helisensor armored sensor cable
4-PAK	Four zone Perimeter Alarm Kit with Controller/Display
4-PAK/H	Four zone Perimeter Alarm Kit with Controller/Display, utilizing Helisensor armored sensor cable
FPS-3 DZPA	Dual zone pre-amplifier for use with FPS-3 Central Controller and MX-5300 Control Unit
FPS-3 DZPAH	Dual zone pre-amplifier for use with FPS-3 Central Controller and MX-5300 Control Unit, utilizing Helisensor armored sensor cable

The MSI FPS-2 Series communicates via either copper or fiber optic multiplex communications. The MX-5000 Series Annunciation and Control Unit and the CEnDe Data Collection communicate on copper wire. The MX-5400 Series Annunciation and Control Unit communicates on fiber optic cables.

The FPS-3 series sends the sensor signal to the FPS-3 Central Controller for alarm analysis and processing. Only the pre-amp is mounted outside; the rest of the processor electronics reside indoors.

FPS MODEL FEATURES

	Supplied	EOL Furnished - Cable Ties	Helisensor	MB Cable	MEX Cable	Dual Zone	Single Zone	Tamper	19 Pin Connector	Removable terminal Blocks	Multiplex Output	Programmable Relay Output	Self Test	Audio Assessment	Lightning Protection	Internal Count Adjustments	Sensitivity Adjustments	All Openings Gasketed & Sealed	Cast Aluminum Enclosure	
FPS-EX		✔			✔		✔	✔		✔		✔	✔	✔	✔	✔	✔	✔	✔	1 Zone Cost effective
FPS-EXH		✔	✔				✔	✔		✔		✔	✔	✔	✔	✔	✔	✔	✔	1 Zone Cost effective
FPS-2 •		✔		✔			✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	1 Zone Mil Spec Connector
FPS-2H •		✔	✔				✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	1 Zone Mil Spec Connector
FPS-2-2R	✔	✔			✔	✔		✔		✔		✔	✔	✔	✔	✔	✔	✔	✔	Dual Zone Unit
FPS-2-2RH	✔	✔	✔			✔		✔		✔		✔	✔	✔	✔	✔	✔	✔	✔	Dual Zone Unit
FPS-2-2M •	✔	✔			✔	✔		✔		✔	✔		✔	✔	✔	✔	✔	✔	✔	Multiplex Comm. on 6 conductor wire
FPS-2-2MH •	✔	✔	✔			✔		✔		✔	✔		✔	✔	✔	✔	✔	✔	✔	Multiplex Comm. on 6 conductor wire
FPS-2-2MH/AP	✔	✔	✔			✔		✔		✔	✔		✔	✔	✔		✔	✔	✔	EDAPT Processing at MX
FPS-2-2M/AP	✔	✔			✔	✔		✔		✔	✔		✔	✔	✔		✔	✔	✔	EDAPT Processing at MX
2-Pak		✔			✔	✔		✔		✔			✔	✔	✔	✔	✔	✔	✔	Dual Zone kit
2-Pak/H		✔	✔			✔		✔		✔			✔	✔	✔	✔	✔	✔	✔	Dual Zone kit - Helisensor
4-Pak		✔			✔	✔		✔		✔			✔	✔	✔	✔	✔	✔	✔	4 Zone kit
4-Pak/H		✔	✔			✔		✔		✔			✔	✔	✔	✔	✔	✔	✔	4 Zone kit - Helisensor
FPS-2-2M/FOC	✔	✔	✔			✔		✔		✔	✔		✔	✔	✔	✔	✔	✔	✔	Dual Zone/Fiber Optic Comm
FPS-2-2MH/FOC	✔	✔			✔	✔		✔		✔	✔		✔	✔	✔		✔	✔	✔	Dual Zone/Fiber Optic Comm/Heli
FPS-3 DZPA		✔			✔	✔		✔		✔			✔	✔	✔		✔	✔	✔	No Exterior Sensor Processing
FPS-3 DZPAH		✔	✔			✔		✔		✔			✔	✔	✔		✔	✔	✔	No Exterior Sensor Processing

Figure 1. FPS Models/Features

SYSTEM LAYOUT

General

This section provides step-by-step information for the layout of your FPS system. First, determine the typical length and placement of zones in the system. Next, determine how to handle gates, openings, and special cases. After you have decided these items, move on to locating equipment. As you proceed through the design steps, you can refer to three typical installation examples. Example 1 (Figure 5) is a typical correctional facility with two sally ports and towers. Example 2 (Figure 6) is a typical military facility with operations areas, quarters, storage buildings, guard posts at the main gates, and sentries along the perimeter. Example 3 (Figure 7) is an industrial complex enclosed within a perimeter fence, including administration buildings, manufacturing facilities, raw materials storage, and gates for receiving and shipping material, and personnel. A large parking lot is outside the protected area. Example 4, (Figure 8) illustrates a small site on which a 2-PAK (2 sensor kit) has been installed and Example 5 (Figure 9) represents a 4 zone kit (4-PAK).

What are the fence requirements?

Several different types of fence are normally used in facilities. However, most fences utilize chain link fence fabric. Other types of metal fabric may be able to be treated in the same way as chain link. The guidelines in this Design Guide assume the fence will be a chain link type. If you have an unusual fence type or different fence fabric, you may want to contact the MSI factory or your representative before proceeding.

The fence height is important. Typical fence heights are 8, 10, 12, and 14 feet. Barbed wire or razor wire may be installed on the top of the fence for additional protection. This may be important when you are figuring the equipment installation. The type of chain link fence fabric can also affect the sensitivity of the fence protection system. Typical types of fence fabric are 8- or 9-gauge galvanized steel, or vinyl-covered steel.

If the facility already has a fence, you must look over the fence installation before proceeding. The condition of the fence can seriously affect the FPS system. A fence that has been installed for some time will probably need quieting and some minor maintenance before the FPS system is installed. If you are inspecting the fence, please refer to the FPS Installation and Operations Guide, Section II, for fence inspection guidelines.

How long should the alarm zones be?

The typical length of fence protection zones in the facility will be determined by several factors. These are:

- Line of Sight
- Level of Security Necessary
- Response Time
- Government Regulations or Guidelines

- Other Security Systems Installed

FPS detection zones can be as short as a few feet or as long as 300 meters (almost 1000 feet). Sensor cable is packaged in lengths of 100, 200 and 300 meters, or 328, 656, and 984 feet respectively. Detection zones should be as short as practical to allow for accurate assessment.

It is best to have the entire zone in a direct line of sight by responding personnel. For example, if a perimeter fence goes around a corner, behind a building or structure, or over a hill, the zone should be ended and another zone started.

The length of a zone is also determined by the average response time to a fence protection alarm. The average response time is dependent on the type of facility and the type and location of response personnel. For example, a correctional facility or a military facility will usually have a designated response team positioned for a rapid response. The typical response time will be under 20 seconds. With the rapid response time, smaller zones will allow the personnel to pin point the alarm and respond directly. This response time is practical when you consider that the person causing the alarm will probably be moving at about 16-20 feet per second. In 10 seconds, the person could be almost 200 feet from the alarm point. The shorter alarm zones will allow personnel to look in the correct place. Therefore, these types of facilities will normally utilize zone lengths of 200 to 300 feet. Complicated structures and areas where the fence makes many turns will normally have shorter zone lengths.

A typical industrial facility will not have a large or distributed response force, so the average response time will usually be longer. For example, an industrial facility may have a guard force of less than five people patrolling the buildings of the complex. A fence alarm may have a average response time of 30-60 seconds. In this time, the individual causing the alarm could be 500 to 1000 feet from the alarm point. A shorter alarm zone will not provide any benefit. In these cases, a typical alarm zone length is usually 200 to 600 feet.

The FPS zone lengths can also be affected by the operation of other facility security systems. For example, some facilities use a closed circuit television system to view the perimeter and assess the nature of alarms. A fence protection alarm will activate the camera viewing the fence protection zone so the control room operator can immediately determine the nature of the alarm. In these cases, the FPS alarm zone length should be limited to the viewing distance of the camera used.

