Southwest Microwave, Inc.

Security Systems Division

INTREPID™

MicroTrack™ II

A BURIED TERRAIN-FOLLOWING
OUTDOOR PERIMETER INTRUSION DETECTION SYSTEM

MicroTrack II Installation and Operation Manual

SOUTHWEST MICROWAVE

Version 0

INTREPID™ MicroTrack™ II Software

Southwest Microwave Inc. thanks you for your purchase of the INTREPID MicroTrack II System. Please refer to the Universal Installation Service Tool II (UIST II) for the software setup of this sensor.

There is one disk required to setup the system**.**

1. Universal Installation Service Tool II (UIST II) Software

   This software is used to configure and set-up the system as well as being used for maintenance and troubleshooting the system.

Basic Tools Required for Installing the MicroTrack II System

The basic tools and materials required for installing the MicroTrack II system are:

- Laptop computer running Windows XP Pro, Vista Pro or 7 Pro™
- Basic hand tools (screwdrivers, wrenches, cutters, etc.)
- Soldering gun (100 watt minimum)
- Inverter with battery or AC source for the soldering gun
- Multi-meter
- Goo Gone, WD40, Xylene, Kerosene or Mineral Spirits to remove the flooding compound on the MicroTrack sensor cable
- Trencher, shovels and bobcat
- Marking paint, string, stakes and tape measure
- Tools for installing conduit in a metal enclosure
- Pole to un-spool the MicroTrack sensor cable

Trademark and Regulatory Notice

FCC Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense. FCC ID: CA6MTP

NOTE: changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

CE Notice

This equipment has been designed and tested to meet EN 6950-1, EN 300-330-1, EN 300-330-1-7.2, EN 300-330-1-7.4.2 and EN 300-330-1-8.2.

Patent Notice

Southwest Microwave Inc. intellectual property in INTREPID and MicroTrack is protected by the following patents:

USA 6,577,236,B2

Patents are pending in many counties of the world.

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1. Introduction

Welcome to Southwest Microwave Inc.'s new buried cable outdoor perimeter intrusion detection system – MicroTrack™ II – the most advanced buried cable sensor system available. MicroTrack II is the first buried cable sensor that is truly site-adaptive and can both detect and locate intruders. It is patented and it is the first outdoor intrusion detection sensor to use ultra wide band FS/PCM (frequency stepped, phase code modulated) technology.

MicroTrack II communicates with all INTREPID™ Series II devices using the INTREPID Polling Protocol II (IPP II). It also incorporates Sensitivity Leveling™, Free Format Zoning and security level settings. MicroTrack II is terrain following with the ability to go up and down hills and around corners. It provides a large invisible volumetric detection field as shown in Figure 1.1, and operates in difficult environmental conditions with a very high probability of detection and low false and nuisance alarm rate. MicroTrack II uses Multi-Segment Target Analysis (MSTA) – a new concept in sensor design enabling each sensor cable to be divided into small cells, each 7.5 feet (2.3 meters) in length, to be independently adapted to site conditions and analyzed. These new concepts allow MicroTrack II to overcome numerous limitations of past generation buried cable sensors.

The system utilizes Microsoft Window XP (.net framework required), Vista or Windows 7™ based software called Universal Installation Service Tool II (UIST II) for installation setup and service.

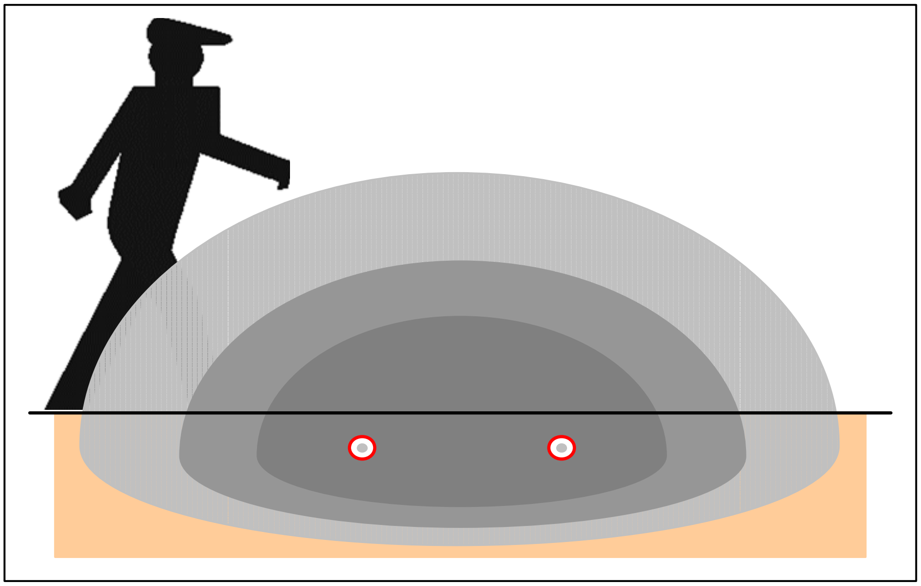

Figure 1.1 - MicroTrack II Terrain Following Detection Field

1.1 Theory of Operation

The MicroTrack II processor uses a technique known as FMCW (Frequency Modulated Continuous Wave) to determine the location of an intruder along each pair of 200-meter sensor cables. The RF transmission consists of a stepped frequency sweep. The receiver uses a combination of analog and digital processing to determine alarms and alarm location. A system overview block diagram, Figure 1.2, is provided to illustrate the detection process. The MicroTrack II processor supports two cable pairs; the processing is the same for both cable sets.

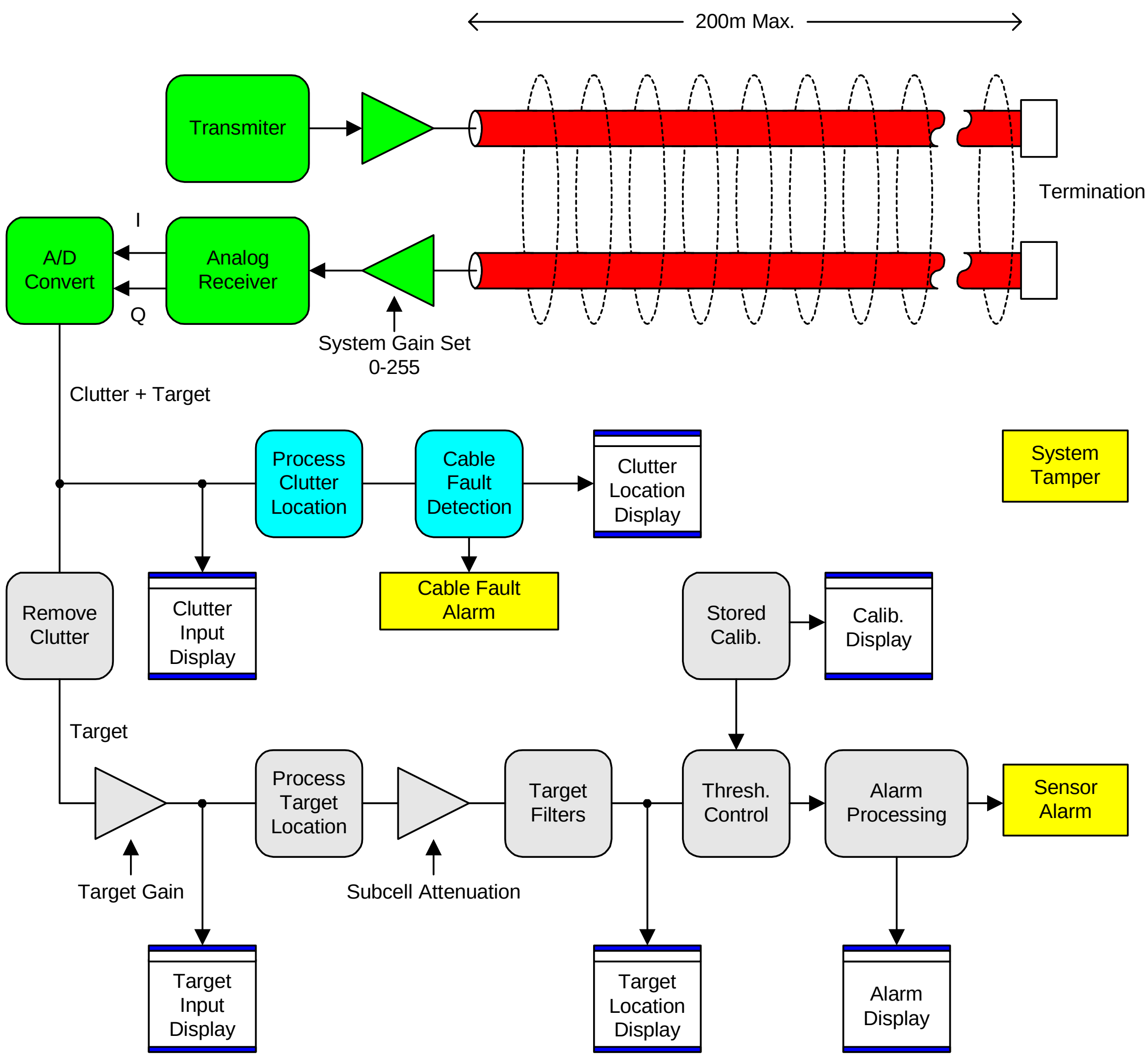

Figure 1.2 - MicroTrack II Block Diagram

A volumetric detection field is developed between cables as the processor transmits the RF sweep as shown in Figure 1.3.

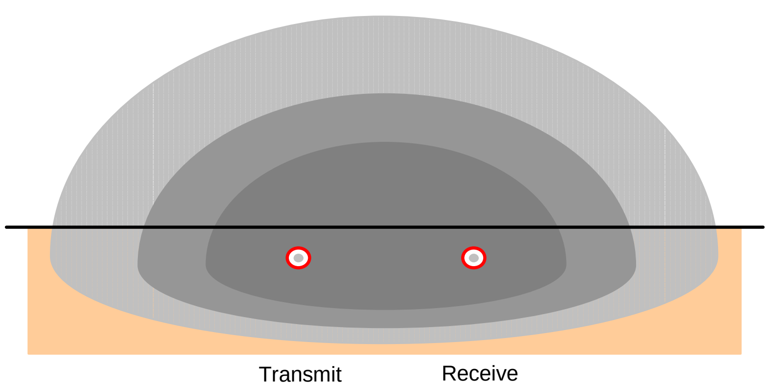

Figure 1.3 - Static Coupling between Transmit and Receive Cables

The volumetric detection field is comprised of two components, defined here as clutter and target. Clutter is the static field that is developed between the cables without a target present as shown in Figure 1.4. The target component is the change in the static clutter as an intruder enters the volumetric field. The target component is extremely small compared to the size of the clutter. The clutter is the coupling along the entire length of the cable pair whereas an intruder tends to change the coupling about a single point.

Figure 1.4 - Static Coupling along the Cable Pair

There are two waveforms on the Clutter Input screen of the UIST II representing the quadrature signals I & Q. The two waveforms are used so that magnitude and phase of the received signal may be processed in the detection algorithm. The sole purpose of this screen is to ensure that the system gain (see block diagram) of the processor is adjusted properly for the site. Since each site has individual characteristics, the MicroTrack™ II system, upon start up, adjusts the gain of the system to optimum for the receive signal level. The system gain set value may be observed on the Clutter Input screen in the upper right hand corner. The system gain level range is 0-255. A typical gain level would be between 30 and 200. The waveforms represent the clutter returned from all locations along the cable for each frequency. The next process is to determine the locations where the clutter originates.

Once the Clutter Input levels have been properly adjusted the system then processes the input signal into range data. This is accomplished using a mathematical process known as the Fast Fourier Transform (FFT). The Clutter Location screen displays the coupling between the cables as a function of distance.

The blue trace represents the actual clutter values while the red lines represent the cable fault thresholds.

The Clutter levels for sites will vary and are determined based on the soil type, burial depth of the cables and mean distance between cables, as well as other factors.

1.2 Target Processing

The predominant coupling term is the static clutter. Through the use of digital signal processing, the clutter term is calculated and removed thus leaving only the target to be processed. The Target Input displays the result of this process which is the noise of the system. The peak-to-peak level of the system noise should be adjusted to between +/- 256 and +/- 1024 counts (target range of +/- 512 counts) for optimum performance.

An intruder entering the volumetric field, as shown in Figure 1.5, will change the coupling at a single point producing a sine wave on the Target Input Display. The number of cycles that are produced on the Target Input display is a function of the distance from the processor to the disturbance. The closer the disturbance is to the processor, the fewer number of cycles are produced. Thus if a target was close to the termination as many as 17 cycles would be produced compared to a close in target that may only produce 2 cycles.

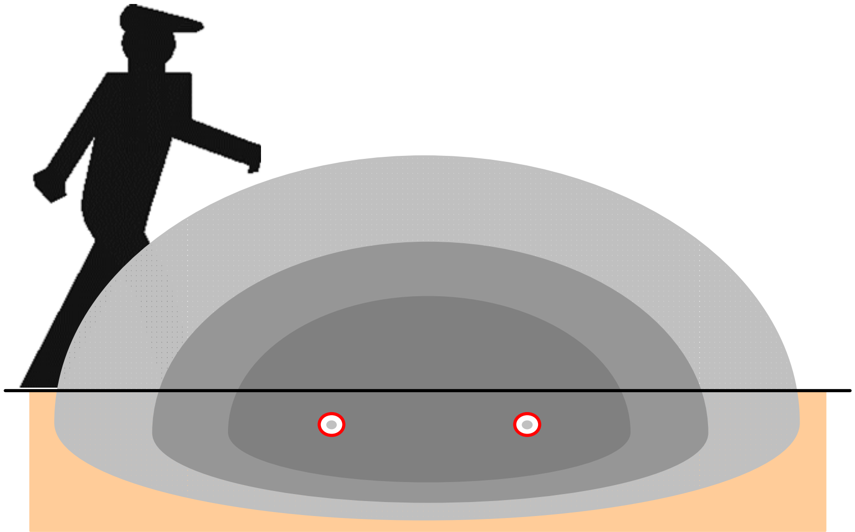

Figure 1.5 - Intruder Entering the Volumetric Detection Field

The next step is to process the Target Input values into location data. Again the Fast Fourier Transform is employed to perform this function. With no target present the resulting output is the noise level of the system as a function of range.

As the target enters the detection field the system responds by increasing the magnitude of the signal at the location of the disturbance. After further processing, the target is located to a single cell.

Calibration of the system begins with the user performing a calibration walk along the length of the cable as shown in Figure 1.6.

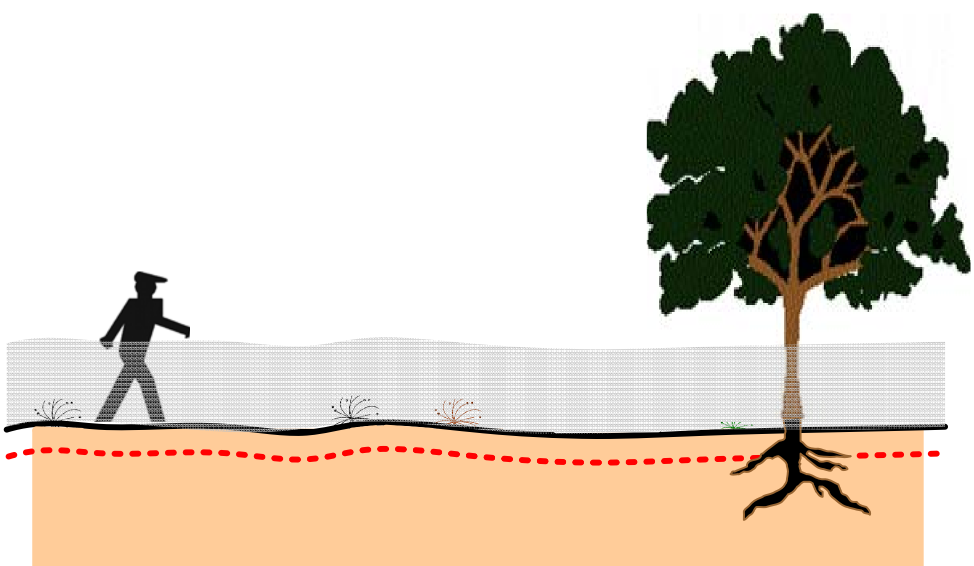

Figure 1.6 - Calibrating the System

With the system in Calibrate mode, the signal level is recorded for each position along the cable.

The calibration is saved in the processor and the threshold defined. The user has the ability to adjust the threshold either globally or incrementally. Additionally sections of the cable may be completely disabled. Figure 1.7 is an example of an intruder entering the detection field.

Figure 1.7 - Intruder entering the Detection Field

The alarm information is available by polling the MicroTrack™ II sensor. The Southwest Microwave MicroTrack II SDK -Polling Protocol Specification allows alarm, fault & tamper status to be easily accessed over RS422 data lines or direct connection by RS232 to the processor.

Additional features include the internal logging of alarms, providing magnitude & location of the alarm as well as a time/date stamp.

1.3 Features and Benefits

MicroTrack II provides a combination of features and performance benefits unequalled in other outdoor sensors. These include:

- **Invisible Detection Field** – unobtrusive and covert
- **Wide Detection Field Pattern** – volumetric high-security detection
- **Terrain Following** – follows ground contours and goes around corners
- **Target Location** – the ability to locate intruders anywhere along the cable
- **Sensitivity Leveling™** – the sensor adapts precisely to its installed environment so detection sensitivity is uniform along the entire length of sensor cable
- **Free Format Zoning** – each sensor cable set will have the capability of 100 zones per 210 meters of sensor cable, or approximately 200 zones per processor
- **Remote Diagnostics via Networks** – for quick problem resolution and lower support costs
- **Uniform Sensor Cable** – the sensor cable is identical from one end to the other for easy repair
- **Factory-Made Connections** – for high reliability. Eliminates the need to install cable connectors in the field
- **Sensor Cable Configuration** – fewer components make it easier to configure and install

2. MicroTrack™ II - Detection Characteristics

The MicroTrack II Sensor consists of the MicroTrack Processor II (MTP II) and either one or two sets of buried sensor cables (MTC400) with MicroTrack End of Line Termination (MTT) units or MicroTrack In Line Termination (MTI) units on the ends of each cable assembly.

A detection field is created around each set of sensor cables, each set having a maximum length of 200 meters (656 feet), for a total of 400 meters (1,312 feet) of coverage per MTP II. The cables are buried in sand, soil, asphalt, concrete or other burial medium. The processor uses ultra wide band FMCW transmission to create an invisible electromagnetic detection field around and along the sensor cables. The MicroTrack II Processor not only detects the presence of a disturbance to this field, but actually locates the target, allowing for such features as Sensitivity Leveling™ and Free Format Zoning. This approach provides a far superior probability of detection (Pd) and a lower false and nuisance alarm rate (FAR/NAR) compared to other sensors.

MicroTrack II is designed to detect walking, running, crawling, jumping, and rolling intruders. MicroTrack II will locate intruders to within approximately 10 feet (3.0 meters) along the length of the sensor cable set(s). It will also operate in unfavorable and changing environmental conditions including rain, wind, and fog, blowing sand, seismic effects, snow and hail. The processor unit transmits radio frequencies between 19.5 and 25 MHz through one of the sensor cables which acts as a transmit antenna, releasing energy along its entire length. The second sensor cable acts as a receive antenna and provides information about the transmit signal back to the processor. This process creates an electromagnetic surface wave moving above the ground surface and along the cables. An intruder crossing the cables changes the surface wave, thus altering the return signal on the receive cable. The processor unit compares the transmitted and received signals in terms of phase and amplitude and declares an alarm when changes occur which match a human intruder.

The shape of the detection field of the MicroTrack II sensor is determined by several factors, which includes the cable spacing, burial depth, burial mediums conductivity, and the sensitivity setting desired on the MTP II. These four items, when combined, will determine the maximum cable length recommended. Note that on high-security sites, the typical maximum zone lengths are 100 meters (328 feet).

2.1 Detection Requirements and Expectations

It is very important to begin the system design process by fully understanding the customer's security requirements. Make sure that this is the right product to meet their requirements and insure that the customer has the correct expectations. MicroTrack II is designed as a ground crossing sensor that will detect an unaided person attempting to walk, run, jump, crawl, or roll across the detection field. This product is not designed to detect bridging attempts that are above the detection field. For that, you would add microwave or IR sensors above the MicroTrack II detection field to obtain the desired detection height, while using the MicroTrack II Sensor to detect all low-level crossing attempts.

2.2 MicroTrack II Typical Detection Pattern

2.2.1 Detection Field

It is important to identify a characteristic of all volumetric detection sensors, which includes MicroTrack II. MicroTrack II is designed to detect human intruders crossing its primary detection field, as shown in Figure 2.1. It can also detect larger objects, such as moving vehicles, with its secondary detection field.

This is because a small target close to the cables will appear to be the same "size" as a larger target further away from the cables.

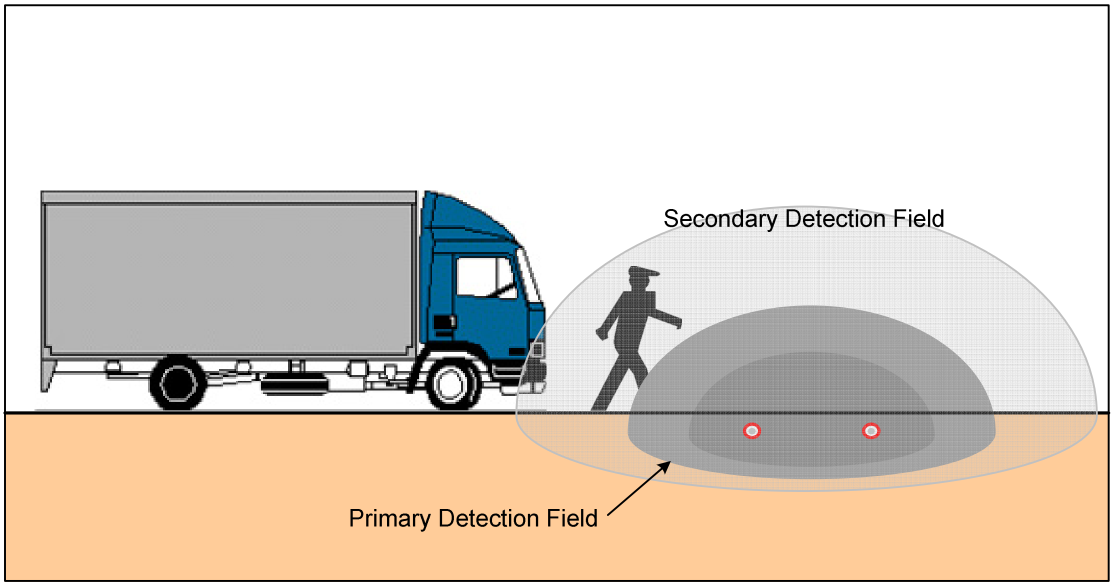

Figure 2.1 - MicroTrack can Detect Large Targets in Secondary Field

It is important to recognize the existence of this secondary field because it governs the safe distance from which MicroTrack™ II can be positioned from fences, buildings and roads without interference and potential nuisance alarms. For the remainder of this manual, the "primary detection field" will simply be referred to as the "Detection Field", which is the area in which a human intruder will be detected.

