Sentrax®

S∞Trax™

TM100-1
Systems manual

SENSTAR®

A2DA0402-001, Rev B
First edition
March 8, 1996

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Patents

Canada No. 1214232, 1216340, 1332185
U.S. No. 4562428, 4987394, 5247270
U.K. No. 2120823, 2163580, 2165681
French No. 95587253
Other patents pending.
Patents also pending in other countries.

Approvals

USA: FCC Certification
FCC Identification Number: I5T-SENTRAXS-TRAX

This device complies with Part 15 of the FCC Rules. Operation is subject to the following 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.

Any changes or modifications not expressly approved by Senstar Corporation could void the user's authority to operate the equipment.

Canada: Industry and Science Canada Type Approval
Certification Number: 1454 101 685A
Certification Certificate Number: 5891A, 5892A

This device complies with RSS-210 of Industry and Science Canada. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Dok.-Nr.: VIM9-17/96
Datum: 30.1.1996

CE

EG-Konformitätserklärung

Als Hersteller erklären wir hiermit, daß unser Produkt

S-TRAX,
bestehend aus:
Control Module, Teilekennzeichen CM100-xx,
max. 16 Transceiver Modules, Teilekennzeichen TM100-xx,
Sensorkabel TR1

auf Grund seiner Konzeption und Bauart sowie in der von uns in den Verkehr gebrachten Ausführung mit den Vorschriften folgender europäischer Richtlinien übereinstimmt:

73/23/EWG Niederspannungsrichtlinie
geändert durch 93/68/EWG

nachgewiesen durch die Einhaltung folgender Normen:
- harmonisierte europäische Normen (mit Ausgabedatum):
  EN 60950:1992 + A1:1993 + A2:1993

89/336/EWG EMV-Richtlinie
geändert durch 91/263/EWG
92/31/EWG

nachgewiesen durch die Einhaltung folgender Normen:
- harmonisierte europäische Normen (mit Ausgabedatum):
  EN 55022:1994, Grenzwertklasse B
  ENV 50140:1993, 80...1000 MHz: 3 V/m, Ampl.-mod. 80%, 400 Hz
  ENV 50141:1993, 0,15...80 MHz: 3 V
  EN 60801-2:1993, Schärfegrad 3
- nationale Normen (mit Ausgabedatum):
  E DIN VDE 0843 T.4: 9.87 = draft IEC 801-4, ± 2 kV (Netzleitung)
  ± 1 kV (Signalleitg.)
- IEC-Publikationen (mit Ausgabedatum):
  draft IEC 1000-4-5: 2.95, ± 2 kV: common mode (10 Pulse)
  ± 1 kV: differential mode (10 Pulse)
  draft IEC 1000-4-11: 6.94

Anbringung der CE-Kennzeichnung: **1996**

Prüfberichte: VFL021-VDE-21-94; VIA43T-77/95

Dornier GmbH
Produktbereich Informations- und Kommunikationssysteme
D-88039 Friedrichshafen

i.V. B. Hübsch, Leiter der Qualitätssicherung

i.A. M. von Sarnowski, QS-Fachgebietsbeauftragter

Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, bedeutet jedoch keine Zusicherung von Eigenschaften. Die Sicherheitshinweise der mitgelieferten Produktdokumentation sind zu beachten.

09.01/01.95

DK

EU-Konformitetserklæring

Vi erklærer hermed, at vårt produkt

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innehålder: **Control Module, CM100-xx,**
max. 16 Transceiver Modules, TM100-x,
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stämmer overens med

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E

Certificado de conformidad de la UE

Declaramos que este producto

S-TRAX

conteniendo: **Control Module, CM100-xx,**
max. 16 Transceiver Modules, TM100-x,
cable del sensor TR1

conforme a

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NL

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Certificat de conformité CE

Nous déclarons que notre produit

S-TRAX

contenant: **Control Module, CM100-xx,**
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câble senseur TR1

conforme avec

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EC Declaração de Conformidade

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GB

EC Declaration of Conformity

We declare that our product

S-TRAX

including: **Control Module, CM100-xx,**
max. 16 Transceiver Modules, TM100-x,
sensor cable TR1

conforms to

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EU-Konformitetsförklaring

Vi förklarar att vårt produkt

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I

Dichiarazione di conformità CE

Dichiariamo che nostro prodotto

S-TRAX

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SF

CE Keivoilisuusvakuutus

Vakuutamme että tuote

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sisältää: **Control Module, CM100-xx,**
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ovat

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mukaiset.

Dornier GmbH, Produktbereich Informations- und Kommunikationssysteme
D-88039 Friedrichshafen

i.V. B. Hübsch
Leiter der Qualitätssicherung

i.A. M. von Sarnowski
QS-Fachgebietsbeauftragter

Dok.-Nr.: VIM9-17/96
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Anbringung der CE-Kennzeichnung:	**1996**

Prüfberichte: VFL021-VDE-21-94; VIA43T-76/95

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D-88039 Friedrichshafen

i.V. [signature] i.A. [signature]

i.V. B. Hübsch, Leiter der Qualitätssicherung — i.A. M. von Sarnowski, QS-Fachgebietsbeauftragter

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9 09.01/01.95

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E

Certificado de conformidad de la UE

Declaramos que este producto

SENTRAX

conteniendo: **Control Module, CM100-xx,**
max. 16 Transceiver Modules, TM100-x,
cable del sensor

conforme a

73/23/EEC EN 60950:1992 + A1:1993 + A2:1993

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GB

EC Declaration of Conformity

We declare that our product

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including: **Control Module, CM100-xx,**
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sensor cable

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Dok.-Nr.: VIM9-18/96
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Related publications

Sentrax®/S∞Trax™ Site Planning Guide (A2DA0302): Describes Sentrax and S∞Trax system features, operation, components and applications. It also provides information regarding the design, planning, and ordering of Sentrax and S∞Trax systems.

Sentrax®/S∞Trax™ Buried cable systems Installation Guide (A2DA0102): Provides instructions for installing Sentrax and S∞Trax sensor cables and fittings, TM100-1, TM100-2, TM100-3, and TM100-4 Transceiver Modules and the DM100-4 Data Module.

Sentrax®/S∞Trax™ Network systems Manual (A2DA0202): Provides instructions for calibrating and maintaining Sentrax and S∞Trax systems that use the TM100-2, TM100-3 and TM100-4 Transceiver Modules and the DM100-4 Data Module. Information on system setup, testing, system reports, diagnostics, and troubleshooting is also found in this manual.

Sentrax®/S∞Trax™ TM100-1 systems Manual (A2DA0402): Provides instructions on calibrating and maintaining systems that use the TM100-1 Transceiver Module. Troubleshooting charts and maintenance procedures are also found in this manual.

Table of contents

System troubleshooting

Removal and replacement of Transceiver Module

System description

The Sentrax®/S∞Trax™ systems

The Sentrax® and S∞Trax™ systems are high-security perimeter intrusion detection systems that can detect the presence of intruders within the detection field formed around buried cables. The Sentrax system uses two cables buried in parallel around the site to be protected, while the S∞Trax system uses a single buried cable. Both types of cables carry radio-frequency (rf) signals to create an invisible electromagnetic detection field around the perimeter of the site.

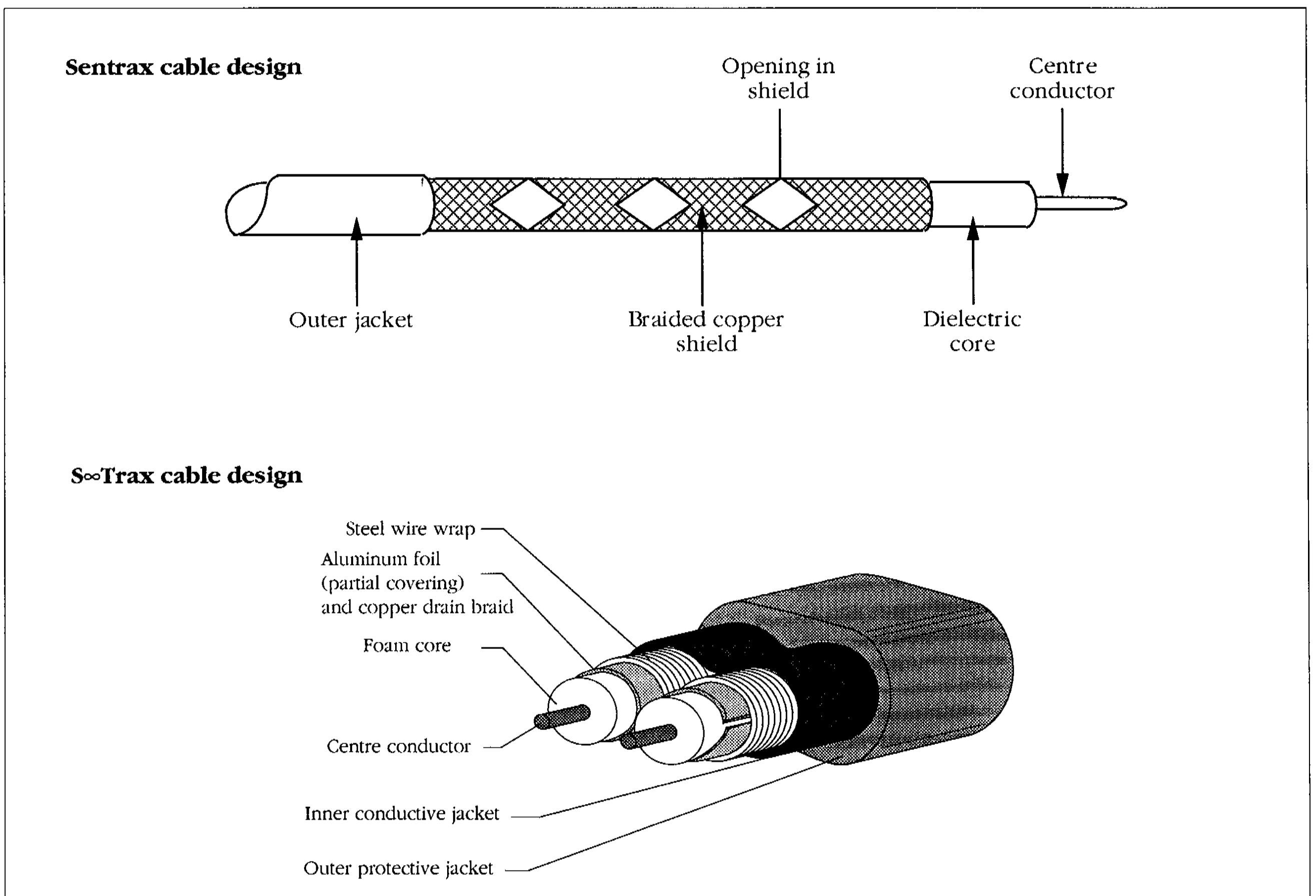
The Transceiver Module and buried cables make up the sensor component of the system. Transceiver Modules are installed in enclosures along the perimeter. Buried cables are connected to the front panel of each Transceiver Module. The cables create a continuous field of detection around the perimeter.