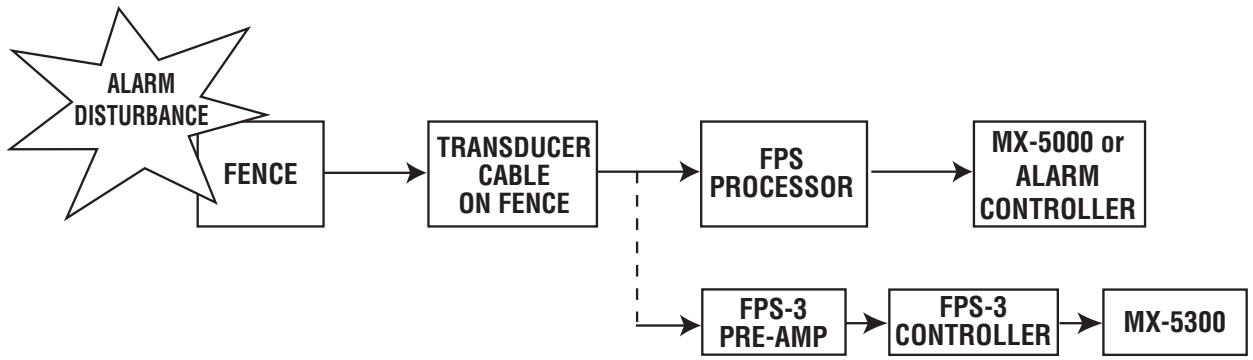


Figure 2. FPS System Block Diagram

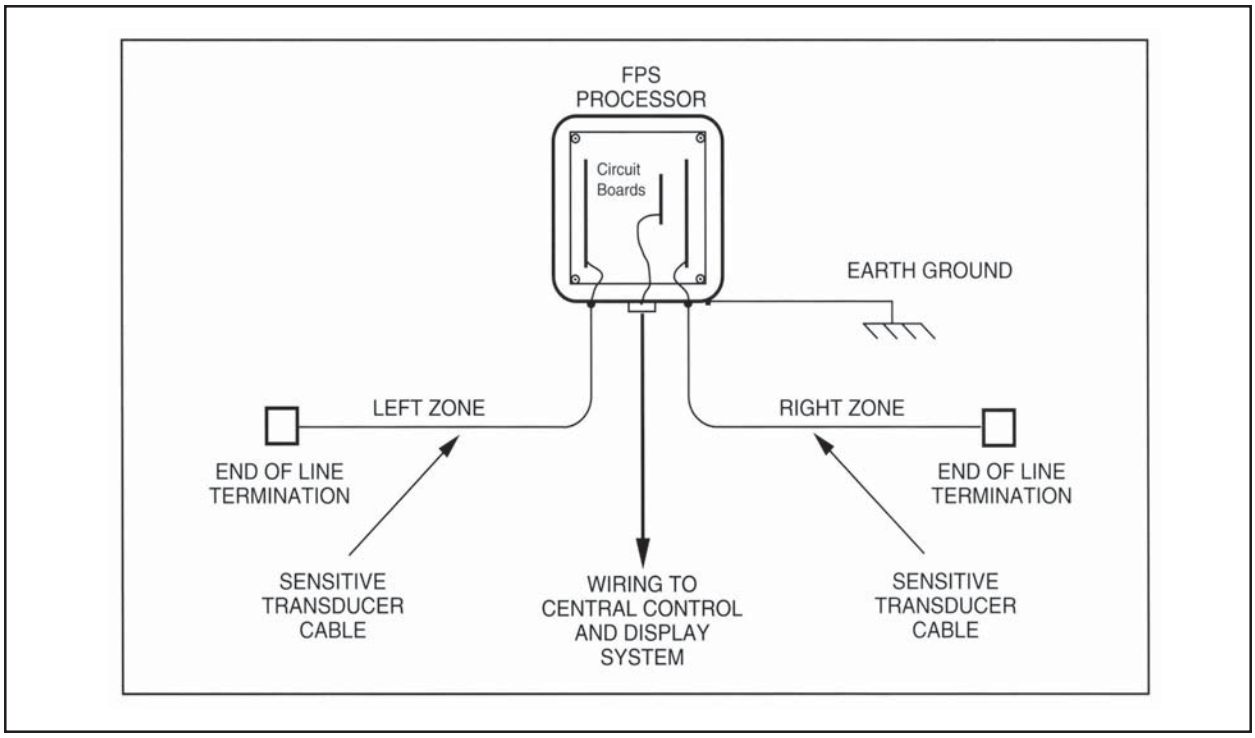


Figure 3. FPS Alarm Zone Connections

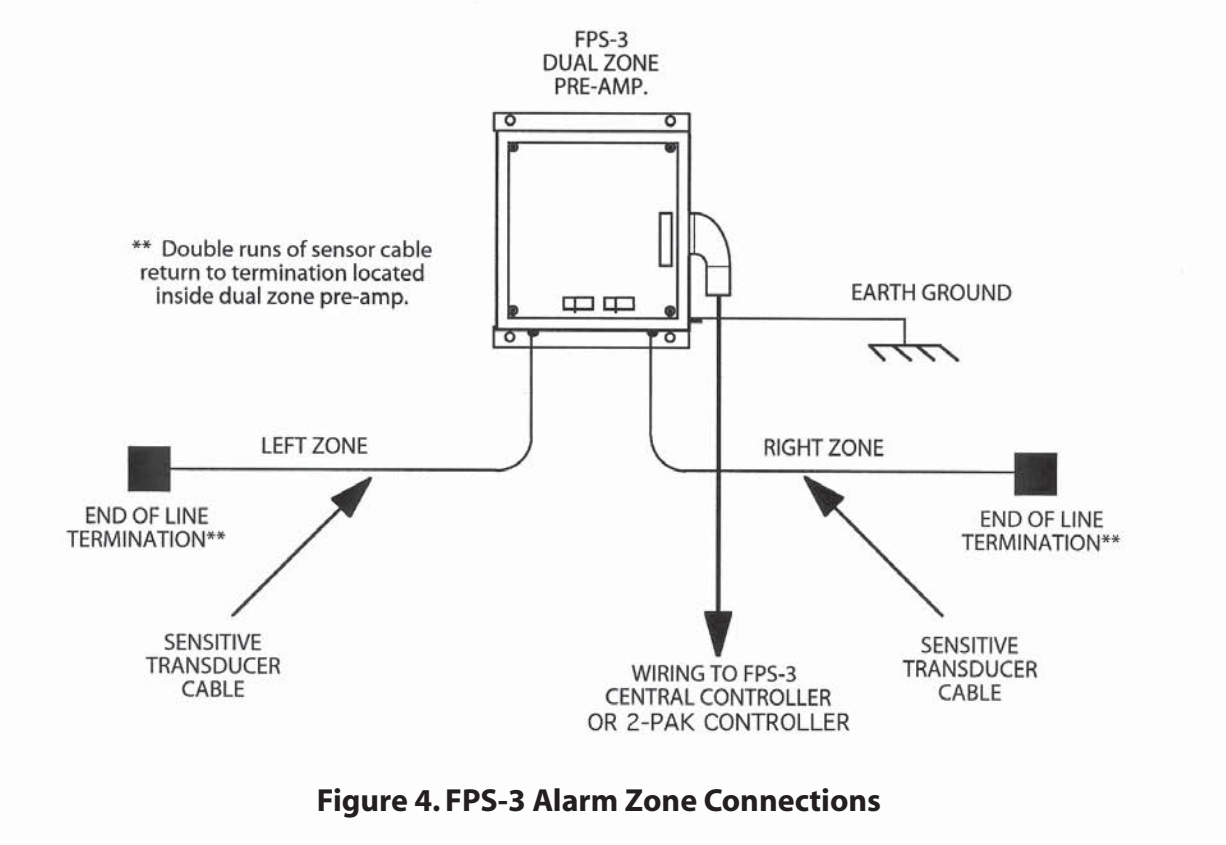


Figure 4. FPS-3 Alarm Zone Connections

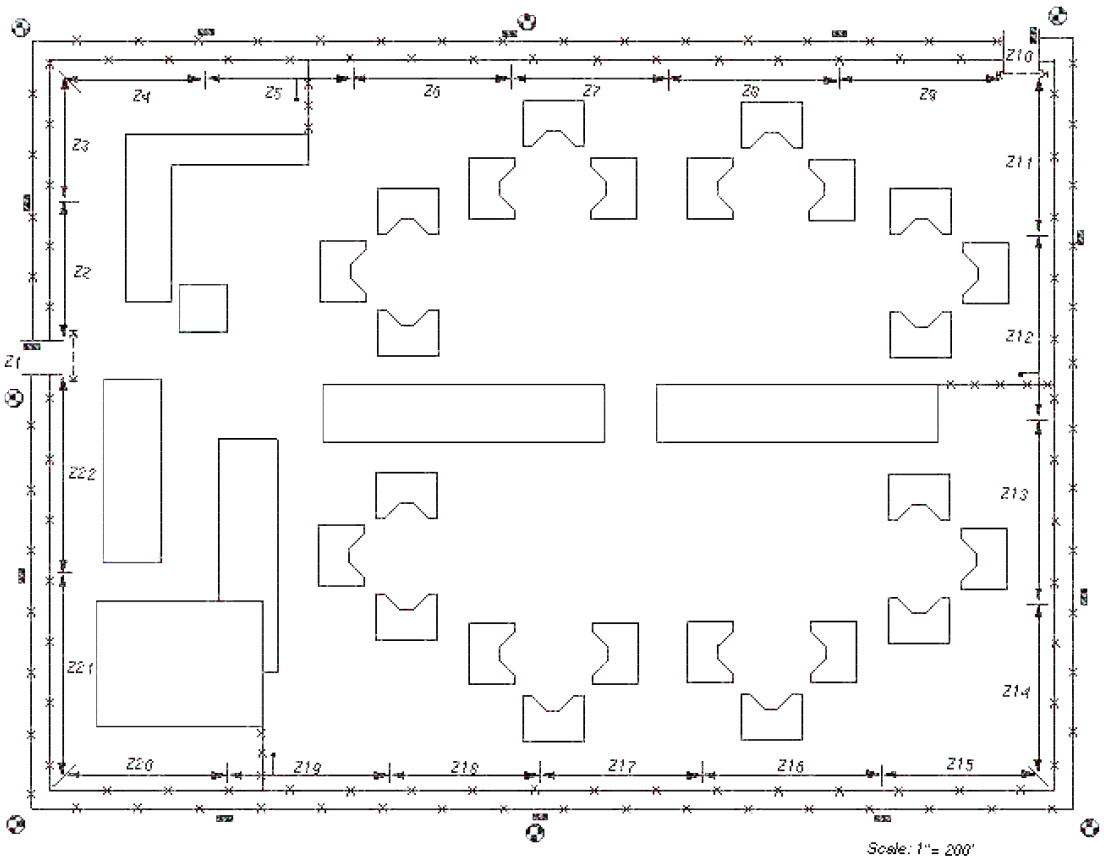


Figure 5. Example 1, Typical Correctional Facility

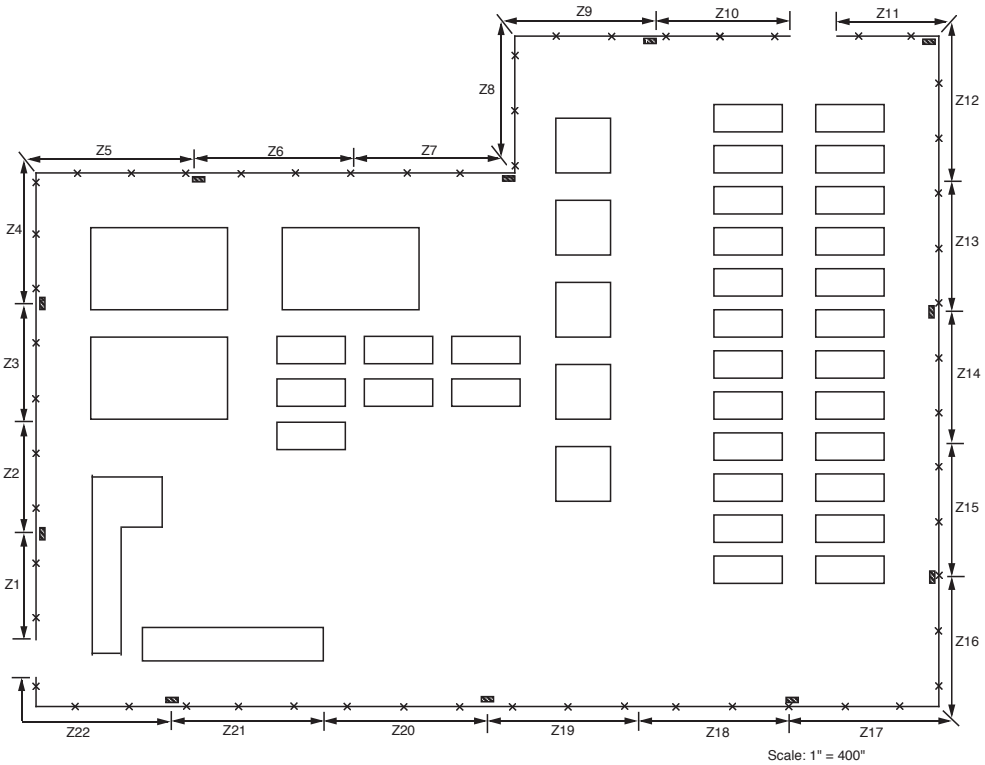


Figure 6. Example 2, Typical Military Facility

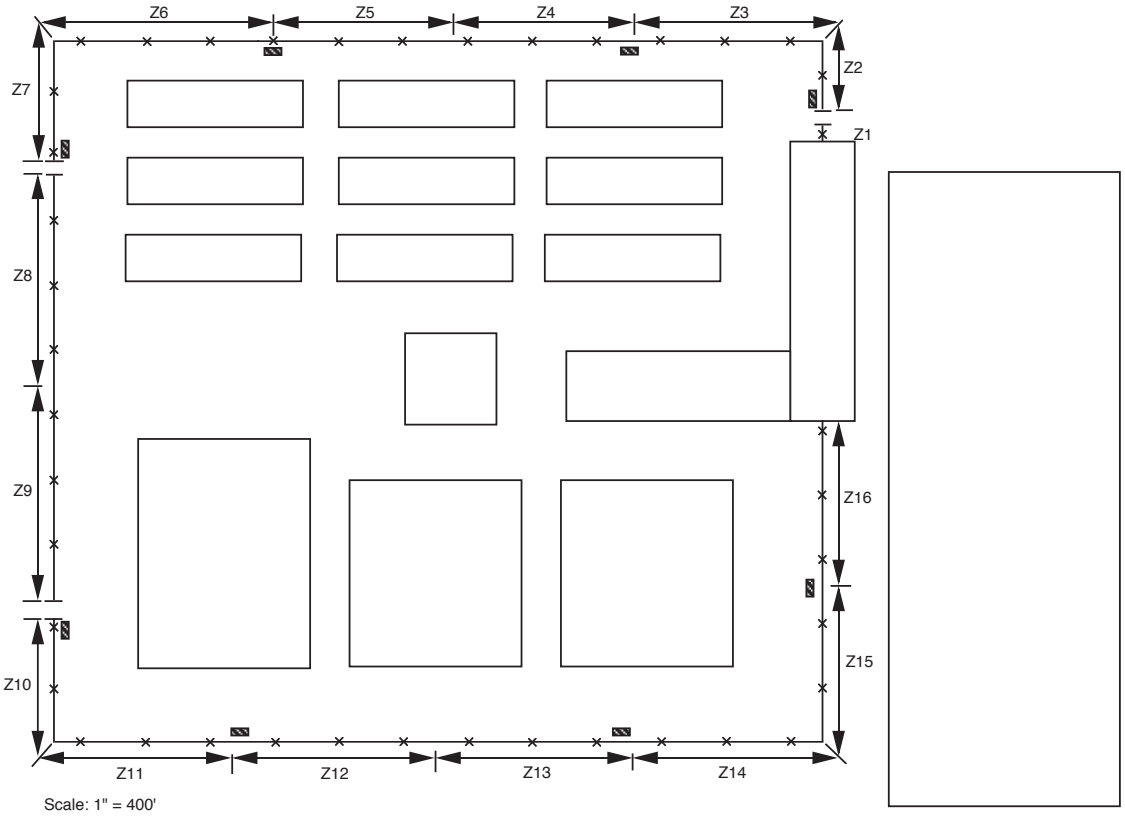


Figure 7. Example 3, Typical Industrial Facility

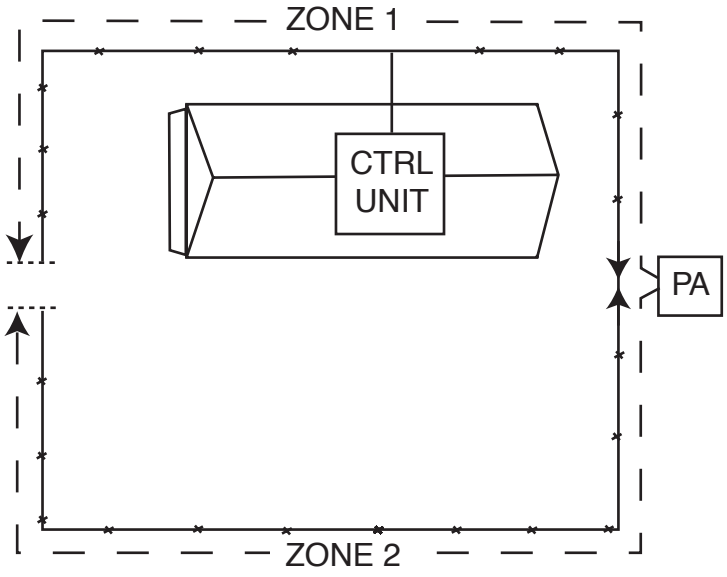


Figure 8. Example 4, 2-Pak Typical Installation

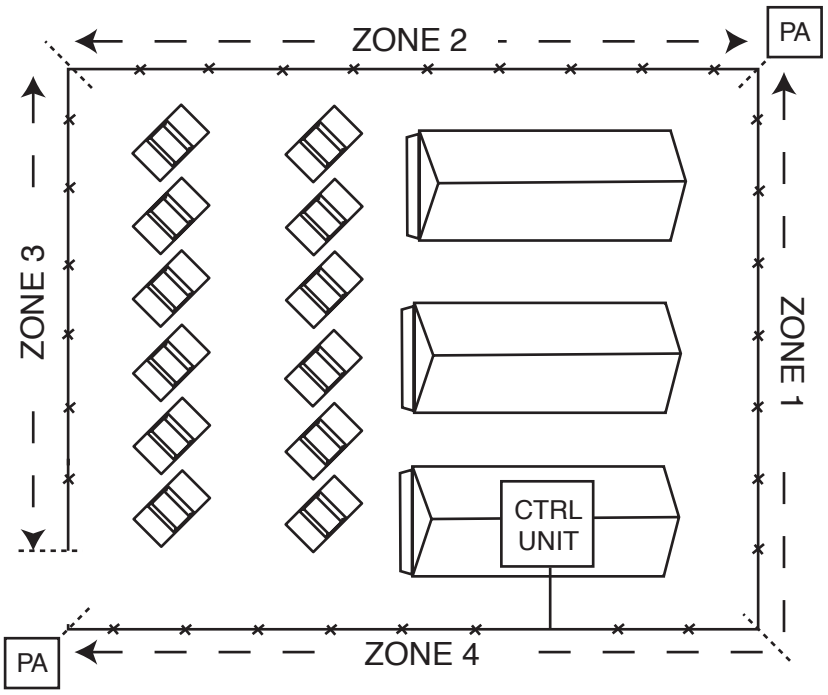


Figure 9. Example5, Typical 4-Pak Installation

Where Should the Alarm Zones be Placed?

Now that you have determined the approximate zone length for the facility design, you can place each zone on the drawing. It is best to use a scaled drawing (plot plan) of the facility. Using a scaled drawing, each zone can be easily measured once it is placed on the drawing.

You may wish to use the symbols that we use for laying out the perimeter zones. Place a short straight line to mark the beginning and end of each zone. Refer to Figure 10 for the standard fence protection symbols.

Normally, zones start at the front gate and proceed around the facility perimeter. As you proceed around the perimeter, mark off the perimeter zones in the approximate length chosen for this facility. The zone length chosen may not exactly coincide with the facility corners, sally ports, and gates, etc., so the zone lengths can be varied to accommodate the actual perimeter. However, the length of any zone should not exceed the maximum length chosen. When zones can be started or ended at gates, the need for conduit and cable under the gate is eliminated, making a simpler and less expensive installation.

While you are laying out each zone, you will probably run into at least one special case such as gates and intersecting fences. Here are some ideas on how these special cases can be handled:

- Each gate should be viewed as a special case. See the question about gates (page 15) for more information. Beginning or ending zones at the gates will make a simpler installation since the nonsensitive cable requirement under the gate will not be necessary.

- Perimeter fences often have internal fences that intersect with the perimeter fence. To ensure proper protection at the intersection, the sensor cabling should be run on the intersecting fence at least for one section, typically 10 to 16 feet. The sensor cabling on the intersecting panel will ensure that climbing or cutting in the corner will be detected.
- Using a highlighter, mark special conditions such as sally ports, gates, intersecting fences, etc., so you will be sure they are considered when you designate the position of each zone.
- Layout the length of each zone, one after another, for the entire perimeter and any other fences that require perimeter protection. Completing all zones provides a double-check of your zones because the end of the last zone should be the beginning of the first zone. When the zones meet, you are assured that you have complete perimeter protection.