It is also important to understand the RF fields' characteristics as it travels along the cable set. The RF field begins to form where the lead-in cables are factory-connected to the sensor cables. The RF Field builds to full strength in the first 16 feet (5 meters). This is known as the "Detection Field Startup" area. The RF Field will follow the sensor cables around corners and over uneven terrain until it reaches the MicroTrack Termination. This is known as the "Detection Field". When the RF Field reaches the MicroTrack Termination, the RF Field begins to diminish. This is known as the "Detection Field Shutdown" area. The MTT shutdown is also 16 feet (5 meters) long (does not apply to MTI). The detection field startup and shutdown is shown in Figure 2.2

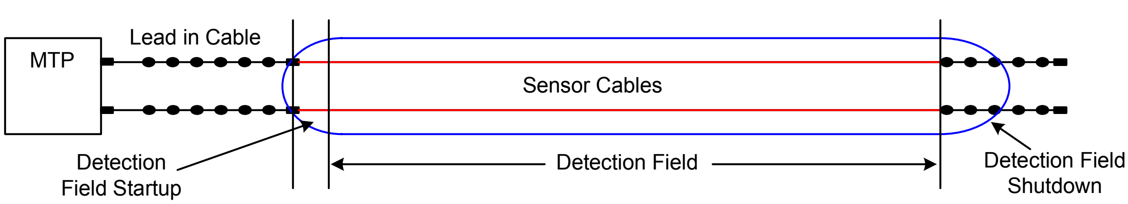

Figure 2.2 – Detection Field Startup and Shutdown (with MTT)

When two cable sets from the same MTP II or adjacent MTP II's meet at a common point, they will be connected and terminated with two MTI In Line Termination units to allow the Detection Fields to slightly overlap, forming a continuous detection zone.

2.2.2 Detection Patterns Width

Cable spacing is the main determining factor that controls the width of the detection pattern (wider cable spacing = wider detection pattern). The cables should be spaced out far enough to detect a jumping intruder, without making the pattern so wide that it detects the fence or other nuisance sources. In protecting an open area where a jumping intruder can get a running start, you will want a wider detection pattern, and therefore wider cable spacing. If the cables are between two fences that are close together, then the intruder will not be able to get a running start, so the threat has changed, allowing for a narrower detection pattern that will help to avoid nuisance sources while still maintaining the required detection level.

The cable burial depth and the burial mediums conductivity do not have a significant affect on the detection patterns width. These factors can be ignored when selecting the desired pattern width since the cable spacing is the dominating factor.

It is important to note that the Detection Patterns Width is also affected by the MTP II's Threshold setting. A lower threshold setting (which makes it more sensitive) will increase the detection patterns width, as well as height.

As a rule of thumb, with the MTP II at default settings (Threshold = -12 dB), the detection field for a slow walking person is approximately 1/2 to 1 foot (.15 to .3 meters) beyond each cable. This means that a cable set with 5 foot (1.5 meter) spacing will have a default detection field approximately 6 to 7 feet (1.8 to 2.1 meter) wide. The detection patterns width will increase approximately 1 foot (.3 meters) for every 6 dB drop in the Threshold setting.

2.2.3 Detection Patterns Height

The MTP II's Threshold Setting (sensitivity) has the greatest effect on the detection patterns height (lower the threshold setting {more negative number} to increase the detection height). The cable spacing will limit the maximum pattern height that can be obtained (the closer the cables are, the smaller the maximum detection height).

The MTP II's Threshold Setting will have more affect on the detection patterns height than on its width. Figure 2.3 shows a typical example of how the detection pattern changes as the Threshold setting is adjusted. The cables in this figure were spaced at 5 feet (1.5 meters). Using the -18dB setting in this figure, the pattern width would be 8.2 feet (2.5 meters) and the pattern height would be approximately 3.3 feet (1.0 meter).

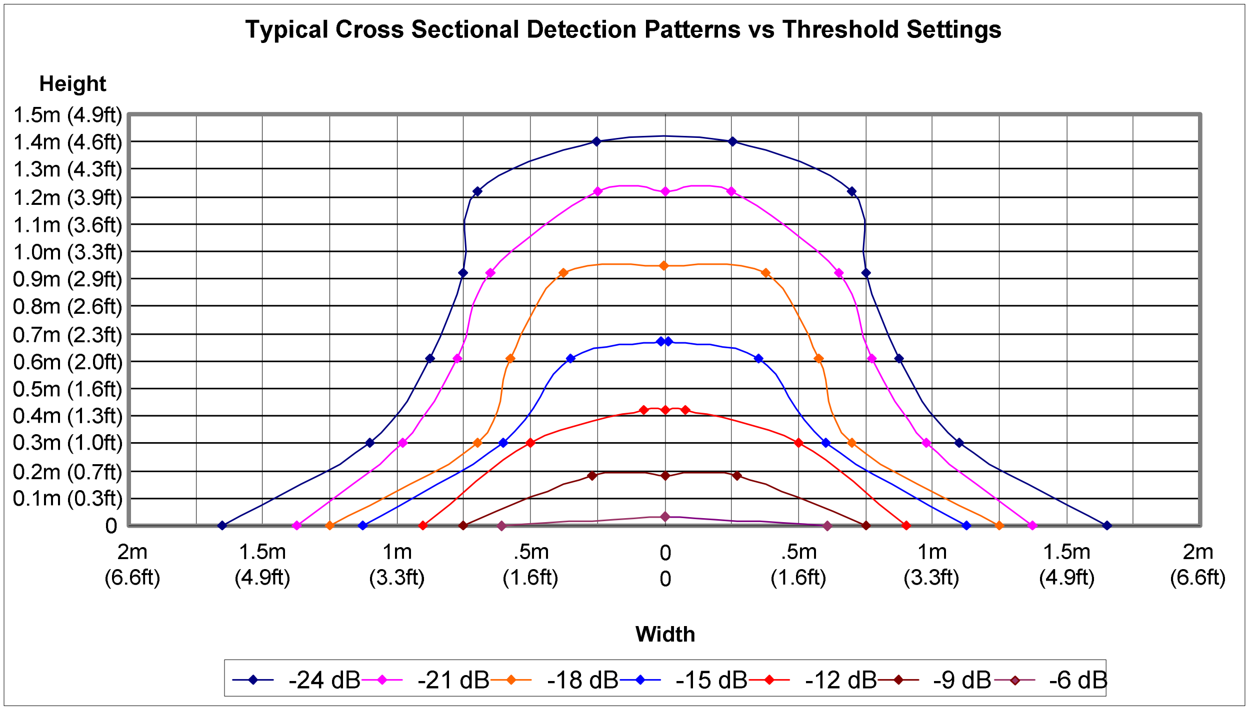

Figure 2.3 –Typical Detection Fields Cross Sectional Shape for 5 Foot (1.5m) Spacing

The cable burial depth and the burial mediums conductivity do not have a significant affect on the detection patterns height.

As a rule of thumb, with the MTP II at default settings (Threshold = -12 dB) and the cables spaced 5 feet (1.5 meters) apart, the detection field for a slow walking person crossing on a wooded plank is approximately 1.3 feet (.4 meters) high at the center. The detection patterns height will increase approximately 1 foot (.3 meters) for every 6 dB drop in the Threshold setting.

2.2.4 Sensor Cable Maximum Length

There are several factors that all affect the maximum cable length. This includes the burial mediums conductivity, the expected MTP II Threshold setting, the cable burial depth, detection requirements and the cable spacing. The most important factors are the burial mediums conductivity and the threshold setting. ***It is recommended that low conductivity sand be used in the cable trenches to minimize attenuation.***

Since the sensor cables are buried directly in the soil (or other burial medium); the soil becomes part of the system. The signal that is transmitted on one cable must pass through the soil and into the air above, then back through the soil to the receive cable. If the soil is very conductive, then it will attenuate the signal as it passes through. This attenuation adds up along the length of the cable, resulting in a weaker signal at the far end. ***If the soil is highly conductive, it is recommended that the soil in the trenches be replaced with low conductivity sand***. This would have been determined during the site survey or design phase of the project. This will help to extend the maximum cable length for the installation. Soil samples obtained from along the proposed path of the sensor cables should have been examined. See the MicroTrack™ II Application Guide for testing soils.

The next important factor is the MTP II's Threshold setting. The default setting is –12 dB and is the nominal setting for most applications. At this or any setting, the concern is with the difference between the calibration profile and the noise level. When calibrating the cables, a graph will be generated that represents a walking target at each location along the cable. This calibration line is adjusted by the Threshold setting (-12 dB default) and becomes the Alarm Threshold. Concern must be taken with the background noise level. If the Alarm Threshold is lowered too much, then the background noise may generate alarms. Since the Calibration Profile will tend to drop down as the calibrator moves further down the cable and at the same time, the noise level is flat or rising; the far end of the cable will have the smallest Alarm Threshold to Noise margin and therefore may generate unwanted alarms towards the far end of the cables. Highly conductive soils will cause the calibration profile to drop faster as the calibrator moves towards the end of the cables. If the site has heavy clay soil and / or requires a more sensitive detection pattern, then shorter cable lengths are required

Burial depth also has an affect on the maximum length, for the same attenuation reasons stated above. If the cables will be installed below grass and there is a chance that an aerator may be used over the cables, then the cables need to be buried deep enough that they can't be damaged. This may be 6 to 9 inches (150 to 230 mm) or more, depending on the equipment. If installed between fences where there is no reasonable chance of damage, then they can be buried shallower, for example, 4 inches (101mm) deep. When the cables are buried deeper, the signals must pass through more soil, adding more attenuation. Raising the cables from 9 inches (230mm) up to 4 inches (101mm) may increase the detection level by up to 6 dB without increasing the noise level.

The cable spacing has only a minimal affect on the maximum cable length.

3. MicroTrack™ II System Components

MicroTrack II system components are presented in three categories: hardware, controllers and software components.

3.1 Hardware Components

3.1.1 MicroTrack Processor II (MTP II)

The MTP II is the principal component of the MicroTrack II system. It provides all the electronic processing for two-210 m (689 ft.) sensor cable sets for a total perimeter length of 400 m (1312 ft.). 16 feet (5 m) of each sensor cable are overlapped at the detection field startup to allow the field to build to full height. The MTP II is packaged in a black metal EMI/RFI housing which must be installed in a weather-tight enclosure when used outdoors. The MTP II is 13.25 H x 8.5 W x 4 inches D (33.7cm H x 21.6cm W x 10.2cm D) and weighs 5.5lbs (2.5kg). MTP II's can be used with other INTREPID™ Series II devices such as the AIM II, ROM II, Microwave 330 and MicroPoint II as well as the controllers RCM II, CM II, and GCM II. It can also communicate directly with reporting systems, such as Perimeter Security Manager or other monitoring systems through use of the INTREPID™ Polling Protocol II (IPP II) Customer Development Specification.

Figure 3.1 – MicroTrack II Processor (MTP II)

3.1.2 MicroTrack™ Sensor Cable Assembly (MTC400-110, MTC400-210)

An MTC400-110 or MTC400-210 sensor cable assembly consists of one spool of sensor cable with 66 feet (20 meters) of lead-in cable attached. Cable junctions are factory made to ensure high integrity. A TNC connector is installed on the lead-in cable to connect with the MTP II. Ferrite beads are also factory installed on the lead-in cable to inhibit the detection field from migrating back from the sensor cable to the MTP II. MicroTrack sensor cable assemblies are available in two lengths: 110 m (361 ft.) the MTC400-110, and 210 m (689 ft.) the MTC400-210 as shown in Figure 3.2. They can be buried in sand, soil, concrete or asphalt. Labels are included to attach and identify transmit and receive cables. Sensor cables are always used in sets. Two sensor cable assemblies are required to make one sensor cable set. One or two sensor cable sets can be monitored with a single MTP II.

Figure 3.2 – MicroTrack Cable Assembly (MTC400-110 left & MTC400-210 right)

3.1.3 MicroTrack End of Line Termination Kit (MTT)

MTT's are an end of line termination used to terminate the detection field at the end of a Sensor Cable Assembly that is not overlapping another Sensor Cable Assembly. The MTT kit includes 6 ferrite beads, insulating wrapping tape, conduit adapter assembly, 51 ohm resistor and potting compound as shown in Figure 3.3. One MTT is required for each sensor cable assembly; therefore, two MTT's are required for a sensor cable set. *Terminations will require field soldering of resistor*.

Figure 3.3 – MicroTrack Termination Kit (MTT)

3.1.4 MicroTrack™ In Line Termination Kit (MTI)

MTI's are an in-line termination used to terminate the detection field at the end of a Sensor Cable Assembly that is overlapping another Sensor Cable Assembly. The MTI kit includes an enclosure with adapters, strain reliefs, two 51 ohm resistors, vinyl boot and potting compound. One MTI is required for each transmitter and receiver cable assembly; therefore, two MTI's are required for this in-line overlap termination. *Terminations will require field soldering of resistor*.

3.1.5 MicroTrack Enclosure - Metallic (MTE-ME)

This is a painted-steel weather-tight enclosure used to house a MTP II. It is a NEMA 4 rated enclosure and includes a tamper switch assembly, keyed door lock, pre-drilled mounting plate, hardware, and U-bolts for 2 ½ inch (63.5mm) pole mounting. The dimensions are 20 x 14 x 6 inches (508 x 355 x 152mm). It weighs 27 lbs. (12.2kg).

3.1.6 MicroTrack Enclosure - Stainless Steel (MTE-SS)

This is a stainless steel weather-tight enclosure used to house an MTP II in a high corrosion environment. It is NEMA 4X rated and includes a tamper switch assembly, keyed door lock, pre-drilled mounting plate, hardware, and U-bolts for 2 ½ inch (63.5mm) pole mounting. The dimensions are 20 x 14 x 6 in. (508 x 355 x 152mm). It weighs 27 lbs. (12.2kg).

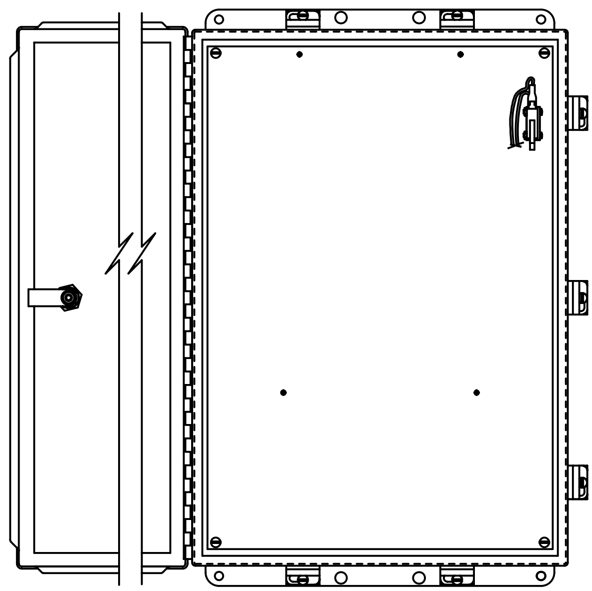

Figure 3.4 – MicroTrack Enclosure

Note: If a larger or smaller mounting post is to be used, fit the enclosure with Unistrut and straps (not provided) to fit the diameter of pole to be used.

3.1.7 MicroTrack™ Splice Kit (MTS)

A splice kit is used to repair a damaged section of sensor cable. A kit includes two splice boxes, a large and small splice connector, heat shrink and potting compound. A length of MTC400 sensor cable is required and must be ordered separately by the foot or meter. *Splicing will require field soldering*.

3.1.8 MicroTrack Sensor Cable (MTC400)

MTC400 sensor cable is used to replace sections of damaged sensor cable. It is available on spools of 110 m (361 ft.) or 210 m (689 ft.) for use with MicroTrack Splice Kits. Shorter cable lengths are available on special order by part number 28C45843-A01. *Note that this sensor cable does not include the lead-in cable assembly or connectors*.

3.1.9 MicroTrack Lead-in Cable Assembly Repair Kit

This is 66 feet (20 meters) of lead-in cable with factory-installed ferrites and TNC connector. A splice box, cable labels, and potting compound are included. *Splicing to MTC400 cable will require field soldering*. Note that the Lead-in Cable Assembly must be replaced as a unit, never spliced or repaired.

3.1.10 JB70A Lightning/Surge Protection Module

The JB70A provides protection against lightning, EMI, RFI, and other induced voltages through the use of gas discharge and transorb devices. The JB70A offers a weatherproof enclosure for protection of data signal and power lines as shown in Figure 3.5. The box includes two installed 1/2" (12.7mm) strain relief's for the signal and power lines. Four mounting holes are spaced for 2 1/2" (63.5mm) u-bolts, clamps or unistrut (not provided) for pole mounting, or lagging into side of building. The holes diameter is .375 inches (9.5mm). The power lines clamp at 75 VDC and the Data Hi and Lo lines clamp at 18 VDC.

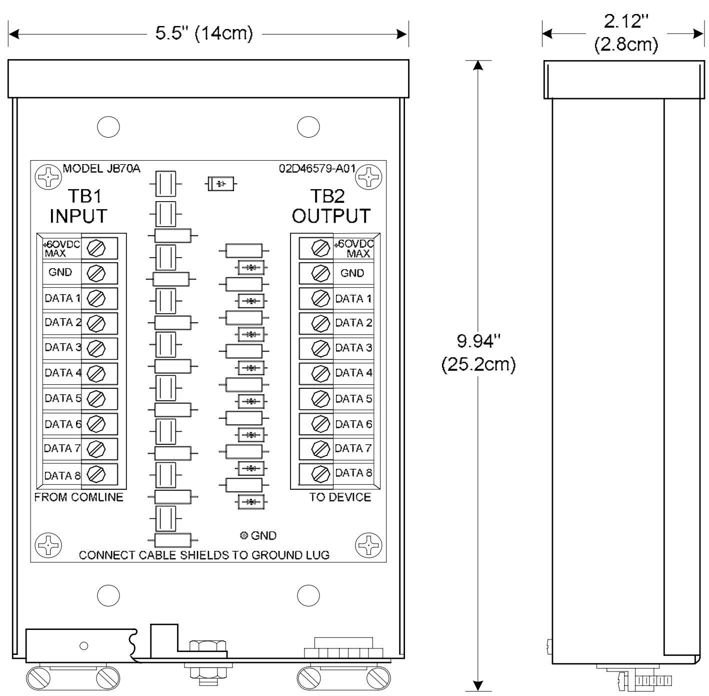

Figure 3.5 – JB70A

3.1.11 Power Supplies

12 VDC power supply: Model PS13 Power Supply operates from 85-246VAC, 47-63Hz and furnishes 13.6 VDC at up to 2.8A. Power supplies contain automatic switchover and battery charging circuitry for optional standby batteries of up to 25AH. Temperature rated from 14° to 122° F (-10° to 50° C). UL, ETS, EMC, CE, RoHs compliant.

24 VDC power supply: Model 78B1064 operates from 120VAC to provide 24VDC at 5A with 6.5AH battery backup. Includes; indoor enclosure 15 x 11 x 4 in. (381 x 280 x 102mm). Temperature rated from 32° to 122° F (0° to 50° C).

48 VDC power supplies: Model PS48 operates from 120VAC to provide 48VDC at 3A. Includes; indoor enclosure 14 x 12 x 4 in. (356 x 305 x 102mm). Model PS49 operates from 220VAC to provide 48VDC at 3A. *Model PS49 power supply does not include enclosure*. Temperature rated from 32° to 122° F (0° to 50° C). UL, CSA, TUV, CE compliant.

3.2 Control Modules

There are several control modules that can be used to annunciate alarms from the MTP II. The alarms that can be annunciated are: intrusions, enclosure tamper, cable faults, communication failure, service alarm and device configuration change. The controllers function is to be a “Poll Master” using the IPP II protocol. The available controllers are: Relay Control Module II (RCM II), Control Module II (CM II), Graphic Control Module II (GCM II), Perimeter Security Manager (PSM) and the third party INTREPID™ Polling Protocol II Customer Development Document (57A46504-A01). *Please refer to each of the control modules manual for setup and operation.*

3.2.1 Relay Control Module II (RCM II)

The RCM II allows up to eight (8) INTREPID™ Series II devices to be connected to the communications line. The RCM II also has eight (8) form C dry relay output contacts. These outputs or outputs from the Relay Output Module II (ROM II) can be connected to alarm panels, CCTV matrix systems or any other device that can use contact closures for alarm annunciation. A maximum of 32 zone records can be programmed.

3.2.2 Control Module II (CM II)

The CM II allows up to sixteen (16) INTREPID Series II devices to be connected to the two (2) communication lines. The CM II also has 8 form C dry relay output contact s. These outputs or outputs from the Relay Output Module II (ROM II) can be connected to alarm panels, CCTV matrix systems or any other device that can use contact closures for alarm annunciation. A maximum of 256 zone records can be programmed.

3.2.3 Graphic Control Module II (GCM II)

The GCM II allows up to sixteen (32) INTREPID Series II devices to be connected to the four (4) communication lines. Eight (8) devices can be connected to each line for a one (1) second alarm delivery time. The outputs from the Relay Output Module II (ROM II) can be connected to alarm panels, CCTV matrix systems or any other device that can use contact closures for alarm annunciation. The GCM also provides a graphic display. A maximum of 1024 zone records can be programmed. The GCM II is available in a commercial grade package and in a heavy duty package.

3.2.4 Perimeter Security Manager (PSM) Software

Perimeter Security Manager is a software package that provides easy-to-use operator command and control for MicroTrack™, MicroPoint™, MicroTrack II, MicroPoint II, 330 MicroWave, AIM II, ROM II and auxiliary sensors. It uses Microsoft Windows™ based software (2000 Pro, XP Pro or Windows 7) and a PC with a color monitor to display all sensor zones on a custom site map. The Perimeter Security Manager communicates with all INTREPID™ and other SMI products, and displays intrusion alarm information. It is available for single or multi-user operation as well as in a migrating server configuration. Please refer to the Perimeter Security Manager user's guide for additional information.

3.2.5 INTREPID Polling Protocol II (IPP II)

The INTREPID Polling Protocol II (IPP II) is a document that allows third party vendors to develop a software or data stream interface to the processor. For more information, please contact Southwest Microwave, Inc. and request document number 57A46504-A01.

3.3 Software Components

3.3.1 Universal Installation / Service Tool II (UIST II)

The Universal Installation / Service Tool II, is a Microsoft Windows™ (XP with .NET Framework 3.5, Vista or Windows 7™) based program that runs on a standard PC. This software is used to configure the MTP II for proper operation, detection, service and maintenance.

4. Site Planning / System Configuration

This chapter describes several MicroTrack™ II Processor typical configurations. Other INTREPID™ devices used in these configurations will also be shown.

4.1 Basic MicroTrack II Configuration Parameters

MicroTrack II can be configured in many ways and used in conjunction with a wide variety of complementary devices. A summary of the configuration limits for a Single MicroTrack II Processor and its system components are shown in Table 4.1.

