MPS-4100

Microwave Protection System

Product Guide

E6DA0102-003, Rev C
Third Edition
April 27, 2009

SENSTAR™

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Senstar's Quality Management System is IS0 9001:2000 registered.

Compliance:

USA: FCC Certification - This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Identification Number: I5TMPS4100

Canada: This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

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1 Overview

Introduction

The MPS-4100 Microwave Protection System provides exterior perimeter intrusion detection coverage. The MPS-4100 detects movement within a microwave field between the Transmitter and Receiver and initiates an alarm to alert responding personnel.

General description

The MPS-4100 bistatic microwave system consists of one Transmitter (Tx) unit and one Receiver (Rx) unit. The Transmitter is a Dielectric Resonant Oscillator (DRO) designed to radiate microwave power at 10.525 GHz. This oscillator is pulse modulated (on-off switched at a 50% duty cycle) with a selectable frequency of 3, 4.5, 7.5, 10.5, 18 or 27 kHz. The transmitted energy is received and processed by the Receiver using Phase Locked Loop (PLL) technology. An intruder moving in the pattern causes variations in the signal and is detected. This is referred to as multi-path detection.

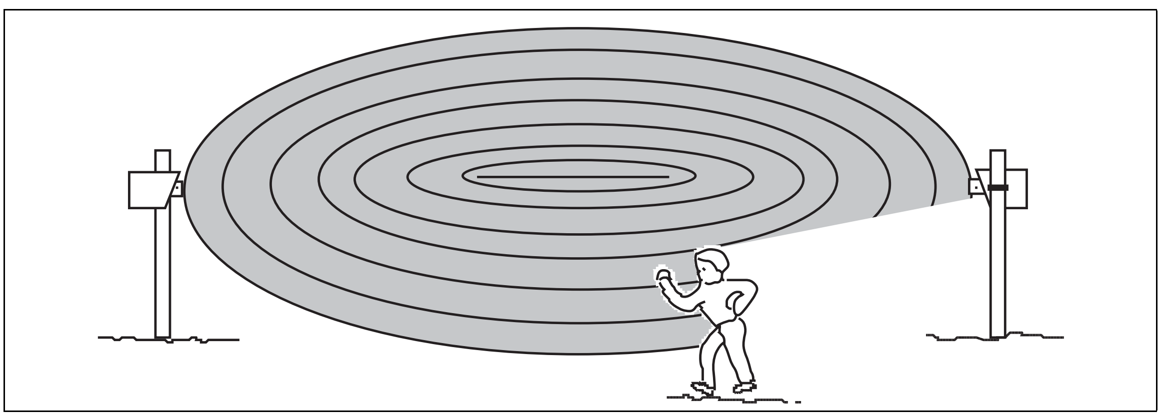


Figure 1-1 MPS-4100 operation

Figure 1-2 MPS-4100 microwave unit

Features

Antenna Pattern

The pattern of the microwave field is established by the Planar Linear Array Antenna elements housed within the Transmitter and Receiver. The maximum range is 183 m (600 feet). The pattern width is proportional to the distance between the Transmitter and Receiver (see Figure 1-4).

Operating frequencies and polarization

Six selectable modulation frequencies allow multiple sets of MPS-4100 to be used in either a stacked or linear configuration. Selecting different modulation frequencies prevents crosstalk between different units located in the same area.

The Planar Linear Array Antenna transmits the microwave signal in either a vertical or horizontal polarization depending on the orientation of the antenna assembly. The output polarization can be changed by rotating the antenna assembly 90 degrees. This reduces interference between multiple units mounted in close proximity to each other.

Vertical polarization = Narrow Beam;
Horizontal polarization = Wide Beam;
default setting = Narrow Beam.

The Transmitter and Receiver in a microwave link must use the same modulation frequency and antenna polarization.

Built-in AGC

The received RF amplified signal is processed by an automatic gain control (AGC) amplifier enabling the amplifier output to be held to a constant level, regardless of the Transmitter-Receiver separation distance (maximum TX-RX separation distance = 183 m {600 feet}). The amplifier output is applied to a phase-locked loop (PLL) detector which operates as a narrow bandpass filter at the selected modulation frequency. The Receiver's modulation frequency is selected to match the modulation frequency of the Transmitter, while rejecting spurious signals and other Transmitters.

PLL circuit

The PLL detector output is a voltage level which is held constant under normal conditions by the slow-acting AGC loop. Rapidly changing signal strength caused by a target moving into the microwave beam is not affected by the AGC loop and causes an AC signal to appear at the PLL detector output. The signal is amplified, filtered and compared with upper and lower alarm threshold voltages. Whenever a signal exceeds either threshold voltage, an alarm is generated. The gain of the signal amplifier may be adjusted with a Sensitivity potentiometer on the circuit board. The signal bandwidth, affecting the MPS-4100 response to moving targets, may be set to Fast or Slow with a PCB jumper. The Slow setting detects human intruders (default setting) and the Fast setting detects moving vehicles.

Alarm output

Two alarm reporting formats are available for signalling alarm or tamper conditions. The formats are dry relay contacts and network communications.

For relay contact notification, the MPS-4100 provides jumper-selectable NC/NO relay outputs for alarm and tamper conditions. The alarm output relay is energized on power-up and goes into an alarm condition upon loss of DC power. A NC/NO tamper output is available on both the Receiver and Transmitter.

For network communications there are three options, the Silver Network, the StarNeT 1000 Alarm Display and Control system, and the MX-5000 Series Command and Control Center. For the Silver Network and StarNeT 1000, an optional Communication Interface Card (CIC) provides redundant communications between the MPS-4100 and the alarm display and control system. For the MX-5000 Series system, a network transponder enables multiplex communication over a twisted pair using the proprietary CEnDe protocol. Each network communication option requires a CIC, which plugs into header P1 on the Receiver circuit board. Each CIC can handle two microwave zones, enabling the reporting of an adjacent relay version MPS-4100 system.

Alignment

Accurate alignment of the Transmitter and Receiver, which establishes the strongest possible signal, is facilitated by a built-in alignment aid. A series of LED’s on the Receiver circuit board indicate when optimum alignment and maximum signal strength have been achieved. A 600 ohm impedance audio jack and voltage test points are also provided on the Receiver card to enable headphones or a voltmeter to be used as alignment aids.

Audio output

The MPS-4100 Receiver has a built-in audio output that can be used to evaluate signal variations in the detection path. A tone is generated, which corresponds to objects moving within the microwave field. The tone varies in frequency and amplitude according to the disturbance in the microwave field. During quiescent operation, no tone is generated. As an intruder moves within the protected area, an audio tone is generated. The tone increases in volume and pitch in relation to the disturbance of the microwave field. The audio output can be taken to an amplifier. The Receiver circuit board includes a 3 mm (1/8 in.) audio plug for connecting a headphone to the local audio output. The local audio output is very useful in locating the source of nuisance alarms generated by moving objects within the detection path.

Self-test

The Receiver includes a self-test function to verify proper operation. A 12 VDC input activates the self-test, which then generates a multi-path signal that simulates a disruption of the microwave field. The Receiver processes the signal and generates an alarm.

MPS-4100 Transmitter

The Model MPS-4100 Transmitter consists of two major sub-assemblies, the antenna assembly and the Transmitter circuit board.

The antenna assembly is a planar or linear patch array (see Figure 1-3) coupled to a pulse modulated dielectric resonant oscillator located on the back of the antenna. The antenna directs the microwave energy toward the Receiver. The antenna assembly and associated DRO attaches to the Transmitter circuit board by means of stand-off fasteners so that the two form a single removable assembly.

The Transmitter circuit board includes the modulator circuit to drive the oscillator. One of six modulation frequencies can be selected via jumpers located on the board.

The Transmitter includes a Tamper switch with selectable NO/NC output that signals when the cover on the rear of the housing has been removed. The Tamper switch is a 2-position plunger (secure, alarm) and includes a pull-out position that disables tamper notification, for servicing the unit.

An optional method for Tamper detection (switched power) which requires no additional tamper wiring, has been incorporated in the Transmitter. With this option selected, the power to the Transmitter is interrupted whenever the enclosure cover is removed. This stops the transmission of microwave energy, resulting in an alarm condition at the Receiver.

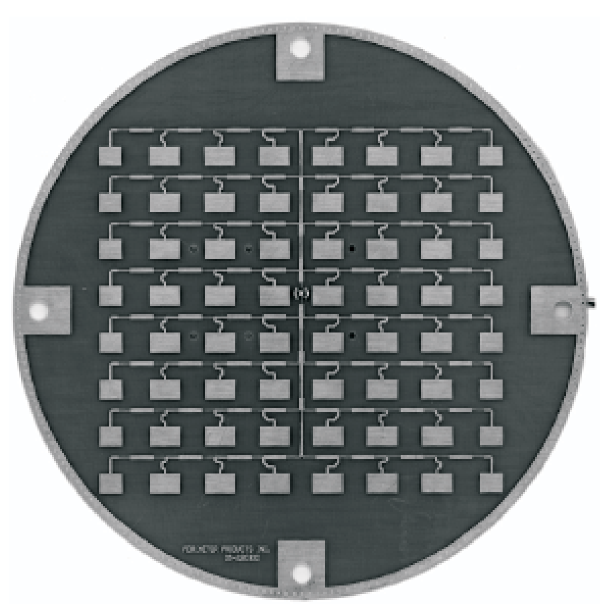


Figure 1-3 Linear patch array antenna

MPS-4100 Receiver

The Model MPS-4100 Receiver consists of two major sub-assemblies, the antenna assembly and the Receiver circuit board. The antenna assembly is a planar or linear patch array antenna, with a signal preamplifier and Schottky diode detector located on the rear side. The antenna captures the microwave energy from the Transmitter. The microwave signal is first preamplified. This compensates for attenuation of the incoming signal due to environmental factors such as objects in the pattern or rain. The Schottky diode detector converts the modulated X-band energy into an audio frequency signal for processing by the Receiver circuit board. The antenna assembly attaches to the Receiver circuit board by means of stand-off fasteners so that the two form a single removable assembly.

The Receiver circuit board includes the processing circuitry that generates an alarm when sufficient changes in the microwave signal are detected. The modulation frequency is set to match that of the Transmitter via jumpers located on the circuit board. The gain of the signal amplifier may be adjusted by means of a Sensitivity potentiometer. The higher the sensitivity setting, the lower the change in received signal required to generate an alarm. The signal bandwidth, affecting the response to fast moving targets, may be set to Fast or Slow via a jumper on the Receiver circuit board.

The Receiver circuit board includes three LED's for indicating Alarm, Wrong Channel, and Jam conditions. The Alarm LED indicates an alarm condition. The Wrong Channel LED indicates that the modulation frequency of the Receiver does not match that of the Transmitter. The Jam LED indicates that the Receiver is picking up two microwave signals at the same modulation frequency, signifying interference between two microwave units. A Jam condition can be set to trigger an alarm output via a switch on the Receiver.

The Receiver circuit board includes header P1 for connecting a Communications Interface Card. This enables communication via the Silver Network, the StarNeT 1000 system or the MX-5000 Series Control Center. The Receiver also includes a pre-amp that outputs audio signals enabling audio assessment of activity within the microwave field.

The Receiver includes an alignment aid consisting of a series of ten LED's that indicate the received signal strength. Test points are available for voltmeter verification of the microwave's alignment. There is also a local audio output for connecting a 3 mm (1/8 in.) headphone jack, which is used for audio assessment of microwave field disturbances. In addition, several operating parameters are selectable via jumpers and DIP-switches on the Receiver circuit board.

Coverage pattern

The antenna creates a microwave energy field at an approximate 13° angle (horizontal polarization app. 13°; vertical polarization app. 11°). This results in a typical maximum width protection pattern of 12 m (40 feet) at a mounting height of 76 cm (2.5 feet) above level earth (see Figure 1-4). The maximum beam width occurs at the maximum Transmitter-Receiver separation distance of 183 m (600 ft.). Actual patterns will vary depending on the site topography and surface conditions. Generally, lower mounting heights or a rougher surface will increase pattern width.

The pattern height above the center-line will be approximately one half of the pattern width. The protection pattern below center-line will tend to fill the area between the beam center-line and the ground, except for a dead zone directly in front of the Transmitter and Receiver.

The energy field development is not immediate, resulting in a dead zone in front of the Transmitter and Receiver, in which it is possible to crawl under the pattern undetected. For this reason it is necessary to overlap or offset Transmitters and Receivers to cover this dead zone. Receivers and Transmitters should be offset at least 4.5 m (15 ft.) at corners and 9 m (30 ft.) at midpoints in a linear array (see Figure 1-5 and Figure 1-6).

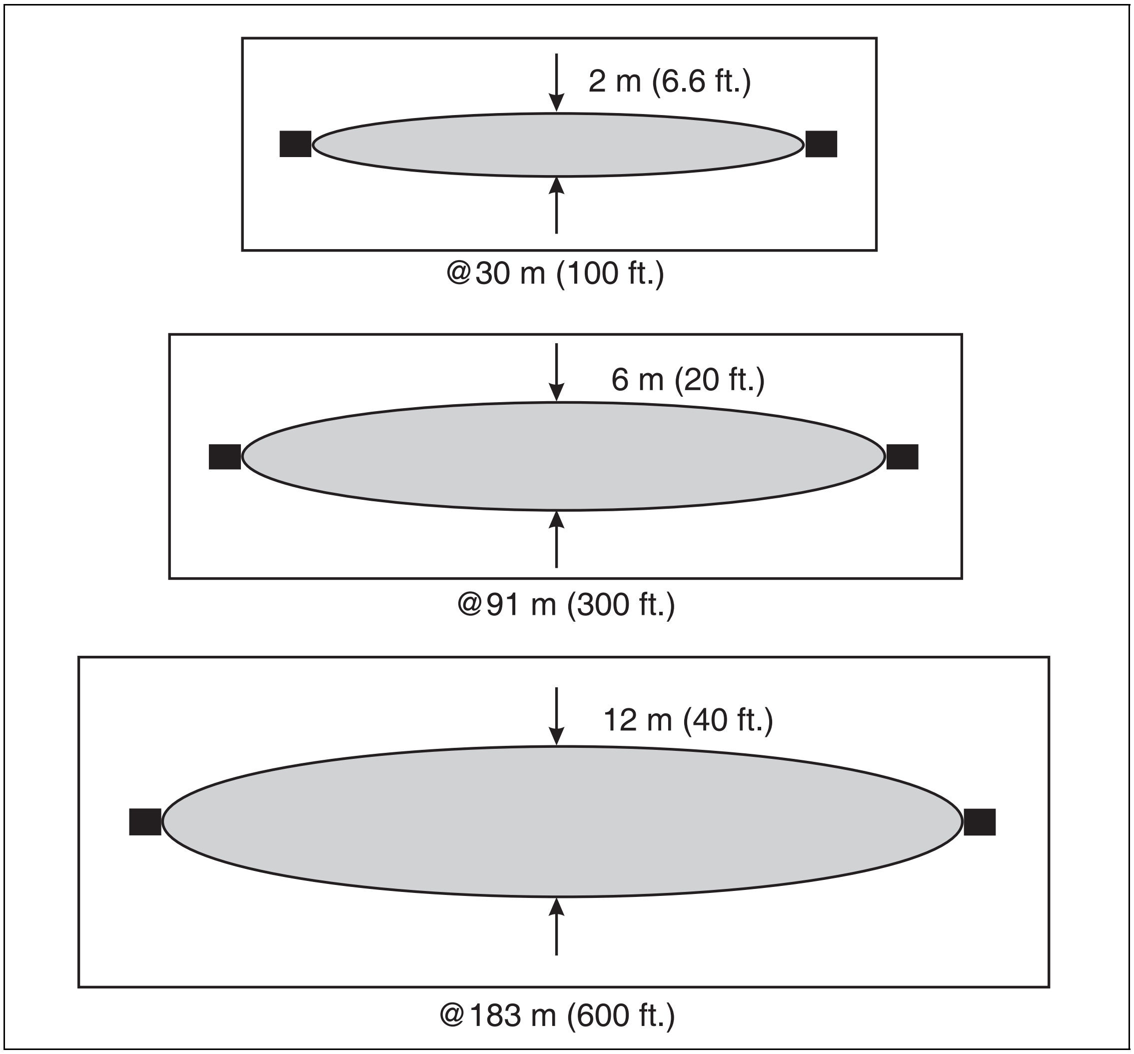


Figure 1-4 Typical MPS-4100 coverage patterns

Large nearby metallic objects such as vehicles, fences and buildings can be detected well beyond the typical detection envelope. Refer to Application note #1, Do’s and Don’ts: a *planning primer, in Appendix a for information about zone lengths and maximum beam widths for microwave zones near metal objects.*

Figure 1-5 provides an example of using offset microwave pairs to eliminate the dead zone directly in front of the Transmitter/Receiver. Figure 1-5 also demonstrates the use of a corner overlap to provide complete coverage around a corner on a protected perimeter.

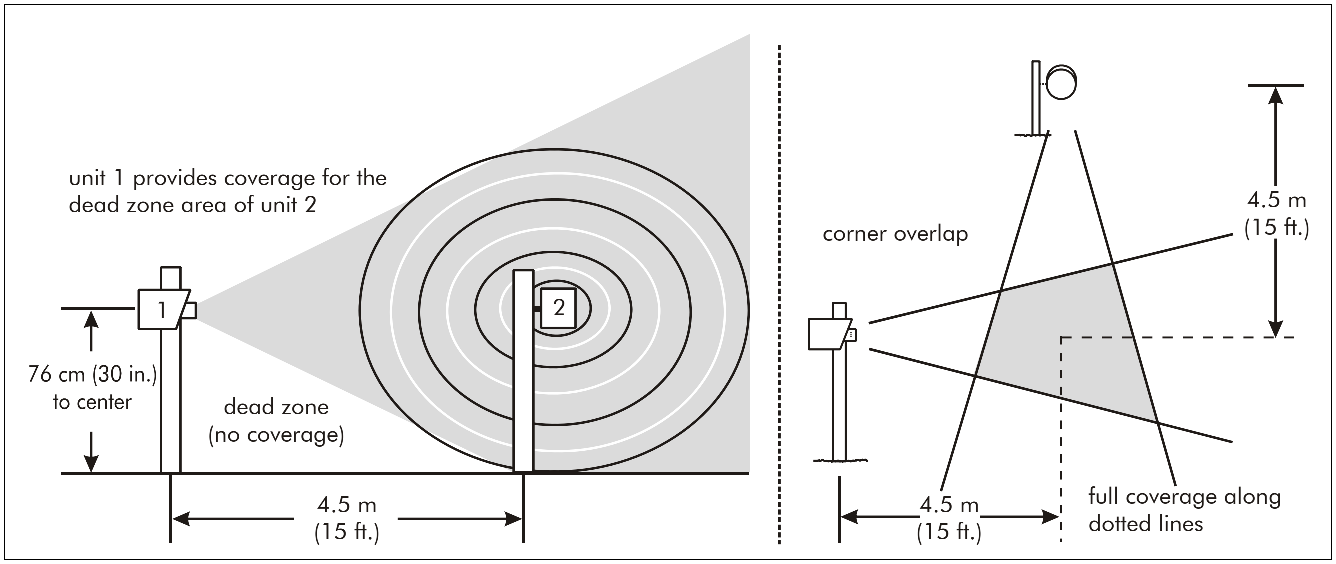


Figure 1-5 Dead zone overlap protection (side view)

Figure 1-6 illustrates an intermediate offset, which is used to extend the length of a straight microwave coverage pattern by using two microwave pairs.

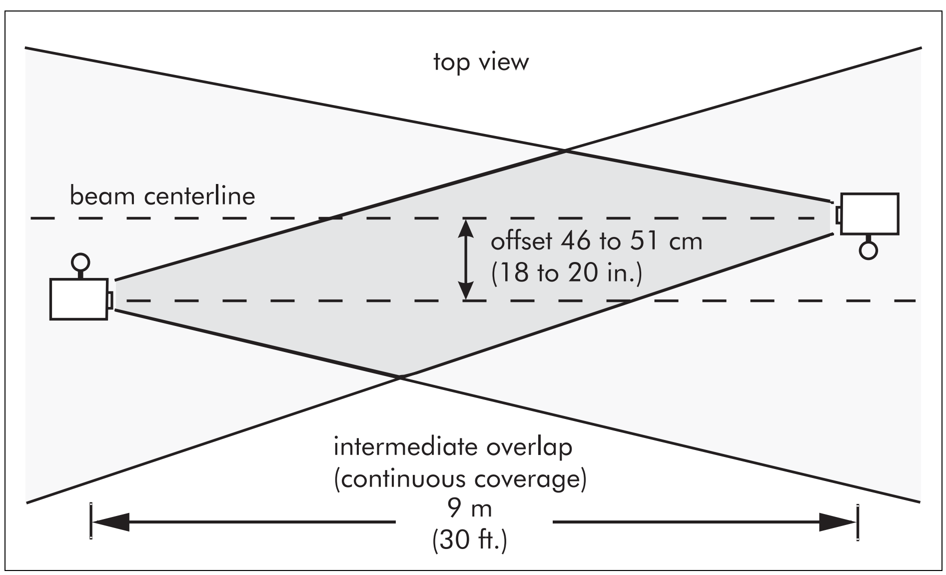


Figure 1-6 Intermediate overlap (top view)

2 Installation

Installation planning

Refer to Do's and Don'ts a planning primer, in Appendix a for information about site planning and design.

Begin with a site survey to ensure that the area being protected meets the MPS-4100 installation requirements. Next, determine the locations of the Transmitter and Receiver pairs. Install the mounting posts, conduit and junction boxes in the selected locations. The MPS-4100 can then be mounted, wired and configured.

There are two methods of wiring and configuring the MPS-4100 depending on the application. The Wiring and Configuration section of this chapter is divided into Relay Output wiring and Network wiring.