- Number the zones in the system, normally starting with the front gate and continuing around the perimeter. Double check your zone lengths, keeping in mind special considerations like closed circuit television assessment on the perimeter. Locating other security devices, such as cameras, at this time may help coordinate the design of these other systems.

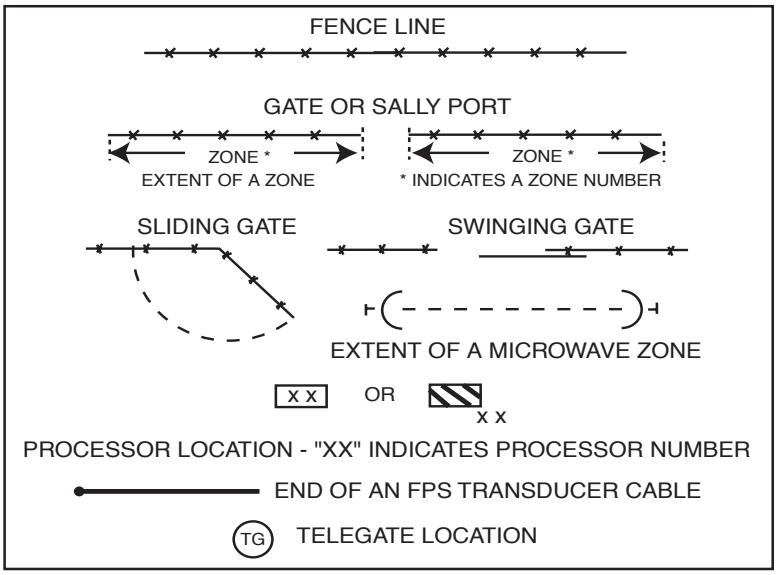


Figure 10. Drawing Symbols

Where Should The Alarm Processors Be Located?

Once the zone lengths and numbers have been assigned to the system, the alarm processors can be located. Each FPS processor contains the circuitry for monitoring two zones, so a typical processor location will be between the two monitored zones.

In a typical installation, zone 1 will begin and run the length of the first zone. At the end of the first zone, the processor will be located. Then the second zone from the same processor will proceed along the perimeter. The second zone will terminate and the third zone will begin. At the other end of the third zone, the second processor will be located. This processor monitors zones 3 and 4. In general, the locations of alarm processors will proceed around the perimeter in a similar manner until the last zone meets the first zone of the perimeter system.

Since each FPS-2-2 (or FPS-3 Pre-Amp) processor is capable of monitoring two zones, a facility with an even number of FPS zones will utilize all the zone monitoring capability of the FPS units. In your design, all the zone capability of each FPS processor should be used.

Pay particular attention to the layout of zones around sally ports and personnel gates that are used often. Sally ports and personnel gates will normally be protected by a Telegate or a microwave system. Refer to the discussion of both Telegates and microwave installations under the question about gates.

Number each of the FPS alarm processors. Typically, processors are numbered starting at the first zone and continuing around the perimeter in the same manner as the zone numbering. Processor numbering will allow you to double check each location and refer to each of them later, if necessary.

FPS processors should always be mounted on the non-threat side of the fence. For example, if escape is the typical alarm, the processors are mounted on the outside of the fence. If intruders are the typical alarm, the processors are mounted on the inside of the fence.

How Should The Processors Be Mounted?

FPS processors are manufactured in moisture-proof housings suitable for direct mounting to the fence, or within an electrical service enclosure.

Mounting to the fence can be accomplished using metal brackets or Unistrut-type material to provide a solid backing as shown in Figure 11. Mounting at one of the fence posts will provide a solid mounting.

FPS-3 Pre-Amps are mounted in the same manner as the FPS-2-2 processors.

Mounting away from the fence can be accomplished as shown in Figure 12. Electrical conduit should be provided from the fence to the electrical enclosure as shown in the illustration. In this case, nonsensitive cable is connected to the sensor cable at the fence and run through the conduit to the FPS processor as shown.

Regardless of mounting method, each processor installation MUST include a suitable ground rod connecting the processor to a good earth ground. The ground rod AT EACH PROCESSOR LOCATION is necessary for maximum lightning protection and system noise reduction. DO NOT use the fence as a ground connection.