Theory of operation

Coaxial cables

The Sentrax/S∞Trax systems are based on ported ('leaky') coaxial-cable technology.

On the outside, the sensor cables appear identical to standard coaxial transmission cables. Standard coaxial cables have a layer of braided wire to contain the signals within the cable. However, Sentrax/S∞Trax coaxial cables are designed to permit rf signals to leak through openings in the copper shield (see figure below). The signals that leak through the openings form the electromagnetic detection field outside the cable. If another ported cable is placed within the detection field, an rf current is induced in its centre conductor, because the signals pass through the openings in its shield.

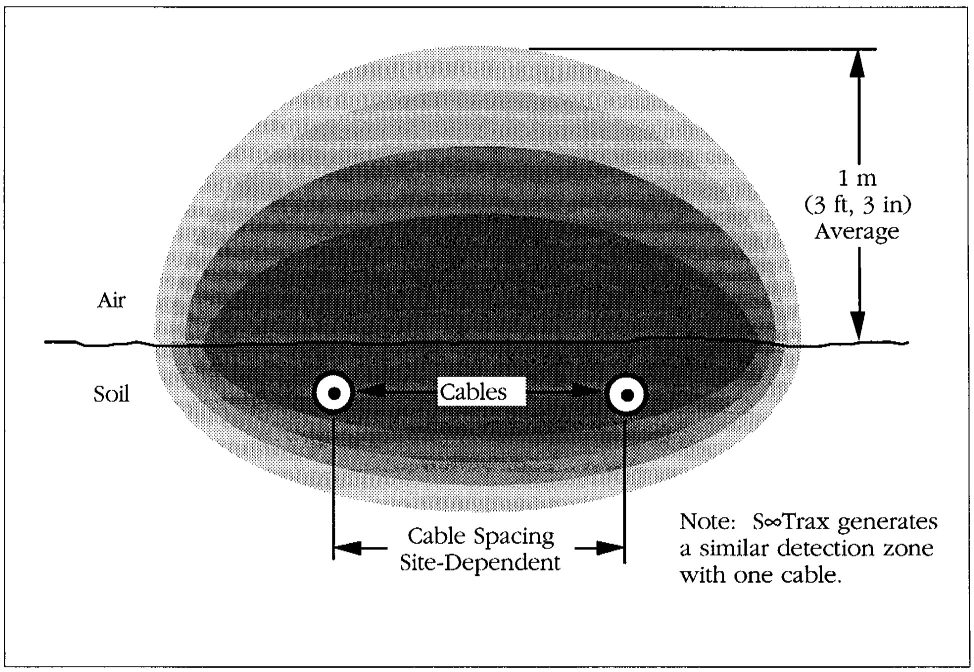


Leaky coaxial cable

The Sentrax system uses two cables (one transmit, one receive) buried in parallel around the site perimeter. The S∞Trax system uses a single, twin-coaxial cable with one transmit side and one receive side, housed in a protective outer jacket.

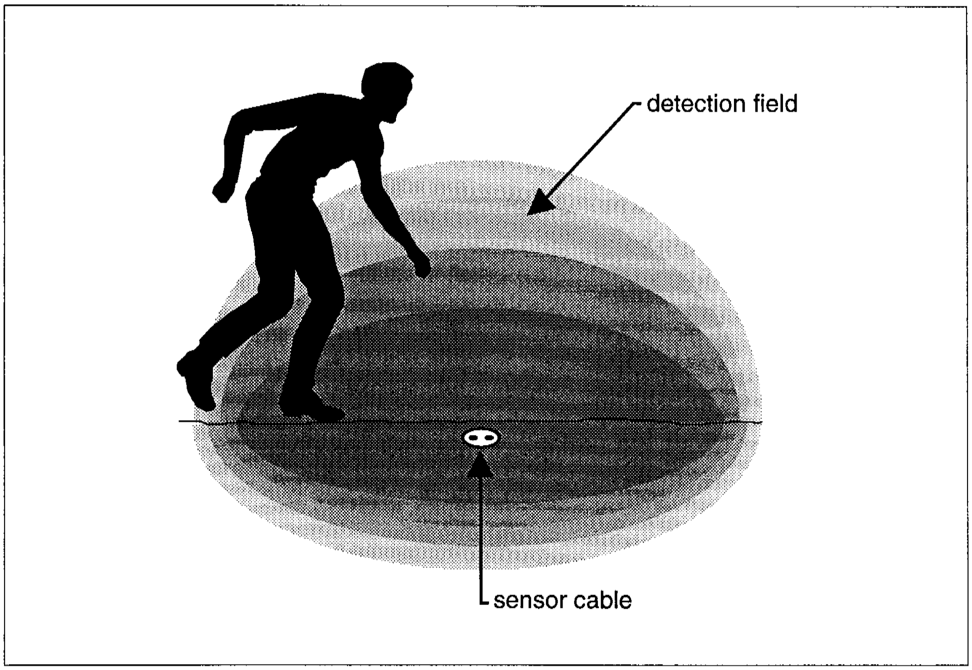
How the detection field is formed

The Transceiver Module generates an rf signal in the transmit cable, (or the transmit side of the cable for the S∞Trax system). The signal travels along the length of the cable and ends at a terminating device called a decoupler. The incomplete shield in the leaky coaxial cable allows the rf signal to form the detection field along the path of the cable(s). The detection field is bound to the air-ground interface and follows the sensor cables around corners and up and down hills.



Sentrax detection zone cross-section

If there are no disturbances in the detection field, the signal induced on the receive cable, (or the receive side of the cable for the S∞Trax system), remains stable, with a fixed amplitude and phase, compared to the transmit signal. An intruder entering the detection field causes a disturbance that results in a change to the signal on the receive cable. This change appears as a small variation in the amplitude and/or phase of the return signal when compared with the transmitted signal. The Transceiver Module amplifies and filters this change, compares it with a threshold level, and signals an alarm if the change exceeds the alarm threshold.



S∞Trax detection zone cross-section

Note: The S∞Trax and Sentrax cable systems generate similar detection zones. Sentrax sample xones will be illustrated throughout this manual unless otherwise stated.

Factors affecting the detection field

The detection field's size depends on:

- cable burial depth
- burial medium
- threshold setting used on the Transceiver Module
- cable spacing (Sentrax only)

The detection field normally peaks in intensity at the centre line of the cable path. The field extends below the ground surface to provide detection of shallow tunnellers, and extends approximately 1 m (3 ft, 3 in) above the ground.

Variations in permittivity and conductivity of burial mediums can cause the detection field to vary in height and width along the cable length. However, if the correct installation procedures are followed and if thresholds are set correctly, there should be only slight variations in size in different burial mediums.

With Sentrax cables, increasing the cable spacing increases the size of the detection field. The maximum cable spacing for the Sentrax system is 2 m (6 ft, 7 in). Cable spacing must be uniform in each zone, but can be changed from zone to zone.

How intruders are detected

The Sentrax/S∞Trax system is sensitive to moving objects that have adequate physical size and electrical conductivity. The system does not detect objects such as wooden structures, blowing sand or non-metallic debris, snow, or ice. The human body is large enough and sufficiently conductive to cause a disturbance in the detection field. Small animals are sufficiently conductive but are not large enough, and are therefore ignored by the system.

The Transceiver Module analyzes the signal picked up on the receive cable (receive side) for changes only. A filter in the Transceiver Module ignores fixed signals and changes that occur very slowly. The target must move through the detection field at a sufficient speed to be detected. Objects moving faster than 8 m/sec (26 ft/sec) or slower than 2 cm/sec (3/4 in/sec) are ignored. Changes in environmental conditions are also ignored.