Positioning the MPS-4100

First, you must establish the length of each microwave zone. The maximum separation distance between the Receiver and Transmitter is 183 m (600 ft.) However, for high security applications, the recommended maximum separation distance is 100 m (328 ft.). The maximum width of the zone is determined by the amount of open space to the left and right of the center-line between the Transmitter and Receiver. The area to be protected must be free of obstructions and moving objects such as trees, shrubs, bushes, utility boxes and other structures. Figure 2-1 illustrates the relationship between zone length and width. Do's and Don'ts a planning primer in Appendix a includes a formula for calculating the approximate beam width based on the zone length.

Generally, there must be a clear open space that exceeds one half the pattern width on each side (i.e., the minimum required clear area is equal to two times the microwave beam width).

Large nearby metallic objects such as vehicles, fences and buildings can be detected well beyond the typical detection *envelope. Refer to Do's and Don'ts a planning primer, in Appendix a for information about zone lengths and maximum beam widths for microwave zones near metal objects.*

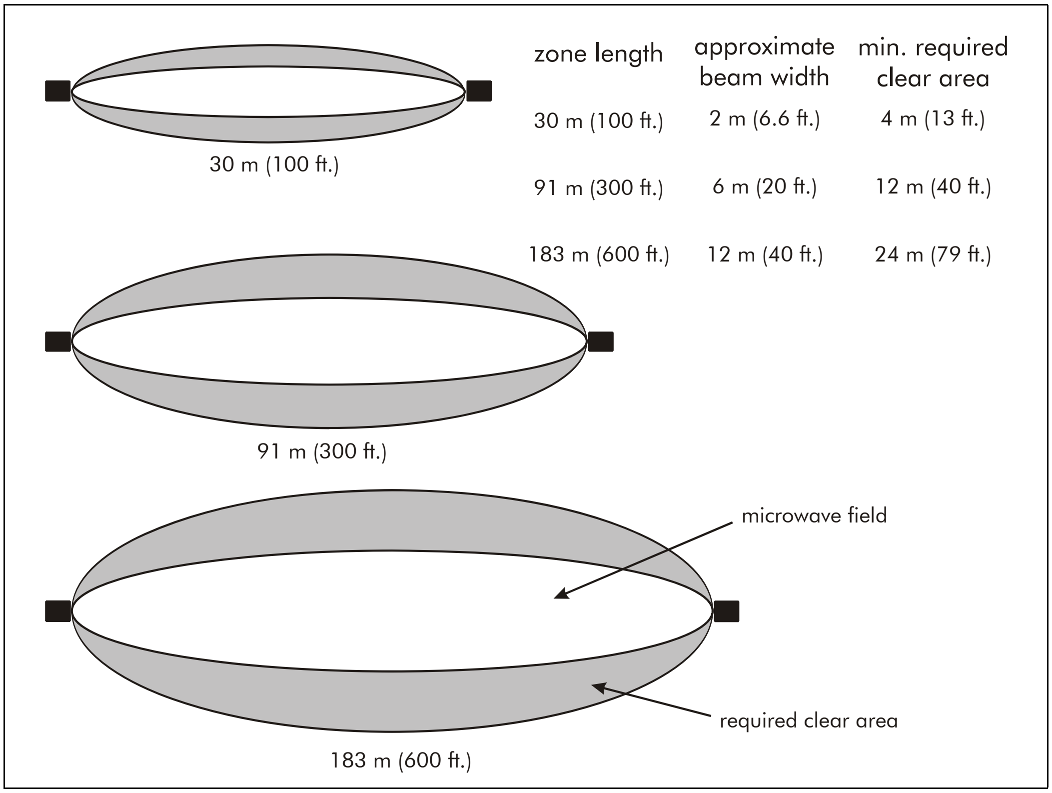


Figure 2-1 Zone length/width relationship

Terrain

Since operation of the link requires the transmission of energy from the Transmitter to the Receiver, you must maintain a clear line of sight between the units. Therefore, the ground must be flat across the protected area. Any bumps, hills or ditches must be filled or graded so that the area is level to within 15 cm (6 in.) (see Figure 2-2).

The protected area's surface can be any stable, reasonably smooth material such as concrete, asphalt, soil, or gravel. If there is grass or vegetation in the protected area, it must be kept cut to a maximum of 8 cm (3 in.) in height. An MPS-4100 should not be operated over open water, or where standing puddles will form. For environments in which snow accumulates during the winter months, a hard surface is recommended to facilitate snow removal.

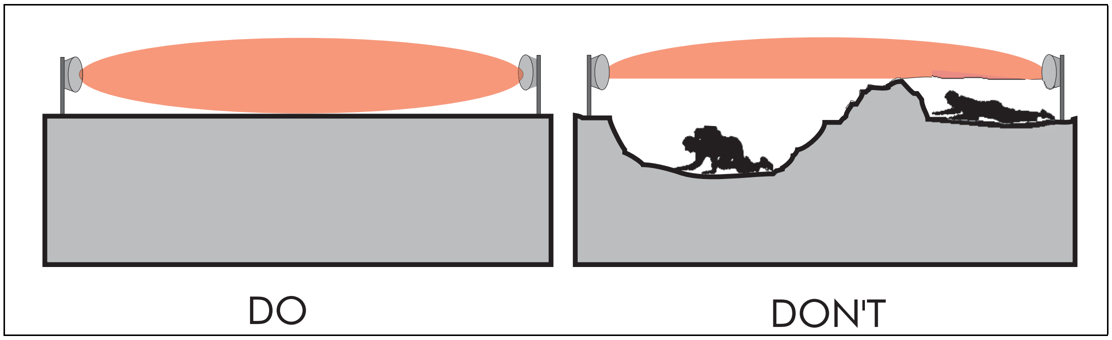


Figure 2-2 Level terrain

Microwave signal considerations

Microwave signals can pass through common construction materials such as glass, plaster and drywall. Microwave signals will reflect off of solid objects and metallic surfaces.

Microwave signals will pass through standard chain link fences if the beam axis is at a right angle to the fence. The more the fence deviates from a right angle to the beam, the less signal penetration, and the more reflection.

Microwave signals that detect a moving or flexing fence, or other large metallic objects, can generate nuisance alarms. A large metallic object can cause a small amount of motion to appear as a large moving target.

Other potential nuisance alarm sources include moving machinery parts, as well as the vibrations caused by machinery, large vehicles such as trucks, buses and aircraft.

Physical protection

Install the Transmitter and Receiver in a location, which provides protection from both accidental damage and tampering. If microwave units are being installed near roadways, or where they are vulnerable to vehicle traffic, install protective devices such as bumper posts or parking guards.

Optimum security

Choose a location that will provide optimum security, yet be free from nuisance alarms. Always locate the MPS-4100 inside a fence or controlled access area to prevent nuisance alarms due to random foot traffic, vehicles, or animals.

Units should be located away from parallel fences to avoid reflection of the microwave signal off the surface of the fence, and to prevent the possibility of jumping over the protection pattern. As a general rule, the clear area around a microwave system should be at least two times the maximum beam width.

For maximum security it is necessary to overlap the ends of links so that the dead spot below and immediately in front of the adjoining link is protected. A 4.5 m (15 ft.) overlap is required at corners and a 9 m (30 ft.) overlap at intermediate points. The side-by-side offset of overlapping in-line links should be approximately 46 cm (18 in.), measured from the center of each unit.

At each point of overlap either two Transmitters or two Receivers should be installed. This arrangement prevents an adjacent Transmitter and Receiver from establishing an unwanted link across the short overlap distance, which could result in a Jam or Wrong Channel indication at the Receiver (see Figure 2-3).

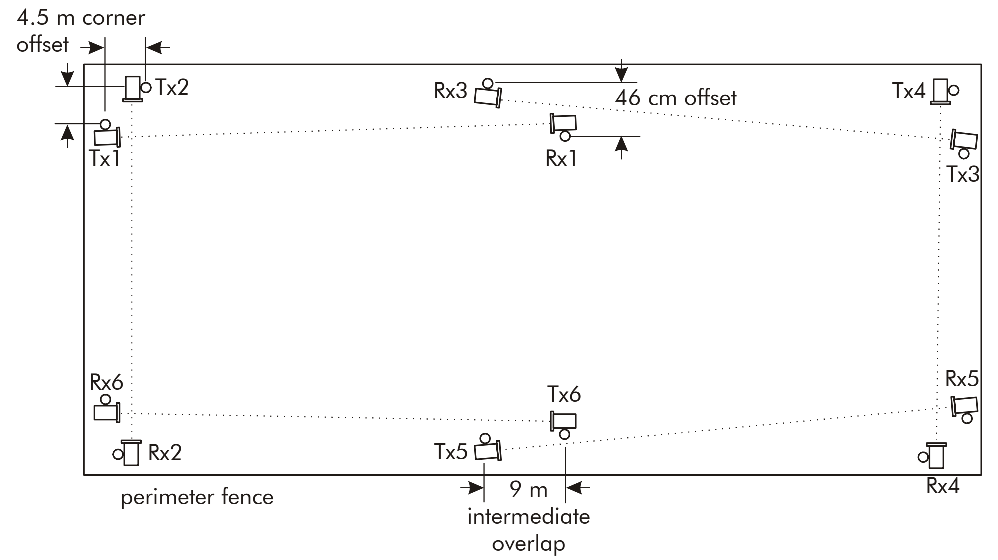


Figure 2-3 Perimeter layout (100% coverage)

Wiring and configuration

CAUTION: DO NOT apply power until all wiring connections have been made.

The MPS-4100 may be configured for Relay Output or for Network Communications depending on the model installed. All wiring connections are made on removable terminal blocks, which facilitates maintenance and service activities.

The MPS-4100 provides dry relay outputs for alarm and tamper that can be wired to virtually any alarm sensor with auxiliary inputs, including the OmniTrax® processor, XField® processor, Perimitrax® Sensor Module, Intelli-FLEX™ processor, PLC transponder, etc. The MPS-4100 can report alarm data via the Silver Network to the Sentient™ security management system, or to a Perimitrax or Intelli-FLEX Central Controller, Senstar®100, StarNeT 1000™, FPS-3 Central Controller, MX-5000 Command and Control Center, etc. The Silver Network can also communicate with a third party alarm display and control system via the Network Alarm Interface.

For network communication, an optional Communication Interface Card (CIC) connects the MPS-4100 directly into the Silver Network or the StarNeT 1000 network. An optional network interface transponder enables direct connection of the MPS-4100 to the MX-5000 Series Command and Control Center. In the network communication format, a second MPS-4100 can be wired into the Host MPS-4100 as a Slave system. Power feeds from the Host Receiver to the Slave Receiver and Transmitter. The alarm and tamper signals from the Slave Receiver are fed into the Host Receiver. The Host Receiver reports the alarm data to the head-end system. This configuration reduces the wiring requirements and allows two MPS-4100 systems to share one communication interface card, reporting to the head end as two zones.

MPS-4100 configuration options

The following is a summary of the configuration options for the MPS-4100 via jumpers and DIP-switches.

Transmitter S1 (tamper)

- S1-1 - ON selects NO tamper output. OFF disables NO output.
- S1-2 - ON selects NC tamper output. OFF disables NC output.
- S1-3 - ON bypasses the 3 kΩ end of line resistor (EOLR). OFF adds the 3 kΩ EOLR in series with the NC output.
- S1-4 - ON enables unswitched power to Transmitter. OFF enables switched power when S1-5 and S1-6 are set to ON.
- S1-5 - ON enables switched power through the tamper switch. OFF disables switched power.
- S1-6 - ON enables switched power through tamper switch. OFF disables switched power.

Transmitter jumper

- JP1-Selects the Transmitter modulation frequency (Channels 1 through 6).

Receiver S1

- S1-1 - OFF for Relay Output operation; ON for network.
- S1-2 - ON enables self-test in Relay mode; OFF for network.
- S1-3 - OFF for Relay Output operation; ON for network.
- S1-4 - ON enables self-test in Relay mode; OFF for network.
- S1-5 - ON enables alarm output on Jam condition. OFF disables alarm on Jam.
- S1-6 - OFF connects tamper for Relay output; ON for network.

Receiver S2

- S2-1 - ON enables audio output via TB3. OFF for audio output via TB1.
- S2-2 - Not Used.
- S2-3 - OFF connects tamper for Relay output; ON for network.
- S2-4 - ON enables Alignment Aid LED's. OFF disables LED's.
- S2-5 - ON enables alarm relay reset. OFF latches alarm relay.

To reset the latching relay, you must open the receiver enclosure and toggle S2-5.

- S2-6 - ON enables alarm relay. OFF disables alarm relay.

Receiver jumpers

- JP1 & JP2 - Selects the modulation frequency Channels 1 through 6.
- JP3 - Sets tamper output to either Normally Open or Normally Closed.
- JP4 - Sets the optional 3 kΩ end-of-line supervision for tamper NC output.
- JP5 - Sets the alarm output to either Normally Open or Normally Closed.
- JP6 - Sets the optional 3 kΩ end-of-line supervision for alarm NC output.
- JP7 - Sets the Receiver's response to signal disruption to FAST or SLOW.

DIP-switch illustration conventions

Figure 2-4 illustrates the DIP-switch conventions, used in this guide.

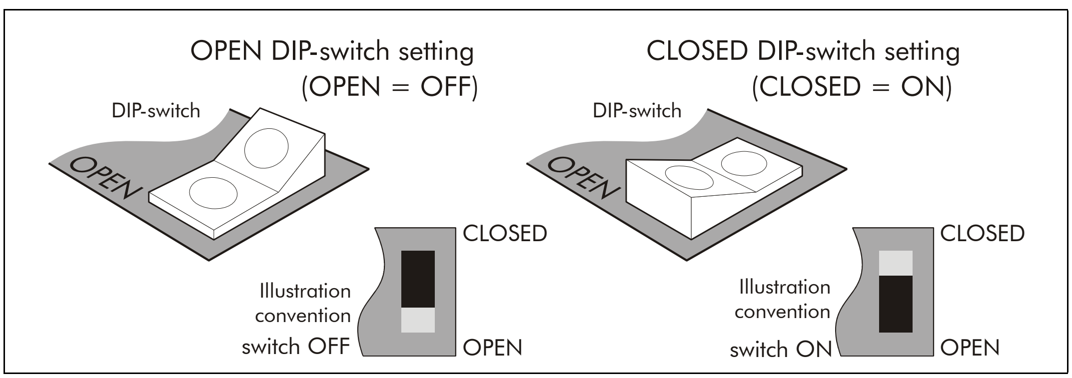
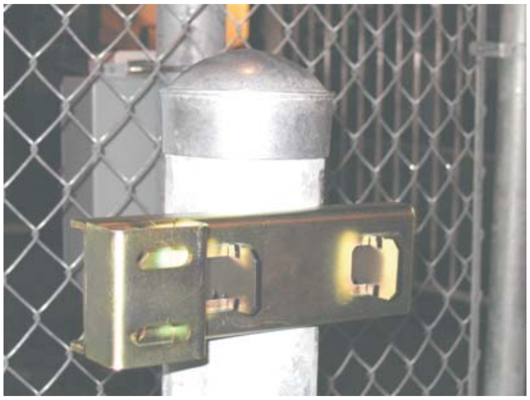


Figure 2-4 DIP-switch conventions

Mounting

The following assumes that all posts have been installed, conduit run with junction boxes to each post, and wire pulled through the conduit into each junction box.



Post mount bracket (microwave side)

Post mount bracket (post side)

Post mounted MPS-4100 (front view)

Post mounted MPS-4100 (post side view)

Figure 2-5 Post mounting

The MPS-4100 requires a stable, permanently anchored mounting post. Mounting posts should be 8, 9, or 10 cm (3, 3½ or 4 inch) O.D. pipe, 1.2 m (4 ft.) high and fixed in a concrete footing. The wire size for power cables should be sufficient to minimize the voltage drop between the power supply and the units. Refer to Table 2-1 for recommended wire sizes based on the load requirements and the length of each wire run.

WIRE GAUGE (STRANDED COPPER BARE)	VOLTAGE DROP PER 150 m (500 FT.) TRANSMITTER OR RECEIVER	VOLTAGE DROP PER 150 m (500 FT.) TRANSMITTER and RECEIVER
#18 AWG (1.05 mm dia.)	0.2 V	0.4 V (0.8 V*)
#20 AWG (0.82 mm dia.)	0.3 V	0.4 V (0.8 V*)
#22 AWG (0.66 mm dia.)	0.5 V	1.0 V (2.0 V*)
#24 AWG (0.54 mm dia.)	0.8 V	1.6 V (3.2 V*)
#26 AWG (0.41 mm dia.)	1.2 V	2.4 V (4.8 V*)
* Voltage drop with Communication Interface Card installed in Receiver.		

Table 2-1 Voltage drop vs. wire gauge

For alarm data communication wiring, the cable should be individually shielded, twisted, with overall foil and braided shield in a High Density Polyethylene outer jacketing. The number of conductors required depends on your alarm reporting requirements. Contact Senstar for data cable availability.

Wire must be rated for outdoor direct burial use in wet conditions.

Mounting procedure

Mount MPS-4100 microwaves 76 cm (30 in.) above ground to the center of the unit.

1. Attach the post mounting bracket to an 8, 9, or 10 cm (3, 3½, or 4-inch) OD post. The bracket should be 76 cm (30 in.) above ground to center, with the two slotted holes toward the rear (away from the zone). Tighten the bracket firmly into place. (See Figure 2-5 and Figure 2-6.)
2. Insert the supplied mounting hardware (machine screw, lock washer, flat washer) through the slotted holes in the post mount bracket, and screw them into the bracket on the side of the MPS-4100 (see Figure 2-6).
3. Remove the cover by loosening the 4 captive screws. Pull the cover away and allow it to hang by the strain relief.
4. Attach 2 cm (¾ in.) diameter watertight flex conduit between the junction box at the base of the post and the conduit connector on the rear cover of the microwave unit.

Be sure the conduit outlet on the back of the unit faces down to allow water to drain away from the connector.

5. Route the wiring through the flex conduit. Pull enough wire to create a service loop and to allow for the removal of the cover.
6. Using a suitable ground wire, connect a properly installed ground rod to the ¼ X 20 ground screw on the outside bottom of the enclosure (see Figure 2-6).

Refer to the local electrical code for grounding requirements and information.

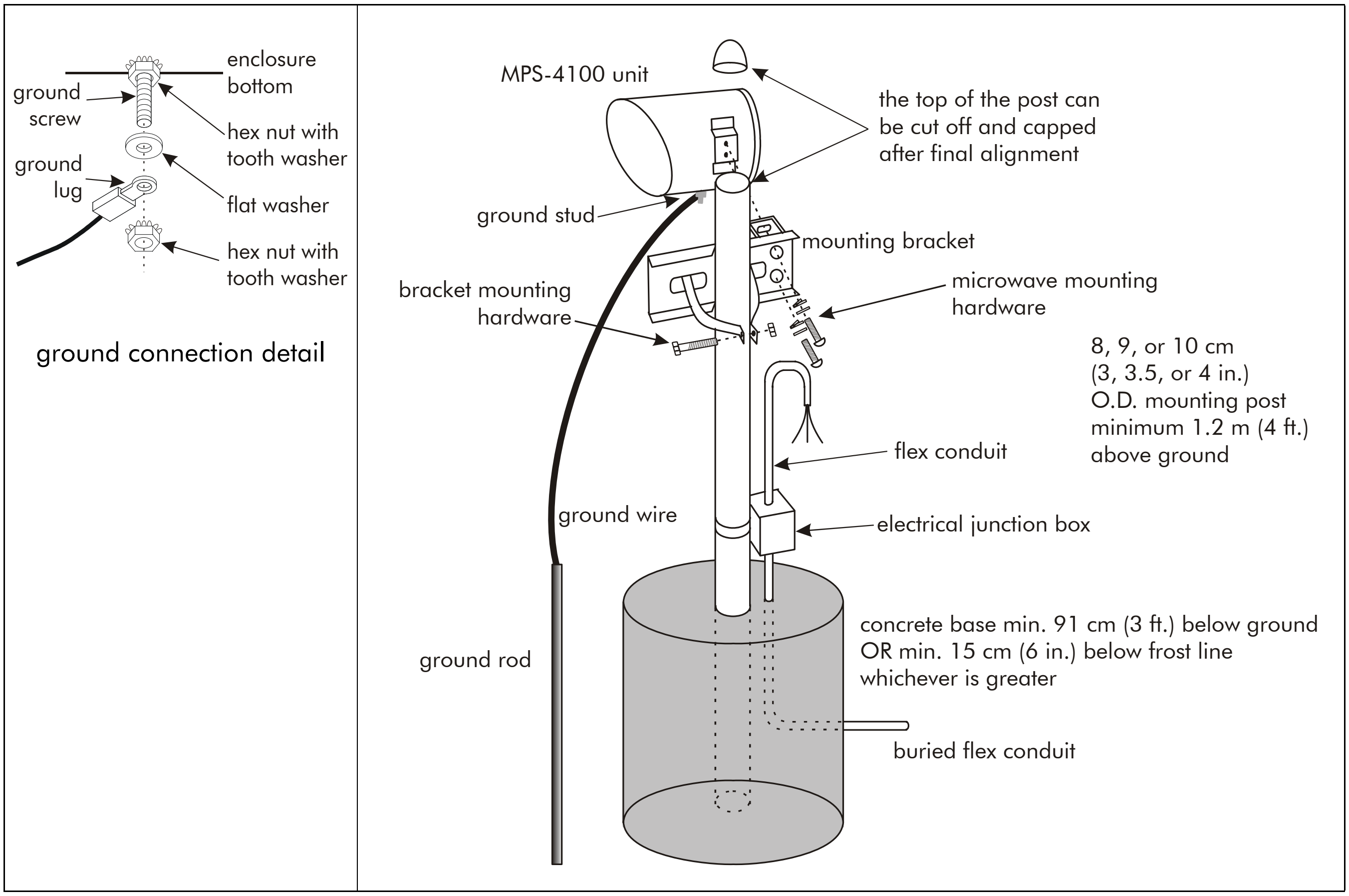


Figure 2-6 Mounting post/microwave unit installation

For lightning protection and system noise reduction the microwave unit must be connected to a properly installed ground rod using the 1/4x20 screw located on the bottom of the enclosure.

