E-Field®

Perimeter Protection System

Installation, Operation & Maintenance Manual

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Introduction

The E-Field Perimeter Protection System employs the latest generation of a proven volumetric intrusion detection technology designed specifically for use in high-risk security applications.

E-Field is a proprietary terrain following perimeter sensor, not dependent on "line of site" operation. It is designed to be attached to existing chain link fences, walls, or installed as a free-standing sensor (usually positioned in a clear zone between two physical barriers). E-Field can also be attached to buildings, and go around or over roof tops. It can be configured to provide intruder detection in any irregular terrain-following situation. It is an active sensor system consisting of a field generator which excites one or more field wires. Parallel sense wires detect changes in the coupling from these field wires when an intruder enters the electrostatic field. If these changes have certain pre-determined characteristics, an alarm signal is generated. E-Field detects a compound signal consisting of:

Amplitude Change	=	mass of the intruder
Rate of Change	=	motion of the intruder
Time of disturbance	=	time the intruder is in the electrostatic field.

Any E-Field system consists of three basic elements:

1. The field and sense wires, the hardware by which they are mounted to a fence, free-standing poles or a building, and the terminators which supervise the integrity of the wires.

2. The sense filters which serve as both the mechanical and electrical interface between the wires and the signal processor.

3. Processor which contain the field generator, signal processing circuitry, supervisor circuitry, alarm circuitry and power supplies.

In the current generation of E-Field, which includes the Series 800 processor and Series 5000 mounting hardware, the processors have the additional feature of a diagnostic panel with instrumentation to facilitate calibration and maintenance of each E-Field sensor zone.

System Overview

The E-Field system consists of circuitry that produces a low power, very low frequency (VLF) signal. The very low frequency (VLF) signal excites a field wire that then creates an electrostatic envelope.

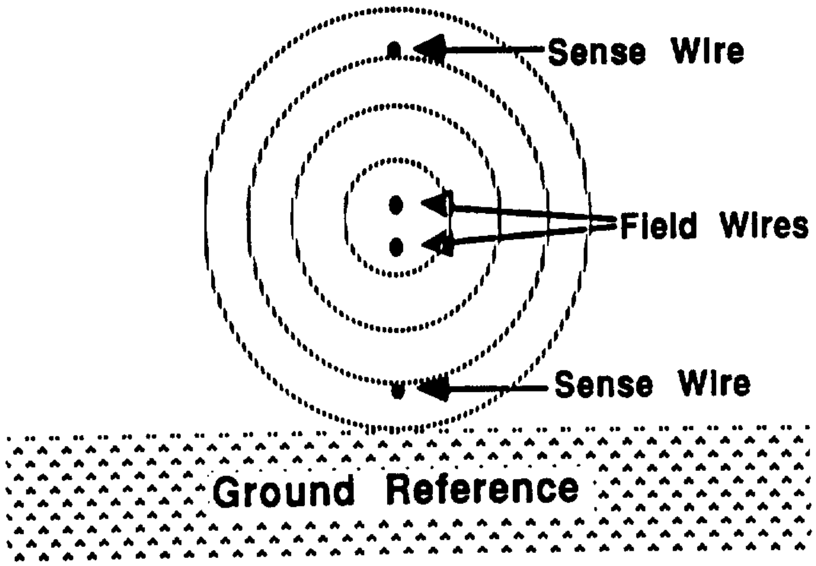


Figure 1-1. Electrostatic Envelope

The electrostatic envelope, or E-Field, is detected by sense wires installed parallel to the field wire(s). Although no high level of VLF energy is radiated, people or objects entering the E-Field sensor will cause its characteristics to be altered. These altered characteristics result in a change to the current in the sense wires. Attached to the sense wires is a sense filter, which transforms the changing current into signals that can be interpreted by the processor.

A change in the strength of the E-Field signal relates to the mass of the intruder, the rate of change of the strength relates to the intruder's movement, and the duration of the change relates to the time that the intruder is within the E-Field. All three of these factors, when present simultaneously in predetermined values, represent the "signature" of a human being, and cause the processor to produce an alarm output.

While the system responds to changes in the E-Field, it automatically adjusts to stationary objects that may move in and out of the E-Field over long periods of time. If, for example, an automobile were parked near an E-Field installation, it would cause an alarm as it was driven both in and out of the E-Field. After it was stationary, however, the system would automatically adjust to its presence and continue to provide undiminished perimeter protection.

If there is a permanent coupling change between the field and sense wires because of excessive grass and vegetation growth, or loose and sagging wires, a supervision alarm will be generated to signal the need for ground maintenance, or other maintenance.

System Protection

As part of the perimeter protection, the system monitors the status of its processor enclosure. Each enclosure is equipped with a tamper switch. The tamper switch may be connected to produce a visible or audible alarm in the control room.

A terminating device, or terminator, installed at the end of each pair of field and sense wires, provides full supervision for the E-Field wires. An alarm is generated if the system wires are tampered with by shorting, opening (cutting), or grounding any of the E-Field wires.

A special kind of terminator, a remote test terminator, will cause the system to react to a test voltage pulse (12 VDC) in the same manner as an actual intruder. The remote test terminator provides a means of testing a portion of an E-Field system from a remote location without physically being present at the facility perimeter.

E-Field Zones

Perimeter sensors are installed in specific zone lengths to allow the location of an intrusion attempt. Having the perimeter divided into zones permits a response force to be directed to a specific location in the secured area. The E-Field maximum zone length is 500 feet (150 m).

An E-Field zone consists of:

- Processor and sense filter
- Field and sense wires
- Mounting hardware for wires
- Terminators

Operating Frequencies

The processors operate on any of four different frequencies (summarized in Table 1-1). In systems consisting of more than one detection zone, no two adjacent processors (single or dual zone) can operate on the same channel frequency.

TABLE 1-1. Field Generator Frequencies

CHANNEL		FREQUENCY (KHz)
A		9750
B	60 Hz	9630
C		9930
D		9510

Figure 1-2 shows a simplified sketch of a perimeter protected by a 7-zone system using single zone processors.

Channel frequencies may be repeated in non-adjacent zones. The operating frequencies are functions of the available power line frequency (60 Hz). Dual-zone processors operate both zones on the same frequency (see Figure 1-3). Additional frequencies are available.

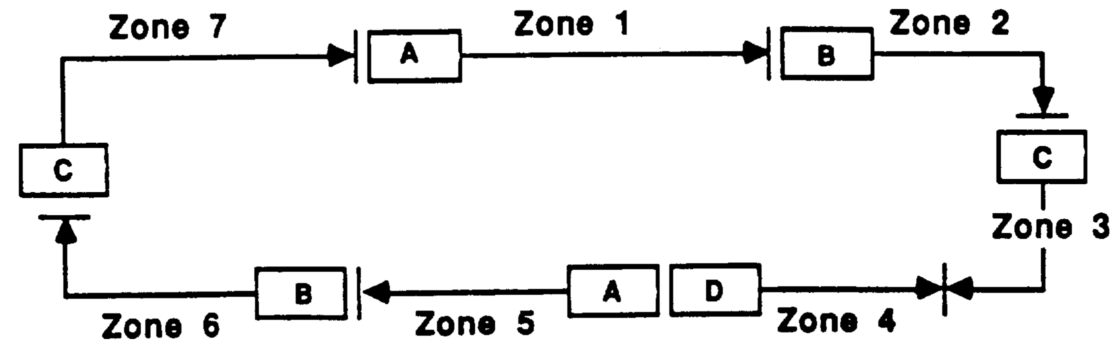


Figure 1-2. Single Zone Processors, Multi-Zone Perimeter 60 Hz

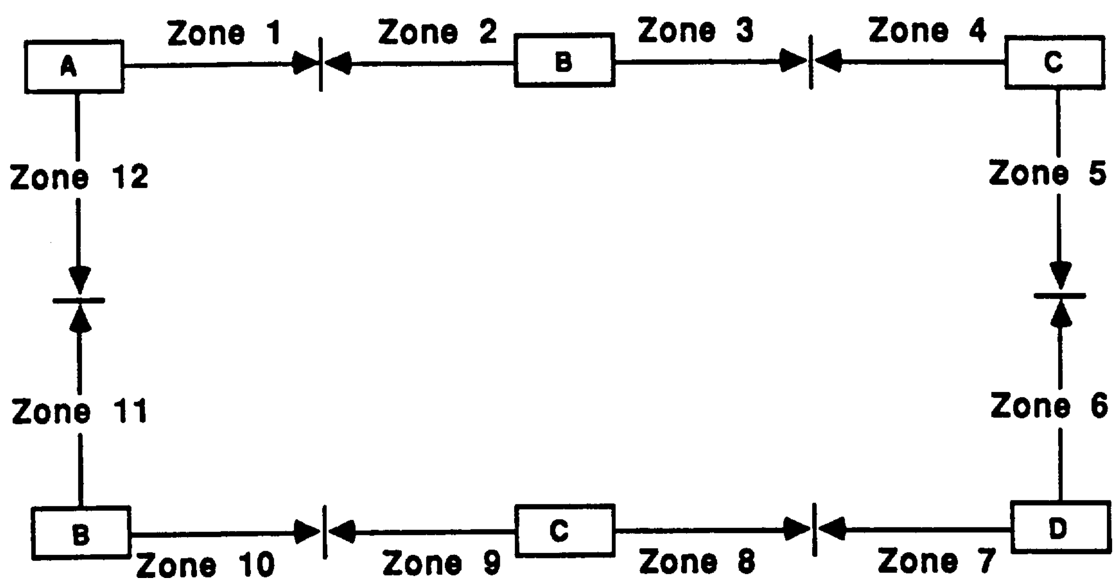


Figure 1-3. Dual Zone Processors, Multi-Zone Perimeter 60 Hz

Input and Output Signals

Inputs to processors:

20 VAC operating power - models EF-810, EF-820
+12VDC 2.6 A.H. standby battery power
Tamper switch
Sensor input (zone 1 and 2 on dual zone processors)

Outputs from single zone processors:

Alarm relay (SPDT)
Supervision relay (SPDT)
AC power status relay (SPDT)
Field generator voltage
Supervision status (T2, Front Panel Meter)
Tamper switch

Additional output from the second zone of dual zone processors:

Alarm relay zone 2 (SPDT)
Supervision relay zone 2 (SPDT)
Supervision status (T6, front panel meter)

Controls

Controls on Model 800 series processors are:

Front Panel

(See Figures 1-4)	Power switch and LED indicator
	Sonalert switch
	Test point selector switch
	Sensitivity adjust switch - zone 1
	Sensitivity adjust switch - zone 2

Single Zone Processors

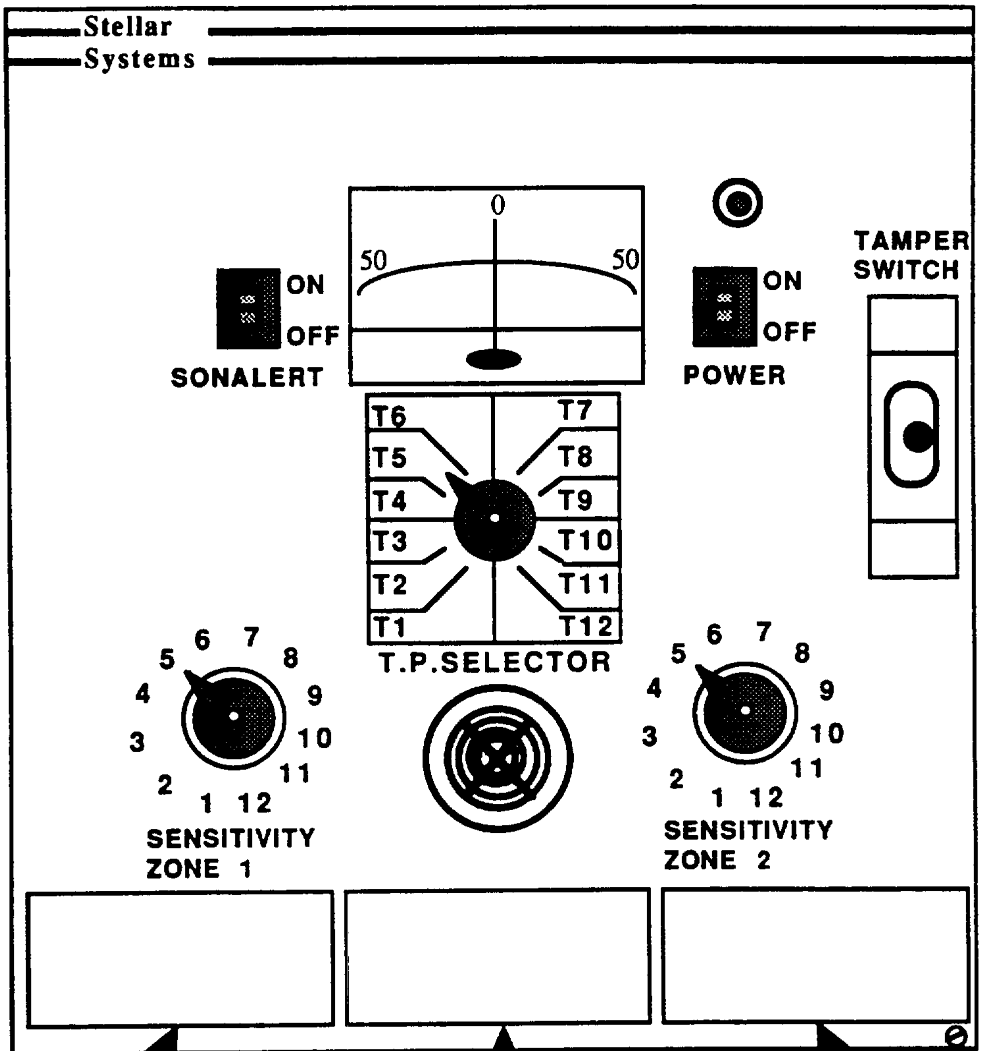
(mother board, Figure 1-5)	S1	Sensitivity adjust switch*
	L3	Field generator adjustment
	R70	Sense input nulling
	JU1	Bandpass select adjustment
	JU2	AC input power level adjustment.

Dual Zone Processors

(B88 board, Figure 1-5)	S1	Sensitivity adjust switch*
	R3	Sense input nulling
	JU1	Bandpass select adjustment

* S1 must remain in position 1 on front panel EF-810/ EF-820 model processors. This switch is physically located on the electronic processor boards. Do not use S 1 to set sensitivity levels when a front panel sensitivity switch, S2, is present. See Figures 1-4 and 1-5 for switch locations.

NOTE: Adjusting any controls other than those listed invalidates the warranty.



Test Point	Designation	Reading
T1	INTRUSION OUT ZONE 1	
T2	NULL ADJUST (R70)ZONE 1	0
T3	FLD REG OUT ADJUST (L3)	MIN.
T4	UNREG. IN VOLT	+20 TO +30

Test Point	Designation	Reading
T5	INTRUSION OUT ZONE 2	
T6	NULL ADJUST (R3)ZONE 2	0
T7	BATTERY VOLTAGE	+30
T8	FG VOLTAGE	+30

Test Point	Designation	Reading
T9	+6VDC	+30
T10	-6VDC	-30
T11	EXT. +14.3 VDC IN	+30
T12	UNREG. VDC IN	+20 TO +50

Figure 1-4. Front Panel, Dual Zone Processor

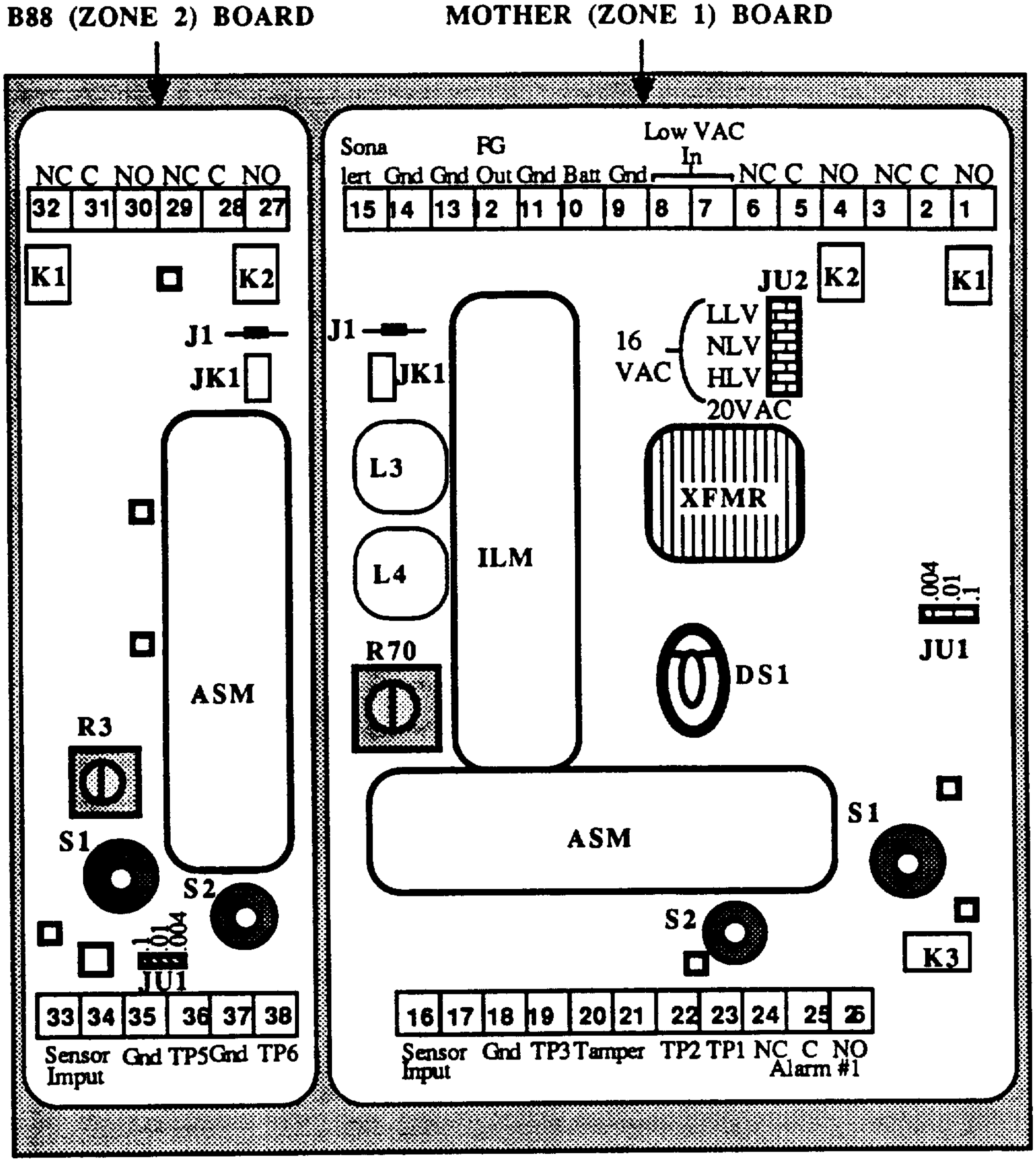


Figure 1-5. Dual Zone PCB

Sense Filters
Sense filters, which are installed between the sense wires and processor, transform disturbances in the E-Field into signals that the processor can analyze and interpret. The sense filters also act as the electrical interface between the sense wires and the processor. The sense filter (model 8333-4) is used in all EF-810 and EF-820 installations.

Terminators
Terminators are installed at the end of a zone, between the field and sense wires, to achieve the correct sensitivity or coupling by compensating for wire length and spacing. They also provide a means of supervising the coupling should it be tampered with or grounded. For 4-wire balanced phase, 1 each of 8348-4 and 8349-4 terminators are required per zone. These terminators provide the proper coupling capacitance for supervision.

Alarm Relay Functions
The alarm relay provides the means for an alarm reporting system to monitor the alarm output of the processor. The alarm signal generated by the E-Field (or the absence of all power to the processor) causes normally closed contacts on the alarm relay to open and activate the appropriate alarm (audible, visible, or other type monitor) annunciation at the monitoring system. If the alarm relay is used to activate an external relay, a diode (IN4001 or equivalent) should be installed across the external relay coil to suppress voltage spikes that could cause relay chatter or sticking contacts.

Dual Alarm Relay Option
The dual alarm relay card (model 2349) contains two relays. It is used if an additional relay output is required. The standard alarm relay will activate the dual alarm relay, thus converting a single contact closure into two outputs. For example, dual alarm output are required when the E-Field is monitored by centers, or logically combined sensor systems. Refer to Section 7 for more information.

Drain Coils
Drain coils (Model 3131-3) (optional) are installed after sense filters and before the field wires. They bleed off static or induced charges that may accumulate in an E-Field system under certain conditions. Drain coils should be installed for the protection of personnel wherever atmosphere conditions lead to high static charges in the surrounding environment, (such as under power lines or near sub-stations or switching yards).

AND Gate Module Option
The AND Gate module (model 2451) is a failsafe device that logically combines the alarm outputs of two perimeter sensors. An adjustable timer (variable 15 - 120 sec.) trips on the first alarm indication from either sensor. The timer runs until:

- No alarm is received from the second sensor of the logical combination. The time setting (15-120 sec) expires and the timer is reset to zero.

- An alarm is received from the second sensor of the logical combination within the timer setting. This will result in an alarm output change from the AND gate module alarm relay.

For more information refer to Section 7.

Space Heater Option
Space heaters are available to keep the processor enclosure at the correct operating temperature for the electronics during extreme adverse weather.

MPS-12 Power Option
The MPS-12 provides DC voltage for multiple zones of E-Field. This option simplifies and reduces power distribution requirements. Refer to Appendix B.

Batteries
The standard eight hour standby Gel-Cell battery is trickle charged by a float charger circuit contained in the processor.

Lightning Arrestor Package (Standard all units)
The lightning arrestor package includes transzorbs and spark gap discharge devices that protect the processor during lightning discharges, or near-field disturbances. For more information refer to Section 7.

Specifications

AC Power Requirements	110/125 VAC 60 Hz using 120 to 20 VAC transformer Single Zone - 475 mA max. at 20 VAC Dual Zone - 550 mA max. at 20 VAC
DC Power Requirements	Current supplied at 12 VDC: Single Zone - 225 mA max. Dual Zone - 275 mA max.
Battery Charger (Built-in for all models)	Gelled electrolyte type. Built-in float charger provides charging current at 13.8 VDC; current limited to 180 mA
Controls:	
Sensitivity	Detented potentiometer adjustment
Nulling Control	Variable potentiometer adjustment
Bandpass Selector	A 3-position jumper switch (JU1 on the processor main board) allows selection of lower corner frequency of 0.004 Hz, 0.01 Hz, or 0.1 Hz. Dual zone processors have 1 selector per zone.
Operating Frequencies	60 Hz power line - 9750, 9630, 9930, 9510 kHz
Alarm, Supervision, and Power Relay Contacts	Form C, non-inductive load, 3 watts at 0.25 A or 28 VDC max.; reed-type relay, EF-820 has one alarm relay and one supervision relay for each zone.
Supervision	AC monitoring for open, shorting, or grounding of E-Field when model 8348, 8349 terminator is used. Separate supervision alarm provided. A supervision alarm is also initiated in case of excessive loading on the field generator or excessive deviation of TP2 or TP6 reading from nulled position (ground maintenance supervision). Ground Maintenance Supervision -The signal coupling between sense and field wires may be monitored at TP2 (and TP6 on EF-820). This provides an indication of possible faults in the E-Field fence - or the need for ground maintenance. These test points are normally nulled using the nulling control potentiometer. Drastic deviation from a null (0) reading will initiate a supervision alarm. Tamper Switch - 1 -pole / 2-position, mounted on front panel for use separately or in series with supervision relay output.

Audible Alarm	In addition to the front panel Sonalert, an output is provided to drive a meter or Sonalert for remote testing.
Environmental	Operating temperature: -30 degrees C to +70 degrees C -22 degrees F to +158 degrees F Humidity: Conforms to MIL-STD-202 Lightning protection - All processors equipped with a standard lightning arrestor package, which contains a combination of transzorbs and gas discharge tubes; effective against both high energy and fast-rise transients.
Preconditioning	Each processor is burned-in for a period of 96 hours (four days); operational burn-in is performed at a temperature above 60°C.
Enclosure	Steel NEMA 4 enclosure; 12" x 14" x 6" plus mounting flanges. Optional stainless steel enclosure available.
Options	Remote test terminator: tests all functions of a zone (electronics, signal transmission, and annunciator) from remote location by application of 10-15 VDC at 30 mA max. NEMA 4 stainless steel enclosure Drain Coils
Accessories	Test cable: Model 2500

Configurations

The following E-Field configurations apply to various types of sites.

Fence-Mounted Fence-mounted configurations are mounted on existing perimeter fence posts when the electronic intrusion detection requirement is at a specific fence.

Free-Standing Free-standing configurations are used to detect intrusion in either an open area within a controlled perimeter, or the area between two barriers on a perimeter.

Roof-Mounted Roof-mounted are condensed wire, free-standing configurations that protect a rooftop or other similar location that require protection on top of a structure.

Wall-Mounted Wall-mounted installations provide protection for multi-story buildings when a building requires extra security, or is part of the security perimeter.

Balanced Phase

All E-Field configurations with Series 800 processors use the balanced phase operation. This concept relies on the principle of common mode rejection, which cancels equal signals appearing simultaneously on the upper and lower sense wires. Induced voltages from power lines, lightning, and other similar disturbances, are nullified. The resultant signal, seen at processor, is the signal generated on upper or lower sense wire individually, as in the case of an intruder.

Perimeter security systems are usually designed as a combination of zones. Each zone defines a limited area where an intrusion attempt is taking place and the direction of a response force to it.

A complete perimeter security system may involve a mixture of several configurations. As a rule, however, any single zone of an E-Field installation should be a single, homogeneous configuration. For example, roof-mounted configurations should not be incorporated in the same zone as fence-mounted configurations. Properly designed, an installation will provide a customized high-security protection system for virtually any facility.

Fence-Mounted Configurations

E-Field hardware may be mounted on any reasonably sound existing fabric fence. The only requirements are that the fence be strong enough to support the hardware, the fence fabric be reasonably taut, and the support poles firmly set and parallel with each other.

A fence-mounted configuration provides protection against climb-over, crawl-under, and cut-through. The fence fabric also serves, as a shield, to prevent alarms from being generated by movement of personnel or vehicular traffic on the opposite side from the E-Field. While vinyl-coated chain link fences are not normally recommended for E-Field mounting, they can be used, providing installation instructions are followed. Other mounting configurations are possible.

Three-Wire Balanced-Phase Fence Mounted

In this commonly used fence mounted configuration (Figure 2-1), the top and bottom wires are sense wires and the center wire is the field wire. The three-wire configuration provides protection for standard metal fabric fences 6 to 7 feet in height.

Typical wire spacing is 6-8 inches (15 to 20 cm) above the ground for the lower sense wire, with 2.6 feet (0.78 m) between the field and lower sense wire and 4.4 feet (1.35 m) between the top sense wire and the field wire. This spacing places the top sense wire approximately 7.7 feet (2.3 m) above the ground, thus detecting climb-over and penetration of the E-Field.

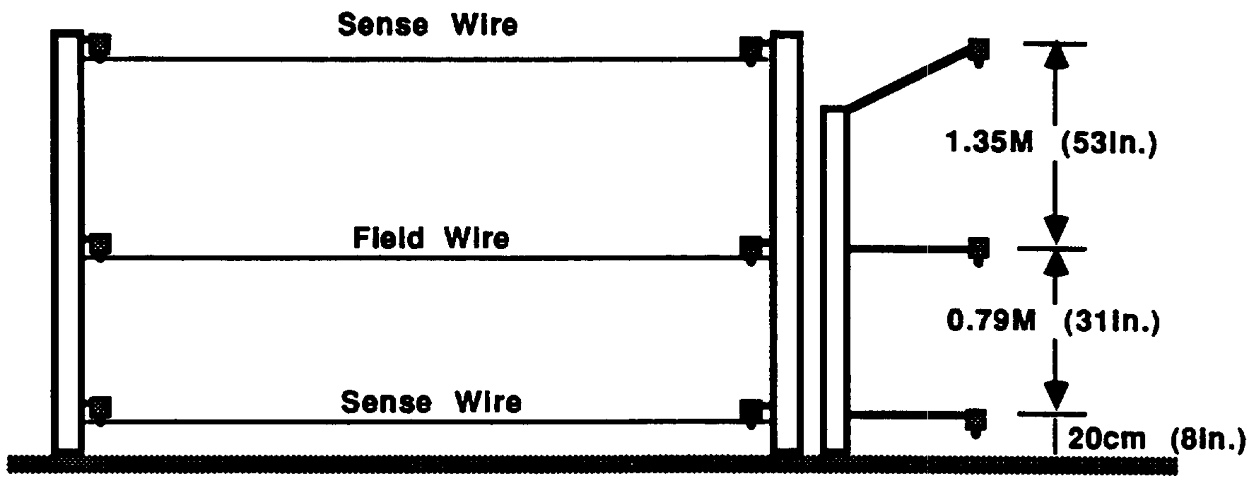


Figure 2-1. Three-Wire Configuration

Four-Wire Balanced-Phase Fence Mount

This fence mounted configuration (Figure 2-2) calls for 2 field and 2 sense wires, spaced as shown in the illustration. This wire spacing puts the top sense wire approximately 8 feet above ground level. The balanced phase configuration provides a high immunity to electrical interference such as that found around electrical power distribution facilities. A terminator is required between each of the sense and field wire pairs. The two field wires provide improved detection capability at lower sensitivity settings.

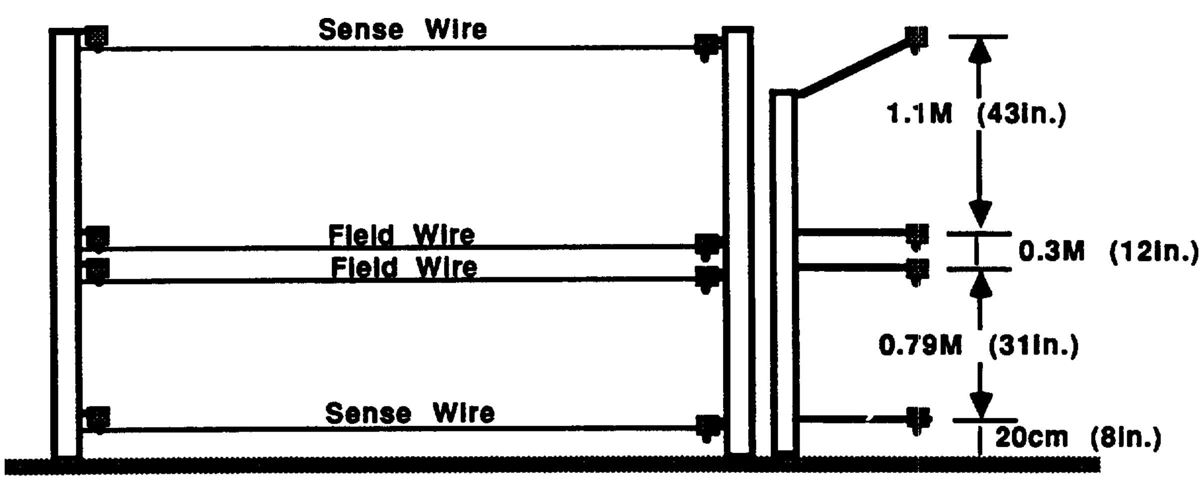


Figure 2-2. Four-Wire Configuration

Six-Wire Balanced-Phase Fence Mount

The six-wire fence-mounted configuration (Figure 2-3) is essentially two stacked 3-wire configurations. This configuration places the top sense wire at approximately 11.5 feet maximum height. For shorter fence requirements, wire spacing can be compressed proportionally to accommodate the reduced height. A dual-zone processor and two sense filters are required, with one zone used on the lower half of the fence, and the second zone used on the upper half of the fence.

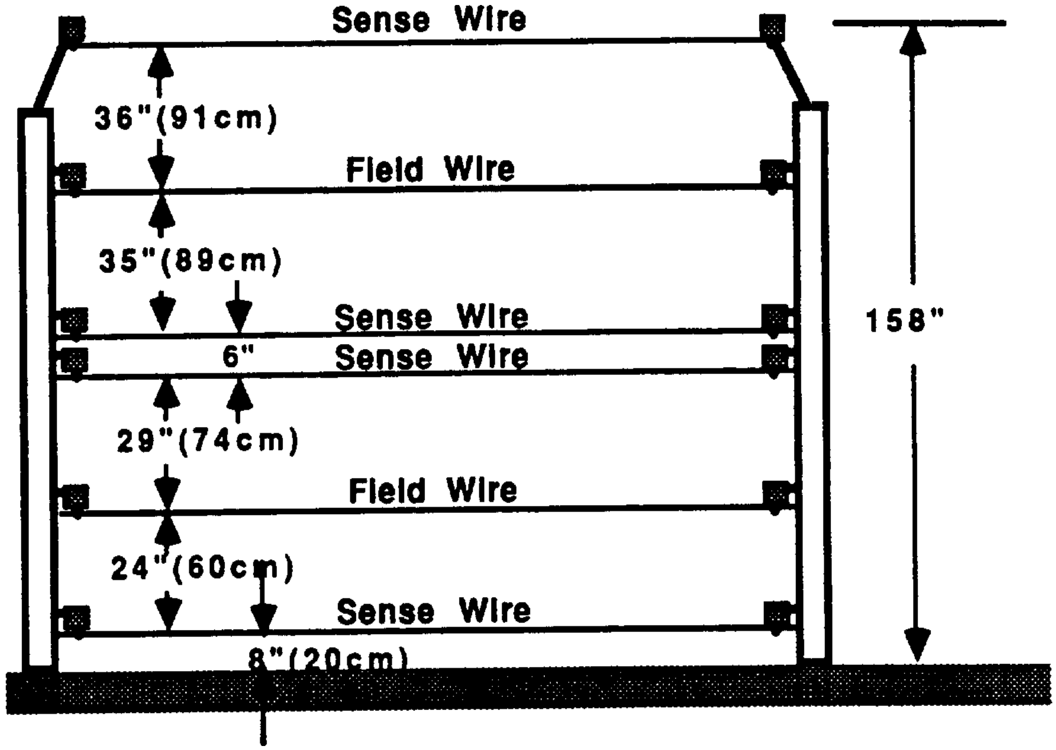


Figure 2-3. Six-Wire Configuration

Eight-Wire Balanced-Phase Fence Mount

The eight-wire balanced phase fence mounted configuration is essentially two stacked four-wire configurations. The top sense wires are placed approximately 14 ft. off the ground, which is suitable for the type of high fences found around correctional facilities and high-threat areas. A terminator is required between each pair of field and sense wires. A dual-zone processor and two sense filters are required, with one zone used on the lower half of the fence and the second zone used on the upper half of the fence.

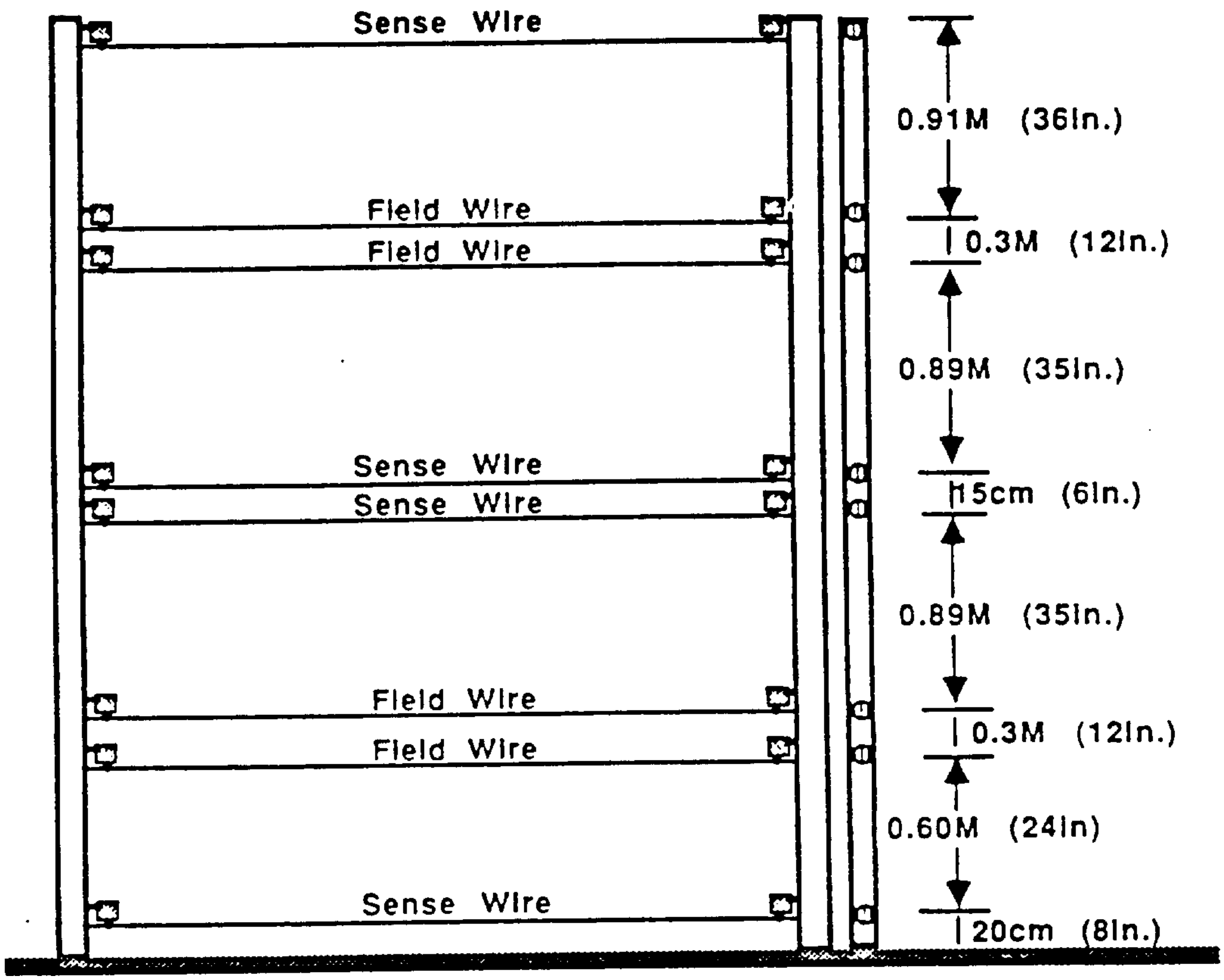


Figure 2-4. Eight-Wire Configuration

Dummy Wires

Dummy wires, not electrically connected to the system, can be installed to increase the physical deterrent presented by an E-Field zone. Placed equidistant between the field and sense wires, dummy wires enhance the performance of the zone by increasing the uniformity of the E-Field. Dummy wires must not be grounded, and they must be maintained at the same 50 lb (23 kg) tension as field and sense wires. Dummy wires are not supervised. However, they cannot be removed or tampered with without disturbing the E-Field and generating an alarm. To increase the height of an E-Field system, a double stacked E-Field configuration is recommended. Refer to Figures 2-3 and 2-4.

Free-Standing Configurations

The free-standing configurations use supporting hardware mounted on galvanized steel or fiberglass poles. Free-standing configurations are well suited for the protection of unfenced areas, and for use in conjunction with single or parallel security barriers. They are an excellent defence against bridging attempts.

NOTE: All poles should be interconnected, with a common ground strap for each zone.

If fiberglass poles are used, additional care must be taken to connect all support hardware (on each pole) to the common ground strap and ground reference within each zone.

The physical protection afforded by free-standing installations may be increased by incorporating dummy wires (not an electrical part of the system) in the configurations. The dummy wires produce, in addition to physical protection, a more uniform E-Field by increasing the coupling between the active elements of the system.

Four-Wire Free-Standing

Like the four-wire fence-mounted configurations, the four-wire free-standing configuration (Figure 2-5) places the top sense wire approximately 8 feet above the ground. It is most effectively used in the area between parallel security fences. When used with dummy wires, it provides an 8 foot physical, as well as electronic, barrier.