Parameter	*Configuration Limit*
Sensor Cable Assemblies per Sensor Cable Set	**Two 110 meter MTC400-110 Sensor Cable Assemblies or Two 210 meter MTC400-210 Sensor Cable Assemblies**
Sensor Cable Sets per MTP II	**Two Sensor Cable Sets – maximum of 400 m (1312 ft.) coverage per MTP II**
Detection Zones per Sensor Cable Set	**Detection zones are based on cells, which are each ~2.3 meters long. Each cell is an independent zone giving ~ 91 zones for each 210 meter Cable Set**
Inputs and outputs	**When used with AIM II and ROM II**
Controllers	**RCM II, CM II, GCM II, Perimeter Security Manager or Customer Development Document**

Table 4.1 - Basic Configuration Parameters per MicroTrack II Processor

4.2 MTP II System Architecture – Example

Configuration guidelines for designing a single MTP II system and multiple MTP II systems are shown in the following example drawings and summarized in Table 4.1. These examples include all options as an example to work from. If the site requirements are greater than what is shown here, please contact Southwest Microwave for assistance.

Figure 4.1 shows a fully-configured single MicroTrack Processor II (MTP II) with two cable sets, marked “Cable A” and “Cable B”, forming a closed loop around a building. The two cable sets are overlapped at the MTP where the detection field’s first form and they are joined at the MTI’s where the detection fields are diminished. This provides a continuous, closed detection field around the entire perimeter. The corners are marked with references such as B77, or A81. This refers to the position along the cable. For example, A81 means “Cable A, cell 81”. Since each cell is a separate, adjustable zone that is only approximately 7.5 feet (2.3 meters) long, it allows for easy software zoning and full control of the perimeter. *Note that Cable A and Cable B transmit and receive cables are in line with each other. They can not be installed transmit to receive.*

There is one (1) Relay Control Module II (RCM II) attached that will be the controller (poll master) to monitor alarms from the MTP II and provide relay outputs and two (2) Relay Output Module II (ROM II) devices for relay outputs to annunciating equipment. If an alarm is detected, the appropriate output relay(s) will respond as programmed. The MTP II will report each cell independently to the RCM II, which allows the RCM II to be programmed with any zoning required, up to 32 zones. A typical example from Figure 4.1 is to assign zone 1 to be Cable A from cell 18 to 24 (shown as A18 – A24 in the drawing) and assign this zone to RCM II- relay output 1. A PC running an alarm monitoring program such as the Perimeter Security Manager or the GCM II can be substituted for the RCM II for graphic alarm annunciation.

This example uses a 48 VDC power supply (SMI Model PS48 or PS49) to power the MTP II, RCM II, ROM II-8 and ROM II-16. There is also a recommended UPS on the system.

The RS422 com-line connects all four devices together in series. (No star configurations are allowed). All power and com-lines pass through the JB70A Surge Suppressor at the point of entry to the building and at the MTP II in the field, which must be properly attached to earth ground.

A PC is required for configuration of the MicroTrack™ II, but it is not required for operation. Use a laptop PC with a standard RS232 port (or use a USB to RS232 converter) and plug directly into the MTP II's RS232 port using a DB9 serial cable to configure the MTP II using the UIST II. Use a laptop PC with a terminal emulator like PuTTY to program the RCM II alarm information for the ROM II-8, ROM II-16 and MTP II.

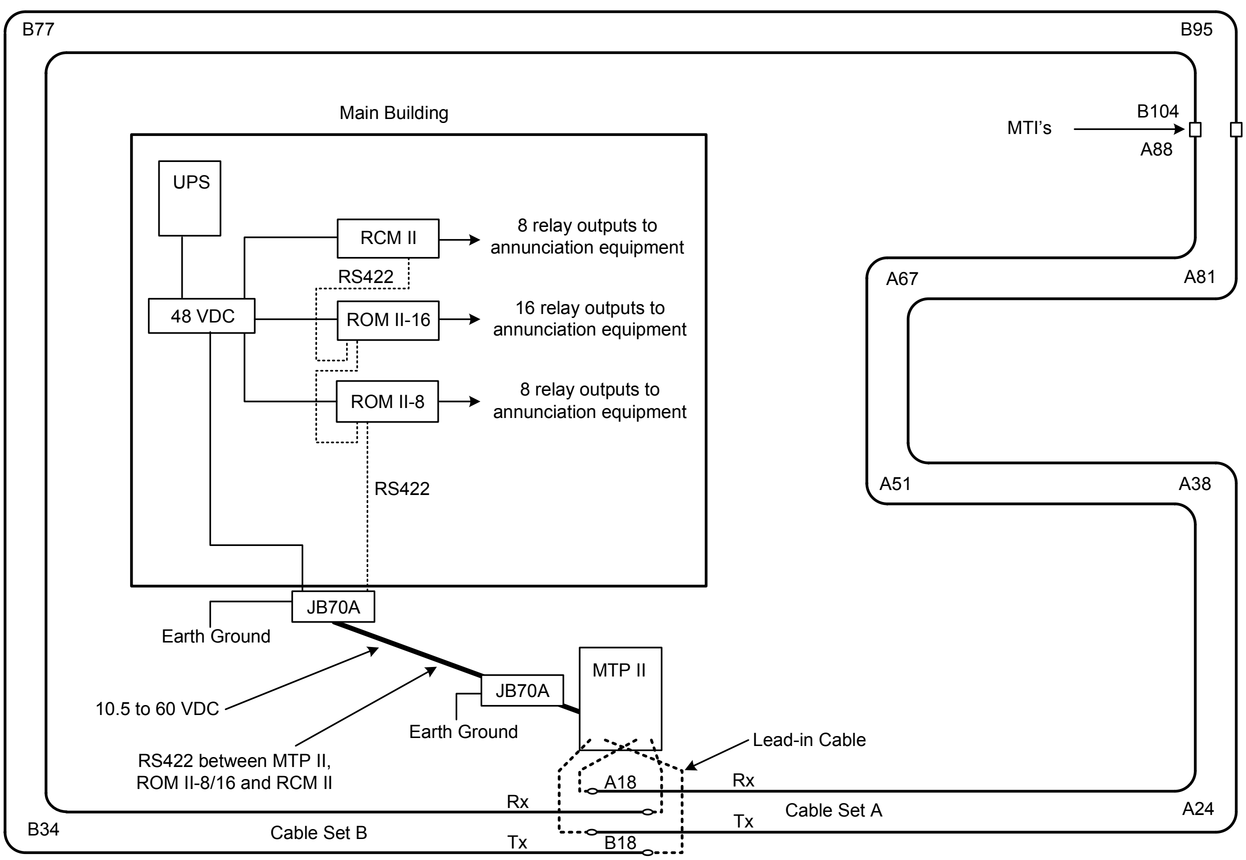

Figure 4.1 - Example of a Fully Configured Stand Alone MicroTrack II System

Figure 4.2 shows a minimum system configuration. The very minimum requirements will be one (1) MTP II, 1 Sensor Cable set, 2 MTT's, 1 Power Supply, 2 JB70A Surge Module and one (1) RCM II. A PC running an alarm monitoring program such as the Perimeter Security Manager or the GCM II can be substituted for the RCM II for graphic alarm annunciation. ***Please note that a single cable set cannot form a closed loop perimeter***. Two sensor cable sets must be used for a closed loop configuration so that the transmit signal at the end of the cable will not couple back onto the start of the cable which can cause target location errors and/or multiple alarms from a single crossing. When two cable sets are used to form a closed loop, they operate on separate channels (A and B) that do not interfere with each other.

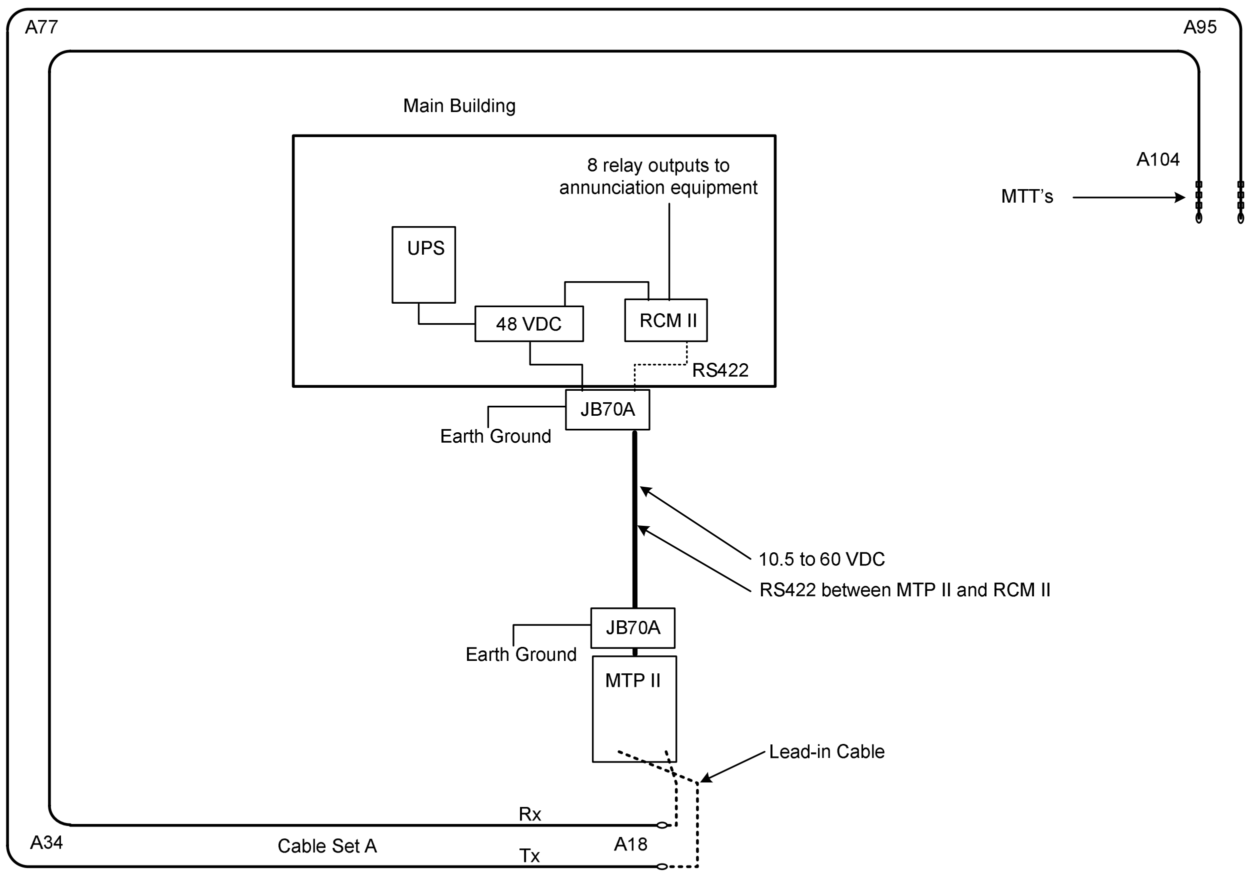

Figure 4.2 – Example of Minimum Configured Stand Alone MicroTrack II System

If a PC with a GUI interface to the MicroTrack™ II Customer Development Document is to be used, such as Perimeter Security Manager or the GCM II, the RCM II can not be used as shown in Figures 4.1 or 4.2. Only one (1) "Poll Master" can be connected to the system. This PC would be connected to the RS422 communications line. A RS422 to RS232 data converter may be required or a RS422 expander board installed in the PC.

Figure 4.3 shows an example configuration using four MTP II's. A Graphic Control Module II (GCM II) is used to communicate with the MTP II's, ROM II-16's and the AIM II. Each MTP II has a PS48 power. All power supplies and the GCM II are connected to the recommended UPS. Cable overlaps from the MTP II's are connected using the MTI (MicroTrack In-line Termination). Some typical items are shown such as: cable sets, subcell numbers, conduit runs, MTI's, and earth grounds. *Note: Individual component wiring has been purposely omitted as it is shown in each device's manual and in a later chapter. The A cables are overlapped with B cables and TX cables and RX cables are in the same trenches.*

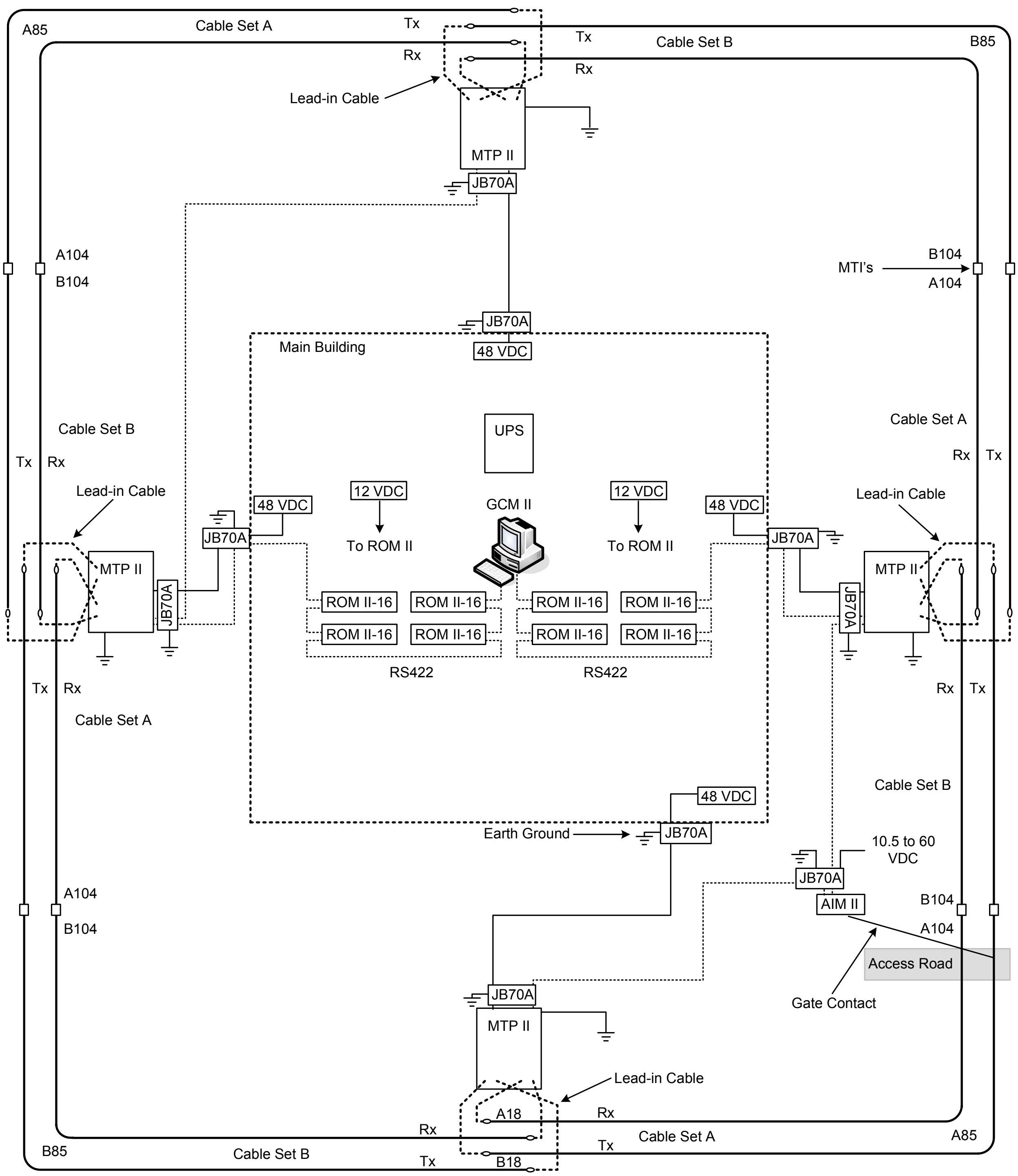

Figure 4.3 – Example of Multiple MicroTrack II Processors

Figure 4.3 also shows that the power and data wiring can be in the same conduit for a direct connection to the first MTP II. An alternative to the independent conduit wire runs is to include the power and data wiring in the same trench as the sensor cables. This would use a direct burial cable from such companies as Beldon, Alpha or any equivalent source. ***Note: This wire can not be put in conduit in the same trench as the sensor cable***. Direct burial cable requires a sand base to prevent damage to the cable. *Note: Ferrite beads may be required on these lines*.

Table 4.2 shows the basic configuration guidelines for the MicroTrack™ II system. A PC operating the Universal Installation Service Tool II software can be connected to Com 1.

Parameter	*Configuration Guidelines*
Maximum Number of devices	**8 (MTP II, ROM II or AIM II) for 1 sec alarm delivery**
MTP II communication options	**Com1: RS232 to PC running UIST** **Com2 & Com 3: RS422 to RCM II, CM II, GCM II, PSM or other Third Party Software and device to device**
- *RS422 over a two twisted pair cable*	**Point-to-point capability, 2 devices maximum, 1.5 km (5000 ft.)** **Used to communicate between devices**
- *RS232 over a DB9 cable*	**Point-to-point capability, maximum 1 MTP II, 15 m (50 ft.) max** **Used only for system configuration with UIST**

Table 4.2 - Basic Configuration Guidelines for MicroTrack II Architecture

4.3 Site Survey

Site planning is an essential step to ensure MicroTrack II is properly applied and configured to a specific site. A site survey should have been conducted prior to the installation of the MicroTrack II system. For information on the site survey, please reference the MicroTrack II Application Guide document.

5. System Design

This section will provide guidance on how to design a MicroTrack™ II System. It includes information on sensor performance characteristics, selecting cable spacing, burial depth, and maximum sensor cable lengths, how the sensor cables should be installed in different burial mediums, how to deal with various site environmental conditions, and how to layout the sensor cables.

5.1 Burial Medium

Light sandy (silica based) soils, concrete and asphalt tend to produce strong coupling between the MicroTrack sensor cables which results in a low gain setting in the MicroTrack II processor. This will increase the size of the secondary detection field as shown in Figure 5.1. With sandy soils, care should be taken in the location of the cables in relation to fences, roads walls, etc. that could cause nuisance alarms. *In line attenuators may be required to correctly adjust the gain to a nominal operating value*.

Heavy (clay or mineral base) soils tend to produce weak coupling between the MicroTrack cables which results in a high gain setting in the MicroTrack II processor. This may decrease the size of the secondary detection field as shown in Figure 5.1. ***With hard soils, the cable length and cable spacing need to be shorter and closer to achieve the required nominal gain operating value***.

Sand is the standard recommended medium for the trenches as it will eliminate any abrasive materials (rocks) that may damage the cable.

Soil type should have been evaluated along the proposed cable path to determine cable distance and spacing with respect to fences and other objects prior to designing the system.

Even though, MicroTrack II's Sensitivity Leveling™ capability will accommodate significant changes in burial mediums, it is still necessary to know the soil type to determine system cable lengths and spacing.

5.2 Site Environment and Occurrence of Frost

Ground frost has the effect of significantly changing the soil permittivity. This can have an effect on the size of the detection field. Tests with frozen and unfrozen ground should be conducted to ensure proper detection.

There are other site environment parameters, such as water, snow, ice, and ground moisture content to consider. Water, particularly moving water, is another parameter of importance. Deep snow has the effect of slightly enlarging the detection field. However, snow should not be allowed to build up to such a depth as to enable an intruder to tunnel through, under or bridge over the snow. This depth should not exceed 6 inches (152mm). While MicroTrack II would detect and identify the location of the intrusion, it would not be possible to assess and verify the intrusion with CCTV.

It is important to create a uniform detection field to ensure that the probability of detection is maintained and optimized with respect to the nuisance alarm rate. While it may appear that a larger detection field is preferable, it may not be because the larger field may be affected by fence generated electrical noise, greater sensitivity to nearby road traffic and environmental changes. Figure 5.1 illustrates typical cable locations for a site with a high security requirement. *Closer proximity to fences may be accomplished if certain site criteria are met. Some of these criteria are: fence condition, location and types of gates, bottom rails or support wires, and soil conditions.*

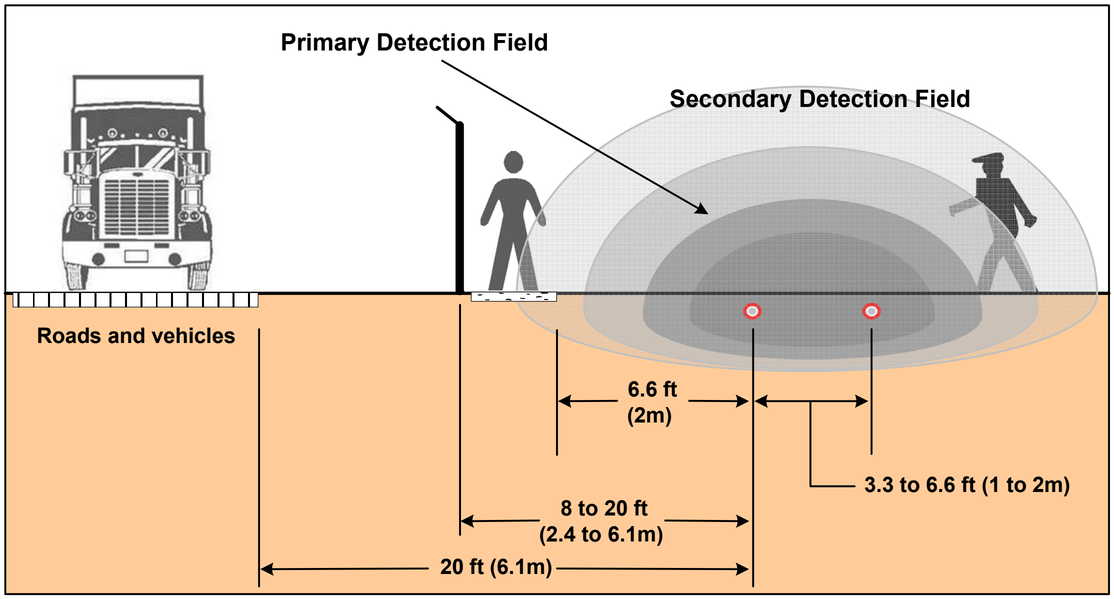

Figure 5.1 - MicroTrack II Detection Field Proximity to Fences & Roads for Typical Site Conditions

5.3 Animals and the Detection Field

MicroTrack™ II can detect large animals, such as deer, horses and large dogs. Therefore, fencing would be required to keep animals away from the detection field if nuisance alarms from these sources are to be avoided. MicroTrack II will not detect small animals, such as birds, rabbits, gophers, and small dogs. However, if large numbers of small animals congregate in the vicinity of the detection field, nuisance alarms may occur if all the animals move at the same time.

5.4 Accommodating Grass, Trees and Shrubs

MicroTrack II can be installed in and around a wide variety of vegetation including lawns, field grass, trees and shrubs. While most high security sites will have a sterile area where no trees or vegetation is permitted, there are numerous sites with various forms of vegetation which must be accommodated.

Installing MicroTrack II under lawns where grass is kept short by routine mowing is ideal. Areas where grass is allowed to grow wild and tall will not affect MicroTrack II detection performance. However, if tall grass, approximately 12 inches (30 cm) or more, accumulates moisture from dew or rain and moves due to wind action, nuisance alarms are possible. Tall grass also creates a security assessment problem because it could allow an intruder to hide. Grass should not exceed 6 inches (152mm).