Relay output wiring

MPS-4100 Transmitter wiring

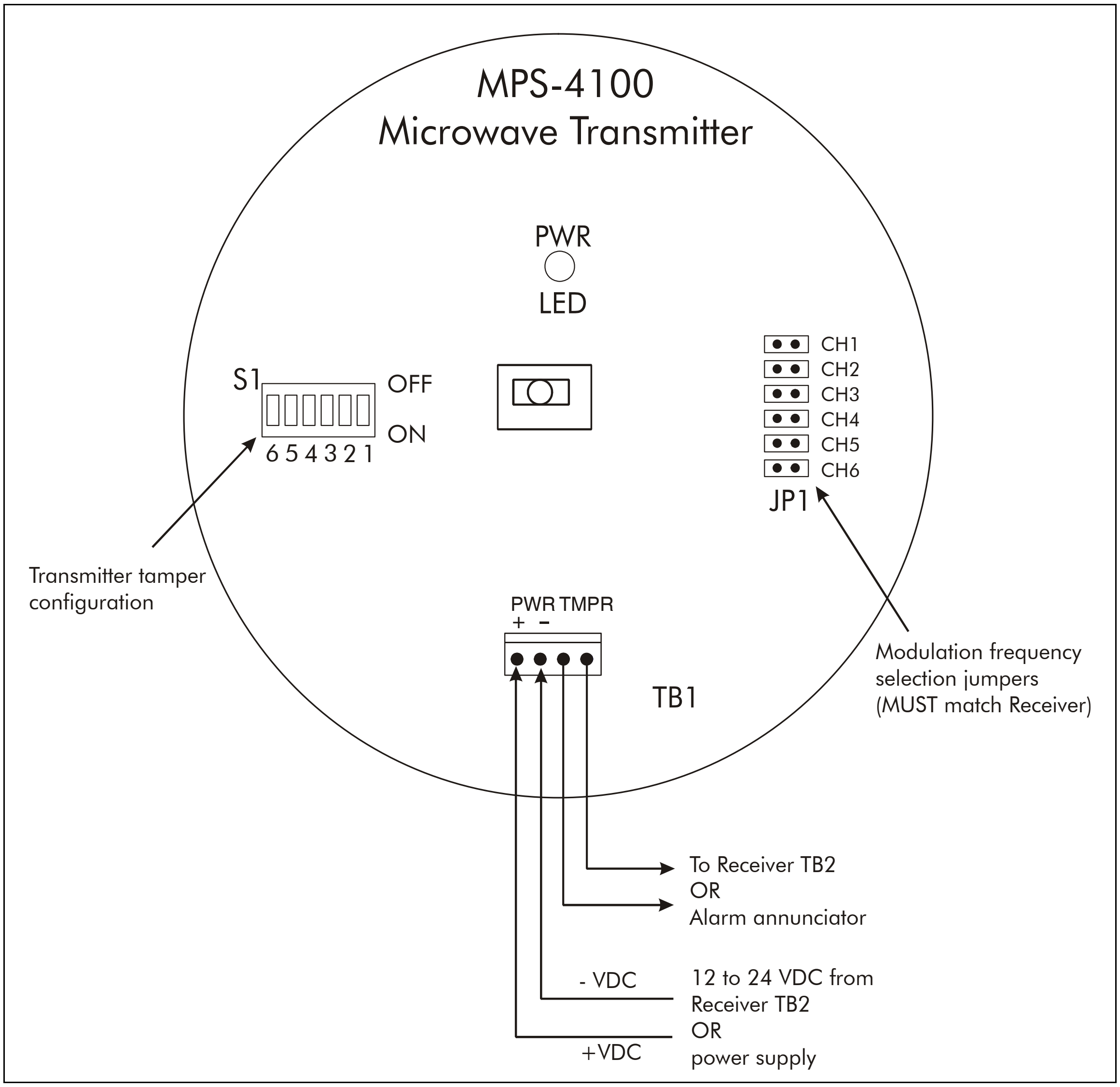


Figure 2-7 MPS-4100 Transmitter connections

1. Connect the power and tamper wires to TB1 (see Figure 2-7). Power may come from a power supply, or from TB2 on the Receiver. **Observe polarity**.
2. Set the modulation frequency to the desired channel (1 through 6) via JP1.

The Transmitter modulation frequency must match the Receiver modulation frequency.

3. Configure the Tamper notification for conventional relay output or switched power (see Figure 2-8).

S1-4 must be ON and S1-5 and S1-6 must be OFF for relay output tamper notification.

S1-4 must be OFF and S1-5 and S1-6 must be ON for switched power tamper notification.

You must select the Normally Closed tamper option if the Transmitter tamper output will be connected to TB2 on the Receiver.

S1 - Transmitter tamper configuration

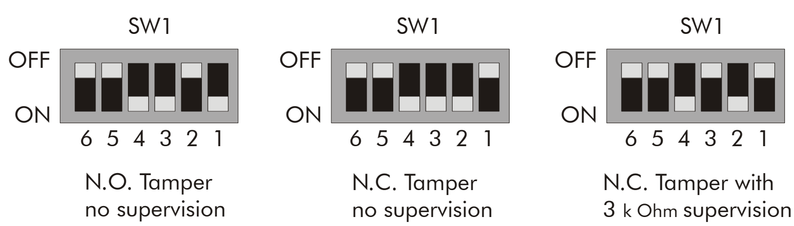
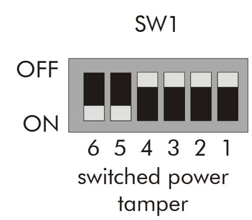
Relay output tamper	Switched power tamper
 Use SW-1, SW-2 and SW-3 to configure Relay Output Tamper notification. SW-4 is always ON, SW-5 and SW-6 are always OFF. SW-1 - ON = N.O. tamper notification (SW-2 OFF and SW-3 ON) SW-2 - ON = N.C. tamper notification (SW-1 OFF) SW-3 - OFF = 3 k Ohm supervision for N.C. option; SW-3 - ON bypasses the 3 k Ohm supervision resistor	 For Switched Power Tamper notification - SW-1, SW-2, SW-3 and SW-4 must be OFF. SW-5, and SW-6 must be ON.

Figure 2-8 Transmitter tamper notification options

Definition of functions (Transmitter tamper)

Unsupervised output: provides a tamper circuit without an end-of-line resistor.

Supervised output: provides a 3k Ohm end-of-line resistor in series with the Normally Closed tamper output for wire supervision.

Unswitched power: provides conventional direct routing of Transmitter power.

Switched power: runs the Transmitter input voltage through the tamper switch. Opening the cover interrupts the input voltage and shuts off the transmission of microwave energy, resulting in an alarm condition at the receiver. This option can be used when it is impractical or undesirable to run wiring for the tamper output.

MPS-4100 Receiver wiring

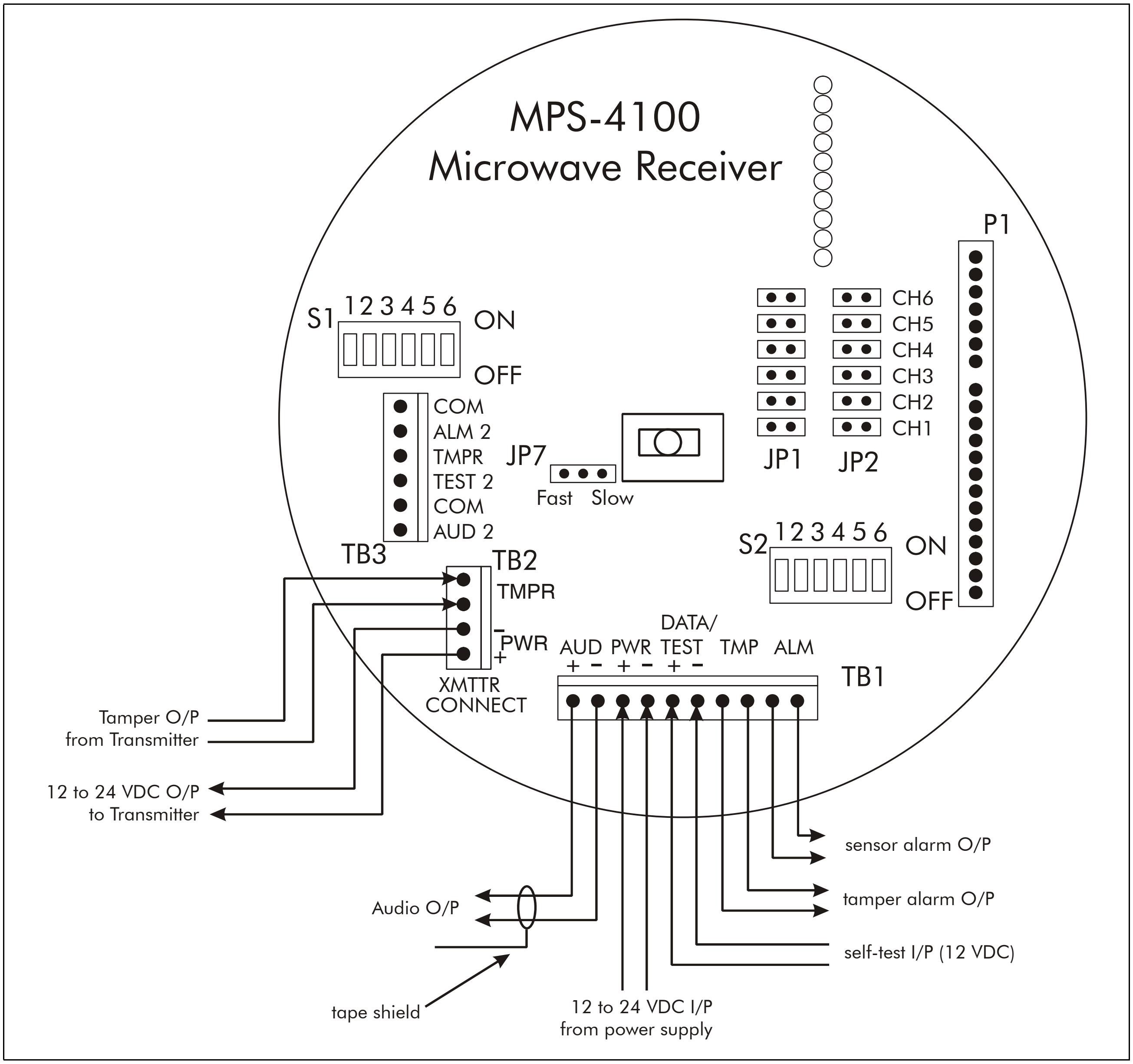


Figure 2-9 MPS-4100 Receiver connections for relay output

Receiver wiring procedure

1. Connect the power, alarm, tamper, self-test, and audio pairs to TB1 (see Figure 2-9). **Observe polarity**.
2. Connect the Transmitter power and tamper wires to TB2. **Observe polarity**.

   To connect the tamper input from the Transmitter to TB2, the Transmitter tamper must be set to NC.

3. Configure the alarm and tamper relay outputs via jumpers JP3, JP4, JP5, and JP6 (see Table 2-2).

4. Set the Receiver modulation frequency to match the Transmitter modulation frequency via jumpers JP1 and JP2.
5. Configure the operating parameters via S1 and S2 (see Figure 2-12 and Table 2-4).

   If the Transmitter tamper output is not being wired to the Receiver, and a tamper output from the Receiver is required, you must place a jumper across pins 3 & 4 of TB2.

6. You can adjust the alarm relay hold-in time via RV2. The factory default setting is approximately 1.5 seconds. Clockwise increases the relay hold-in time, counter-clockwise reduces the hold-in time. The minimum relay hold-in time is 0.5 seconds and the maximum is 2.5 seconds.

Alarm Relay	Tamper Relay
For N.C. - place a shunt on JP5 pins 1 and 2 For N.O. - place a shunt on JP5 pins 2 and 3 For N.C. 3 K Ohm supervision - place a shunt on JP6 pins 2 and 3	For N.C. - place a shunt on JP3 pins 1 and 2 For N.O. - place a shunt on JP3 pins 2 and 3 For N.C. 3 K Ohm supervision - place a shunt on JP4 pins 2 and 3

Table 2-2 Alarm and tamper relay configuration

Receiver details

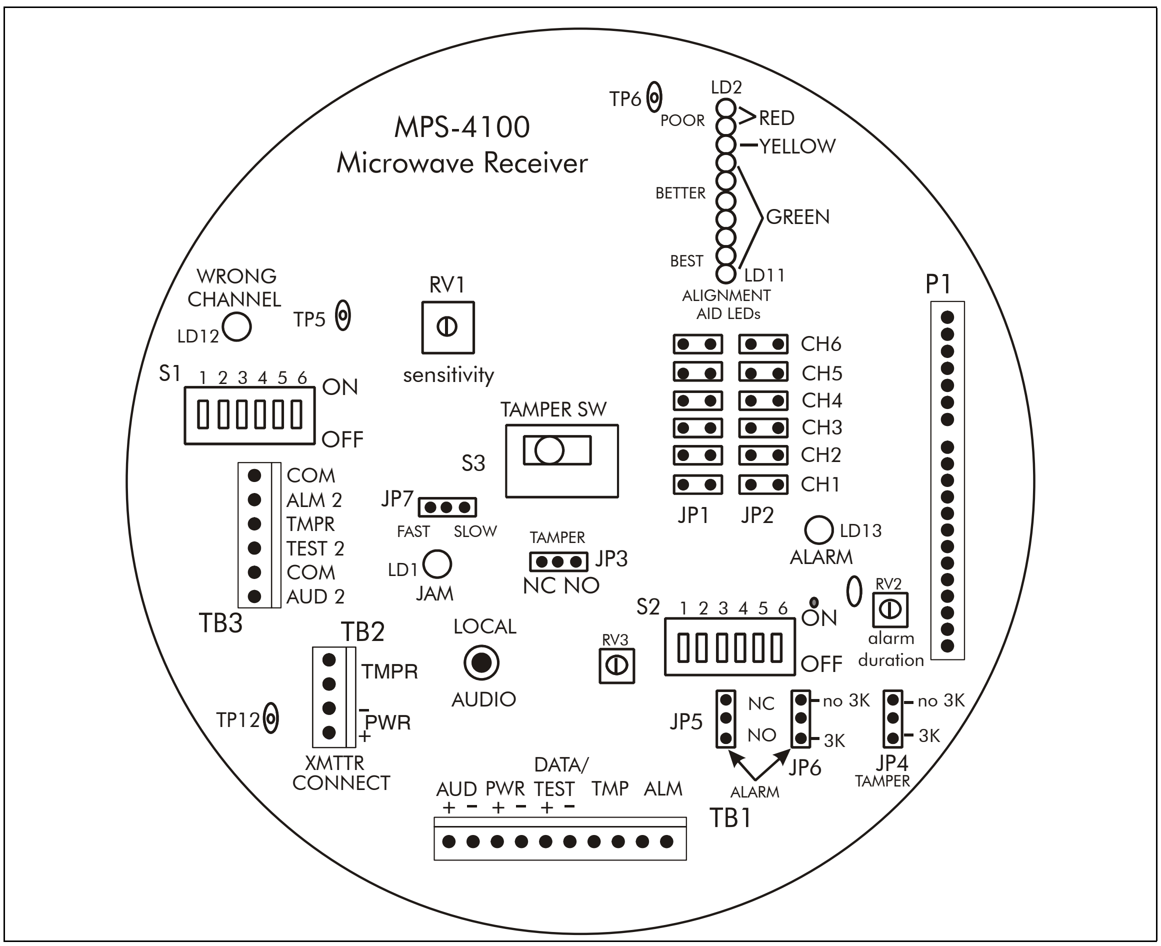


Figure 2-10 MPS-4100 Receiver circuit board

Receiver features

Feature	Function	Feature	Function
LD1	Jam - Receiving interference no detection	TB1	Receiver I/O connections - Audio O/P, Power I/P, Self-test I/P (relay)/data I/O (MPS-4100), Tamper O/P, Alarm O/P
LD2 to LD11	Alignment aid LEDs - visual indication of received signal strength (S2-4 ON enables LEDs; OFF disables LEDs)	TB2	Mate Transmitter interconnection - Tamper I/P from Tx, Power O/P to Tx
LD12	Wrong channel - Tx and Rx modulation frequency settings do not match	TB3	Slave system interconnect - 2 common terminals (COM = gnd), Alarm 2 (Alarm O/P from slave), Tamper (Tamper O/P from slave), Test 2 (self-test O/P to slave), Audio 2 (Audio O/P from slave)
LD13	Alarm - ON indicates alarm condition	JP1/JP2	Modulation frequency selection jumpers - both jumpers must be set to the same channel as the mate transmitter
TP6/TP12	Alignment aid - connect voltmeter (TP6 = +, TP12 = gnd) to get a voltage reading of the received signal strength (0 to 5 V range; >3.5 V = OK)	JP3	Receiver tamper relay setting - NO = normally open, NC = normally closed
Local Audio	1/8 in. headphone jack - audio assessment of microwave field disturbance	JP4	Tamper relay supervision selection - 3K = on-board 3 kΩ series EOL supervision (requires NC setting on JP3), NO 3K = no supervision resistor
S1	Receiver configuration DIP-switch (see Table 2-4 for details)	JP5	Receiver alarm relay setting - NO = normally open, NC = normally closed
S2	Receiver configuration DIP-switch (see Table 2-4 for details)	JP6	Alarm relay supervision selection - 3K = on-board 3 kΩ series EOL supervision (requires NC setting on JP5), NO 3K = no supervision resistor
RV1	Sensitivity adjustment POT - clockwise to increase microwave sensitivity; counter-clockwise to decrease	JP7	Microwave response selection - Fast setting used for vehicles - 25 cm/s to 61 m/s (10 in./s to 200 ft./s); Slow setting used for human intruders - 5 cm/s to 13.4 m/s (2 in./s to 44 ft./s) (default setting = Slow)
RV2	Alarm relay duration POT - set the period for which the alarm relay will remain active following an event, max. 2.5 sec., min. 0.5 sec., default = 1.5 sec.	Tamper Switch	Two position plunger - held down by enclosure cover = secure state; enclosure opened = alarm state; pull out plunger to over-ride tamper for servicing unit
P1	Polarized 21-pin header for the connection of a Communication Interface Card		

Table 2-3 Receiver features

Velocity response

The MPS-4100 has two jumper-selectable target speeds, Slow and Fast. The default setting is the slow target speed, which is used for detecting human intruders. The fast target speed is used in situations where only vehicles must be detected. The slow setting will reliably detect a typical human sized target moving between 5 cm (2 in.) per second and 13.4 m (44 ft.) per second. The fast setting will reliably detect targets moving between 25 cm (10 in.) per second and 61 m (200 ft.) per second. The fast setting is used for detecting vehicles.

The target speed is set via JP7 on the Receiver PCB. Figure 2-11 illustrates the shunt settings; and Figure 2-10 indicates the location of JP7 on the receiver PCB.

- Place a shunt on pins 1 and 2 of JP7 for the fast target setting.
- Place a shunt on pins 2 and 3 of JP7 for the slow target setting.

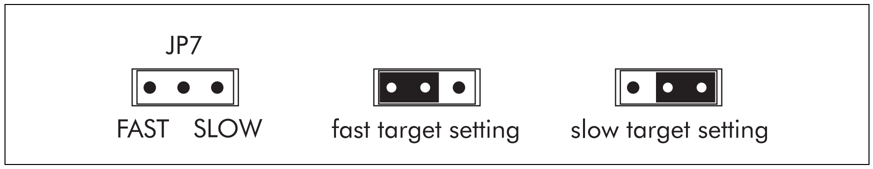


Figure 2-11 JP7 target speed settings

Receiver DIP-switch functions

DIP-switch S1	Function	DIP-switch S2	Function
S1-1	ON for network operation OFF for relay output (standard mode)	S2-1	ON enables audio O/P via TB3 OFF enables audio O/P via TB1
S1-2	ON enables self-test (standard mode) OFF for network operation	S2-2	Not used
S1-3	ON for network operation OFF for relay output (standard mode)	S2-3	ON connects Tamper to network O/P OFF for standard Tamper O/P
S1-4	ON enables self-test (standard mode) OFF for network operation	S2-4	ON enables alignment aid LEDs OFF disables alignment aid LEDs
S1-5	ON enables alarm O/P on jam OFF disables alarm O/P on jam	S2-5	ON enables alarm relay reset OFF latches alarm relay
S1-6	ON connects Tamper to network O/P OFF for standard Tamper O/P	S2-6	ON enables alarm relay OFF disables alarm relay

Table 2-4 Receiver DIP-switch functions

Receiver DIP-switch settings

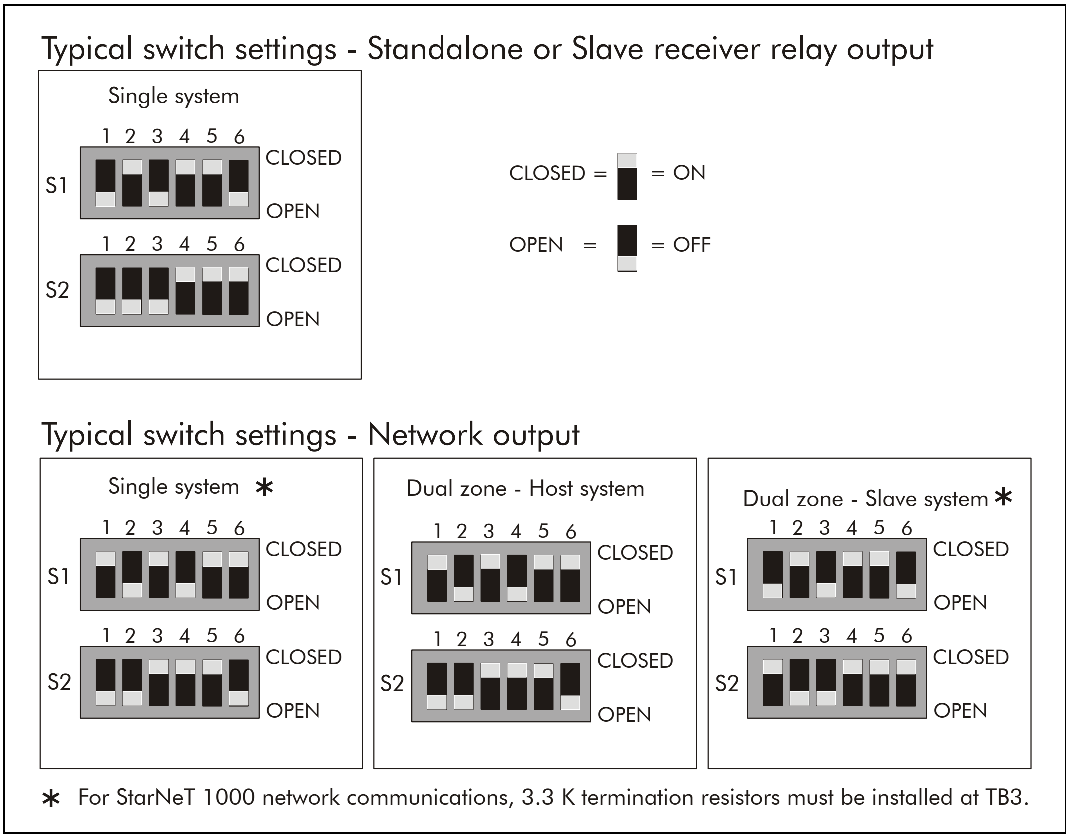


Figure 2-12 MPS-4100 Receiver configuration options

Definition of Receiver DIP-switch functions

Network operation: Enables network communication via plug-in communication interface card.