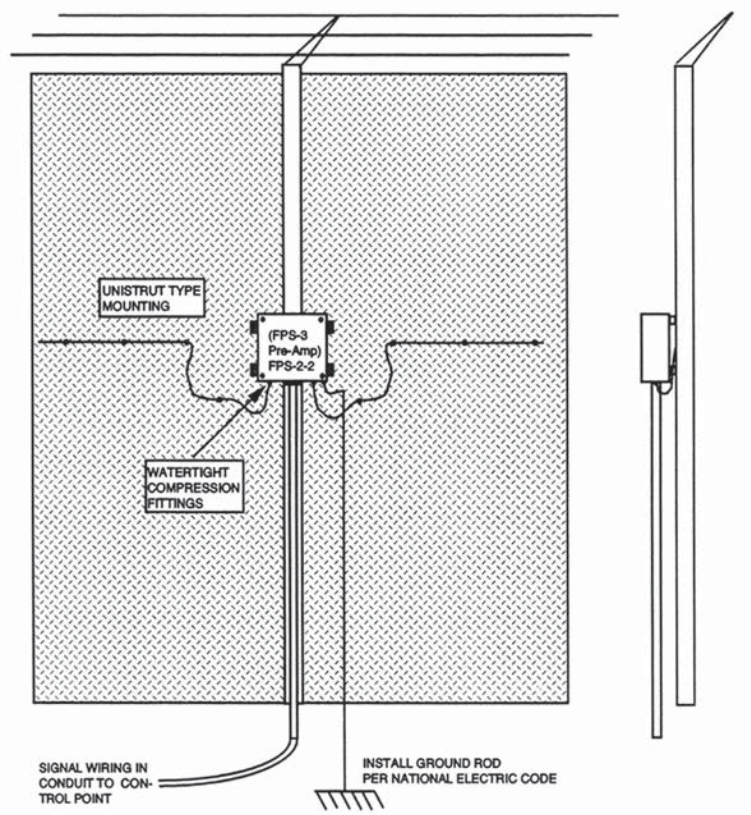


Figure 11. FPS Processor Mounting

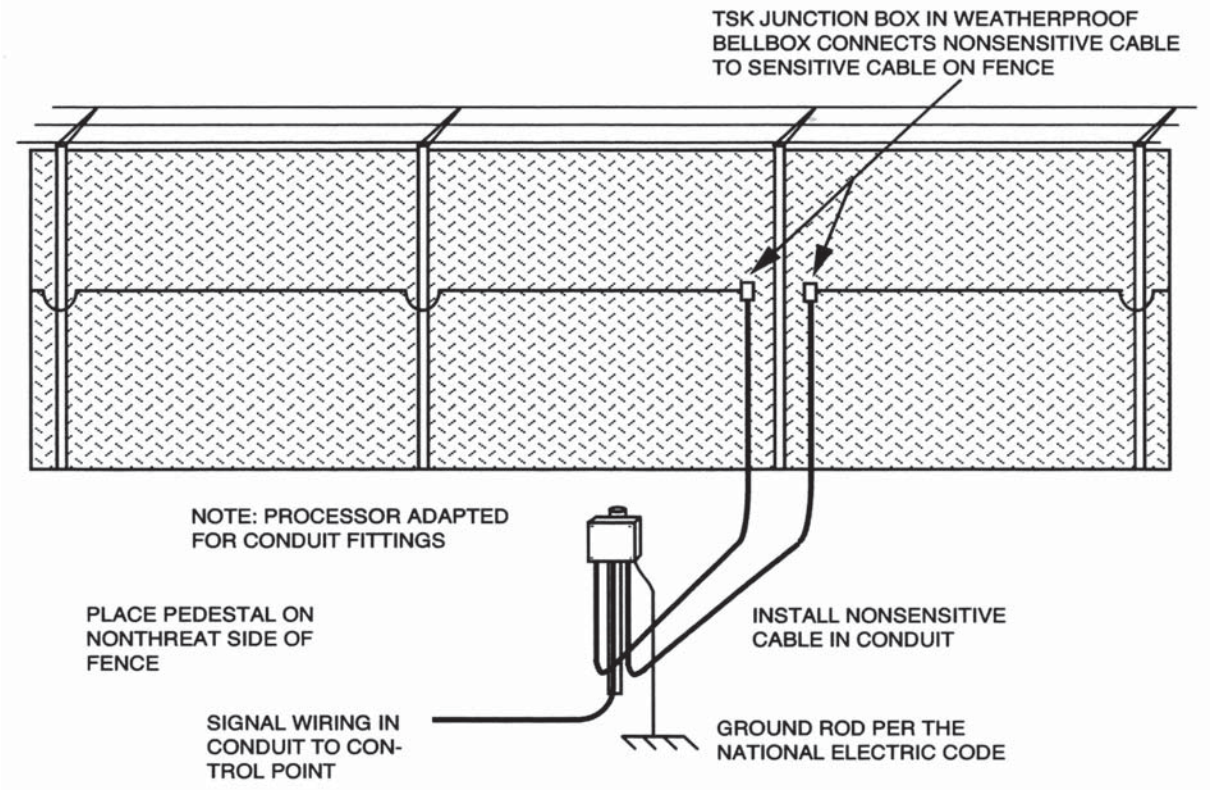


Figure 12. FPS Mounting in Electrical Pedestal

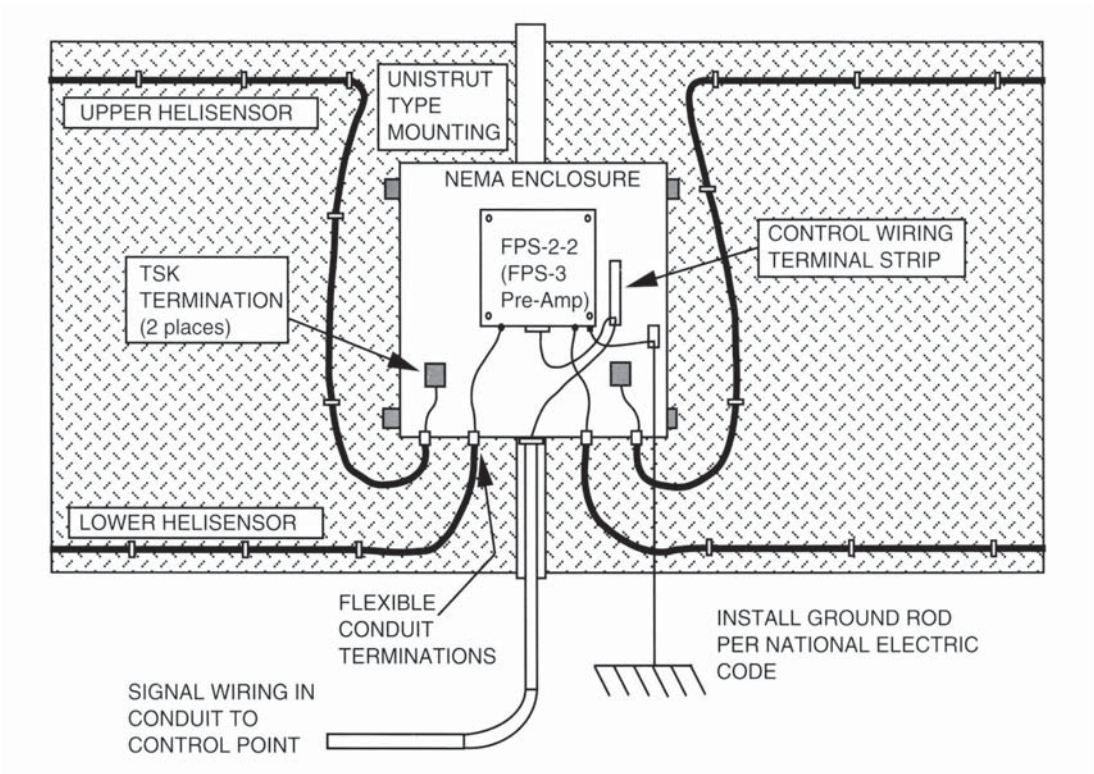


Figure 13. Helisensor Installation/Termination (Double run of Helisensor)

Which Sensor Cable Should Be Used: Helisensor or Sensor Cable?

Helisensor is an armored sensor cable that has been designed for use in areas where physical damage to the sensor cable can occur. Typical uses are in prison and jail exercise yards and in industrial sites. If potential vandalism is a problem, Helisensor should be installed. Helisensor provides a 3/8-inch flexible metallic jacket over the sensor cable and is installed with cable ties in the same manner as standard sensor cable.

Helisensor can also be used along with standard sensor cable in the same system but only in those zones that require physical protection. However, do not install standard sensor cable and Helisensor in the same zone. Install Helisensor in the areas where physical damage can be caused to the sensor cable installation. Install standard sensor cable in all areas that do not require Helisensor. Figure 13 shows the recommended processor mounting and sensor cable termination when Helisensor is installed in a NEMA enclosure.

Where Should the Sensor Cable be Located on the Fence?

The location of the sensor cable on the fence is very important to the effective detection of cutting or climbing. However, if some general rules are followed, the installation of the sensor cabling is quick and simple.

The sensor cable must always be installed on the opposite side of the fence from the threat. The FPS sensor cable is unique in that additional sensitivity can be gained by simply adding more sensor cable to the fence. However, care must be taken that the maximum permissible length of sensor cable is not exceeded.

Some fence sizes and material types are not as sensitive to monitoring as others. However, these fences can be successfully monitored by the proper installation of sufficient sensor cable.

Sensor Cable Versus Fence Height

Fences up to 10 feet may be protected with one row of sensor cable as shown in Figure 14. The sensor cable should be mounted in the center of the fence (4-6 feet from ground level) as shown. Fences with very heavy gauge fence fabric may require a double row of sensor cable. See Figure 15.

Higher fences may require a double row of sensor cable as shown in Figure 15, depending on the physical design of the fence. If you have a question, contact the factory. The two cables should be installed in the upper and lower halves of the fence as shown. Most fences of 12 feet and higher have a center rail approximately in the center of the fence. These fences should have a double row of sensor cable—upper and lower.

Sensor Cable Versus Fence Fabric

Sensor cable on normal galvanized-type fence fabric can be installed as indicated on following page. However, fence fabrics with a vinyl covering need greater sensor sensitivity to provide the same level of protection as standard galvanized fencing. Vinyl covered fences over 8' in height should be protected with a double row of sensor cable as shown in Figure 15.