If necessary, MicroTrack II can be installed close to large shrubs. However, nuisance alarms could occur if the shrubs have large leafy moisture laden branches and move with the wind. Detection performance should not be affected, although assessment could be compromised by providing cover for an intruder.

MicroTrack™ II can also be installed close to and around trees, large or small as shown in Figure 5.2. A concern with installing sensor cables close to trees is the potential damage to the tree(s) root system resulting from trenching. To avoid damaging roots, trenches can be hand dug and the sensor cable threaded under or around the roots of the tree. Also if they are small trees, as they grow and their root system expands, it may move the sensor cables. Unlike seismic sensors, the motion of a tree or its roots should not cause nuisance alarms because their rate of motion is much too slow to affect the MicroTrack II electromagnetic field. However, should large leafy branches move rapidly due to wind action within the detection field, or break and fall into the detection field, nuisance alarms could occur. Detection performance will not be affected by the presence of trees within or close to the detection field. While it is preferable not to have trees close to a secure area because they limit assessment and provide bridging capability, MicroTrack II can be easily adapted to such sites.

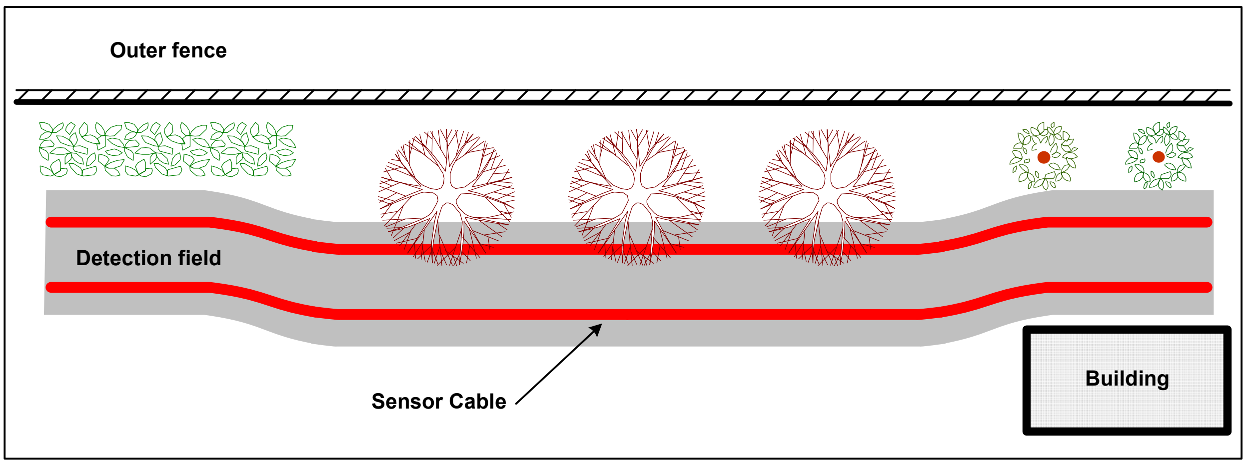

Figure 5.2 - Routing Sensor Cables around Trees, Shrubs and Buildings

There is no standard distance for locating MicroTrack sensor cables from trees and shrubs. If possible this should be avoided however, unless there is no alternative, a minimum of 3.3 feet (1 m) is preferable for leafy shrubs. The distance from trees depends more on the practicality of installing under or around tree roots. Sensor cables can be installed around one side of the tree, or if there is insufficient space they can be divided so that one cable goes around each side of the tree.

5.5 Uneven Terrain

MicroTrack II is a terrain following sensor so it can be easily adapted to sites with uneven terrain as illustrated in Figure 5.3. It is preferable to avoid abrupt changes in slope so that the detection field can develop smoothly along the cable path. Abrupt changes of + and - 30° or more in a 16 foot (5m) area may reduce detection field height or cause gaps near the ground depending on the direction of slope change.

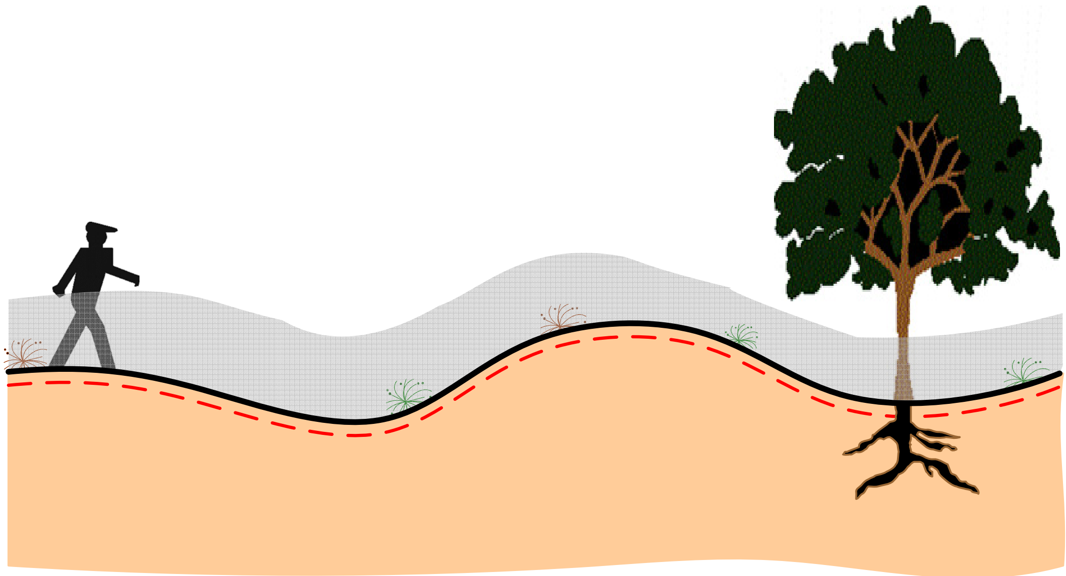

Figure 5.3 - MicroTrack™ II Detection Field is Terrain Following

5.6 Rain, Standing Water and Run-off

Rain typically falling through the detection field will not affect detection performance nor cause nuisance alarms. The issue to be concerned with is the water after it reaches the ground. If water is allowed to run across or accumulate into large puddles of approximately 3.3 to 6.6 feet (1 to 2 m) over the sensor cables, nuisance alarms may generated from that location. It is the movement of the water that creates alarms, not its presence. If pools are allowed to form, then falling rain or wind can cause disturbances on the waters surface, which may also generate nuisance alarms. The accumulation of water will not reduce the detection performance; in fact it may increase detection.

There are a variety of solutions to either completely avoid or at least minimize this problem.

To prevent the accumulation of water over the sensor cable it is recommended that the ground surface be either slightly crowned or sloped as shown below in Figure 5.4. In areas where puddles or water runoff cannot be avoided, it is recommended that crushed stone be applied over the detection area deep enough to prevent any standing water from being disturbed by wind and falling rain, and to smooth out the flow of running water. It is not recommended to add more than 4 to 6 inches (102 to 152mm) of stone. Adding crushed rock to an area effectively raises the intruder a little higher above the cables. This will affect the calibration profile and therefore the Alarm Threshold. If crushed rock is added to solve a problem area, retest the area and, if necessary, make appropriate adjustments to the MTP II threshold setting or calibration.

The most desirable solution, if possible, is to provide drainage to allow the water to drain away from the sensor cable area.

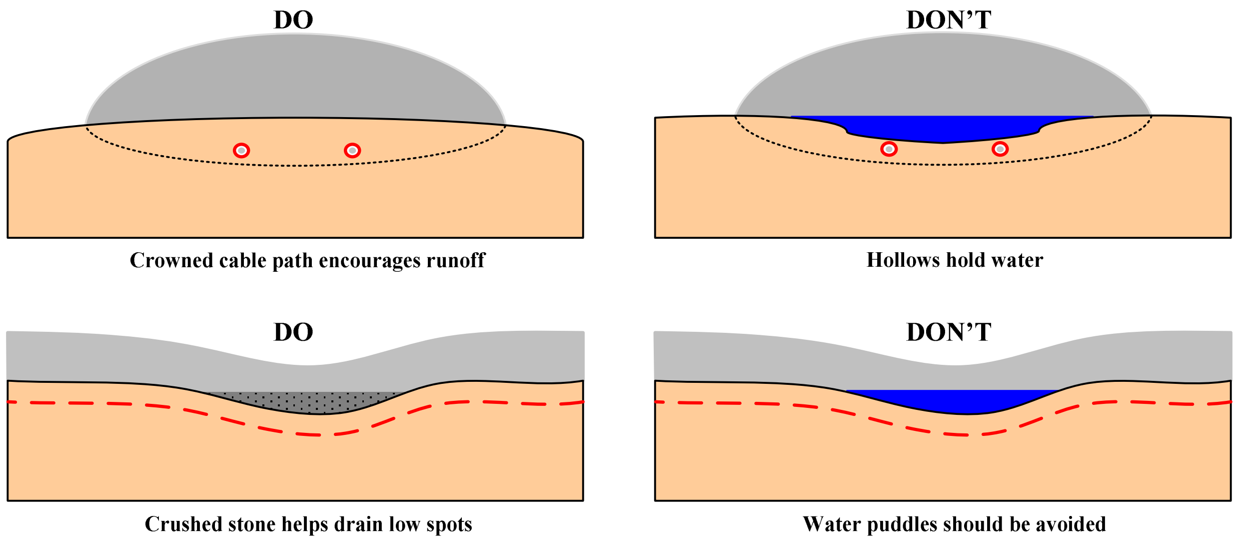

Figure 5.4 - Encouraging water runoff reduces potential nuisance alarms from moving water

It is important to note that standing water is not a problem for MicroTrack™ II, and neither is having the sensor cables installed in a totally saturated burial medium, e.g., mud. The problem is moving water near the sensor cables! Since MicroTrack II detects objects that have a certain electromagnetic cross-section and have motion, large bodies of water moving close to the sensor cables exhibit similar characteristics and could cause nuisance alarms. Therefore, having running water, such as a stream moving across or along the sensor cable path is to be avoided.

5.7 <u>Positioning MicroTrack II Components on the Perimeter</u>

The MTP II(s) should be positioned at a point(s) on the perimeter closest to the control center, when possible, to provide best access for power and data communications. MTP II's are usually installed on or near the perimeter fence and can be located up to 66 feet (20 m) from the sensor cable set. Power and data connections are made directly to the front panel of the MTP II.

When the MTP II is used with two cable sets, it is preferred to keep both cable sets roughly the same length. For example, to protect a 820 foot (250 meter) area, it is better to use two 410 foot (125 meter) cable sets than to use a 656 (200 meter) and a 164 foot (50 meter) set. This is because there is a better Signal-to-Noise Ratio at the beginning of the cable set than at its far end. The shorter cables will allow for higher sensitivity settings before noise becomes an issue.

This section outlines the steps for positioning the MicroTrack Processor II (MTP II), laying out the sensor cable sets, and MicroTrack End of Line Terminations (MTT's) or MicroTrack In Line Terminations (MTI's) along the perimeter. Laying out a MicroTrack II system involves six steps that are outlined below and illustrated on Figure 5.5.

1. Determine sensor cable sets and MTT or MTI termination kits.
2. Identify the longest cable path length for each sensor cable set.
3. Plan for 90 m and 190 m (for 110 and 210 sensor cable assemblies) to allow for possible errors.

4. Allow for the 16 feet (5 m) startup on each side of the MTP II.

5. Locate the MTP II centrally between the two sensor cable sets.

6. Determine if an auxiliary sensor will be required to close gaps at buildings, and if so, include an Alarm Input Module II (AIM II) and provide data communications and power.

7. Insure that "A" cables are overlapped at the ends by "B" cables from the adjacent MTP II. (See Figure 4.3)

8. Insure that Transmit cables are in one trench and Receive cables are in the other trench around the entire site. (See Figure 4.3)

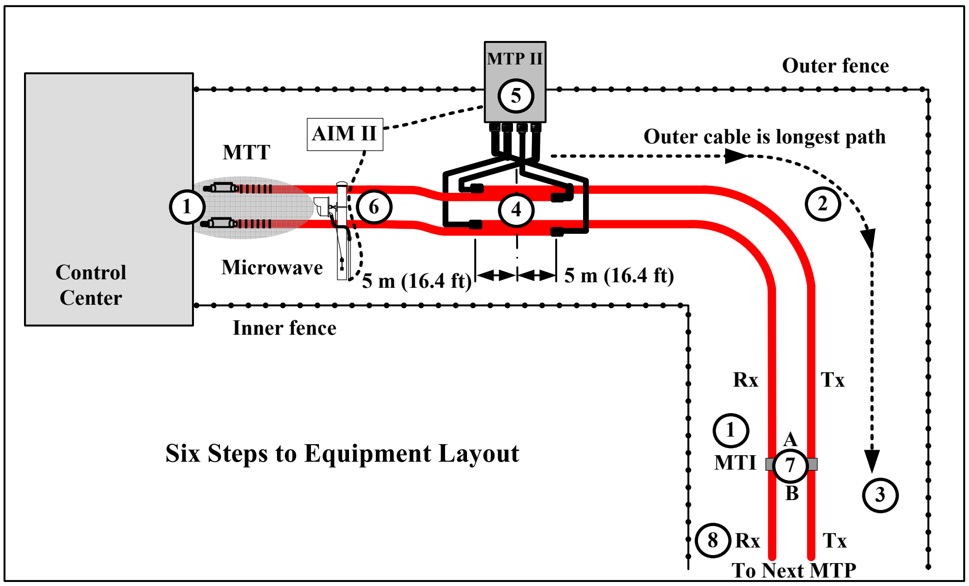

Figure 5.5 - Six Steps to Laying out a MicroTrack™ II System

The detailed sequence for laying out each sensor cable and system component is described below. Using paint or a minimum of two dozen stakes will be required to layout each sensor cable set and MTP II.

- <u>Stake-out the start and end points for each sensor cable set</u> starting from the location of the first MTP II, a building or other point on the perimeter such as a gate or sally port.

- Outer (or longest) sensor cable. <u>Stake the outer sensor cable start point</u> 5 m (16 ft.) back from the centerline of each MTP II (point #4 in Figure 5.5). <u>Stake the corner points and end points</u> where MTT's or MTI's will be installed. Stake the position of the cable closest to the perimeter fence first. The position of this cable is based on the criteria set out in Sections 5.8, 5.9 and 5.10. To allow for measurement errors and site irregularities do not exceed a 90 m (295 ft.) or 190 m (623 ft.) length depending on whether the 110 m or 210 m sensor cable assemblies will be used.

- Inner sensor cable. Stake the location of the inner sensor cable based on the sensor cable spacing selected. Stake the start points at each MTP II, corner points and the end points, as above.

- Stake-out the corner details based on either an arc radius turn (preferred) or 30º step-turns described in Section 6.10. Use several stakes to define the corners.

- Stake-out the startup area where adjacent sensor cable sets overlap each other. Be sure to keep a minimum separation distance (horizontally) of at least 1 foot (30 cm) between all lead-in cables and all sensor cables. Use stakes to mark each change of direction. See Section 6.8.

- Stake-out the lead-in cables for the A side and B side for each cable set. See Section 6.8.

- Connect the stakes along each cable path with masons line; one cable set at a time. Ensure the line(s) are taut, then using surveyors marker paint (or a paint wheel), paint along each line to identify exactly where the trenches are to be made. Repeat steps for each cable set.

- Remove the mason lines but leave the stakes in place to make it easier for the trenching operator to provide a line-of-sight. (Remove and set aside each stake as the trencher approaches.)

- Stake-out the location of each MTP II around the perimeter. Ensure that it will be located within the 66 ft. (20 m) length of the lead-in cable, i.e., not further than 39 ft. (12 m) from the sensor cables.

- Now stake-out the path for the power and data lines from the first MTP II to the control center. Also, if auxiliary sensors will be installed, the paths for additional power and data lines will need to be staked-out.

5.8 Selecting the Optimum Sensor Cable Spacing and Position Near Fences

One of the first steps of system design is to select the optimum sensor cable spacing for the site. Sensor cable spacing is primarily site dependent and based on a combination of the following parameters:

- Proximity to fences, buildings, roads, sidewalks and passers-by

- Burial medium characteristics, e.g., type of soil, concrete, asphalt, etc.

- Threat Analysis

- Detection field desired

Cable spacing for MicroTrack™ II's primary detection field can range from 2.5 to 6.6 feet (0.75 to 2 meters). Since the primary detection field at default settings (threshold = -12 dB) extends approximately 12 inches (305mm) on each side of the sensor cables, the total detection field width can range from 4 ½ to 8 ½ feet (1.4 to 2.6m) as shown in Figure 5.6.

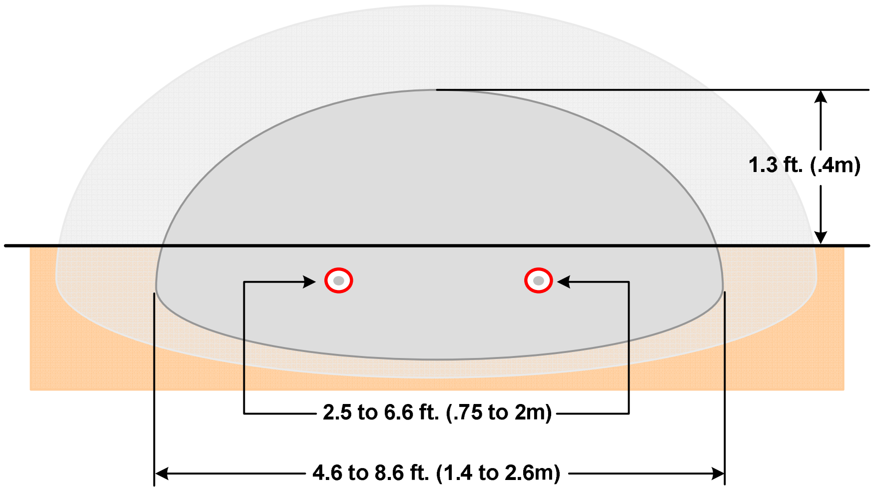

Figure 5.6 - MicroTrack II Primary Detection Field and Cable Spacing

The formula for calculating the cable spacing relative to fences and buildings is a 3 to 1 ratio as shown in Figure 5.7. Using this figure as the example, if the cable spacing “Y” is 5 feet (1.5m) then from centerline of the MicroTrack cables to the fences, “3 x Y”, would be 15 feet (4.6m).

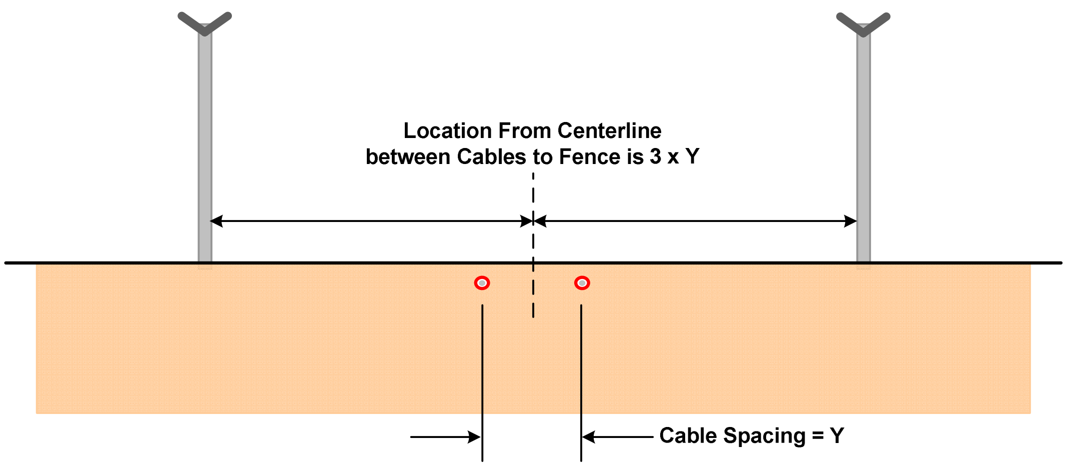

Figure 5.7 - MicroTrack II Cable Spacing with 3 to 1 Ratio

Narrower cable spacing has the advantage of permitting MicroTrack™ II to be installed in more restrictive areas, such as between closely spaced fences and between a fence and a building - with a low potential for nuisance alarms. A wider detection field increases the probability of detection for running and jumping intruders.

The standard cable spacing is 5 feet (1.5 meters) with the cables buried at 9 inches (228.6mm) deep in sand or screened soil. This width can be narrowed to accommodate space restrictions but the placing of cables closer together makes it easier for a running jumper to go undetected. Narrow cable spacing should only be used where some obstacle prevents a jumper from getting a running start.

In general, the cable spacing is the primary control for the detection width. The MTP II's Sensitivity settings will have a smaller affect on the width of the detection field. Typical detection patterns are illustrated in Figure 2.3.

5.9 Proximity to Fence Types

The first parameter to consider in determining sensor cable spacing is the proximity to a metal fence. It is important that MicroTrack™ II be located at a minimum distance from a metal fence to avoid nuisance alarms and to avoid detection at or beyond the fence. Generally, the higher the mechanical and electrical integrity of the fence the closer the sensor cable can be located.

It is the electrical characteristics of the fence that are most important to MicroTrack II. Fences that are rigidly constructed of solid fabric, such as welded mesh, palisade or expanded metal create the lowest electrical noise. Chain link mesh fences are often a source of electrical noise, especially if the mesh is poorly tensioned, the posts, gates and rails move with wind action or thermal effects. These can all be a source of nuisance alarms if MicroTrack II is installed too close to the fence.

Non-metallic fences, such as wooden fences or PVC fences, can be placed closer to the detection field without any affect on nuisance alarm rate. However, it is important to consider position of the fence and detection field with respect to nearby roads and passers-by to ensure they are not detected.

5.10 Double Fences, Concertina and Razor Tape

Double fences are commonly used at high security sites and MicroTrack II is usually installed between the fences. At correctional sites, it may be desirable to install MicroTrack II inside the inner fence to provide an advanced warning of an escape attempt, depending on the availability of space.