Relay output operation: Enables relay output for alarm and tamper.

Self-test enable: Enables a self test upon 12 VDC input. Relay version only. Must be OFF for network operation.

Alarm on jam: Triggers an alarm output upon JAM condition.

Tamper enable for network operation: Enables tamper signal for network operation. Must be off for relay output operation.

Slave Audio: Enables audio output via TB3. Must be ON for slave Receiver audio.

Alignment LED Enable: Enables Alignment Aid LED's. Disable after alignment for reduced power consumption.

Alarm Relay Reset: Enables reset of alarm relay. In OFF position, alarm relay latches following alarm until reset manually. (Toggle S2-5 to reset alarm relay.)

Alarm Relay Enable: Enables alarm relay operation for relay output version. May be turned OFF for network operation if local alarm annunciation is not required.

Network wiring (Silver/StarNeT 1000)

Communication Interface Card

The optional MPS-4100 Communication Interface Card (P/N E6BA010X-003) enables the MPS-4100 Microwave system to communicate via the Silver Network or the StarNeT 1000 network. Installed on header P1 on the MPS-4100 Receiver unit PCB, the card provides redundant network communications through two separate channels (A and B).

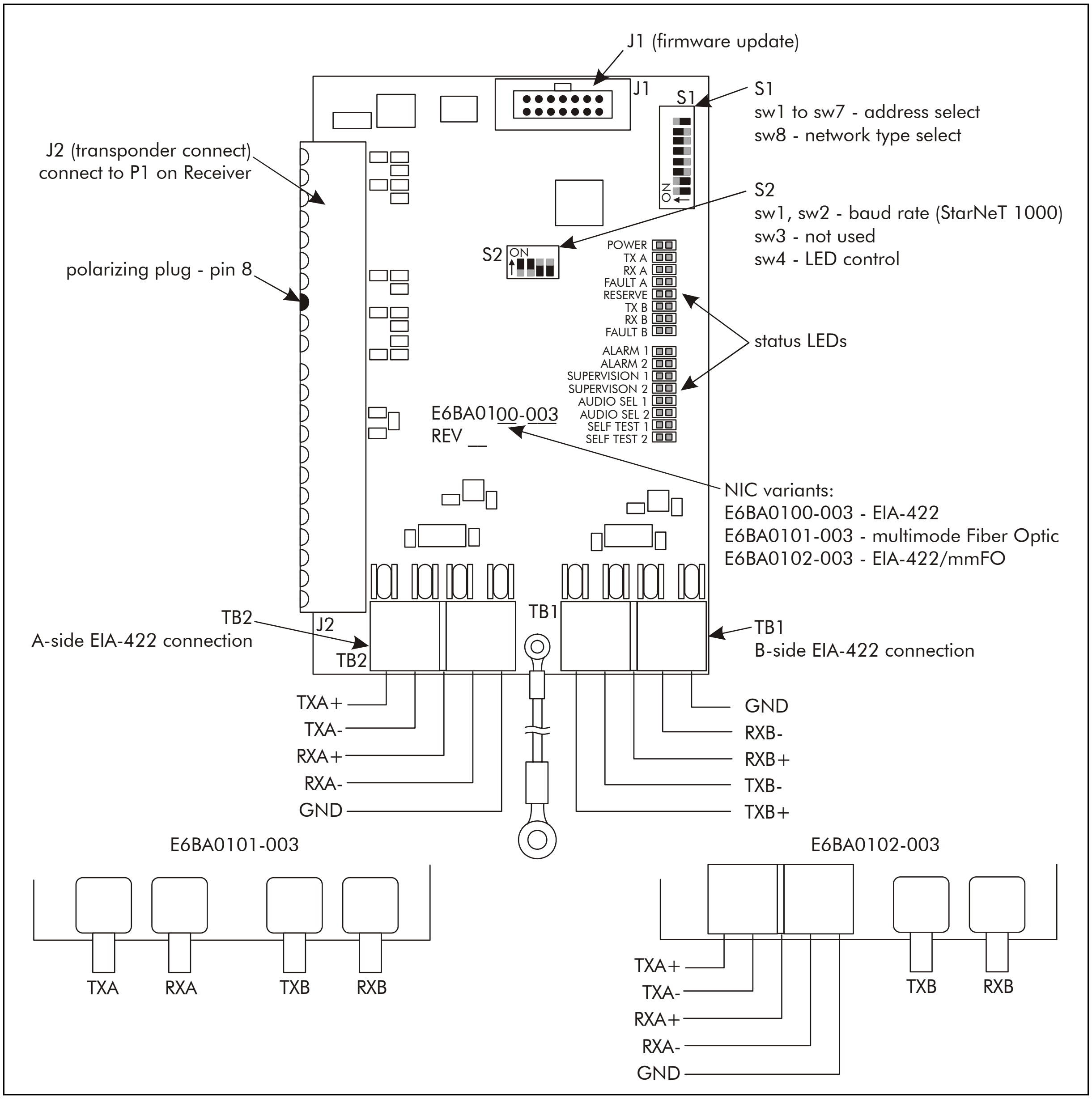


Figure 2-13 Communication Interface Card

Features

- quick connection to network - removable terminal blocks for EIA-422 and ST connectors for multi-mode fiber optic
- network device address - DIP-switch-selectable (1 to 32 for Silver and 0 to 127 for StarNeT 1000)
- StarNeT 1000 network baud rate - DIP-switch-selectable (Silver = 57.6 k)
- dual redundant communications ports
- network wiring enters through existing conduit outlet
- receives power, ground and alarm data through 21-pin header on the Model MPS-4100 Receiver card
- fits in Model MPS-4100 Receiver unit enclosure (no modifications required)
- low power consumption
- diagnostic LED ON/OFF power switch for reduced power consumption
- supports dual zone configuration (host/slave) with minimal additional wiring from the second microwave unit to TB3
- lightning suppression devices for communication circuits
- on-board microprocessor
- conformal coated PCB
- 16 diagnostic/status LEDs:

LED	Function	LED	Function
POWER	power ON/OFF	ALARM 1	detection alarm HOST zone
TX A	transmitting data A-side	ALARM 2	detection alarm SLAVE zone
RX A	receiving data A-side	SUPVN 1	supervision alarm HOST
FAULT A	CRC fault A-side	SUPVN 2	supervision alarm SLAVE
RESERVE	future use	AUDIO 1	audio output HOST
TX B	transmitting data B-side	AUDIO 2	audio output SLAVE
RX B	receiving data B-side	TEST 1	self-testing HOST
FAULT B	CRC fault B-side	TEST 2	self-testing SLAVE

Table 2-5 CIC LED functions

Software setup

For StarNeT 1000 systems, configure the MPS-4100 Microwave System in the StarNeT site database as a **PLC-430/IWAVE Transponder** by following the directions in the *SIMPL Site Creation Guide, J4DA0202* and the *Control Program Maintenance Guide, J4DA0402*. Refer to the following point mapping tables for MPS-4100 Silver Network point assignments.

MPS-4100 input point mapping (Silver Network)	
Point	Description
Sensor Alarms	
1 - 2	Microwave 1 - 2 (bit 0: Alarm, bit 1: Tamper)

MPS-4100 output point mapping (Silver Network)	
Point	Description
Controls	
1	Audio Select 1 (Audio 2 LED)
2	Audio Select 2 (Audio 1 LED)
3	Self-Test 1 & 2 (Self-Test LED 1)
4	Self-Test LED 2

System configuration

Before installing the Communications Interface Card, install, align and test the MPS-4100 microwave system.

Installing the Communication Interface Card

WARNING: Disconnect the power source to the MPS-4100 microwave before installing the card.

CAUTION: Observe proper ESD handling procedures when working on the card.

CAUTION: It requires considerable force to install the interface card on P1 of the MPS-4100 receiver. Apply firm, even pressure along the card edge while installing the card. Avoid twisting the card or uneven pressure.

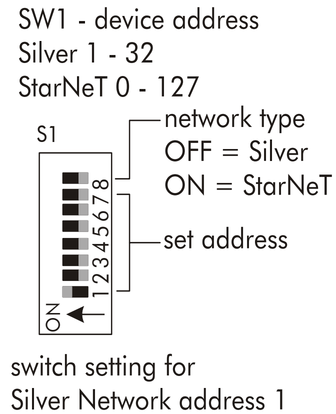
CAUTION: Connect the Interface card ground strap to the ground stud on the MPS-4100 Receiver enclosure. A good earth ground is essential for lightning and transient protection.

No special calibration equipment or tools are required to install the Communications Interface Card:

- set the network device address and baud rate on the CIC DIP-switches
- make the network wiring connections on the removable terminal blocks (data grade shielded cable is recommended) or ST connectors
- setup the Model MPS-4100 Receiver card for network operation
- carefully, plug the card into P1 on the Model MPS-4100 Receiver unit PCB
- attach the ground strap to the ground screw on the enclosure

Setting the network device address

Each Silver or StarNeT 1000 network device requires a unique address. Refer to the site plan to determine the network device address assigned to the MPS-4100 Microwave system. For the Silver Network, the address must be between 1 and 32. For StarNeT 1000 the address must be between 0 and 127. The address is set on DIP-switch S1 (see Figure 2-14).

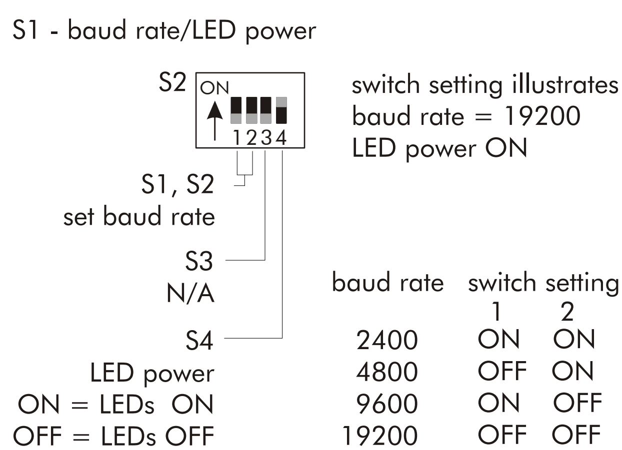


address	switch position 1	2	3	4	5	6	7
0	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1	ON	OFF	OFF	OFF	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF	OFF	OFF
3	ON	ON	OFF	OFF	OFF	OFF	OFF
4	OFF	OFF	ON	OFF	OFF	OFF	OFF
|	|	|	|	|	|	|	|
8	OFF	OFF	OFF	ON	OFF	OFF	OFF
|	|	|	|	|	|	|	|
16	OFF	OFF	OFF	OFF	ON	OFF	OFF
|	|	|	|	|	|	|	|
32	OFF	OFF	OFF	OFF	OFF	ON	OFF
|	|	|	|	|	|	|	|
64	OFF	OFF	OFF	OFF	OFF	OFF	ON
|	|	|	|	|	|	|	|
126	OFF	ON	ON	ON	ON	ON	ON
127	ON	ON	ON	ON	ON	ON	ON

Figure 2-14 Network device address settings

Setting the baud rate

All network devices on a Crossfire network (StarNet 1000) must communicate at the same baud rate (typically 19.2 k). Refer to the site plan for the Crossfire baud rate and set the baud rate via S2 on the Communications Interface Card (see Figure 2-15). All Silver Network based devices communicate at a fixed baud rate of 57.6 k (the Silver Network baud rate cannot be adjusted).



baud rate	switch setting 1	2
2400	ON	ON
4800	OFF	ON
9600	ON	OFF
19200	OFF	OFF

Figure 2-15 Baud rate settings

Connecting the network wiring

For network communications, both the A-side and B-side channels must be connected. For EIA-422 wiring, there are two removable terminal blocks for the network connections (A-side = TB2, B-side = TB1). For multimode fiber optic communications there are four ST connectors (A-side U6 = TXA, U7 = RXA; B-side U8 = TXB, U9 = RXB). For mixed media 422/FO the A-side is EIA-422 and the B-side is fiber optic.

For added security, install the network wiring inside conduit.

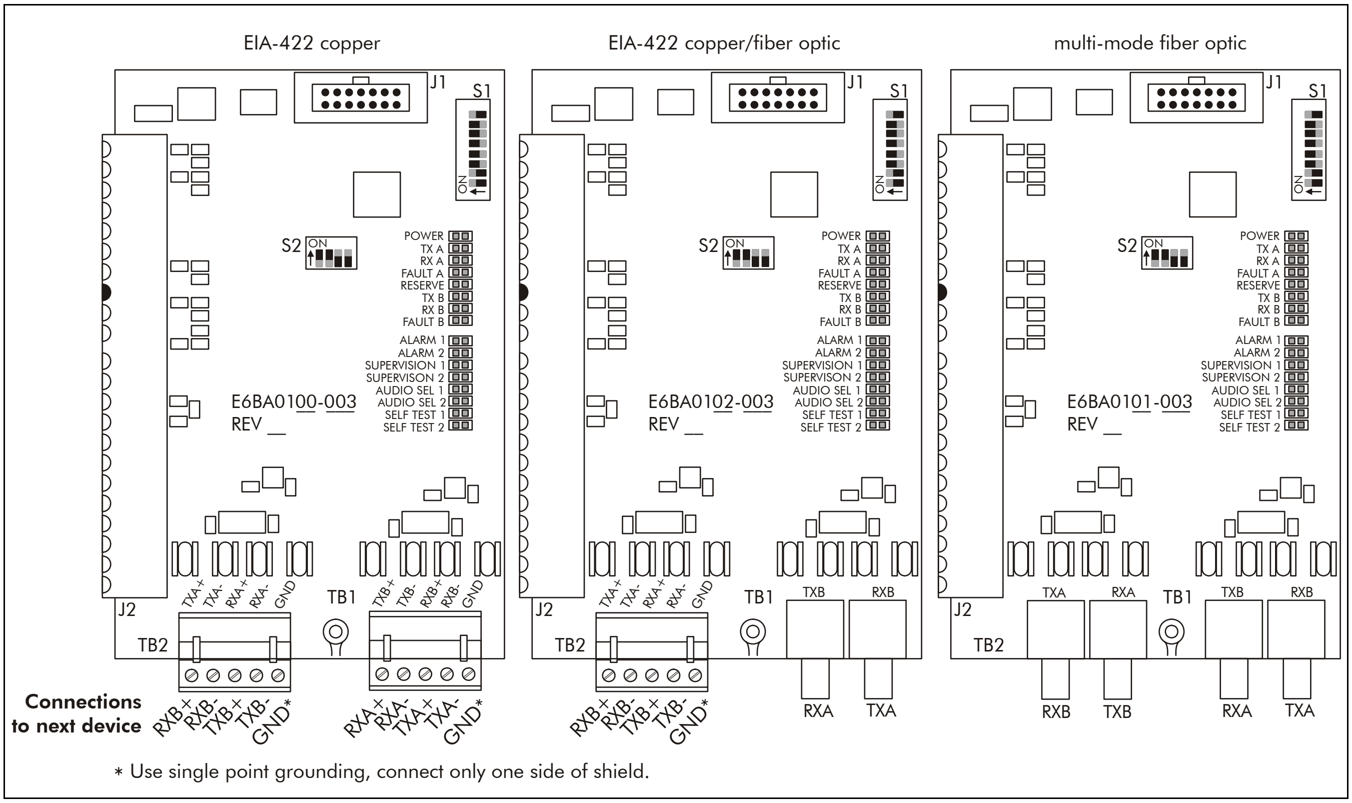


Figure 2-16 Network communication wiring connections

1. Remove the cover from the back of the MPS-4100 Receiver unit.
2. Route the network communication cables through the conduit port on the back cover.
3. For EIA-422, remove terminal blocks TB1 and TB2 from the card.
4. Make the network wiring connections according to Figure 2-16.
5. Ensure that each cable shield is connected to pin 5 (GND) of the appropriate terminal block. (Use single point grounding - connect the shield to ground at one end, trim and tape the shield at the other end.)
6. Plug the B-side terminal block into TB1.
7. Plug the A-side terminal block into TB2.
8. For multi-mode fiber optic cable make the wiring connections according to Figure 2-16.

Mounting the Communications Interface Card

The communications interface card receives power, ground and alarm data signals via P1 on the MPS-4100 Receiver card.

1. Connect J2 on the Communications Interface Card to P1 on the Model MPS-4100 Receiver card (see Figure 2-17). (The card must be fully installed onto the header.)
2. Connect the ground strap on the card to the ground screw on the bottom of the Receiver enclosure. (A good earth ground is essential for transient protection.)

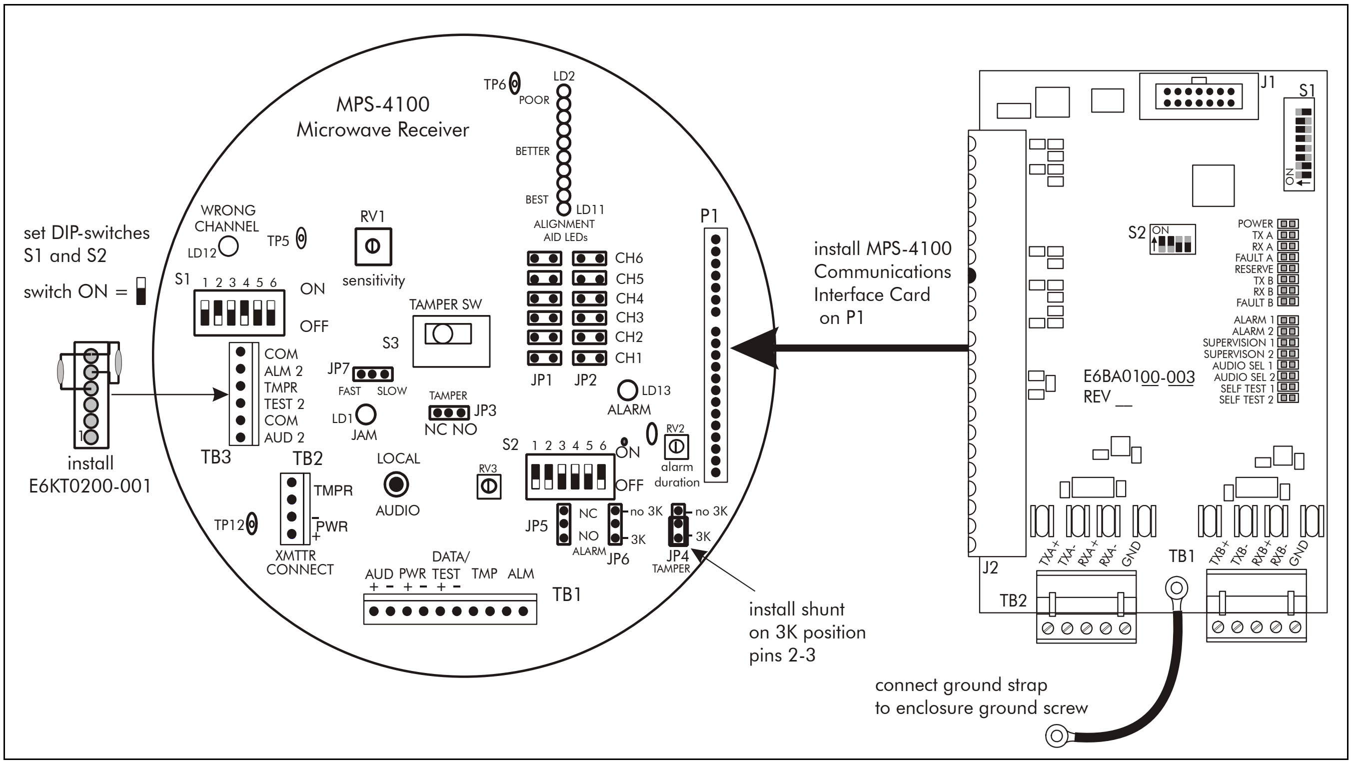


Figure 2-17 Installing the Communication Interface Card

Labelling

Affix the network device label P/N E6LS0400-002 on the back cover of the receiver housing as indicated in Figure 2-18:

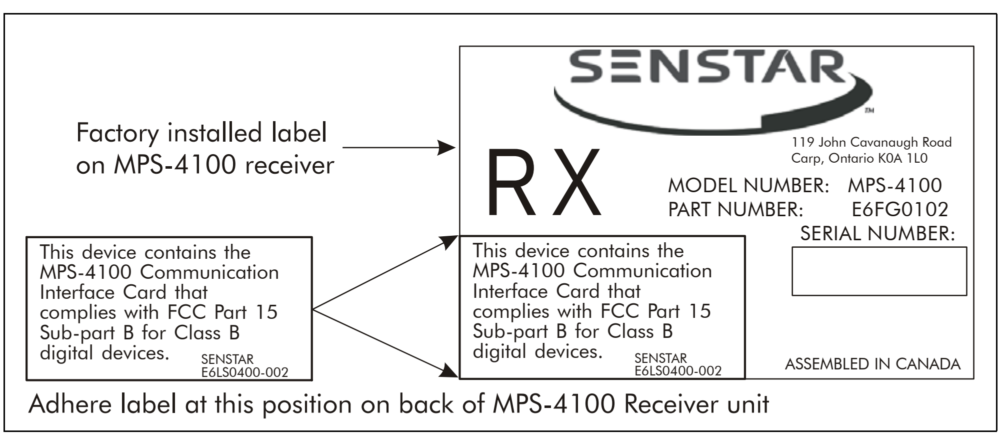


Figure 2-18 Installing the FCC label

Setting up the MPS-4100 Receiver card

The Receiver card requires shunt and DIP-switch adjustments to communicate on the Silver or StarNeT 1000 networks. The following procedure applies to single system MPS-4100 microwaves, which are connected to Silver Networks or StarNeT 1000 systems. For dual systems, refer to Figure 2-12 for information about Host/ Slave setup.