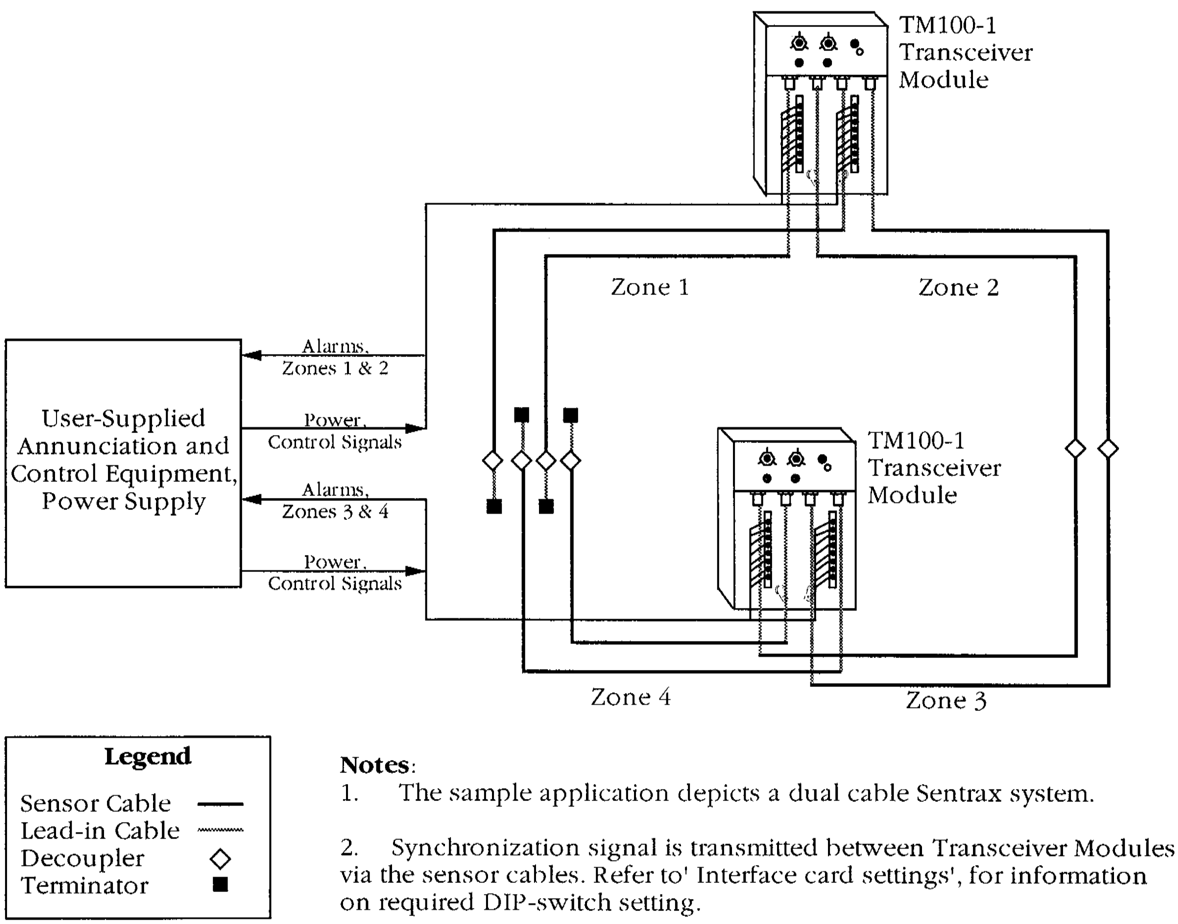
Radio frequency

The operating frequency used in the system maximizes sensitivity to human intruders but ignores crossings by small animals. An Industrial, Scientific, and Medical (ISM) band is used. Because the system produces very narrow-band rf transmissions, the possibility of interference with other devices is small. Portable communication devices are not generally allowed to use ISM bands.

Detection filters in the Transceiver Module reduce sensitivity to signals that are different than the Transceiver Module transmitter frequency. The Transceiver Module can trigger a jam alarm if interfering rf signals are detected.

Typical application

The TM100-1 Transceiver Module is connected to external alarm monitoring and control equipment via terminal connections on its front panel. You must supply 12 Vdc power to the Transceiver Module. Other front-panel terminal connections allow you, from a remote control panel, to reset the Transceiver Module electronics and initiate the self-test function. The figure below shows a typical configuration comprising two TM100-1 Transceiver Modules.

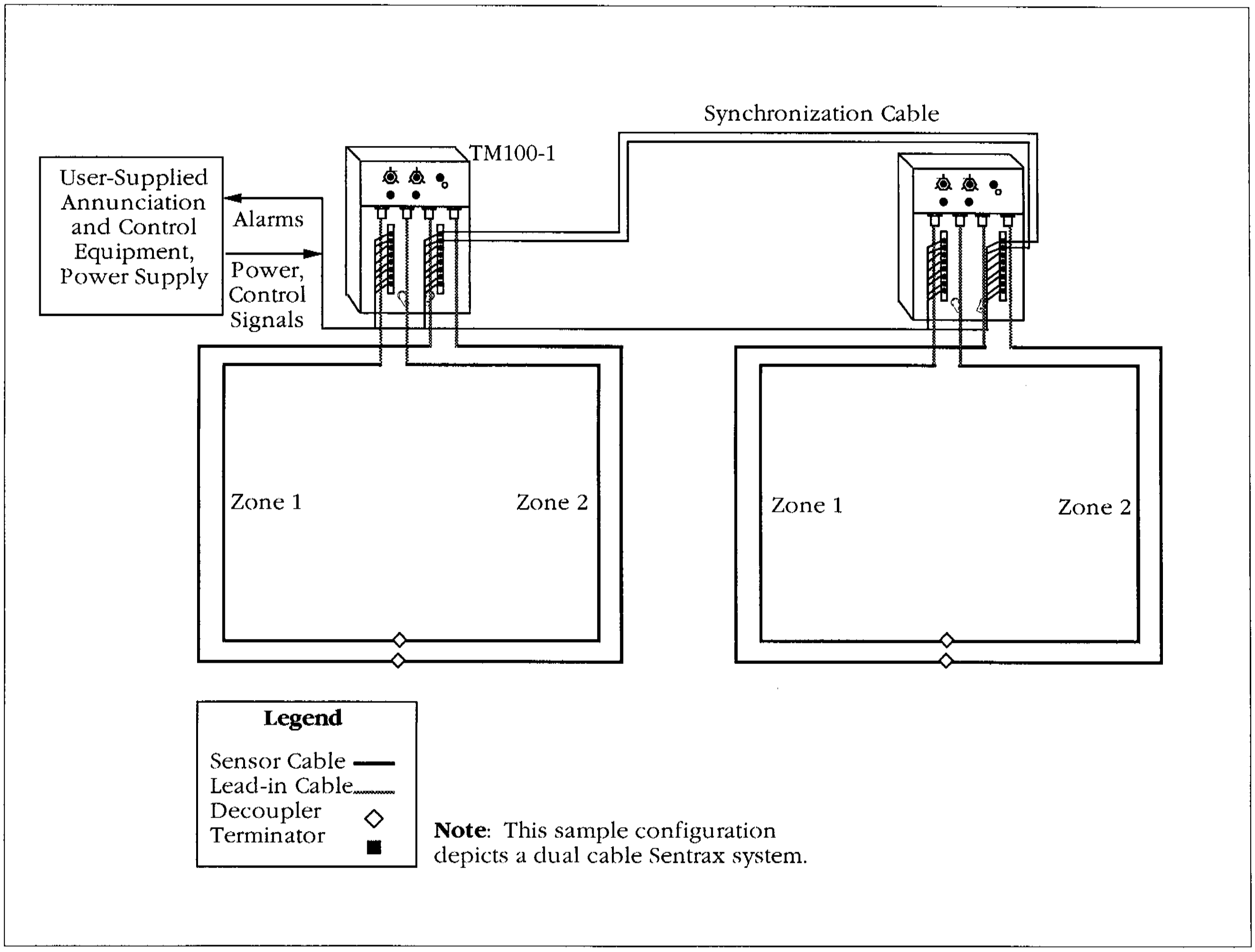


Notes:
1. The sample application depicts a dual cable Sentrax system.

2. Synchronization signal is transmitted between Transceiver Modules via the sensor cables. Refer to' Interface card settings', for information on required DIP-switch setting.

Typical application

This figure shows TM100-1 Transceiver Modules on separate perimeters.



Note: This sample configuration depicts a dual cable Sentrax system.

System checkout procedures

Introduction

Use the procedures given in this chapter to check out your Sentrax®/ S∞Trax™ system. Procedures are given for:

- checking the TM100-1 Transceiver Module settings
- checking connections to the front-panel terminals
- checking the Sentrax sensor cables
- applying power to the Transceiver Module

Each of the procedures is covered in detail in the sections that follow.

Required tools

- no. 1 Phillips screwdriver
- standard screwdriver
- needle-nose pliers
- digital multimeter

Main circuit card settings

The TM100-1 Transceiver Module has DIP switches and a jumper on the main circuit card that you must set to ensure proper operation. The DIP switches and jumper are located on the right-hand side of the unit.

DIP switches on the main circuit card enable you to set the following parameters:

- address number (1 through 16)
- detection frequency (F1, F2, or F3)
- detection velocity (there are two possible settings)
- annunciation of interfering rf signals (on or off)

An attenuation jumper on the main circuit card allows you to reduce the received detection signal. This jumper is left disconnected when shipped from the factory, but it can be connected if the detection signal is too strong. Instructions for changing this jumper are contained in, 'Adjusting sensitivity', p. 4-14.

A label affixed to the side of the Transceiver Module shows all possible DIP-switch and jumper settings. Make sure the settings are recorded on the **DIP-Switch and Jumper Settings** form that is kept in a plastic pocket at the Transceiver Module site.

Check the DIP-switch settings as explained in the following sections.