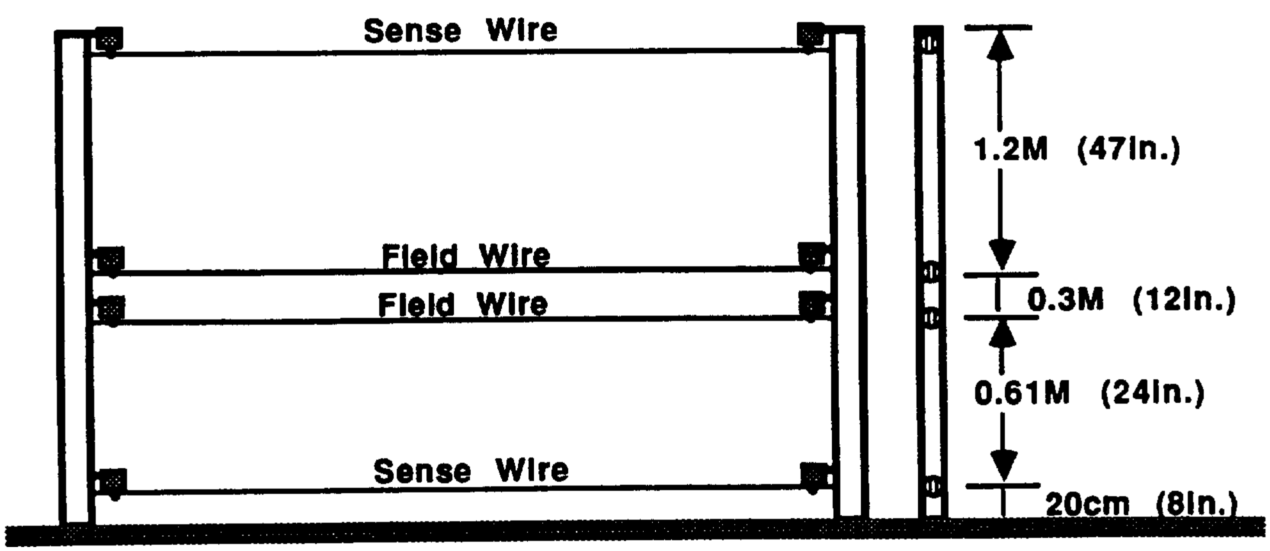


Figure 2-5. Four-Wire Free-Standing Configuration

Six-Wire Free-Standing

The six-wire flee-standing configuration is essentially a 4-wire configuration with 2 dummy wires. This configuration places the top sense wire at 8 feet maximum height. For shorter fence requirements, wire spacing can be compressed proportionally.

Roof Mounted Configuration

The roof mounted E-Field is a 4-wire condensed free standing special application. Figure 2-6 illustrates a typical installation.

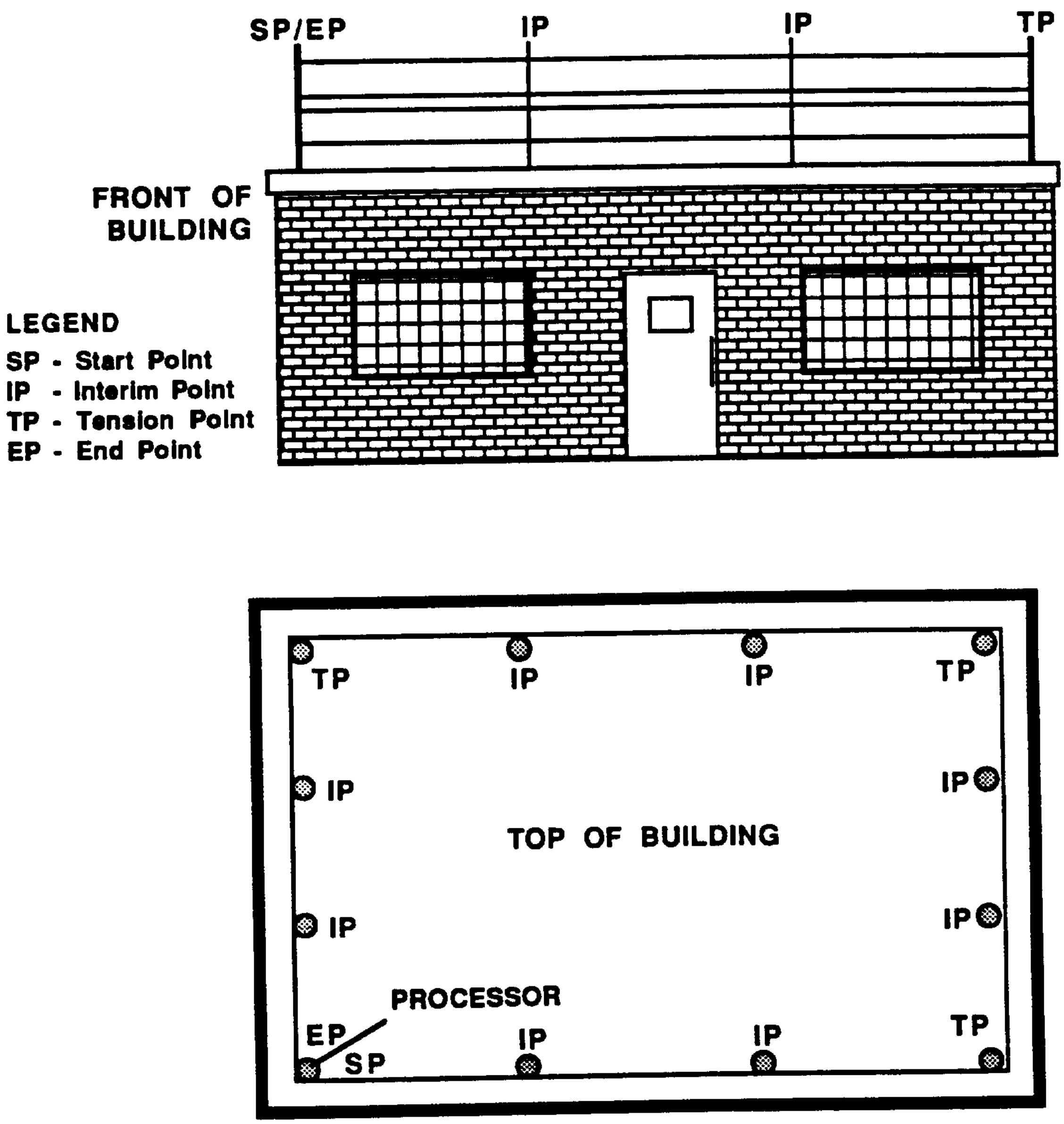


Figure 2-6. Roof Mounted Installation

Vertical Wall-Roof Mount

The vertical wall-roof mounted application is a special E-Field configuration that requires special assistance. Please contact Stellar Systems when this configuration is being planned.

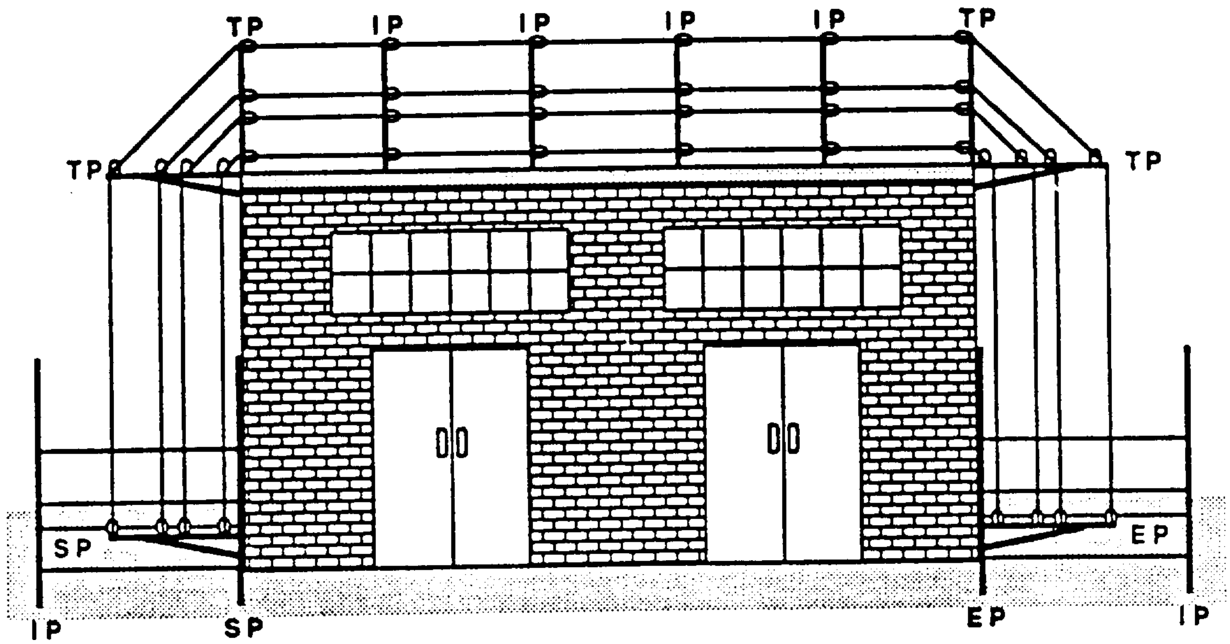


Figure 2-7. Vertical Wall-Roof Mount Installation

Vertical Wall Mount

The wall mounted configuration is a reduced version of the three-wire fence mounted E-Field. Attached to the side of a building with special hardware, it provides protection for multi-story buildings.

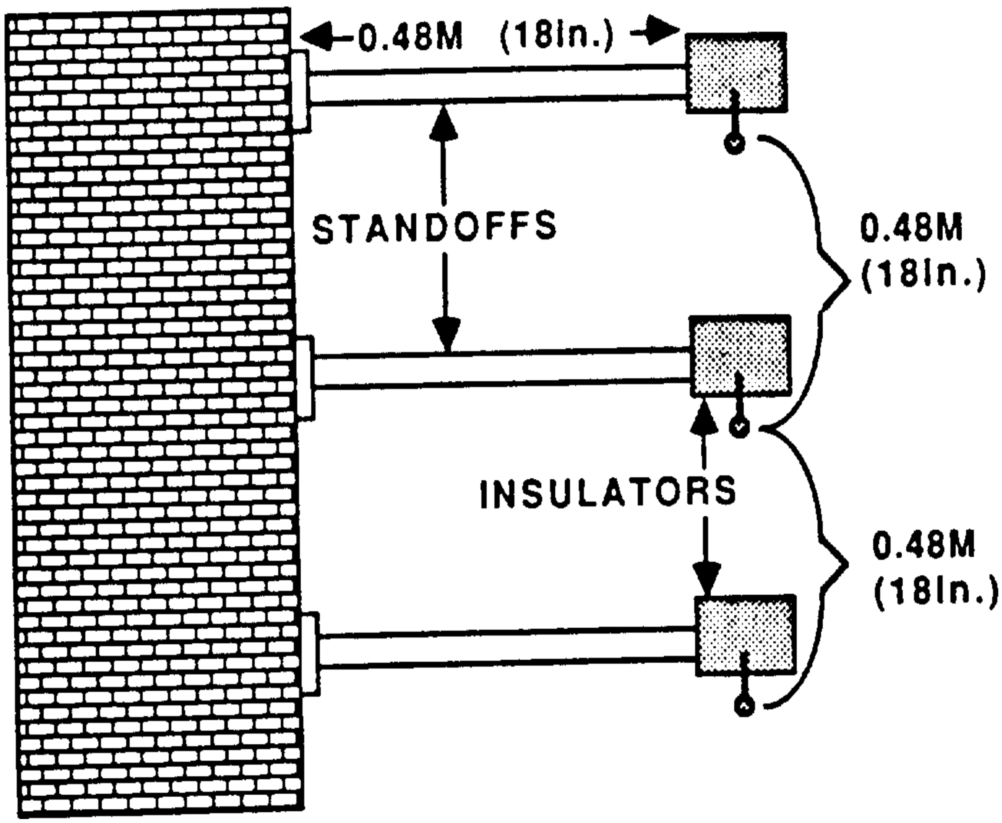


Figure 2-8. Wall Mounted Configuration

Introduction

This section provides a description of critical factors relating to site preparation prior to installation of the E-Field system. These preparations include clearing the perimeter, grading, the condition of existing structures and chain link fences. This section should be read thoroughly before beginning the installation.

Site Requirements

Removal of Existing Equipment

Care must be taken when removing the existing installation to prevent damage to mounting hardware (poles) and fence fabric. If any mounting hardware or fence fabric needs to be repaired or replaced this is the time to do so.

Grading and Clearing The Perimeter

The bottom sense wire of any configuration should be a constant 6 to 8 inches (15 to 20 cm) above the ground, from post to post, to maintain normal levels of security. Though an E-Field zone can be installed over nearly any terrain, ideal conditions are rarely found, and minor grading may be necessary. If a section of the lower wire varies more than 2 inches (5 cm) from its normal height above the ground, some irregularity in detection may occur at that location. The condition could be corrected by adding additional interim support posts, however minor grading might be more economical.

Tree limbs and vegetation must be removed to at least 6 feet (2 m) on both sides of the wires. Weeds must be cut to ground level and kept controlled. A plastic sheet placed below the wires and covered lightly with earth or gravel will inhibit the growth of weeds or grass. It is recommended that the earth or gravel be shaped in a crown-like fashion to prevent water from collecting beneath the wires. Gravel should not be larger than 3/4 inch diameter, nor deeper than 3 inches otherwise the ground reference will be affected.

Any large objects must be removed from the zone. All rubbish should be collected and the general area should always be kept clear a minimum of 6 feet (2 m) around the zone.

Preparation for Fence-Mounted Installation

The existing fence, that constitutes the perimeter of the facility, must be maintained in good condition. Any spaces beneath it, where animals could enter and cause nuisance alarms, must be filled, and loose fence fabric must be braced or tightened in accordance with the manufacturer's recommendations. A suitable fence must be reasonably taut, with support posts firmly implanted in the ground and properly plumbed, particularly on sloping surfaces.

Installation on fences with vinyl-coated mesh are not normally recommended, but E-Field can be used under carefully controlled conditions when installation procedures are followed. Barbed wire strands at the top of a fence (where the upper sense wire will be located) should be removed. If double victory arms with barbed wire are used, it is advisable to remove the barbed wire on the side of the fence where the hardware and wire are to be installed.

All metal attachments on the fence (signs, etc.) must be securely fastened to prevent movement. They should also be electrically connected to a fence post or system ground to prevent intermittent grounding in wet weather.

Preparation for Free-Standing Installation

Posts used for free-standing installations should be galvanized steel or fiberglass, firmly implanted in concrete and plumb, particularly on sloping surfaces. Metal attachments to the support posts must be securely fastened to prevent movement.

NOTE: All poles should be interconnected, with a common ground strap for each zone.

If fiberglass poles are used additional care must be taken to connect all support hardware (on each pole) to a common ground strap and ground reference within each zone.

Table 3-1. Free-Standing 8 Foot Galvanized Steel Poles

POLE TYPE	LENGTH	OUTSIDE DIAMETER	WALL THICKNESS (Schedule 40 steel)
Tension	10 feet (3 m)	3 inch (7.6 cm)	0.203 inch (0.51 cm)
Interim	10 feet (3 m)	2.38 inches (6.0 cm)	0.154 inch (0.39 cm)

When setting posts in concrete, dig a post hole 12 inches in diameter by 2 feet deep. Center the post in the hole and fill with compacted soil to a depth of 1 foot. Fill the remaining hole with concrete. Crown the concrete for water runoff.

Maximum spacing for interim support poles is 20 feet (6.1 m) for normal environmental conditions, and 10 feet (3.05 m) where severe icing and wind conditions prevail.

Preparation for Roof-Mounted Ground Planes

The roof or mounting surface for a roof-mounted installation must provide an adequate ground reference for proper operation. If the roofing material is not of a conductive nature, an adequate ground reference cannot be established. This condition may result in nuisance alarms because of changing E-Field reference in rainy weather, or due to movement beneath the roof surface.

A ground plane can be established by placing light gauge wire mesh fencing on the roof surface. The ground plane should extend a minimum of 3 feet on each side of the wires and be tied to ground. Where the specified minimum ground plane width cannot be established, a short test section should be installed to evaluate the performance of the system.

Installation Planning

Perimeter security systems are normally divided into zones (sections) to aid in locating the point of intrusion or escape attempt along the perimeter and to facilitate periodic maintenance without the need of placing the entire perimeter in an access mode. The higher the security requirement, the shorter the zone length. For ease of installation and operation, the environment of each zone should be as homogeneous as possible. Do not attempt to incorporate many changes of terrain, elevation, or contour in a single zone.

1. The installation starts with the perimeter plan or zone segments as defined by the needs of the particular facility, its security plan, environmental and topographical factors. Figure 3-1 outlines a hypothetical case.

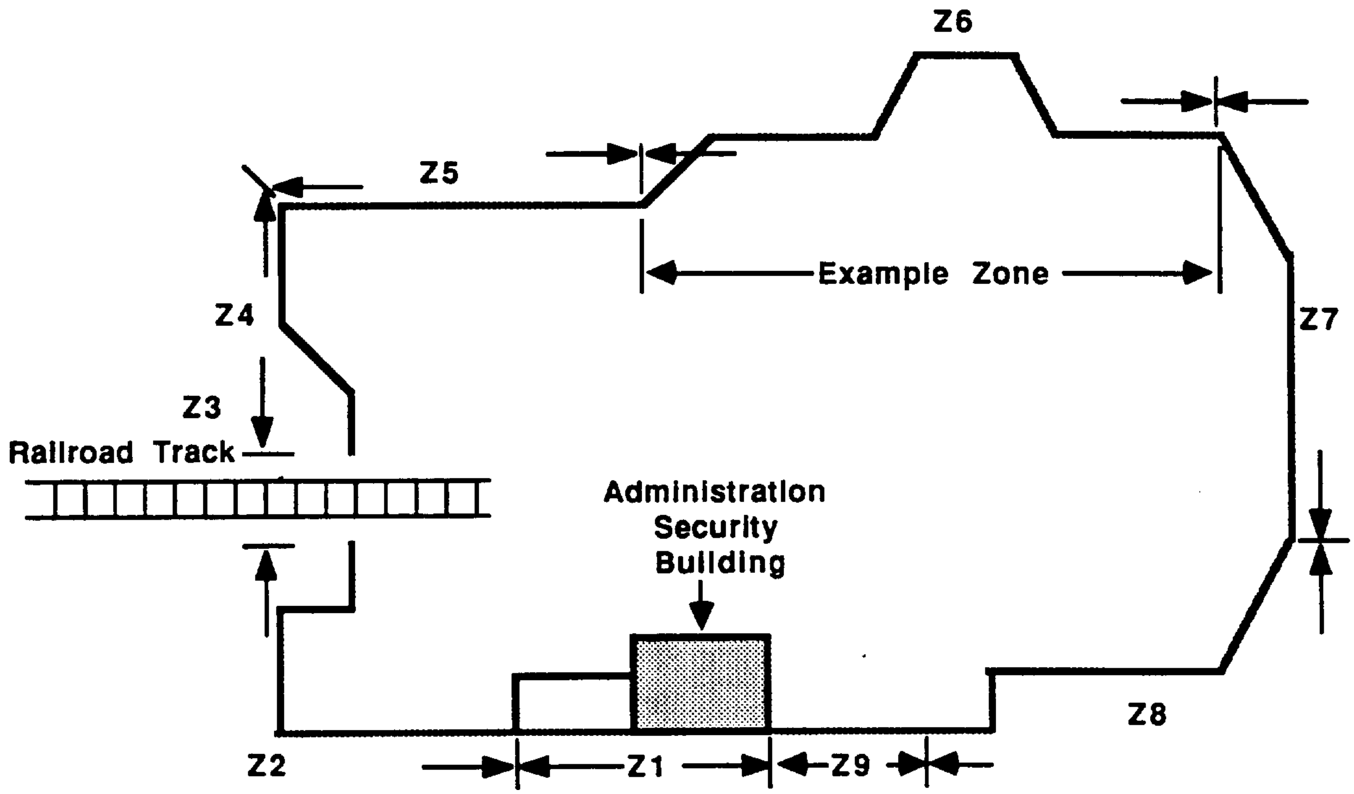


Figure 3-1. Perimeter Plan

2. From the perimeter plan, an individual zone plan (Figure 3-2) is designed. The configuration for that zone is specified along with its overall length while noting any elevation changes from point-to-point.

3. The individual zone elements for the particular configuration are entered on the zone plan.

Start Point (SP) Start point hardware (1 per zone) secures wires to their support posts at the beginning of a zone. This hardware point provides the initial wire tensioning, via a spring and winder, for the zone and is normally located in close proximity to the sense filter and processor.

End Point (EP)	(1 per zone) Located at the end of a zone; end points have no tensioning hardware. Terminators are connected to end points.
Tension Point (TP)	Identical to start point hardware; its function is to maintain proper wire tension in long length zones. Tension Points are located every 160 ft. (49 m) along the zone. They are also placed at any point where the zone changes direction by more than 30 degrees in elevation.
Interim Point (IP)	(1 or more per zone) Support wires without applying tension. These points are located every 20 feet (6.1 m). Under severe conditions, high winds, heavy snow or ice load, spacing is reduced 10 feet (3 m).
Corner Point (CNR)	Identical to start point hardware. Provides tension at the corner points of a zone when there is a change in horizontal direction of more than 20 degrees.

The various types of configurations are described as:

4WFS	= 4-Wire, Free-Standing, Balanced Phase (BP).
3WFM	= 3-Wire, Fence Mounted, Balanced Phase (BP).
4WFM	= 4-Wire, Fence Mounted, Balanced Phase (BP).

4. Noted on each zone plan is the location and type of processor (P), terminators (T), drain coils (DC) and sense filters (SF). In working with each zone plan, there are several simple computations that are made. They are:

Tension Point In a straight zone, a tension point is located at least every 160 feet (49 m). A tension point is also located at any point in the zone where the zone changes direction by more than 20 degrees horizontally or 30 degrees in elevation.

Interim Point The number of interim points (IP) = total zone length divided by the spacing between points minus the number of end points (EP), tension points (TP), and corner points (CNR).

Example: A 300 foot (91.44 m) zone having one EP, two TP and one CNR would also include: 300/20 - (1 +2 +1) = 15 - 4 = 11 interim points

NOTE: Under normal conditions, interim spacing is 20 ft. (6.10 meters). Under heavy snow and ice load, interim spacing is 10 ft. (3.05 m).

5. The specific plan is similarly set for each individual zone about the perimeter. The installation can now be performed.

SECTION 4
E-FIELD INSTALLATION

Unpacking and Inspection

The Series 800 E-Field processor front panel, with the processor PC assembly attached, is shipped separate from the NEMA-4 mounting enclosure. The field generator crystal is shipped separate, and must be installed in the interlocking module (ILM) on the processor PC assembly prior to operation (see Figure 4-30). There are no other special requirements associated with unpacking the processor. All mounting hardware is shipped in individual kit form according to configuration. In other words, there are separate cartons for each start point, end point, interim point, etc. Notify Stellar Systems of any incorrect or missing components.

Perimeter Hardware

Prior to installing hardware, the zone(s) must be designed and site preparations made. Installation and calibration of the electrical components are contained in this Section and in Section 5. Each zone will contain, at minimum, a start point, an interim point and an end point. Zones may also contain tension and/or corner points. The hardware supports the E-Field wires for fence-mounted, free-standing, or roof-mounted configurations. Commonly available items, such as free-standing poles and coaxial cable, are to be supplied directly by the installer. These items are identified on the site-specific drawings.

Tools and Equipment Required

Volt-Ohm meter	Ladder, 8 foot	Measuring tapes, 100 ft, 15 ft
Coax Wire Stripper	Wire Cutters	Wire Markers
Long Nose Pliers	Electrical Tape	Tie-Wraps

3/8 Ratchet Drive (Battery operated is optional)

Socket Wrench, 3/8 drive, 7/16, 5/16 and 3/8, and 1/2 deepwell

Open End Wrenches, 7/16,1/2,5/16,3/8

Screwdrivers, Flat blade and Phillips numbers 1 and 2

Common Assemblies for All Configurations

The major common assemblies for mounting E-Field to a fence are:

5001 Interim Insulator(s)	Used between the tensioning hardware in a zone at 20 feet (6.1 m) intervals (10 feet (3.05 m) if in high wind areas) attached to the mounting brackets. Refer to Figure 4-4. These consist of the housing, insulator and carrier lock for capturing the wire.
5020 Tension Insulator(s)	Used at the start, tension, corner and end points of a zone. Refer to Figure 4-5. Components of these insulators are the housing, insulator and stainless steel insert.
5014 Winder	Used in conjunction with the high tension spring to exert 50 lbs tension on the wires.

2350 Spring, High Tension	Used in conjunction with the winder to exert 50 lbs tension on the wires.
5102-2 45° Mounting Bracket	Used to mount the hardware, associated with the top wire, to the fence. Refer to Figure 4-2.
5102-1 90° Mounting Bracket	Used to mount the hardware, associated with the other field and sense wire(s), to the fence. Refer to Figure 4-3.

Fence-Mounted Hardware

NOTE: For descriptive purposes, four-wire fence-mounted and four-wire free-standing hardware and illustrations will be referenced in these instructions.

Four-wire fence-mounted support housings must be mounted with the wire spacing shown in Figure 4- 1.

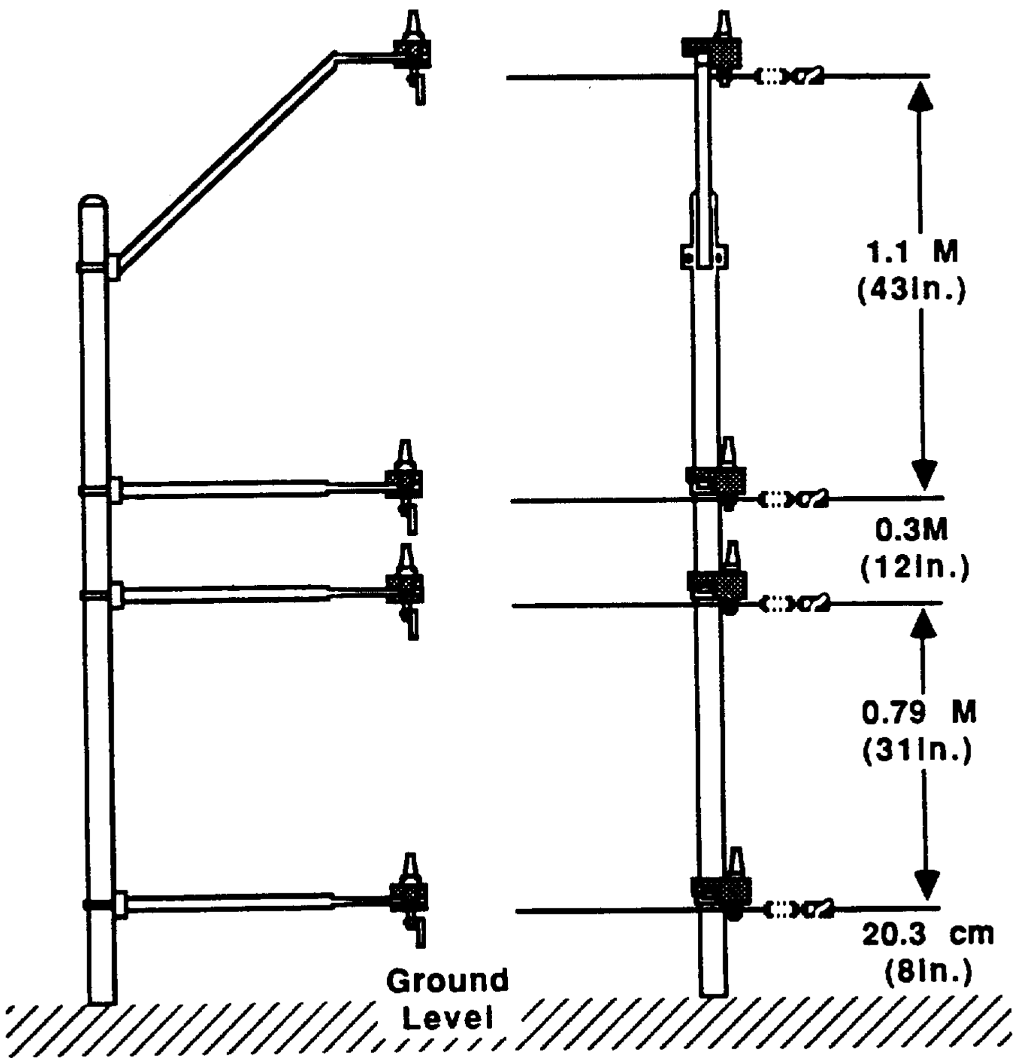


Figure 4-1. Four-Wire Fence Mounted Installation

Fence-Mount Hardware Options

The fence fabric will be either on the opposite side of the pole from the E-Field mounting bracket or the same side as the mounting bracket. When mounting bracket is on the same side as the fence fabric, spacers are required as shown in Figures 4-2 and 4-3. The yoke and mounting bracket are installed with the fence fabric between them. The yoke and spacers are not used on installations where the fabric is on the opposite side of the pole.

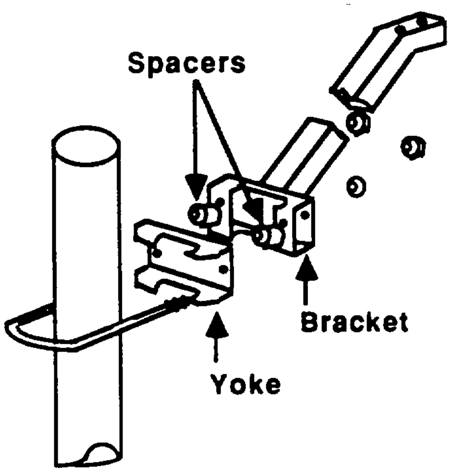


Figure 4-2.
45° Mounting Bracket
(Fence Fabric same side)

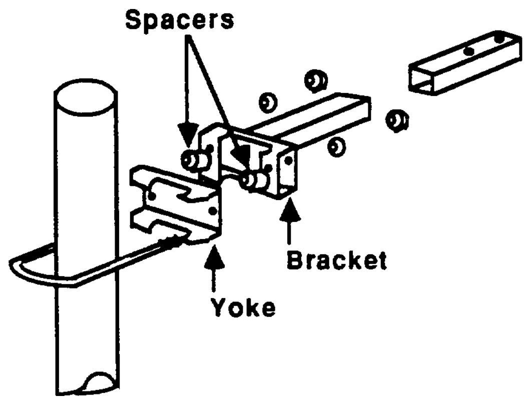


Figure 4.3.
90° Mounting Bracket
(Fence Fabric same side)

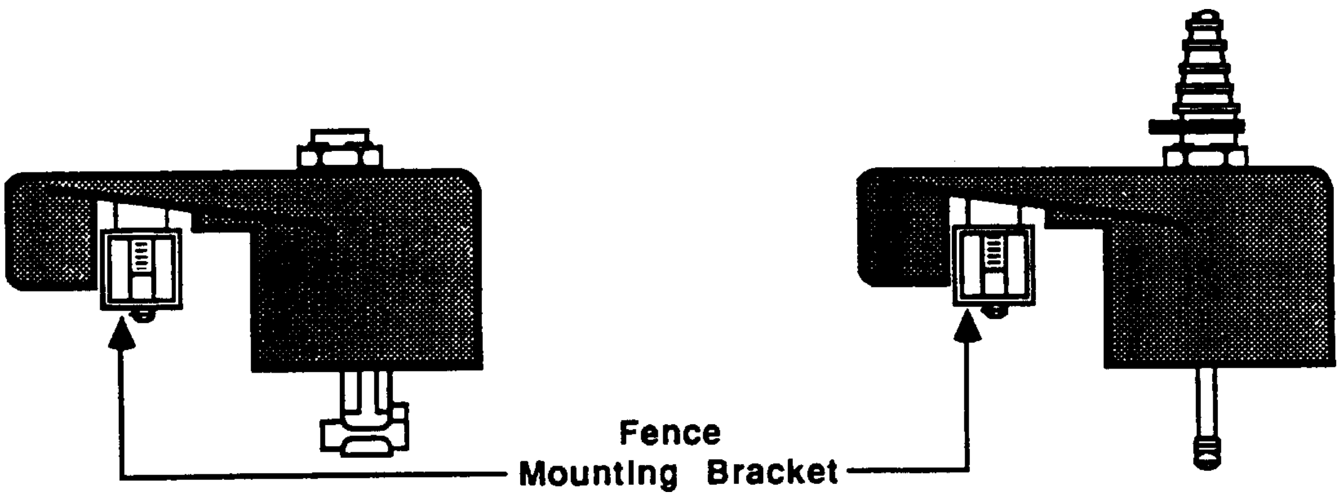


Figure 4-4.
Interim Insulator

Figure 4-5.
Tension Insulator
with Terminal Boot

Start Point Hardware

Install start point hardware at the beginning of the zone where the processor is located. Fit the connecting link on the lower groove of the stainless steel insert. To this, fit the spring and winder. The wire is wrapped around the upper groove of the insert and pulled towards the beginning of the zone. The connecting link, spring and winder are installed on the lower groove of the insert and continue towards the end of the zone.

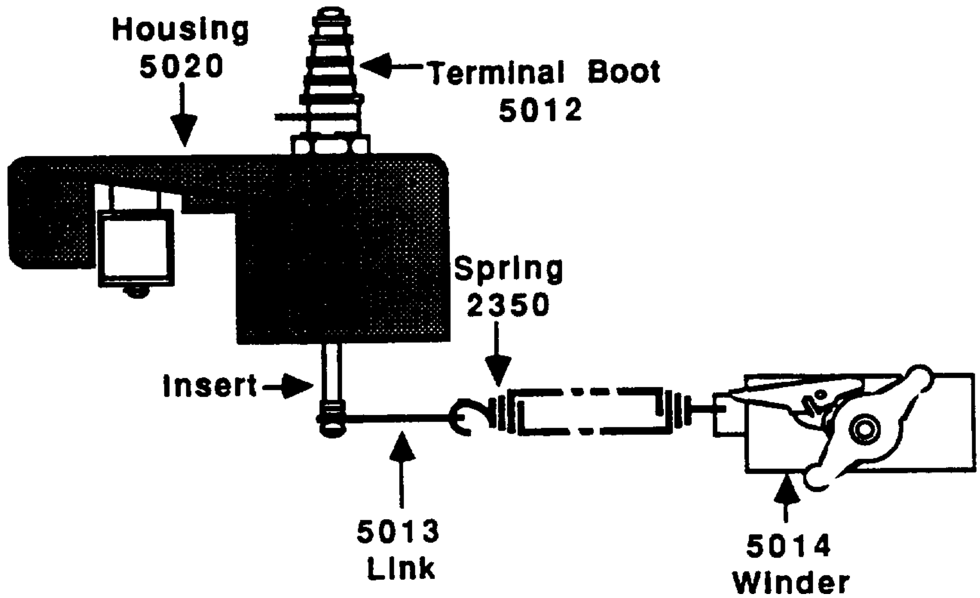


Figure 4-6. Start Point

Interim Point Hardware

Interim points are mounted to the fence at 20 feet (6.1 m) intervals under normal conditions (less than 20° horizontal angle change, or 30° elevation change). These can be located at 10 feet (3 m) intervals if ice buildup or high winds are a consideration. The E-Field wire, once pulled, is fit into the carrier lock of the insulator and the lock rotated 90° to capture the wire.

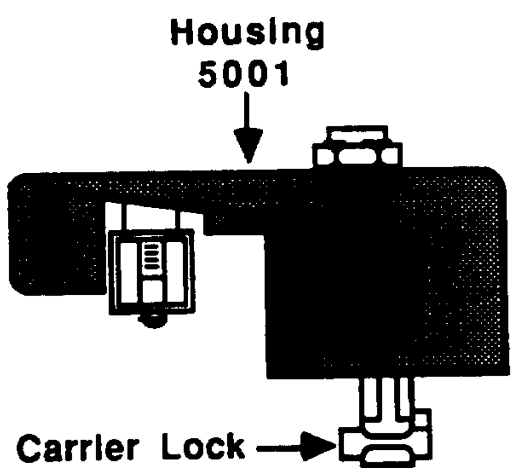


Figure 4-7. Interim Point

Tension Point/Corner Point Hardware

Corner point hardware should be installed whenever the zone changes direction at an angle greater than 20° from line of sight, or 30° elevation. The corner point extender (5017) is used to maintain proper spacing from the fence fabric. Tension Points should be installed at least every 160 feet (49 m) along the zone length.

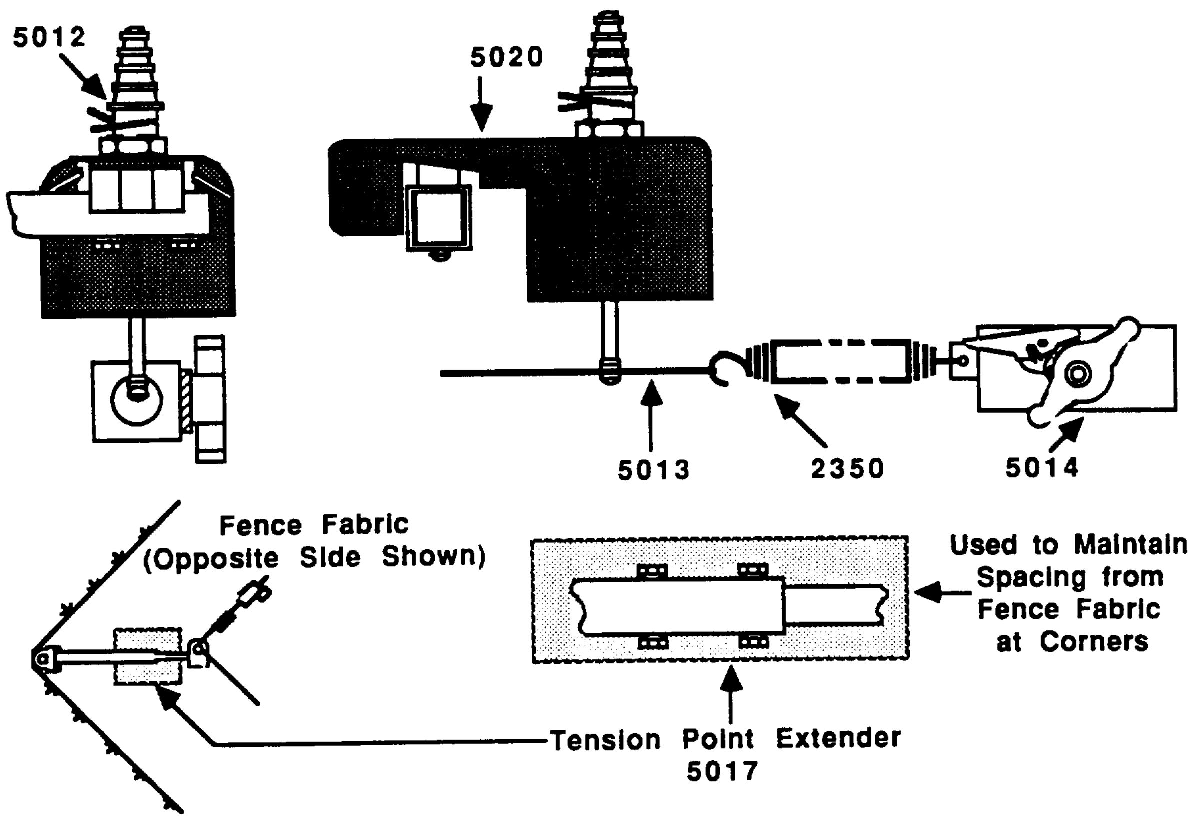


Figure 4-8. Inside Corner Point

Outside corner points require an adjustment of the standoff bracket so the wire will be equally spaced from the fence fabric. This will result in an offset of about 15° from the center-line of the corner.

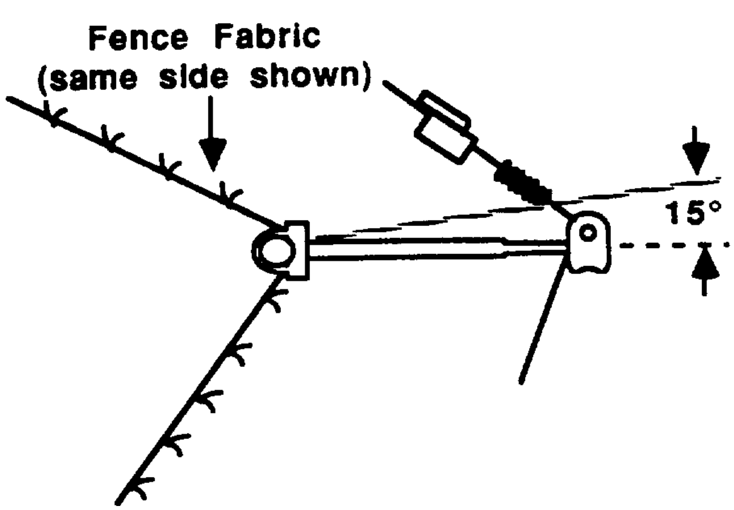


Figure 4-9. Outside Corner Point

Corner or Angle Point Hardware

Inside tension points, with fabric on the same side, make it necessary to use the mounting bracket yoke (12747-2) against the fence fabric rather than under it.