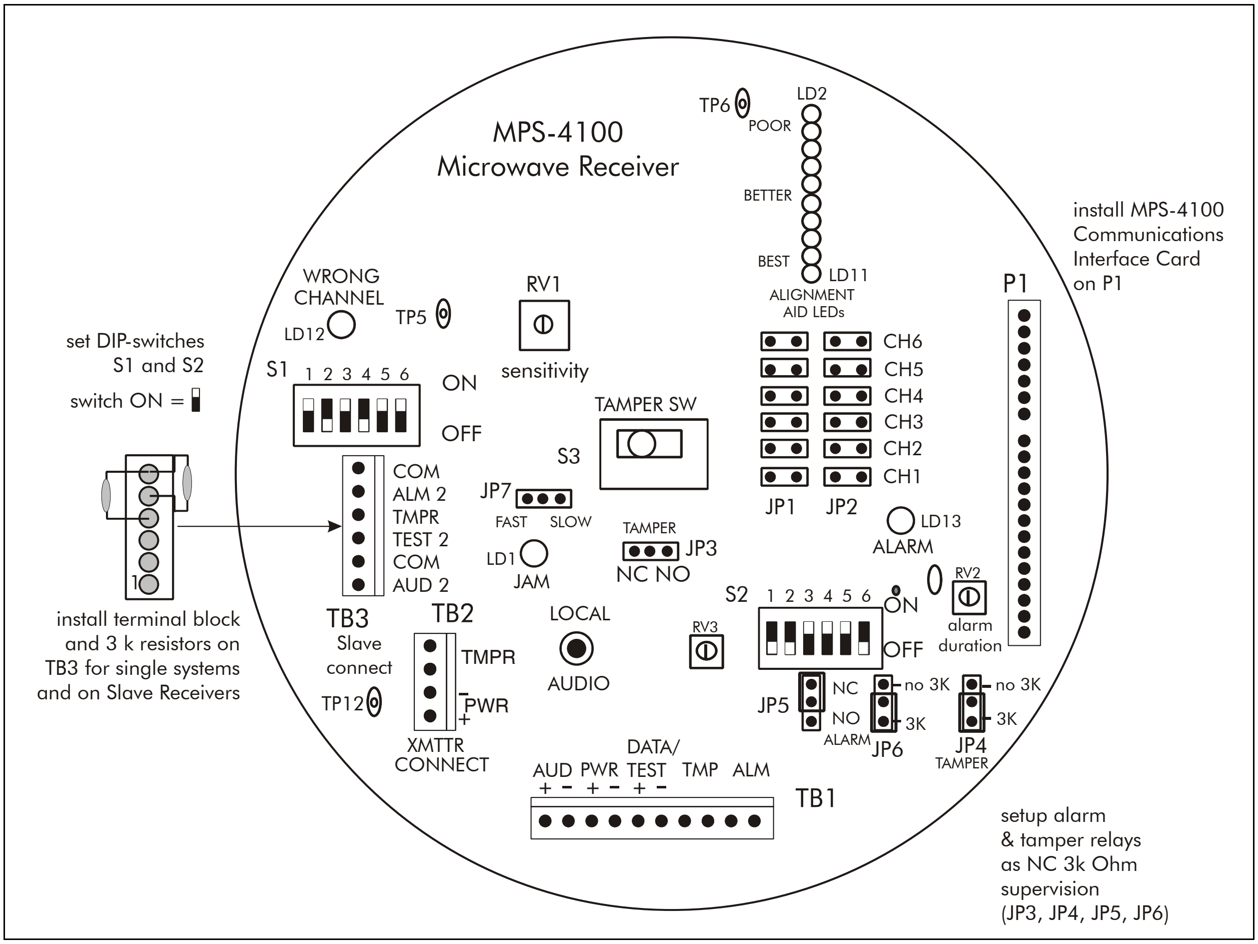


Figure 2-19 Receiver setup for Silver Network/StarNeT 1000 (single system)

1. Install a shunt on JP4, pins 2-3 (3 K position).
2. Set DIP-switch S1 as follows:

SWITCH	1	2	3	4	5	6
POSITION	ON	OFF	ON	OFF	ON	ON

3. Set DIP-switch S2 as follows:

SWITCH	1	2	3	4	5	6
POSITION	OFF	OFF	ON	ON	ON	OFF

Wiring the Receiver for Silver/StarNeT 1000

Single Zone

For single zone network operation, install the terminal block included in kit E6KT0200 on TB3 and terminate with 3kΩ resistors (see Figure 2-19).

Dual Zone (Host/Slave configuration)

The first MPS-4100 Receiver/Transmitter pair is designated as the Host system. The second MPS-4100 Receiver/Transmitter pair is designated as the Slave system. The Host Receiver includes the Communications Interface Card, which connects to the network. The Slave Receiver wires to the Host receiver.

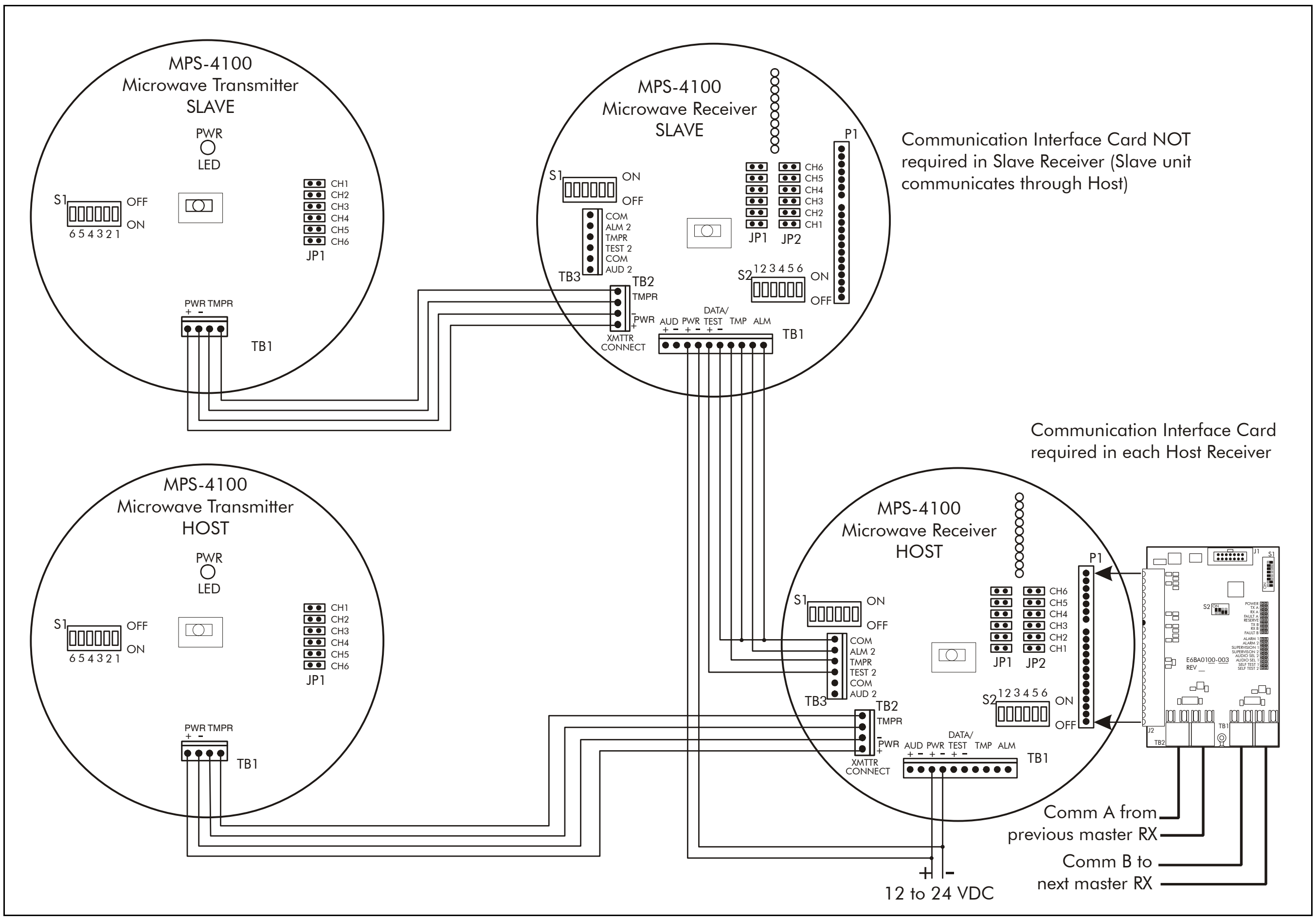


Figure 2-20 Master/Slave connection diagram

Setup all tamper and alarm relays as NC with 3 kΩ resistor supervision.

Depending on the Transmitter powering and tamper reporting scheme being used there are two options for Transmitter tamper wiring.

- The Host Transmitter wires to the Host Receiver, the Slave Transmitter wires to the Slave Receiver.
- The switched power Transmitter tamper reporting option (no tamper wiring).

Host or Slave Transmitter

Wire according to the instructions for Relay Output Wiring.

Host Receiver

Use single point grounding for all shields. Ground the shields to the ground screw on the Receiver housing. Trim and tape the shields at the other end. Do not allow the individual pair shields to touch each other or the overall shield.

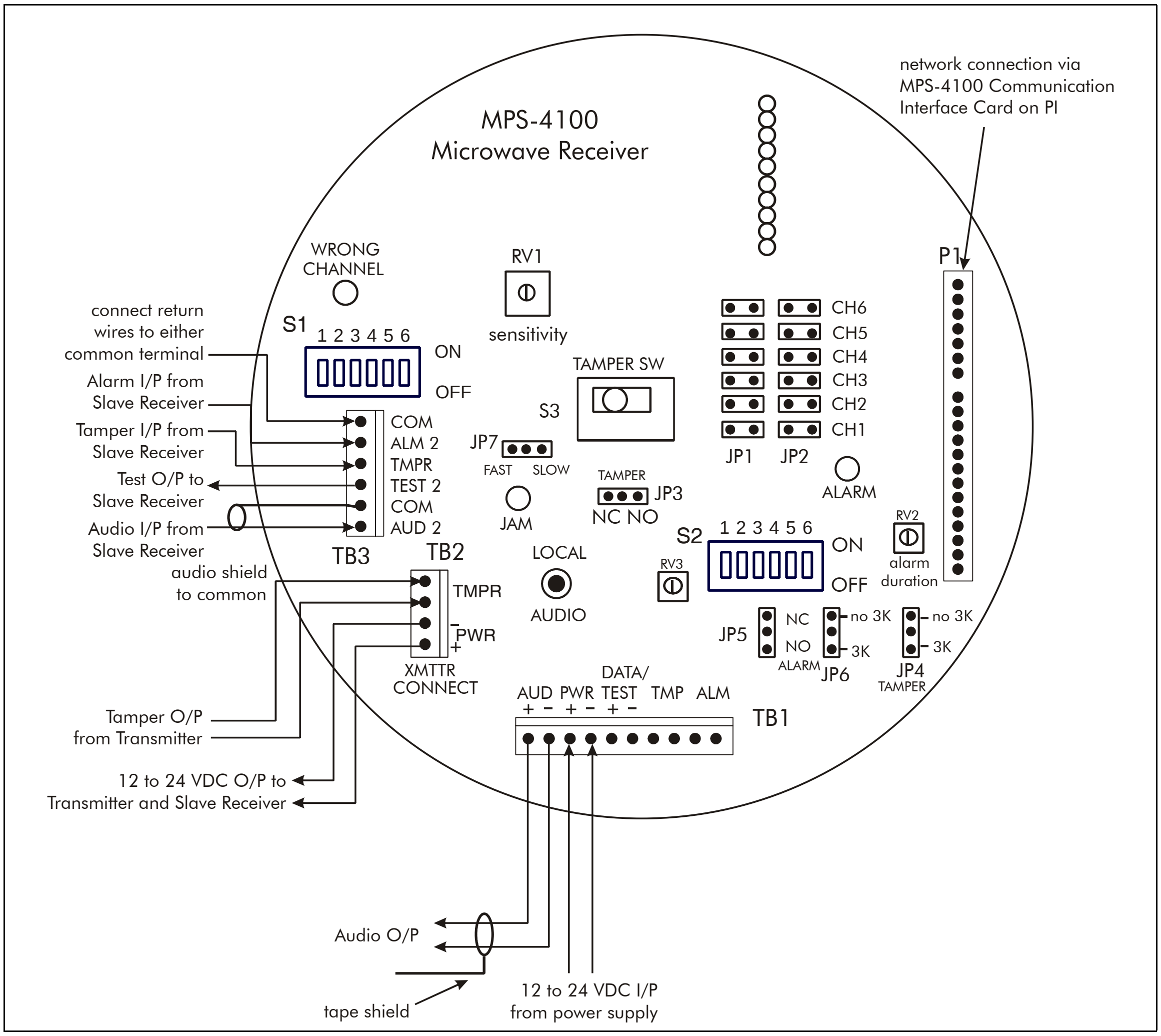


Figure 2-21 MPS-4100 Host Receiver connections

1. Connect the power wires to TB1. **Observe Polarity**. (See Figure 2-21.)

   If the Transmitter tamper is not being connected to the Receiver, a jumper must be placed across pins 3 & 4 on TB2.

2. Connect the Host Transmitter power and tamper pairs to TB2. Power for the Slave Receiver also connects to TB2. The tamper input from the Transmitter must be NC.
3. Install the terminal block and 3 k resistors included in kit E6KT0200 on TB3.

4. Set the Receiver modulation frequency to match the Transmitter modulation frequency via JP1 and JP2.
5. Connect the Slave Receiver outputs for audio, alarm, self-test and tamper to TB3. The return wire for the audio, alarm, self-test and tamper outputs may be connected to any Common terminal on TB3. Connect the audio pair shield to any Common terminal on TB3.
6. Configure the operating parameters via S1 and S2. See Table 2-4.

Slave Receiver

The Slave Receiver is wired according to the Relay Output method. Relay outputs for alarm and tamper must be set for NC, 3 kΩ supervision via jumpers JP3, JP4, JP5, and JP6. See Figure 2-10. The 3 kΩ EOL resistor for the tamper circuit must be set at the Slave Transmitter.

If the Transmitter tamper is not being connected to the Receiver, a jumper must be placed across pins 3 & 4 on TB2.

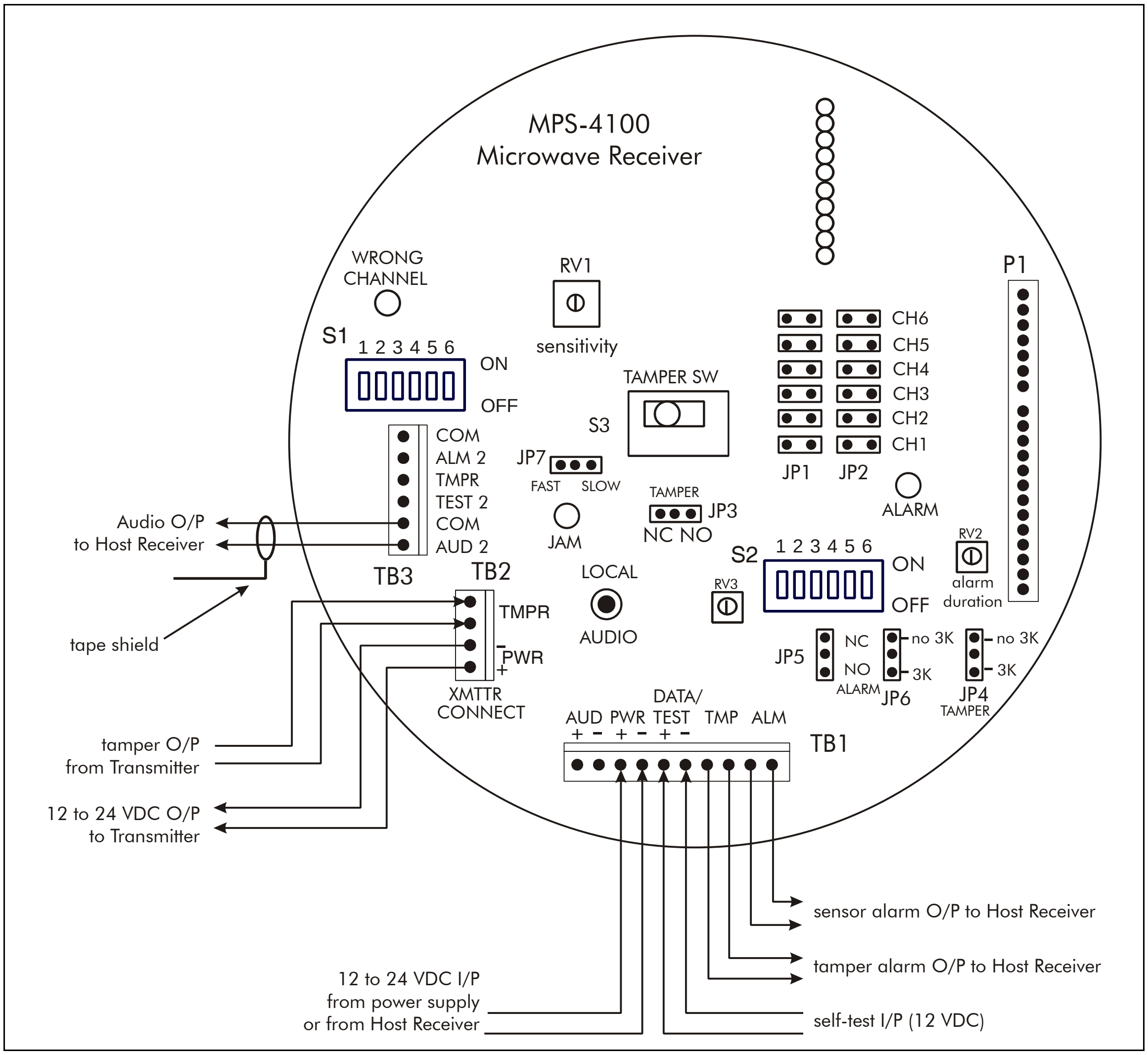


Figure 2-22 MPS-4100 Slave Receiver connections

1. Wire the power, alarm, tamper and self-test pairs to TB1 (see Figure 2-22). **Observe polarity.**

   Use a shielded twisted pair cable for the audio connection between the Slave and Host Receivers. Connect he shield to any Common terminal on TB3 of the Host Receiver. Trim back and tape the shield at the Slave Receiver.

2. Wire audio to the Slave audio terminals on TB3.

   Do not use the TB1 audio terminals for a Slave Receiver.

3. Wire power and tamper for the Slave Transmitter to TB2. Transmitter tamper output must be set to NC.
4. Set the Receiver modulation frequency to match the Transmitter modulation frequency via JP1 and JP2.
5. Configure the operating parameters as a Relay Output version, via S1 and S2 (see Table 2-4).

Network Wiring (MX-5000 Series)

The optional MPS-4100 network transponder enables the MPS-4100 Microwave system to communicate on the MX-5000 multiplex data bus. Installed directly on the MPS-4100 Receiver unit PCB, the card provides network communications through a two wire data bus, which connects to TB1 (Data/Test). One or two Microwave sets can report to the MX-5000 Series Control Center via one transponder card. For dual zone reporting, the Receiver, which includes the transponder card is designated as the Host Receiver. The second Microwave pair is configured as a Relay output version, and wires into the Host Receiver as a Slave.

WARNING: Disconnect the power source to the MPS-4100 microwave before installing the card.

CAUTION: Observe proper ESD handling procedures when working on the card.

CAUTION: It requires considerable force to install the interface card on P1 of the MPS-4100 receiver. Apply firm, even pressure along the card edge while installing the card. Avoid twisting the card or uneven pressure.

Setup all tamper and alarm relays as NC with 3 kΩ resistor supervision.

Transmitter

For the Host or Slave Transmitter, follow the instructions for Relay Output Wiring. The Host Transmitter wires to the Host Receiver, the Slave Transmitter wires to the Slave Receiver.

Host Receiver

1. Connect the audio, power, and data pairs from the shielded interconnect cable to TB1 (see Figure 2-23). See the note below regarding shield terminations. **Observe Polarity**.