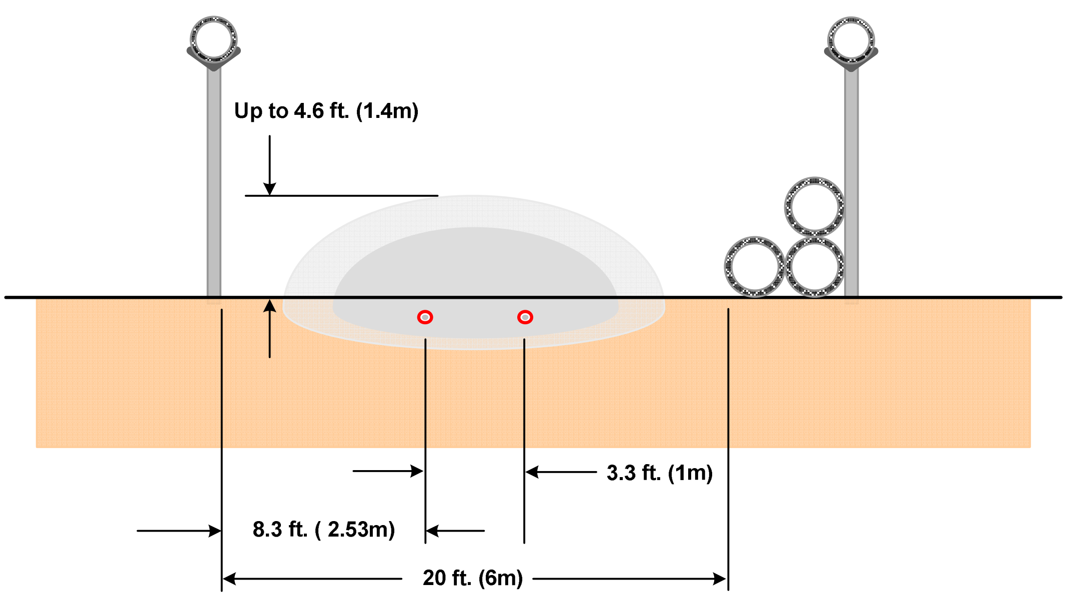

Figure 5.8 - MicroTrack II Detection Field between Fences for a High Security Sites

Many high security sites use barbed concertina wire or razor tape on fence tops, as well as stacked on the ground, as illustrated in Figure 5.8. Concertina and razor tape can cause electrical noise as a result of wind action or thermal changes resulting in nuisance alarms if placed too close to MicroTrack™ II cables. For this reason it would be best not to install razor tape between the fences unless there is sufficient space to position MicroTrack II cables. Should it be necessary to install razor tape between the fences the same distance rules for spacing the sensor cable from a loose, poor quality fence would apply to the position of the razor tape.

5.11 Cable Spacing Near Buildings

One of the unique features of MicroTrack II is its ability to accommodate restrictions such as narrower spaces, as illustrated in Figure 5.9. This example shows a building intruding into the secure area between fences. To accommodate this narrower space, the sensor cable spacing can be reduced to approximately one-half. Thus, if the cable spacing was 5 feet (1.5 m) before the building, then it can be gradually reduced to approximately 2.5 feet (0.75 m) starting about 10 feet (3 m) before the building. The cable can be restored back to its former spacing after the building if space permits.

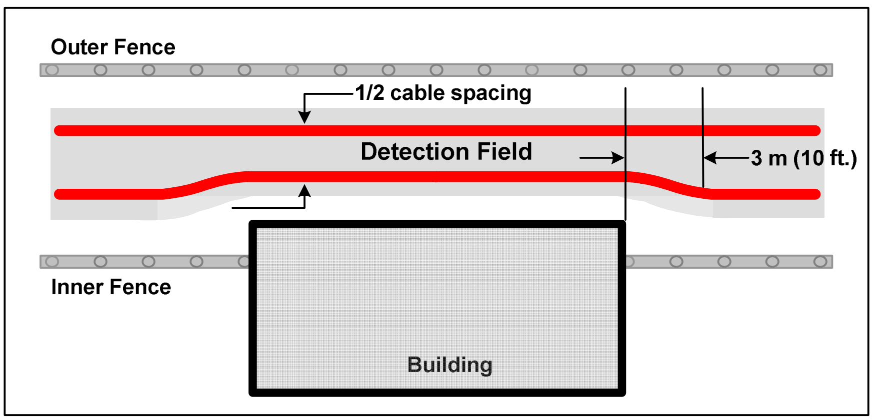

Figure 5.9 - Reducing Sensor Cable Spacing for Narrower Spaces

6. Installation of the Sensor Cables

This section shows how the cable is to be installed in various burial mediums, at start up, around corners and also shows how to deal with conductive materials that are within or below the detection area.

6.1 Burying Sensor Cables in Soil

The sensor cables are usually directly buried in sand or soil as shown in Figure 6.1. Trenches are dug with a mechanical walk-along or ride-on trencher. Rocks should be removed from the trench to avoid damaging the cable. Also, if sharp rocks are present it is advisable to place sand or screened soil around the cable to prevent mechanical or physical damage. This is especially necessary where frost action may move rocks and sharp stones into the cable.

Even though MicroTrack™ II has a very wide tolerance for cable depth and spacing, it is recommended to install the cables at a consistent depth and spacing whenever possible. Keep the burial depth within ±2 inches (± 5cm) and cable spacing within ±4 inches (± 10cm). If you have a special application where the cables need to be moved closer together or further apart in a certain section, such as when going between a building and the fence, then gently taper the cable spacing by no more than 30°. Any deviations will be compensated for by MicroTrack II's unique Sensitivity Leveling™ feature.

After the trench is made it should be inspected to check depth and to remove rocks and debris. It is very important that metal objects be removed from the immediate area (up to 3 feet [1 meter]) from where the cables will be installed, as these could be a potential source of nuisance alarms or field distortion.

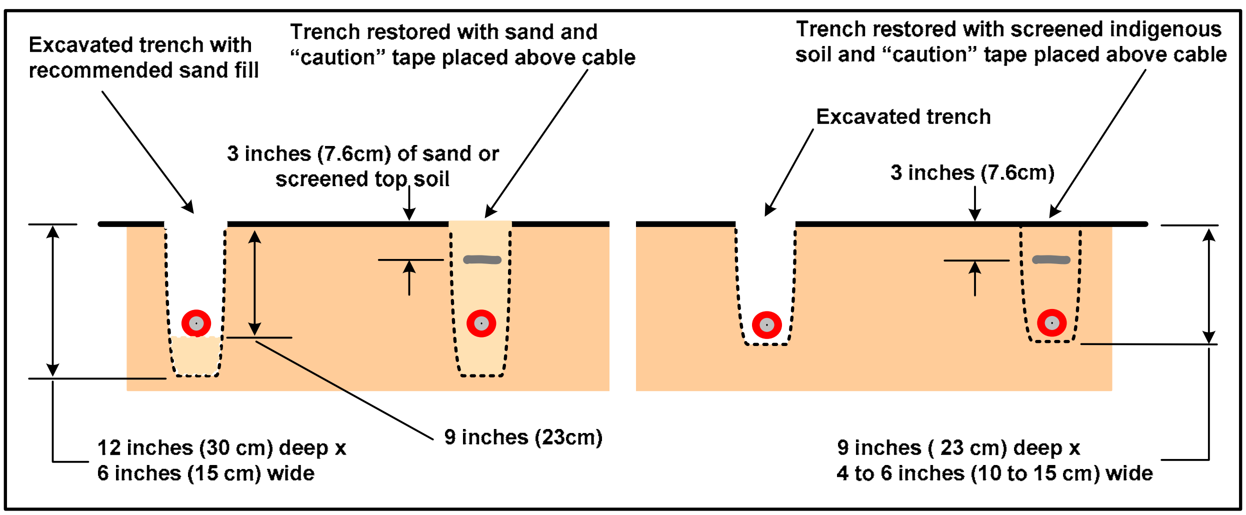

Figure 6.1 - Sensor Cable Buried in Sand or Soil

As described in Chapter 4, the power and data cables can be buried in the same trench as the MicroTrack sensor cable as shown in Figure 6.2.

The sensor cable is supplied on a wood spool and contains either 110 or 210 meters (361 or 689 feet) of sensor cable with a 20 meters (66 feet) section of lead-in cable attached. The lead-in includes factory installed TNC connectors and ferrites. The far end of the cable will be trimmed to length and terminated with a MicroTrack End of Line Termination unit (MTT) or MicroTrack In-Line Termination unit (MTI). A description of the MTT and MTI is provided in Section 3.1.3.

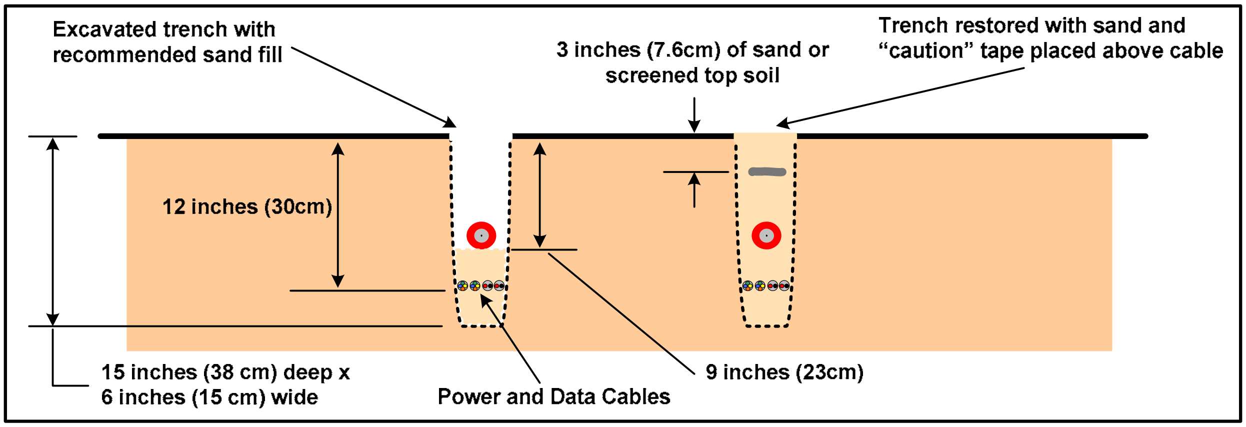

Figure 6.2 - Sensor Cable Buried in Sand with Power and Data Cables

The procedure for burying the cable is as follows:

- Excavate the trench.
- Fill, smooth and pack trench with sand, as necessary, to the desired burial depth.
- Install cables (See Figure 6.3).
- Terminate the cables.
- Backfill and pack sand or screened soil to 3 inch (7.62cm) depth.
- Install plastic "caution" tape in trench.
- Backfill trench with sand or top soil, pack and crown area over cables to direct water to flow away and not accumulate. This will also allow for the backfill settling over time.

Figure 6.3 – Installing Sensor Cable in Soil

6.2 Burying Sensor Cables in Concrete/Asphalt. Thickness of 4 inches (10 cm) or more

There are two methods of burying the sensor cables in concrete and asphalt depending on the thickness of each material. When the thickness is greater than 4 inches (10cm), the materials can be slotted with a concrete saw and the sensor cable installed directly in the material, as shown in Figure 6.4.

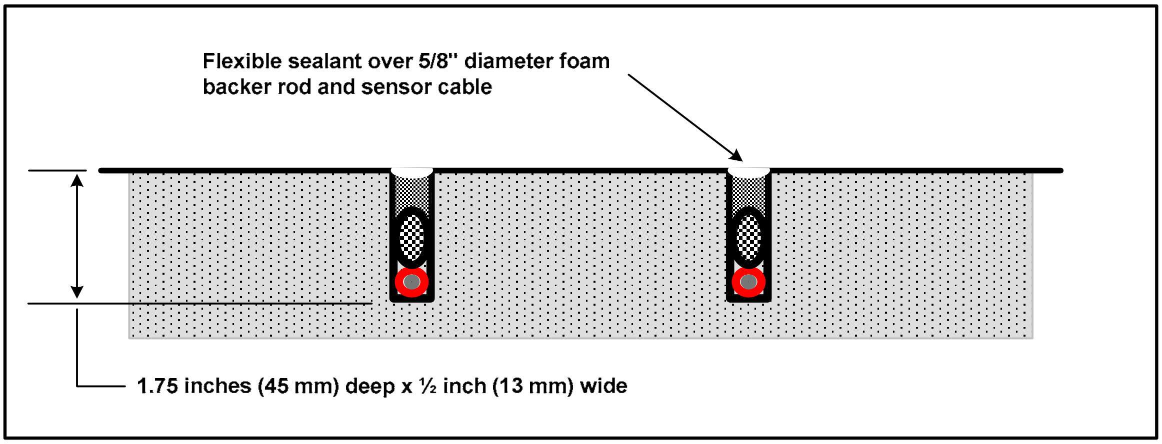

Figure 6.4 - Sensor Cable in Concrete or Asphalt over 4 inch (10 cm) thick

The saw cuts are made with a walk-behind concrete and pavement saw. Concrete dust and debris should be removed from the saw cut with compressed air and the slot treated with a concrete sealer. The cable is then laid at the bottom of the slot and packed tight with a 5/8 inch (16mm) diameter foam backer rod, which holds the cable at the bottom of the slot preventing any motion. A high quality traffic grade sealant is applied to provide a waterproof seal over the concrete and backer rod. There are several varieties available, such as Gold Label Loop Sealant, Dow Corning 888 or 890SL silicone highway joint sealer (the 888 is for use with concrete and the 890SL is for use with asphalt) and Bondo P-606 Flexible Sealer. A gap of at least 1/2 inch (13mm) should remain between the top of the backer rod and the top of the slot to allow for adequate bonding of the sealant.

The saw cut can be either 1.75 inches (45mm) deep, as shown in Figure 6.4, which is recommended for reinforced concrete, or 2.4 inches (61cm) deep for non-reinforced concrete. The deeper slot will require the use of two tightly packed 5/8 inch (16mm) diameter foam backer rods to fill the additional depth.

The same approach applies to asphalt surfaces with a thickness greater than 4 inches (10cm).

6.3 Burying Sensor Cables in Concrete/Asphalt. Thickness less than 4 inches (10 cm)

When the thickness of the concrete or asphalt is less than 4 inches (10cm) it is best to cut completely through the materials to install the cables in the soil below as shown in Figure 6.5. The material is saw cut to a width of approximately 6 inches (15cm) depending on the base materials. The larger width is recommended when there is a deep base of crushed stone.

The concrete or asphalt is then removed and disposed of. A trencher can be used to excavate the crushed stone and soil to the depth of 12 inches (30cm) below the surface of the concrete or asphalt. It is recommended that the trench be backfilled with sand or screened soil so that the cable is protected from the crushed stone. If necessary, geo-textile fabric can be installed in the trench to stabilize the soil backfill to prevent it sifting into the crushed stone.

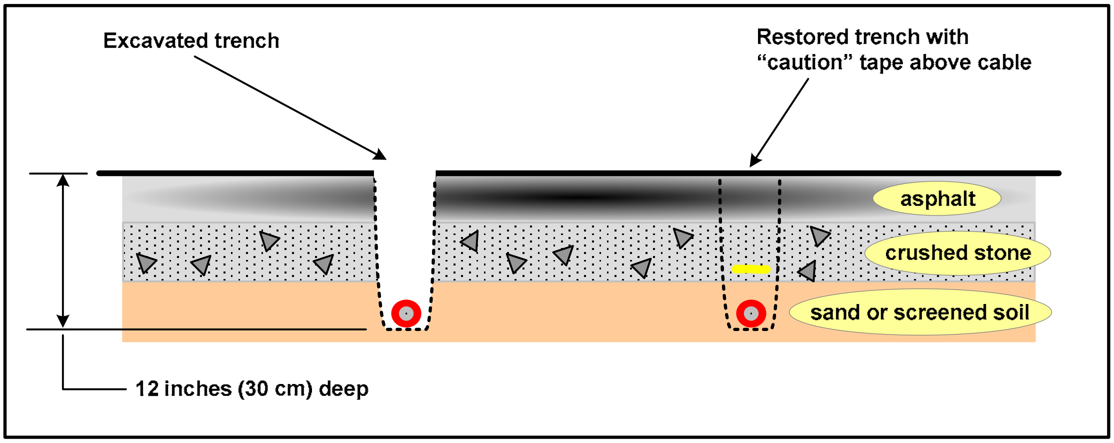

Figure 6.5 - Sensor Cable in Asphalt (or Concrete) less than 4 inches (10 cm) thick

The sensor cable should be partially backfilled and “caution” tape installed between the sand/soils and crushed stone. The trench can then restored by patching the asphalt or concrete to match the top surface.

6.4 <u>Burying Sensor Cables in Different Mediums</u>

As shown in Figure 6.6, the sensor cables can be buried in a variety of mediums while providing detection fields with uniform sensitivity. Variances in burial medium characteristics are compensated by MicroTrack™ II’s unique Sensitivity Leveling™ technique.

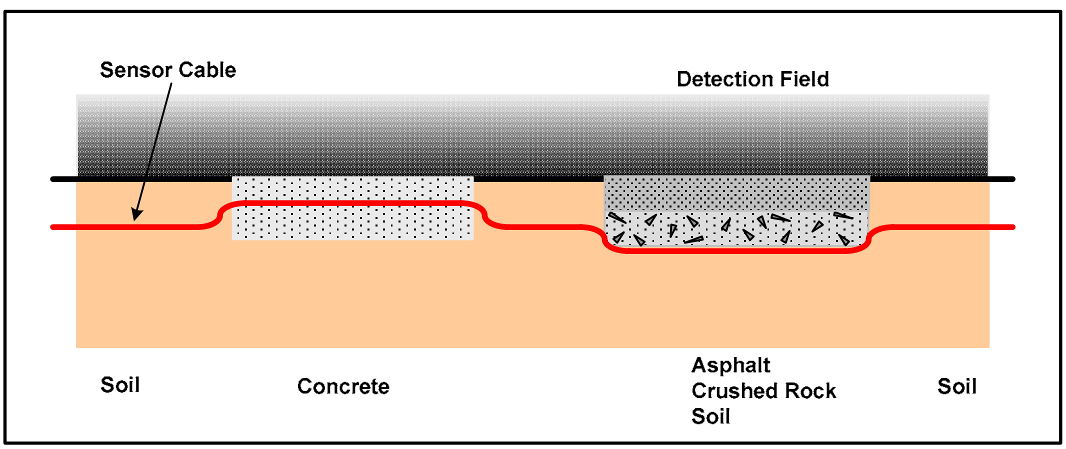

Figure 6.6 - Sensor Cable Buried in a Variety of Mediums

6.5 Bypassing Large Non-metallic Drainage Pipes and Culverts

When large non-metallic drainage pipes or culverts (over 4 inches [10cm] in diameter) are located within 3 feet (1 meter) of the sensor cable they should be shielded so that water flowing through them will not be detected. This could occur from water suddenly appearing in pipes. MicroTrack™ II would not sense this effect in metallic pipes or culverts, which provide their own shielding.

There are two methods to provide shielding. If the pipes are small diameter, i.e., up to 6 inches (15cm), it may be more practical to wrap them in a metal foil with a plastic coating to prevent corrosion. Larger pipes and culverts should be shielded using a large sheet of metal, such as galvanized or stainless steel, or a metal foil wrapping as shown in Figure 6.7. Note that the shielding should extend at least to the bottom of the pipe.

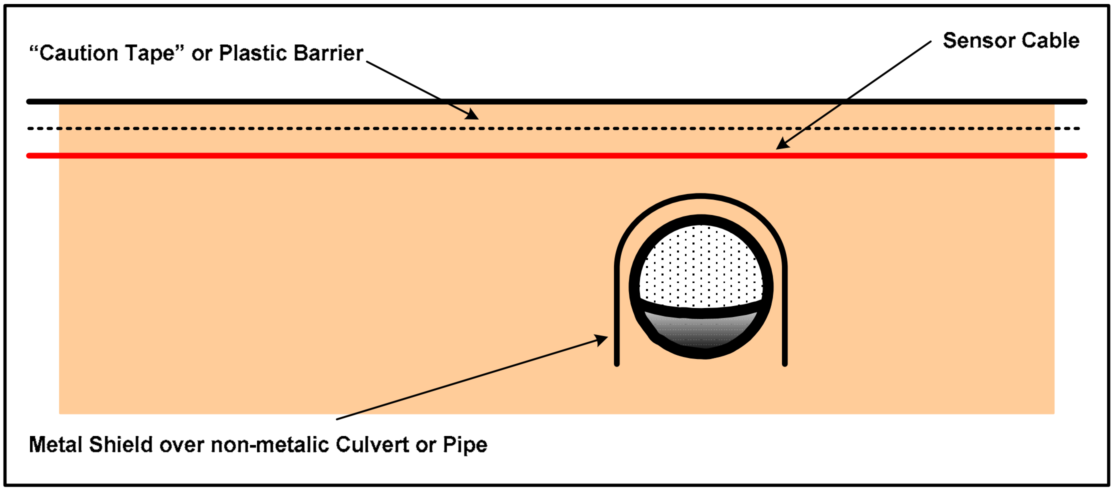

Figure 6.7 - Metal shielding over Non-metallic Culvert

The shielding should also extend over the pipe or culvert for a distance of 3.3 feet (1 meter) to each side of the sensor cable path as shown below in Figure 6.8. It should be a continuous piece of metal or if multiple sections are used, they should be fastened together to ensure there are no loose metal contacts between the sections which could generate electrical noise.

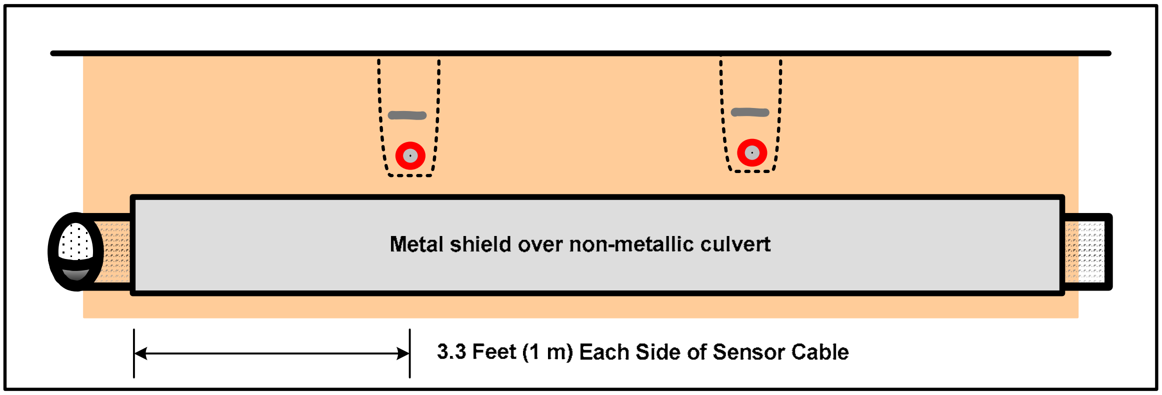

Figure 6.8 - Metal shielding over Non-metallic Culvert - Side View

Small pipes, such as those used for irrigation and sprinkler systems should not cause any interference with MicroTrack™ II. However, if MicroTrack II is installed within the range of an operating water sprinkler head, nuisance alarms may occur. Avoid long (16 ft. [5m]) parallel runs within 3 feet (.9m) of the cables.

6.6 Buried Electrical Cables, Conduits and Wires

The presence of electrical cables either buried directly in the ground or installed in metal conduits should not have any adverse effect on MicroTrack II if they are located 3.3 feet (1 meter) or more from the sensor cable. However, if electrical conduits are buried within 3.3 feet (1 meter) of the cable, it is important that they be mechanically well connected so that there are no intermittent contacts between sections, which could be sensed by MicroTrack II. Cables that are installed in PVC can create more problems. As the temperature changes, the cables can expand and contract, causing movement of the wire within the PVC pipe. This could create nuisance alarms. These can be shielded in the same fashion as the water pipes.