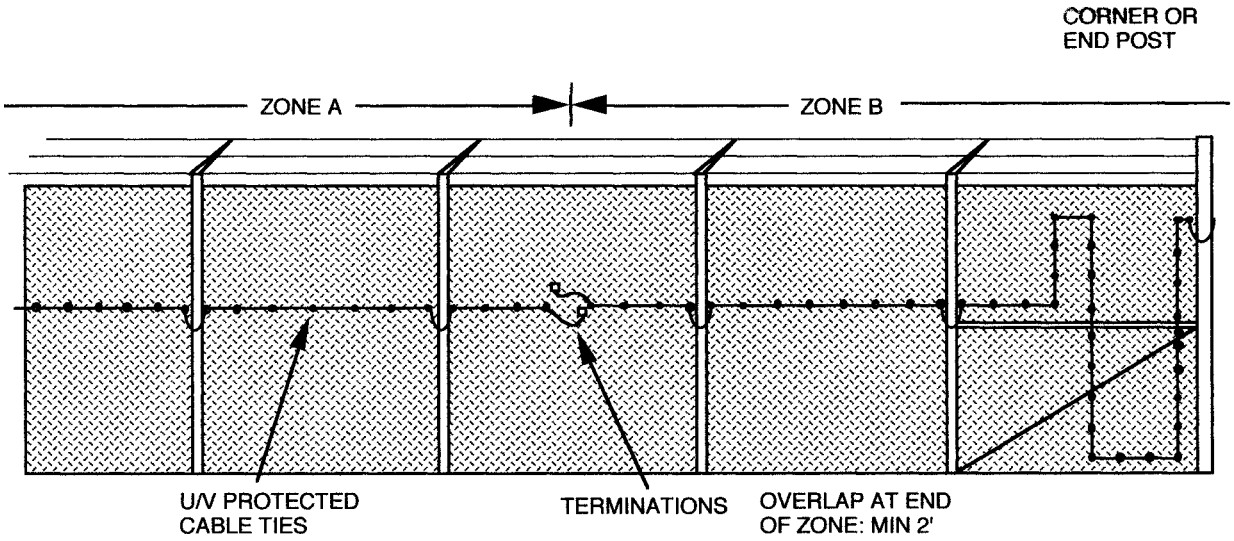


Figure 14. Single Sensor Cable Installation

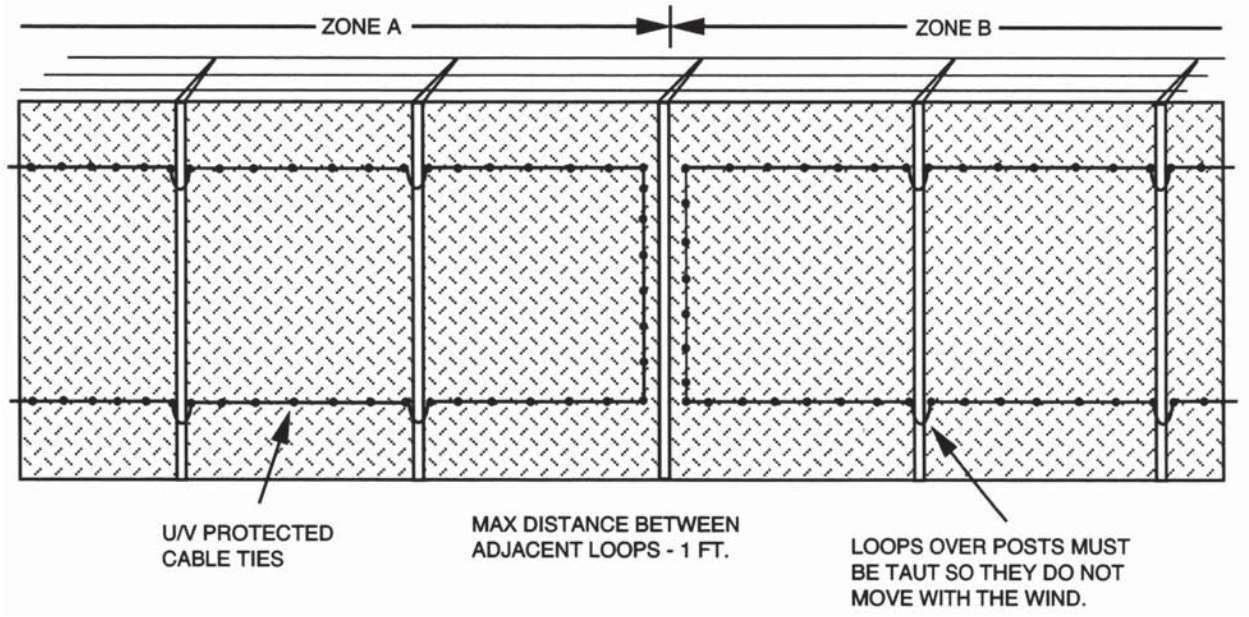


Figure 15. Double Sensor Cable Fence Installation

How Can Sensitivity Be Increased at Critical Areas?

In many fence installations, tension posts, corner posts and the fence fabric around them are very rigid due to the horizontal and diagonal stiffeners installed. Corners are also a prime target for climbers.

To better ensure detection of a climber in the corners, increase the sensitivity of the sensor system by vertically looping the sensor cable as shown in Figure 16. The additional sensor cable installation on both sides of the corner posts will increase detection of both climbing and cutting. A corner need not be 90˚. Many corners are at a 45˚ angle. Additional coverage is required at any location where fabric is separated, including straight sections of the fence.

Measure and label the amount of cable adjacent to each zone. Be sure to allow enough additional cable (typically 10%) for increasing the sensitivity at corner posts, allowing for the additional sensor cable on intersecting fences and to provide service loops.

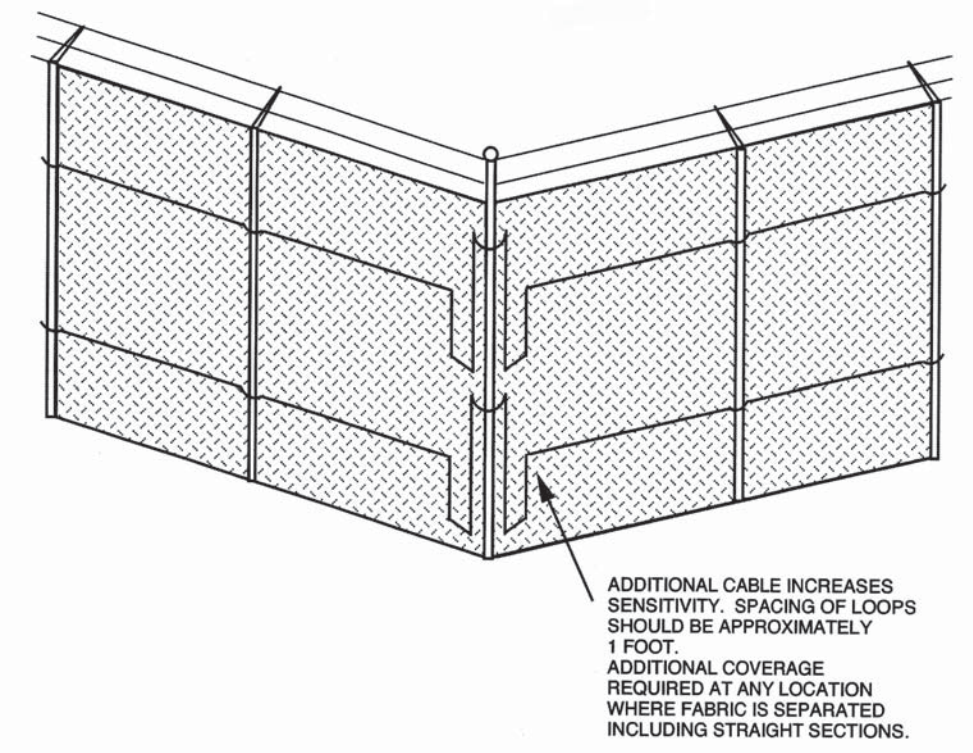


Figure 16. Increasing Sensor Cable Sensitivity

How Should Gates Be Protected?

Gates, including sally ports, require comparable protection to the fence. If suitable protection is not provided at the gates, there is a possible hole in the perimeter protection. Both intruders and potential escapees are very good at finding holes in a protected perimeter.

There are many types of gates, but they all are generally sliding or swinging. Additionally, gates are generally installed as single or double gates. Normally, the gates are manufactured with the same fabric as the fence. Therefore, the FPS sensor system will provide the same protection on the gates as on the fence.

Some gates are installed for incidental use such as maintenance. These gates are used only occasionally and elaborate protection is not needed. These types of gates can be included in the zone where they are installed. Other gates, such as the main vehicle and personnel entry and exit points, are used very often and should be protected as their own zone.

Gates Located Within a Fence Zone (Low Usage Gates)

Gates that are installed for incidental use, such as maintenance, are normally swinging gates and are kept locked most of the time. These gates can be easily protected by looping the sensor cable on the gate as shown in Figure 17. Care must be taken to ensure that the sensor cable is looped over the hinge side and is not stressed by the gate movement. Neither should there be any loose cable when the gate is in the closed position. A conduit and nonsensitive cable under the gate area continues the sensor cable through the zone.

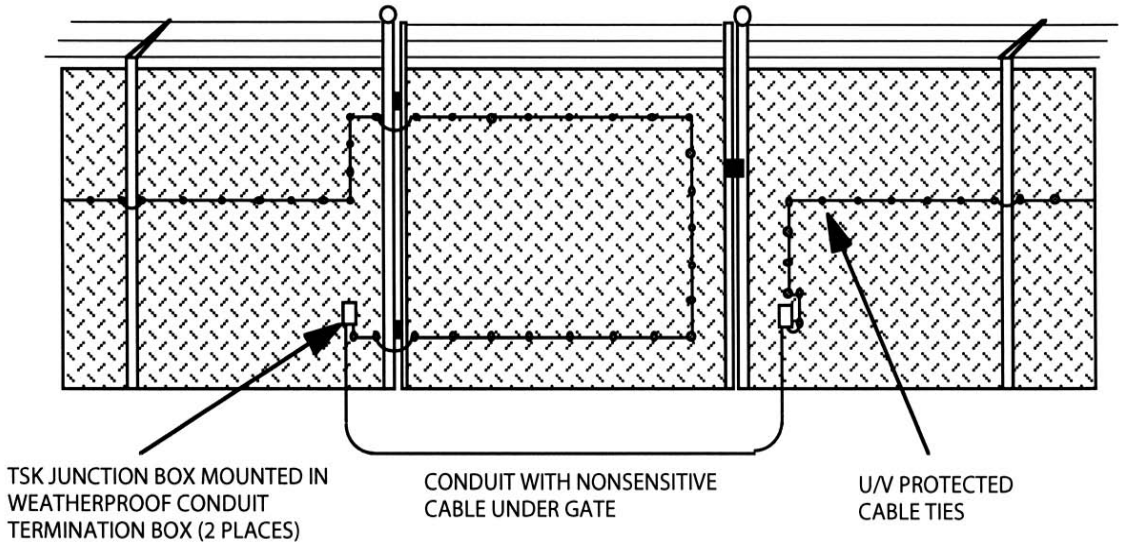


Figure 17. Swinging Gate Sensor Cable Installation

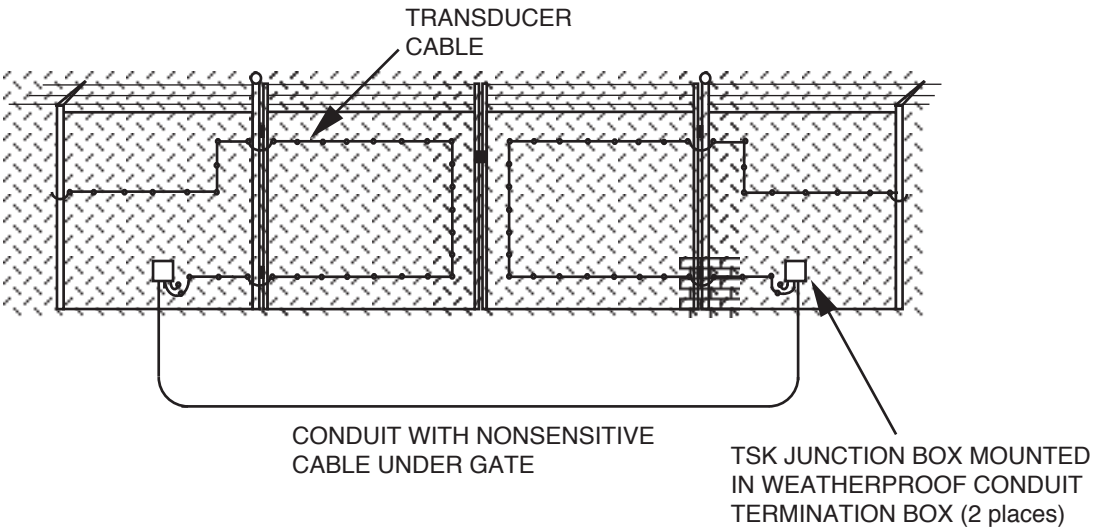


Figure 18. Double Swinging Gate Sensor Cable Installation

In a like manner, double swinging gates can be protected as shown in Figure 18.