   All shields should be clipped and taped off including the overall shield. Incoming and outgoing cable shields should be connected and taped off. DO NOT ALLOW THE INDIVIDUAL PAIR SHIELDS TO TOUCH EACH OTHER OR THE OVERALL SHIELD.

2. Connect the Host Transmitter power and tamper pairs to TB2. Power for the Slave Receiver also connects to TB2.

   The tamper input from the Transmitter must be NC.

   If the Transmitter tamper is not being connected to the Receiver, a jumper must be placed across TB2-3 & 4.

3. Connect the Slave Receiver inputs for audio, alarm, self-test and tamper to TB3. The inputs for alarm and tamper must be NC 3 kΩ supervision. The return wires for alarm, tamper, audio, and self-test may be tied to any Common terminal on TB3. Connect the audio pair shield to any Common terminal on TB3.
4. Set the Receiver modulation frequency to match the Transmitter modulation frequency via JP1 and JP2.
5. Set the address for the transponder. Refer to the MX-5000 manual for network device addressing. The transponder inserts upside down with the DIP-switches positioned at the top.
6. Configure the operating parameters via S1 and S2. See Table 2-4.

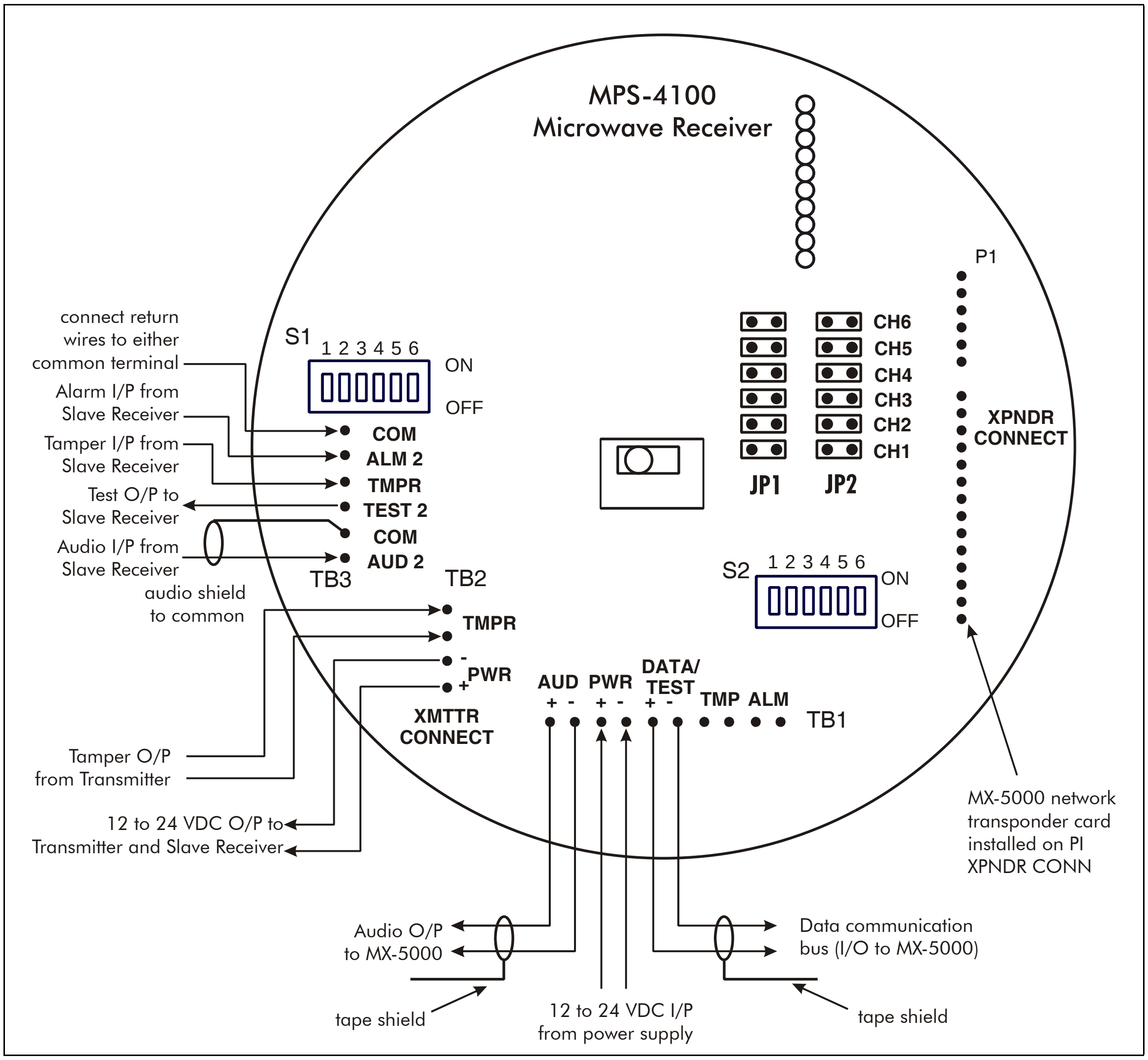


Figure 2-23 MPS-4100 Host Receiver connections

Slave Receiver

The Slave Receiver is wired according to the Relay Output method. Relay outputs for alarm and tamper must be set for NC, 3 kΩ supervised via jumpers JP3, JP4, JP5, and JP6 (see Figure 2-10). The 3 kΩ EOLR for the tamper circuit should be set at the Slave Transmitter. The return wires for alarm, tamper, audio and self-test may be commoned together.

1. Wire power, alarm, tamper and self-test pairs to TB1 (see Figure 2-22). **Observe polarity**.
2. Wire audio to the Slave audio terminals on TB3.

   Do not use the TB1 audio terminals for a Slave Receiver.

3. Wire power and tamper for the Slave Transmitter to TB2. The Transmitter tamper output must be set to NC.

   If the Transmitter tamper will not be wired to the Receiver, a jumper must be placed across TB2-3 & TB2-4.

4. Set the Receiver modulation frequency to match the Transmitter modulation frequency via JP1 and JP2.
5. Configure the operating parameters via S1 and S2. See Table 2-4.

   A shielded pair cable for the audio between the Slave and Host Receivers is recommended. The shield should be tied to any Common terminal on TB3 of the Host Receiver only.

3 Power Up and Alignment

Once the MPS-4100 Microwave system's wiring has been completed and checked for correct terminations, power can be applied and the system alignment calibrated. Alignment can be calibrated by observing the Alignment aid LED's (LD2 - LD11) on the Receiver circuit board. A DC voltage reading of the received signal strength can be obtained by connecting a voltmeter to TP6 (+) and TP12 (Ground).

Powering up

Relay output version

Apply power to the MPS-4100. Observe that:

- The power LED illuminates on the Transmitter.
- Several LED's illuminate on the Receiver to verify initial operation of the system.

Network version (Silver Network/StarNeT 1000)

Apply power to the MPS-4100. Observe that:

- LED 1 on the Communication Interface Card illuminates.
- If the alarm display and control System is configured to poll the MPS-4100 System, the Rec A, Rec B and Xmit LEDs will flash intermittently.
- Passing your hand in front of the receiver causes a zone 1 detection alarm (Alm1 LED illuminates).
- Pressing and releasing the Tamper switch on the receiver causes a Zone 1 supervisory alarm.

  When the Tamper switch is pressed, the Sup1 LED is OFF. When the Tamper switch is released, the Sup1 LED is lit.

To observe the diagnostic LED's on the CIC, set switch S2-4 to the ON position. To operate with reduced power consumption, set switch S2-4 to the OFF position.

Alignment

Alignment is easier, faster, and more accurate if done by two people, one at the Transmitter and one at the Receiver. The microwave unit mounting holes in the post mounting bracket are slotted to enable vertical adjustment of the MPS-4100. (Loosen the two screws, adjust the vertical aspect, and re-tighten the two screws.) Horizontal adjustment is accomplished by loosening the bracket's nut and bolt and rotating the complete assembly on the mounting post.

There are two methods for aligning the MPS-4100 Microwave system. The first method is the standard alignment procedure, which optimizes the received power level by adjusting the positions of the Transmitter and Receiver independently. This works well in applications where the physical characteristics of the zone are not expected to change (a stable zone). The second alignment procedure is for environments, which experience significant snowfall (an unstable zone). For environments where there is significant snow accumulation, refer to application notes 1 and 2 in Appendix a for installation and alignment information.

Alignment procedure

Proper alignment is critical to the reliable operation of the MPS-4100. A poorly aligned MPS-4100 can result in nuisance alarms, which can reduce the confidence level and thereby the effectiveness of the system.

1. Remove the cover from the back of the Receiver unit and observe the Alignment aid LED's (LD2 - LD11).
   The green LED's LD4 -LD11 indicate an acceptable alignment level. The higher the number of the lit LED, the better the alignment.
2. Visually aim the Transmitter and Receiver directly toward each other.
3. Loosen the mounting hardware as required, and adjust the vertical and horizontal position of the Receiver enclosure by pivoting the unit up and down and side to side until the highest alignment level is obtained.
4. Secure the Receiver in place.
5. Adjust the vertical and horizontal position of the Transmitter to see if the alignment can be improved. The person monitoring the Alignment LEDs at the Receiver must promptly inform the person at the Transmitter of any improvement or deterioration of the received signal level.
6. Once the best signal is received, secure the Transmitter in place.

7. Make final adjustments at the Receiver to see if the signal can be further improved.
8. Secure the Receiver in place.

> *If adjusting both the Transmitter and Receiver does not improve the alignment, and the present received signal level is in the Red, Yellow, or the first few Green LEDs, it may be necessary to move the Receiver, the Transmitter, or both units slightly up or down on the mounting posts.*

If it is difficult to obtain an acceptable alignment level via the Alignment LED's it may be beneficial to connect a volt meter to the Receiver's alignment test points TP6 (+) and TP12 (-). The alignment voltage range is from 0 to 5 VDC. An acceptable alignment measures above 3.5 VDC. Repeat the alignment procedure while measuring the alignment voltage at TP6 and TP12.

Unstable zones (significant snowfall)

If you are in an area that experiences significant snowfall, the mounting height and alignment procedure may differ from the standard procedures. In this type of environment a hard paved surface is recommended for the microwave zone to facilitate snow removal. Refer to Do's and Don'ts a planning primer and Stacking bistatic microwaves for information about installing and aligning the MPS-4100 Microwave system in environments with significant snow accumulation.

Final testing and adjustment

1. Verify that all alarm and supervision indicator LED's are off. On units that do not include a Communication Interface Card or network Transponder, ensure the alarm relay is in the non-alarm state.
2. Move your hands or body in front of the Receiver to test for proper detection. Look for the alarm LED to illuminate, and listen for the alarm relay to activate. For network systems, verify the annunciation of a microwave alarm on the alarm display and control system.
3. Walk into the microwave field at various points along the zone to verify proper detection.
4. If it is necessary to increase the Microwave's sensitivity, turn the Sensitivity Pot (RV1) clockwise. To decrease the sensitivity, turn the Pot counter-clockwise (see Figure 3-1).

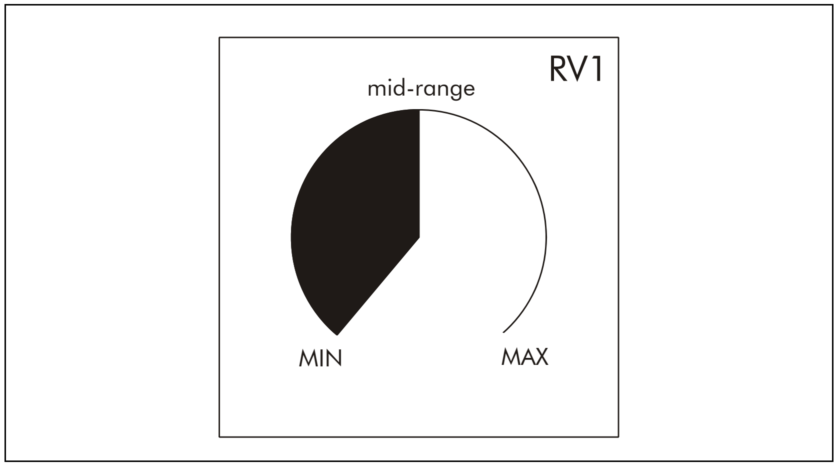


Figure 3-1 Sensitivity Pot adjustment

Increasing the microwave sensitivity increases the probability of nuisance alarms. The MPS-4100 Microwave system is designed as a penetration detector, not as a volumetric detector. The sensitivity should be increased only as required, to better detect objects in accordance with specific detection criteria.

5. Consult the project specifications for additional detection tests and perform as required.

Silver Network Test

Refer to the product documentation for the alarm display and control system to test MPS-4100 units that communicate over the Silver Network.

StarNeT 1000 Test

Refer to the *Control Program Maintenance Guide, J4DA0402* and the *Control Program Operator's Guide, J4DA0302* for StarNeT 1000 test information.

MX-5000 Series test

Refer to the MX-5000 Series manual for detailed test procedures.

Changing antenna polarity

There are two field adjustable antenna polarizations for the MPS-4100 Microwave system. Narrow Beam (vertical polarization) is the default setting and results in a slightly narrower detection field. Wide Beam (horizontal polarization) is achieved by rotating the Receiver and Transmitter antennas 90° and results in a slightly wider detection field.

When stacking multiple sets of MPS-4100 units in a vertical array, it is recommended that the antenna polarity be altered from set to set. This is in addition to changing the modulation frequency of each set. Use the Narrow Beam setting for the upper microwave pair and use the Wide Beam setting for the lower microwave pair. Changing both the antenna polarity and the modulation frequency eliminates any possible crosstalk between sets (indicated by the Wrong Channel LED on the Receiver). Antenna polarity is altered by rotating the antenna assembly of the Transmitter and Receiver as follows:

1. Remove the rear cover of the Transmitter.
2. Loosen the 4 screws that hold the PCB assembly to the chassis.
3. Rotate the assembly 90° clockwise until the Wide Beam mark points down.
4. Tighten the 4 screws to secure the assembly to the chassis.
5. Repeat the process at the Receiver. The Receiver board is not labelled for Narrow Beam and Wide Beam. When in the Narrow Beam position, terminal block TB-1 is horizontal across the bottom of the circuit board. In the Wide Beam position TB1 is vertical on the left side of the circuit board.

Self-Test function

To activate the self-test function for the MPS-4100 Receiver, apply +12 VDC to the self-test terminals on TB1 for at least one second (**observe polarity**).
The alarm relay will activate and the alarm LED will turn ON, indicating proper operation of the Receiver.

Refer to the StarNeT 1000 *Control Program Maintenance Guide, J4DA0402 and Control Program Operator's Guide, J4DA0302* for directions on how to configure the self-test for a StarNeT 1000 network system. Refer to the MX-5000 Series manual for directions on how to configure the self-test for an MX-5000 network system.

Troubleshooting

There are generally two problems, which can occur with microwave protection systems, non-detection and a high false alarm rate.

Non-detection

There are several possible causes for an MPS-4100 Microwave system to be unable to detect valid targets. The following procedure offers suggestions on how to determine and correct these problems. This procedure assumes that the microwave was properly aligned and calibrated before being put into service.

1. Remove the covers and pull out the tamper switch plungers at both the Transmitter and Receiver to disable the tamper alarms.
2. Verify that power is present at both the Transmitter and Receiver. Measure the voltage, at the inputs, to ensure that the voltage meets the minimum +12 VDC requirement.
3. Verify that the frequency modulation selection jumpers on the Transmitter and Receiver match.
4. Verify the tamper setting at both the Transmitter and Receiver and test the tamper switch on each unit. Disable the tamper switch after verifying its operation.
5. Occasionally, one of the microwave units can be accidentally knocked out of alignment. Verify the alignment of the microwave system (refer to the Alignment section). Realign the system as required.
6. Increase the sensitivity at RV1 to the maximum setting (turn fully clockwise) and retest the microwave detection.
   If the microwave does NOT detect a valid target, obtain an RMA number and return the units to Senstar.
7. If the microwave detects valid targets at the maximum sensitivity setting, reduce the sensitivity and retest the unit.
8. Continue reducing the sensitivity and retesting the zone until the detection meets your site requirements.

High false alarm rate

If your microwave system is encountering an unacceptably high false alarm rate, you must determine the cause of the false alarms and make adjustments as required. Review the site planning information in Chapter 1 and Appendix a for possible sources of false alarms. If possible causes are found, correct the problems, (for example, tighten a loose fence panel adjacent to the microwave zone, or fill a depression in which standing water accumulates).

1. Remove the cover from the receiver and pull out the tamper switch plunger to disable the tamper alarm.

2. Connect a set of headphones to the 1/8 in. local audio plug (P3) on the Receiver circuit board.
   When the microwave field is disturbed, an audio tone is generated. The audio tone increases in pitch and volume as the disturbance moves through the field.
3. Listen to the headphones while observing the zone. Look for a correlation between any activity in or near the zone and an increase in the audio output. If a potential problem is identified, correct the problem and retest the zone.
4. Decrease the sensitivity slightly and retest the zone. Continue reducing the sensitivity setting until you achieve an acceptable level of detection without an unacceptable false alarm rate.

Silver Network/StarNeT 1000 Communication Interface Card

The Communication Interface Card includes 12 diagnostic/status LEDs to assist troubleshooting. Test the MPS-4100 according to the directions in the alarm display and control system. Using a two-way radio for communication, have a technician monitor the LEDs on the CIC while an operator conducts the test. If the Communications Interface Card is faulty, power down the card, label and disconnect the network communication cables, and remove the faulty card. On a replacement CIC, set and verify the dip-switches for proper configuration, install the new card and reconnect the network communication cables on the new card. Return the faulty card to Senstar after obtaining an RMA number.

MPS-4100 Specifications

Circuit components	100% solid state on plug-in circuit boards
Frequency	10.525 GHz
Radiated Power	10 mW peak, 5 mW average, square wave modulated
Modulation Frequencies	Six selectable modulation frequencies: 3, 4.5, 7.5, 10.5, 18, and 27 kHz
Nominal Detection Width	30 m (100-ft.) Zone = 1.8 m (6-ft.) beam width 91 m (300-ft.) Zone = 5.5 m (18-ft.) beam width 183 m (600-ft.) Zone = 11 m (36-ft.) beam width
Range (standard)	3 m (10 feet) to 183 m (600 ft.)
Range (high-security)	3 m (10 feet) to 100 m (328 ft.)
Velocity response	Slow target setting - 5 cm/s to 13.4 m/s (2 in./s to 44 ft./s) Fast target setting - 25 cm/s to 61 m/s (10 in./s to 200 ft./s)
Connectors	Removable terminal blocks
Tamper alarm actuation	Enclosure switch (2-position plunger) continuous alarm until corrected
Remote testing	Built-in self-test generator simulates actual intrusion signals
Cable entry	2 cm (¾ inch) flexible weather proof conduit fitting for power and alarm cables.
Weather proofing	Aluminum enclosure - powder coated - All openings gasketed and sealed - Conformal coated circuit boards
Lightning protection	Input/Output lines protected by gas discharge arrestors and Transorbs (90 volts 5000 amperes)
Operating temperature	- 40°C to 70°C (-40°F to 158°F)
Alarm output	Isolated and supervised relay contacts - jumper-selectable N/O, N/C Contacts with 0.25 A @ 30 VDC rating
Alarm duration	Adjustable from 0.5 sec. to 2.5 sec
Tamper output	Isolated and supervised relay contacts - jumper-selectable N/O, N/C contacts with 0.25 A @ 30 VDC rating
Audio assessment	Audio information via 1/8 in. phone jack 100 mV RMS Typical, 600 Ohm
Input voltage range	+12 to +24 VDC
Supply Current	MPS-4100T, 25 mA max. MPS-4100R, 50 mA max. StarNeT 1000 Communications Interface Card, 70 mA max. MX-5000 transponder card, 25 mA max.
Enclosure size	20 cm (8 in.) dia. x 23 cm (9 in.) deep
Power supplies:	
E6FG0300 (UPS-PFI)	input 115 VAC, output 13.7 VDC @ 1.2 A with 1 A/h gel-cell battery
E6FG0400 (UPS-PFI-2)	UPS - input 220-250 VAC, output 13.7 VDC @ 1.2 A with 1 A/h battery

a Application notes

Do's and Don'ts a planning primer

Introduction

The purpose of this Application Note is to outline the "rules" for bistatic microwaves, to allow for the successful installation and operation of microwave units.

Bistatic microwave sensors have been used in security applications for many years. They operate successfully, as long as the rules for bistatic microwaves are understood and followed. These rules include limitations in site coverage and detection capability, as well as the critical need for proper site preparation. Improper site preparation will result in nuisance alarms and inconsistent detection.

Microwave basics

A transmitter sends out an electromagnetic wave in the microwave band toward a receiver. The receiver picks up an electromagnetic signal composed of both the direct signal from the transmitter and the reflected signal from the ground and other nearby objects. Any metallic or water-containing (living) conductive object moving within the microwave field alters the received signal in amplitude and phase. The changes in the received signal are analyzed, and if they meet the criteria for object size and speed, an intrusion alarm is declared.

Microwave detection zone size

The size of the microwave detection zone varies greatly between the transmitter and the receiver. The detection coverage is very small near either unit, typically 15 cm (6 in.) in diameter. Therefore, the areas directly below the transmitter and receiver are unprotected, as indicated in Figure a-1. Microwave units MUST be offset to provide complete coverage of these unprotected areas, as indicated in Figure a-2, Figure a-3 and Figure a-4.