Should any cables, conduits or wires be located near the sensor cables they may locally alter the detection field depending on their orientation. If they are perpendicular to the sensor cable they should not adversely affect performance, and should variances occur they would be compensated through Sensitivity Leveling™ during system calibration. Cables, conduits or wires running parallel to the sensor cable may affect performance and should be kept 6.6 feet (2 meters) away from the sensor cables.

6.7 Overhead Electrical Cables and Conduits

Overhead electrical cables and wires should not have any effect on MicroTrack II if they are located more than 10 feet (3 meters) above the ground. Movement of the wires from wind is the most likely source of alarms from overhead wires.

6.8 Arranging Lead-in and Sensor Cable for Detection Field Startup

The detection field takes approximately 16 feet (5 meters) from the start of the sensor cable to develop to its full height and width. To ensure that the detection field is continuous and fully developed, the MTP II's two cable sets must be overlapped for a distance of 33 feet (10 meters), as shown in Figure 6.9.

Lead-in cables are used to link the MicroTrack Processor II (MTP II) electronics to the sensor cable. The lead-in cable is 20 meters (66 feet) long and is factory spliced to the sensor cable to make the sensor cable assembly. The lead-in cable is shielded so RF energy will not escape before it reaches the sensor cable, and has ferrites along its length to prevent the RF field from traveling back along the outside of the lead-in cable to the MTP II. Since care must be taken in affecting the RF field, it is important that the following instructions be followed regarding placement of the lead-in cables.

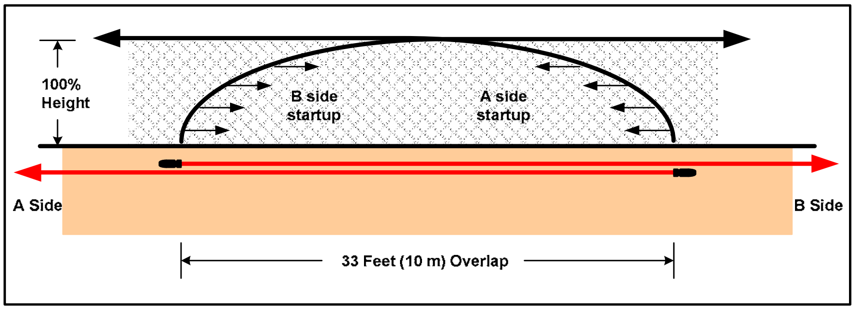

Figure 6.9 - Sensor Cable Overlap for Detection Field Startup at MTP (Side view)

Figure 6.9 presents a side view of how the detection field starts and develops to full height and width over the overlap distance. The sensor cables for each cable set are in fact buried at the same depth, although they are drawn separately here for clarity.

The lead-in cables can be positioned in either the triangular format as shown in Figure 6.10, or in a rectangular pattern as shown in Figure 6.11. The lead-in cable trenches between the sensor cable and the MTP II must be at minimum 7.5 feet (2.3 meters) in distance to ensure there is no RF energy feedback from the sensor cables to the MTP II.

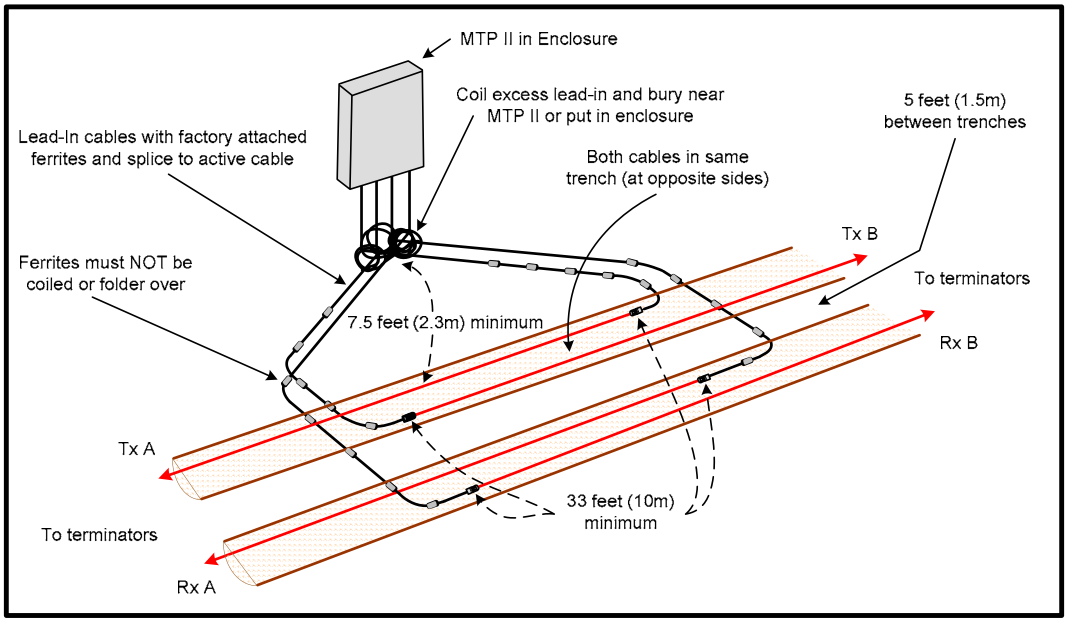

Figure 6.10 - Sensor Cable Startup Overlap - Triangular Format

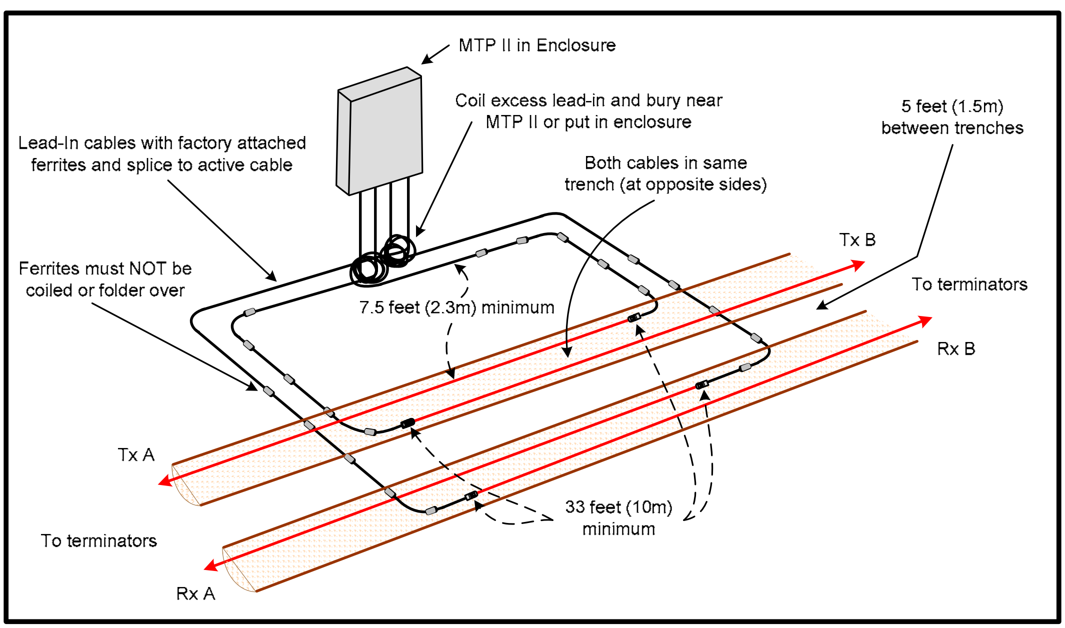

Figure 6.11 - Sensor Cable Startup Overlap - Rectangular Format

The lead-in cable is a fixed length and cannot be shortened or lengthened. Excess lead-in cable must be buried in the ground by either coiling the lead-in near the MTP II, as shown in Figure 6.10 and 6-11 or coiling the lead-in in the MTP II enclosure as shown in Figure 7.2. Under no circumstances should the lead-in cable be overlapped with or coiled next to the sensor cable or the ferrites. *The ferrites must not be coiled or folded over*.

Alternatively, the MTP II may be offset so that it can be located further away from the startup area, as shown in Figure 6.13. Also a 66 foot (20 meters) Lead-In Extension Cable Kit is available for projects where the MTP II must be further away from the start of the sensor cable location.

Where the lead-in cable crosses sensor cable(s) it must be buried under the sensor cable by at least 4 inches (10cm), as shown above in Figure 6.12.

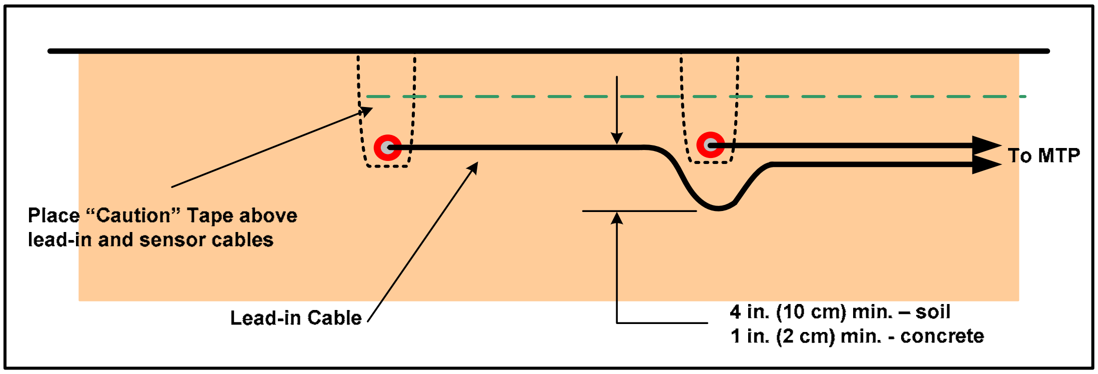

Figure 6.12- Lead-in Cable Crossing under Sensor Cable at Start-up

6.9 Locating an MTP II Near a Fence Corner

When an MTP II must be located at a corner of a perimeter fence it is recommended that the cable startup area be offset to one side of the corner or the other as shown in Figure 6.13. It is possible to position the startup area and cable overlap in a corner if there are no space restrictions, however, we do not recommend this practice when MicroTrack™ II is being installed close to a fence or between double fences. It is recommended that the processor be installed on the secure side of the perimeter fencing.

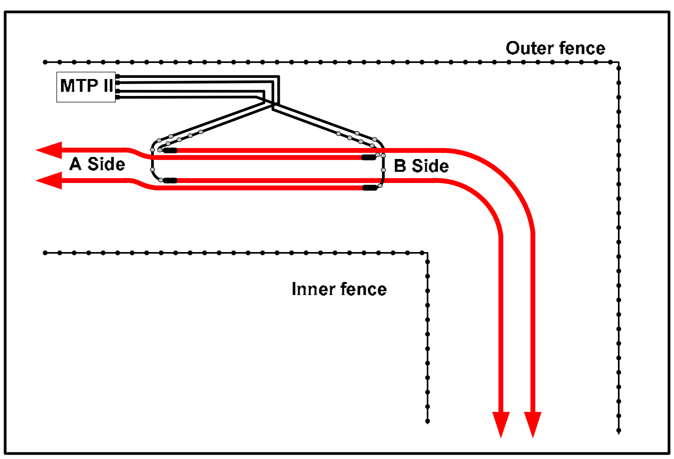

Figure 6.13 - Sensor Cable Overlap near a Corner between Double Fences

6.10 Making Turns with Sensor Cables

Sensor cables can be turned around corners and obstacles in either a smooth continuous curve or in incremental steps. When sensor cables must turn a corner, it is important to remember that it is not only the sensor cable that must be turned but also the detection field. While it may be possible to rapidly turn the sensor cable, it is not possible to rapidly turn the detection field. For this reason, the sensor cable must be turned at a rate that will allow the detection field to follow the cable path and not cause it to skew away from the cable and into other objects.

Figure 6.14 illustrates the right and wrong way to make a 90º turn. In the diagram on the left, notice how the detection field closely follows the sensor cable when it is turned along a radius. While the detection field flows slightly away from the cable during the turn it soon returns to follow the cable after the turn.

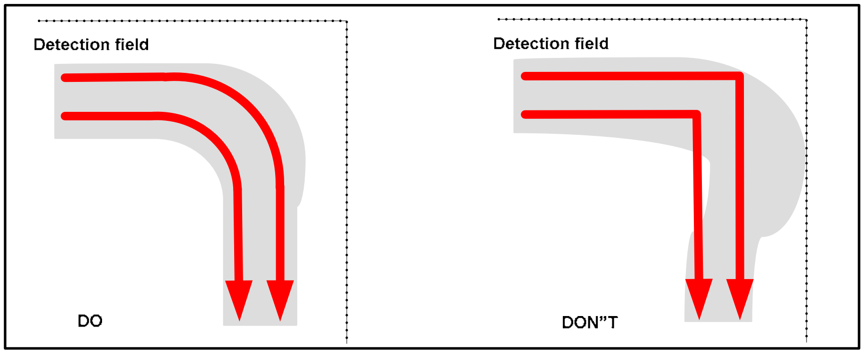

Figure 6.14 - Do's and Don'ts of Turning Corners with Sensor Cable

However, in the diagram on the right, a sharp right-angle turn is made which causes the detection field to skew past the cable and run into the fence before eventually realigning itself with the cable path. This should be avoided because not only could the fence now cause nuisance alarms, but detection may occur beyond the perimeter fence.

Another method to turn sensor cables around corners is to take short step turns. Depending on the turning space available, step turns of up to 30º can be taken, as shown in Figure 6.15.

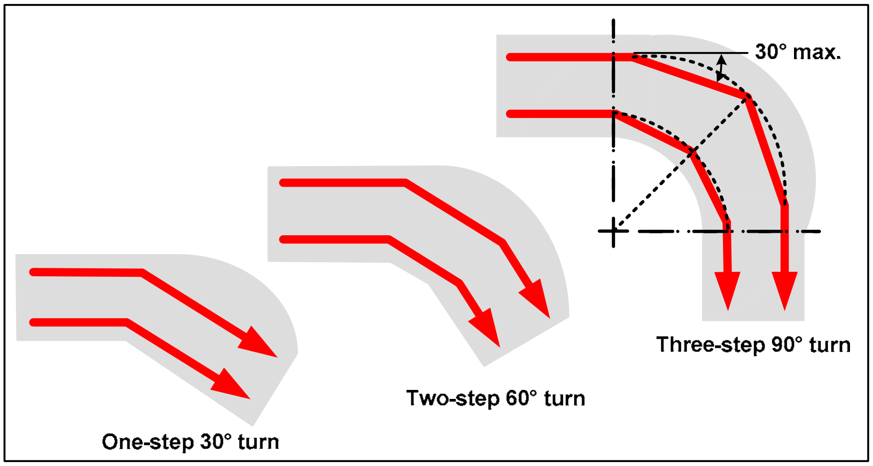

Figure 6.15 - Making Sensor Cable Corners with 30° Step Turns

It is always preferable to make gentle continuous turns when changing direction. This provides better control over the path of the detection field. Sharp turns will develop large lobes in the corner that will extend beyond the fence line. This may be into unwanted areas that will produce nuisance alarms. Figure 6.16 shows how to do the arc turn and step turn in a 90° corner. For the arc turn, using the corner post (A) as the marker, tie a string to it and move to the first trench (B). Mark the ground as it is moved to the other trench (C). Do this for both trenches. This will provide the arc keeping the correct distance between cables and appropriate distances from the fence. If no fence is there, a stake at that position (A) must be used. A radius turn should be no less than 5 feet (1.5m).

The step turn is similar to the arc except that it has three (3) equal length sections. Another easy way to layout a three step turn is to stake-out a 90º radius turn and then divide the quadrant in half, as shown in Figure 6.15. Straight lines can then be drawn between the two halves which represent the first and second 30º steps.

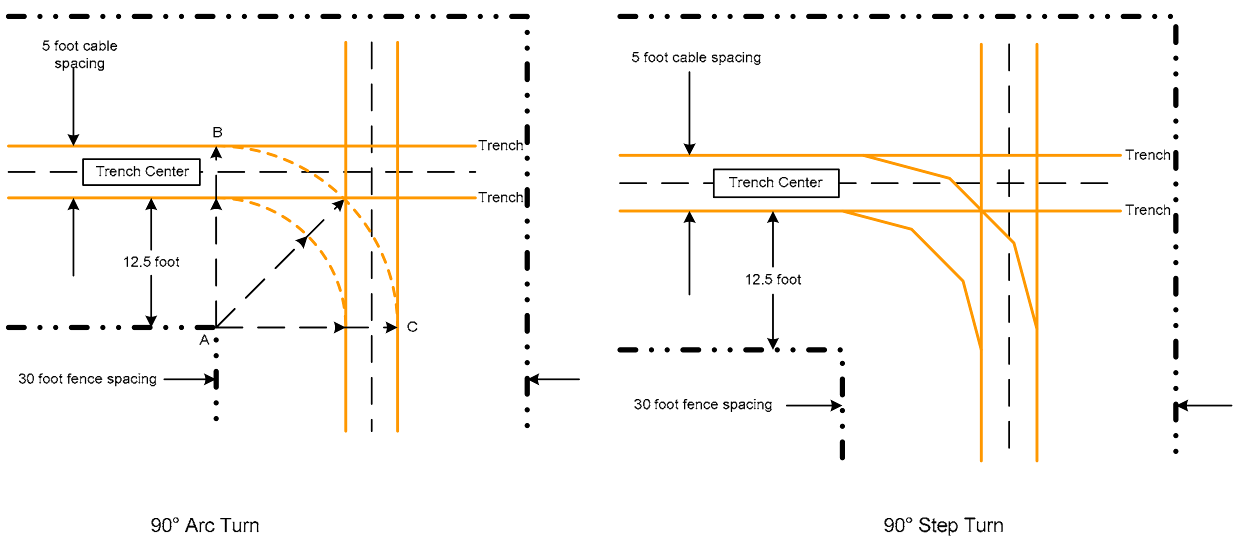

Figure 6.16 - Turning Sensor Cable Around 90° Corners between Double Fences

6.11 Terminating the Sensor Cable Near Buildings

The sensor cables should be terminated before a building, gate, large object or fence, so that the detection field does not continue into the object. Otherwise, nuisance alarms may occur, for example, from people moving inside the building or from metal objects on or within the building.

When the sensor cable set is terminated away from the building as shown in Figure 6.17, a gap will remain between the detection field and the building. It is recommended that a microwave transceiver unit or microwave link be installed to fill the detection gap up to the building. The overlap distance between the microwave sensor and MicroTrack™ II's detection field is determined by site detection specifications.

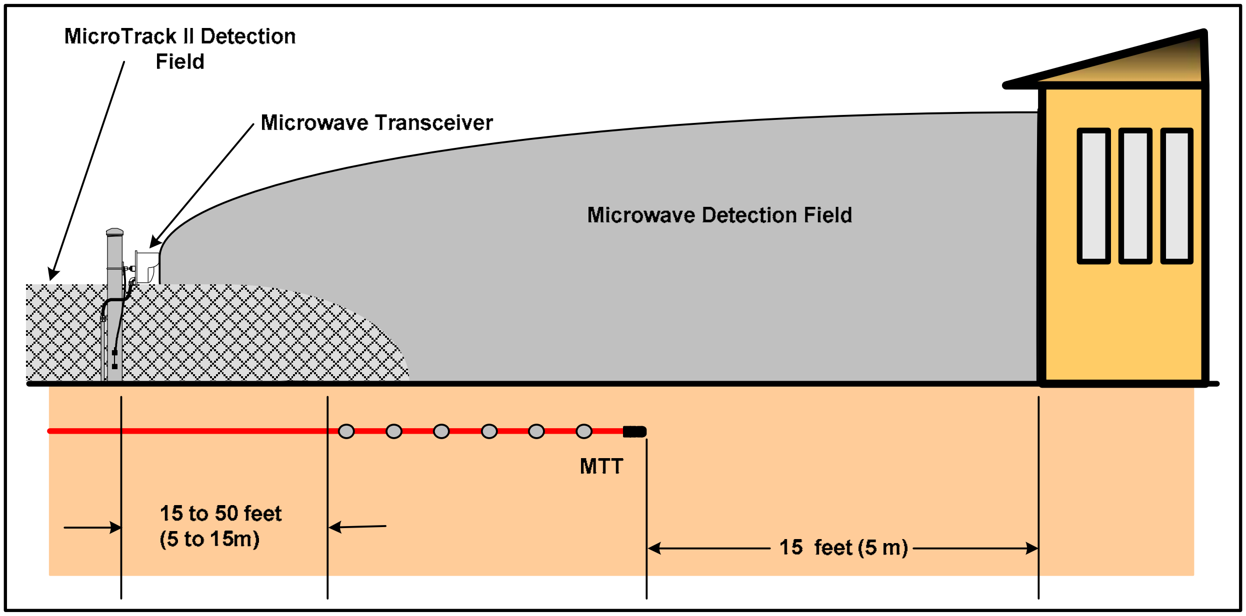

Figure 6.17 - Sensor Cable Termination near Building with Microwave Auxiliary Sensor

6.12 Terminating the Sensor Cable

MTT's are used to terminate the detection field at the end of a Sensor Cable Assembly when there is no adjoining set of cables. The MTT kit includes 6 ferrite beads, insulating wrapping tape, conduit adapter assembly, 51 ohm resistor and potting compound. One MTT is required for each sensor cable assembly; therefore, two MTT's are required for a sensor cable set.

The assembly instructions for the MTT are shown in the following steps 1 through 8 and as illustrated in Figure 6.18.

- **Step 1**: Cut the cables to match at the ending point. Slide all 6 Ferrites over the end of the MicroTrack Sensor Cable. Caution: The Ferrites are very fragile. Use care and do not let the Ferrites slide down the cable hitting each other. This can fracture the Ferrites.
- **Step 2**: Remove the End Cap from the Conduit Adapter Assembly and set aside.
- **Step 3**: Slide the Conduit Adapter Assembly over the end of the MicroTrack II Sensor Cable as shown in Figure 6-18.
- **Step 4**: Strip the end of the Sensor Cable to the dimensions shown in Figure 6-18. Clean the braid thoroughly using Goo Gone, WD40, Xylene, Kerosene, or Mineral Spirits to remove the flooding compound.
- **Step 5**: Attach the resistor to the end as shown in Figure 6-18. Twist the resistor leads around the center conductor and also around the braid wires. Make sure that no free ends of the braid are in contact with the center conductor. Keep the wire leads as short as possible, as shown.

- **Step 6**: Solder both ends of the resistor to the Sensor Cable. Be sure that the solder flows well into the braid. **It is very important to have good solder connections. Cold solder joints will create noise and potential nuisance alarms**. Trim the excess wires.

- **Step 7**: Center the resistor in the Conduit Adapter Assembly then secure the connector on the cable. Completely fill the Conduit Adapter Assembly with potting compound and install the end cap. It is important to completely seal the entire braid, resistor, and center conductor to prevent any water from getting inside. Tighten the connector and end cap.

- **Step 8**: Slide the Ferrites to the positions shown in Figure 6-18 and secure them in place using the Rubber Splice Tape provided. **When applying the tape, stretch the tape to about twice its original length as the tape goes on.** Be sure to remove the backing paper from the tape. Cover the entire ferrite and at least 0.75 inches (19mm) of the Sensor Cable on both ends of the Ferrite. Avoid leaving any air gaps for water to enter around the Ferrites.