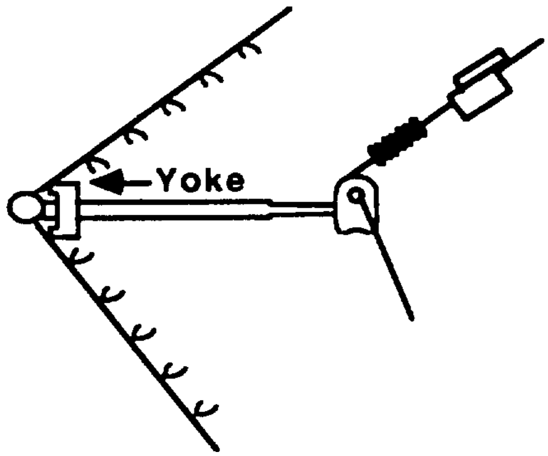


Figure 4-10. Inside Corner Yoke Placement

End Point Hardware

The end point hardware mounts with the insulator housings facing towards the start point of the zone. This is also the place to start attaching the E-Field wire.

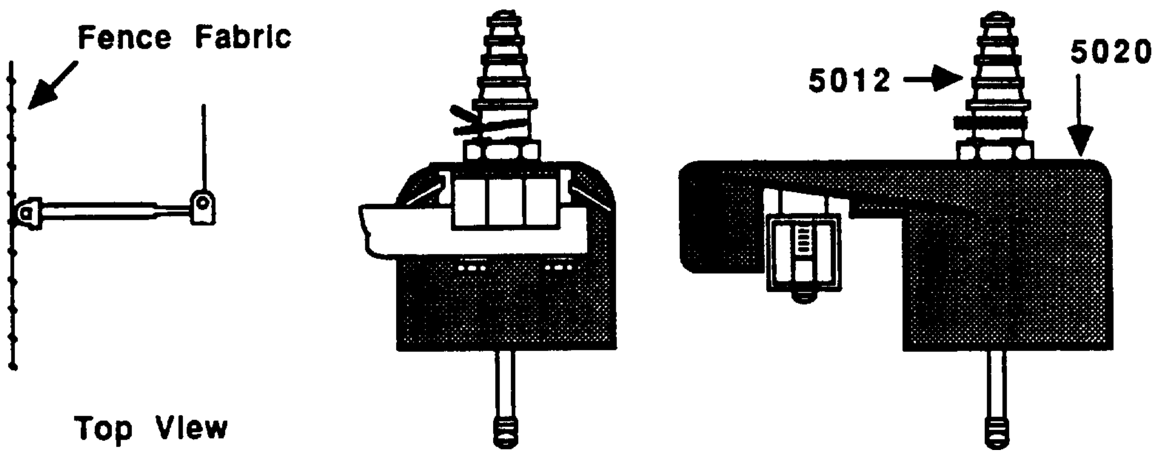


Figure 4-11. End Point

Adjacent Zone Brackets

Adjacent zones are installed using the adjacent zone bracket (kit 5016) for fence mounted hardware. The bracket mounts using 2 each 1/4 - 20 X 15/8 inch bolts to the fence weldment. The insulators mount using 4 each 1/4 - 20 X 3/4 inch bolts side by side on the bracket. The adjacent zone bracket is used with the adjacent start point/start point, adjacent end point/end point, and adjacent start point/end point hardware. Selection of which to use depends on the zone layout and if a single zone or dual zone processor is used.

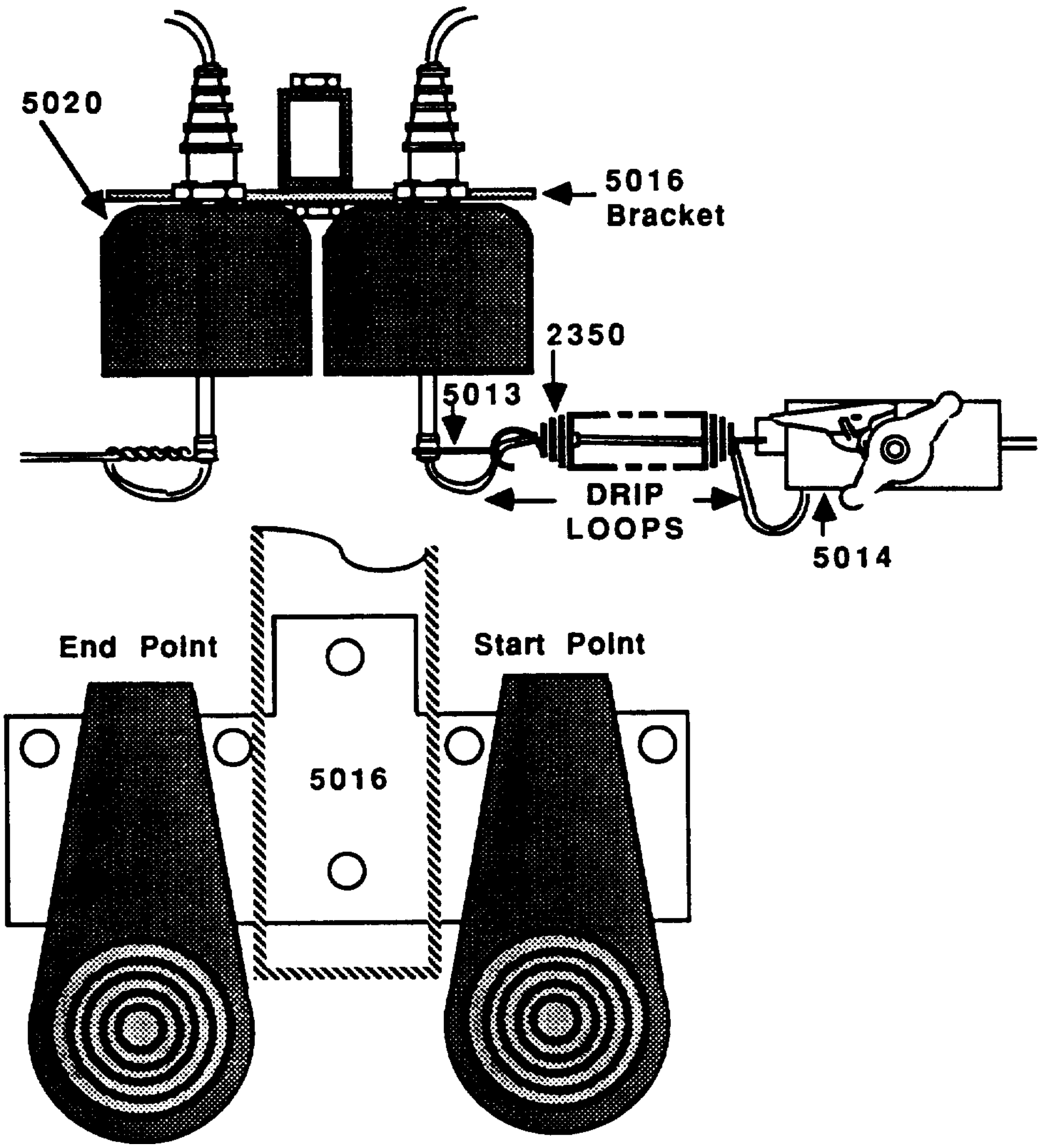


Figure 4-12. Adjacent Zone Bracket

Free-Standing Installations

Posts used for free-standing installations can be of galvanized steel, firmly set in concrete. Posts for start points, tension points, end points and corner points should be 3 inch (7.62 cm) in diameter. Posts for interim points should be 2.38 inches (6 cm) in diameter. The maximum distance between tension points on a straight fence section is 160 feet. The maximum spacing between interim support poles is 20 feet.

If fiberglass poles are used additional care must be taken to interconnect all support hardware (on each pole) to a common ground strap and ground reference within each zone.

NOTE: Many clamps are used in a normal E-Field installation. A great deal of time can be saved by using a power driver, at approximately 300 rpm, to attach the clamps.

Using a premarked measuring pole, locate the hose clamp positions. The Series 5000 hardware is designed to mount directly to the free-standing pole. Refer to Figure 4-13. Wire installation, tensioning and interconnections are the same as a fence-mounted configuration.

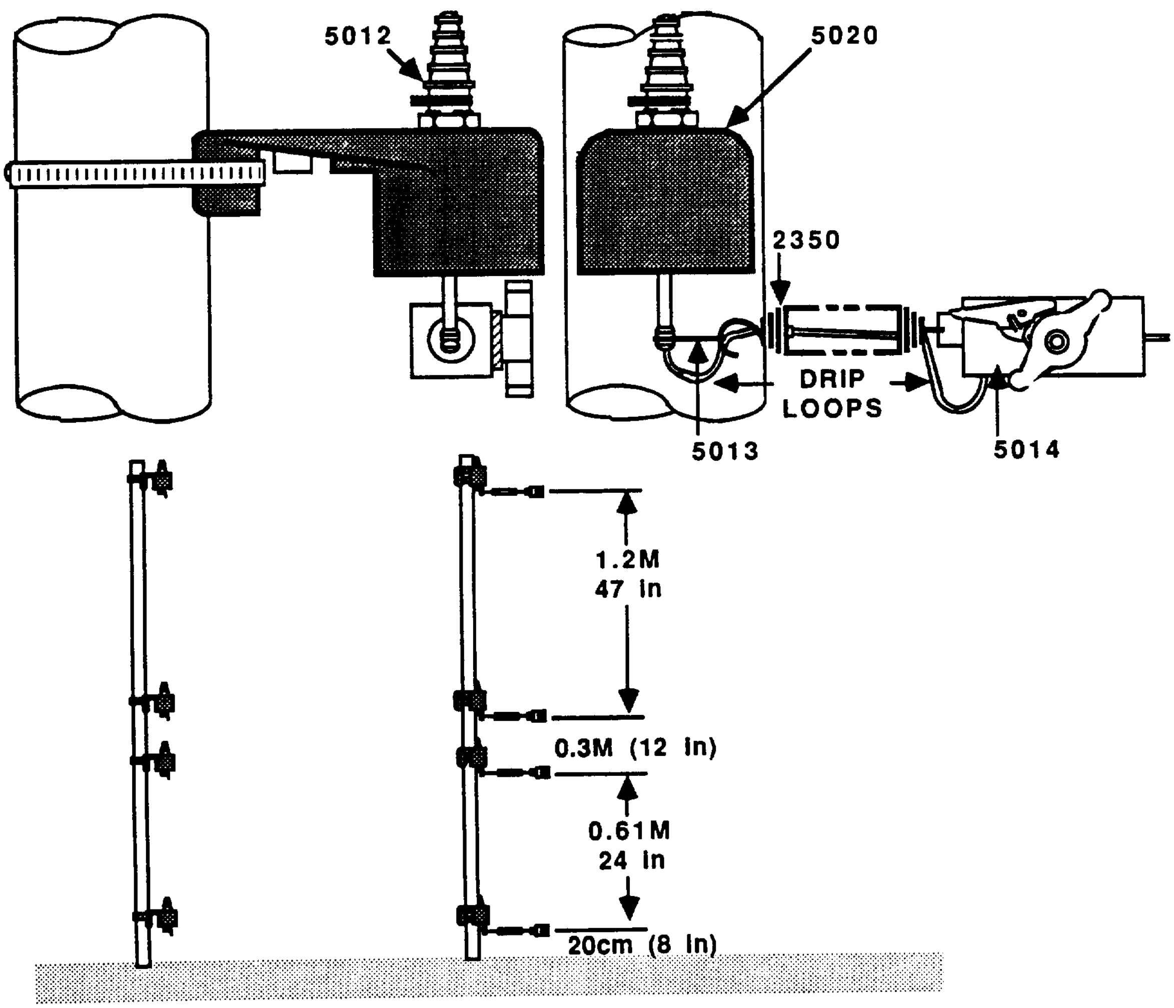


Figure 4-13. Free-Standing Installation

Start Point Hardware

Trim the narrow end of insulator boot to fit snugly over the type of coax being used. Slip the nylon clamp and boot over the coax cable. The coax should be routed from the sense filter, along the mounting bracket, with enough excess for a smooth radius to the insulator top.

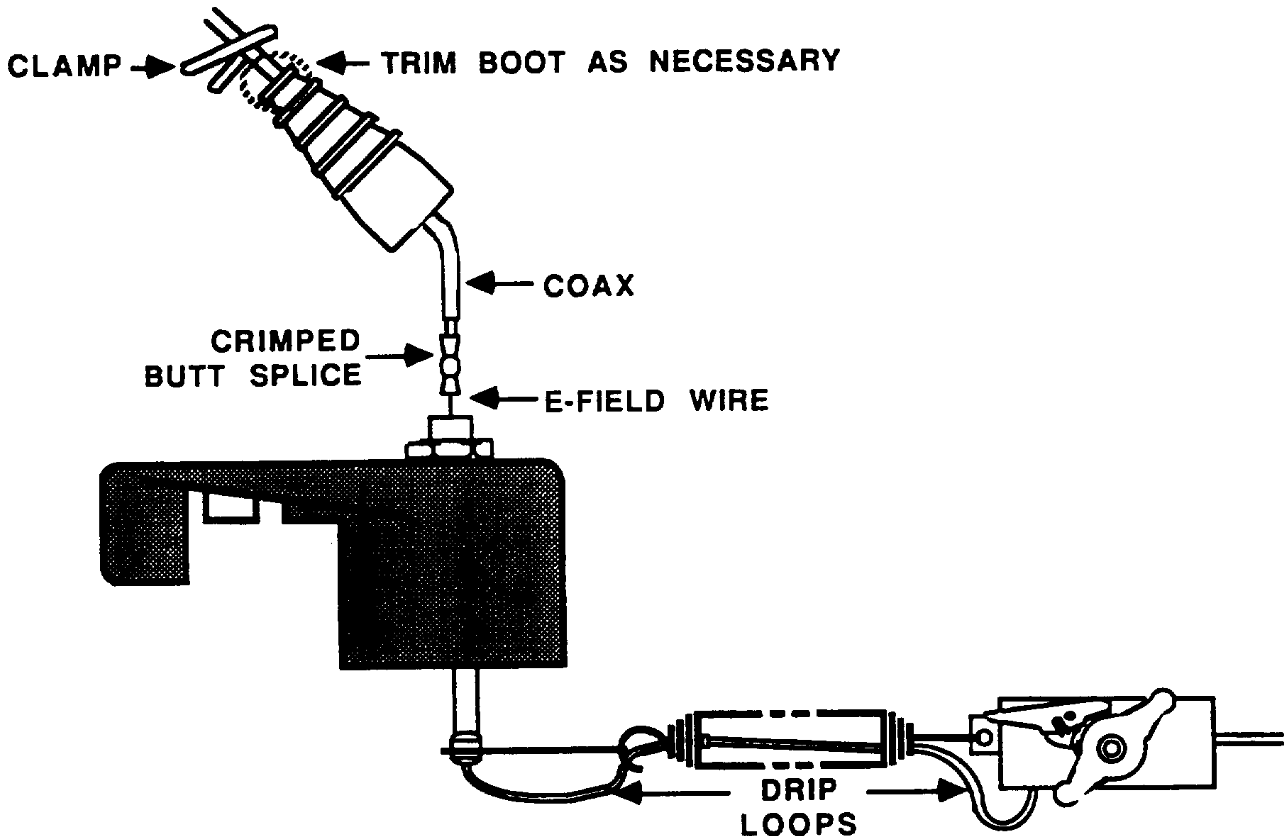


Figure 4-14. Start Point Wiring

When the length has been determined, cut the coax and trim the outer jacket approximately 1 inch (2.5 cm). Trim the coax shield even with the outer jacket edge, exposing the inner insulator. Strip the inner insulator to expose 1/4 inch (.64 cm) of the center conductor. Cut the E-Field wire 1/2 inch (1.27 cm) above the top of the insulator, and strip off 1/4 inch (.64 cm) of the Tefzel insulation. Crimp the butt splice on the coax cable and wire. Do not ground the coax shield at this end.

NOTE: The coax cable shielding must be insulated from the wire and insulator housing using black electrical tape.

Interim Point Hardware

Interim points are mounted to the fence at 20 feet (6.1 m) intervals under normal conditions (less than 20° horizontal angle change, or 30° elevation change). These can be located at 10 feet (3 m) intervals if ice buildup or high winds are a consideration. The E-Field wire, once pulled, is fit into the carrier lock of the insulator and the lock rotated 90° to capture the wire.

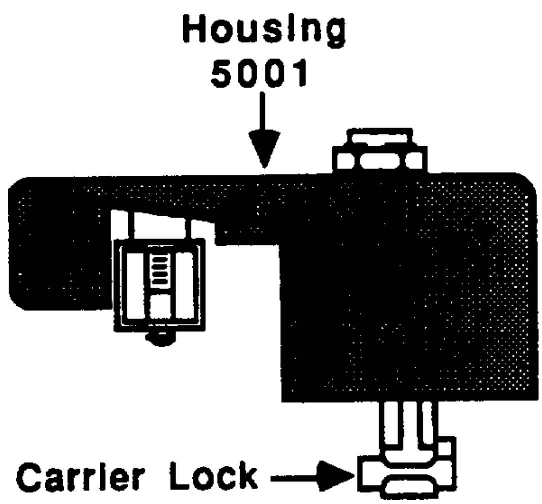


Figure 4-15. Interim Point

Tension and Corner Point Hardware

Tension and corner points are connected in the same manner as non-insulated butt splices. At these points 2 pieces of E-Field wire are fit through the center of the insert. One piece of wire is cut 1/2 inch (1.27 cm) above top of the insulator, and the other is cut about 1 1/2 inches (3.27 cm) long. The longer wire is bent 180° so it will align with the shorter wire. Both wires are stripped 1/4 inch (. 64 cm) and joined with the butt splice.

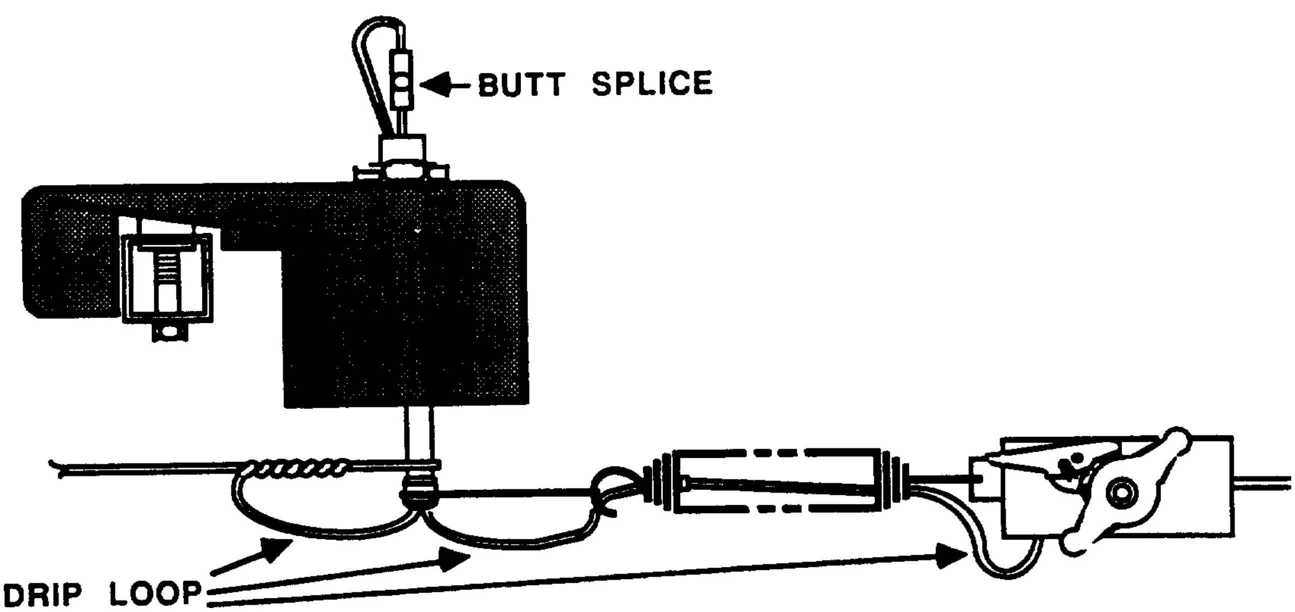


Figure 4-16. Tension/Corner Point Connection

End Point Hardware

When the terminators are mounted to the fence support pole, route the coax along the mounting bracket (with a smooth radius) to the top of the insulator. Cut off any excess (this should be minimal). Slide the boot and clamp on the coax. Make the coax-to-E-Field wire splice as directed for start points.

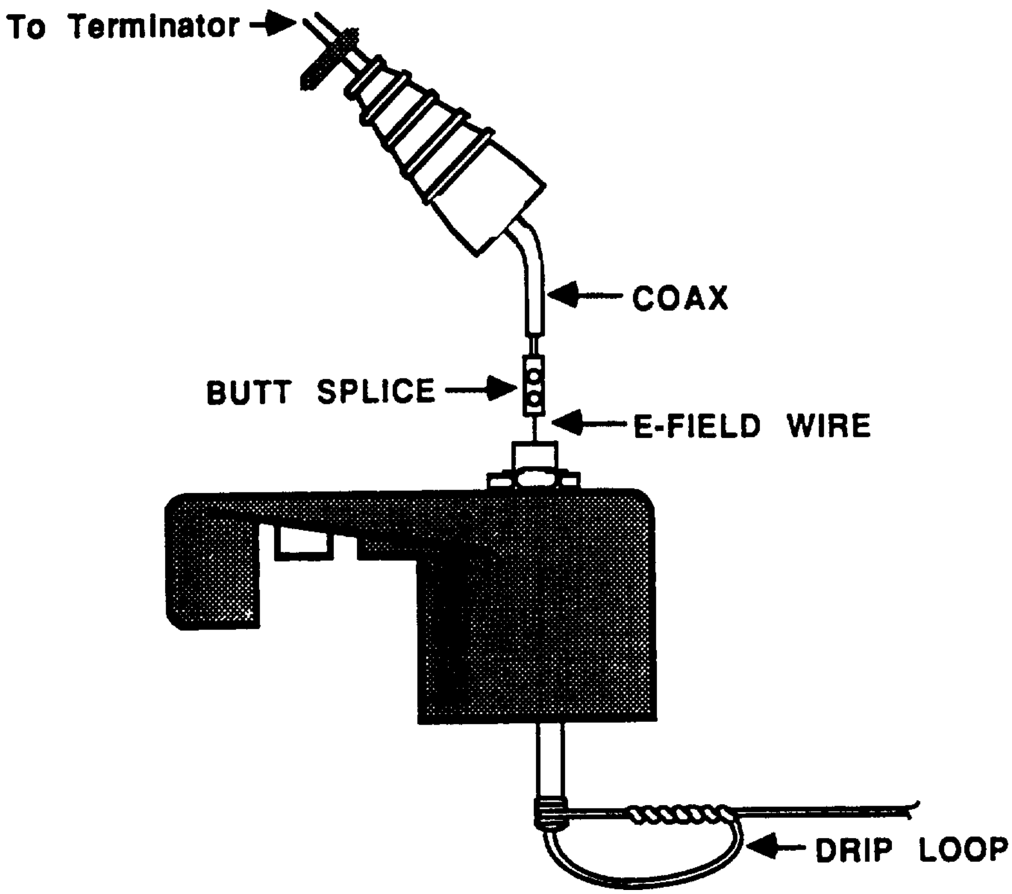


Figure 4-17. Wire/Terminator Connection

Adjacent Zone Brackets

Adjacent zones are installed using the adjacent zone bracket (kit 5015) for free-standing hardware. Depending on the size of the pole, the bracket mounts using a 3 inch or 4 inch hose clamp. The insulators mount to the bracket using 4 each 1/4 - 20 X 3/4 inch bolts side by side.

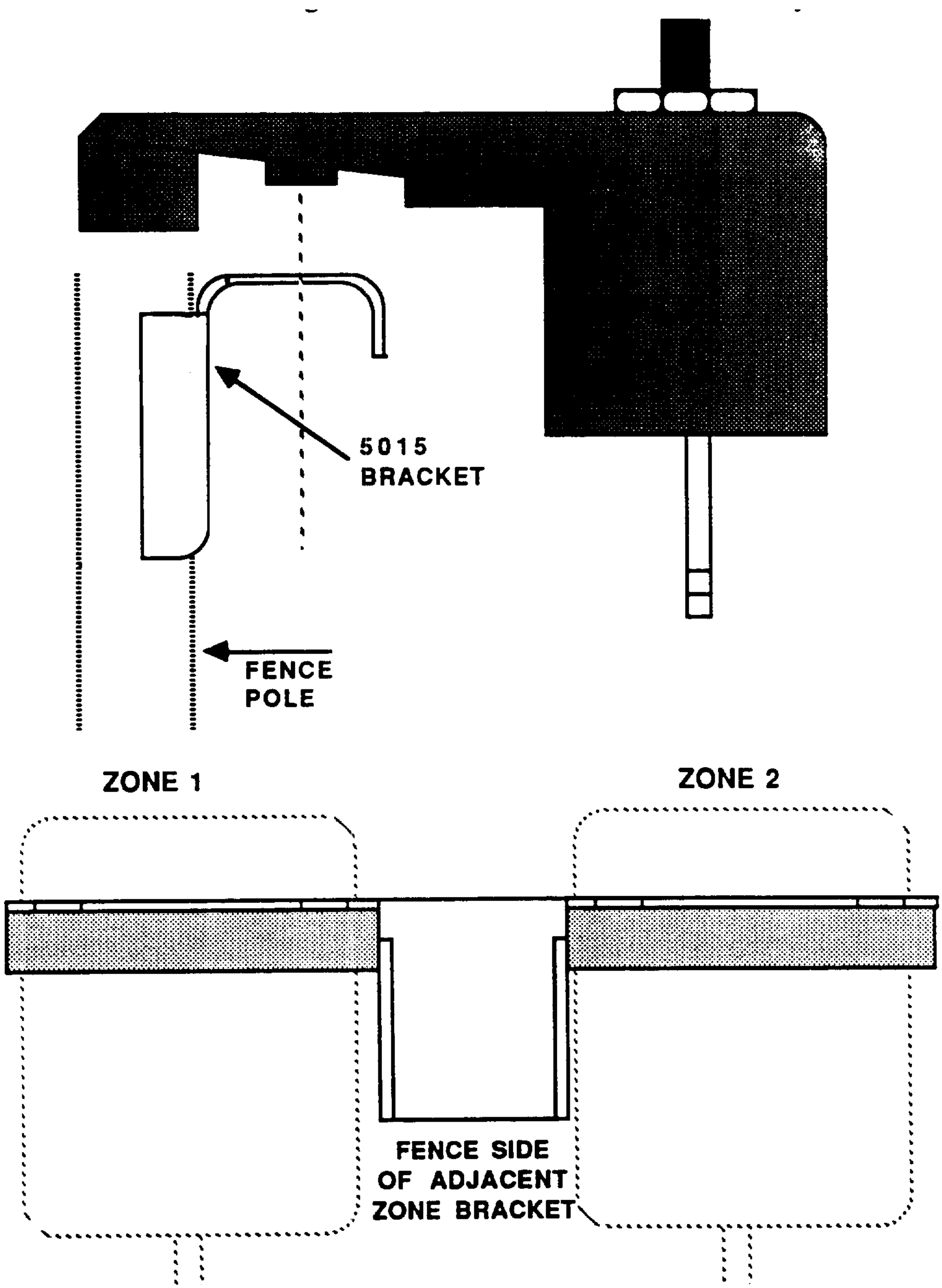


Figure 4-18. Adjacent Zone Bracket

Roof Mounted Installations
Though design considerations vary, roof-mounted hardware is installed the same as free-standing hardware. Where necessary, ground reference planes must be placed in accordance with the criteria specified in Section 3.

Interconnections and Terminal Boot Kits
E-Field wire interconnections are made with non-insulated butt splices. Use a proper crimp tool to ensure that a good mechanical splice is made.

Terminal Boots
After all butt splices between the coax cables and E-Field wires are connected, test each field and sense wire for continuity or, if possible, power up the zone with the processor. If any connections are loose or faulty, repair them first. When all zone connections are satisfactory, cover them with non-corrosive RTV. Half fill the terminal boot with RTV and slide the boot over the top of the insulator until it touches the lock nut. Position the nylon clamp over the boot 1/2 inch (1.27cm) from the locknut and squeeze it closed. Wipe off any excess RTV. Refer to Figure 4-19. Terminal boots are also used at tension points to protect splices.

NOTE: Dow/Corning 738 or 3145 RTV (Room Temperature Vulcanization) Silicone Rubber Compound, or equivalent non-corrosive sealant.

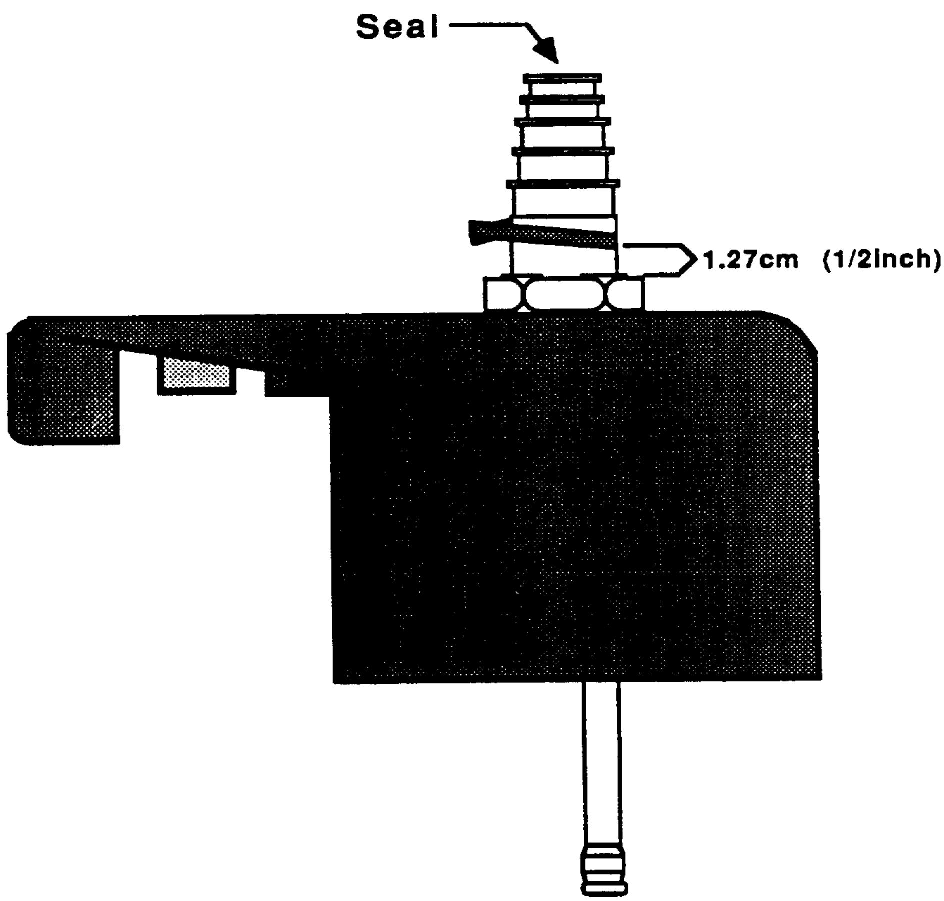


Figure 4-19. Terminal Boot or Tension Insulator

Wall Mounted Installation

This configuration installation requires start, tension corner and end point hardware. The interim support hardware should be installed at a maximum spacing of 20 ft (6.1 m). Wire installation, tensioning and interconnections are the same as fence mounted configurations. Please contact Stellar Systems when this configuration is being planned.

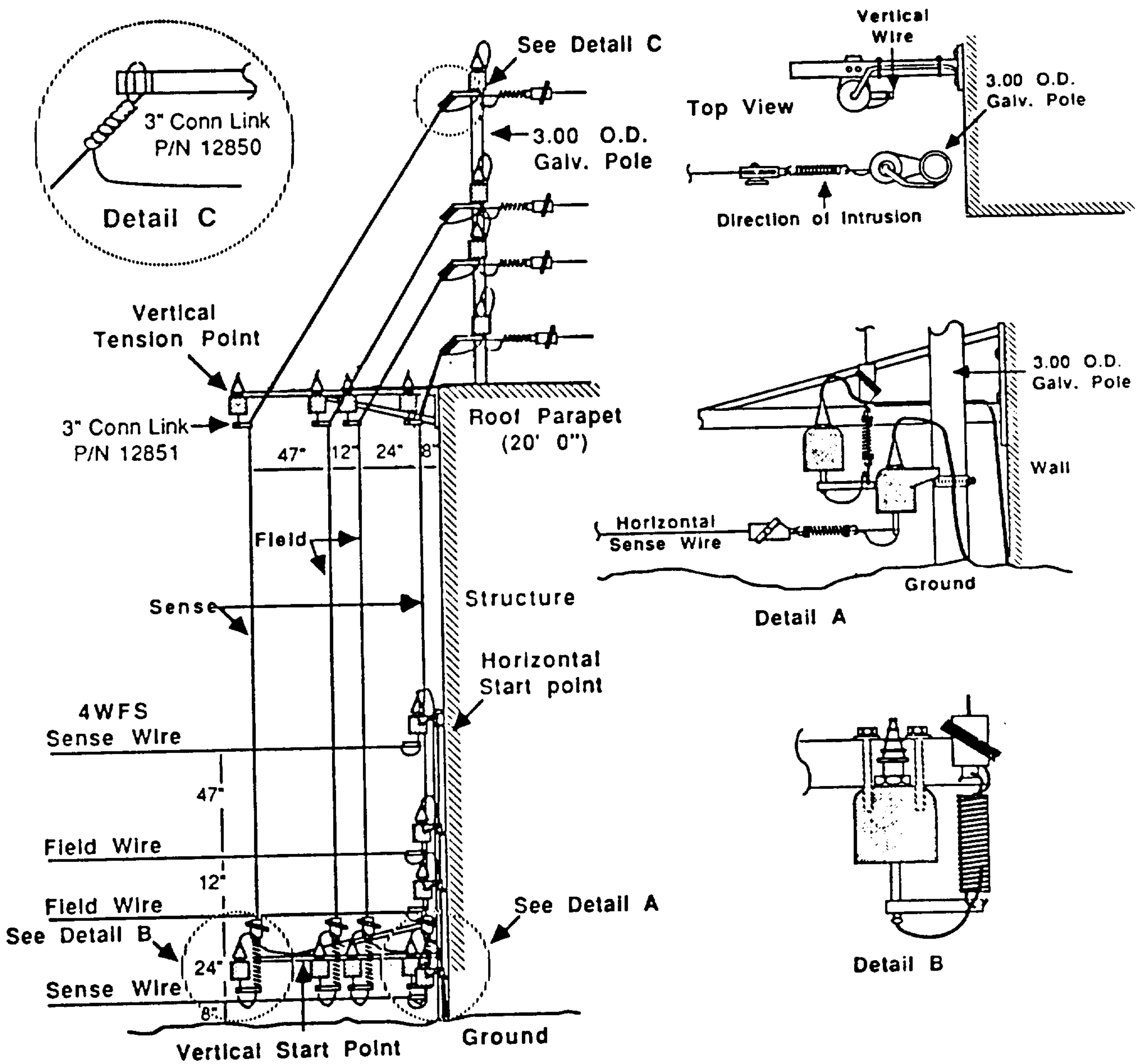


Figure 4-20. Wall Mounted Installation

Gate Protection and Bypass Details

High Traffic Driveways

The Microwave Model 300B is recommended for protection of gate areas in high-traffic driveways. This type of gate protection allows vehicles to come and go without turning off the E-Field perimeter or disconnecting any E-Field wires. Positioning the E-Field in front of the microwave (to provide an overlap) will eliminate the possibility of an intruder being able to crawl under the E-Field at the microwave units points. To continue the E-Field wires across the driveway, field and sense wires are rerouted in a separate shielded cable assembly.

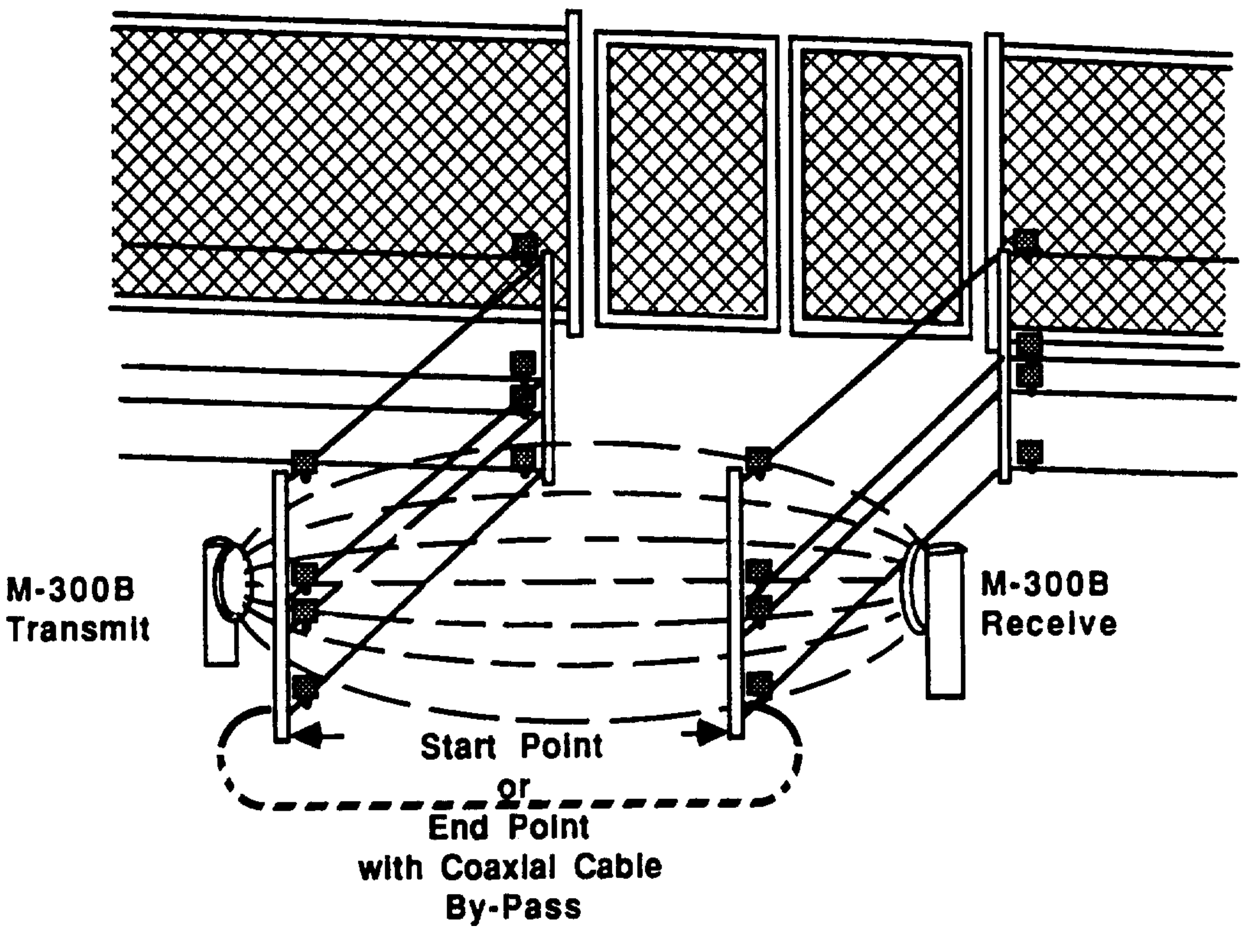


Figure 4-21. Microwave Gate Coverage

Bypass Instructions

When bypassing a personnel gate, building or other area where no detection is required, the field and sense wires must be continued in buried coaxial cable. The shields of the coaxial cable are tied to a common earth ground at one end only. All jumpers and connections must be made with crimped butt splices.