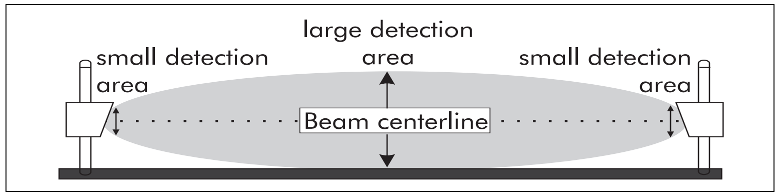


Figure a-1 Microwave detection zone

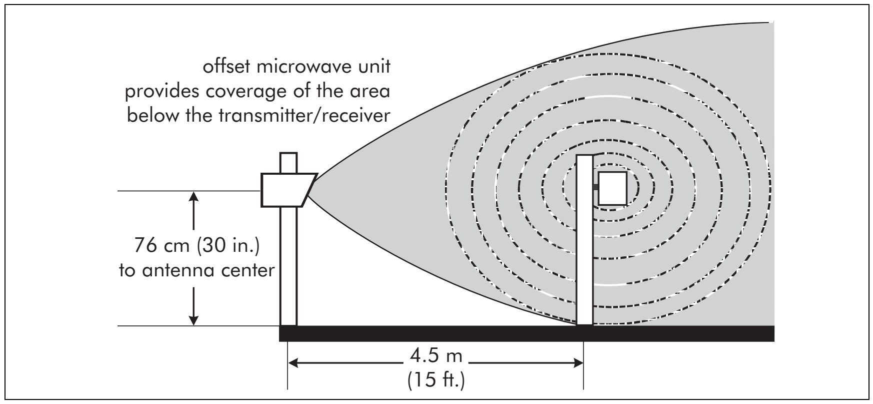


Figure a-2 Offset microwave coverage for dead zone

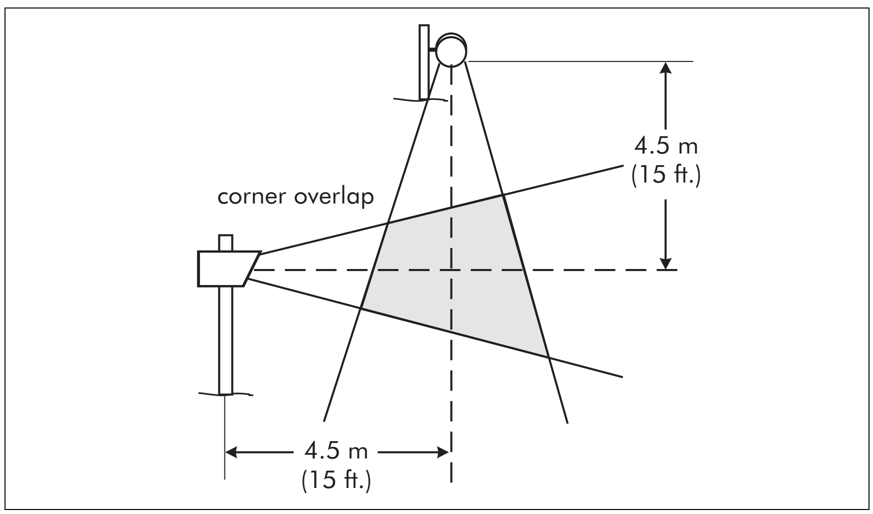


Figure a-3 Corner overlap

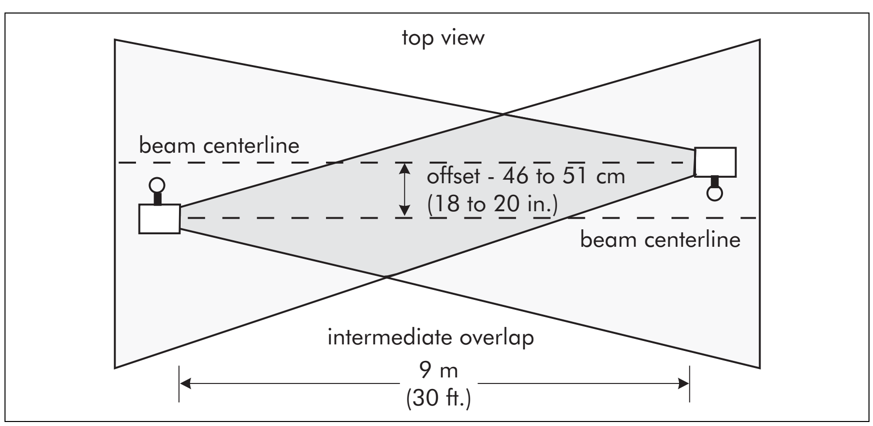


Figure a-4 Top view intermediate overlap

The detection coverage is largest midway between the transmitter and receiver. The size of the detection coverage increases as unit separation increases (see Figure a-5).

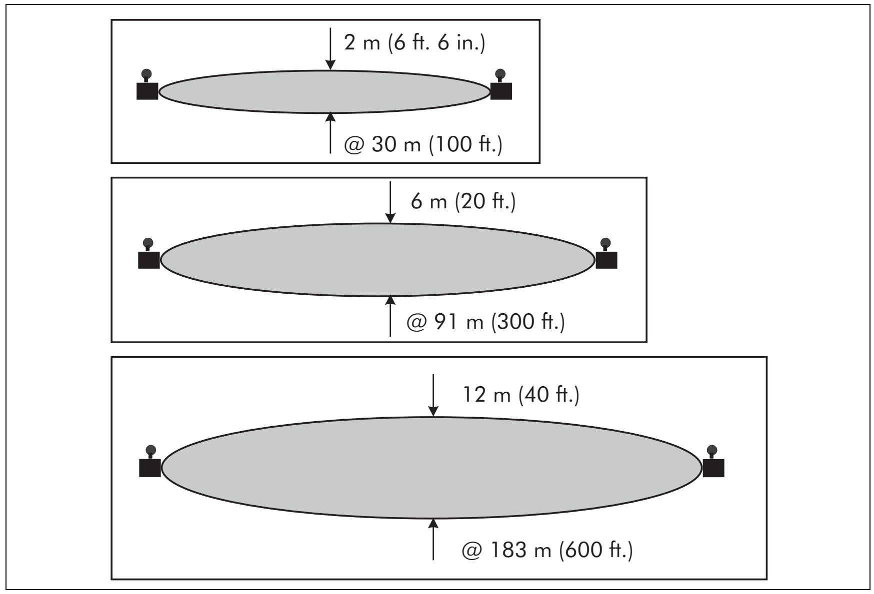


Figure a-5 Approximate coverage patterns

The coverage patterns in Figure a-5 are for human-size objects. Large metallic objects, like vehicles or moving fence panels, can be detected beyond the indicated envelopes. The pattern is approximately the same horizontally and vertically, creating an elongated cylindrical detection field that is tapered at both ends. However, the pattern does not extend below the surface of the ground.

Detection capability depends on the sensitivity setting, the transmitter/receiver separation and mounting height, and the intruder profile (walking, creeping, crawling, or rolling). For reliable detection of all intrusion profiles, the separation between the transmitter and receiver must not exceed 100 m (328 ft.). This is referred to as a high-security microwave detection zone.

At the maximum separation distance for bistatic microwave units, only upright walking intruders are reliably detected. Microwave detection is NOT terrain-following. Only line-of-sight detection is provided by bistatic microwaves.

Unit separation and the mid-point zone width

There is direct relationship between the separation distance of the transmitter and receiver (zone length), and the diameter of the detection envelope at the mid-point of the zone. The approximate beam width relationship for various products is indicated in the following table.

Product	Beam width relationship
MPS-4100	BW = ZL x 0.066
Microwave Series 14000	BW = ZL x 0.018
Microwave Series 16000	BW = ZL x 0.055
Microwave Series 24000	BW = ZL x 0.035
BW = beam width ZL = zone length (i.e., unit separation)	

Approximate beam width relationships

The beam width also depends on the sensitivity setting of the receiver. The beam width increases as the sensitivity is increased.

Physical limitations to the maximum beam width

Large metal objects such as vehicles, fences and buildings can be detected well beyond the typical detection envelope. To prevent nuisance alarms caused by nearby metallic objects, reduce the separation distance (zone length) for microwave zones that are close to any large metallic object.

When there is a physical limitation to the maximum size of the beam width, (for example, when the microwave units are located between two parallel fences or beside a single fence, near a vehicle storage area or parking lot, or close to buildings) a variation of the beam width formula must be used to calculate the maximum transmitter/receiver separation. In this case, measure the distance from the beam centerline to the closest limiting object. Use this measurement as the maximum allowable beam width. As a general rule, the clear area around the zone should be twice the maximum beam width. The following formula can be used to determine the maximum zone length that can be used when there is a physical limitation to the microwave beam width:

zone length (max.) = BW (beam centerline to nearest limiting object) ÷ numeric factor (product specific)

For example, if an MPS-4100 is being installed between two parallel fences that are 6 m apart, the maximum zone length is calculated by dividing 3 m (distance from beam centerline to fence) by 0.066 (MPS-4100 numeric factor), which equals 45 m. Figure a-6 illustrates a typical MPS-4100 zone length/detection pattern at 91 m, and the zone length adjustment that must be made for the same system if it is installed between parallel fences that are 6 m apart. It is possible to increase the length of this zone by reducing the microwave's sensitivity setting. However, reducing the system sensitivity also reduces its effectiveness.

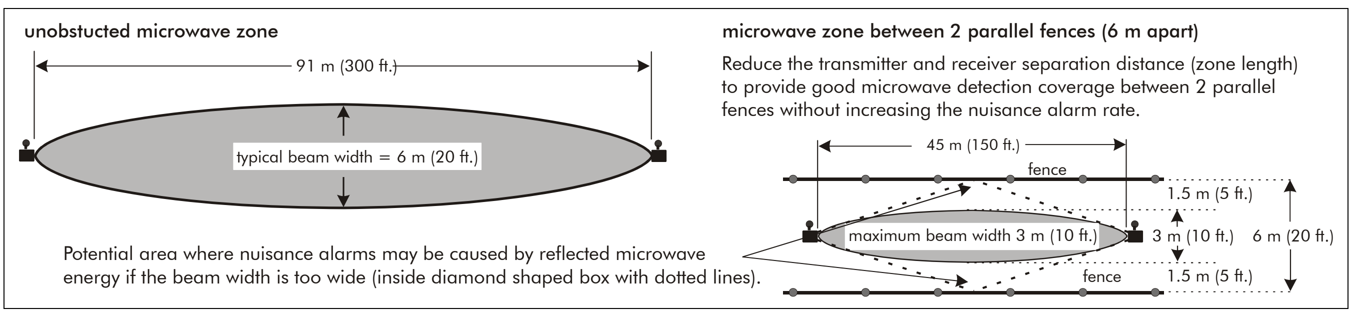


Figure a-6 Reduced zone length between fences

Site Rules - DO's and DON'Ts

- DO use bistatic microwave sensors in clear, flat areas that provide a clean line-of-sight. Bistatic microwave units are line-of-sight sensors that require a reasonably long and flat detection zone.
- DON'T use bistatic microwave sensors in areas where the line-of-sight will be blocked, for example, in parking areas, where fixed objects are inside the beam pattern (out buildings, guard shacks), where power or light poles are in the direct center of beam.

- DO use bistatic microwave sensors in areas where the ground is smooth and flat.
- DON'T use bistatic microwave sensors over drainage ditches, hills, or ungraded areas where there is more than a 15 cm (6 in.) change in terrain over the full length of the zone. Microwave detection is not terrain-following (see Figure a-7).

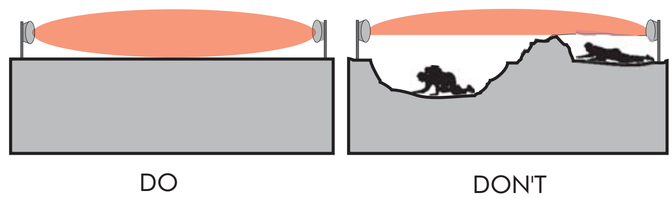


Figure a-7 Do's and Don'ts of installation terrain

- DO use bistatic microwave sensors in areas that are free of extraneous motion.
- DON'T use bistatic microwave sensors in areas with trees, shrubs or vegetation in, or near, the detection zone. Vegetation within the detection zone will cause nuisance alarms.
- DO eliminate all puddles and areas of standing water inside the detection zone.
- DON'T use bistatic microwave sensors near large areas of water, such as ponds, streams, drainage ditches and water runoff areas.
- DO use bistatic microwave sensors in areas that are fenced-in.
- DON'T use bistatic microwave sensors in unfenced/ uncontrolled areas because of potential problems with animal-initiated nuisance alarms.
- Do limit the length of the microwave zone to exclude fences, buildings and other reflective surfaces from inside the detection area. Use additional overlapping and offset microwave units to provide complete coverage of the area.
- Don't allow fences, buildings or other reflective objects into the microwave zone or nuisance alarms and inconsistent detection will result.
- DO mount microwave units at least 3 m (10 ft.) inside the fence line for short zones. For longer zones, follow the guidelines for unit separation.
- DON'T mount the microwave unit too close to the fence to protect against bridging attempts, and to avoid nuisance alarms caused by fence movement.
- DO keep microwave units away from traffic areas, and DO provide protective devices to prevent damage.
- DON'T mount microwave units near fence gates that can swing into the heads.
- DO use microwave offsets and corner overlaps to provide complete coverage of an area, including the transmitter and receiver mounting locations.
- DON'T leave vulnerable areas at the transmitter and receiver mounting locations.

Ground cover rules for reliable detection

- The transmitter/receiver separation distance must not exceed 100 m (328 ft.) for high-security applications.
- The transmitter and receiver units are to be mounted with the beam centerline (center of antenna) 60 to 75 cm (24 to 30 in.) above the ground (according to the unit's installation instructions).
- Terrain within the detection zone must be level to grade, plus or minus 7.5 cm (3 in.).
- Terrain within the detection zone must be completely covered with crushed rock (2 cm {0.75 in.} maximum) to a depth of 10 cm (4 in.). Crushed rock allows for the proper drainage of rainwater and prevents the formation of puddles.
- For areas where snow accumulates, pavement is the recommended surface, to allow for easy snow removal. Snow build-up can cause changes in the microwave pattern, which can result in nuisance alarms. Remove snow, as it accumulates.
- The detection zone must be completely free from vegetation, for the full width of the microwave pattern.
- Perform all routine site maintenance, as required.

Low-security applications

For low security applications where only upright walkers must be detected, the following ground covers are acceptable: well-mown grass (7.6 cm (3 in) or less), asphalt, concrete, or hard-packed soil.

Rules for areas with significant snow accumulation

The accumulation of snow in the detection zone between the transmitter and receiver reduces their effective mounting height. The reduction in mounting height changes the ground reflection characteristic, which greatly affects the received signal level. Therefore, it is strongly recommended that snow be removed from inside the microwave zones. There are additional problems arising from the accumulation of snow:

- If the snow blocks the line-of-sight from transmitter to receiver, the zone stops working.
- Snow drifts may produce "radar shadows", thereby increasing vulnerability.
- Intruders can burrow into the snow to avoid detection.

If snow removal is impractical due to site conditions, the following procedure should be followed when installing the microwave sensor:

1. Select the unit's mounting height from the unit separation/mounting height charts included in Stacking bistatic microwaves, so that the operating point is approximately half-way between two nodal lines. At this mounting height the received signal will be close to the minimum level.
2. Check the alignment.
   For MPS-4100, if the received signal is adequate (LED 6 or greater on the alignment aid, or a voltage measurement of 2.5 VDC at tp6 and tp12) the selected mounting height is correct.

OR
If the received signal is below the minimum acceptable levels, reduce the mounting height in small increments, until the signal level is adequate.

3. Ensure that the units are in correct line-of-sight adjustment.

This procedure will provide the greatest possible margin for snow accumulation. However this will NOT provide optimum system performance under normal conditions.

Post mounting and grounding

Each transmitter and receiver is mounted on a 7.6 to 10 cm (3 to 4 in.) steel post, depending on the hardware supplied. Each post is installed in a concrete base that is at least 61 cm (24 in.) in diameter and 91 cm (36 in.) deep, OR 15 cm (6 in.) below the frost line, whichever is greater. The microwave units must be securely fixed, and must not move when the wind blows, or when the ground freezes and thaws.

At each transmitter and receiver location, a proper ground rod must be installed according to local electrical codes. The ground rod must be connected to the unit according to the installation instructions.

Stacking bistatic microwaves

Introduction

Bistatic microwave sensors have been used in security applications for many years. Typically, microwave sensors provide a detection zone with a limited height. One method of increasing the height of the detection zone is to stack two transmitter-receiver pairs, with one pair mounted above the other (see Figure a-8). This method of stacking microwave sensors can be used to detect bridging attempts made with ladders or other climbing apparatus.

This Application Note outlines some of the advantages and disadvantages of stacking the MPS-4100, Series 14000, Series 16000, and Series 24000 microwave sensors.

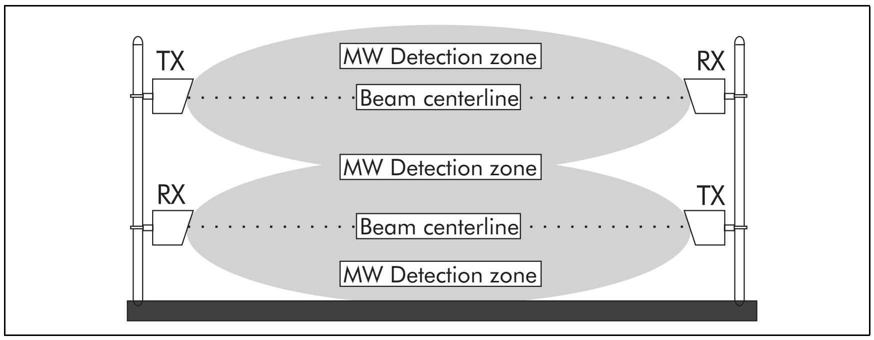


Figure a-8 Stacked standalone microwave detection zones

Good practice

Follow the rules for site preparation, ground cover, clearances and unit separation, as outlined in Do's and Don'ts a planning primer.

The following steps MUST be taken in order to stack two microwave sensors:

1. Ensure that the two pairs have DIFFERENT modulation frequencies.
2. Ensure that the two pairs have DIFFERENT antenna polarizations for the microwave signal. This will help prevent interference between the two sets of microwave units.
   - Order one pair with the antenna elements rotated 90º, or for the MPS-4100, rotate both antennas 90º prior to installation.
   - The lower pair should have horizontal polarization (wide beam), and the upper pair should have vertical polarization (narrow beam).
3. For stand-alone (single zone) or perpendicular zone configurations, install one transmitter and one receiver on each post (see Figure a-8). Ideally, the two pairs fire in opposite directions.
   Alternatively, the two transmitters or two receivers can be installed on the same post (see Figure a-9). Generally, the choice is dictated by site wiring considerations.

4. For multiple in-line zones, mount 2 transmitters on one post, and 2 receivers on another (see Figure a-9). Ensure that the modulation frequencies and polarizations of the 2 units on each post are different.

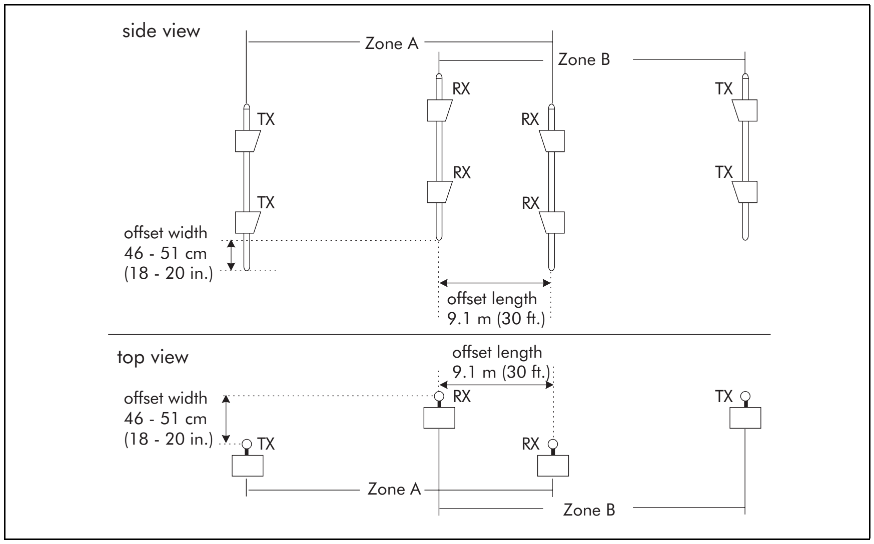


Figure a-9 Stacked multiple in-line microwave detection zones

5. For multiple zone configurations, carefully plan the layout, ensuring that there are no possible conflicts or interference in modulation frequency or polarization.
6. Use a minimum 10 cm (4 in.) post to ensure stability. Each post must be installed in a concrete base that is at least 61 cm (24 in.) in diameter and either 91 cm (36 in.) deep, OR, 15 cm (6 in.) below the frost line, whichever is greater.

Determining the mounting height

The received signal is the vector sum of the direct signal and the reflected signals. The quiescent (no intruder) received signal is greatly influenced by the mid-point reflections. The phase relationship between the direct and reflected signals will slowly change as the sensor antennas are raised from the ground level.

The two signals (direct and reflected) will combine constructively (in phase), or destructively (out of phase), depending on the sensor mounting height and separation distance. Constructive phasing is preferable because of the higher net signal level received. Destructive phasing should be avoided because the low signal level causes the receiver’s automatic gain control (AGC) to operate closer to the top of its range. This will result in a higher nuisance alarm rate when the microwave path loss increases, for example, during rain or snow.

Figure a-10 and Figure a-11 plot the calculated antenna height versus the separation distance relationship for constructive phasing for X-Band (MPS-4100, Microwave Series 14000, and Series 16000) and for K-Band (Microwave Series 24000) respectively. The calculation assumes that the two antennas (transmit and receive) are mounted at the same height above a relatively flat surface. The areas of constructive phasing are located on each nodal line, (i.e., N1, N2, N3, etc.) and below N1.

The following procedure and recommended mounting height table provide a starting point for determining the mounting height for your specific application. Many factors must be taken into account to ensure optimum performance. Therefore, some adjustments to the recommended mounting heights will most likely be required.