Address number

Each Transceiver Module must be assigned a unique address number between 1 and 16. Refer to your site plan to identify the address number of each Transceiver Module. Ensure that the correct address number is set on DIP switch SW1. Use the table below:

Address Number	DIP switch			
	SW1-1	SW1-2	SW1-3	SW1-4
1	closed	closed	closed	closed
2	closed	closed	closed	open
3	closed	closed	open	closed
4	closed	closed	open	open
5	closed	open	closed	closed
6	closed	open	closed	open
7	closed	open	open	closed
8	closed	open	open	open
9	open	closed	closed	closed
10	open	closed	closed	open
11	open	closed	open	closed
12	open	closed	open	open
13	open	open	closed	closed
14	open	open	closed	open
15	open	open	open	closed
16	open	open	open	open

DIP-switch SW1 settings

Detection frequency

The Transceiver Modules in a Sentrax/S∞Trax perimeter must use different radio frequencies to avoid electromagnetic interference between adjacent units. Each Transceiver Module can produce three different frequencies — F1, F2, and F3. Use F1 and F2 for every other Transceiver Module around the perimeter, i.e., use F1 for odd-numbered Transceiver Modules and F2 for even-numbered Transceiver Modules.

If you have a closed perimeter with an odd number of Transceiver Modules, use F3 for only the last Transceiver Module in the perimeter. Using F3 for the last Transceiver Module will prevent the interference that would be caused by having two adjacent units operating at F1.

Refer to your site plan to determine the frequency of each Transceiver Module. Use the table below to ensure that the correct frequency is set on DIP switches SW2-3 and SW2-4. (Interference between Transceiver Modules can result if the frequencies are set incorrectly.)

	DIP switch	
Frequency	**SW2-3**	**SW2-4**
F1	closed	open
F2	open	closed
F3	closed	closed
off	open	open

Detection frequency

If DIP switches SW2-3 and SW2-4 are both open, the detection field is switched off.

Detection velocity

When DIP switch SW2-2 is in the open position, the Transceiver Module can detect intruders crossing the detection field at speeds between 0.02 and 8 m/s (0.07 and 26 ft/s). If the DIP switch SW2-2 is set to the closed position, the Transceiver Module can detect intruders crossing the detection field at speeds between 0.04 and 8 m/s (0.14 and 26 ft/s). The closed setting reduces the possibility of nuisance alarms caused by rain and water draining through the detection field.

Ensure that DIP switch SW2-2 is set to give the desired result, according to the table below:

Detection velocity range	DIP Switch SW2-2
0.02 to 8 m/s	open
0.04 to 8 m/s	closed

Jam alarm annunciation

The Transceiver Module reports jam alarm conditions if interfering rf signals are detected. DIP switch SW2-1 controls the reporting of jam alarms. Check its setting according to the table below:

Jam alarm annunciation	DIP Switch SW2-1
Interfering rf signals that are strong enough to cause sensor alarms trip both sensor alarm and fail-alarm relays.	open
Interfering rf signals cause the sensor alarm but not the fail-alarm relays to trip.	closed

Interface card settings

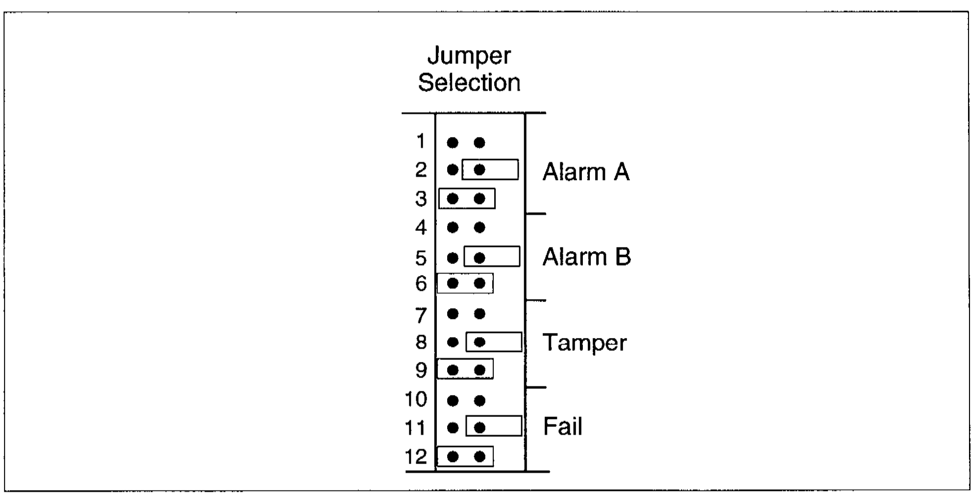
The TM100-1 Transceiver Module is equipped with an interface card that is located behind the terminal strips on the front panel. The interface card provides the following features:

- allows you to choose from normally open or normally closed contacts, with or without line supervision, for the output of sensor, tamper, and fail alarms
- allows you to select different alarm output formats
- detects a variety of fail conditions
- enables the TM100-1 Transceiver Module to be synchronized with other TM100-1 Transceiver Modules

The DIP switches and jumpers located on the right-hand side of the Transceiver Module let you select the various features. Check that the interface card DIP switches and jumpers are set as explained in the following sections.

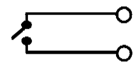
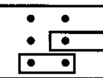
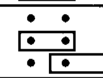
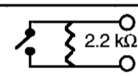
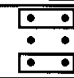
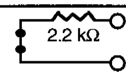
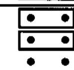
Alarm circuit configuration

The wiring of the alarm relays on the interface card can be altered to suit your requirements. For each type of alarm — alarm A, alarm B, tamper, and fail — you can select one of four alarm circuit configurations. Use the alarm circuit configuration that will work with your alarm annunciation equipment.



Interface card jumper block

The alarm circuits are controlled by the setting of jumpers on the interface card. The table below indicates the alarm circuit configurations and jumper settings that support them. Any jumper setting shown in the table can be applied to any alarm type. That is, you can use any one of the four jumper settings shown to assign a circuit configuration to alarm A, alarm B, tamper, and fail alarms. Check that the jumpers are set to the desired positions.

Circuit Configuration		Internal Wiring Configuration	Required Jumper Setting
Alarm Relay Contacts	Line Supervision		
normally open	none		
normally closed	none		
normally open	yes*		
normally closed	yes*		

* These settings connect a 2.2 kΩ resistor (factory-installed on the interface card) to the front-panel terminals.

Jumper settings

Alarm output format

A sensor alarm activates internal relays that are connected to terminals 1 through 4 on the front panel. DIP switch SW3-1 lets you select the output format for alarms in zones A and B. When DIP switch SW3-1 is open (the default setting), an intrusion in zone A activates alarm-A terminals (1 and 2), while an intrusion in zone B activates alarm-B terminals (3 and 4).

If DIP switch SW3-1 is closed, an intrusion in either zone A or zone B activates both the A- and B- alarm terminals simultaneously. This means that an intrusion anywhere in the Transceiver Module's detection field will output simultaneously on both sets of alarm terminals. You can use the closed setting if there is only a single input for both zones on your alarm panel.

Ensure that DIP switch SW3-1 is set correctly:

Alarm output format	Switch SW3-1
Alarms in zone A and B are annunciated separately.	open
Alarms in either zone A or zone B are annunciated on both A- and B-alarm terminals simultaneously.	closed

Alarm contact action

As stated previously, an alarm in zone A or B activates internal relays that are connected to terminals 1 through 4 on the front panel. DIP switches SW3-2 and SW3-3 allow you to select one of three alarm contact actions. The actions are:

1. Alarm contacts are activated continuously for the duration of the alarm.

2. Alarm contacts are activated for 150 ms ±50 ms when an alarm occurs. The contacts are reactivated only if the first alarm goes away and another alarm occurs.

3. Alarm contacts are activated for 150 ms ±50 ms when an alarm occurs. The contacts are activated repeatedly every 10 s ±3 s for the duration of the alarm.

The actions listed above apply only to zone A and B alarms, not to tamper and fail alarms. Select the action that is compatible with the data collection system or alarm annunciation equipment used in your system. Check that DIP switches SW3-2 and SW3-3 are set correctly, as outlined in the *DIP-switch settings for alarm contacts* table that follows.

DIP switch	Setting	Alarm contact action
SW3-2	open	Alarm-contact activation is pulsed according to the setting of DIP switch SW3-3.
SW3-2	closed	Alarm contacts are activated constantly for the duration of the alarm; the setting of SW3-3 does not matter.
SW3-3	open	If SW3-2 is open: When an alarm occurs, contacts are activated for 150 ms ±50 ms and are reactivated every 10 s ±3 s for the duration of the alarm.
SW3-3	closed	If SW3-2 is open: When an alarm occurs, contacts are activated for 150 ms ±50 ms and are reactivated only if another alarm occurs.

DIP-Switch settings for alarm contacts

Synchronization source

The following information applies if your installation has:

- more than one TM100-1 Transceiver Module connected by sensor cables, or
- separate Sentrax or S∞Trax perimeters located within 45 m (147 ft) of each other.

Transceiver Modules and multiple Sentrax/S∞Trax systems can be synchronized to eliminate the possibility of mutual interference.

Synchronization over the sensor cables

When multiple Transceiver Modules are connected via sensor cables and decouplers, the sensor cables can be used to synchronize all interconnected units. A maximum of 16 sequentially addressed Transceiver Modules, protecting a perimeter up to 4.8 km (3 mi) long, can be synchronized via interconnected Sentrax sensor cables, and a maximum of 8 sequentially addressed Transceiver Modules, protecting a perimeter up to 2.4 km (1 1/2 mi) long, can be synchronized via interconnected S∞Trax sensor cables.