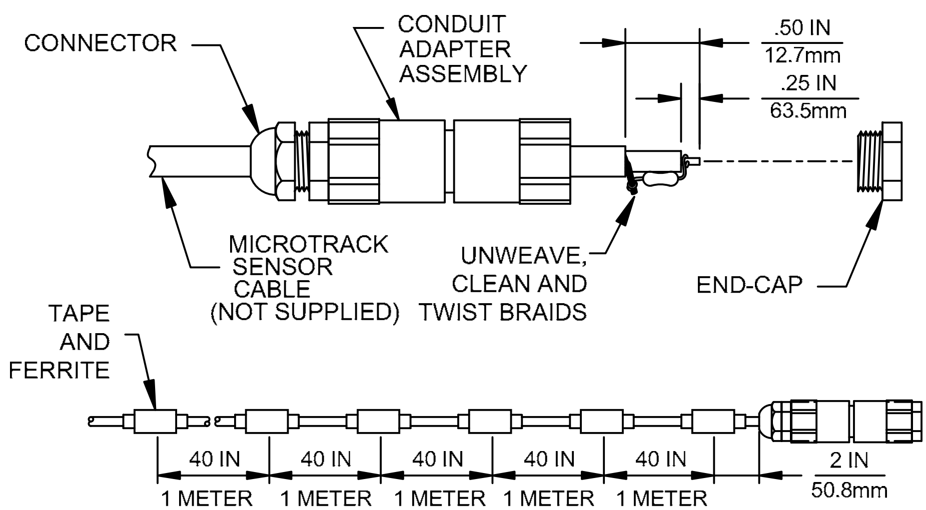

Figure 6.18 - Sensor Cable End of Line Termination (MTT)

MTI's are an in-line termination used to terminate the detection field at the end of a Sensor Cable Assembly that is adjacent to another Sensor Cable Assembly. The MTI kit includes an enclosure with adapters, strain relief's, two 51 ohm resistors, vinyl boots, splice connector and potting compound. One MTI is required for each transmitter pair and receiver pair cable assembly; therefore, two MTI's are required for this in-line overlap termination.

The assembly instructions for the MTI are shown in the following steps 1 through 10 and as illustrated in Figures 6.19 to 6.24.

It is important to follow the instructions below. ***Poor connections can create nuisance alarms, so care must be taken to insure good quality solder connections***. Simply crimping the wires together is not sufficient. It is required that they be soldered to prevent any possible noise from the connection.

- **Step 1**: Lay all 4 cables back in the trenches. Pull the cables tight. Cut the cables to a length that leaves an extra 6 inches (152mm) of cable when brought end-to-end. Insure that both inline terminators are located directly across from each other as shown in Figure 6.19.

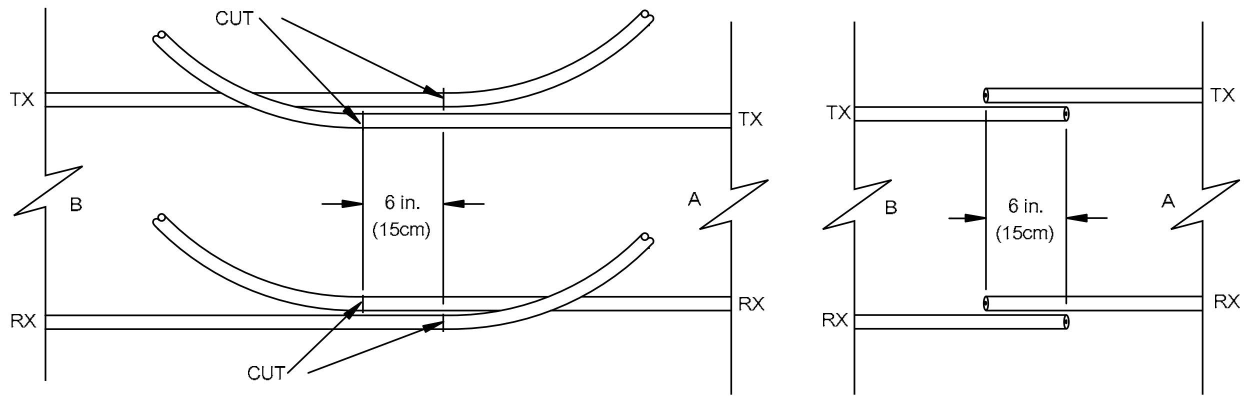

Figure 6.19 –Preparing Cables for MTI

- **Step 2**: Follow Figure 6.20, slide the enclosure with the strain relief over the end of one cable. Slide the other strain relief over the end of the other cable.

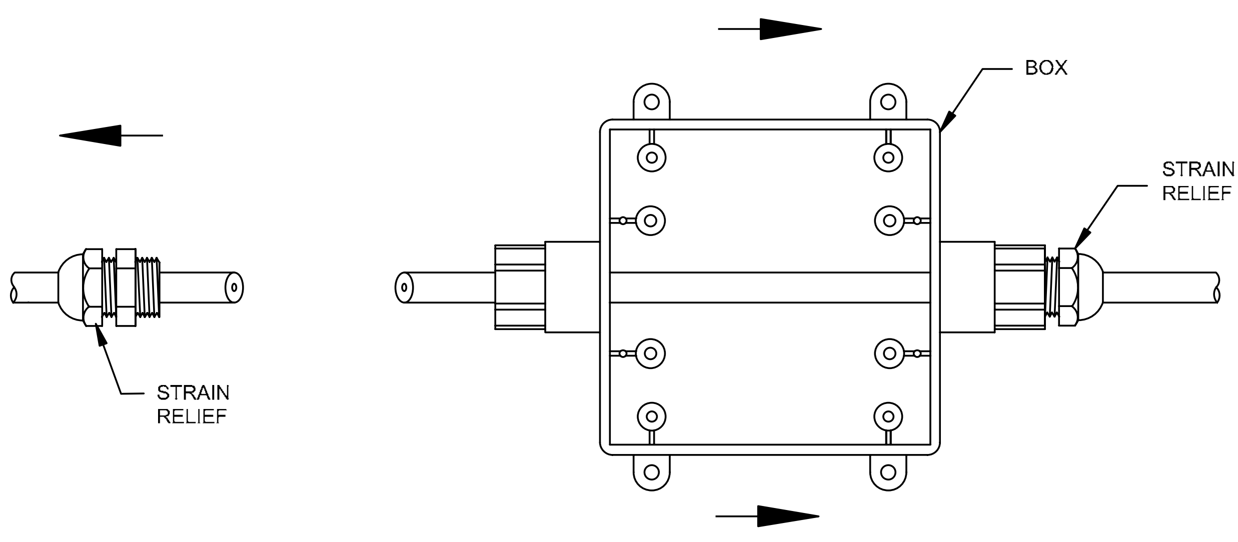

Figure 6.20 – MTI Strain Relief and Enclosure

- **Step 3**: Strip the cables to the dimensions as shown in Figure 6.21. Clean the braid thoroughly using Goo Gone, WD40, Xylene, Kerosene, or Mineral Spirits to remove the flooding compound.

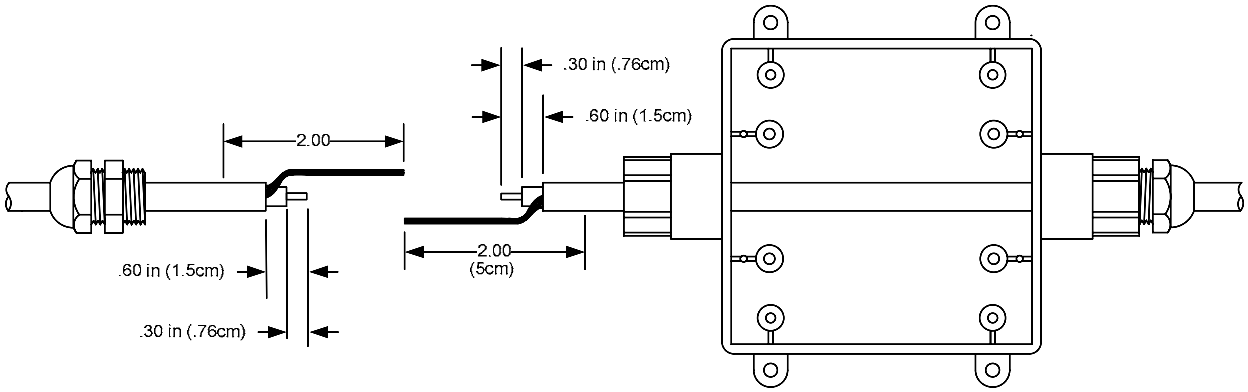

Figure 6.21 – Cable Stripping Dimensions for MTI

- **Step 4**: Place a resistor along side the cable as shown in Figure 6.22. Twist the lead wire around the center conductor as shown. Twist the other lead around the braid wire as shown. Solder both connections.

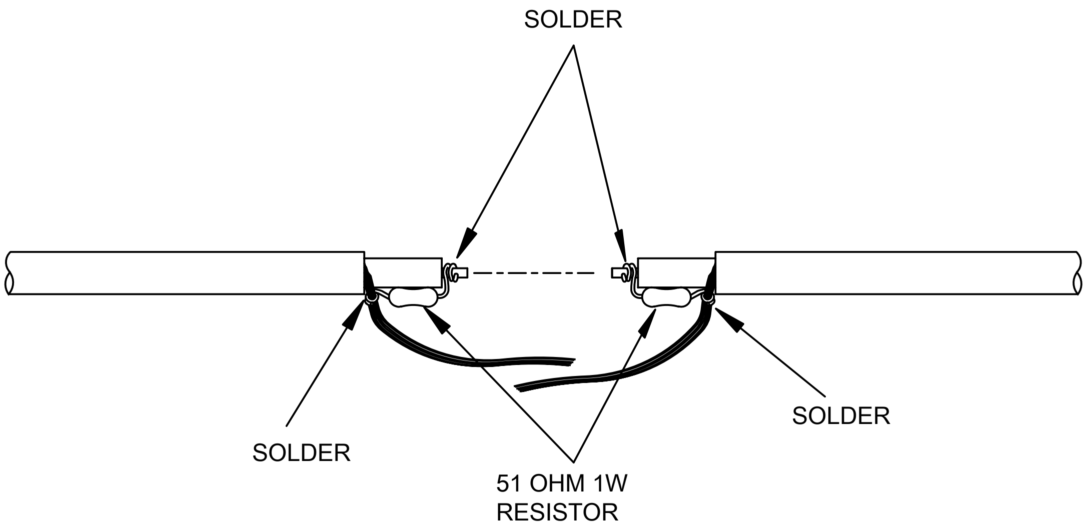

Figure 6.22 – Attaching Resistor and Soldering for MTI

- **Step 5**: Repeat Step 4 by placing the second resistor on the other cable.

- **Step 6**: Insert the ends of the braids into the crimp connector, crimp and solder into place as shown in Figure 6.23. Install vinyl boot to insulate center conductor and resistor from braid.

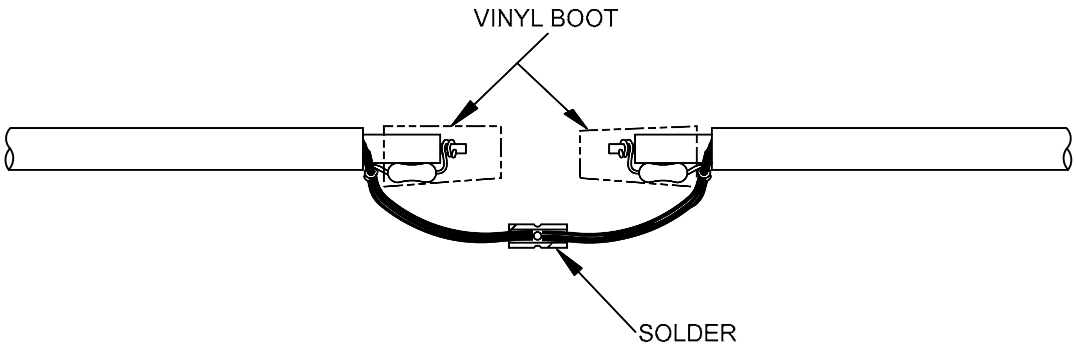

Figure 6.23 – Attaching Connector and Soldering for MTI

- **Step 7**: Slide the housing over the splice. Slide the strain relief up and screw it into the enclosure and tighten. Center the splice inside the box and tighten the strain reliefs. Insure that the connections are not shorted inside the box. See Figure 6.24.

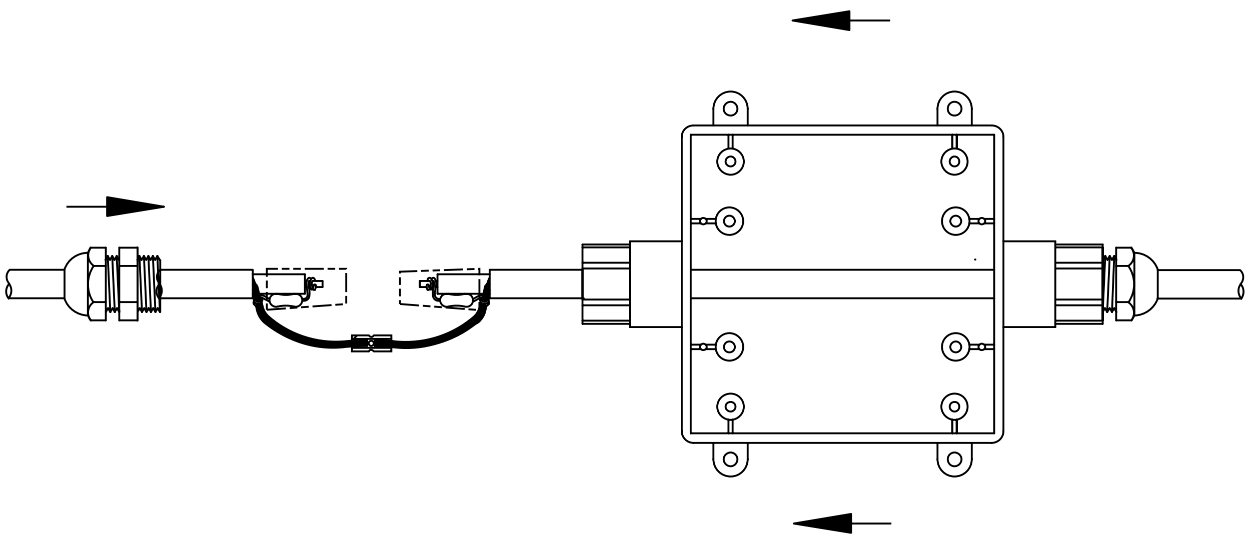

Figure 6.24 – Positioning Housing and Strain Relief for MTI

- **Step 8**: Repeat steps 2 through 7 above at the other inline termination location using a 2nd MTI kit. Make sure the second box is placed directly across from the first box.

- **Step 9**: Test the cables for proper connections by measuring the resistance of all 4 cables at their TNC connectors. They should be between 51 and 54 ohms.

- **Step 10**: Fill both boxes with potting compound and install the covers. Place the box at 45° in the trench to allow slack in the cable to prevent stress breakage. Cover the trench and calibrate the MicroTrack™ Processor II(s). Test for proper operation.

6.13 Splicing the Sensor Cable

The **MTS** is a splice kit used to repair a section of damaged cable. The MTS kit includes two enclosures with adapters, strain relief, heat shrink, two small crimp connectors, two large crimp connectors and potting compound. The MTS plus a piece of MTC400 MicroTrack cable (ordered separately) is required to repair a damaged sensor cable.

The splicing instructions for the MTS are shown in the following steps 1 through 10 and as illustrated in Figures 6.25 to 6.31.

It is important to follow the instructions below. ***Poor connections can create nuisance alarms, so care must be taken to insure good quality solder connections***. Simply crimping the wires together is not sufficient. It is required that they be soldered to prevent any possible noise from the connection.

- **Step 1**: Cut away the damaged section of cable. Lay the existing cable and the new section of splice cable back in the trench. Cut the cables to a length that leaves an extra 6 inches of cable when brought end-to-end as shown in Figure 6.25.

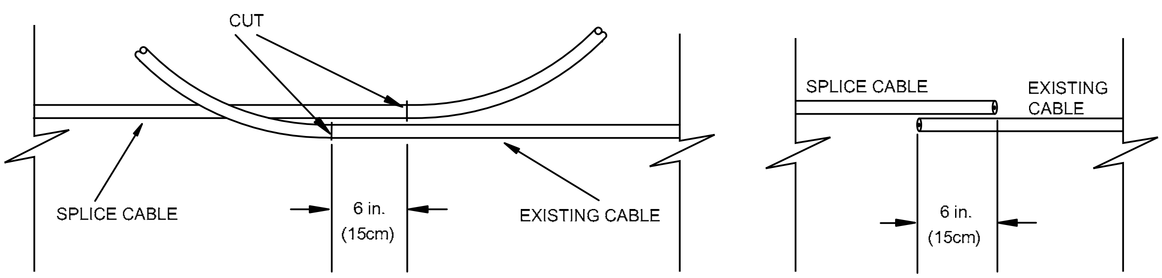

Figure 6.25 – Preparing Cables for Splicing

- **Step 2**: Follow Figure 6.26 and slide the enclosure with the strain relief over the existing cable. Slide the other strain relief over the end of the splice cable.

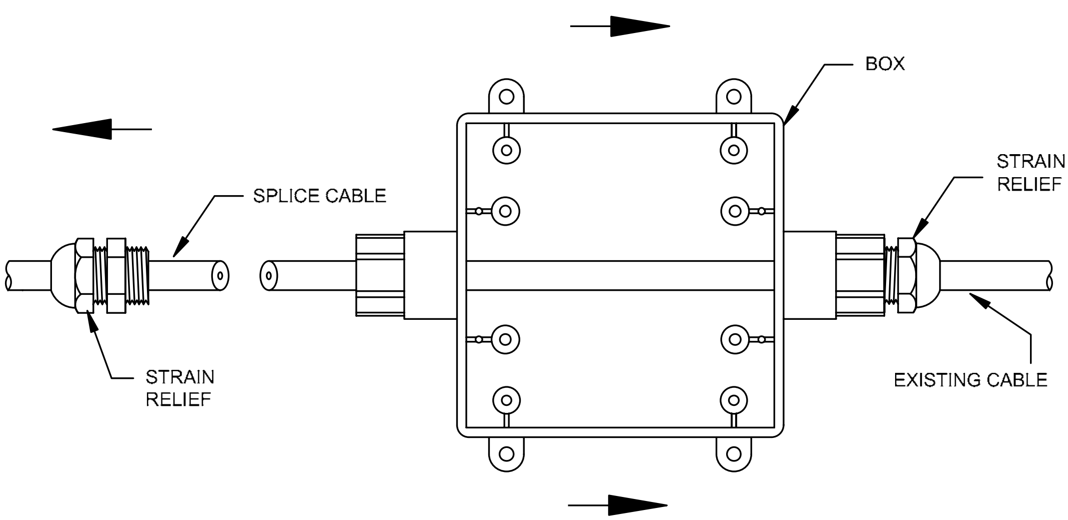

Figure 6.26 – Splice Kit Enclosure and Strain Relief

- **Step 3**: Strip the cables to the dimensions as shown in Figure 6.27. Clean the braid thoroughly using Goo Gone, WD40, Xylene, Kerosene, or Mineral Spirits to remove the flooding compound.

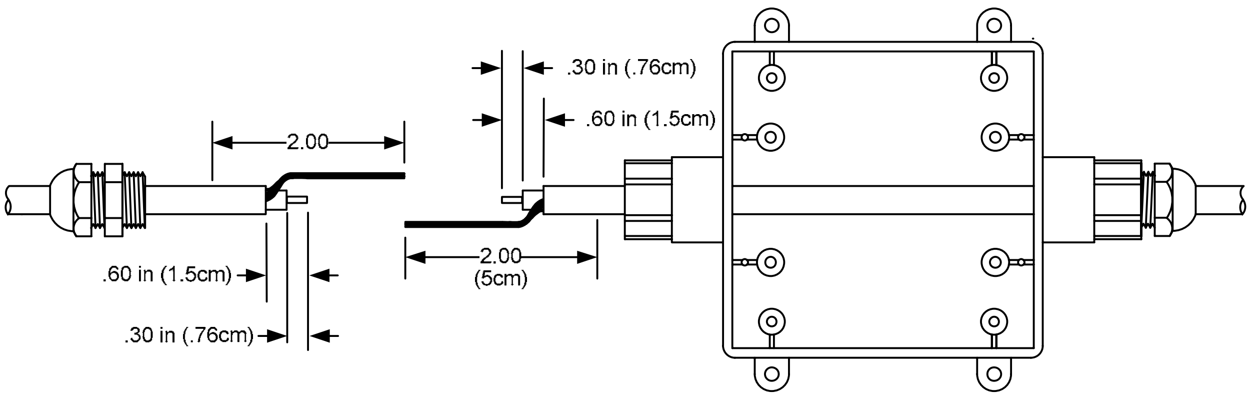

Figure 6.27 – Cable Stripping Dimensions

- **Step 4**: Slide cable into heat shrink folding the braid back as shown in Figure 6.28. Crimp and solder the small connector around the center conductor ensuring solder flow around the conductor on both cables as shown.

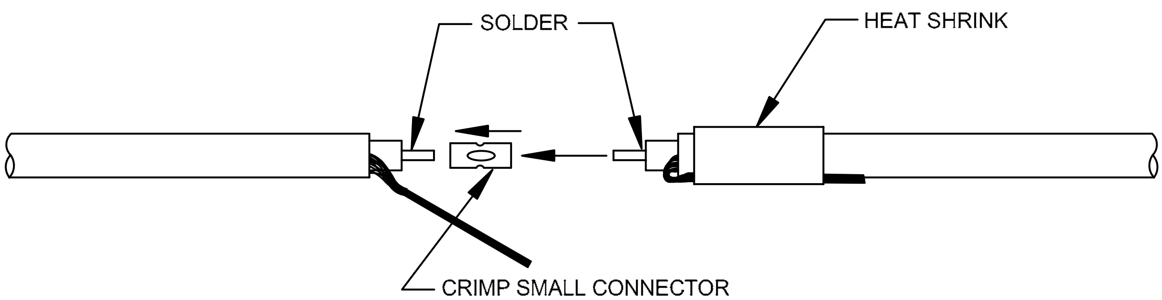

Figure 6.28 – Crimping and Soldering the Center Conductor

- **Step 5**: Move the heat shrink over the center conductors and shrink as shown in Figure 6.29.