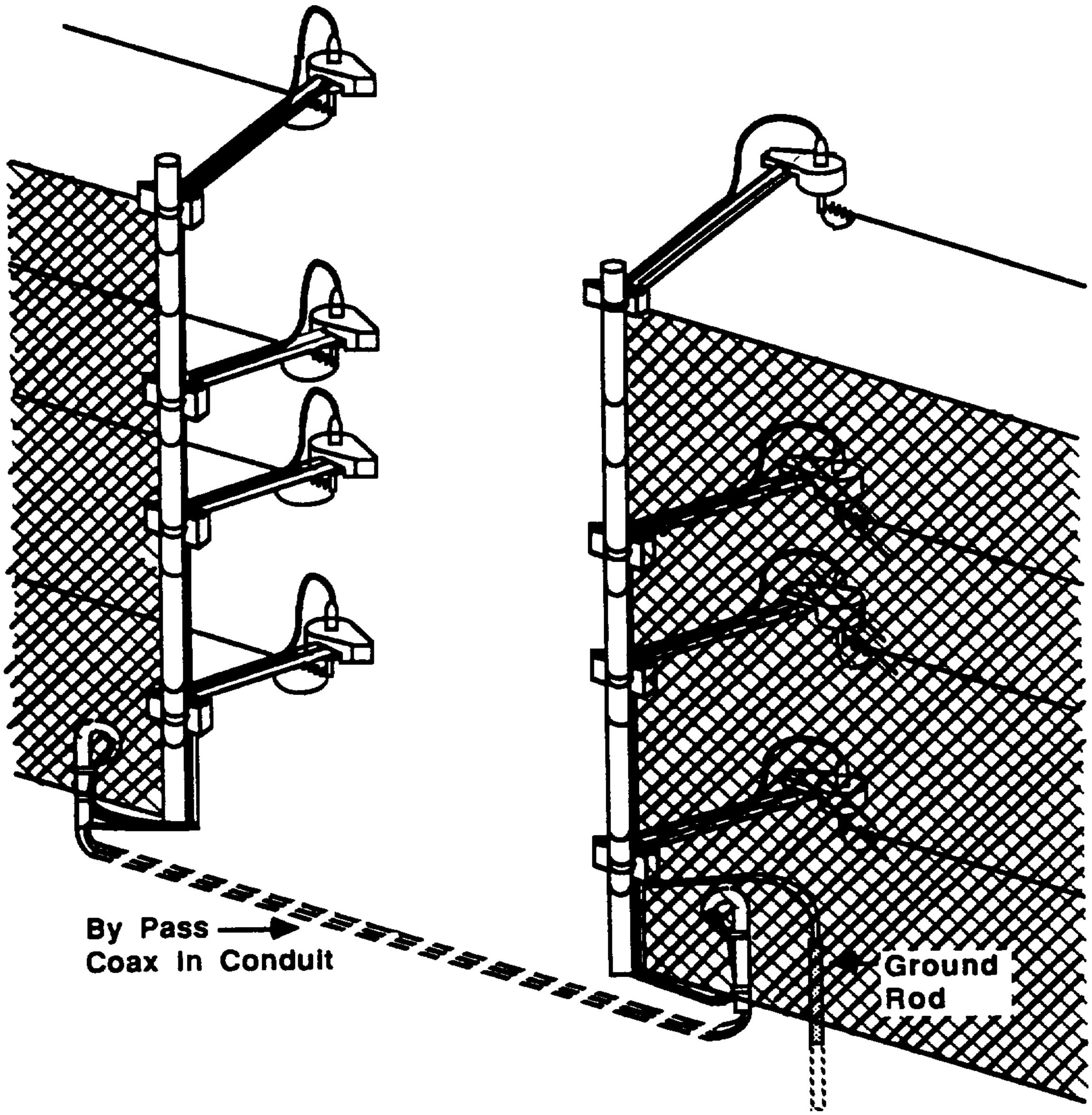


Figure 4-22. Bypass Detail, View 1

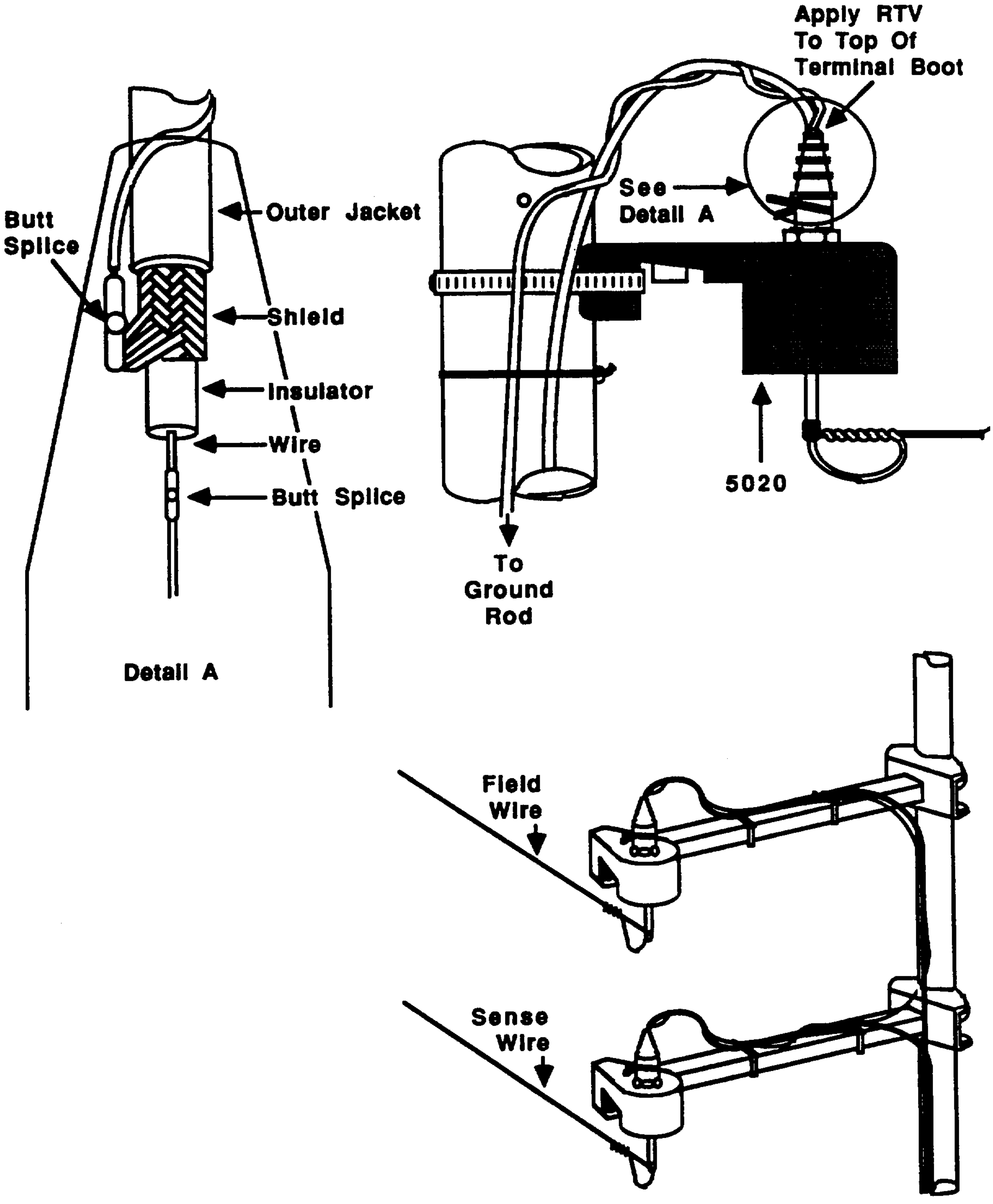


Figure 4-23. Bypass Detail, View 2

Wire Installation and Tensioning

E-Field wire is made of 0.040 inch (1 mm) stainless steel with and without a Tefzel coating. The wire is tensioned to approximately 50 lbs. so the resonant frequency (15 Hz) is outside the band pass of the E-Field processor's amplifier. Wires loose enough to move in the wind may cause nuisance alarms.

At the end point of a zone, place wire in the upper groove of insert, loop around insert, wrap wire around itself 8 times in close coils, and feed the end through the center of the insert. Leave enough excess for a butt splice to the terminator coax cable.

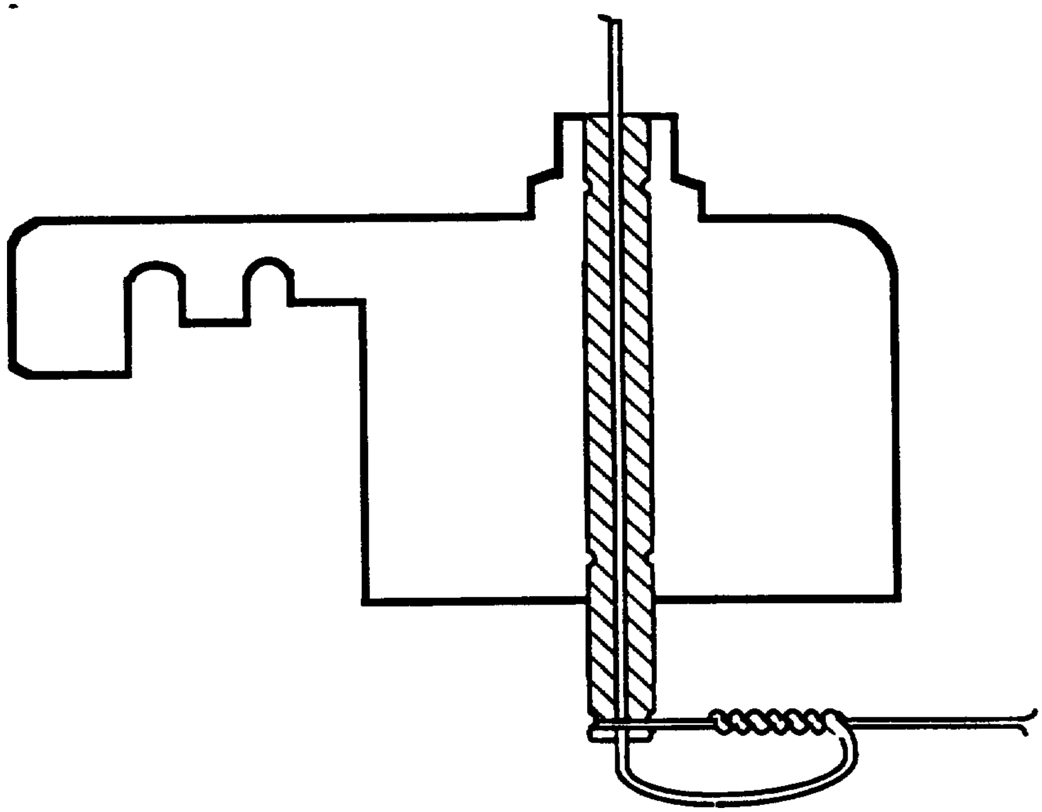


Figure 4-24. End point Wire Installation

Tension is applied using a connecting link spring and winder installed at a start or tension point, depending on zone configuration. The wire is pulled to 50 lbs.(23 Kg) tension resulting in a spring length of 8.5 inches (22 cm) hook-to-hook when measured. Refer to Figure 4-25.

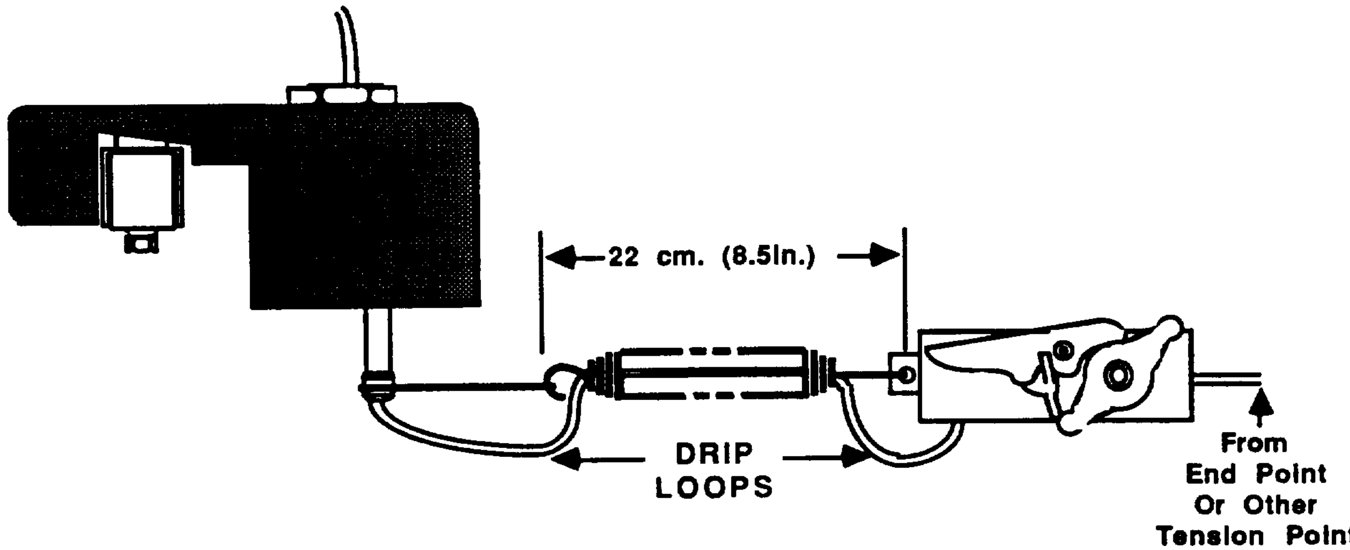


Figure 4-25. Wire Tensioning - Start or Tension Point

1. Pull wire from the end point to the next tensioning point in the zone.

2. Cut wire about 3 feet (1 m) longer than needed to reach the insulator.

3. Feed the wire through the end of the winder, down through the chamfered hole in the winder capstan, loop it once around the capstan and draw through the extra wire.

4. Turn the winder to tension the wire until the spring is 8.5 inches (22 cm) hook to hook. Unwind the wire until 1 1/2 turns remains.

5. Feed the loose end through the spring, leaving 3 inch max. (7.5 cm) radius relief loops at each end of the spring.

6. The remaining wire is then fed through the center of the insert for interconnection.

7. After the wire is tensioned, place the wire in the interim insulators and rotate the carrier lock 90°. Recheck tension at springs.

Coaxial Cable

Coaxial cable used with E-Field must be RG 59 or equivalent. The ungrounded end of the shield should be trimmed so it will not interfere with any interconnections. All coax shields must be grounded at *one end only.*

Sense Filter Installation

The sense filter (8333) is pre-installed in the MC-20 enclosure.

Table 4-1. E-Field Coverage

System Type	Minimum distance from fence	Maximum span length per zone
3-wire fence mounted or Roof mounted	0.5 m (20")	Up to 150 m (500')
4-wire fence mounted	0.5 m (20")	150 m (500')
4-wire free standing	1.2 m (4')	150 m (500')
6-wire free standing	1.2 m (4')	150 m (500')

Terminator Installation

Terminators (2 per zone) are mounted on the end point and are wired between the field and sense wires. Hose clamps secure the top of the housing to the end point support pole.

Drain **Coils**

The optional drain coil assembly (model 3131) contains three individual drain coils. Drain coils are installed on the start point post of each zone when needed. In single zone systems, 1 coil is connected between each sense wire and field wire to a good earth ground. Dual zone installations require two drain coil assemblies mounted at the start point post, one for each zone.

For single zone installations and zone 1 of dual zone installations, connect the drain coils as illustrated in Figure 4-26.

For dual zone installations, connect the second drain coil assembly (for zone 2) just as the first drain coil assembly was connected for zone 1. Do not make the connection between terminals 1 and 2 on the drain coil assembly, and terminals 12 and 14 on the control board. The field generator is common to both zones, so only ground through a drain coil once.

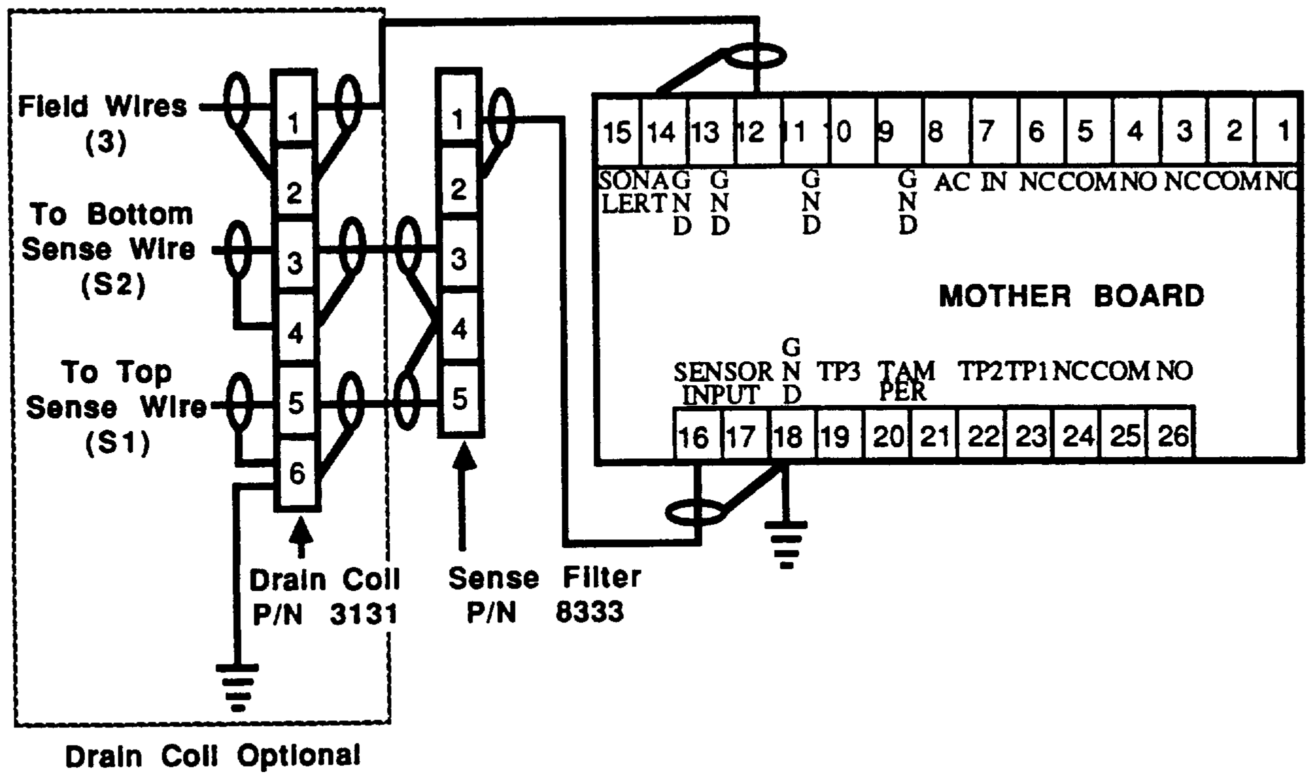


Figure 4-26. Wiring Diagram, Drain Coil Assembly

Processor Mounting

Processor and Sense Fitler Location

The E-Field processor should be mounted at the start of its zone(s) for ease of calibration and maintenance, and to avoid long coaxial cable runs. However, in special circumstances, it may be located in a building or other shelter as far as 340 feet (104 m) away, depending on the type of coaxial cable chosen. Refer to Table 4-2. The processor enclosure is weatherproof and designed for installation outdoors.

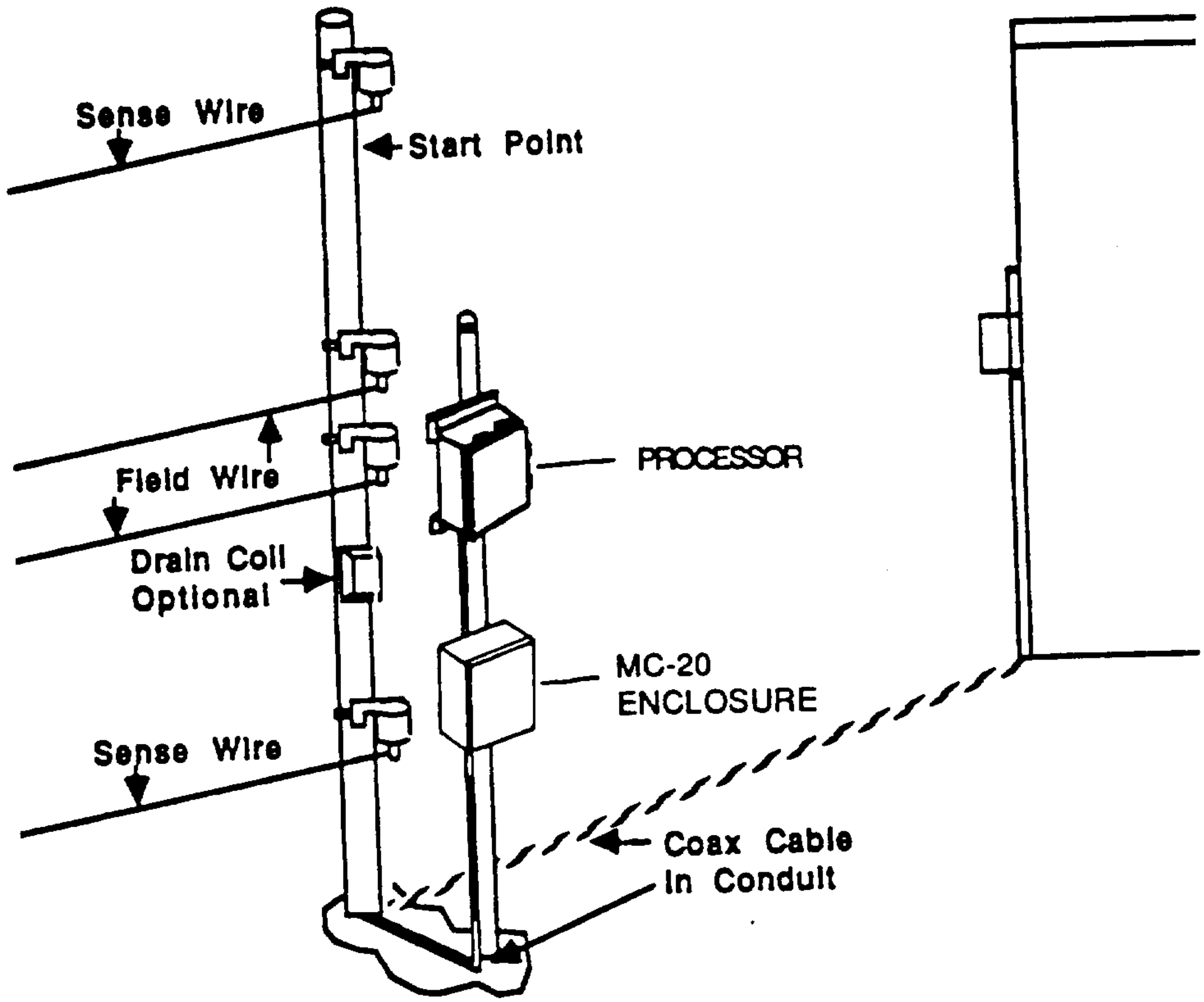


Figure 4-27. Processor Location

The limiting factor associated with the processor location is the capacitance per foot of the feed cable connection from the processor to the start of the tensioned E-Field wire. Total capacitance of the cable run must not be more than 4700 pF (Table 4-2). Very high total capacitance may complicate the alignment procedure. For dual zone controllers, combined feed cable length for both zones (that connect the processor to the tensioned E-Field wire) must not exceed the specified capacitance. If additional cable length is essential, 4700 pF of capacitance can be subtracted from the processor circuitry by removing jumper Jl on the mother board.

Table 4-2. Coaxial Cable Capacitance

LEAD-IN COAX CABLE	CAPACITANCE PER FOOT (pF)	MAXIMUM LENGTH METERS (FEET)
RG-174/U	30.0	46 (150)
RG-58 AX	30.0	46 (150)
RG-59	21.0	67 (220)
Belden 9221	17.4	82 (270)
Belden 9259	17.3	82 (270)
Belden 9233	16.3	85 (280)
RG-62 A/U	13.5	104 (340)

Processor Enclosure Mounting

The processor has holes for .25 inch (6.4 mm) fasteners on its upper and lower flanges. It may be mounted to a pipe using U-bolts, unistrut channels or similar mountings, or to a wall.

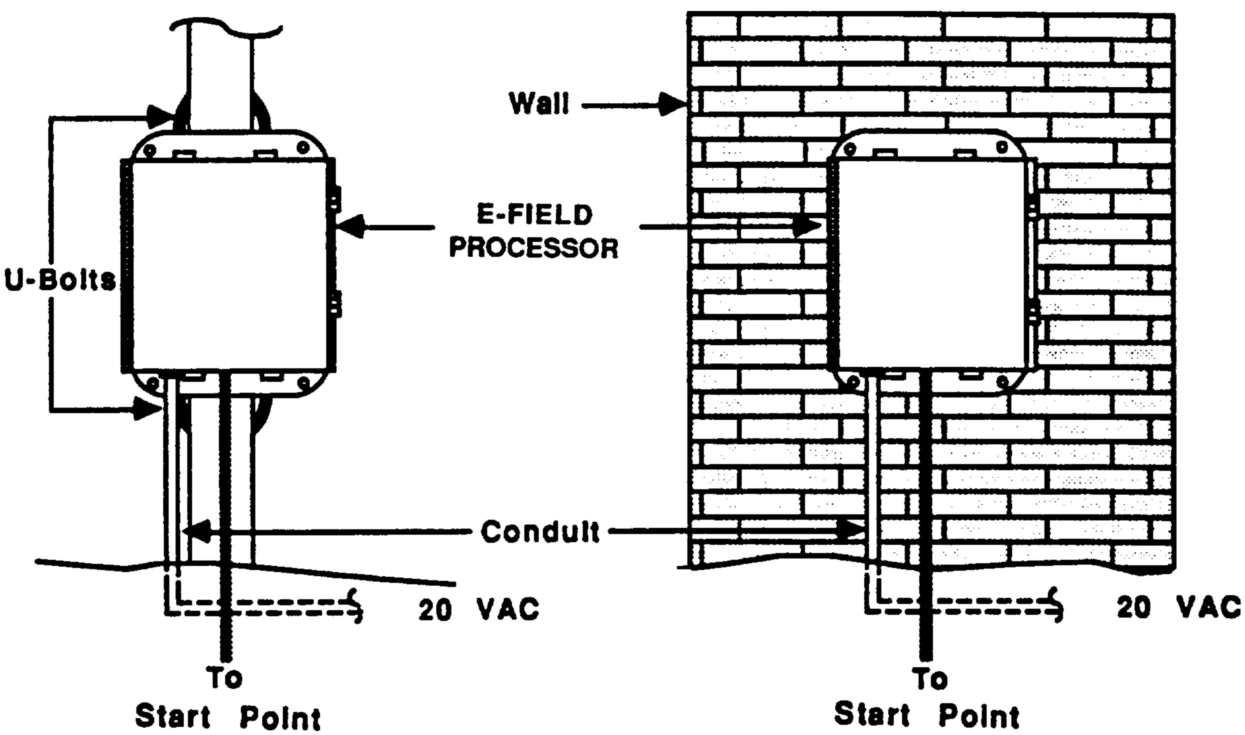


Figure 4-28. Processor Mounting, Version 1

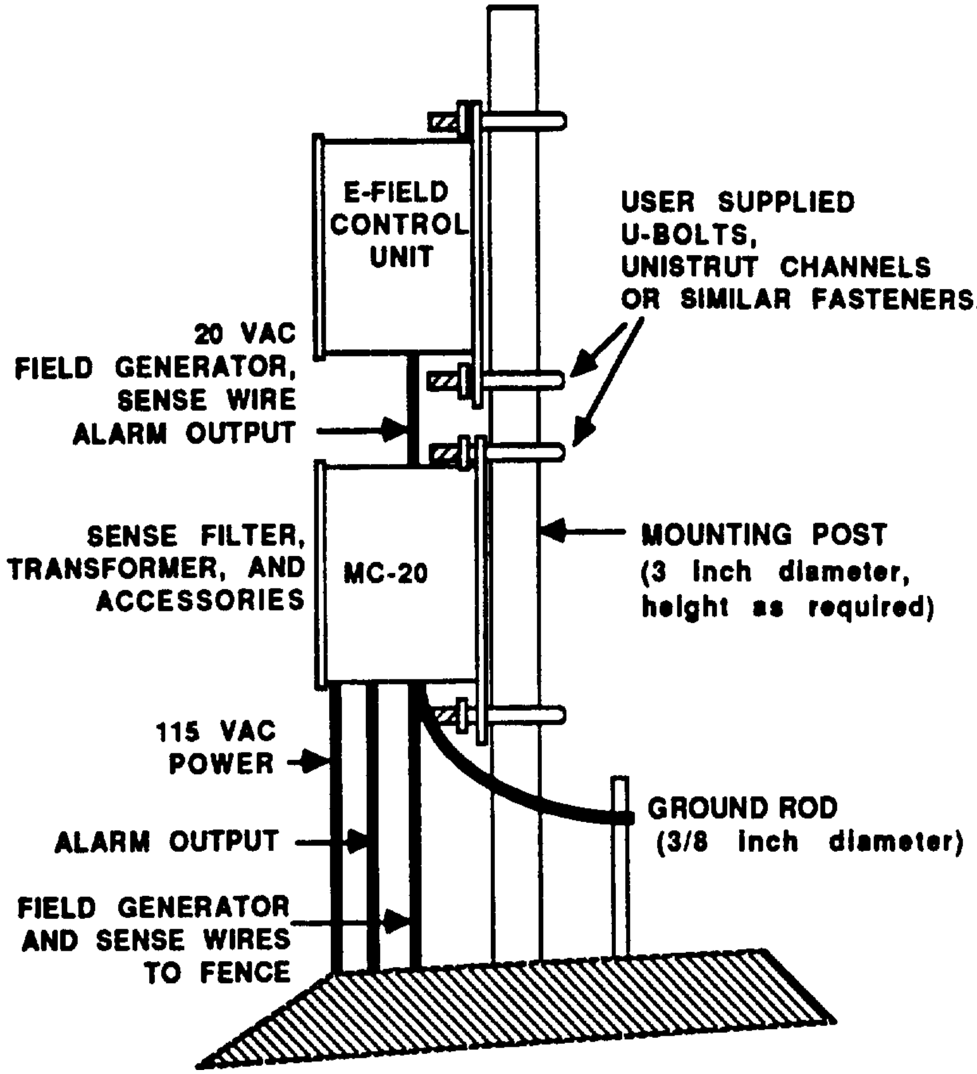


Figure 4-29. Processor Mounting, Version 2

The sense filter may be mounted on the start point post, with a single coax cable routed to the processor in the same conduit as the field generator coax cable. Alternatively, the sense filter can be mounted near the processor, then the two sense coax cables must be clearly marked "upper" and "lower" and may be run in the same conduit as the field coax cable.

Junction Box (MC-20) Mounting

The junction box (MC-20) contains a backup battery, AC stepdown transformer, and dual-screw terminal strips for the system interconnect wiring. Refer to Figure 4-30. The junction box is mounted as illustrated in Figure 4-29. The junction box has holes for .25 inch hole (6.4 mm) fasteners on the upper and lower flanges. It may be mounted to a pipe using U-bolts, unistrut channels or similar mountings. U-bolts and unistrut channels are user supplied.

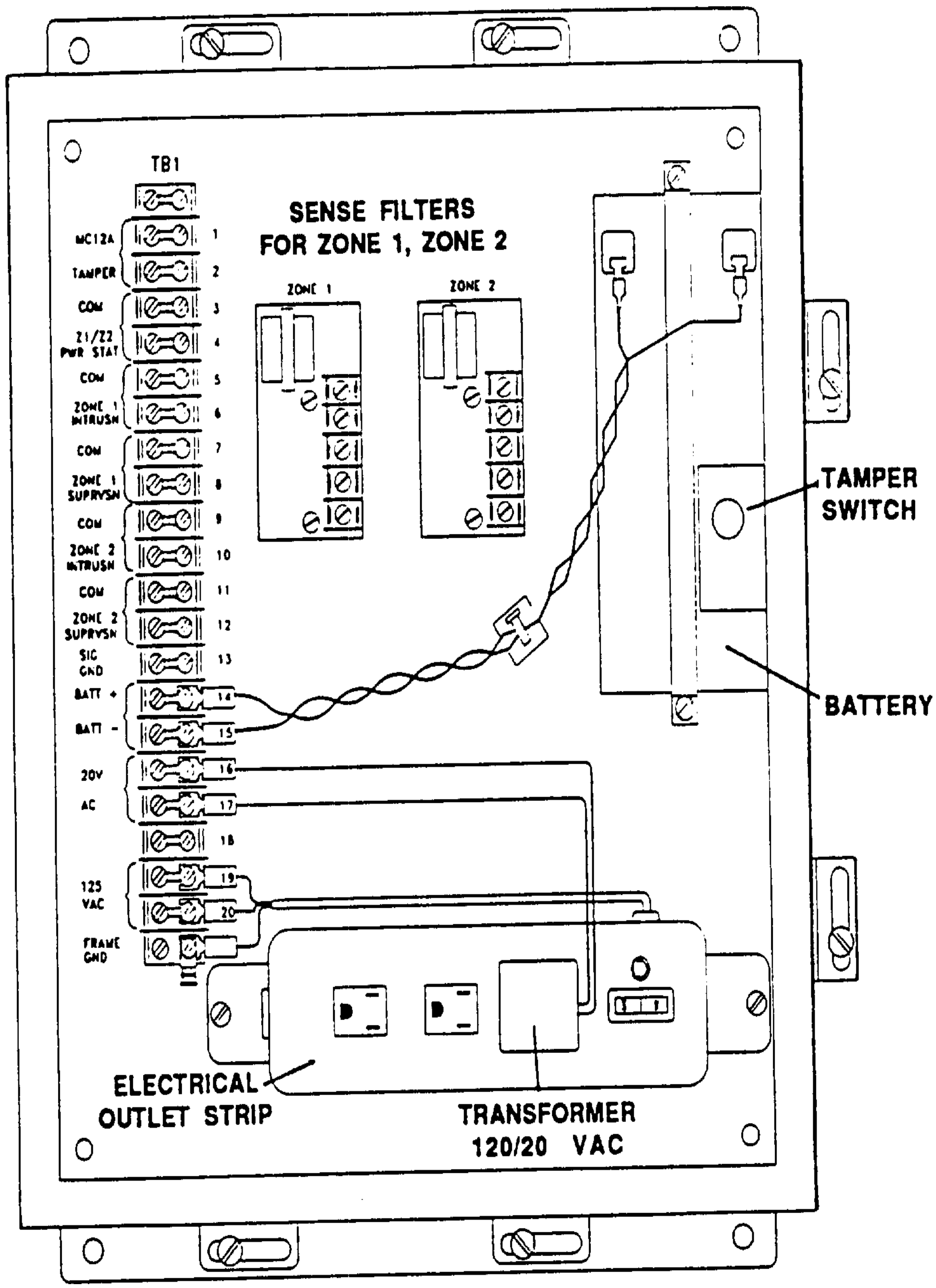


Figure 4-30. MC-20 Internal Layout

System Grounding

General

An E-Field system will not operate as specified unless it is properly grounded and a uniform ground reference is maintained throughout each zone. An improper electrical connection, or common ground, can cause fluctuating currents that will result in a nuisance alarm. Electrical grounding of a system means connecting the components of the system to a common metal object firmly set in earth. A wire (12 AWG min.) should be routed from the terminators to a ground rod. Terminal 18 of the processor must be grounded at a ground rod in close proximity to the processor location.

If fiberglass poles are used, care must be taken to connect all E-Field support hardware to a common ground strap and a ground reference within each zone.

Nearby metal objects must also be grounded. Metal fences, which are normally at ground potential because of the way their posts are set, may have to be connected to the common system ground. Swinging gates are a potential source of intermittent connections. Where necessary, a ground wire connecting the gate posts should be buried across the gate opening. The swinging gate should then be electrically connected to the posts with a grounding strap, then to the common system ground.

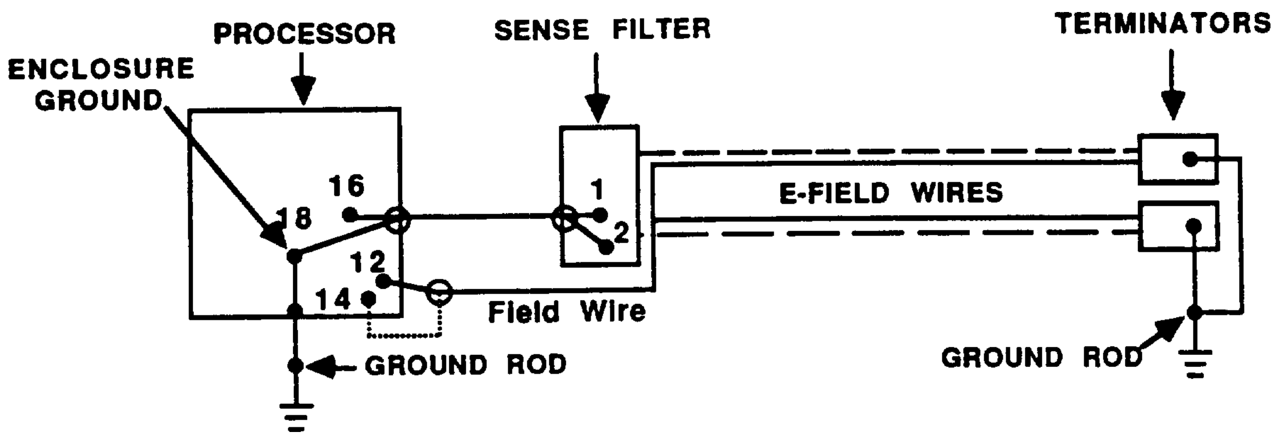


Figure 4-31. System Grounding Schematic

Terminator Grounding

On both the roof mount and ground mount systems it is recommended that a ground wire be run from the terminators to earth ground.

Electrical Connections

System Installation Procedures
The Series 800 E-Field processor front panel assemblies are shipped separate from the E-Field mounting enclosure. The front panel assembly must be installed on the enclosure before making electrical connections for power and alarm monitoring. Refer to the following assembly procedure for E-Field processor.

NOTE: Do not attempt to assemble equipment before thoroughly reviewing the contents of this entire section. Exercise care in the assembly and handling of equipment during installation.

Before applying power to the processor, verify that electrical connections are correct. Refer to wiring diagram illustrations in this section.

NOTE: The field generator crystal is shipped separately, and must be installed in the ILM module prior to operation.

Front Panel Assembly Procedure
Remove the NEMA-4 enclosure and the front panel from their respective shipping containers. The enclosure should be mounted in the intended location before installing the front panel assembly.

Install the front panel assembly after the enclosure is mounted. This will prevent damage to the front panel during the initial phases of installation. Refer to Figure 4-32, and install the front panel as follows:

1. Align the hinge assembly screw holes with the pre-threaded holes located on the mounting flange.

2. Install the 6-32 x 1/4 inch screws with washers (contained inside the enclosure in a plastic bag) through the hinge assembly holes and loosely secure the hinge plate to the mounting flange. Do not tighten the screws because an alignment of the front panel assembly must be performed to assure that the front panel thumb screws are aligned correctly.

3. Support the front panel assembly as it is slowly closed. Make certain that the thumb screws are aligned with the threaded inserts of the enclosure.

4. Slowly swing the front panel assembly out of the enclosure and tighten the 6-32 x 1/4 inch screws (if the thumb screws are aligned properly). It may be necessary to repeat this step until the alignment of the front panel assembly is correct.