Low usage sliding gates can be protected in a similar manner, except that the nature of the sliding action makes connection to the fence sensor cable more difficult. The connection can be made using a Telegate. The Telegate was designed to provide a constant cable connection to a sliding gate. The Telegate contains an armored nonsensitive cable that provides a convenient means of connecting the gate-mounted sensor cable to the sensor cable on the fence. The installation of Telegate is discussed more fully under the high usage gates section below.

In some instances, a bypass switch such as the Gate Bypass Unit allows the protection on the gate to be turned off when the gate is being used, while the rest of the zone remains protected. This method can be used on both swinging and sliding gates. The bypass unit should be installed a minimum of 20 feet away from the gate to ensure that gate movement does not trigger the active portion of the zone. MSI does not recommend the use of Gate By-pass units in high security applications because the control & monitoring system is not notified the sensor has been shunted.

minimum of 20 feet away from the gate to ensure that gate movement does not trigger the active portion of the zone. MSI does not recommend the use of Gate By-pass units in high security applications because the control & monitoring system is not notified the sensor has been shunted.

Personnel and Vehicle Gates (Moderate & High Usage Gates)

A facility normally has several gates that are used for everyday personnel and vehicular traffic. These gates are usually staffed with personnel who are responsible for the operation of the gates and for checking the vehicles and personnel passing through. Whenever possible, each gate should be connected as an independent alarm zone.

These types of gates are normally protected in one of two ways: Telegate, or microwave. Telegate provides protection on each gate as though the gate was a fence section. The microwave system protects the gate by making an invisible barrier across the gate area. Any movement through the invisible barrier will cause an alarm.

Typical operation of high usage gates is open or in an access condition (nonalarming) during normal working hours and closed and alarmed during nonworking or nighttime hours. During normal working hours, personnel are constantly monitoring the gate area so alarm monitoring is not necessary.

The Telegate should be installed as shown in Figure 19. Each Telegate should be an individual zone. For example, a sally port that has a Telegate installed at each of the two sally port gates will have two zones in the gate area. The Telegate must be installed on the side to which the gate is opening. The sensor cable is installed on the gate fence panel in the same manner as on the fence in accordance with the height and type of fence material.

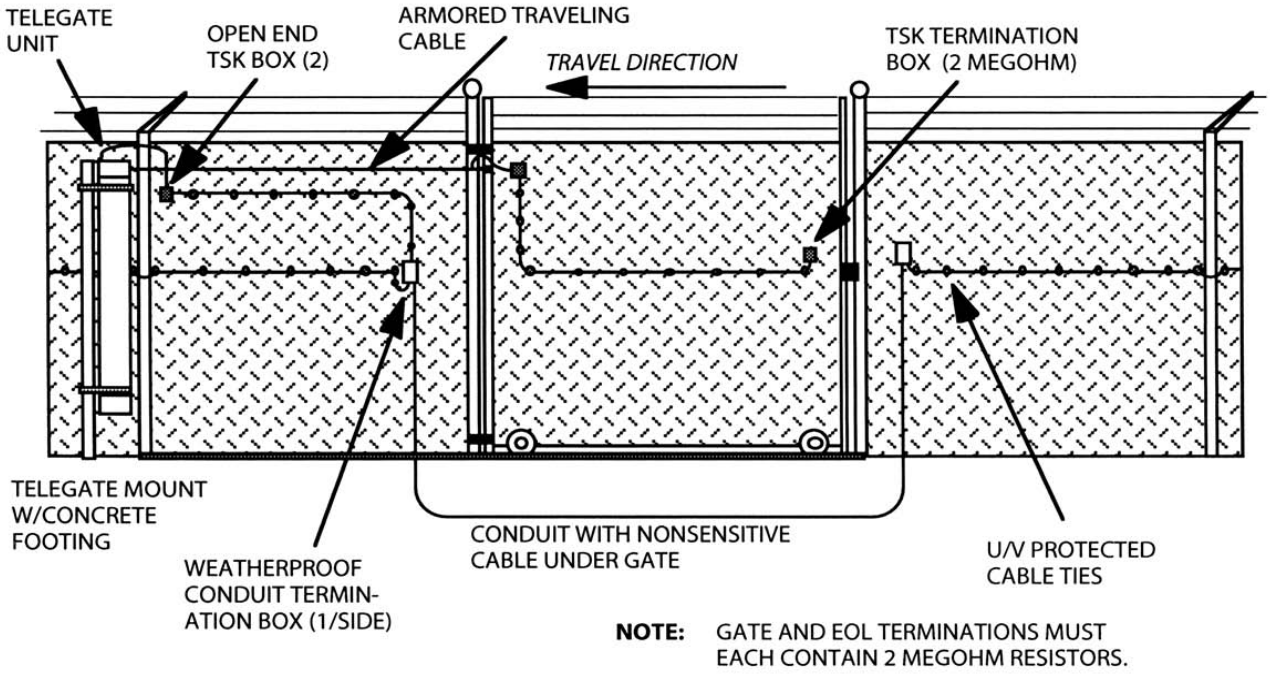


Figure 19. Telegate Installation

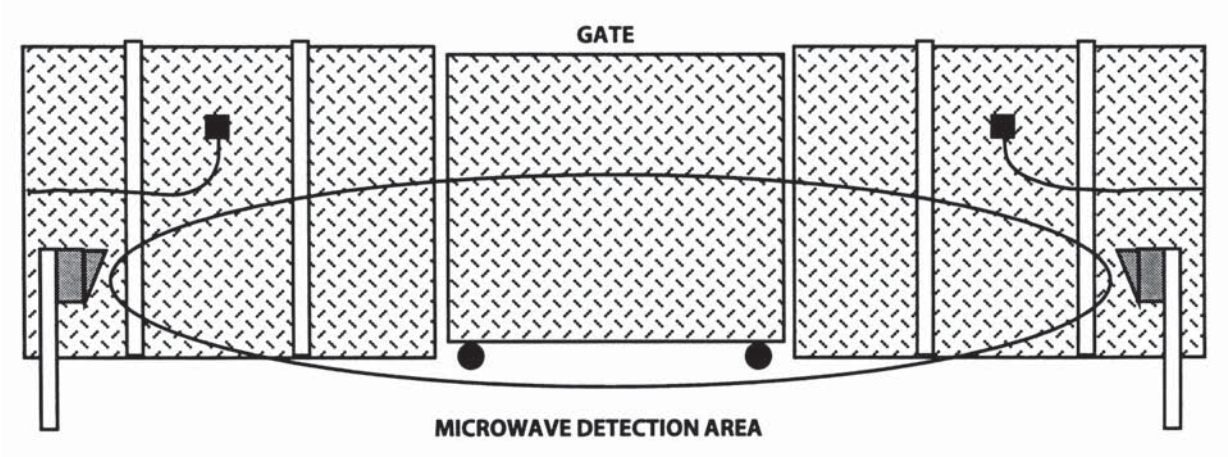


Figure 20. MPS Microwave System

The microwave detection system is typically installed across the gate area in a manner so that anyone passing through the gate will be detected by the microwave system (Figure 20). For more information on the design and placement of the microwave system components, refer to the MSI Microwave System Installation and Operation Manual.

What Are The Signal Cabling Requirements?

The FPS processors must be connected by wiring to the central control point that will monitor the fence protection system. In FPS-2-2M installations, the wiring will consist of one cable pair for the alarm and tamper data, one cable pair for power, and one cable pair for the audio listen-in feature. These three pairs are individually shielded and normally provided in one jacketed cable with an overall foil and braided shield. The jacket should be high density polyethylene (H.D.P.E.).

FPS-3, 2-Pak & 4-Pak installations utilize a two-pair, low capacitance, individually shielded cable to handle alarm and tamper signals and power. The jacket should be H.D.P.E. This cable is homerun from each Pre-Amp to the FPS-3 Central Controller.

There are several ways of running the signal cabling from the control point to the FPS processors:

The wiring can be run in an electrical conduit on any rail of the fence. If there is a top and bottom fence rail, it is preferred to install the electrical conduit along the top rail so it is protected by the fence protection system.

If there is only a bottom rail, or no rail, install the electrical conduit along the bottom rail or along the bottom of the fence.

A buried electrical conduit can connect the FPS processors. This is an acceptable method but involves more cost than mounting the conduit on the fence.

What About Electrical Power for the Security System?

Each FPS processor requires electrical power. When the FPS-2-2 processors are connected to the MX-5000 Security Communications and Control Center or the Data Collection Unit (DCU), the electrical power is provided by the MX-5000 or the DCU. In those rare instances where the power circuit from the MX is extremely long, in-line voltage boosters can be used to maintain the required voltage level. This approach requires no alteration to the MX power supply or backup battery voltage.

If the FPS-2-2 processor is connected to another type of security monitoring system or the MX-5400 Fiber Optic Multiplex system, electrical power provisions must be provided at each processor. Each

FPS-2-2 processor requires 12-16 VDC well-filtered power, with a typical current drain of 30 milliamperes per processor.

Most security systems require battery backup so protection is not interrupted if a power failure occurs. FPS-2-2 processors connected to an MX-5000 or DCU Security Control Center can be provided with battery backup power from the control center. FPS-2-2 processors utilized with other security control equipment must have separate battery backup equipment provided.

FPS-3 Pre-Amps are powered from the FPS-3 Central Controller, 2-Pak Controller or 4-Pak Controller.

What Security Control Equipment is Recommended?

The FPS is designed to include several types of interfaces to alarm monitoring equipment. The FPS processor receives fence disturbance information and determines which signals represent an attack on the fence. When climbing or cutting are detected, the FPS processor operates in two modes, (1) the processor can analyze the events and make the alarm decision and output an alarm signal to the alarm monitoring equipment, or (2) the processor sends the event information to the MX Series monitoring equipment for the alarm decision to be made.

MX-5000

The MX-5000/AP Security and Communications Control Center is recommended for use with all FPS-2-2 fence protection systems that are installed as a complete system. The MX-5300 Control Center is used in the FPS-3 system. In addition, the MX series is recommended whenever the FPS system must interface with a host computer being used to monitor all facility security systems.