Mounting height procedure

1. Determine the unit separation in accordance with the detection requirements and clearances (see the MPS-4100 Application Note #1 - *DO's and DON'Ts: a planning primer*).
2. For the lower pair, select the mounting height of the center of the antenna from the Recommended mounting heights table. Adjust the height to ensure that the operating point is below N1 (see Figure a-10 or Figure a-11).
3. For an installation where both X-Band and K-Band microwave units are being employed, the K-Band (Microwave Series 24000) unit MUST be the lower unit.
   K-Band microwave sensors have better sensitivity to slow-moving intruders. However, they are more susceptible to nuisance alarms from rain and snow. The closely spaced nodal lines (see Figure a-11) for K-Band microwaves means that if the K-Band unit is used as the upper unit, it will be very difficult to ensure constructive phasing under all weather conditions.
4. For the upper units, select the mounting height of the center of the antenna from the Recommended mounting heights table. Adjust the height to ensure that the operating point is on a nodal line, and that the received signal strength is at the maximum possible.
5. Ensure that both the transmitter and the receiver of each pair are mounted at the same height.
6. Perform all site maintenance as required.

Lower unit	Mounting height	Upper unit	Mounting height
MPS-4100	76 cm (30 in.)	MPS-4100	150 cm (60 in.)
Series 14000	60 cm (24 in.)	MPS-4100	136 cm (54 in.)
Series 16000	60 cm (24 in.)	Series 16000	120 cm (48 in.)
Series 24000	30 cm (12 in.)	Series 16000	90 cm (36 in.)

Recommended mounting heights

Ensure that the operating point (mounting height versus separation) is on a constructive nodal line, or below N1 (see Figure a-10 and Figure a-11).

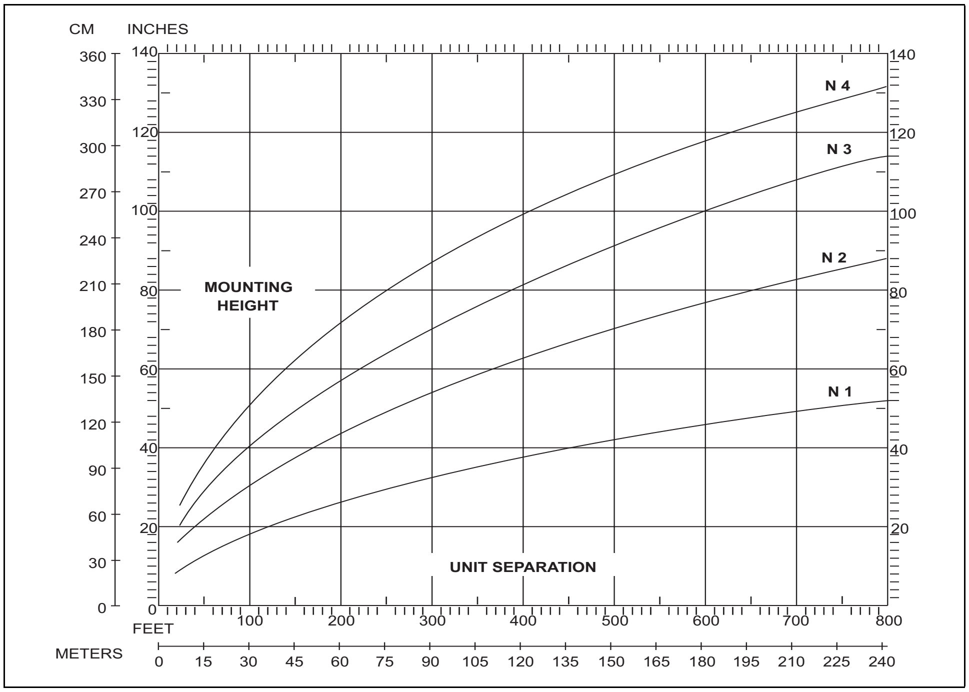


Figure a-10 X-band sensor (MPS-4100, Series 14000, Series 16000)

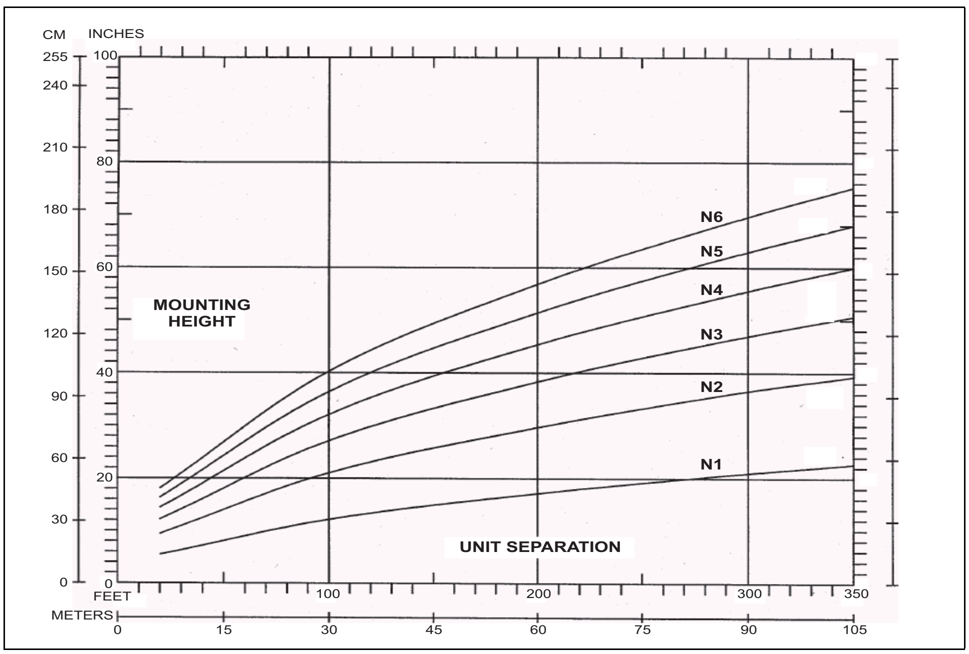


Figure a-11 K-band sensor (Series 24000)

Heavy snow areas

Snow accumulation decreases the effective mounting height. This moves the operating point toward destructive phasing, which could result in degraded performance. To compensate for snow accumulation, the setup of the upper unit should be changed as follows:

- Select the height of the upper pair to be at a point of destructive phasing midway between two nodal lines. (As snow accumulates, the effective mounting height will decrease and the operating point will shift toward an area of constructive phasing).

- Check the signal strength of the upper unit according to the product manual. If the signal strength meets the specification for proper operation, do NOT adjust the mounting height. If the signal strength is below the specification, reduce the mounting height in small increments, until the signal strength meets the minimum specification.
- Ensure that both units of each pair are in a correct line-of-sight adjustment.

Advantages of microwave stacking

- increased zone height
- increased Probability of Detection (PD)
  (There is double coverage from the two pairs for most of the zone.)
- with an X-Band, K-Band combination, the lower K-Band unit is more sensitive to slow-moving and crawling intruders; the upper X-Band unit is more sensitive to faster, upright intruders (This combination provides increased detection against both types of intruders.)

Disadvantages of microwave stacking

- the cost is almost doubled
- the probability of nuisance alarms is increased
- if the lower unit is a K-Band microwave, there may be an increase of nuisance alarms caused by rain and snow
- there is a greater potential for interference between microwave pairs
- because the upper unit is so high above the ground, its operating characteristics (received signal) can change from constructive phasing (strong received signal) to destructive phasing (weak or no received signal) with a slight change in mounting height (Although the mounting height is optimized during installation, snow accumulation changes the effective mounting height. Therefore, during a snowstorm as the snow accumulates on the ground, the operation of the upper microwave pair can become unreliable. Some measures can be taken during installation to anticipate this effect. However, sufficient snow accumulation will severely affect performance.)

Conclusion

For most installations, the mounting height and detection coverage of the MPS-4100 will provide sufficient protection against bridging attempts, as long as the recommendations for zone coverage overlap are followed correctly.

When the stacking of bistatic microwave sensors is required, Senstar recommends the use of two MPS-4100 (MPS 4100) X-Band units:

- MPS-4100 is easily field-configured
- MPS-4100 antenna elements are field-rotatable
- MPS-4100 will have fewer nuisance alarms from weather effects than an X-Band, K-Band combination

b StarNeT 1000 CIC

Introduction

This appendix applies to MPS-4100 units communicating with a StarNeT 1000 display and control system over the Crossfire network, and using either an E6BA0100-001 or E6BA0100-002 variant communications interface card.

Communication Interface Card

The optional MPS-4100 Communication Interface Card P/N E6BA0100-001 (-002) enables the MPS-4100 Microwave system to communicate on the StarNeT 1000 network. Installed directly on the MPS-4100 Receiver unit PCB, the card provides redundant network communications through two removable terminal blocks.

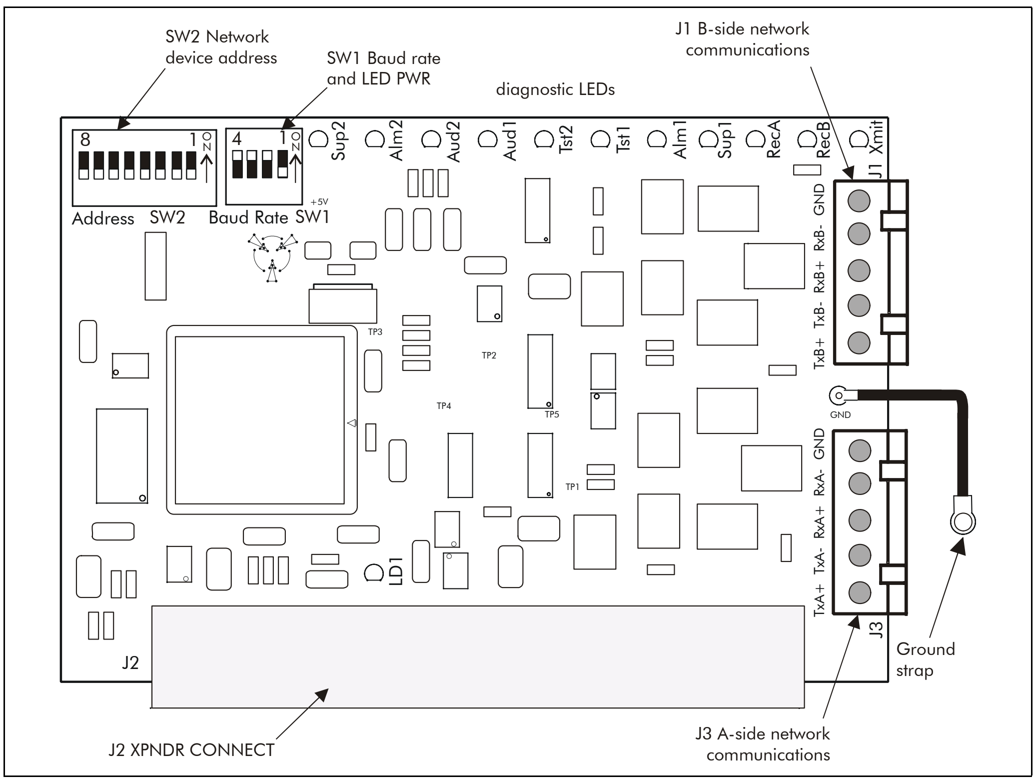


Figure b-1 Communication Interface Card

Features

- quick connection to network - removable terminal blocks
- network device address - DIP-switch-selectable
- network baud rate - DIP-switch-selectable
- dual redundant communications ports
- network wiring enters through existing conduit outlet
- receives power, ground and alarm data through 21-pin header on the Model MPS-4100 Receiver card
- fits in Model MPS-4100 Receiver unit enclosure (no modifications required)
- low power consumption
- diagnostic LED ON/OFF power switch for reduced power consumption
- supports dual zone configuration (host/slave) with minimal additional wiring from the second microwave unit to TB3
- lightning suppression devices for communication circuits
- on-board microprocessor
- conformal coated PCB
- 12 diagnostic/status LEDs:

LED	Function	LED	Function
LD1	power	Tst 1	self-testing microwave unit 1
Xmit	transmitting data	Tst 2	not used for the MPS-4100
Rec B	receiving data on B side channel	Aud 1	audio output evaluation for zone 1
Rec A	receiving data on A side channel	Aud 2	audio output evaluation for zone 2
Sup 1	supervisory alarm in zone 1	Alm 2	detection alarm in zone 2
Alm 1	detection alarm in zone 1	Sup 2	supervisory alarm in zone 2

Com Card LED functions

Software setup

Before installing the Communications Interface Card, configure the MPS-4100 Microwave System in the StarNeT site database as a **PLC-430/IWAVE Transponder** by following the directions in the *SIMPL Site Creation Guide, J4DA0202* and the *Control Program Maintenance Guide, J4DA0402*.

System configuration

Before installing the Communications Interface Card, install, align and test the MPS-4100 microwave system.

Installing the Com card

> *WARNING: Disconnect the power source to the MPS-4100 microwave before installing the card.*

> *CAUTION: Observe proper ESD handling procedures when working on the card.*

> *CAUTION: It requires considerable force to install the interface card on P1 of the MPS-4100 receiver. Apply firm, even pressure along the card edge while installing the card. Avoid twisting the card or uneven pressure.*

> *CAUTION: Connect the Interface card ground strap to the ground stud on the MPS-4100 Receiver enclosure. A good earth ground is essential for transient protection.*

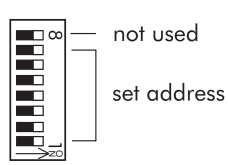
No special calibration equipment or tools are required to install the Communications Interface Card:

- set the network device address and baud rate on the DIP-switches
- make the network wiring connections on the removable terminal blocks (data grade shielded cable is recommended)
- set up the Model MPS-4100 Receiver card for network operation
- plug the card into P1 (XPNDR CONNECT) on the Model MPS-4100 Receiver unit PCB
- attach the ground strap to the ground screw

Setting the network device address

Each StarNeT 1000 network device requires a unique address. Refer to the site plan for the network device address assigned to the MPS-4100 Microwave system. The address must be between 0 and 127 and is set on DIP-switch S2 (see Figure b-2).

SW2 - device address
(0 - 127)



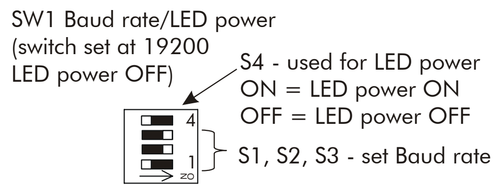
switch setting
for address 0

address	switch position 1	2	3	4	5	6	7
0	ON	ON	ON	ON	ON	ON	ON
1	OFF	ON	ON	ON	ON	ON	ON
2	ON	OFF	ON	ON	ON	ON	ON
3	OFF	OFF	ON	ON	ON	ON	ON
4	ON	ON	OFF	ON	ON	ON	ON
|	|	|	|	|	|	|	|
8	ON	ON	ON	OFF	ON	ON	ON
|	|	|	|	|	|	|	|
16	ON	ON	ON	ON	OFF	ON	ON
|	|	|	|	|	|	|	|
32	ON	ON	ON	ON	ON	OFF	ON
|	|	|	|	|	|	|	|
64	ON	ON	ON	ON	ON	ON	OFF
|	|	|	|	|	|	|	|
126	ON	OFF	OFF	OFF	OFF	OFF	OFF
127	OFF	OFF	OFF	OFF	OFF	OFF	OFF

Figure b-2 StarNeT 1000 network device address settings

Setting the baud rate

All network devices on a Crossfire network must communicate at the same baud rate (typically 19.2 k). Refer to the site plan for the Crossfire baud rate and set the baud rate on the Communications Interface Card (see Figure b-3).



Baud rate	switch position 1	2	3
300	OFF	OFF	OFF
600	ON	OFF	OFF
1200	OFF	ON	OFF
2400	ON	ON	OFF
4800	OFF	OFF	ON
9600	ON	OFF	ON
19200	OFF	ON	ON
38400	ON	ON	ON

Figure b-3 Baud rate settings

Connecting the network wiring

For network communications, both the A-side and B-side channels must be connected. There are two removable terminal blocks for the network connections. J1 is for the B-side wiring, J3 is for the A-side wiring. For added security, install the network wiring inside conduit.

1. Remove the cover from the back of the MPS-4100 Receiver unit.
2. Route the network communication cables through the conduit port on the back cover.
3. Remove terminal blocks J1 and J3 from the card.
4. Make the network wiring connections according to Figure b-4.

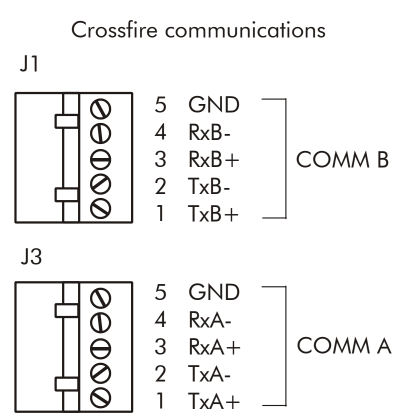


Figure b-4 Network Wiring Connections

5. Ensure that each cable shield is connected to pin 5 (GND) of the appropriate terminal block. (Use single point grounding - connect the shield to ground at one end, trim and tape the shield at the other end.)
6. Plug the B-side terminal block into J1.

7. Plug the A-side terminal block into J3.

Mounting the Communications Interface Card

The communications interface card receives power, ground and alarm data signals via P1 on the MPS-4100 Receiver card.

1. Connect J2 on the Communications Interface Card to P1 on the Model MPS-4100 Receiver card (see Figure b-5). (The card must be fully installed onto the header.)
2. Connect the ground strap on the card to the ground screw on the bottom of the Receiver enclosure. (A good earth ground is essential for transient protection.)

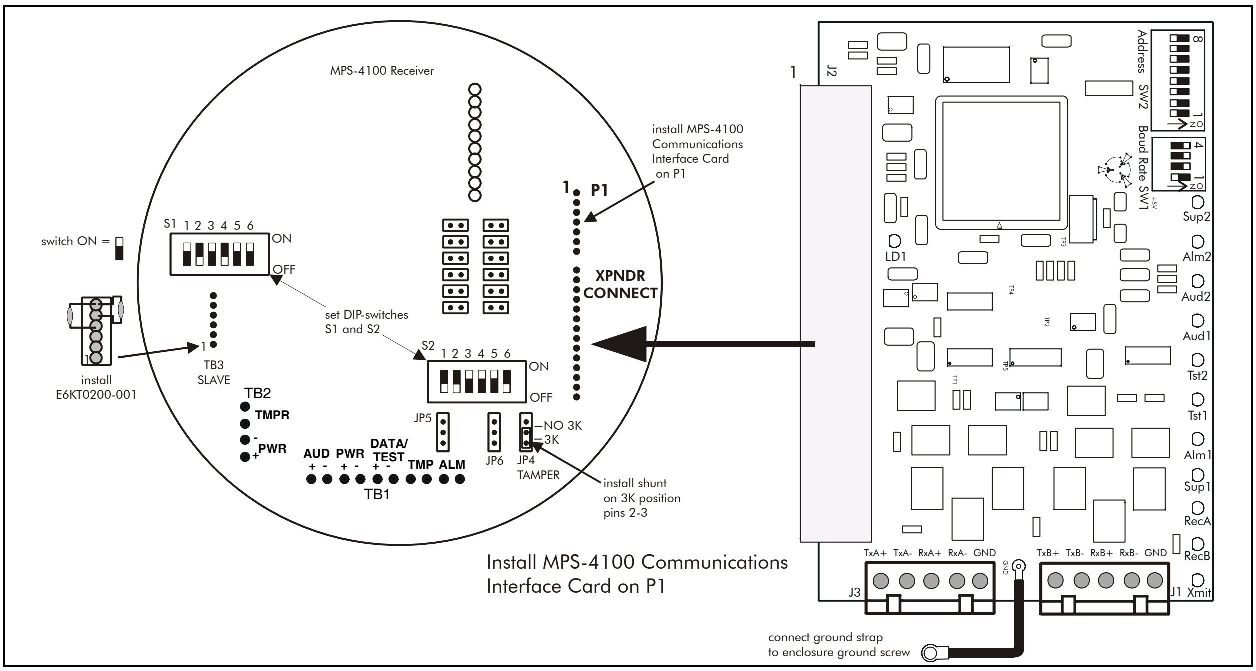


Figure b-5 Installing the Communication Interface Card

Labelling

Install the network device label P/N E6LS0400-001 on the back cover of the receiver housing as indicated in Figure b-6:

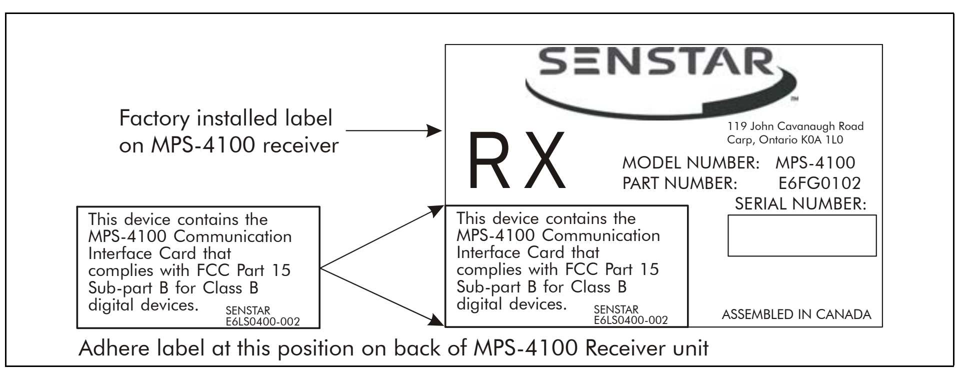


Figure b-6 Installing the FCC label

See Chapter 2 for details on setting up the receiver for network communications.