When synchronizing multiple Transceiver Modules in this manner, you must ensure that:

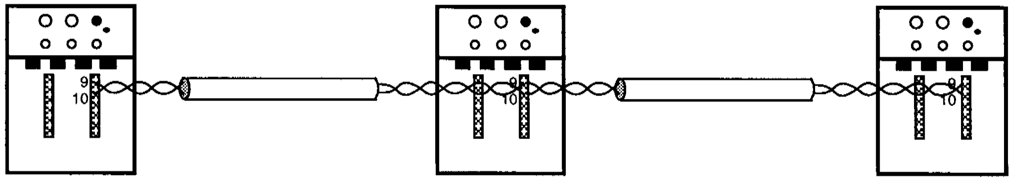
- each Transceiver Module's address number is set on DIP switch SW1. Address numbers must be set consecutively in each group of TM100-1's
- different frequencies are selected using DIP switches SW2-3 and SW2-4 on each adjacent Transceiver Module
- DIP switch SW3-4 is set in the open position on all Transceiver Modules
- DIP switch SW3-6 is set as specified in this application note
- no wires are connected to front-panel SYNC terminals 9 and 10
- sensor cables from the B side of one Transceiver Module are connected to sensor cables from the A side of the next Transceiver Module

DIP switch SW3-4 selects the synchronization source. The **open** setting enables synchronization via both the sensor cables and the front-panel SYNC terminals. The **closed** setting enables synchronization via the front-panel SYNC terminals only.

DIP switch SW3-6 selects a master/subordinate configuration for synchronizing adjacent units. This applies only if your site has more than 16 Transceiver Modules connected via Sentrax sensor cables, more than 8 Transceiver Modules connected via S∞Trax sensor cables, or separate standalone systems protecting adjacent perimeters. Leave DIP switch SW3-6 **open** unless you want the Transceiver Module to be a receive-only unit. If you want the unit to listen to, but not generate, synchronization signals, set DIP switch SW3-6 **closed**.

Synchronization via front-panel terminals

You can also synchronize TM100-1 Transceiver Modules so that interference does not occur when separate perimeters are located within 45 m (147 ft) of each other (see figure on page 1-7). In this case, a twisted-pair cable (minimum 22 AWG) connected between terminals 9 and 10, the SYNC terminals, on the front panels of adjacent Transceiver Modules carries synchronization signals between the adjacent perimeters.



Pin 9 to pin 9; pin 10 to pin 10.
Connect cable shield to ground (pin 10) at one end only.

Synchronization via front panel terminals

The following considerations must be ensured when synchronizing adjacent perimeters in this manner:

- terminal 9 must be connected to terminal 9, and terminal 10 to terminal 10
- the cable shield must be connected to ground (pin 10) at one end only
- DIP switch SW3-6 must be set open and on every Transceiver Module
- DIP switch SW3-4 must be closed on every Transceiver Module
- different frequencies must be selected on adjacent Transceiver Modules using DIP switches SW2-3 and SW2-4
- sensor cables must be set up so that cables from the B side of one Transceiver Module run beside cables from the A side of the next Transceiver Module

There is no limit on the number of standalone systems that can be synchronized in this manner. (Cable separation distances are listed in the **Sentrax/S∞Trax Site Planning Guide**, A2DA0302)

Synchronization of multiple groups of Transceiver Modules

If your site has more than 16 Transceiver Modules in a Sentrax perimeter, or more than 8 Transceiver Modules in an S∞Trax perimeter, they can be synchronized by using a combination of synchronization over sensor cables and synchronization via front panel terminals. The following points must be ensured:

- separate groups of up to 16 Transceiver Modules for a Sentrax perimeter, and 8 Transceiver Modules for an S∞Trax perimeter, can be synchronized via the sensor cables. Transceiver Modules in each group must be addressed (via DIP switch SW1) in consecutive order from 1 through 16 (or 8 for S∞Trax).

- at the end of one group and the start of an adjacent group the sensor cables can be overlapped, but not connected.

- the last Transceiver Module in a group, and the first Transceiver Module in the next (or subsequent) group can be synchronized via the front-panel SYNC terminals.

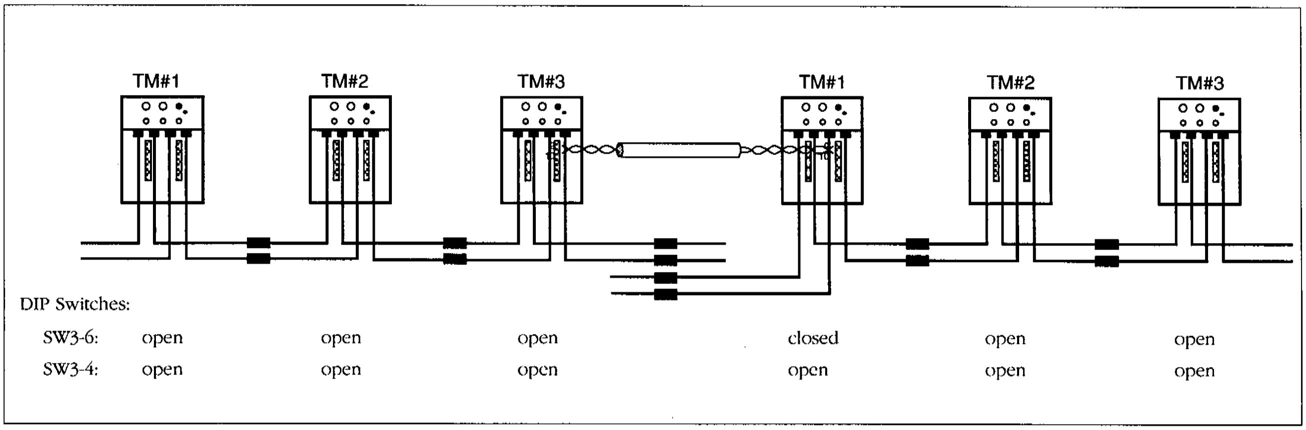
- the first Transceiver Module in the next and subsequent groups must be made a 'receive only' unit. On these units, set DIP switch SW3-6 to **closed**. Set DIP switch SW3-6 open on all other Transceiver Modules. Setting DIP switch SW3-6 closed on the first unit in all groups (except for the first one) enables such units to receive but not to generate synchronization signals.

- when starting up the Transceiver Modules, apply power first to the first Transceiver Module in the second and subsequent groups. Then apply power to the remaining units in each group.

- select different frequencies on adjacent Transceiver Modules using DIP switches SW2-3 and SW2-4.

- make sure that sensor cables from the B side of each Transceiver Module are connected to sensor cables from the A side of the next Transceiver Module.

- DIP switch SW3-4 must be **open** on every Transceiver Module.



Synchronization of multiple groups of Transceiver Modules

Cable-fault detection

The Transceiver Module will annunciate a fail alarm when a cable-open or cable-short condition occurs if DIP switch SW3-5 is open and the system is installed with DC4-1 decouplers. If SW3-5 is closed, cable-fault detection is disabled. Cable-fault detection must be disabled if non-supervised DC2-1 decouplers are used.

Set DIP switch SW3-5 to the desired position:

Switch SW3-5	Cable-fault detection
open	Cable open or short causes a fail alarm (DC4-1 decouplers are required).
closed	Cable open or short does not cause a fail alarm.

Cable tests

Before applying power to the system, check the cables by performing the following tests:

- leakage resistance test
- cable integrity test
- test-target resistance test

Repair and installation procedures

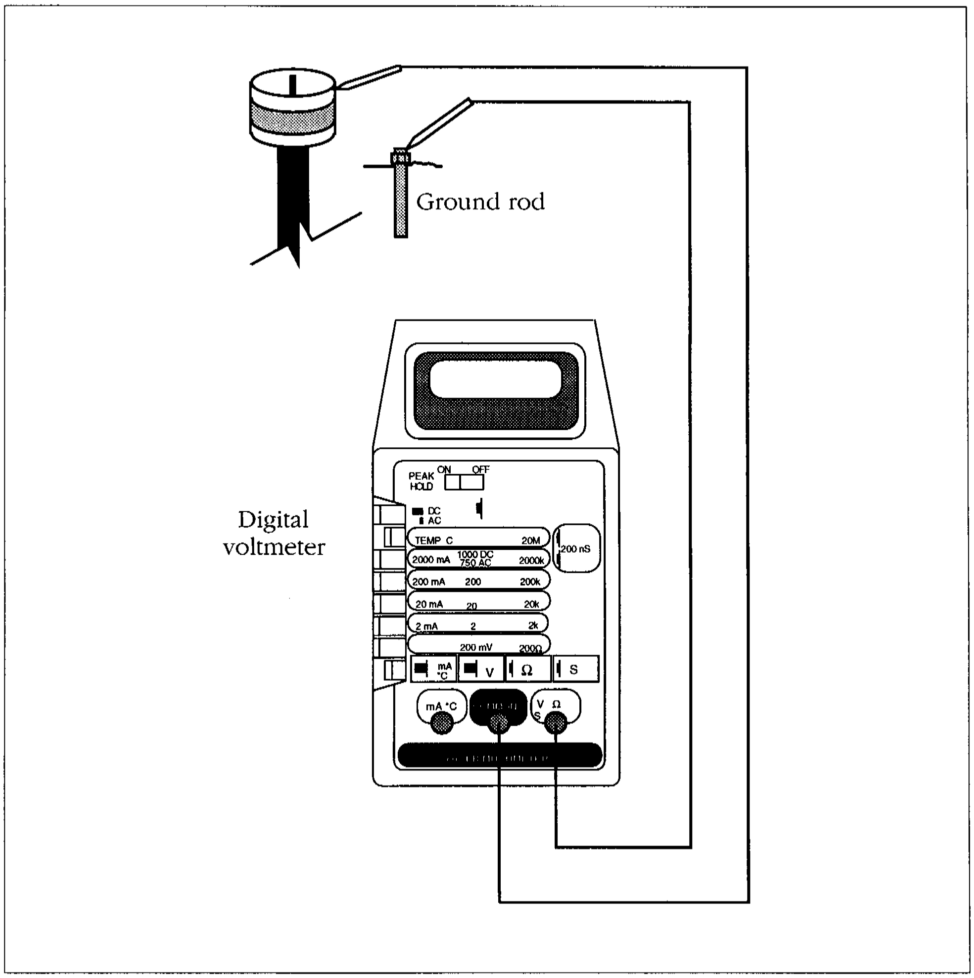
If the tests reveal any cable faults, refer to the **Buried cable systems Installation Guide** (A2DA0102) for instructions on repairing damaged sensor or test-target cable, and for instructions on installating connectors and decouplers.