5. Mount the supplied self-adhesive pad on the inside of the enclosure door to ensure activation of the tamper switch.

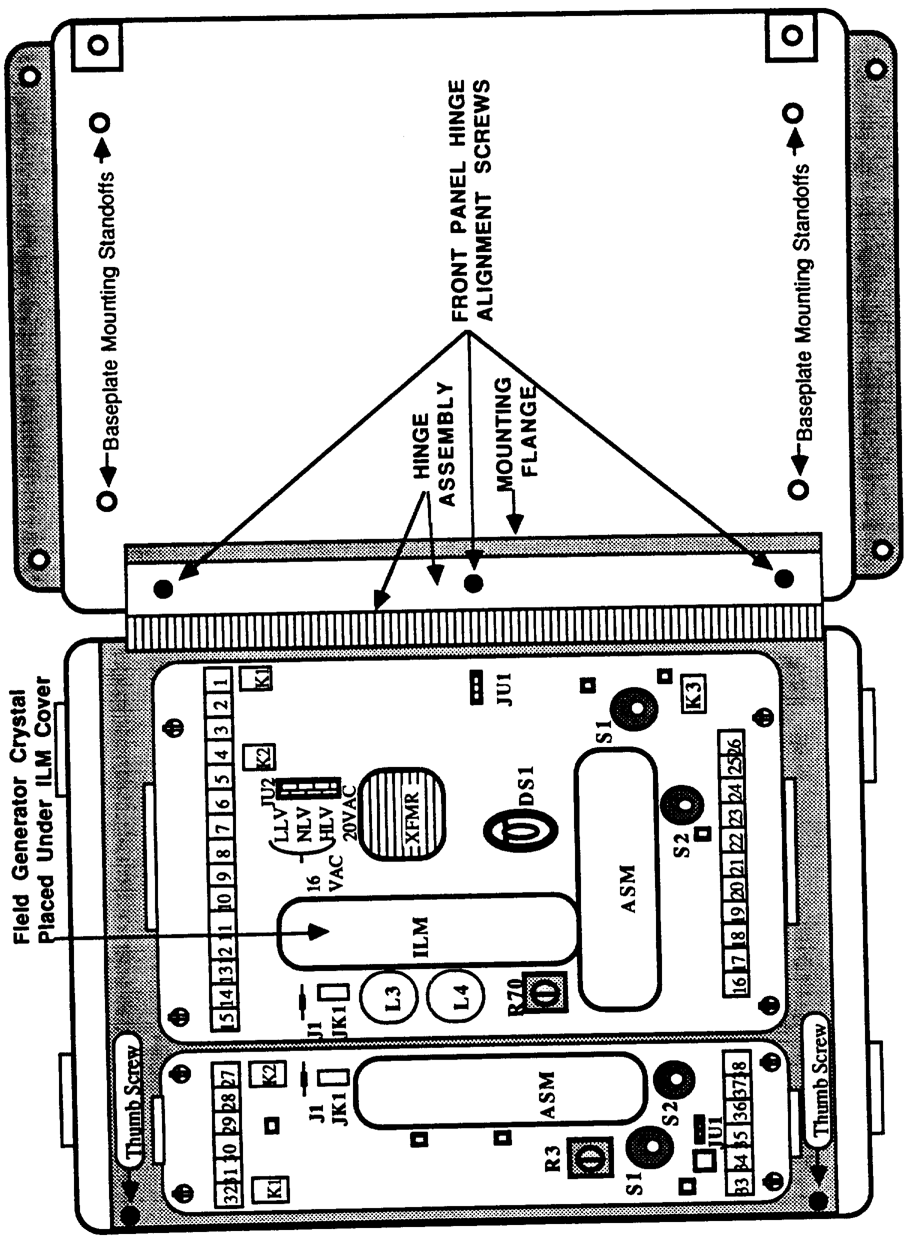


Figure 4-32. Front Panel Assembly, Installation and Alignment

Primary Power Considerations

The Series 800 processors are powered by either an AC or DC power source. Power is supplied through a 6 pin Molex cable assembly (J1) which must be attached to the P1 input connector on the side of the front panel assembly next to the hinge. See Figure 4-33 for location of connector Pl. Front panel power is supplied to processor through connector P1.

The processors are powered by 20 volt AC, the power interconnect cable (00767) must be connected as shown in Figure 4-34. Please note that provision is made for battery connections as well. Modify J1 wire lengths as needed.

The processor must be kept shielded from the AC line source. The 20 VAC transformer will be installed in an enclosure separate from the processor. Use the Stellar Systems junction box (model MC-20). Do not operate more than one processor per transformer. If more than one processor is connected and the transformer fails, or a processor fails and overloads the transformer, more than one zone will be out of operation. The junction box contains a 110 VAC power supply and an eight-hour standby battery as standard equipment.

Once the final connections are complete, make certain the appropriate adjustment is made to the JU2 select jumper, located immediately below the transformer mounted on the Zone 1 mother board. Refer to Figure 4-35. The voltage supplied to the processor is 20 VAC, install the JU2 jumper in the 20 VAC position.

NOTE: No wiring should be connected to motherboard terminals 7 and 8 or TB2. These terminals are used only when a processor is installed without a front panel assembly.

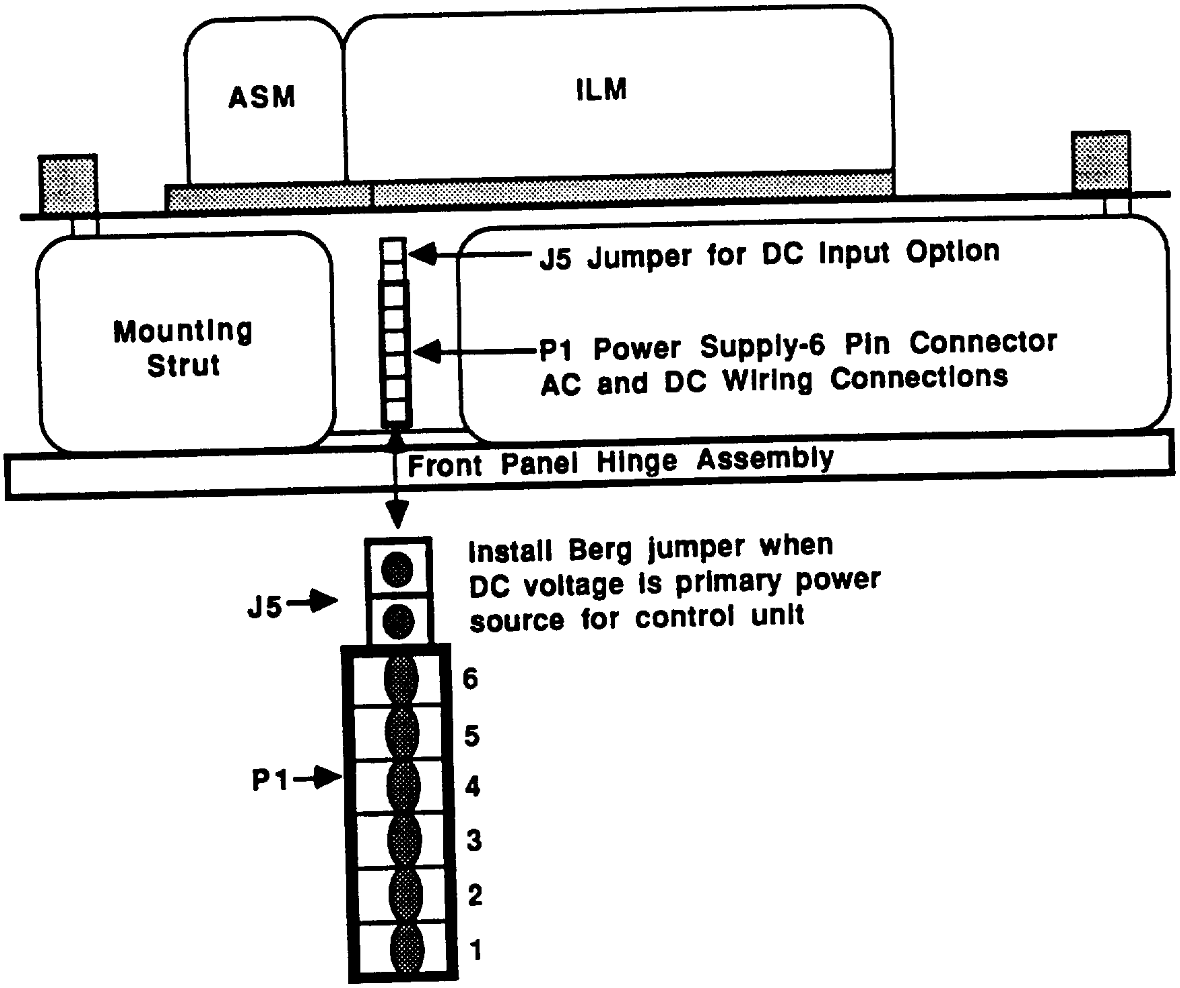


Figure 4-33. Power Connector

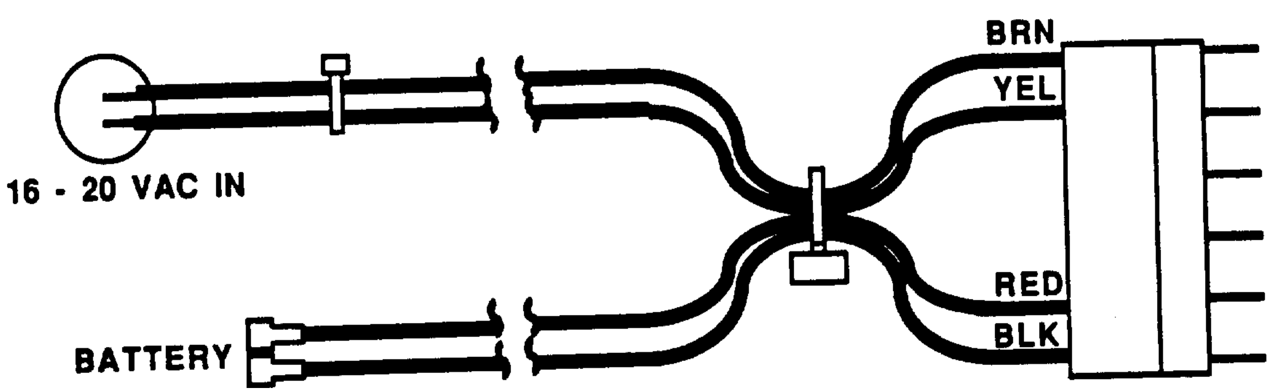


Figure 4-34. Power Cable

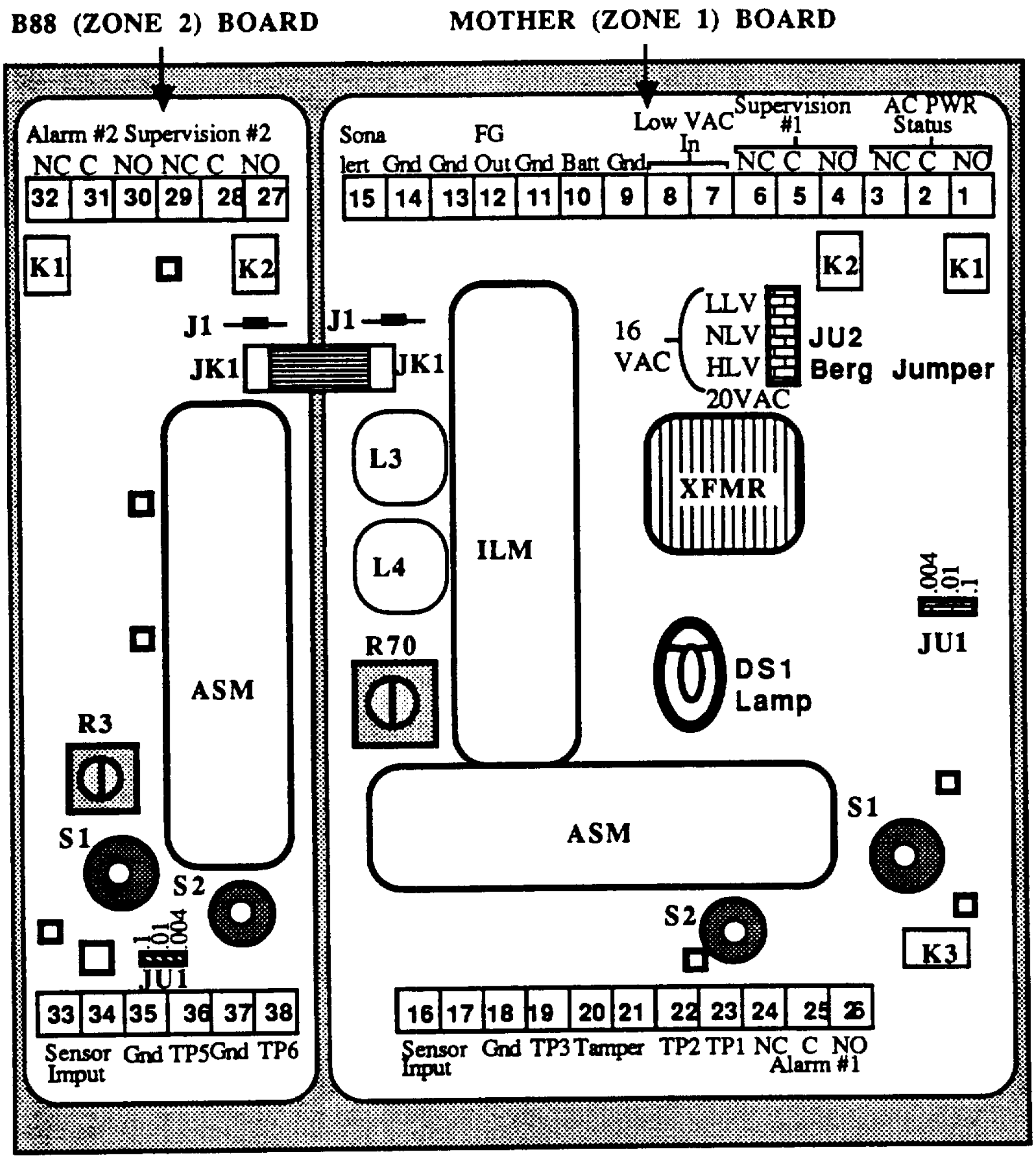


Figure 4-35. Processor PCB Assemblies

Alarm Relay Wiring Considerations

Note that the alarm relay is in a normally energized condition. The relay coil is energized until an alarm occurs or all power is removed from the processor. Relay output labelling (NO or NC) corresponds to the energized (non-alarm) condition.

System Wiring

System wiring depends on the processor model and configuration of the E-Field system. Wiring diagrams for various system configurations are shown on the following pages.

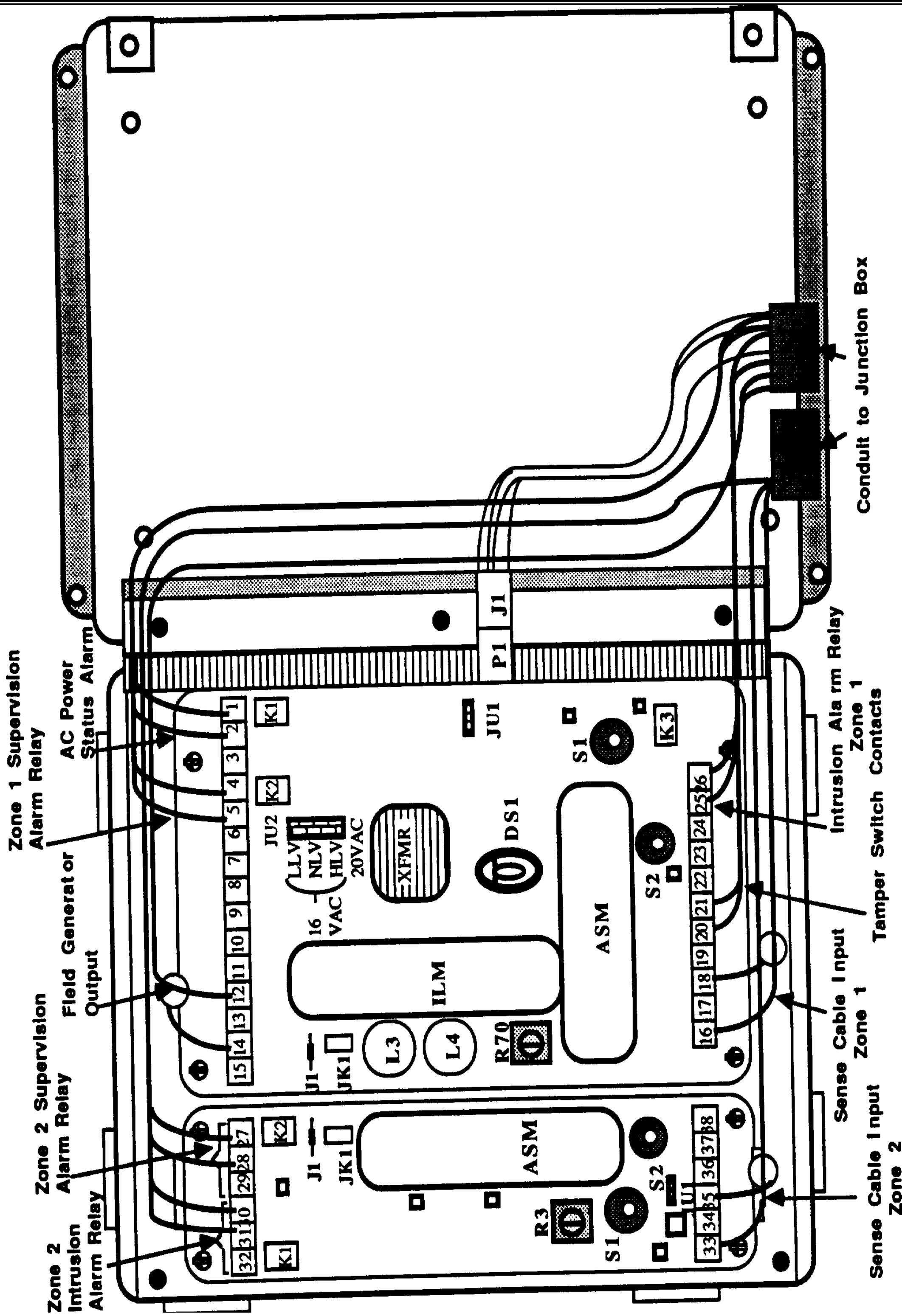


Figure 4-36. Dual Zone Processor

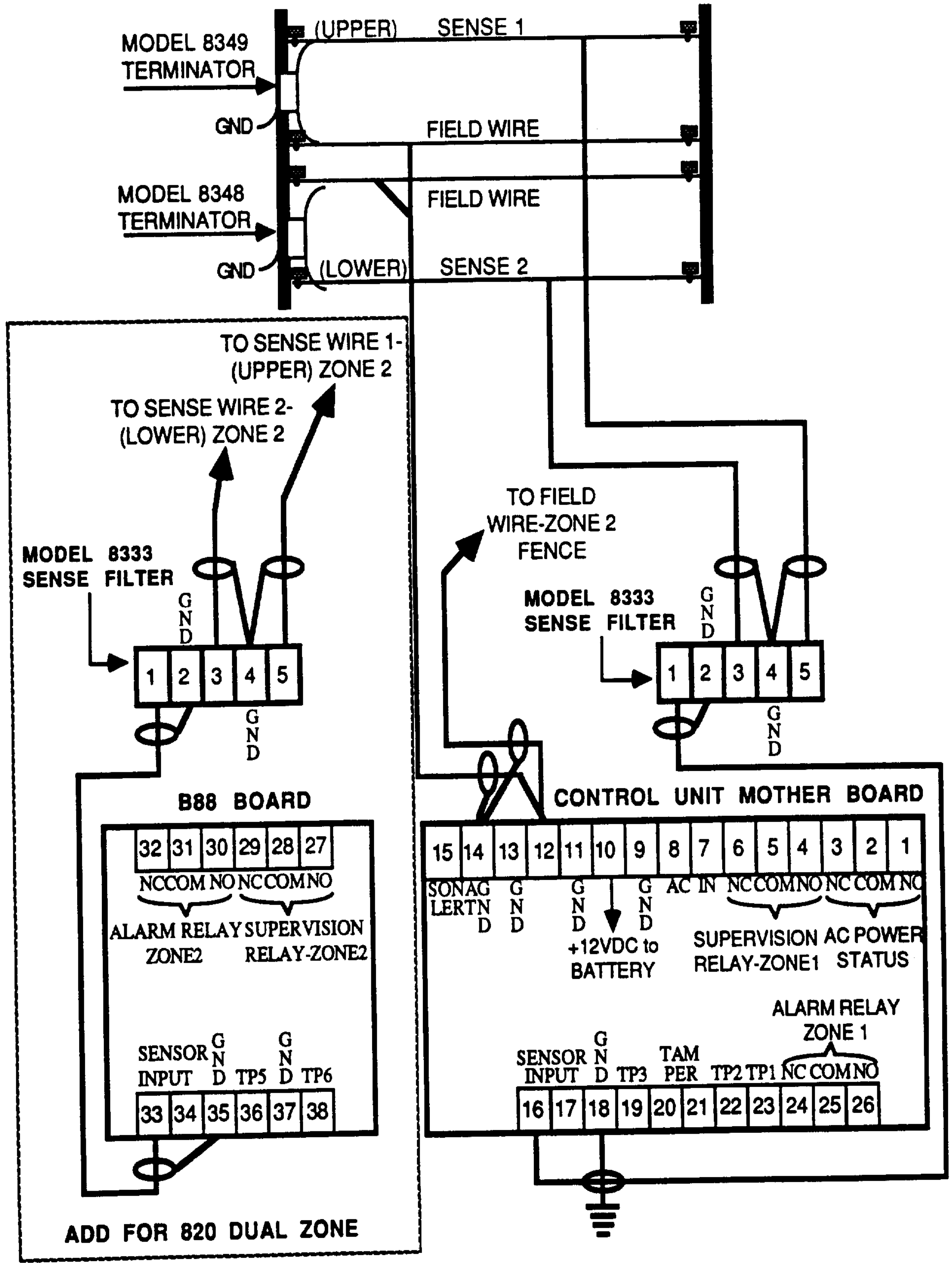


Figure 14-37. Four-Wire, Balanced-Phase Configuration

Terminator Installation

Two types of terminators are used with the Series 800 processors.

Standard Terminators The upper terminator (8349-4) and lower terminator (8348-4) are of fixed capacitive value (360 pf and 180 pf respectively) and provide the necessary signal coupling and AC supervision path for each zone. The upper terminator is connected between the upper sense wire and the field wire; and the lower terminator is connected between the lower sense wire and the field wire.

Remote Test Terminators The upper terminator (8359-4) and lower terminator (8358-4) perform the same function as the standard terminators with the added capability of remote testing the associated zone. The test feature is activated by a switch operated 12 VDC pulse. The upper terminator is connected between the upper sense wire and the field wire; and the lower terminator is connected between the lower sense wire and the field wire.

Upper and Lower Terminator Capacitor values must be different due to the sense wires distance from ground.

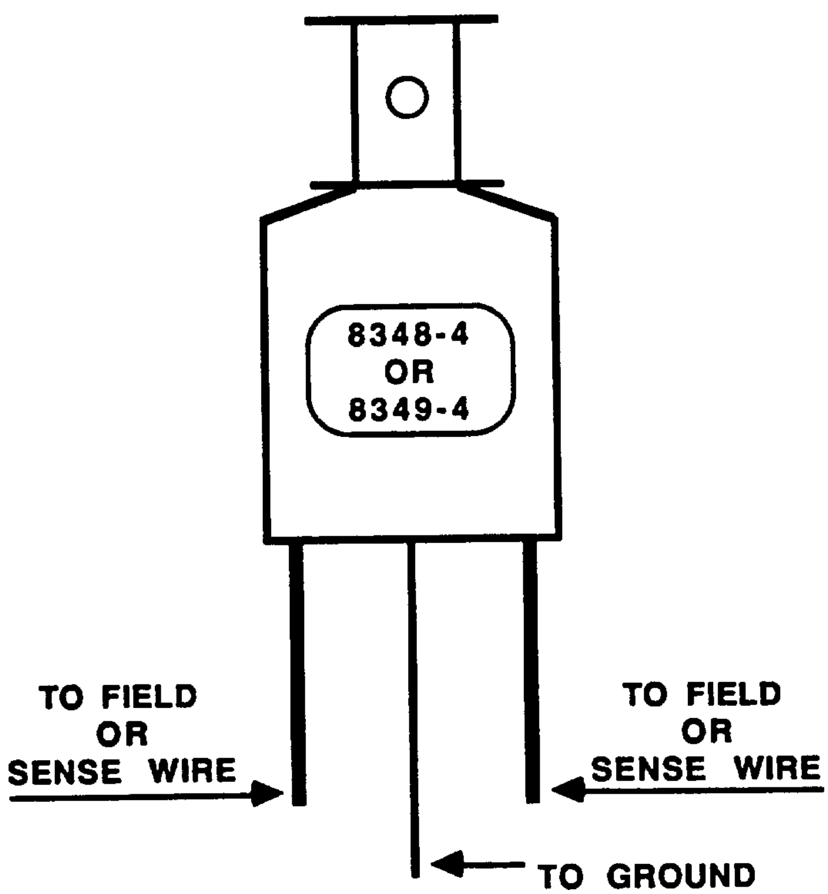


Figure 4-38. Standard Terminator

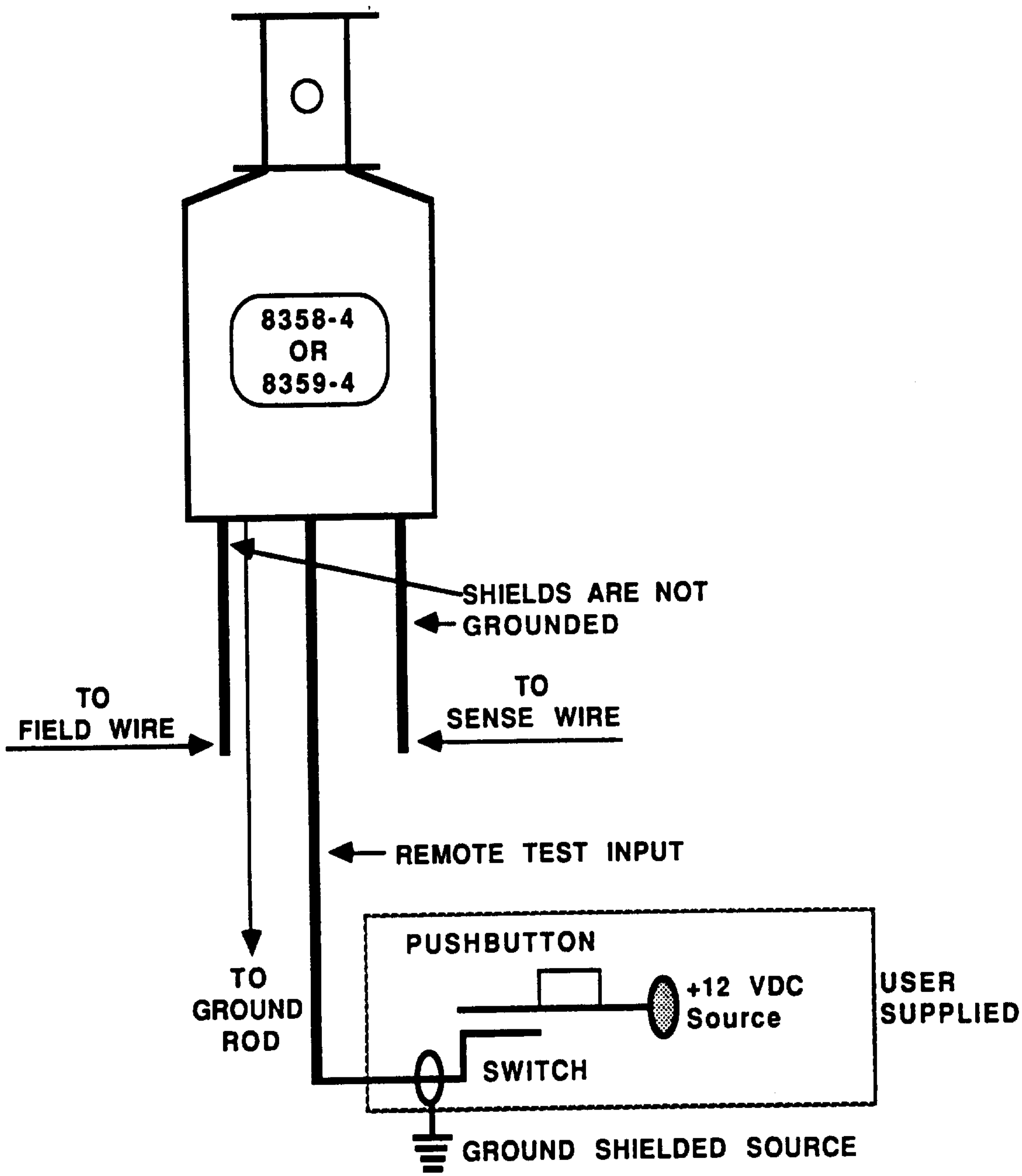


Figure 4-39. Remote Test Terminator

Alignment and Calibration

Variables involved in an E-Field configuration, such as terrain, climate, measurements made during installation, building shapes and sizes, and differences in the electrical characteristics of components, make it virtually impossible to install a perfectly working system without making adjustments. In fact, the ability to tune an E-Field system to its environment is one factor in its versatility. In electrical terms, the overall aim of the calibration procedures are to tune the field generator, set and adjust the system's AC coupling sensitivity levels and provide the highest probability of detection without causing nuisance alarms.

System sensitivity must be maintained at the lowest possible level to detect an intruder upon penetration of the system (as opposed to detecting the intruder some distance away from the E-Field wires). The sensitivity setting will vary from one configuration to another. The sensitivity should always be set by testing the system for detection by penetration.

Varying ground conditions (soil composition, moisture content, etc.) will also affect sensitivity from one zone or site to another, because the system measures the mass of an intruder with respect to ground. As the reference point from the E-Field wires to ground varies, so will the result of the conductivity of the ground and the distance from the E-Field wires to ground, thus affecting the overall sensitivity. For example, a system adjusted for penetration in spring or summer would most probably produce different results when tested with ice or snow on the ground. The sensitivity of such a system would probably be somewhat increased in winter and may require seasonal adjustments.

NOTE: Penetration detection is defined as the point of minimum sensitivity required to cause an alarm to sound when a human body attempts to pass between the E-Field wires.

Tools and Equipment Required

Tools required for the calibration procedures are:

- Volt-ohm-milliammeter
- Plastic tuning tool (Stellar supplied)
- Flat-blade screwdriver
- Phillips screwdriver
- Adjustable wrench

Accompany this list with the variety of small tools normally associated with light electrical work (needle-nose pliers, diagonal cutters, etc.)

Single Zone Alignment and Calibration Procedures

Refer to Section 1 for location of front panel zone sensitivity controls, test point selector switch and null adjust potentiometers, L3 field generator tuning coil and bandpass jumper adjustments.

Electrical Connections

For required electrical connections refer to wiring diagrams shown in Section 4.

Initial Tuning

Pull the tamper switch to the maintenance position.

1. Apply 20 VAC to the processor. Ensure that lamp DS l (battery polarity rev./excess charge current) is not illuminated and jumper JU2 is in the 20 VAC position.
2. Monitor test point T4 and verify that reading is within the range of +20 to +30 on the front panel motion meter. If not, refer to Section 6.
3. Select T3 on the front panel test point selector switch.
4. With the red plastic tuning tool provided, adjust the field generator coil (top of coil has yellow paint) L3, for minimum reading on the motion meter. The tuning core should be well inside the coil, not protruding from the top, when properly adjusted. Normal reading will be between 18 to 35 on the motion meter. (Oscillator crystal must be installed in ILM module for proper generator operation.)

Sense Input Nulling

1. Select T2 on front panel.
2. Adjust the nulling potentiometer (R70) for a zero or null reading on the motion meter. R70 is a 10-turn potentiometer, therefore, several turns are most likely required. A shaft lock is provided to lock the shaft in its position once nulled. Refer to Figure 4-33. If the reading will not reach zero it is possible that the sense wires are reversed at the sense filter, or the terminator positions are reversed. The null point on the meter should correlate approximately with the mid point of R70.

Bandpass Adjustment

E-Field intrusion detection conditions can span the full range of human movement. Bandpass jumper JUl (on the mother board) controls the intrusion speed detection range of the system. This jumper can be placed in one of three positions corresponding to a response of 0.1 Hz, 0.01 Hz, or 0.004 Hz.

- 0.1 Hz provides detection of intruder movements as slow as 6 in/sec (15 cm/sec).
- 0.01 Hz provides detection of intruder movements as slow as 2.3 in/see (6 cm/sec).
- 0.004 Hz provides detection of intruder movements as slow as 1.2 in (3 cm/sec).

The exact detection figures for these settings depend on installation tolerances and environmental conditions. Setting of 0.01 Hz is usually recommended, but the optimum position is best determined by intrusion testing. See Figure 4-34 for JU1 setting. The factory setting is 0.01 Hz.

NOTE: The 0.01 Hz and 0.004 Hz positions require additional time for stabilization. Start in 0.1 Hz position for initial check of system operation. The 0.004 Hz low end has a 44 second time constant, and may require up to 10 minutes to stabilize around a zero reading on the motion meter (set to TP position T1 or T5 for zone 2). The 0.1 Hz and 0.01 Hz positions have a 1.6 and 16 second time constant respectively.

Sensitivity Adjustment

1. Select Tl on front panel TP selector switch. Assure that all moving objects are well away from the E-Field. Allow the motion meter to settle around 0. With Sonalert switch on, no tone from the Sonalert should be heard. On initial power-up the system will alarm for several minutes before resetting. Analog E-Field output is monitored at T1.

2. Adjust sensitivity according to the parameters of the Functional Intrusion Detection Testing procedure for optimum detection and minimum nuisance alarms.
3. Maintain a record of T2 and T3 values as well as the sensitivity switch position. This is useful as a forewarning of system problems.

Dual Zone Alignment and Calibration

Electrical Connections
For the required electrical connections refer to wiring diagrams shown in Section 4. Perform steps 1 through 4 of the single zone test and alignment procedure, if not already complete.

Sense Input Nulling
1. Select T6 on front panel TP selector switch.
2. Adjust the nulling potentiometer (R3) for a zero reading on the motion meter. A shaft lock is provided to lock the shaft in position once nulled. The meter null point should correlate approximately with the midpoint of R3.

Sensitivity and Bandpass Adjustment

1. Adjust the bandpass (JU1 of the B-88 board) to the desired position and the zone 2 sensitivity knob for the desired sensitivity following the single zone procedure. Analog output is monitored at T5.
2. See Section 6 for recommended method of setting system sensitivity for optimum detection and minimum false/nuisance alarms.

Functional Intrusion Detection Testing

Performance Criteria
An E-Field perimeter alarm system shall:

- Detect an individual weighing a minimum of 77 lbs (35 kilograms) whether crawling and rolling under the lower sensing wire, or stepping and jumping between the field and sense wires at a minimum velocity of 3 cm, per second.

- The field and sensing wires shall be supervised to prevent the undetected cutting or bypassing of the system through electronic or clandestine means.

- The system design shall employ techniques to minimize alarms caused by high winds, thunderstorm related electrical phenomena, and small animals.

Achieving desired performance in a properly installed and operating E-Field system may require adjustment of both the processor sensitivity and bandpass selector JU1. The recommended JU1 position is .01 (6 cm per second). However, facilities with special requirements for slow-speed detection may wish to experiment with the .004 (3 cm per second) JU1 position.

Sensitivity /Performance Tests

Stoop Test
The balanced-phase system looks for an imbalance between the upper and lower pair of wires.

1. Walk up to the E-Field at a normal pace and stop at the point where the alarm sounds.
2. Turn parallel to the sensor wires *and remain motionless until the control unit stabilizes.* TP1 zone 1 (TP5 zone 2) should read less than 5.0.
3. Stoop or squat to unbalance the field between the upper and lower pairs of field and sense wires. The intrusion alarm should sound again.
4. Adjust the sensitivity so the distance from the sense wires at which the alarm sounds, in both instances, is not more that 0.5 m.

Normal Walk Test
The system should alarm when approached within 20 inches (0.5 m ± 10 cm) by test person walking at a normal pace. This test should be performed at 5 m intervals along the sensor zone. The test is designed to evaluate system sensitivity. Note that speed of approach and size of person will affect detection distance. Therefore, the same person should perform all tests and should strive to walk in a consistent manner.

1. Walk within 20 inches (0.5 m) of E-Field.
2. Test at 16 foot (5 m) intervals along the E-Field.
3. Make a note of the detection distances at each location by marking and measuring.

Shuffle Walk Test

Perform this test very slowly. It may be possible to get within 10 inches (25 cm) of the E-Field without causing an alarm. An attempt to slowly (3 cm per second) climb through the E-Field without touching the wires should generate an alarm. To perform test:

1. Shuffle toward the E-Field with arms held motionless at the side. Both feet must remain on the ground during the shuffle walk. Limit steps to about 2 inch (5 cm) in length.

Crawl Test

This test applies to all E-Field fence configurations where crawl detection is required. A person weighing at least 77 lbs (35 kilograms) is required for the test.

1. The intruder lies down at least 1 m from the bottom sensor wire.
2. After allowing several seconds for the system to stabilize, the intruder attempts to slide under the wire. The intruder's body should be perpendicular to the sensor wires to minimize the length of wire affected by the intruder. Every effort should be made to restrain any sudden movements (brush the fly off your nose later).
3. The intruder should crawl slowly, less than 3 cm per second, and should avoid touching the sensor wire if possible.
4. Areas where crawls were undetected should be investigated, and efforts should be made to achieve equal detection with respect to the rest of the zone. Wire height, earth grading, or sensitivity may need to be changed to achieve desired performance.

Troubleshooting and Maintenance

Tools required for troubleshooting and routine maintenance are the same as those specified in Section 5.

It is important to inspect the entire length of the E-Field zones periodically, especially following inclement weather. The site preparation initially performed must be maintained continuously. Walk the entire length of the fence zone, checking that weeds have not grown under or close to the fence. Be sure shrubs and tree limbs are trimmed away from the fence.

WARNING
Contact with field generator wiring can
result in a mild electrical shock.

When E-Field is used with chain link fence (whether free standing or mounted on it), verify that the fence is not slack or damaged so it moves with the wind. Verify that all nearby objects are similarly immobile. If the site installation is surrounded by any kind of fence, be sure there are no holes through which animals could enter and cause nuisance alarms. Be sure insulators are clean, in good condition, and supporting the wires properly. Verify that field and sense wires are properly tensioned. Verify that all inter-connections are in good condition.

E-Field Malfunctions

When making test point readings use the front panel selector switch to choose the function to be monitored. When a problem is suspected, or malfunction observed, first verify that there is the normal AC or DC power supplied to the processor.

AC power (to terminals 7 and 8 on TB 1 of the processor) is normally 15V RMS minimum to 24V RMS maximum The DC operating voltage (measured at terminals 9 and 10 of TB 1) is 11.5 VDC minimum to 14.5 VDC maximum. With AC power applied, and battery disconnected, terminals 9 and 10 should measure 13 VDC minimum.

Check the field generator tuning at front panel test point T3, followed by the sense input null at T2 and T6 (dual-zone). Refer to the alignment procedures in Section 5. If problems are found, refer to the corresponding section of the following troubleshooting procedure.

Insufficient or No Detection Range

1. Measure signal level at T3 to verify that field generator is tuned properly, and field generator loading conditions are not excessive.
2. Tune field generator again. Look for a minimum reading at T3 (displayed on the front panel motion meter). Normal tuning range is from 18 to 35 µA. If the system will not tune properly there may be a problem with the installation.
3. Measure field wire voltage between TB 1-1 and ground, using an AC voltmeter. The reading must be between 90 and 125 V.

4. Verify that bandpass selector switch, JUI (located on the processor main board) and B88 board (dual-zone) is present and jumpered in correct position. Nominal placement of JU I jumper is in 0.01 Hz position, but may vary depending on site requirements.
5. Refer to alignment procedure and recalibrate sensitivity by adjusting appropriate zone sensitivity control.
6. Inspect for shorts or opens on the field or sense wires.
7. Check wiring interconnections between sense filters, processor and terminators.
8. If the problem persists, refer to processor troubleshooting procedure.

Unequal Zone Detection Range

It's normal to find minimal changes in the detection range due to variations in the terrain. However, large changes are cause for concern. A major contributing factor is the spacing between the lower wire and the ground. Consistent ground-to-wire and wire-to-wire spacing is necessary for uniform detection throughout the zone.

If the problem persists look for changes in terrain, or the presence of large structures or objects which are not uniform distributed throughout the length of the zone. Look for large variations in soil moisture content and stone or gravel depth changes, which could result in a non-uniform ground reference.

Unstable Detection Range

Check for poor or missing ground connections in the system. Lack of good ground reference for the E-Field can cause unpredictable performance and nuisance alarms.

Continuous Supervision Alarm

Test points 72 and T6 (dual-zone) are used to measure the total change in coupling, between field and sense wires, with reference to the zero value set at time of nulling. Supervision alarms could be caused by a short or open along the fence zone, a faulty terminator, sagging fence or wires touching the ground, or vegetation in contact with the fence.

1. Verify that the tamper switch will depress when the enclosure door is closed, because the tamper switch is annunciated through the zone 1 supervision alarm output
2. Monitor the signal levels at T2 and T6 (dual-zone). Levels exceeding ±20 mA (on the front panel meter) will result in a supervision alarm. If this is the cause, the installation should be rechecked and the system renulled. For renulling, refer to the alignment procedure in Section 5.
   If the system cannot be nulled at T2 or T6 check the following:
   a. Inspect wiring from the sense filter (model 8333-4) to the sense wire, and from the sense and field wires to the terminators. If the wiring from the sense wires to the sense filter is reversed (terminal 5 on the sense filter connects to the upper sense wire) or if the terminators are reversed (the upper sense and field wires are terminated with either 8348 or 8358 terminators), a null will not be possible.
   b. Check for shorts from the field to sense wire(s).

   c. Check for faulty terminator.