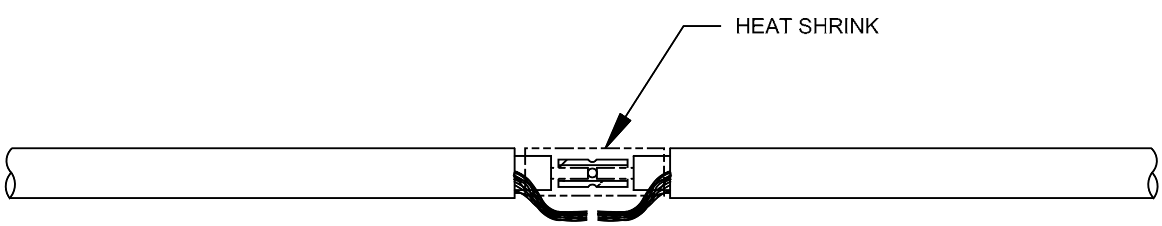

Figure 6.29 – Heat Shrinking the Center Conductor

- **Step 6**: Trim the braid. Crimp and solder the large connector to the braid on both cables as shown in Figure 6.30.

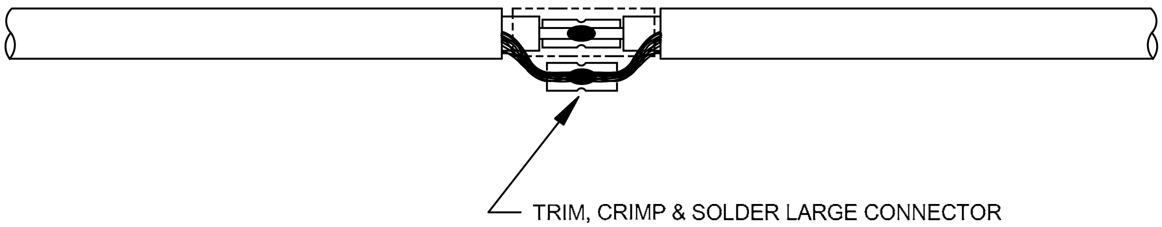

Figure 6.30 – Crimping and Soldering the Braid

- **Step 7**: Slide the housing over the splice. Slide the strain relief up and screw it into the enclosure and tighten. Center the splice inside the box and tighten the strain reliefs. See Figure 6.31.

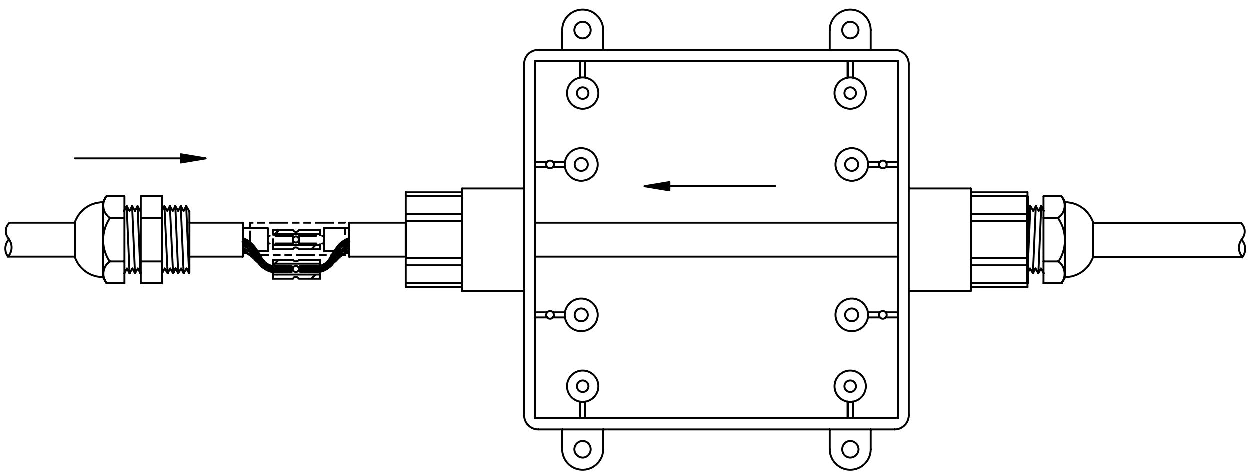

Figure 6.31 – Positioning Housing and Strain Relief

- **Step 8**: Repeat steps 1 through 7 for the other end of the splice and for any other damaged cable that needs to be spliced.

- **Step 9**: Test the cable(s) for proper connections by measuring the resistance at their TNC connector(s). They should be between 51 and 54 ohms.

- **Step 10**: Fill box(s) with potting compound and install the covers. Place the box at 45° in the trench to allow slack in the cable to prevent stress breakage. Cover the trench and calibrate the MicroTrack™ Processor II(s). Test for proper operation.

7. Installing the MicroTrack™ Processor II (MTP II)

The front panel of a MicroTrack Processor II with its key interface points is shown in Figure 7.1.

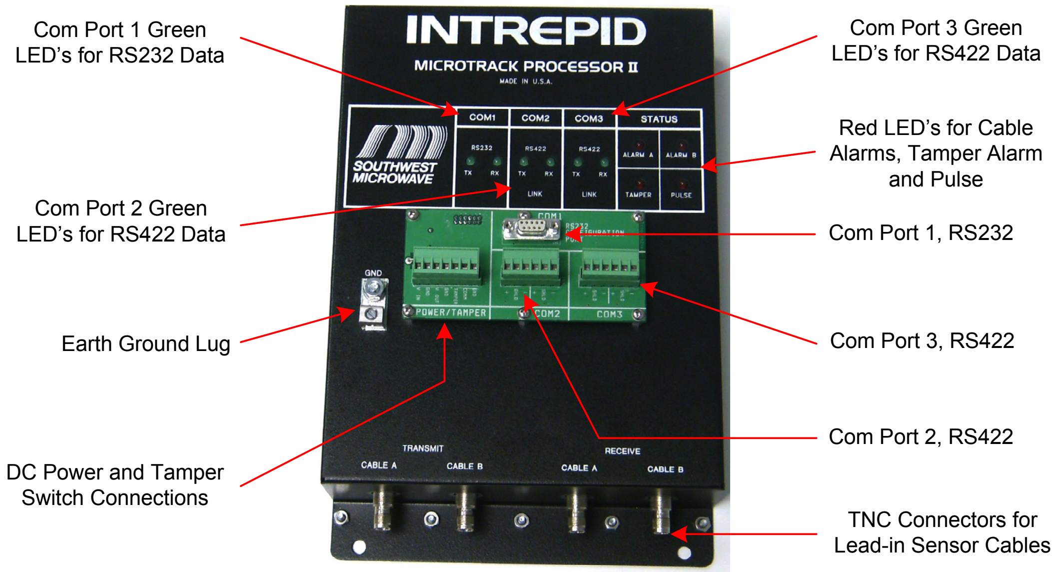

Figure 7.1 - MicroTrack Processor II Front Panel

7.1 Positioning the MTP II

MTP II's must be located within reach of the 66 ft. (20m) length of the lead-in cables, and to facilitate accessing the MTP II without causing alarms. It should also be located away from the detection field. This distance accounts for the branching-out to the detection field startup overlap, the vertical distance to the enclosure, and the loop around the MTP II to the TNC connection points. Typically, MTP II's are located within 10 ft. (3m) of the sensor cables, but can be located up to 39.3 ft. (12m) away.

7.2 Installing the MicroTrack II Enclosure (MTE)

MTP II's are installed in a weather-tight MicroTrack II Enclosure (MTE) as shown in Figure 7.2. Several enclosure options are offered, as listed in Chapter 3.1.4 and 3.1.5. The MTE can be mounted directly on a perimeter fence post or on a freestanding post near the perimeter with the 2 ½ in. (6.35cm) u-bolt mounting hardware provided. ***Note: If a larger or smaller mounting post is to be used, fit the enclosure with Unistrut and straps (not provided) to fit the diameter of pole to be used.*** A pre-drilled mounting plate and fasteners are included to mount the MTP II within the enclosure.

The MTE is sized to provide sufficient space to loop the lead-in cables around the MTP to facilitate connecting them to the MTP II. Alternatively, a user supplied equivalently rated NEMA 4 or IP65 enclosure may be substituted. MTP II's can also be mounted in: a) a rain/weatherproof pedestal enclosure of the type commonly used by the telephone and CATV industry, b) a nearby building, or c) a buried submersion-proof enclosure.

The lead-in cables, power cables and data communications cables should be protected in either a PVC or galvanized steel conduit. The conduit can be installed directly in the ground below the enclosure or in a concrete base as illustrated in Figure 7.2.

7.3 Grounding the MTP II

The MTP II should be grounded as shown in Figure 7.2 or by using the JB70A.

- Use an 8 AWG solid copper wire.
- Connect the copper wire to the ground lug on the front of the MTP II enclosure.
- Pull the copper wire through a hole in the enclosure.
- Connect the copper wire to a ground rod that meets local electrical codes.

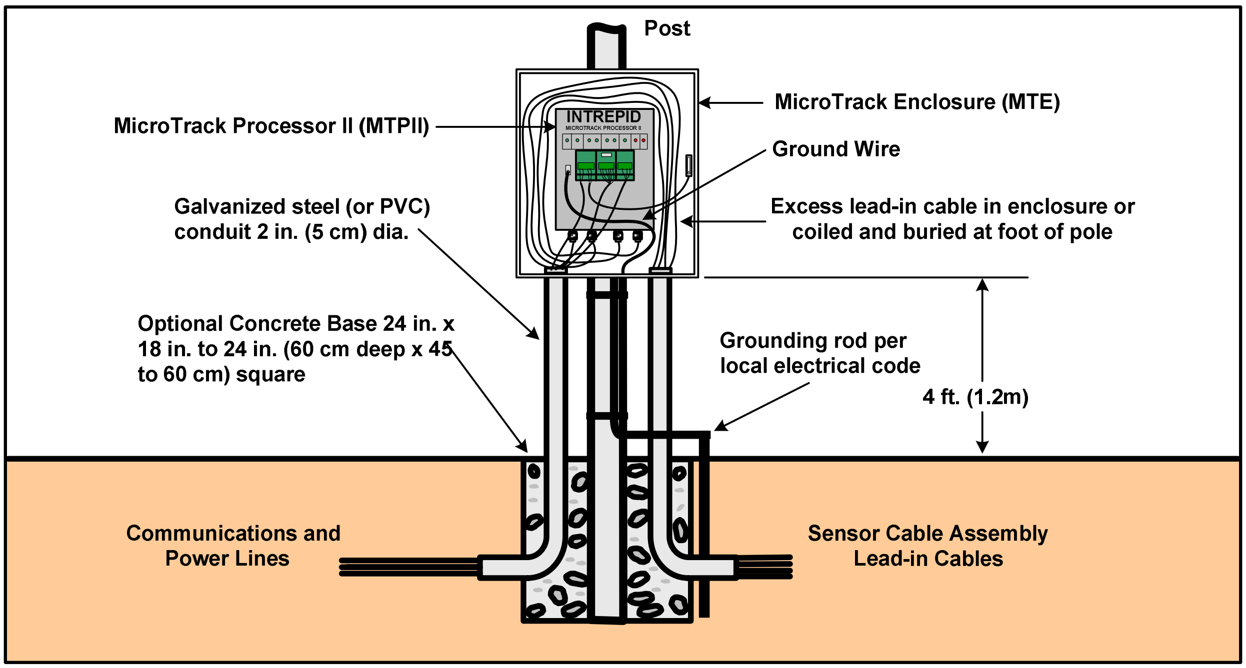

Figure 7.2 - MicroTrack™ Processor II Mounting

7.4 Power and Data Connections between the MTP II and the Control Center

A PC with Installation/Service Tool II can be located in the control center to communicate with the MTP II for setup, calibration and diagnostics. The power supply for the MTP II, as well as a controller (RCM II, CM II, GCM II, PSM or third party program) and ROM II's can also be located in the control center.

7.5 Connecting the PC using RS232

RS232 communications are used between the PC and COM1 on the MTP II for the Universal Installation/Service Tool II (UIST II). This is a 2 wire full duplex RS232 format. The twisted shielded copper wire should be 22 or 24 gauge and not exceed 50 feet (15m). For longer distances a RS232 to RS422 converter will be required or fiber optic devices can be used.

7.6 Connecting the Controller using RS422

RS422 communications is used between the controller and Com 2 on the MTP II. This is a 4 wire full duplex format. Tx + and Tx – wire to Rx + and Rx – of the next device in line. The twisted shielded copper wire should be 22 or 24 gauge and not exceed 5,000 feet (1,500m). Fiber optic devices can be used as well. Com 3 on the MTP II would connect to the next device in line which could be another MTP II, PM II, ROM II or AIM II. Com 2 is the input from the controller or previous device and Com 3 is the output to the next device.

A typical wiring diagram is shown in Figure 7.3 using the RCM II as the controller.

7.7 Connecting the Power Supply to the MTP II

Power is typically supplied to the MTP II on the perimeter from a PS48 or PS49 power supply (120 or 220 VAC to 48 VDC @ 3 Amps). The power supply is usually located in the control center, as shown in Figure 7.3. The MTP II accepts DC voltage input from 10.5 to 60 VDC at ~ 9 Watts. Depending on the location of the MTP II a 12 VDC or 24 VDC power supply can also be used. Section 3.1.12 lists optional power supplies available from Southwest Microwave, Inc. The size of the power cable wire gauge required depends on the distance between the power supply location and the MTP II, as well as the total number of auxiliary units (such as ROM II's or other sensors being powered from the same cable). Table 7.1 gives the typical voltage drop for a 500-foot (152.4m) cable using from 10 to 24 gauge wire. Numbers in RED will not work.

	Gauge	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**
MTP II	**12 VDC**	0.86	1.37	2.17	3.46	5.50	8.69	13.9	22.1
MTP II	**24 VDC**	0.41	0.65	1.03	1.65	2.62	4.14	6.42	10.5
MTP II	**48 VDC**	0.21	0.33	0.53	0.84	1.34	2.12	3.40	5.39

Table 7.1- Voltage Drop for 500 Feet (152.4m) of Cable from 10 to 24 Gauge

It is recommended that a battery-backed UPS be used to provide back-up power in emergency conditions.

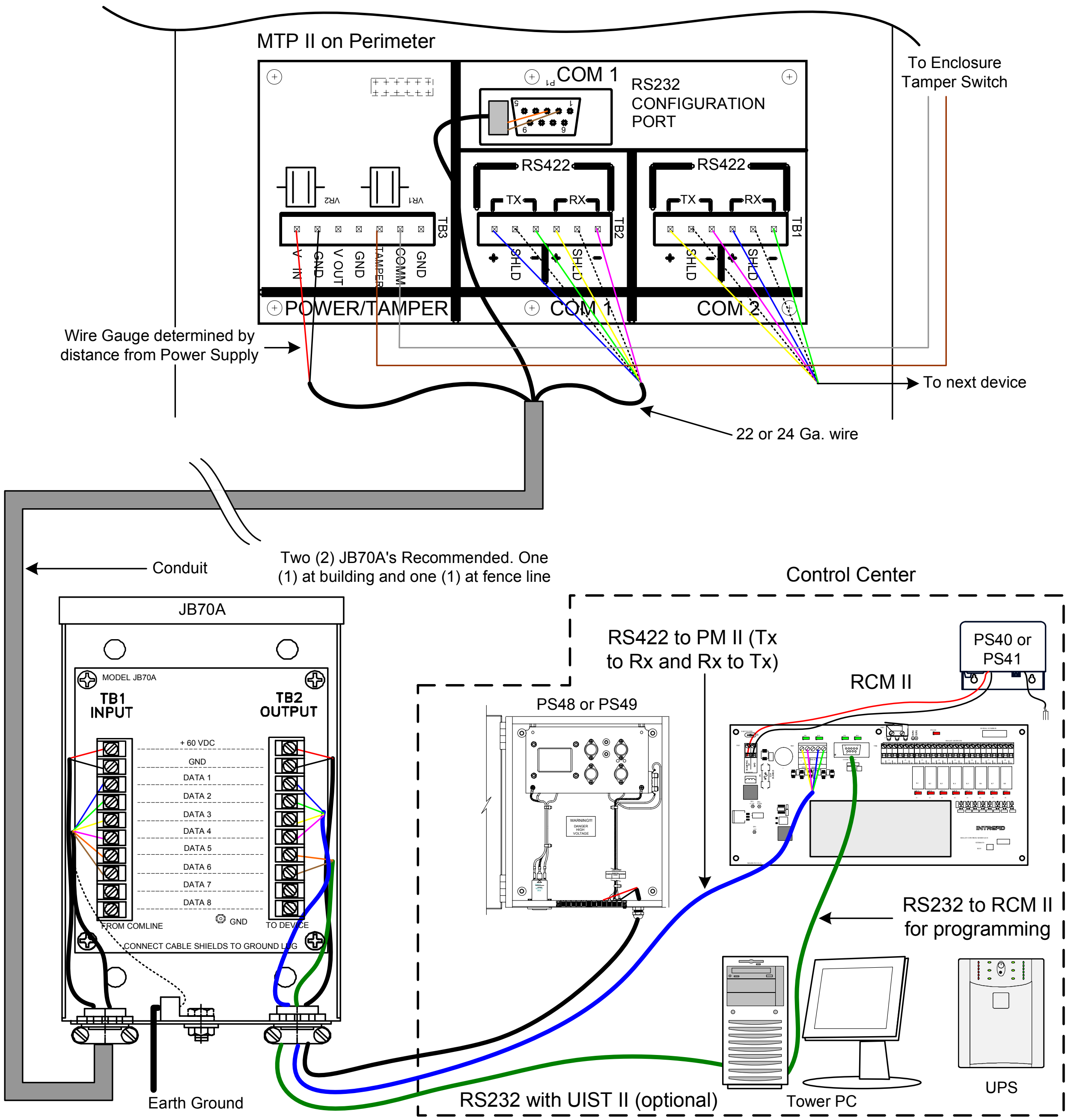

Figure 7.3- Connecting a MicroTrack™ Processor II to the Control Center

7.8 Connecting Sensor Cables to the MTP II

The sensor cable components include the sensor cable assemblies and the MicroTrack™ Terminations (MTT's and MTI's), as described in Section 3.1.2, 3.1.3 and 3.1.4.

Each sensor cable assembly includes a factory-spliced lead-in cable with ferrite beads and a TNC connector for quick connection to the MicroTrack Processor II (MTP II), as shown in Figure 7.4. It also includes labels to mark each cable as transmit or receive cable.

No connectors are installed in the field. After the sensor cable assembly is installed, connected to the MTP II and trimmed to length, the MTT's or MTI's are installed as shown in Section 6.12.

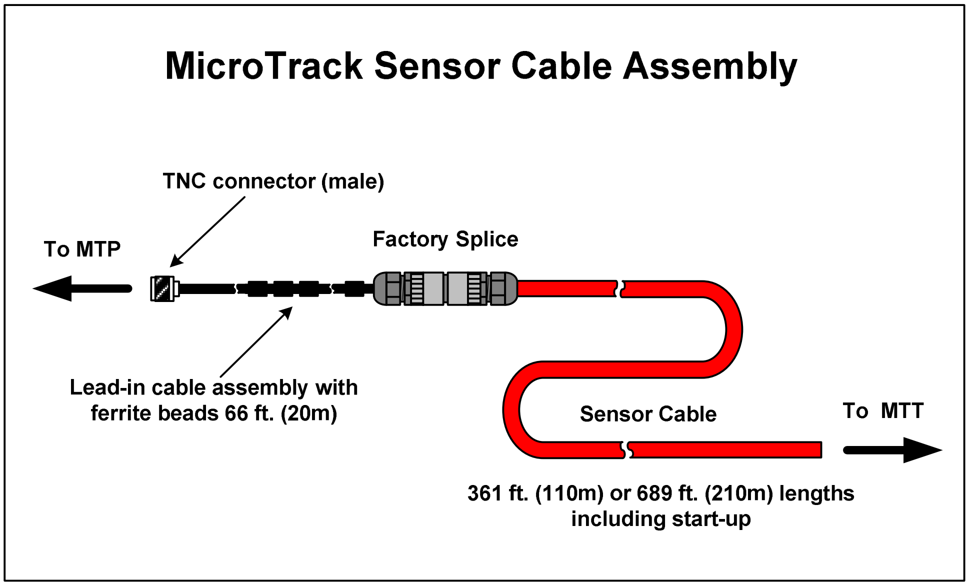

Figure 7.4 - Sensor Cable Assembly MTC400-110, -210 with integral Lead-in Cable Assembly

8. ALARM REPORTING

There are three (3) ways to interface to the MicroTrack™ Processor II: (1) Relays, (2) Graphic Map, and (3) Serial Communications.

8.1 Relay Outputs

There are two (2) controllers that can configure the MicroTrack Processor II to report alarm activity to relays only. The controllers are the Relay Control Module II (RCM II) and the Control Module II (CM II).

Configuration setup of the RCM II can be found in the Relay Control Module II Manual and configuration setup of the CM II can be found in the Control Module II Manual. If RCM II or CM II controllers were purchased with the system, these documents would have been included.

8.2 Graphic Map and Relay Outputs

There are two (2) controllers that can configure the MicroTrack Processor II to report alarm activity to a graphic map and to relays. The controllers are the Graphic Control Module II (GCM II) and Perimeter Security Manager (PSM).

Configuration setup of the GCM II can be found in the Graphic Control Module II Manual and configuration setup of the PSM can be found in the Perimeter Security Manager Manual. If GCM II or PSM controllers were purchased with the system, these documents would have been included.

The Perimeter Security Manager (PSM) is a Windows™ based software package that displays alarms on a custom graphical map and provides the operator with various Alarm Management features. This software requires a PC running Windows 2000, Windows XP Professional, or Windows 7 (32 bit system) a processor with 2.86 GHz or higher, 512 MB of internal memory, 40 GB hard drive, CD ROM, sound card and speakers, and a RS232 comport.

8.3 Serial Communications – INTREPID™ Polling Protocol II

8.3.1 Introduction

The MicroTrack Processor II operates as a polled device. If the MTP II receives a valid polling command to its unique address, then the MTP II will respond by providing the alarm status of each individual cell, plus the status of the Cable Faults, Tamper Alarm, Service Alarm and Communications Failure.

The INTREPID Polling Protocol II (IPP II) Customer Development Document is provided to customers who wish to create their own interface to the MicroTrack II Sensor. This can be used to develop a driver to incorporate MicroTrack II directly into a preferred or custom Alarm Management System. The INTREPID Polling Protocol II Specifications for Third Party Vendors (or SDK), is available by request from Southwest Microwave, Inc.

9. Maintenance

The MicroTrack™ II system requires very little maintenance. The periodic maintenance which should be done at least every six (6) months includes:

- Inspect the MTP II for any physical damage, water damage, corrosion and ingress of insects.
- Inspect the TNC, data, and power connections to the MTP II and ensure they are tight.
- Check the earth ground for continuity and corrosion.
- Observe the LED's on the MTP II for proper operation.
- Check the input power at the MTP II for correct voltage. Check battery status (if used).
- Inspect the MicroTrack sensor cable areas for vegetation, debris, water accumulation, erosion and settling of the trenches. Correct as necessary.
- Every month or on regular intervals, the alarm buffer from the MTP II should be downloaded using the UIST II, saved, evaluated and appropriate adjustments made to the threshold or incremental threshold as necessary. Clear the buffer after evaluation.
- With the UIST II software, the Input Display, Max Peak Holds Display and Clutter Display should be viewed to ensure proper readings.