Security Communications & Control

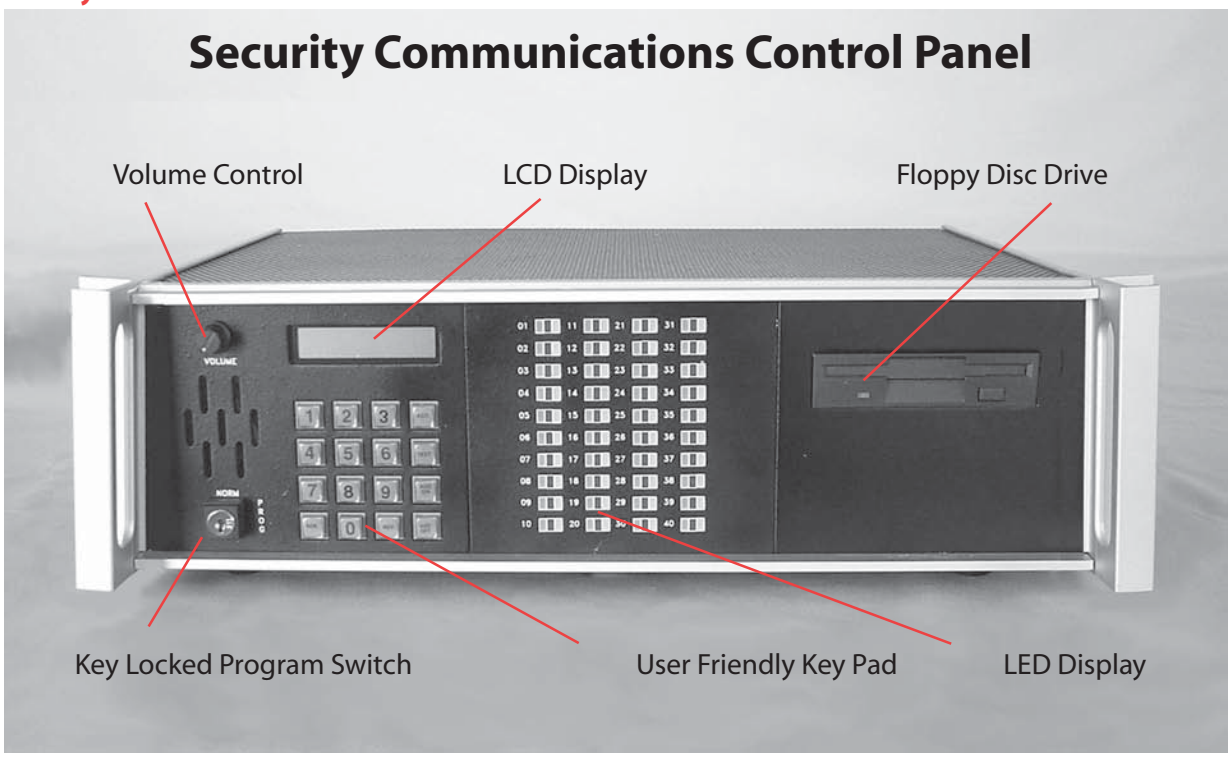


Figure 21. MX-5040 Control Panel

Alarm Displays

Once an alarm or another security system status information is generated, it must be displayed in a manner that will allow operators the most rapid and appropriate response. Each facility is unique and usually has a particular operating procedure for alarm response. For this reason, Magal-Senstar, inc. provides a wide array of alarm display methods. One or more can be used to provide the type of display required to match the response procedure.

The front panel of each MX-5000 has a built-in LED display that constantly indicates the status of each alarm zone in the system. Three LEDs for each zone show Alarm (red), Secure (green), Access (yellow), Priority Alarm (all flashing lamps both zones), Tamper (rapid flashing red), Audio Monitoring (flashing green), and Communications Failure (all solid lamps). A text message representing the same event as the LED display is flashed on a LCD display. The convenient front panel keypad allows the operator full control of the MX-5000. When an alarm or other status change occurs, the operator uses the keypad to acknowledge the alarm and, if appropriate, reset the zones in alarm. All of the operator actions are also displayed on the LCD readout. (Figure 21)

MX-5000 Features

The MX Series serves as the central monitor and control point of a security system. The MX-5000 Series monitors outdoor intrusion detection systems. The following main features demonstrate the versatility and capabilities of the MX Series:

LCD and LED Display - *Word as well as red/green/yellow lamp displays*

Direct Replacement of Older Equipment - *MX-1000/2000 Series*

EDAPT - *(Environmentally Derived Adaptive Processing Technique). Advanced Global Processing ('smart') Technology (see page four in MX-5000 Feature Guide for details).*

Variable Alarm Thresholds - *Set in software and easily changed by authorized personnel with programming key and password.*

Programming Protected - *Keylock program switch plus password*

Multi-Level Security for Operators - *Keypad entry, multi-level password*

Audio Listen-In by Zone - *Audio from FPS sensor or MPS-4100 Microwave signal is presented on MX speaker automatically upon alarm or by manual command*

Remote Self-Test of Compatible Sensors - *Electronic signal simulates alarm condition to test basic operation of sensors and communications*

Uninterruptible Power Supply - *Monitors power status for Control and Sensors. Provides the power for the MX Control, FPS and G-Line sensors. Sound alarm and indications on LED and LCD panels if primary power is lost. Additional alarm indication, sound and LCD read out for low battery condition.*

Zone Access Time-Out - *Allows access (no alarm) for a particular zone for a predetermined time limit established by the facility. MX Control automatically re-secures the zone when time expires, i.e. gate operated during daytime operation 4 hours; typical zone for 20 minutes.*

Alarm Classification - *Alarm classifications established by the facility. Zones with alarm indication cannot be re-set until classification is selected.*

Zone Association - *Programmable association typically between dual sensor technology perimeter zones.*

Integrated Floopy Drive - *Programming for system can be saved and restored via floppy disc.*

Flash Program Storage - *Allows upgrades to system software via modem or floppy drive*

Modem Accessible Diagnostics - *Access to factory via modem (optional) for diagnostic assistance*

Options

RS-232 Communication - *3 separate parts for bi-directional communication*

Built-In Alarm Record Keeping System - *(ARKS)*

Interchangeable Loop Cards - ***Standard*** *- MSI CEnDe Communication,* ***Fiber Optic Multiplex*** *- RS-485 communication via fiber translator,* ***CAN*** *- Controller Area Network*

Optional Interfaces - ***TCP/IP*** *- Ethernet capability,* ***ARI*** *- Dry contact relay interface*

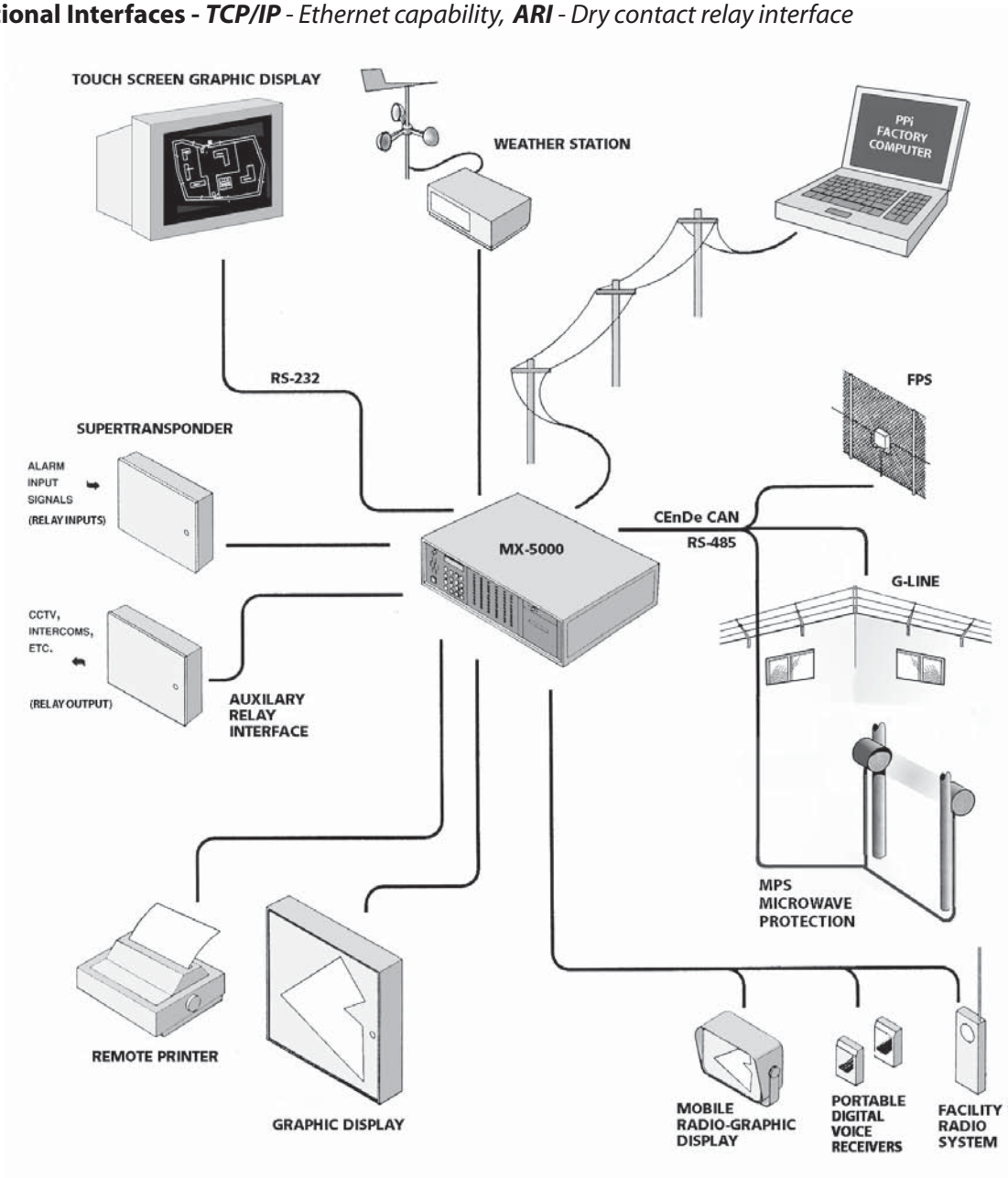


Figure 22. MX-5000 With Some Options

Global Processing
EDAPT is an advanced firmware package which, when used in conjunction with an MX-5000 Series Control Center and FPS-2-2M processors, or FPS-3 Pre-Amps and Controller, provides more intelligent alarm processing and reduced nuisance alarms. This is a "smart" system which learns how the environment affects a particular installation by constantly comparing the activity levels of all EDAPT fence zones and remembering repeated patterns. When activity levels among several zones match one of these pre-established patterns, this indicates that some environmental condition is causing the activity, not an intruder, and alarm thresholds are adjusted accordingly. In this way, alarm discrimination is improved without reducing detection levels.

Data Collections Unit
The DCU is recommended whenever the FPS system must be interfaced to an alarm monitoring system that does not have the capability of communicating with the MX-5000 as a host computer. The DCU multiplexes the FPS system and then communicates to a central control via relays or RS-422 data. Please refer to the DCU Installation and Operations Manual for more design and installation information.

Relay Outputs
The FPS-2-2R provides alarm relay outputs and is recommended whenever an alarm monitoring system is already installed at the facility and the fence protection alarm wiring and conduit is already installed (for example, if the FPS is being installed to replace an older system).

If there is any question about the alarm monitoring interface, please call your representative or the factory.

The central control equipment should be installed in a location that is convenient for the operator monitoring the perimeter security system. Proper location should include a visible location within easy reach of the operator who will use the front panel control and indicators.

How Should Alarm Information Be Displayed?

The method of alarm information display should be determined by the personnel who will receive the alarm signals and respond to alarms. A wide variety of annunciation and display systems are available.

Systems using the MX-Series have various display systems that can be "plugged-in." Systems utilizing other control equipment can use the same display methods; however, consult the factory for interconnection information.

The MX-Series contains a front panel display which constantly indicates the status of all alarm zones. A graphic display is recommended for installations over a few zones. The graphic display will show the alarm status of each zone in an easy to understand "map." The facility map makes it easier to direct a rapid response.

The MX-Series can provide display outputs to other systems by utilizing the Auxiliary Relay Interface (ARI). The ARI will provide a relay contact output for each MX-Series alarm, or alarm and tamper, output.

What About Field Equipment Interconnections?