3. Measure the signal level at T3 (on the front panel meter). If the measured signal exceeds 34 mA, the field generator is mistuned, or an excessive loading condition exists which has resulted in a supervision alarm. The field generator must be returned, or the faulty condition corrected, before the supervision function will return to normal status.

Field Generator Tuning

If field generator will not tune to normal (less than 35 µA on front panel meter at T3) there is probably an excessive loading condition present. Possible causes for excessive field generator loading are:

- Excessive length of a coax cable to the field wire(s).
- Excessive snow buildup, which has buried the field wire(s).
- Short circuit or leakage from field generator output to ground, or coaxial cable center to shield.
- Dirty fence wires, insulators, or moisture in terminal boot cover, causing excessive leakage paths to ground.
- Faulty connection or terminator.

1. To isolate the processor from the E-Field fence wiring when searching for excessive loading condition:
   a. Power off the processor.
   b. Disconnect the field wire from terminal 12.
   c. Install test cable (model 2500) as shown in Figure 6-1.
   d. Apply power to the processor.
2. Monitor T3 on the front panel motion meter.
3. Adjust L3 for a minimum reading on front panel motion meter. If reading is in 18-35 µA range the fault is probably not the processor. Check coaxial cable and connection between coaxial cable and field wire. Other possible causes are faulty terminators or excessive loading due to faulty and/or dirty insulators.
4. Measure field generator voltage between terminals 12 and 14 on TB 1 with a voltmeter capable of measuring AC voltage in the 100 to 200 VAC range.
5. Verify that the voltage measured is between 90 and 125 VAC RMS.
6. If L3 cannot be tuned correctly replace it with a spare. Be sure the correct crystal has been installed.

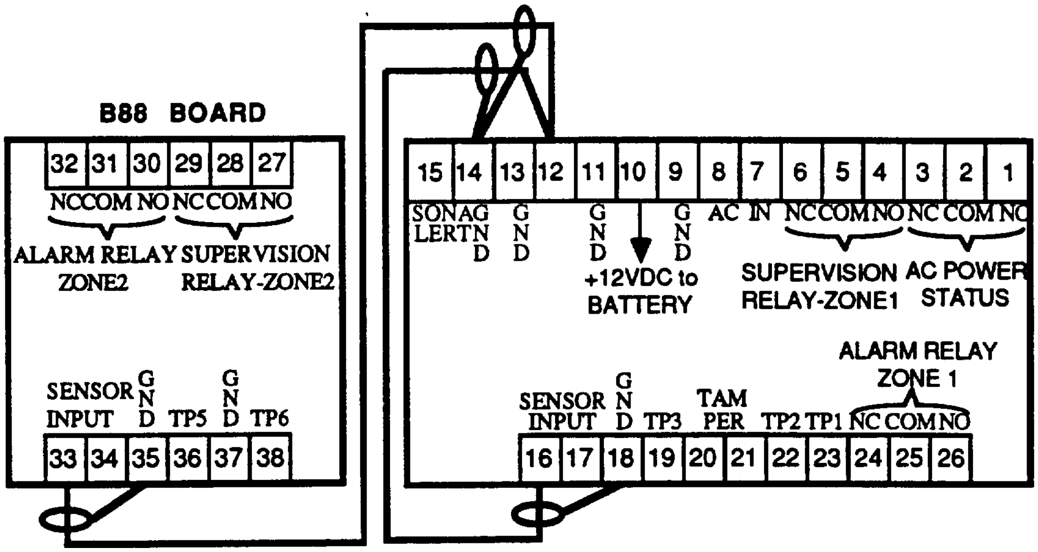


Figure 6-1. Test Cable Connections

If the processor tests successfully using the test cable check the following:

7. Lengthy coax cable runs (from field generator output to E-Field wires) can result in field generator loading. Refer to Table 4-2 for maximum recommended coax cable runs.
8. If a field loading problem occurs intermittently, check for excessive leakage paths to ground as a result of insulating hardware. A problem of this sort will occur intermittently, and should correlate with moist or wet conditions.
9. To eliminate the problem, clean all insulating hardware, particularly the mounting hardware associated with the field wire(s).
10. Clean the outer surface of all coaxial cable from the E-Field wire connection point to the point where it contacts a post or other grounded structure.

Continuous Intrusion Alarm

This condition must not be confused with excessive nuisance alarm rate.

1. If the processor is in continuous alarm, and 20 VAC power is present at terminals 7 and 8 on TB 1, replace the processor with a spare. Be sure the correct crystal has been installed.
2. If the processor is in continuous alarm while operating on a standby battery, measure the battery voltage at terminals 9 and 10 on TB1. If the measured voltage is between 11.5 and 14.5 VDC, battery voltage is acceptable for operation.

3. Replace the processor with a spare. Be sure the correct crystal has been installed. If the battery measures less than 11.5 VDC, the battery is defective or the float charge circuit for changing the battery is inoperable.

Battery Test

1. Disconnect input power.
2. Run processor on the battery for 30 minutes.
3. Measure battery voltage. If voltage is greater than 11.5V, battery operation is acceptable.
4. If battery voltage is less than 11.5V, disconnect battery and apply 20 VAC power. Be sure the charging voltage at terminals 9 and 10 is 13.5 to 14.3 VDC.
5. If voltage is correct attempt to recharge the battery (minimum 48 hours required when charging from the float charge supplied at terminals 9 and 10).
6. If charging voltage at terminals 9 and 10 is incorrect, replace the processor with a spare. Be certain the correct crystal has been installed. When DS l is on it indicates that battery polarity is reversed, or there is a high battery charging rate. Figure 4-33

Excessive Nuisance Alarms

1. Be sure the calibration and sensitivity of the system is adjusted properly.
2. Select Tl on front panel motion meter. Meter fluctuation should be less than ±5 (±10 during high winds). Check for the same meter fluctuation at TP5 (zone 2).
3. Look for natural explanations for large fluctuations within the zone, such as a person walking near the E-Field, the wind blowing shrubs or tree limbs.
4. While watching the motion meter (described in step 2) use a long wooden pole to move support poles of E-Field to see if such conditions cause alarms.
5. Where several zones are used around a perimeter, be sure no adjacent zones are being operated by processors set at the same frequency (causes slow oscillation). This condition will be obvious because the motion meter will periodically swing to plus or minus readings at a regular rate.
6. Look for loose wires that can sway in the wind near the E-Field zone.
7. Ensure that E-Field mounting hardware is rigid and E-Field wires are at the proper tension.
8. Check for faulty terminators by disconnecting the field wire(s) from the terminators.
9. Monitor system performance for a period of time to see if nuisance alarms persist. If they do, reconnect the terminators. The system must be renulled at T2 and T6 (dual-zone) following disconnection of terminators. See alignment procedure, Section 5.

10. Check all coaxial cables to ensure that there is a good earth ground connected to the shield *at one end only.* There must never be an earth ground connection at both ends of a coaxial cable; except when drain coils are used. See Figure 4-24.
11. If a high nuisance alarm rate occurs when the system is operating off an emergency generator, its possible the line frequency is not adequately controlled. This condition is indicated by a full-scale oscillation of the front panel motion meter at T1 or T5. This condition can be verified if the oscillation stops when AC power is removed and the system is powered from a standby battery.
12. Insure that all Series 5000 hardware is at ground potential. Connect ground strap if necessary.

Terminator Malfunctions

A defective terminator (terminator installation/ grounding/terminator components) can cause erratic nuisance alarms. Terminator faults can arise from:

Poor Connection

1. Check all connections to the terminator.
2. Verify that connections to field and sense wires are intact, and properly sealed against moisture penetration/leakage. It is preferable that the coaxial cable center conductor dielectric not be exposed to the atmosphere, since the dielectric material may crack after long exposure to ultraviolet rays. Be sure the ground connection to the terminator is intact.

Improper Grounding

Terminators and the E-Field processor must be properly grounded for correct operation of E-Field systems. Intermittent terminator grounds are a source of high false alarm rates. All support hardware must be at ground potential.

Faulty Capacitor

It is possible that a capacitor may fail within the terminator.

1. Remove both field and sense wires from the terminators and monitor the system for a period of time. Note that system must be renulled at T2 and T6 (dual-zone) following disconnection of terminators. Refer to the alignment procedure, Section 5.
2. If performance improves without the terminators, replace them.
3. To isolate the specific terminator, disconnect one terminator at a time.

Terminators can be bench tested through the use of a standard capacitance meter. The nominal values for the terminators are:

8348-4/8358-4	180 pf, include additional capacitance due to length of coaxial cable attached to terminator. See Table 4-2 for capacitance-per-foot ratings of coaxial cable.
8349-4/8359-4	360 pf, include additional capacitance due to length of coaxial cable attached to terminator. See Table 4-2 for capacitance-per-foot ratings of coaxial cable.

Processor Troubleshooting

1. Disconnect the field generator (terminal 12, TB1) and the sensor input (terminals 16, 17, and 18, TB2).
2. Install the test cable (model 2500). Refer to Figure 6-1.
3. Calibrate the processor per the alignment procedure.
4. Set sensitivity to 5 or 6 on the appropriate zone sensitivity control.
5. Select T1 on the TP selector switch. the front panel motion meter reading should be ±3 μA maximum. Allow sufficient time for stabilization. If step 5 cannot be achieved the processor should be replaced.
6. Check the intrusion alarm and supervision relay for correct operation.
7. Monitor the intrusion alarm relay at terminals 24 and 25 with a VOM or DVM.
8. Momentarily short the sensor input to the adjacent ground, terminal 16 and 18. The relay should change from closed to open state.
9. Repeat step 8 for the supervision relay using terminals 5 and 6.
10. Check the field generator and battery voltage. Field generator voltage should be 90 to 125 VRMS (terminal 12) to ground. Battery voltage should be 13.5 to 14.3 VDC.

If all these steps are successful the problem is in coaxial cable, sense filter, drain coils, E-Field wire, wire connections, or terminators, not the processor.

Field Troubleshooting

This procedure only applies to systems that have already been installed and have become successfully operational.

Three types of problems with E-Field sensor systems are addressed here. They involve supervision alarms, false intrusion alarm(s), or no intrusion alarm during an intrusion. There are basically two kinds of maintenance solutions:

1. When troubleshooting/maintenance consists of:
   a. Localizing a fault to one of the following field replaceable processors:
      - Processor Mother Board
      - B88 Board (dual zone processors only)
      - Terminator
      - Sense Filter

   b. Returning the failed processor to the factory for repair or replacement.
2. Troubleshooting a system to a specific failed component (such as a resistor) and repairing the processor on-site.

Obviously, these two solutions are very different. The first solution is recommended, since experience has shown that technicians not specifically trained for maintenance on E-Field systems can often create additional problems when they attempt to fix a problem. There are also sealed factory adjustments that may require readjusting when a component is changed.

However, in the interest of customer support, this manual provides operational theory and troubleshooting procedures that should be sufficient to enable a competent and well-equipped technician to perform field repair down to the component level in most cases.

The first thing to do before field-troubleshooting a system suspected of giving a false alarm is to verify, if possible, that it is actually a false alarm.

It is important to first eliminate the most likely and easily detected possible sources of a problem. Keep in mind that E-Field systems are highly reliable once they have been correctly installed. Hardware problems with processor electronic circuitry are relatively rare. This troubleshooting approach is based on the following:

CASE 1: a constant or intermittent supervision alarm (with/without intrusion-type alarm)

CASE 2: intrusion-type false alarms and no supervision alarm

CASE 3: the system does not give an alarm when there is an intrusion

CASE 4: a power status alarm only

Most facilities have a monitoring capability that distinguishes supervision alarms from intrusion alarms. If not, the type of alarm is the first thing to be determined when in the field.

The field troubleshooting kit consists of.

- The front panel controls.
- Multimeter
- Field generator tuning tool
- Phillips head screwdriver
- Flat blade screwdriver
- Test Cable (model 2500)
- Other small tools for light electrical work (pliers, cutter, etc.)

Basic Problem Areas

First things to look for when a problem occurs:

1. Environmental factors that interfere with system functions.
2. Electrical connection problems that interfere with system functions.
3. Verification that there is an alarm condition at the processor in the problem zone. An alarm at the monitoring station doesn't necessarily mean there is an alarm condition at the processor. If the alarm output lines are disrupted there will be a monitored alarm. If this happens the alarm relays will be in a non-alarm state.

Verifying an Alarm Condition

If an alarm is monitored it is important to verify that it is coming from the processor. It is also important to know the type of alarm. To look at the output of the supervision alarm relay:

1. For a single zone processor, or for zone 1 of a dual zone processor, measure resistance across pins 4 and 5. If these pins read a short, zone 1 supervision relay (K2) is in an alarm state.
   a. For zone 2 of a dual zone processor, test across pins 28 and 27 . If these pins read a short, the zone 2 supervision relay (K2) is in an alarm state.

   CAUTION

   The alarm reporting system usually provides DC voltage across all alarm contacts. This voltage can damage resistance meters. Check for the existence of voltage across all contacts to verify an open circuit.

To look at the intrusion alarm relay output:

2. For a single zone processor, or for zone 1 of a dual zone processor, measure resistance across pins 25 and 26 . If these pins read a short, the zone 1 intrusion alarm relay (K3) is in an alarm state.
    a. For zone 2 of a dual zone processor, test across pins 31 and 30. If these pins read a short, the zone 2 intrusion alarm relay (K1) is in an alarm state.
3. If there is no supervision alarm, and there is no constant alarm state at the intrusion alarm relay, check processor adjustments. If sensitivity level adjustment is too high nuisance alarms can occur.

NOTE: When adjusting sensitivity , or generating any intrusion alarm, allow a few minutes for the circuitry to settle after an alarm state (because of capacitor charging-discharging rates).

4. If adjustments are suspected of causing the alarm (which is probable if there is no constant alarm output) perform the routine adjustments for field detection detailed in the adjustment procedure and sensitivity adjustment.
5. If adjustments are responsible for a nuisance alarm, there will usually be a momentary alarm and the processor will settle in a non-alarm condition. If there is a constant intrusion alarm output, (observed by checking the output of the intrusion alarm relay) there may be a hardware problem.

If all easily detected and likely causes have been eliminated, it is time to narrow the problem area to a failed subassembly.

Swapping Boards

To exchange processor boards:

1. Remove primary power to the processor.
2. Disconnect all external electrical leads to processor.
3. Remove screws securing board to enclosure, and remove board.
4. To install a board, reverse the above procedure.

Preventive Maintenance

It is recommended that a preventive maintenance program be scheduled four times a year in harsh environments; three times a year should be adequate in mild environments. However, the final determination of a preventive maintenance schedule should be made on a site-by-site basis.

Area Adjacent to E-Field

Vegetation	Remove all vegetation within 6 meters of E-Field wires. Weeds must be cut to ground level and the general area kept clear of debris.
Washouts	Bottom wire spacing must be maintained from 6 to 8 inches (15.2 to 20.3 cm) above the ground, to provide uniform detection along the zone. Washouts can alter bottom wire to ground spacing and thereby cause possible areas of nondetection. Grade or fill uneven ground areas as necessary.
Chain Link Fence	When using fence-mounted systems, look for loose fence fabric that can cause nuisance alarms.

Hardware

E-Field Wire Tension	Proper tension is necessary to ensure that wind-caused wire vibration is not mistaken for the presence of an intruder. Wires loose enough to move slowly in the wind will cause nuisance alarms. The recommended wire tension is 50 pounds, which correlates to a spring length of 8 1/2 inches (21.6 cm).
Terminators	All ground lugs and screws must be free of rust and corrosion. Clean dirty terminals with a wire brush and reapply weather sealant.
Coaxial Cable	All exposed coaxial cables should be inspected for cracks in the insulation and corrosion of the center conductor. Trim back cracked or corroded cables, reconnect to the E-Field wire, and reapply weather sealant.
E-Field Terminal Boot Connections	Inspect a reasonable number of E-Field wire connections selected at random. Remove the weather sealant and check the connection for corrosion. Replace the connection with a butt splice if necessary and reapply non corrosive weather sealant.
Ground Wire Integrity	Check all ground wire connections for intermittent contact, corrosion and breakage.

Electronic Calibration

Test Point Readings	Verify that the test point readings have not changed since the last inspection. Record the readings.
Calibration	Verify penetration detection. Recalibrate and adjust sensitivity if necessary.

Periodic Hardware Checks

Hardware checks should be made when the E-Field is tested for penetration detection by security personnel:

E-Field Wire	Check for breakage or damaged insulation.
Insulators	Check for breakage, dirt or cobweb buildup.
Springs and Winders	Check for looseness or damage.

Preventive Maintenance and Routine Adjustment

Preventive maintenance consists of a periodic visual inspection of the installation site and a check of the operational effectiveness of each E-Field zone.

Periodic Visual Inspection

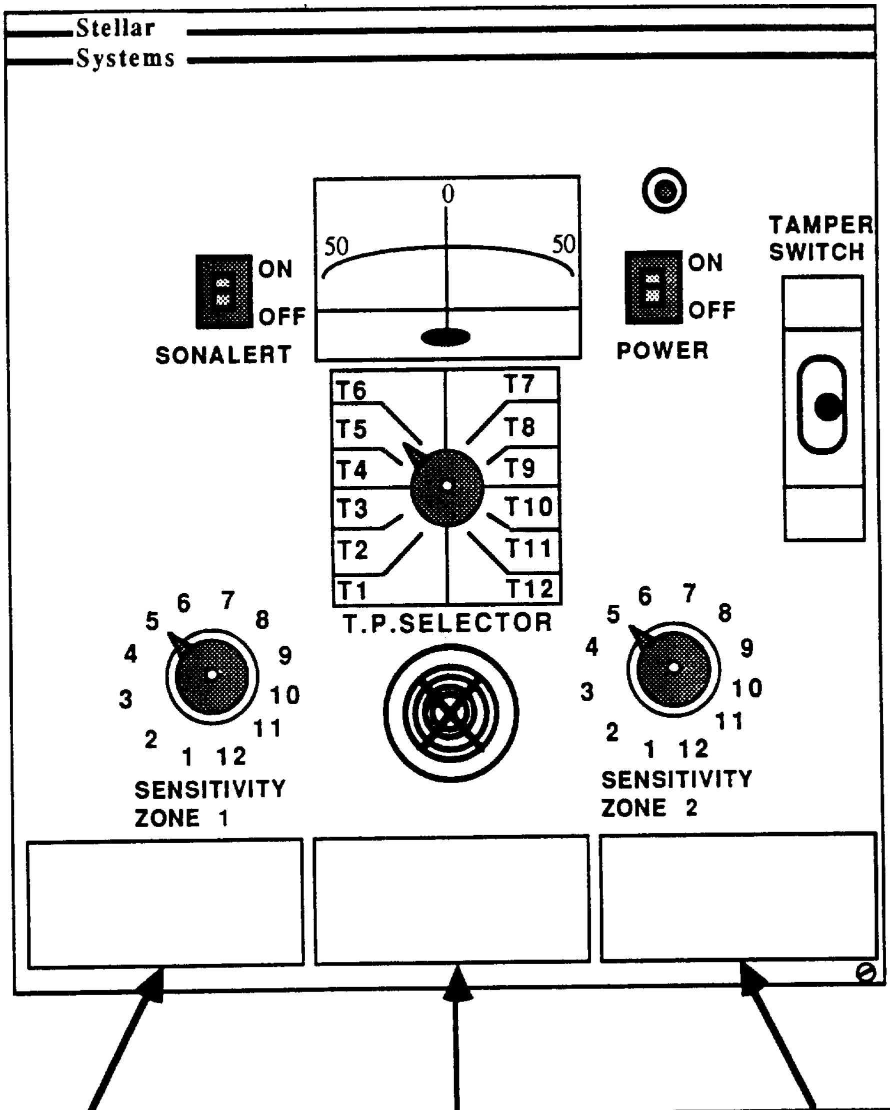
Inspect the installation site periodically to avoid possible problems, especially nuisance alarms, that can be caused by easily avoided factors. When surveying the perimeter and processor installations watch for:

Defective Connections	Examine all inputs to the processors, especially those that have been in place for a long time. If there is any serious wear from environment or other factors, they may need to be repaired or replaced.
Fence Mount Condition	Verify that all insulators are in good condition, clean, and properly support the wires. Check the tension of field and sense wires. Be sure that all jumpers and interconnections are not slack, and that electrical connections are in good condition. Periodic washing of insulators may be required. For processors mounted on a chain link fence, make sure the fence is not slack or damaged. The fence fabric should not sway in the wind. All fence posts should be solid.
Encroaching Vegetation	If trees, bushes, grass, or weeds begin to intrude on the detection zone, nuisance alarms may occur. Vegetation should never exceed the maximum height of 2 inches (5 cm).
Foreign Objects	If there are any foreign objects in the detection zone, they should be removed (if any large objects are moved in or out of the detection area, the null control may need readjustment.

If any new piping, electrical wiring, fencing, etc. is installed in or near the detection zone, it may result in problems with alarm system effectiveness.

Periodic Intrusion Detection Check

Some cumulative non-environmental factors can also effect detection characteristics of the E-Field and make it less effective with time. Because of this, it is recommended that a test of intrusion detection effectiveness be carried out periodically. Testing should be conducted for every zone. Set the TP selector switch on the front panel to T1 for zone 1, or T5 for zone 2 and turn the Sonalert switch on. See Figure 6-2.



Test Point	Designation	Reading
T1	INTRUSION OUT ZONE 1	
T2	NULL ADJUST (R70)ZONE 1	0
T3	FLD REG OUT ADJUST (L3)	MIN.
T4	UNREG. IN VOLT	+20 TO +30

Test Point	Designation	Reading
T5	INTRUSION OUT ZONE 2	
T6	NULL ADJUST (R3)ZONE 2	0
T7	BATTERY VOLTAGE	+30
T8	FG VOLTAGE	+30

Test Point	Designation	Reading
T9	+6VDC	+30
T10	-6VDC	-30
T11	EXT. +14.3 VDC IN	+30
T12	UNREG. VDC IN	+20 TO +50

Figure 6-2. Front Panel

Approach the E-Field at several points along the zone length. As you invade the plane of the detection wires, verify that the needle deflects to over 30 µA and that the Sonalert sounds. If the Sonalert does not give an alarm promptly when you enter the detection range, adjustments are required.

Routine Adjustment of E-Field Detection

Three simple E-Field processor adjustments are normally required after installation.

1. Proper adjustment of the field generator involves adjusting the field generator coil L3 for a minimum T3 reading on the front panel meter.
2. Proper adjustment of the null control involves zeroing the motion meter reading at T2 (T6 for zone 2) with no disturbance to the E-Field. System operation requires reaction to changes in the capacitive coupling between field and sense wires. Nulling the input means adjusting the stable state input to zero so only deviations from the normal state (changes in the capacitive coupling) will be monitored.
3. Proper adjustment of the sensitivity control switch involves identifying the optimum balance between the most sensitive detection and the lowest number of nuisance alarms (Sensitivity control affects the amplification level of the electrical activity in the detection range monitored).

   - Setting sensitivity too low can cause inadequate detection

   - Setting sensitivity too high can cause nuisance alarms.

The E-Field sensor sensitivity can undergo small changes periodically. Keep a record of seasonal variations, and the sensitivity control switch settings, so these seasonal periodic adjustments can be repeated more easily.

NOTE: Be aware that each processor may require different settings to achieve proper sensitivity even under identical conditions. When setting sensitivity, always adjust each processor separately.

When seasonal adjustments have been made and recorded over a period of time, there probably is a simple pattern to seasonal settings. If so, it is practical and convenient to make seasonal settings without performing the walk-test procedure. If there is no problem with nuisance alarms, and there is proper detection, this is acceptable. It is recommended that a copy of Table 6-2 be used for this record and that it be taped on the cover of each processor.

NOTE: All routine adjustments to the processor are done with power applied and the processor fully operational.

Table 6-2 is an installation summary sheet which should be filled out during initial system calibration, and revised when equipment settings are changed, so an overview of the installation configuration and operation is recorded.

Table 6-1. . E-Field Data Sheet Per Processor

ZONE 1 NO.____________ BOARD NO. ____________

ZONE 2 NO.____________ BOARD NO. ____________

CRYSTAL ________________________

POSITION OF JU1: .004☐ .01☐ 0.1☐

COMPLETE ONE FORM FOR EVERY PROCESSOR.

NOTE: In the comment column describe adjacent area vegetation, washouts,fencing, temperature, snow conditions, wind speed, or any other useful data that can be used for future reference for next calibration.

DATE OF VISIT	TEST POINT For T2 T6 record number of CW turns										SENSITIVITY SWITCH		COMMENTS
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	ZONE 1	ZONE 2	

Table 6-2. Test Point Data Per Installation

TP	DESCRIPTION	NOM	ZONE 0	1	2	3	4	5	6	7	8	9
1	ZONE 1	±10										
2	NULL 1 (R70)	±0										
3	FLD REG (L3)	+20										
4	UNREG VDC	+25										
5	ZONE 2	±10										
6	NULL 2 (R3)	±0										
7	BATTERY	+30										
8	FLD GEN	+30										
9	+6 VDC	+30										
10	-6 VDC	-30										
11	EXT 14.3 VDC	+30	N/A									
12	UNREG VDC	+30	N/A									
	LENGTH Z1	100M										
	LENGTH Z2	100M										
	SENSITIVITY Z1	+6										
	SENSITIVITY Z2	+6										
	DETECT WIDTH Z1	0.5M										
	DETECT WIDTH Z2	0.5M										
	CONFIG 4WFM											
	CONFIG 4WFS											
	CRYSTAL											

Phone: (408) 496-6690, FAX: (408)727-8284, Telex: ITT 470-702

Adjustment Procedure for Single Zone Processor

Field Generator Tuning
See Figure 6-2 for location of L3 and set the TP selector on the front panel to T3 position.

With the plastic tuning tool provided, adjust the field generator coil, L3, (top of coil has yellow paint) for a minimum reading on the front panel. See Table 6-1 for proper range. The tuning core should be well inside the enclosure (not protruding out of the top) when properly adjusted. Record the meter reading in Table 6-2. Normal meter reading is between 18 and 32.

If the field generator load becomes excessive, to the point where the system can no longer maintain a constant output, the meter will read more than 32 and the supervision relay will go to alarm status. Possible causes for excessive field generator loading are:

- System not tuned properly at L3
- Excessive length of coax cable to and from fence
- Excessive snow buildup (covering the field wire)
- Short circuit between field and sense wires, or field wire and ground.
- Dirty fence wires, insulators, etc., causing excessive leakage paths to ground.
- Faulty termination or faulty terminator.

The method for checking an installation for excessive loading conditions is:

1. Monitor T3 on the front panel motion meter.

2. Adjust L3 with the field generator load disconnected.

   a) If it can not be tuned there is a problem with the board.

   b) If it can be tuned, connect the cables and attempt to adjust L3 for a minimum reading on the front panel meter.

   If the resulting reading is above 25, the fault is most likely in the coaxial cable or the connection between the coaxial cable and the field wire. Other possibilities are a faulty terminator, or excessive loading due to faulty and/or dirty insulators.

3. As a final check, measure the field generator voltage between terminals 12 and 14 on TB l with a voltmeter capable of measuring AC voltage in the 100 to 200 VAC range. Verify that the voltage measured is between 90 and 125 VAC rms.

4. Capacitance loading is usually the result of long coaxial cable runs from the field generator output to the E-Field wires. Refer to Table 4-2 for maximum recommended coaxial cable lengths.

5. If the field loading problem occurs intermittently, check for excessive leakage paths to ground as a result of dirty mounting hardware.

NOTE: Excessive loading is the type of problem that will occur intermittently, and should correlate with moist or wet environmental conditions. To eliminate the problem clean all insulating hardware. It is important to clean the mounting hardware associated with the field wire(s).

If insulated field wire is used, clean the outer insulation with solvent. Clean the outer surface of all coaxial cable interconnections from the E-Field connection point to the point at which it contacts a post or other grounded structure.

If the field generator load decreases, and the meter reads less than 18, the supervision relay will go to alarm status. Possible causes for low load are:

- System not tuned properly at L3.
- The field wire is cut.
- Faulty termination or faulty terminator.

1. Check wire installation for a wire cut or faulty termination then retune L3.

2. Once T3 is within proper range, turn the front panel TP Selector to T8. The meter should be between 27 and 33.

Null Adjustment

See Figure 6-3 for location of connection and adjustment points.

1. Set TP selector to T2 position.

2. Adjust R70 for a zero reading on the front panel meter. R70 is a 10 turn potentiometer, therefore several turns will be required.

3. A shaft lock is provided to lock the shaft in its position once it has been zeroed. Turn clockwise to lock.

4. Record the number of clockwise turns made for this null adjustment in Table 6-2. If there is a malfunction later, this record can be used to determine if the capacitance of the field wire, terminator, or sense wire loop has changed.

Bandpass/Sensitivity Adjustment Procedure

1. See Figures 6-2 and 6-3 and be sure S1 on the main board is at position 1 (FCCW).

2. Turn sensitivity switch S2 on front panel to position 1.

3. Set the band pass adjust jumper J1 on the main board to the 0.10 Hz position.

4. Turn TP selector on front panel to Tl position, and be sure there are no moving objects near the E-Field fence.

5. Allow the front panel meter reading to stabilize around zero (0).

6. Turn ON the Sonalert switch on the front panel.

There should be no Sonalert tone sounding. The motion meter fluctuations should be less than 5 units deflection on the meter. In high wind conditions, this should be under 15 units deflection. Upon initial power-up the system pulses for several minutes, between alarm and non-alarm states, due to reset circuitry stabilization.

NOTE: Bandpass adjustment JU1 can be in one of three positions: 0.1 Hz, 0.01 Hz, or 0.004 Hz low end response. Optimum position can vary, but 0.01 Hz is recommended for most installations. Some high-risk installations can experiment with settings to obtain optimum performance. In general, the overall gain can be reduced when using the 0.01 Hz or 0.004 Hz low end response.

The 0.01 Hz and 0.004 Hz position require additional time for stabilization. The 0.004 Hz low end has a 44 second time constant and may require up to 10 minutes to stabilize around a zero reading on the motion meter. The nulling pot can sometimes be adjusted for a stable reading around zero. However, this brings the system slightly out of the nulled state, and is not advisable for normal operation. For initial adjustment, the 0.1 Hz position can be useful, but final adjustment should be done using either the 0.01 Hz or 0.004 Hz positions.

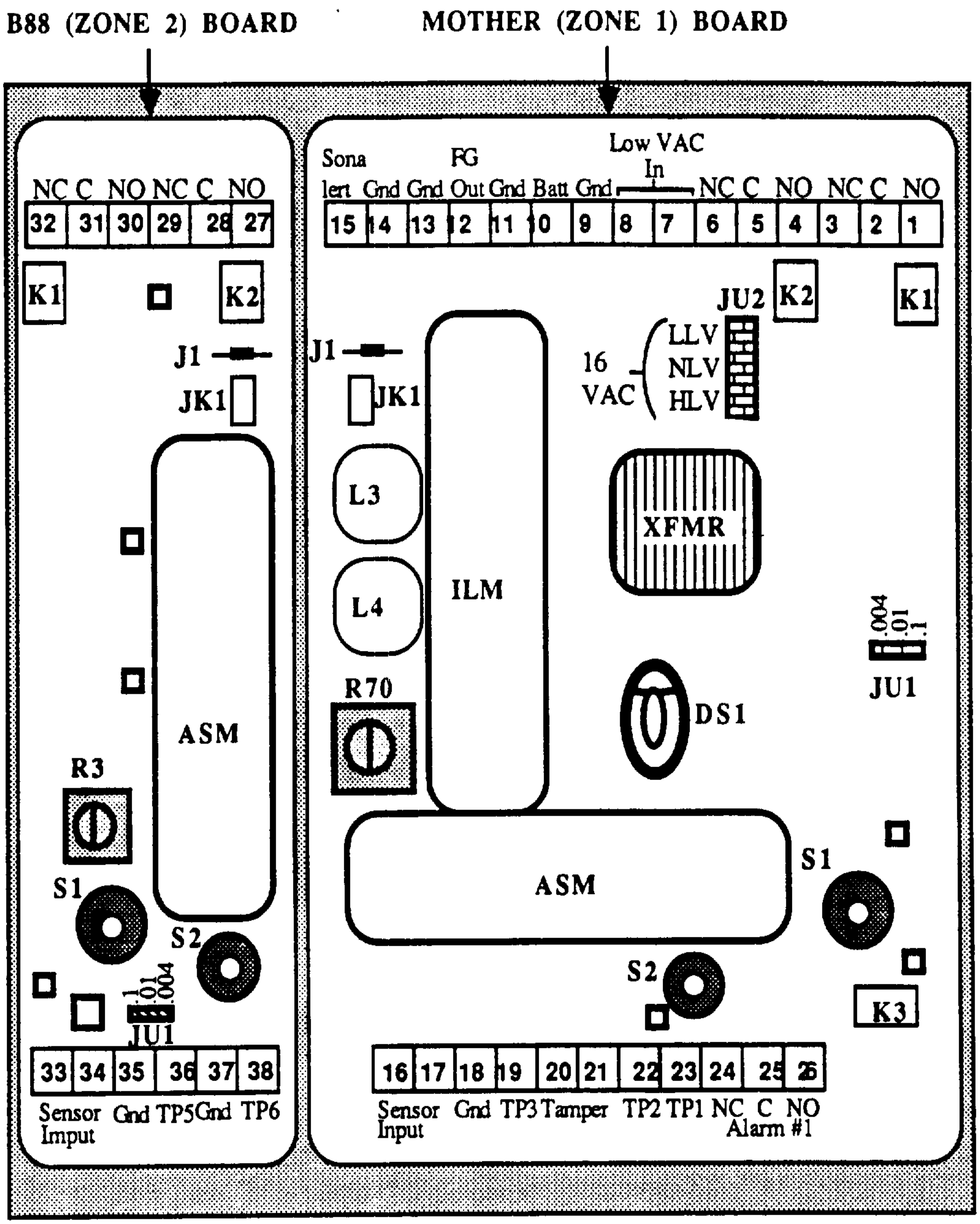


Figure 6-3. Mother Board and B88 Board

Table 6-3. Adjustment Point References

TEST POINT	DESCRIPTION	PHYSICAL LOCATION	ACCEPTABLE READING OR RANGE	ALARM STATE OR UNACCEPTABLE READING
T1	INTRUSION SENSE ADJUST ZONE 1	TB2 - 23 (TP1) MAIN BOARD	0V TO ±165mVDC ±495mVDC FOR WINDY COND.	OVER 1.122VDC OR 1Hz SWING
T2	NULL ADJUST (R70) ZONE 1	TB2 - 22 (TP2) MAIN BOARD	0V TO 33mV	OVER 165mVDC
T3	FIELD REGULATOR OUT ADJUST (L3)	TB2 - 19 (TP3) MAIN BOARD	528mV TO 825mVDC	OVER 1.122VDC
T4	UNREGULATED IN VOLT TEST POINT	MAIN BOARD (TP4)	19VDC TO 28VDC	LESS THAN 19VDC
T5	INTRUSION SENSE ADJUST ZONE 2	TB4 - 36 (TP5) B88	0V TO 165mVDC	OVER 1.122VDC OR 1Hz SWING
T6	NULL ADJUST (R3) ZONE 2	TB4 - 38 (TP6) B88	0 - 33mV	OVER 165mVDC
T7	BATT VOLTAGE TEST POINT (POWER SHOULD BE OFF TO READ BATT VOLTAGE)	TB1 - 10 MAIN BOARD	13.8VDC	LESS THAN 10VDC
T8	FG VOLTAGE TEST POINT	CATHODE OF CR25 MAIN BOARD	64VDC	LESS THAN 57.6VDC OR MORE THAN 70 VDC
T9	+6VDC TEST POINT	TP11 MAIN BOARD	+6VDC	LESS THAN 5.4VDC OR MORE THAN 6.6VDC
T10	-6VDC TEST POINT	TP12 MAIN BOARD	-6VDC	LESS THAN -6.6VDC OR MORE THAN -5.7VDC
T11	EXTERNAL +14.3 VDC IN TEST POINT	B4415 OUTPUT (TB1 - 3)	14.3VDC	LESS THAN 12.9VDC MORE THAN 15.7VDC
T12	EXTERNAL UNREGULATED VDC IN	FRONT PANEL INPUT P1 - 3	24VDC TO 48VDC	LESS THAN 24VDC

Sensitivity Adjustment for Zone 1

Sensitivity adjustment for zone 1 requires an initial experimental sensitivity adjustment procedure, and a number of intrusion tests to set the sensitivity to a minimum setting, and still adequately detect intruder motion to the satisfaction of customer requirements. Refer to types of tests in this manual, and adjust the sensitivity for optimum performance. This may require various types of intrusions, as well as some operational time, to assess the nuisance alarm rate (NAR).

NOTE: The experimental adjustment is generally performed at the time of installation. If not sure what the sensitivity setting of the system will be initially, repeat the experimental adjustment and keep a record of the sensitivity setting, with the date and conditions under which it was performed. Use Table 6-2.

Minimal changes in detection range are normal due to terrain variations. However, large changes are cause for concern. A major consideration when dealing with these detection changes is the spacing between the lower wire and the ground. Consistent ground-to-wire spacing is necessary for uniform detection throughout the zone.

If detection problems persist look for changes in terrain, or the presence of large structures or objects that are not uniform throughout the zone length. Also look for large variations in soil moisture content that could result in non-uniform ground reference.

Intrusion Simulator (model TE-18) Calibration Procedure

The intrusion simulator (TE-18) simulates actual intrusions by producing extremely small step changes (characteristic of a human intruder) in the coupling between field and sense wires. Coupling changes are measured in femto farads (1 ff-1x10-15 farads). Capacitance steps on the TE18 are adjustable from 25 ff to 350 ff, in 25 increments, which cover the normal range for intruder motion.

The intrusion simulator is used to establish and maintain the optimum sensitivity requirement with out repeating the initial experimental sensitivity adjustment.

1. After the initial experimental sensitivity adjustment, connect the intrusion simulator to the mother board.

2. Connect the red leads between the field generator output terminal (TB 12) and the sensor input terminal (TB 16 or TB 17).

3. Connect the black lead to the ground terminal (TB 18) located next to the sensor input terminals.

4. Set the front panel TP selector switch to T1.

5. Turn the Sonalert switch ON.

NOTE: The simulator is now connected to a processor which has been experimentally calibrated for optimum sensitivity.

6. When the field is undisturbed the meter at T1 will normally fluctuate at a zero reading. Make sure the meter indicates 2 amps or less, then depress the ON/OFF switch. A step change in coupling will be produced to simulate an intrusion of a magnitude in femto, farads, determined by the HI/LOW and the rotary switch position on the TE18.

7. Increase or decrease the capacitance step until depressing the ON/OFF switch results in a deflection of 30 ± 4µA, on the front panel meter.
8. Record the meter deflection in µA, and the TE18 capacitance change in Femto farads.

NOTES:

- Avoid deflections greater than 35 µA that result in an alarm condition.

- To obtain accurate deflection, the initial meter reading should be added to, or subtracted from, the final indication to obtain the absolute deflection.

- Meter deflection can be positive or negative if the switch of TE-18 is ON or OFF. Since the magnitude of deflection is the only parameter of interest, disregard polarity.

- To prevent sensitivity adjustment becoming a time consuming task, especially with multiple E-field zones, the first sensitivity and the TE-18 switch positions should be logged in Table 6-2 and only record the sensitivity settings periodically.

Periodic Test and Sensitivity Readjustments

For a routine or a periodic test, the proper sensitivity adjustment does not require the experimental sensitivity adjustment procedure.

1. To calibrate the system connect the TE-18 simulator as explained in the TE-18 calibration procedures.

2. Adjust the magnitude of the capacitance step of TE-18 to that found in the last TE-18 calibration. This calibration should be read from the information recorded on Table 6-2 that was obtained after the initial experimental sensitivity adjustment.

3. Set the TP selector switch to TI and turn the Sonalert switch ON.

4. Make sure the meter indicates ±5, then depress the ON/Off switch. The meter should show a deflection of 30 ±4 µA.

5. If this requirement is not met, decrease or increase the sensitivity switch of zone 1.

6. Make sure the meter stabilizes at ±5 µA, then depress the ON/OFF switch on TE-18.

7. Repeat this procedure until 30 ±4 is displayed on the front panel meter.

NOTE: Multiple zones can be configured without additional intrusion tests if the E-Field fence configuration remains the same. For example, if the sensitivity is initially adjusted on a free-standing four-wire E-Field fence, additional free-standing four-wire fences can be adjusted without additional intrusion tests. However, intrusion tests should be repeated for a four-wire fence-mounted configuration if it has been changed from free-standing to fence-mounted.