Required tools

- digital multimeter

CAUTION

Do not use any high-voltage cable-leakage testers ("meggers") on the sensor cables unless decouplers, terminators, and Transceiver Modules have first been disconnected. These units contain components that can operate at voltages greater than 150 Vdc.



Leakage resistance test

Leakage resistance test

To perform the leakage resistance test, follow the steps outlined below:

1. Disconnect one end of the lead-in portion of the cable to be tested from the Transceiver Module. Disconnect the opposite end of the cable from the second Transceiver Module. If the cable is connected to a second cable through a decoupler, disconnect the cable from the decoupler by removing the heat shrink, (or the mastic tape in the case of the S∞Trax cable), from the decoupler and then disconnecting the cable connector from the decoupler. Let the connectors hang in mid-air during this test.

CAUTION

During the test do not let the connectors touch anything that is grounded.

Note: The black jacket material on the S∞Trax cable is electrically conductive. To obtain accurate measurements, ensure that the material does not come in contact with any metal surfaces.

2. Set the multimeter to a high-resistance ohmmeter function.

3. Measure the resistance between the outer shell of a connector and earth ground (a wire connected to an installed ground rod). The resistance should be more than 20 MΩ. Resistance less than 20 MΩ indicates there is leakage, which can be caused by a break in the cable jacket or faulty heatshrinking. You must locate and repair the cable ground fault.

4. Set the multimeter to the millivolt scale. Measure the voltage between the connector shell and ground. A reading in excess of ±10 mV indicates that electrolysis is occurring between the outer conductor and ground through a damaged cable or improperly installed heatshrink tubing. You must repair the cable.

5. Repeat the test for the other sensor cables.

Note: It is normal to find a low resistance between the connector and the outer shell of the two cables in an S∞Trax configuration.

Cable integrity test

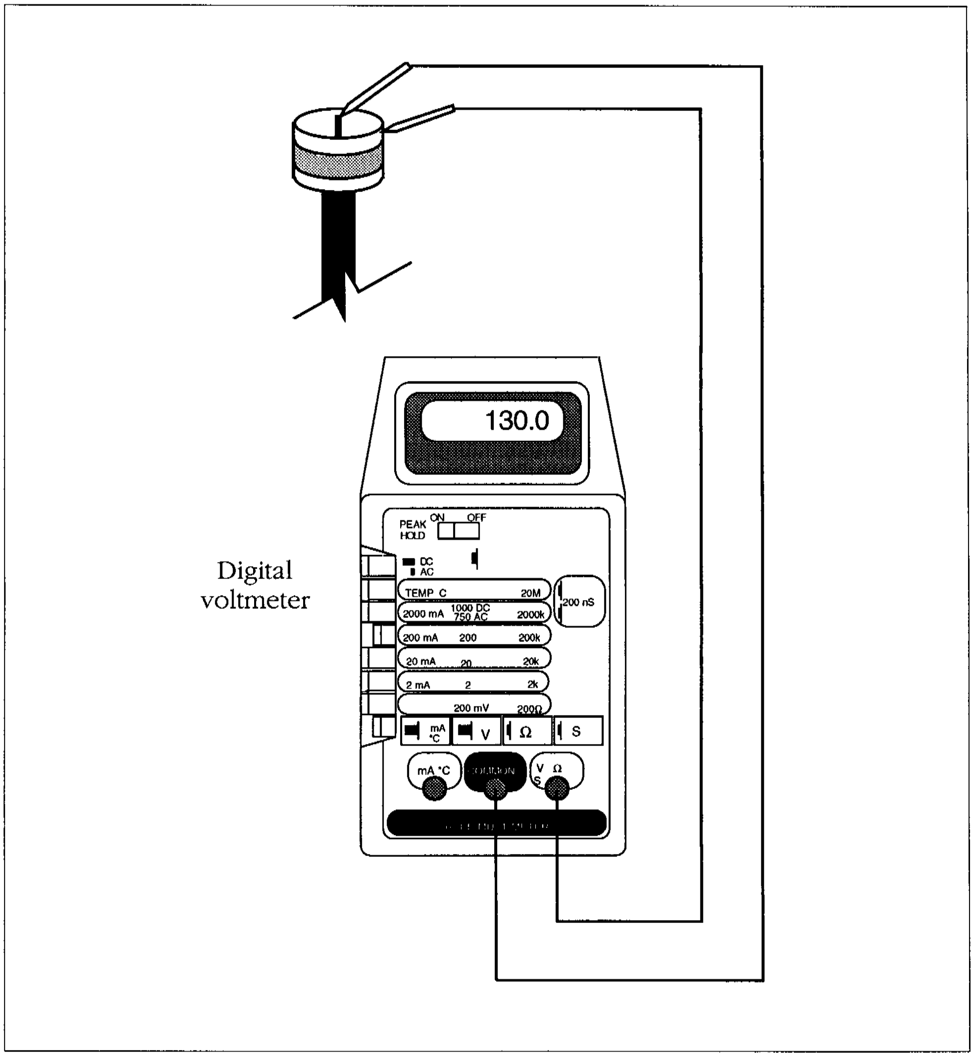
To perform the cable integrity test, follow the steps outlined below:

1. If the lead-in cables are connected to the Transceiver Module front panel, disconnect them by unscrewing the connectors.

CAUTION

Do not let anything touch the connector at the other end of the cable during this test. Do not touch the meter leads when you are taking the measurement.

Note: The black jacket material on the S∞Trax cable is electrically conductive. To obtain accurate measurements, ensure that the material does not come in contact with any metal surfaces.



Cable integrity test

2. Set the multimeter to a high-resistance ohmmeter function.

3. Measure the resistance between the centre conductor and the outer shell of a cable connector. If the resistance is other than 130 kΩ ±2.6 kΩ, the cable might be damaged. This could be the result of corrosion or a nick; if this is the case, the cable must be repaired. The problem could also be caused by a faulty decoupler; the decoupler must be replaced.

4. Set the multimeter to the millivolt scale. Measure the voltage between the centre conductor and the connector shell. A reading in excess of ±10 mV indicates that electrolysis is occurring within the cable. Electrolysis indicates corrosion due to a faulty connector, a defective decoupler, or a damaged cable. You must repair the cable.

5. Repeat the test for the other sensor cables.

Test-target resistance test

To test for leakage on test-target cables, follow the steps outlined below:

1. If the test-target cables are connected to the Transceiver Module front panel, disconnect them.

> **CAUTION**
>
> During the testing do not let the connectors touch anything that is grounded.

2. Set the multimeter to a high-resistance ohmmeter function.

3. Measure the resistance between the outer shell of a connector and earth ground (a wire connected to an installed ground rod). Then measure the resistance between the outer shell and the centre conductor. The resistance should be more than 20 MΩ in both cases. Resistance less than 20 MΩ indicates there is leakage between the cable jacket and ground. Leakage is usually caused by a nick in the cable jacket. The cable must be repaired.

4. Set the multimeter to the millivolt scale. Measure the voltage between the connector shell and ground. A reading in excess of ±10 mV indicates that electrolysis is occurring between the outer conductor and ground through a damaged cable or improperly installed heatshrink tubing. You must repair the cable.