The connections from the FPS units to the central monitoring point will be determined by the type of central control equipment selected. Refer to the Inst & Ops Manuals for the equipment.

Determine the method of routing the cabling back to the central control point.

Measure the quantity of cabling required and place the calculated amount on the drawing. Remember to allow an amount for deviations in the field.

APPLICATION NOTES

Using the FPS on Palisade Type Fences

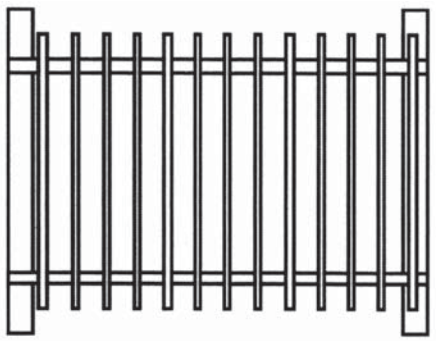


Figure 23. Metal Palisade Fence

The FPS has been successfully applied to "Palisade" type fencing many times. A "Palisade" fence consists of vertical metal bars attached to at least two horizontal stringers. It is usually made in 6 to 8 foot panels which are hung on intermediate posts. The vertical bars can be constructed of either hollow or solid bar stock.

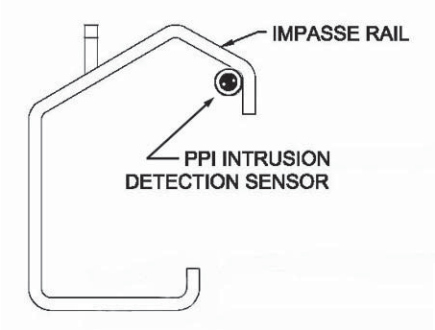
The FPS cable is usually attached under the horizontal stringers and in contact with each vertical bar. For best detection a run of sensor cable is used for each stringer.

The overall structure is more rigid than a normal chain link fence and therefore generates less mechanical noise. Higher gain settings can be used. Generally 5 or 6 is adequate. Lower count settings can be tolerated with (2) the preferred setting.

In all cases with FPS systems, the detection depends upon the amount of energy the intruder imparts to the fence. Sharp points on the posts and vertical bars adds to the difficulty of penetration and this energy. If possible these anticlimbing features should be included in the fence design.

Additional cable should be added at the posts. This area is generally more rigid than the rest of the structure and additional detection is usually required.

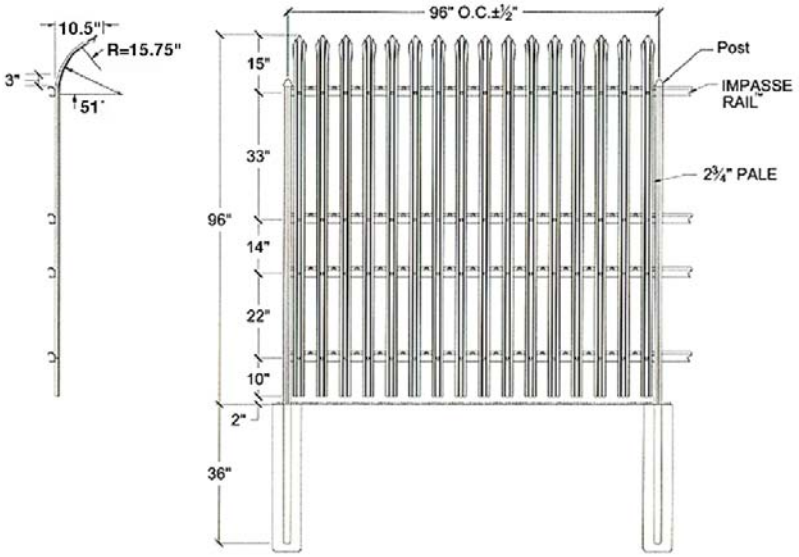
Using the FPS with Impasse Fences



A new type of steel fence has been developed by Ameristar that is both an anti-intrusion fence with the ability to embed the FPS sensor and interconnect wiring as well as the ability to be an anti-ram barrier. The Impasse Fence horizontal rails are designed to act as a cable trough for the FPS interconnect cable whether it is copper or fiber. The posts between the panels are constructed to allow for the cable to pass through.

recommends a double-run of sensor cable, one in the top rail doubled back through the lower rail. Ameristar has designed a special clip to snap over the opening in the rail and secure the sensor cable to the rail. The rails have drain holes to prevent moisture accumulation in the rails.

For more information on the Impasse Fence - Contact Ameristar at 1-866-IMPASSE.



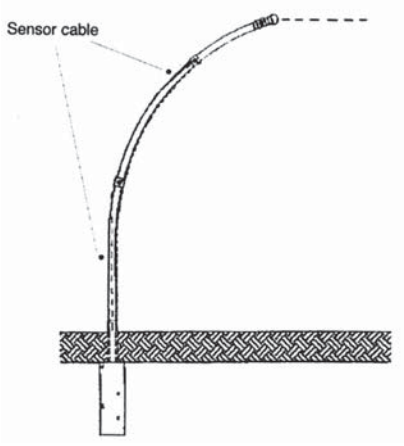


Figure 25. Curved Fence

Using the FPS on Curved Fences

There are several designs of fences that curve at the top (candy cane) or have a less acute curve but begin the curve a few feet above the ground extending 15 to 18 feet in an arch. When designing a fence protection system for these types of fences, it is important to re-evaluate the threat. The threats for these fences are in order of probability: cut through, aided/assisted climb, lifting fabric and stealthy climb.

To detect someone cutting through the fabric, a fence protection system should be installed. Since a cut starts at the bottom of the fence, the bottom run of the sensor cable should be installed about 4 ft. from the bottom.

The primary purpose for curving a fence is to make the fence difficult to climb because the effect of gravity on the climber is substantially increased. This effect greatly reduces the threat of a successful un-aided climb and definitely increases the noise and motion generated by the climb thereby ensuring the detection system will sense the activity.While this design makes a un-aided climb almost certain to fail, the arch design is vulnerable to an aided or assisted climb, i.e. a crude grappling hook with rope or sheeting attached. If an aided climb is successful, it is critical that a run of sensor cable be applied near the top of the fence. To breach an arched fence, the attacker must climb over the top and then move down the gentle reverse arch on the back side of the fence to the vertex of the arch where they can jump to the ground. The apparatus used to breach the fence should produce a detectable signal if the sensor cable is properly installed looping back near the top of the fence in a double-run configuration. The attacker moving down the back-side of the fence should take him directly across the sensor. If the sensor has not been installed in a doubled-back configuration, one must choose between installing a single run of sensor placed on the fence to ensure the best detection for cut or placing it near the top to provide the best detection for un-aided climb. We recommend both.

All fence mounted sensors have a "span of optimal detection". This span is influenced by various factors such as the gauge of wire, height of fence, rigidity of the fence, temperature, etc. As you can see, it is not a simple challenge. One of the primary advantages of a linear sensor is "equal sensitivity". Equal sensitivity enables you to adjust the sensor to the optimum detection setting without excessive nuisance alarms. If you try to cover larger spans of fabric, the sensitivity will have to be set higher which will result in more nuisance alarms from those activities occurring near the cable.

Testing. The standard climb test is probably not necessary for the arched or curved fences however, an aided climb test is very important. Each zone should be tested for the ability to detect a grappling hook setting and for someone crawling down the back of the arch.

Helisensor on Razor Ribbon

One of the objectives of the original Helisensor development was to create a sensor that could be used on razor ribbon. This objective was achieved by a wide margin. The resulting sensor is slightly more sensitive when used on razor ribbon than chain link. We feel this is due to the fact that the signals created in the razor ribbon are higher than those created in climbing chain link and these higher frequencies are passed by the metal jacket easier than the lower ones.

The attachment of the sensor to the razor ribbon is by means of ordinary twist ties used in conventional fence construction. The penetration tests show that in addition to providing a sensing cabability that an additional advantage is holding the razor ribbon together and miminizing the spreading if a coil attachment is removed from the double coil arrangement. The sensor also tends to improve the performance of the barrier if the ribbon is crushed.

Figure 26. Razor Ribbon

The observed nuisance alarm rate of the sensor is very low. This is true as long as the razor ribbon is well tied down and attached with at least three supporting wires as recommended by the manufacturer. In the tests the alarms were not correlated with wind. Several times small animals (racoons) were observed using the razor ribbon as a "freeway".

Using the FPS on Barbed Wire Outriggers

Many of the fences that have the FPS applied to the fabric have a 3 or 4 strand barbed wire outrigger at the top. On shorter fences < 10 feet, it is possible to prop a ladder against the barbed wire and climb over the fence without interacting with the sensor on the fence.

Figure 27. Barbed wire Outrigger

Shown just below is a method of applying the sensor cable to the outrigger that would detect a ladder of being placed against the barbed wire. Either type of sensor cable, standard or Helisensor, can be used in this application. If standard sensor cable is used, care must be taken to ensure that no barbs can cut or damage the cable jacket. It is also important to ensure that the barbed wire is secured well to the outrigger to prevent rattling noises.

In the picture below, a double run of sensor cable was applied to the fence. This same application can be used with a single run.

The observed nuisance alarm rate of the sensor is very low. This is true as long as the razor ribbon is well tied down and attached with at least three supporting wires as recommended by the manufacturer.

FPS SITE SURVEY CHECKLIST

CONTACT NAME		
ADDRESS		
TELEPHONE		
FAX		
CONTACT E-MAIL		
COMPANY	Security Dealer	☐
	System Integrator	☐
	Electrical Contractor	☐
	End User	☐
	Other	☐ Type _____
SITE	Prison	☐
	DOE	☐
	DOD	☐
	Military Base	☐ Facility Name _____
	NATO Site	☐
	Commercial Site	☐ Type _____
	Other	☐
LEVEL OF THREAT	High	☐
	Medium	☐
	Low	☐
EXPECTED SOPHISTICATION OF INTRUDER	High	☐
	Medium	☐
	Low	☐
ALARM REPORTING	On Site	☐
	Off Site	☐
ALARM ASSESSMENT	On Site Guard	☐
	Video	☐
	Off Site Alarm Assessment	☐ Type _____

FPS _____

TYPE OF FENCE

- ☐ Chain Link
- ☐ Chain Link Vinyl Coated
- ☐ Weld Mesh
- ☐ Iron Rod
- ☐ Other — Type _____

FENCE OUTRIGGER

- ☐ Outrigger 3/4 Strands Barb wire
- ☐ Outrigger with Chain Link Fabric
- ☐ Outrigger with Razor Ribbon
- ☐ Other Type of Outrigger — Type _____
- ☐ No Outrigger

FENCE HEIGHT _____

CONDITION OF FENCE

- ☐ Tight Fabric and Outrigger
- ☐ Loose or Torn Fabric
- ☐ Loose Outrigger
- ☐ Vegetation on or Near Fence
- ☐ Noisy Hardware — *loose pool caps, hos rings, signs, etc.*

GATES

- ☐ How Many?

GATE TYPE

- ☐ Swing Gate — How many _____
- ☐ Dual Swing — How many _____
- ☐ Man Gate — How many _____
- ☐ Single Sliding — How many _____
- ☐ Dual Sliding — How many _____
- ☐ Automatic / Slider or Swing — Type _____
- ☐ Other Type — Type _____

PERIMETER LENGTHS _____

PREFERRED ZONE LENGTHS _____

POWER SOURCE _____

ALARM MONITORING _____

NOTES