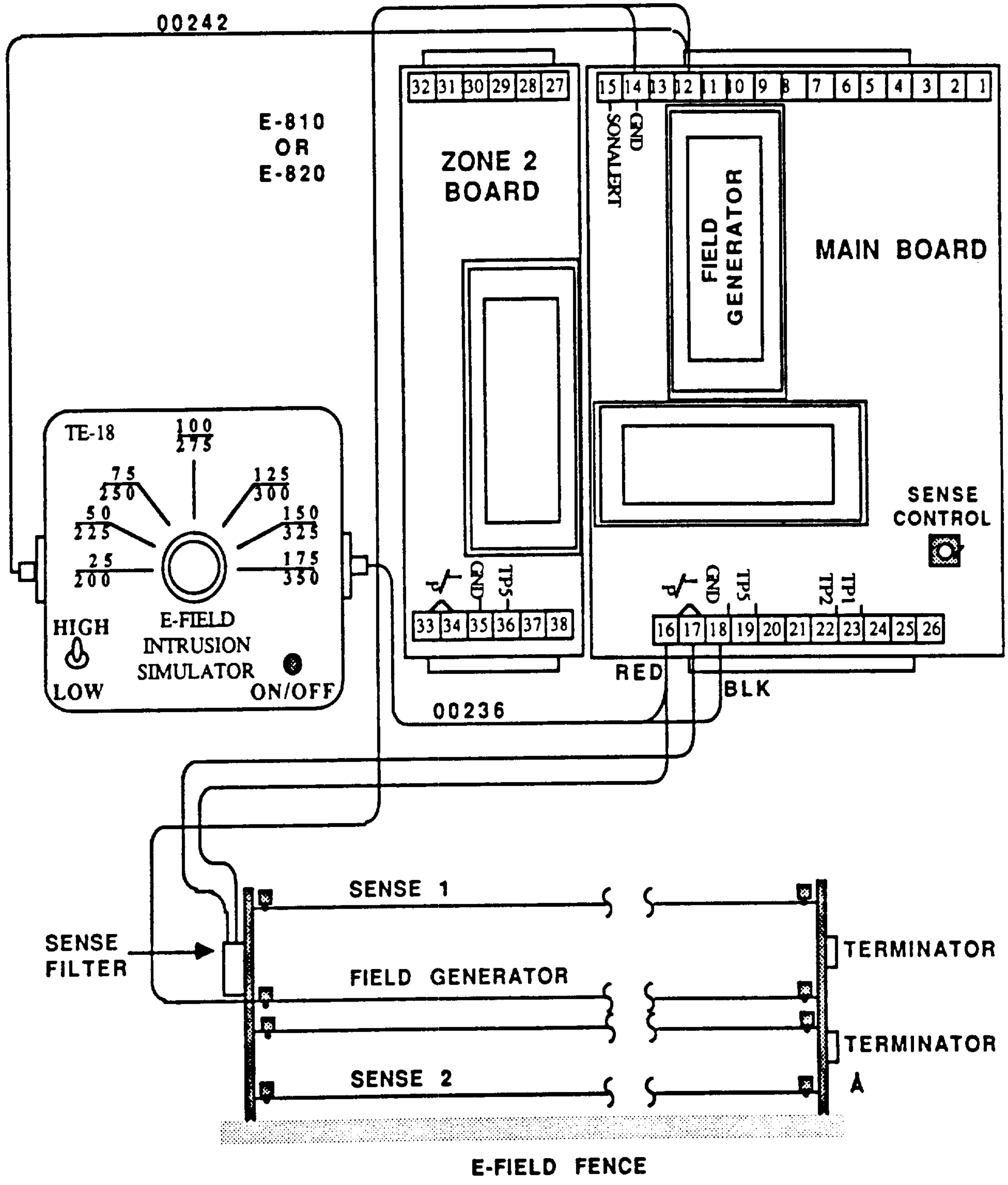


Figure 6-4. Calibration/Connection Diagram for Zone 1

Adjustment Procedure For Dual Zone Processor

To make adjustments to a dual zone processor (model EF-820) first perform the procedure for zone 1, and next perform the following zone 2 procedure.

Null Adjustment Procedure

1. While referring to Figure 6-3, set TP selector switch to T6.
2. Adjust R3 for a zero (0) reading on the front panel meter (see Table 6-1).
3. The shaft lock is used to lock the shaft in position (turn clockwise to lock) once it has been zeroed.
4. Record the number of clockwise turns made for the null adjustment in Table 6-2. If there is a malfunction later, this recorded figure can be used to detect capacitance changes in the field wire/terminator/sense-wire loop.

Bandpass/Sensitivity Adjustment Procedure

1. While referring to Figures 6-2 and 6-3, and Table 6-1, be sure S1 (on the B88 board) is at position 1 (CCW).
2. Turn the front panel sensitivity switch S2 to position 1.
3. Set the bandpass adjust switch JU1 (on processor main board) to the 0.10 Hz position.
4. Turn the front panel TP selector switch to T5 and be sure there are no moving objects near the E-Field.
5. Allow the front panel meter reading to stabilize to around zero ±5.
6. Turn the front panel Sonalert switch to ON.

There should be no Sonalert tone sounding. Fluctuations should be less than ± 5 on the motion meter. In high wind and rain conditions this should be under ±15 deflection. At initial power-up the system will pulse for several minutes between alarm and non-alarm states until the reset circuitry stabilizes.

NOTE: Bandpass adjustment JU1 can be one of three positions corresponding to a 0.1, 0.01, or 0.004 Hz low-end response. The optimum position can vary, but the 0.01 Hz position is recommended for most installations. Some high-risk installations can experiment with settings to obtain optimum performance for their site. The overall gain can be reduced when using the 0.01 Hz or 0.004 Hz low-end response.

The 0.01 Hz and 0.004 Hz positions require additional time to stabilize. The 0.004 Hz low end has a 44 second time constant, and requires up to 10 minutes to stabilize at a 0 reading on the motion meter. The nulling potentiometer can be used to adjust for a stable reading of ±0. However, this brings the system out of the nulled state, and is not advisable for normal operation. For initial adjustment, the 0.1 Hz position can be used, but final adjustment should be done using the 0.01 Hz or 0.004 Hz positions.

Sensitivity Adjustment for Zone 2

Sensitivity adjustment for zone 2 is identical to zone 1 except:

1. Red leads of TE-18 simulator are connected between the field generator output TB 12, and the sensor input terminal of the zone 2 board (B88) TB33 or TB34. The black lead is connected to ground (TB35) of the zone 2 board.
2. When executing the TE- 18 calibration procedure the TP selector switch is set to T5. The sensitivity adjust switch on the front panel is marked zone 2.

There should be no Sonalert tone sounding. The motion meter fluctuations should be less than ±5 on the meter. In high wind and rain conditions this should be under ±15 processors deflection. Upon initial power-up, the system will pulse for several minutes between alarm and non-alarm states due to reset circuitry stabilization.

NOTE: Bandpass adjustment JU1 can be placed in any of 3 positions that correspond to 0.1, 0.01, or 0.004 Hz low-end response. The optimum position can vary, but the 0.01 Hz position is recommended for most installations. Some high-risk installations may wish to experiment with the settings to obtain the optimum performance. In general, the overall gain can be reduced when using the 0.01 Hz or 0.004 Hz low end response.

The 0.01 Hz and 0.004 Hz positions require additional time for stabilization. The 0.004 Hz low end has a 44 second time constant, and may require up to 10 minutes to stabilize around a zero (0) reading on the motion meter. The nulling potentiometer can be used to adjust stable readings around 0. However, this brings the system slightly out of the nulled state, and is not advisable for normal operation. For initial adjustment the 0.1 Hz position can be useful, but final adjustment should be done using the 0.01 Hz or 0.004 Hz positions. Refer to frequency response plot of existing filter shown in Figure 6-10.

Wire Repair

Field or sense wires should only be spliced as a temporary solution. Sections of tensioned wire should be replaced as a whole if a break occurs. Repair broken wires as follows:

1. Remove power from processor.
2. Replacing entire broken wire section between the two tension points containing the break.
3. Remove the broken wire segment from the insulator and spring assemblies.
4. Replace the wire section between the two tension points.
5. Adjust to proper tension.
6. Power up and recalibrate the zone.

Guide To Flowcharts

The remainder of this troubleshooting section contains illustrations and flowcharts to quickly help isolate problems to a specific field replaceable unit. If you have a problem first refer to the appropriate troubleshooting flowchart. The charts will help you narrow the problem to a failure in one of the following:

- Mother Board
- ASM Module
- ILM Module
- Field/Sense Wire lines or connectors
- Sense Filter
- Terminator
- Tamper Switch
  (inside cover of processor - supervision alarm only)

If field testing cannot determine where a problem exists in an ASM module, an ILM module, or the mother board, shop testing can help identify the problem. However, it is helpful to pinpoint a problem with the system in the normal operational setting.

When troubleshooting procedures have been followed, and the problem has been identified with one of the above units, it is a good idea to verify the diagnosis by replacing suspect hardware with one that is known to be working well. If the ASM or ILM module has the problem, install another mother board. Any defective field/sense wiring should be repaired or replaced.

NOTE: For security and practicality, it is recommended that facilities with E-Field systems installed should have a 10% hardware backup in case of failure. With less than 10 zones, there should still be at least one exchangeable unit for each subassembly.

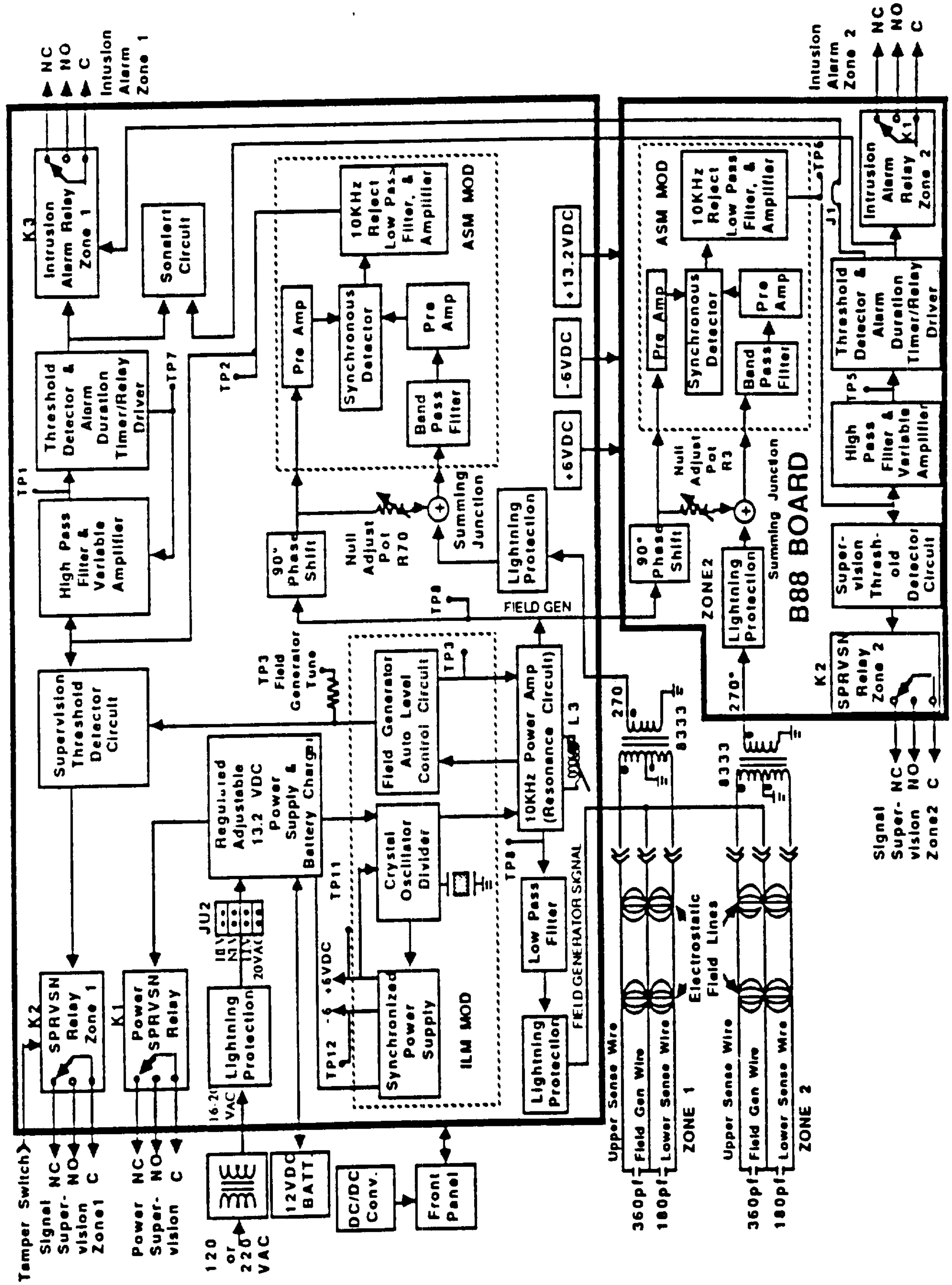


Figure 6-5. Overall E-Field Block Diagram

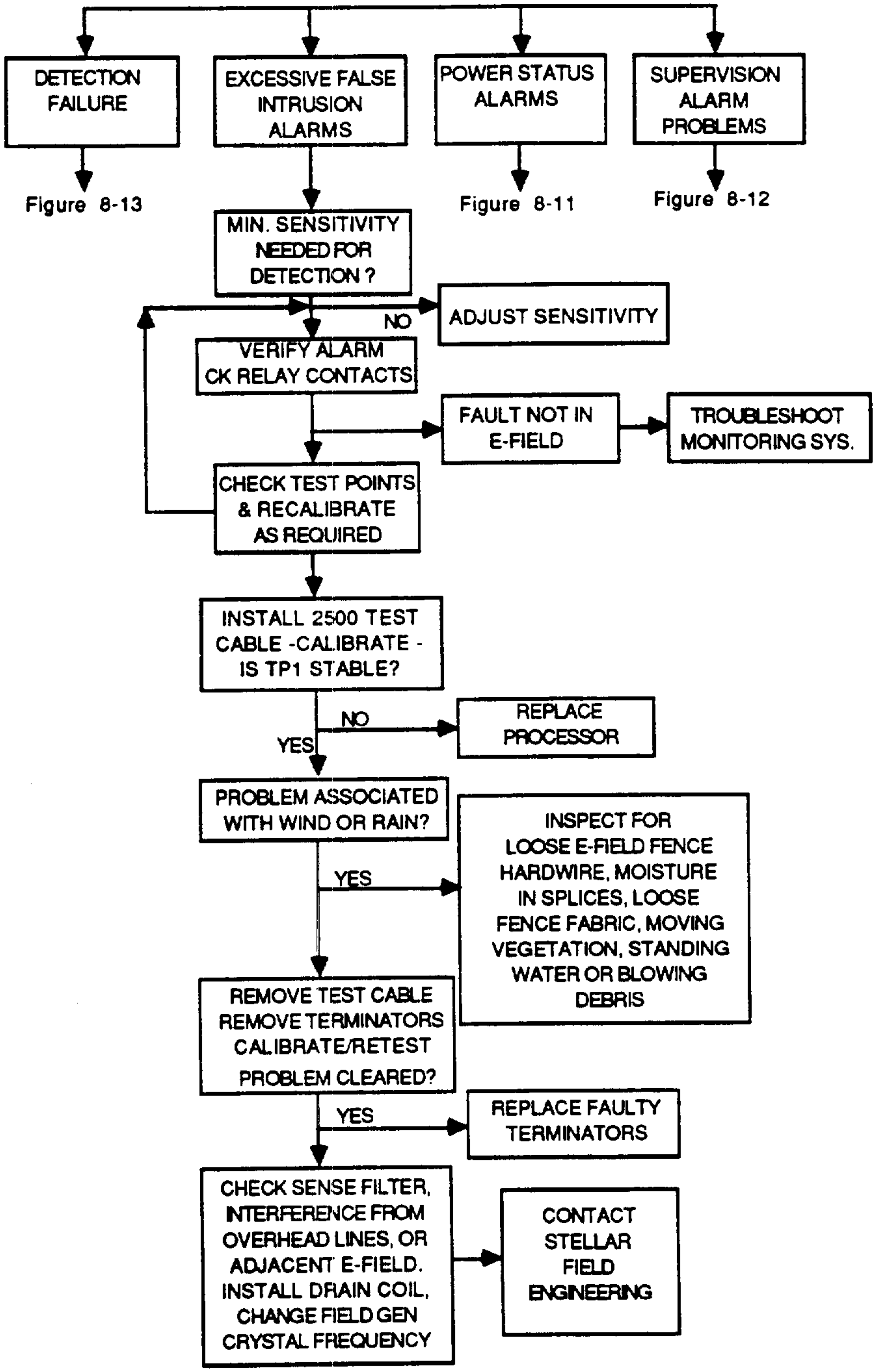


Figure 6-6. Main Troubleshooting Flowchart

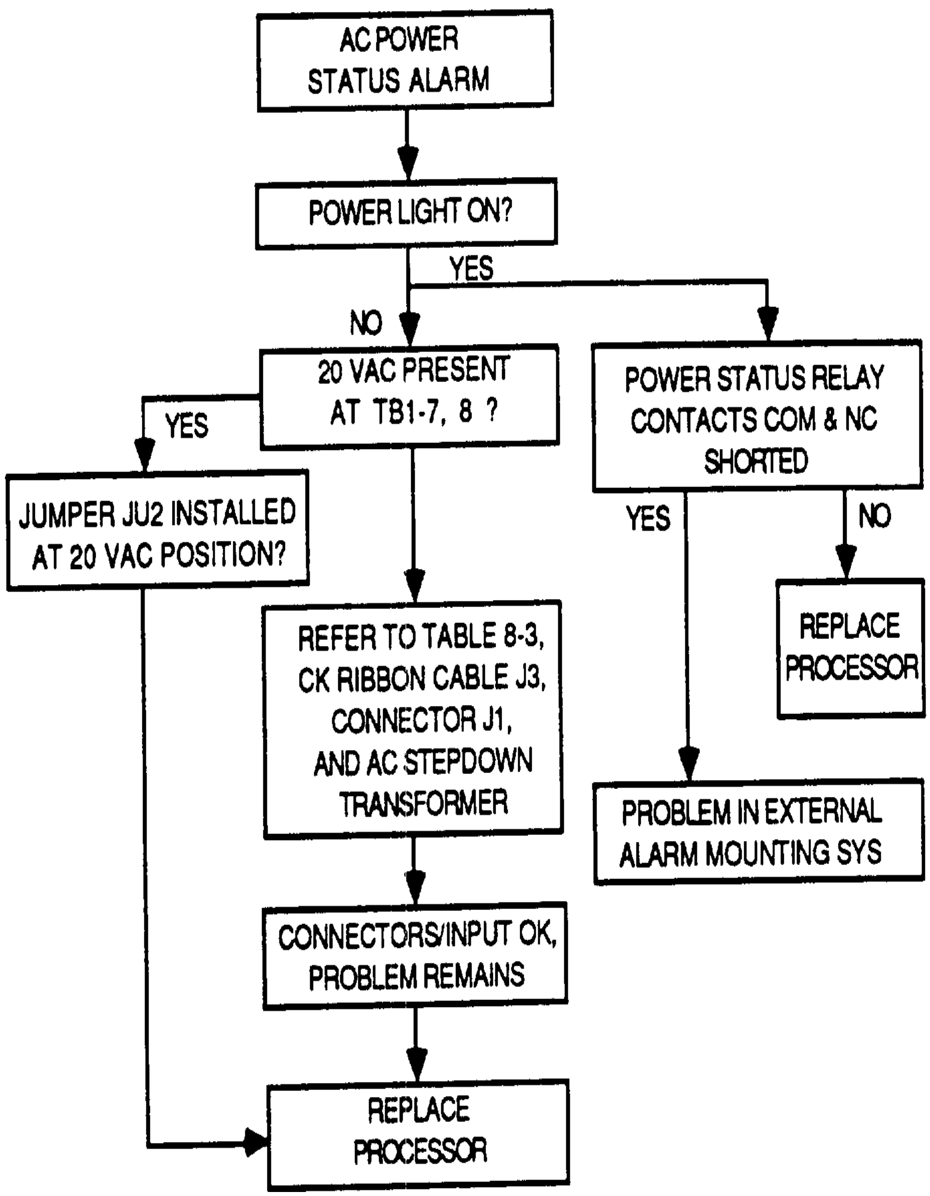


Figure 6-7. Power Status Alarm, Flowchart

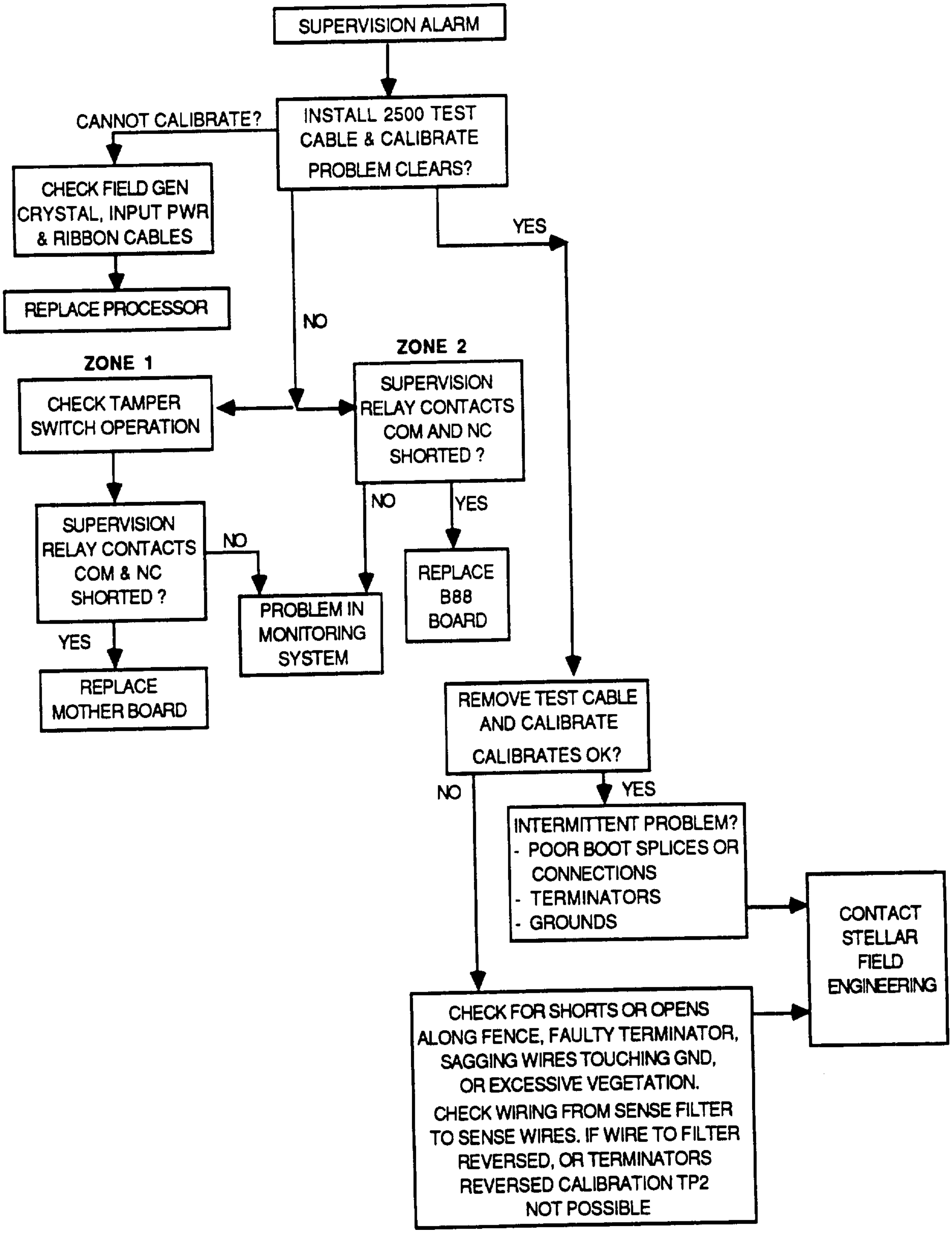


Figure 6-8. Supervision Alarm Problem, Flowchart

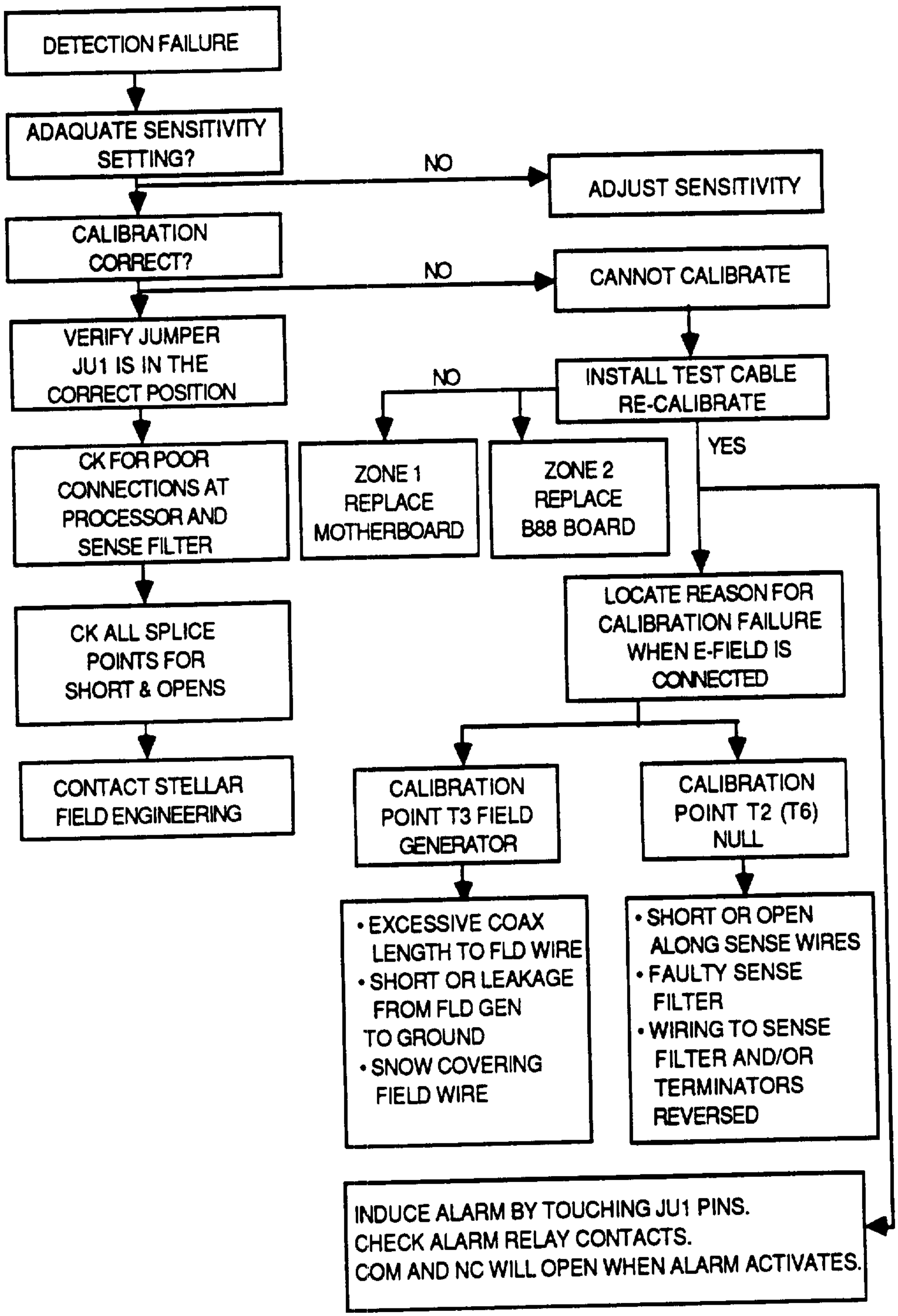


Figure 6-9. Detection Failure, Flowchart

SECTION 7
E-FIELD THEORY OF OPERATION

Power Supply

Power is supplied to all processors via standard 115 VAC. This is transformed to 20 VAC at 60 Hz and sent to the E-Field processor main board at terminals 7 and 8. There is also a backup 12 V battery for power failure. This battery is automatically recharged by the power supply float charging circuit. The battery is connected to pins 9 and 10 on the main board.

The 20 VAC is routed to the main board through a spark gap transzorb combination lightning protection circuitry. If the line voltage is low (80- 100 V rms) the JU2 jumper should be placed in the LLV position. For a normal line voltage (100-120 V rms) JU2 should be placed in the NLV position. Place JU2 in position HLV for high line voltage (120-135 V rms).

When using a 20 VAC transformer, JU2 should be placed in the 20VAC position. This allows the current to bypass the step-up transformer TI. The signal is then full-wave bridge rectified by CR1. The peak waveform from the bridge rectifier should be ±26 V. This signal goes to U1 for voltage regulation, and the regulated voltage at TP4 should be a stable 13.2 (12.9-13.4) VDC. An excessive drop in the +13.2 VDC supply will initiate an alarm. This +13.2 VDC charges the standby battery through the lamp DS1.

The regulated +13.2 VDC generates the ±6 VDC circuitry in the ILM module at FT109. Voltage regulation from U4 (and associated components) provide the +6 VDC output at FT111. The Q3/Q4 circuitry provides a negative clamp and a negative peak detector to produce the -6 VDC output at FT113. The ± 6 VDC outputs are used as reference voltages for supervision comparison and to provide operating voltages for the system. If either of these outputs fail a supervision alarm is produced.

B88 Board (Schematic 97433)
The input at P2-1, -2, and -3 of the model DC4415 receive 24-48 VDC. CR2 allows the current to pass through its diodes. RI, LA1, and C1 are a lightning arrestor circuit. R1, CR1, and U1 are not used in this system. L1 prevents the switching DC/DC converter signals from returning to the line. CBI protects against excessive input currents and against shorts at P4-2. The voltage is then regulated to 15 VDC. The DC/DC converter supplies a maximum of 800 mA. CR4, CR5, CR6, R3, L2, C4, C5, and C6 are not used in this system.

Signal Generator (Schematic 97426)

Crystal Y1 can be selected to provide any of a number of operational frequencies (observed at TP9). Refer to Table 7-1.

Table 7-1. E-Field Crystal Operating Frequencies

Channel	Crystal Freq. (MHz)	Operating Freq. (KHz)
A	2.4960	9.750
B	2.4652	9.630
C	2.54208	9.930
D	2.43456	9.510

Operating frequencies for E-Field processors should not be the same in adjacent zones. The operating frequencies are a function of the available power line frequency. Dual zone processors operate both zones on the same frequency.

The output of crystal Y1 is first frequency divided by 128 via U1. This signal is further divided by 2 and amplified by the U2 circuitry. The output of U2 can be seen as a 5 V square wave at FT1 12 and TP9.

The OSC OUT square wave at FT112 is sent to a field generator circuit that uses a resonant circuit containing Q10, L3, and L4 (L3 is adjustable). The opposing reaction to change in current caused by L4 results in converting the signal from a square to a sine wave. The combination of L3, C29, and C30 form a Q circuit that resonates at 10 kHz, which results in boosting the signal to approximately 300 V peak-to-peak. A sample of this signal is sent back to the ILM at FT107 and TP8 as REG IN. It is passed through a voltage divider, a peak detector, and is voltage regulated to approximately 7 VDC by U3 and associated circuitry.

The REG IN signal of TP8 is also sent through a lowpass RF filter containing L1, L2, and C28, and then out TB1-12 where it serves as the field generator signal to the field wire of the E-Field zone.

To get a sample of the field generator signal, the field generator signal is also sent through a phase inverting amplifier and lowpass filter (U5 and associated circuitry) to the asynchronous modulation (ASM) module at FT102 (LO IN). This sample signal is out of phase with the expected sense wire signal and it is used as a null-adjust reference against the sense wire input signal.

System Monitoring

Each processor has alarm output reed relays for monitoring supervision, power status, and intrusion alarms. The single zone processor has one set of these relays, while the dual zone processor has separate supervision and intrusion alarms for each of the two zones that it monitors.

Intrusion Monitoring

Intrusion monitoring involves evaluating the signal received from the sense wire to determine if an object, in the mass/motion range of a human, is disturbing the detection field. Refer to Figure 7-2 for a diagram of E-Field intrusion logic.

Because of stray capacitance, the coupling between field and sense cables imposes a 90 degree phase shift between them. The phase-shifted signal of the sense wire enters the processor at pins 16/17 (lightning protection is provided at this point). The field generator sample signal is shifted 90 degrees by C34 and U5 to compensate for the shift caused by stray capacitance. The output of U5 can be seen at FT102. A second sample (same phase) is taken from FT102 and fed to the nulling point FT101 through the null-adjust resistor R70. The signal on the sense wire is shifted 90 degrees from the field generator signal because of the stray capacitance between field and sense wire. The sense filter shifts it an additional 180 degrees. The output of the sense filter is at FT101 and it is 180 degrees out of phase with the sample signal at FT102.

While the E-Field wire signal strength is in the 300 V range, and the sense wire signal strength is in the millivolt range, the field generator sample is roughly the same as the sense wire input signal, with the null-adjust used to allow the signals (with no field disturbance) to cancel out for a steady DC input to the ASM circuitry at FT101.

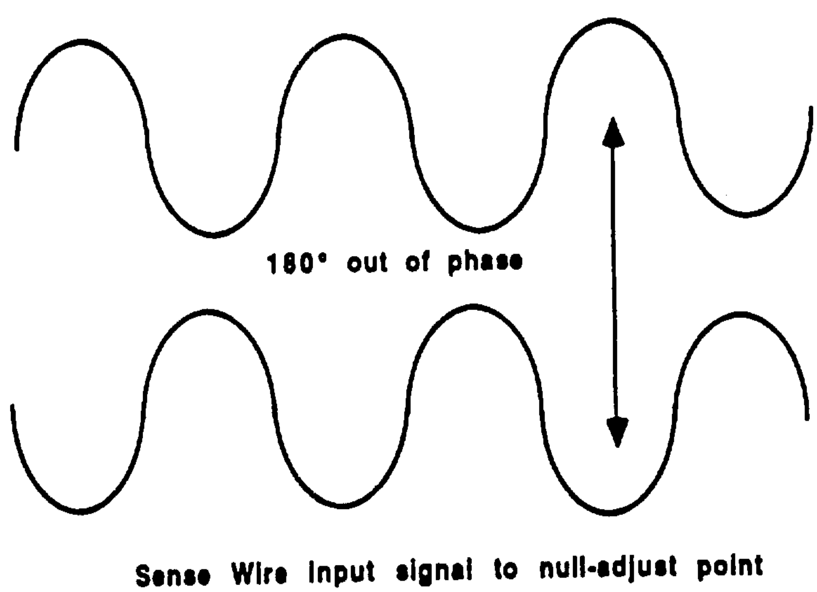


Figure 7-1. Signal Nulling

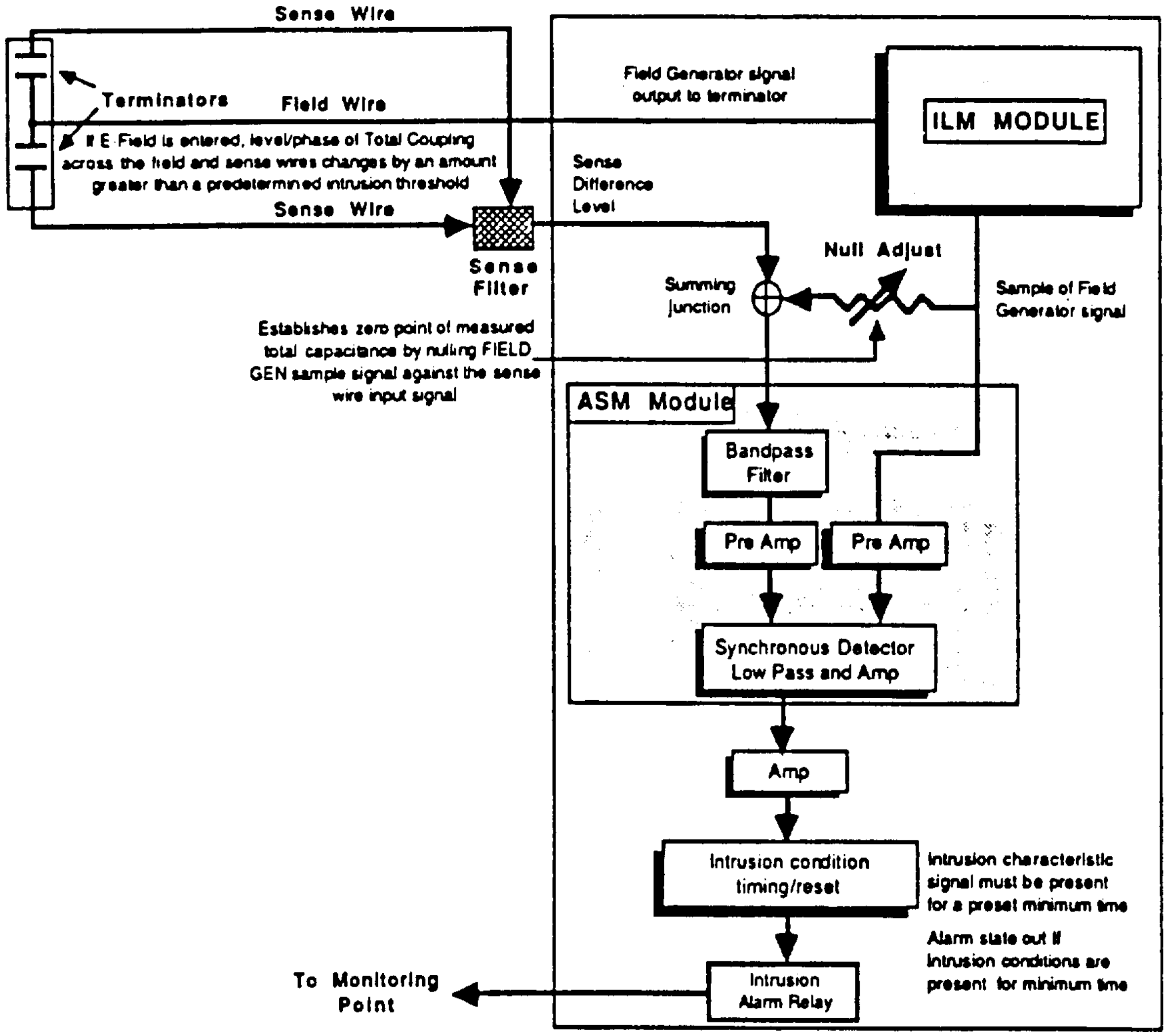


Figure 7-2. Intrusion Logic

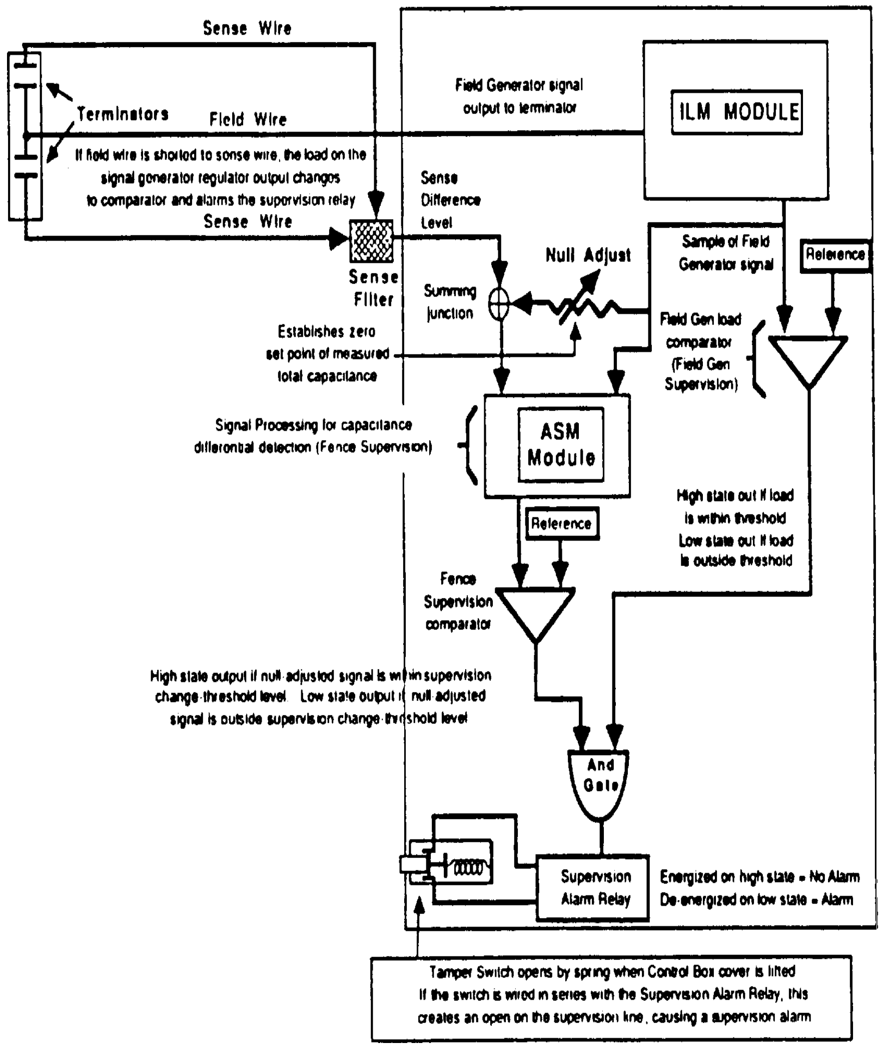


Figure 7-3. Supervision Logic

After the combined signal has been null-adjusted, the signal is zero when there is no disturbance to the E-Field. At this point electrical activity is presented only when there is a change in coupling between the wires. This signal contains information representing:

Change Amplitude	Reflects the mass of an intruder and his proximity to the field.
Change Rate	Reflects the movement of the intruder.
Time Duration of Change	Reflects the length of time the intruder is moving in the field.