5. Repeat the test for all other test-target cables.

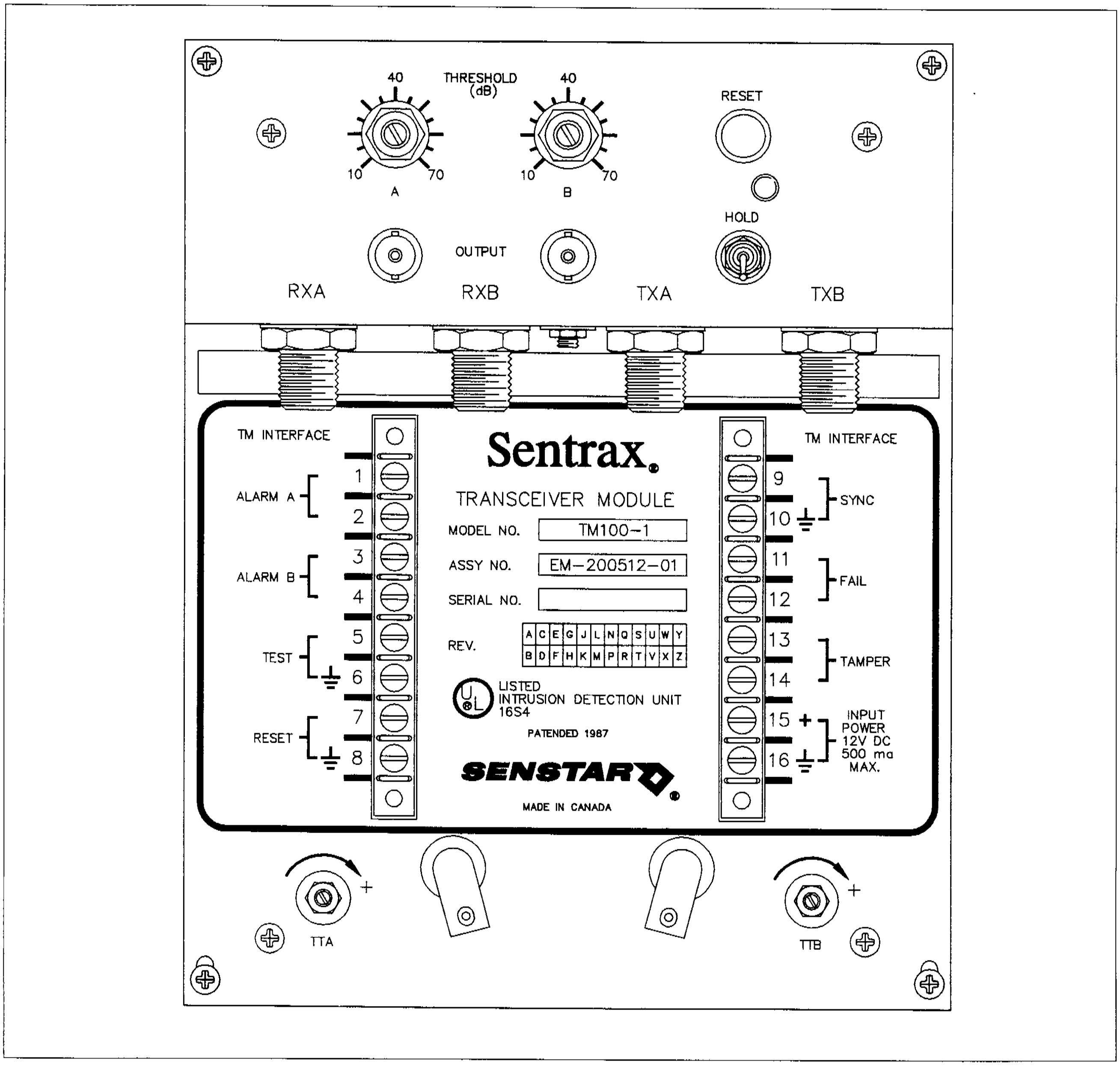
Connections to external equipment

Connect wires from your alarm annunciation equipment to front-panel terminals 1 through 4 on the Transceiver Module front panel. If you are using an external test function, connect wires from an external switch to terminals 5 and 6. If you are using an external reset function, connect wires from an external switch to terminals 7 and 8.

If you are synchronizing the Transceiver Module via an external cable with other Transceiver Module(s) whose perimeters are within 45 m (147 ft), connect the synchronization cable to terminals 9 and 10. The cable must have the following characteristics:

- shielded twisted pair, 0.336 mm^2 (22 AWG) minimum
- maximum length of 450 m (1,476 ft)

Note: Terminal 9 must be connected to terminal 9, and terminal 10 to terminal 10. The shield of the synchronization cable must be connected to ground (pin 10) at one end only. If the cable is not grounded, the Transceiver Modules will not operate properly.



TM100-1 Transceiver Module front panel

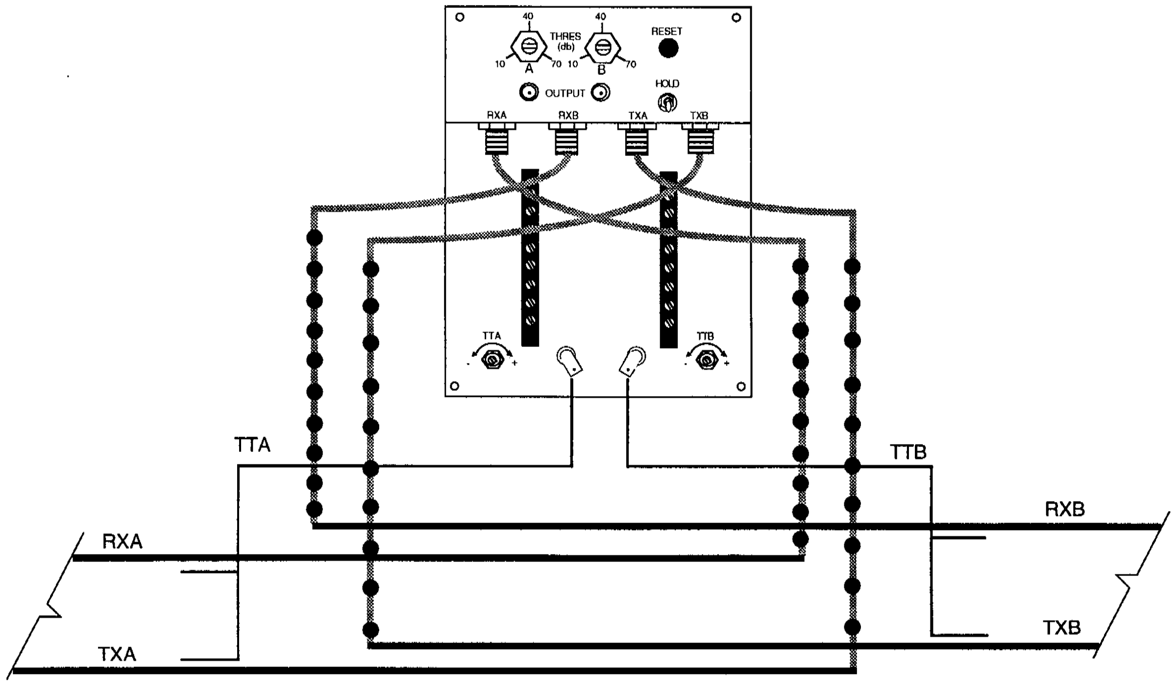
Testing the ground connection

Each Transceiver Module should be connected to earth ground for electrical safety and for protection from lightning. Ensure that the ground wire is connected to a ground lug which is attached to one of the four corner screws that holds the Transceiver Module in the enclosure.

If you are installing the Transceiver Module in an area where it is hard to get a good ground resistance, install a longer ground rod or more ground rods if necessary to achieve a low resistance.

Cable connections

Connect the sensor cables to the Transceiver Module front panel as shown:



Legend

- Sensor Cable
- Lead-in Cable
- Ferrite Beads
- Test-Target Cable

Note: This sample configuration depicts a dual cable Sentrax system.

Connecting cables to Transceiver Module

If the Transceiver Module monitors only one zone, ensure that decouplers are connected (via a short piece of lead-in cable) to the TX and RX sensor-cable connectors of the unused zone, and that the terminators are connected after the decouplers.

Power-up procedure

Follow the procedures below to perform a start-up test on the Sentrax/ S∞Trax system:

1. Fasten the Transceiver Module to its enclosure by tightening the four Phillips-head screws in the corners.

2. Ensure that sensor cables are connected to the front-panel connectors.

3. Supply 12 Vdc power to the Transceiver Module. Wait for one minute.

   If you are starting Transceiver Modules in multiple standalone systems, apply power first to the first unit in the second and subsequent groups. Then apply power to the remaining units in each group.

4. Momentarily connect terminals 5 and 6 on the Transceiver Module front panel to each other. This activates the self-test function. A- and B-alarms should appear on your alarm annunciation equipment.

5. Follow the procedures in chapter 3, **Test procedures**.

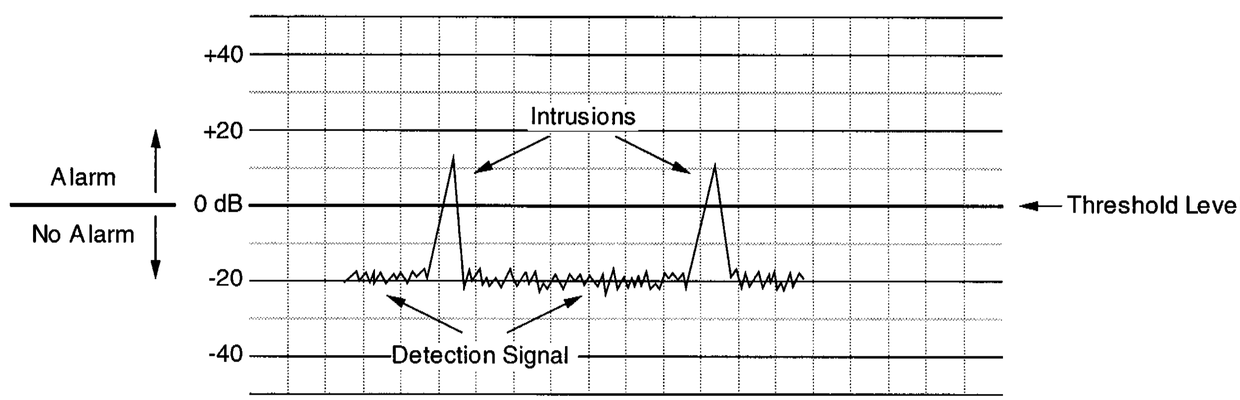
Test procedures

Introduction

Before you can calibrate or troubleshoot the system, you must understand the following concepts:

- detection signal
- threshold value
- clutter level

This chapter explains what the various signals are and explains how to measure them from the Transceiver Module analog output connectors.



Relationship between detection signal and alarm conditions

Detection signal

The detection signal corresponds to the amount of disturbance caused by intruders in the detection field. The signal can vary from a low level (background noise) to a high level (intrusion condition). The Transceiver Module constantly analyzes the detection signal in the zones it monitors. The detection signal for each zone can be measured from the Transceiver Module that is associated with that zone.

Threshold value

The threshold value determines the level the detection signal must exceed for an alarm condition to occur. You set this value independently for each zone using the Transceiver Module's threshold adjustment controls.