The ASM module processes this input to extract activity that corresponds to an intrusion-type disturbance. Input to FT101 is bandpass filtered by C1, C2, L1 and L2. Next it is amplified and shifted 240 degrees by the synchronous detection segment of the ASM. The input to FT102 is phase-shifted 240 degrees, amplified, and input to the synchronous detection circuit.

The synchronous detector (U1, Q1 and U3) use Q1 as a half-cycle detector, and chops the signal input so only frequencies in the 10 kHz range can be integrated through U3. In-coming signals will cancel out over time if they are not approximately 10 kHz, and not in phase with the local oscillator, so only synchronous 10 kHz input will be continuously integrated.

The signal at U3-6 resembles a full-wave rectified amplifier input signal. The combination of bandpass filter and synchronous detector have a gain of 30 times. The output of the synchronous detector is integrated (or averaged) and amplified 3.5 times through a lowpass filter. The total gain of the ASM module is approximately 40 db. Next the signal is sent back to the main board. Under nulled conditions signals of approximately zero volts can be observed at TP2 when the field coupling is undisturbed. The ASM output at TP2 is used for supervision and intrusion detection.

The ASM output signal enters the bandpass filter/amplifier circuit and the main board at R22. It is AC coupled to the input of U3 pin 3. Jumper JU1 is a low-corner frequency adjustment with three positions corresponding to 0.1 Hz, 0.01 Hz, and 0.004 Hz. Sensitivity to slow-moving intruders is increased when using the .01 Hz and 0.004 Hz settings, but the system may then be more susceptible to slowly changing environmental conditions. The high cutoff frequency of the bandpass filter is 3 Hz.

The high bandpass filter/amplifier circuit has a variable gain controlled by a 12 position switch (S 1). (S2 duplicates the function of S I and is used with the front panel.) The switch gain varies from 43 db (position 1) to 62 db (position 12), producing a strength line curve with a slope of 1 (45 degree inclination). Table 7-2 illustrates switch positions versus the gain for each setting.

Table 7-2. Switch Position vs Gain

SWITCH POSITION	GAIN IN DB ± 10 %
1	43
2	48
3	50
4	53
5	54
6	56
7	57
8	58
9	59
10	60
11	61
12	62

If intrusion-characteristic electrical activity is received from the ASM circuitry, an activation-state input is present at U3 pin 3. This activation signal will exceed the threshold of the comparator reference voltage 1.3 VDC at pins 10 and 13 of U4, which will turn on Q3. This produces a +5.6 VDC pulse at the collector of Q3. The pulse is integrated by R36 and C24. If the integrated signal exceeds the threshold of 4 VDC set at U4-3, the output U4 pin 1 drops from +6 to -6 VDC. This results in triggering the alarm duration circuit of U4 pins 5, 6, and 7. The time it takes the signal at U4 pin 2 to integrate from 0 to 4 VDC is the critical time an intruder must be present and moving in the field to initiate an alarm.

Activation of U4 will occur only if intrusion-characteristic activity is present for a minimum of 0.14 seconds. This selected time duration was designed so even an intruder running and leaping at top speed will be detected. In this situation relay K3 will de-energize to indicate an intrusion alarm. C27, R47, and R99 control the duration of the alarm condition on the relay. R99 varies the alarm duration from 1.2 seconds to 5 seconds. When an alarm is generated a FET grounds the input signal to the OP amplifier U3, and allows a quick discharge of C12 through R22.

Supervision Monitoring

Supervision monitoring for single zone processor (model `EF-810`) and zone 1 of the dual zone processor (model `EF-820`) react to four types of activity.

- *If an intruder shorts a field wire to ground,* or to a sense wire anywhere along the zone, the monitoring circuitry of the `FG REG` will immediately detect a load change to the field generator and `U2-1` will de-energize supervision relay `K2`.
- *If an intruder cuts a field wire or cuts or shorts a sense wire* in the zone, the supervision comparator circuitry will immediately detect a large change from zero null in the ASM output and `U8` or 14 will de-energize supervision relay `K2`.
- *If an intruder attempts to* lift *the cover on the processor,* a tamper switch inside the cover will become electrically open and cause a supervision alarm `K2`.
- *If there is a power outage, or a failure in the system detection circuit hardware,* then power status relay K1 will de-energize and an alarm will be activated. In this case the processor will also switch to battery backup operation automatically.

If the supervision relay is not energized a supervision alarm state exists. The relay operates in a failsafe mode which means:

- The processor must have power to energize the relay (can be battery backup power).
- The ILM module's ±6 V output must be operational (as monitored by the supervision comparators) or the relay will not be energized.
- The field generator and ASM signals (monitored by the supervision comparators) must be in the acceptable range or the relay will not be energized.

When all of the above conditions are met there is no supervision alarm. If any of these conditions are not met there is an alarm. The comparator circuitry of U2 (on the main board) must receive proper input from the following sources before it will energize K2 (non-alarm).

- U2 pin 2 receives the REG OUT signal from FT108. This must be less than zero volts.
- U2 pins 9 and 12 receive null-adjusted signal from FT105 (TP2). This must be ±2 VDC.
- U2 also operates on the ± 6 V output of the ILM, which must be present.
- Tamper switch should be in the closed position (K2).

If any of these signals are not in range the comparator will shut off Q1, and will de-energize K2, causing an alarm.

Power Status Supervision

The power status relay is monitored at TP1 pins 1, 2, and 3. This relay is in a non-alarm state only when it is energized. After the 20 VAC primary power to pins 7 and 8 has passed through the step-up transformer T1, it is trapped from TI-8 through CR5 to energize relay K1. If power is not present the relay cannot be energized and an alarm condition is created.

The loss of primary power to the processor should not cause a supervision or intrusion alarm. The power status relay will indicate that the processor has switched to battery backup, allowing several hours to re-establish power. When power returns the battery will recharge automatically.

Field Generator Supervision

If an intruder shorts a field wire the field generator circuitry load will change, causing the reference voltage from REG OUT to move out of tolerance to U2 on the main board. When this happens Q1 will not be driven, and relay K2 will de-energize causing a supervision alarm. If there is a significant increase to the resistive load on the field generator circuit, as might occur with a buildup of salt or other impurities on the field wire, the REG OUT signal will move out of tolerance to U2 and a supervision alarm will result.

Fence Supervision

If an intruder cuts a field wire or cuts or shorts a sense wire, the signal received from the sense filter will change significantly. The null-adjusted input to the ASM will also change significantly. With the signal deviating this much the ASM output (at TP2) to comparator U2 will move well out of tolerance. When this happens Q1 will turn off, and relay K2 will de-energize causing a supervision alarm.

Tamper Switch

The tamper switch is connected in series with K2 and Q1 via TB2-20, 21. When the tamper switch is opened, K2 will lose power and de-energize causing a supervision alarm. The tamper switch can be in any of three positions. When the processor cover is closed the switch is in position A. In this position it acts as a short. No supervision alarm is activated. If the cover of the processor is opened the switch moves to position B. When in position B it produces a supervision alarm. If the processor is going to be left open for inspection or maintenance purposes, the tamper switch control button can be pulled up into position C. In position C the tamper switch also acts as a short and will not cause a supervision alarm.

Lighting Arrestor (Schematic 97426)

Single and dual zone processors are equipped with complete lightning arrestor units which offer protection against false alarms and component damage due to lightning. The lightning arrestor contains both transzorbs and gas discharge tubes for protection. Transzorbs are very fast acting and will clamp the initial fast rise transient to an acceptable level. Gas discharge tubes have a very high current rating capable of dissipating the bulk of the transient energy.

Spark gaps and transzorbs are mounted in parallel, with a series resistor between them for isolation. Lightning protection is included on all relay contacts, 16-20 VAC input terminals, sensor input, and field generator output.

Surge life for the spark gaps is a minimum of 50 surges, with a 500 amp 0.01 microsecond pulse. Power rating for the transzorbs is 1500 watts of peak pulse power dissipation at 25 degrees centigrade, with a 0.01 microsecond waveform. Forward surge rating is 200 A, 1.12 second at 25 degrees centigrade. Maximum clamping voltage for the 36 V transzorb is 52 V; for the 12 V transzorb it is 17.3 V maximum residual voltage.

RFI/EMI Protection

ASM module input is protected by a four-pole bandpass filter. The filter's steep rolloff (of 20 db/octave (67 db/decade) on both sides of the resonance frequency) provides good rejection of frequencies outside the 3 db bandwidth. At 9.75 kHz (the resonance frequency) the impedance of the sense wire to ground is low, which keeps RFI pickup on the exposed sense wire to a minimum. The ASM synchronous detector circuit only allows frequencies in the 10 kHz range (resonance frequency) to be integrated through U3.

To protect the system against transients (such as lightning induced EMI) the ASM sensor circuitry and the clock of the ILM generator circuit are encased in well grounded and shielded modules. In addition, all inputs and outputs of the processor main board are protected by transient protection circuitries. Refer to Figures 7-4 and 7-5.

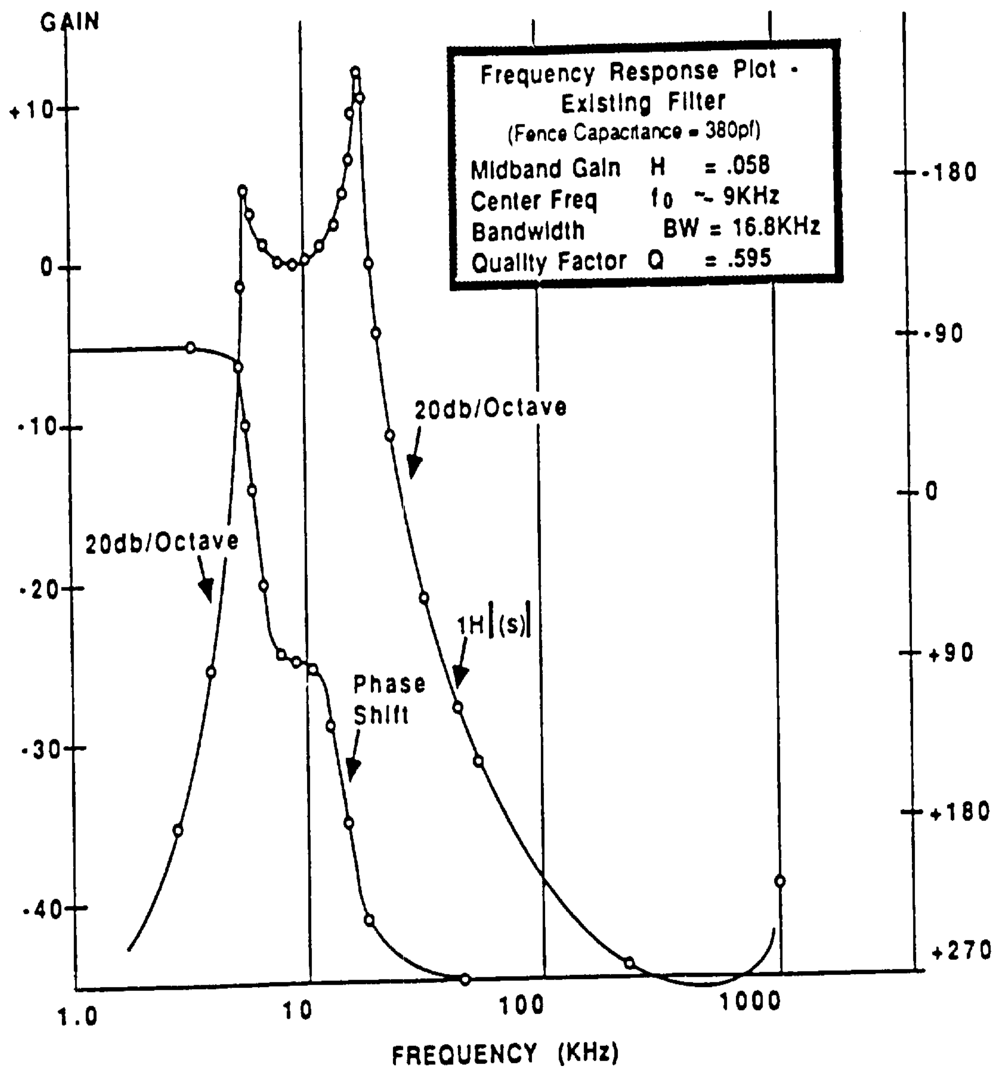


Figure 7-4. Frequency Response Plot

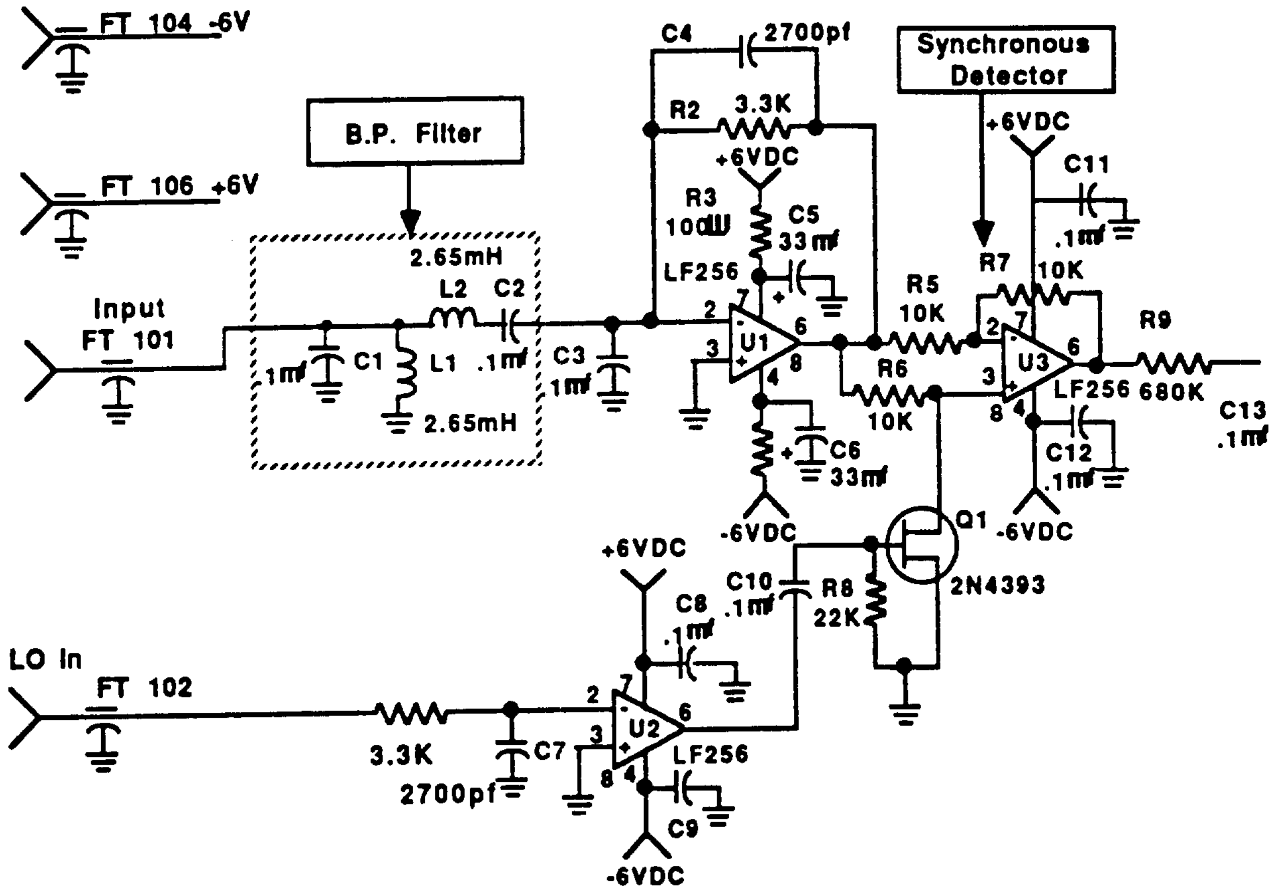


Figure 7-5. ASM Module Synchronous Detector

The frequency of the main clock crystal ranges from 2.496 MHz to 2.528 MHz, depending on the selected crystal. The signal of this frequency is kept at low voltage level (13 Vpp maximum). The signal is divided by 128 to produce 19.5 kHz. Finally it is divided by 2 to produce the operating frequency from 9.750 kHz to 9.875 kHz. The signal leaves the ILM module as a 6 VDC square wave. The signal circuitry module is well grounded and shielded to prevent these signals from radiating externally. For further protection the entire processor is encased in a well grounded NEMA-4 enclosure.

The operating frequencies for 60 Hz. are 9.510 kHz, 9.630 kHz, 9.750 kHz and 9.930 kHz. These operating frequencies were selected to fit between the harmonics of 60 cycles. For example, the frequency of 9.750 kHz is in the exact middle of the 162nd and 163rd harmonic of 60 cycle to prevent exiting the filtering circuits and causing false alarms. The harmonics of the E-Field signal will not cause interference on neighboring 60 cycle power lines.

The I/0 of ASM and ILM modules is protected by 1000 pf feed-through (bypass) capacitors to filter out high frequency interference.

Dual Zone Processors (Schematic 97433)

In the dual zone processor (model EF-820) the B88 board is added to the main board. In a dual zone processor the main board provides:

- All power supply operating voltages
- Power status monitoring
- Field wire signal generation
- Field generator supervision
- Fence supervision and intrusion detection for zone 1

The added B88 board provides:

- Intrusion monitoring for zone 2
- Fence supervision for zone 2

The B88 board receives operating voltage and field generator input from the main board, and provides a sense input for zone 2. The B88 takes the field generator signal and inputs a signal sample to a null-adjust input and the zone 2 sense wire input. The combined signals are adjusted to provide a zero reference level. This null-adjusted signal is input to an ASM identical to the ASM on the main board. The ASM processes the signal to be used for intrusion and fence supervision for zone 2. Separate relays for these functions are provided on the B88 board.

Fence Supervision Monitoring (zone 2 of EF-820)
Fence supervision is activated on the B88 board if an intruder cuts a field wire, or cuts/shorts a sense wire in zone 2. If this happens the signal from zone 2 will change and cause the null-adjusted output of the ASM to change. With the signal deviating significantly the ASM output (TP6) to the comparator (U3) will move out of tolerance. When this occurs Q8 will not be driven, and relay K2 will de-energize, causing a zone 2 supervision alarm.

Alarm Monitoring
Jumper JI on the zone 2 board allows a zone 2 alarm to trip the zone 1 alarm relay also. The Sonalert circuit is shared by the two zones. An alarm in zone 1 or 2 will activate the Sonalert.

Processor Front Panel

The front panel processor is the interface between the user and E-Field board. The panel contains:

Power switch and LED	Red LED is lit when power is ON.
Sonalert switch	Switches the Sonalert audio signal ON or OFF.
Test point selector switch	Selects test points to display by front panel micrometer.
Sensitivity switch	Controls sensitivity of zone by altering gain of signal.
Tamper switch	When the enclosure cover is opened the tamper switch is activated.
Panel meter	Displays signal level of test points selected with TP selector switch.
Test point definitions	These are tabulated at bottom of front panel. They define, designate, and set expected reading levels for each point.
Front panel board	The board mounted under the processor board is interface between the E-Field board and front panel.

Front Panel Interface Board (Schematic 97425)
The interface board is mounted on the back of the front panel under the main board. It is the interface between the front panel and the main board. It channels power from an external transformer or battery to the main board. It has a test point selector switch and the handle of this switch appears on the front panel. Power used for this system is 20 VAC and/or 12 VDC battery. These voltages enter the front panel board through the connector P1.

When using the 20 VAC transformer, current enters the front panel interface board through P1-2 and P1-1. The current path of P1-2 is switched at the front panel then directed through the interface board to TB 1-7 (low AC in) on the main board. The selected position of JU2 depends on the amplitude of the AC signal. J5 on the interface board should be removed for this option, otherwise U1 on the main board will not regulate the voltage. The current path of P1-1 is directed to TB1-8 (low AC in).

The battery is connected to P1-6 (GND) and P1-5. Its current is switched at the front panel then directed to TB1-10 (battery input) on the main board. If the power switch is closed on the front panel, the power LED will light because of the battery current, or because of the current coming from the output of Ul.

All main board test point currents are fed to the front panel interface board. Next the current is run through preselected resistors to bring their values to approximately 30 mA (30 divisions on front panel meter). The test points are selected using the front panel selector switch. The Sonalert on the front panel is switched, then directed through the front panel interface board to the Sonalert output of the main board.

Introduction

The AND Gate module (model 2451) is a bi-directional device which ANDs the output of two redundant sensors. ANDing sensors, during some preset time interval, results in maximum probability of detection (PD) with minimum false alarm rate (FAR).

The preset time interval depends on specific sensor characteristics (PD and FAR) as well as the distance between sensors. The time interval is variable from 15 to 120 seconds.

Specifications

Relay	Form C
Contacts	Rated @ 3 W @ 0.25 A or 28 VDC
Resistive Load Time Interval	0.25 to 2 minutes
Voltage Input	+ 12 VDC
Current	25 mA maximum

Installation and Operation

1. Install in existing processor where annunciator leads are currently wired.
2. Mount on inside surface using standoffs.
3. Wire NO and COM alarm relay inputs as shown in Figure A-1.
4. Wire AND relay output (NO, NC, COM) for direct or supervised contacts.
5. Connect +12 VDC power using +12V from existing sensor terminals.
6. Connect motion meter/Sonalert (model 2391) lead RED to TB1 pin 2 of AND module.
7. Connect black lead to TB1 pin 8, or a convenient chassis ground.
8. Alarm only one sensor by performing a walk test.
9. Time the duration of the sonalert tone.
10. Adjust R4 for desired time duration, variable between 15 and 120 seconds.
11. Walk test system and verify proper operation with an AND alarm condition being generated upon disturbance of both sensors within the preset time interval.
12. Readjust sensitivity of individual sensors where necessary.

The nominal time delay for sensors spaced more than 1 meter apart is 1 minute. This eliminates the chance of defeat by a slow moving intruder, because the required rate of penetration would be exceedingly slow. Overlapping zones will enhance the probability of detection. Overlapping detection zones is achieved by maintaining a separation of < 1 meter between active sensors.

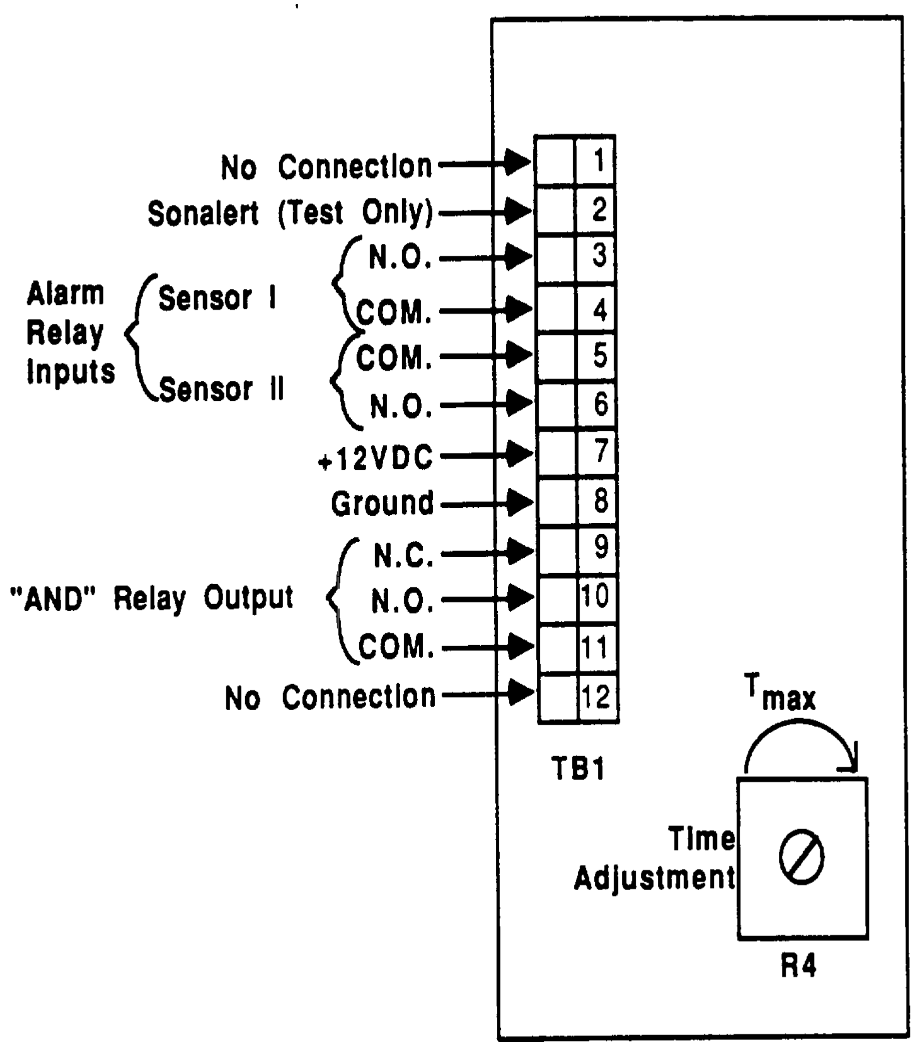


Figure A-1. AND Gate Module

APPENDIX B
MPS-12 UNIVERSAL POWER SUPPLY

Introduction

The MPS-12 Universal Power Supply is a safe economical method of providing distributed direct current (DC) and connecting twelve or more sensor processors to a central power distribution and status monitoring point, up to one mile distant.

NOTICE

The MPS-12 Power Supply is under development. Please contact Stellar Security Products, Inc. for information about available power supplies.

Introduction

The intrusion simulator (model TE-18) is used with the E-Field system (Series 800). It adjusts system sensitivity to intruder motion. Sensitivity adjustments generally require several intrusion tests, and some operational time, to evaluate nuisance alarm rate. The proper sensitivity setting is the minimum setting that adequately detects intruder motion. To maintain proper operation, sensitivity should be checked periodically.

The intrusion simulator simulates an actual intrusion by producing extremely small step changes, characteristic of a human intruder, in coupling between the field and sense wires. Coupling changes are measured in femtofarads (1 ff = 1 x 10 -15 farads). Capacitance steps are adjustable from 25 ff to 350 ff in 25 ff increments, which covers the normal range for intruder motion.

Using an intrusion simulator it is easier to establish and maintain optimum sensitivity requirements. During initial configuration of a single E-Field zone, a series of intrusion tests are performed to determine the optimum sensitivity setting. The intrusion simulator is connected to the E-Field zone. Magnitude of capacitance steps is increased until a desired fixed magnitude of meter deflection is achieved at TP1 (or TP5 for dual zone). Future sensitivity checks and adjustments are performed by switching the simulator to the predetermined setting and initiating a simulated intrusion. Sensitivity is again adjusted to produce the required meter deflection as measured at TP1 (or TP5 for dual zone).

Multiple zones can be configured without additional intrusion tests, providing the E-Field fence configuration remains the same (equal number of wires, approximately the same zone length and soil conditions). For example, if sensitivity is initially adjusted on a free-standing four-wire E-Field fence, additional free-standing four-wire fences of similar configuration can be adjusted without additional intrusion tests. Intrusion tests should be repeated, however, for a four-wire fence-mounted configuration because there is a capacitance difference between free-standing and fence-mounted systems.

Experimental Adjustment

Large E-Field perimeter sensor installations require multiple processors to obtain total coverage. Intrusion sensitivity must be determined experimentally on at least one of the perimeter processors to satisfy individual customer requirements.

Refer to Section 5 and adjust the sensitivity of a single zone to obtain optimum performance. This may require various types of intrusions, and some operational time, to assess the nuisance alarm rate (NAR). Remember, the proper sensitivity setting is generally the minimum setting that will still adequately detect intruder motion.

Experimental adjustments need not be repeated for the second zone of a dual zone processor providing the E-Field fence configuration does not change.

Calibration Procedures

This calibration procedure is for sensitivity adjustments of Series 800 processors. Refer to Figure C-1 for location of connections and test points.

1. Connect simulator (model TE-18) red leads between the field generator output terminal TB 12 and the sensor input terminal TB16 or TB17.
2. Connect the black lead to ground terminal TB18, and to the sensor input terminals.

3. Set front panel test point selector to TP 1 and turn on sonalert switch.

The simulator is now connected to a processor experimentally calibrated for optimum sensitivity.

4. Depress the ON/OFF switch. A step change in coupling will be produced to simulate an intrusion measured in femtofarads that is determined by the HI/LOW and rotary switch positions.
5. Increase magnitude of the capacitance step until depressing the ON/OFF switch results in a deflection of 30 ± 4 microamps on the front panel meter.
6. Record the sensitivity setting in femtofarads, and meter deflection in microamps. To eliminate erroneous readings, avoid excessive deflections (greater than 36 microamps) that result in an alarm condition. To obtain the approximate alarm threshold coupling change, multiply the resulting sensitivity setting by 1.20.

The meter indication measured at TP1 will normally fluctuate around zero when the field is undisturbed. Before depressing the ON/OFF switch be sure the meter indicates ± 5 microamps. The initial meter reading should be added to, or subtracted from, the final meter indication accordingly to obtain the absolute deflection.

Deflection measured at TP1 can be positive or negative if the switch is turned on or off. Polarity should be disregarded, however, since the magnitude of deflection is the only parameter of interest.

Calibrating Additional Zones
Following the calibration for a single zone processor, additional zones can be calibrated or checked by connecting the simulator and adjusting the processor sensitivity to obtain a front panel meter deflection equal to the first zone.

Calibration of zone 2 for dual zone processors is identical to zone 1 except:

1. Connect red leads of the simulator between the field generator output terminal (TB 12) and the sensor input terminal of the zone 2 board (TB33 or TB 34).
2. Connect the black lead to ground (TB35) of the zone 2 board.
3. Set front panel test point selector to TP5.

Operational Checkout
After calibration disconnect the simulator from the processor. Check the null measured at TP2 (TP6 for dual zone processors). If necessary, renulled system for meter reading of zero. Refer to Section 6 for nulling details.

For periodic sensitivity testing the intrusion simulator can be permanently mounted in the processor enclosure. If desired, remove the alligator clips from the TE-18 leads and replace them with crimp-on spade lugs. Connecting the intrusion simulator will result in an unbalance of the system null. For long term use it is best to null the system with the simulator attached, or renull after attachment.

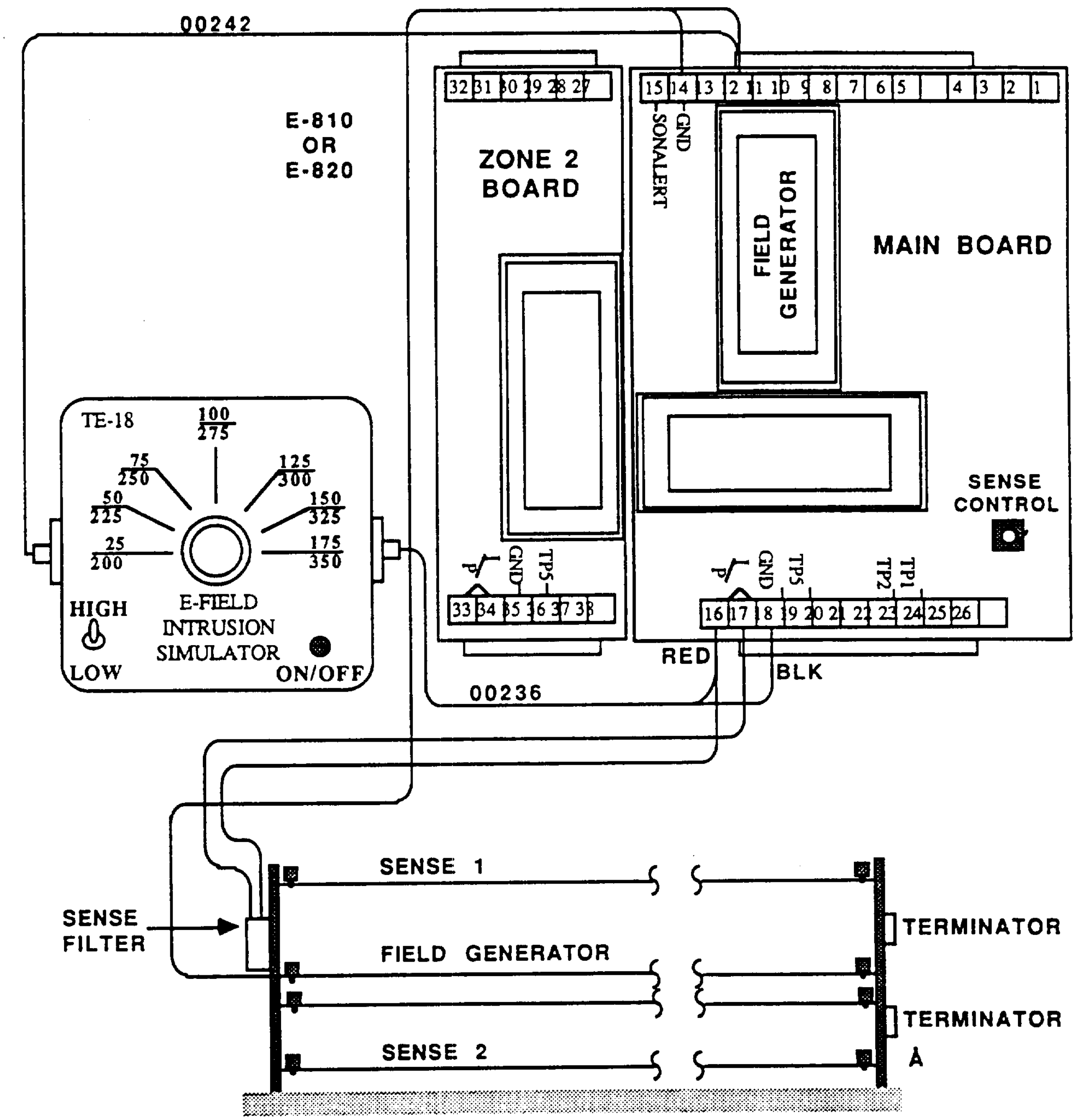


Figure C-1. Zone 1 Calibration and Connection

E-Field Series 800

MODEL NO.	DESCRIPTION
EF810-115 or 230	Hi Rel single zone processor with indicator panel, sense filter, crystal lightning arrestors, transformer and battery in steel NEMA 4 enclosure
ESC-816	Spare Hi Rel single zone processor PCB on baseplate with four plug-in crystals - Spare for EF-680
ESC-818	Spare Hi Rel single zone processor PCB on indicator panel with four plug-in crystals - Spare for EF-810
EF-820-115 or 230	Hi Rel dual zone processor with indicator panel, sense filters, crystal lightning arrestors, transformer and battery in steel NEMA 4 Enclosure
ESC-817	Spare Hi Rel dual zone processor PCB on baseplate with four plug-in crystals - Spare for EF-682
ESC-819	Spare Hi Rel dual zone processor PCB on indicator panel with four plug-in crystals - Spare for EF-820
To Replace Existing EF-32/EF-610/EF-680	Order one ESC-816, one 8333 sense filter and the appropriate terminators from the accessories list
To Replace Existing EF-32/EF-620/EF-682	Order one ESC-817, two 8333 sense filters and appropriate terminators from the accessories list

MANUALS	DESCRIPTION
Zone Element Guide	Part Number 96044 - Description of hardware elements required for a variety of fence mounted, free-standing and building-mounted systems.
Installation Manual	Part Number 96047 - Detailed information for Series 800 processors, and Series 5000 hardware.

Accessories - All Series

MODEL NO.	DESCRIPTION
2331-4	Standard sense filter - Series 600
2333-4	Balanced phase sense filter - Series 600
2348-4	Universal tapped terminator - Series 600
2349-4	Dual alarm relay
2352-3	Remote test terminator (12VDC)- Series 600
2361-2	Wire, coated 305 stainless steel 1,000 ft. (300m) per roll
2373	Interconnecting lugs (lots of 100)
2382	Wire, uncoated 305 stainless steel 1,000 ft. (300m) per roll
2391	Motion meter with Sonalert
2451	AND gate module for logical sensor combinations
2500	Test cable - Series 680 and 800
3131-3	Drain coil assembly (3 coils and enclosure)
8333	Sense filter - Series 680 and 800
8348	Terminator - Series 680 and 800
8349	Terminator - Series 680 and 800
8358	Remote test terminator (12VDC) - used in place of model 8348
8359	Remote test terminator (12VDC) - used in place of model 8349
MC-20	Standby battery enclosure and junction box includes triplex receptacle, terminal strip and provisions for accessories
63002	Standby battery - 2.6 amp per hour
TE-IF	Intrusion simulator

Terminator set for a balanced phase E-Field zone for Series 680 or 800 - one each model 8348 or 8358, and one each model 8349 or 8359

Series 5000 Hardware

MODEL NO.	DESCRIPTION
2350	Spring
5001	Insulator assembly, interim
5012	Terminal boot kit
5013	Connecting link
5014	Winder
5015	Mounting bracket - adjacent free-standing start/end points
5016	Mounting bracket - adjacent fence-mounted start/end points
5017	Corner point extender - fence-mounted hardware
5020	Insulator assembly, tension
5101-1 Straight	Round pole fence-mounting hardware kit
5102-2 45º	Fence fabric opposite side
5102-1 Straight	Round pole fence-mounting hardware kit
5102-2 45º	Fence fabric same side

Four-wire Balanced-Phase Free-Standing Sets

Start point	4WFS-SP
End point	4WFS-EP
Tension point	4WFS-TP
Interim point	4WFS-IP
Corner point	4WFS-CP
Adjacent start/end point	4WFS-SP/EP
Adjacent dual start point	4WFS-SP/SP
Adjacent dual end point	4WFS-EP/EP

Three-wire Balanced-Phase Fence-Mounted Sets

	3-Wire/Fabric Opp Side	**3-Wire/Fabric Same Side**
Start point	3WFM-SP-OS	3WFM-SP-SS
End point	3WFM-EP-OS	3WFM-EP-SS
Tension point	3WFM-TP-OS	3WFM-TP-SS
Interim point	3WFM-IP-OS	3WFM-IP-SS
Corner point	3WFM-CP-OS	3WFM-CP-SS
Adjacent start/end point	3WFM-SP/EP-OS	3WFM-SP/EP-SS
Adjacent dual start point	3WFM-SP/SP-OS	3WFM-SP/SP-SS
Adjacent dual end point	3WFM-EP/EP-OS	3WFM-EP/EP-SS

Four-wire Balanced-Phase Fence-Mounted Sets

	4-Wire/Fabric Opp Side	**4-Wire/Fabric Same Side**
Start point	4WFM-SP-OS	4WFM-SP-SS
End point	4WFM-EP-OS	4WFM-EP-SS
Tension point	4WFM-TP-OS	4WFM-TP-SS
Interim point	4WFM-IP-OS	4WFM-IP-SS
Corner point	4WFM-CP-OS	4WFM-CP-SS
Adjacent start/end point	4WFM-SP/EP-OS	4WFM-SP/EP-SS
Adjacent dual start point	4WFM-SP/SP-OS	4WFM-SP/SP-SS
Adjacent dual end point	4WFM-EP/EP-OS	4WFM-EP/EP-SS