When the detection signal is below the threshold value, no alarm is generated. But if the detection signal rises above the threshold, an alarm is signalled. The system's sensitivity is determined solely by the threshold setting; lowering the threshold setting will make the system more sensitive and raising it will make the system less sensitive.

Clutter level

Clutter refers to the signal present on the receive cable when there are no intruders in the detection field. Any stationary or slow-moving objects in the detection field will have an impact on the clutter level, but the Transceiver Module will filter out their effects in the received signal. The clutter level varies from zone to zone depending on the number and size of fixed objects in the detection field, soil conditions, and the spacing of the cables in the case of Sentrax cables.

Using this chapter

The instructions in this chapter will enable you to test the system to determine the various output readings. You can then use these procedures to calibrate the system.

A table at the end of this chapter summarizes the switch settings required to obtain the various test signals.

Setting up the equipment

Required equipment

- a digital multimeter
- a chart recorder capable of measuring a voltage in the range of -2.5 Vdc to +2.5 Vdc at a speed of about 25 mm (1 in) per minute

If possible, use a chart recorder when measuring the detection signal. This will provide a permanent record of the detection signal throughout the zone over time.

The following chart recorders are recommended:

- Astro-Med Dash II dual-channel recorder
- Gould model 220 dual-channel recorder
- Graphtec model WR7500-2 dual-channel recorder
- Hioki model 8201 single-channel recorder
- Linseis LM23-20-20 dual-channel recorder

A dual-channel chart recorder has some advantages over a single-channel recorder:

- check for overlapping detection fields in a continuous perimeter
- observe the detection signal in two zones simultaneously

Setting up a multimeter

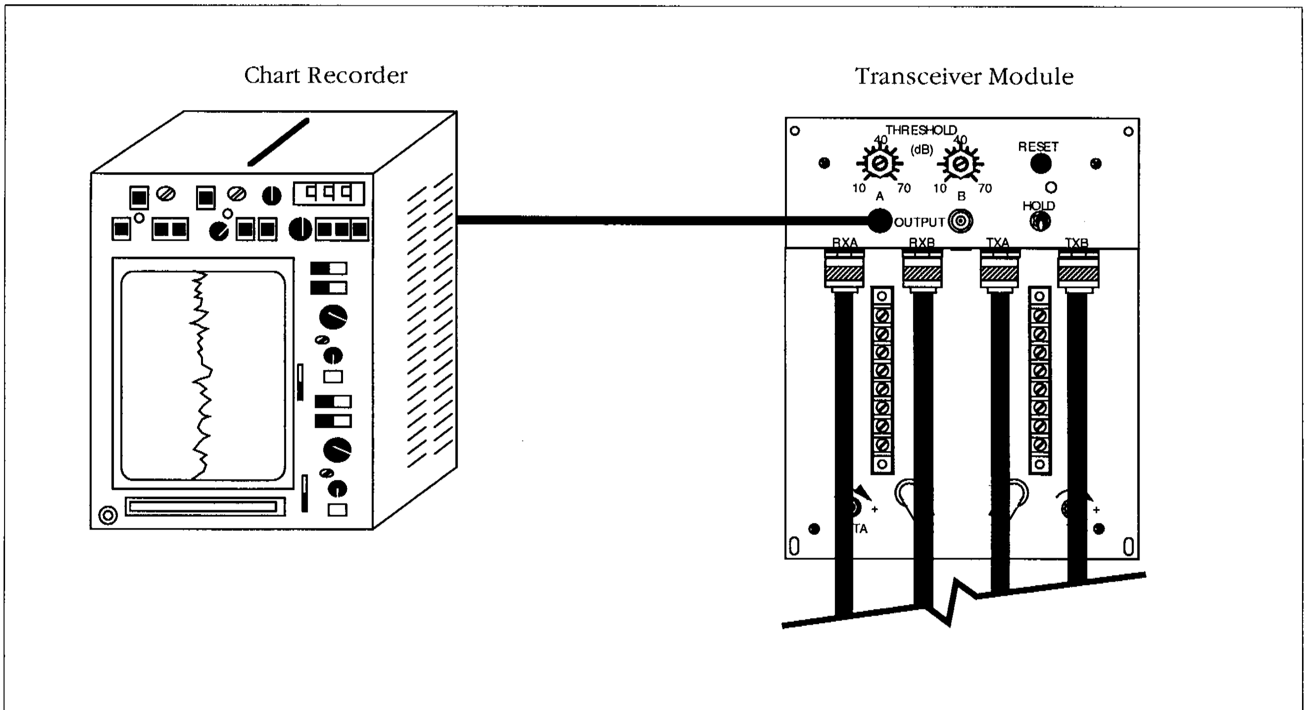
Use a multimeter to check Transceiver Module output voltages. Connect the multimeter leads to the analog output connector(s) of the zone(s) you want to test. Follow the instructions under 'Setting Up a Chart Recorder', p. 3-4 to obtain:

- 0 and 1 Vdc reference voltages
- ramp output

Setting up a chart recorder

1. Connect the chart recorder leads to the analog output connector(s) of the zone(s) you want to test (see the following figure).

2. Apply power to the chart recorder. Set the chart speed to 25 mm/min (1 in/min).

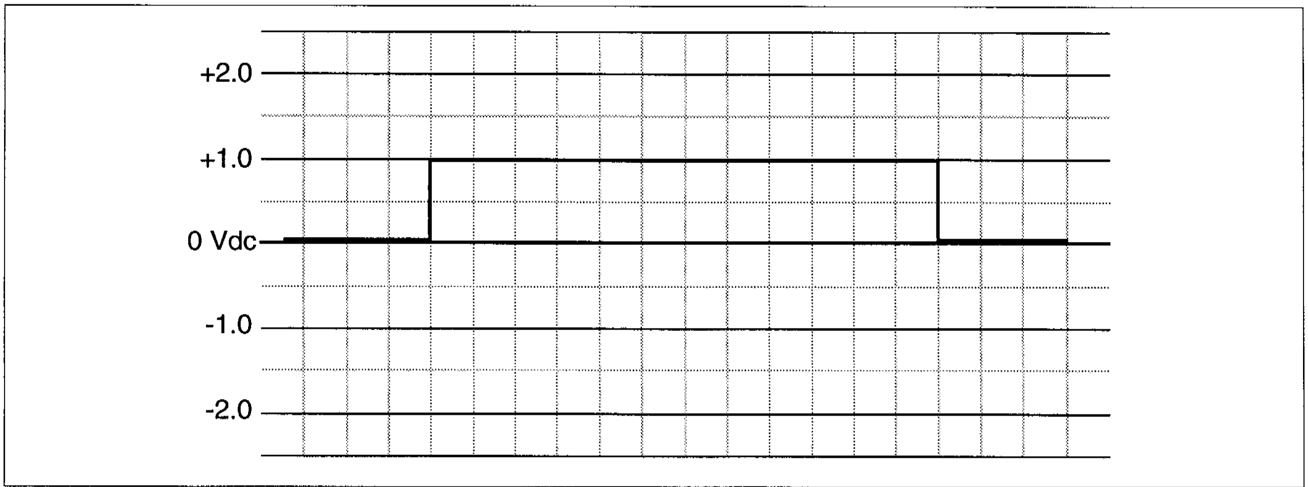


Connecting the chart recorder to the Transceiver Module

3. The Transceiver Module can generate 0 V and 1 V outputs. To obtain the 0 V output:

   a. set the HOLD switch to the up position
   b. press the RESET switch (do not release it)
   c. close the tamper switch (do not release it)

The chart recorder should show a reading of 0 V on the centre line of the chart paper. If it doesn't, adjust the chart recorder's offset or centring control until a reading of 0 V is obtained.



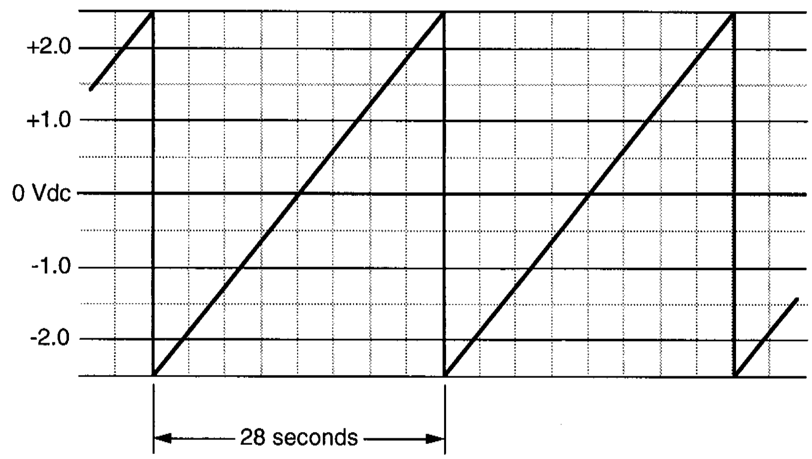
0 and 1 V reference voltages

While leaving the other switches in the 0V output setting, change the HOLD switch to the down position. The chart recorder should now show a reading of 1 V. Adjust the chart recorder's gain or sensitivity control, as required, to register 1 V. Release the RESET switch and the tamper switch.

4. The Transceiver Module can generate a ramp output so you can test the internal functions of the Transceiver Module as well as the range of your chart recorder. To obtain the ramp output:

   a. set DIP switch SW2-1 to the closed position
   b. set the HOLD switch to the up position
   c. close the tamper switch (do not release it)

The ramp output should appear as shown in the figure below. The output at connector A should range between -2.5 V and +2.5 V over a period of 28 seconds. The output at connector B should range between -10 mV and +10 mV over a period of 28 seconds (this ramp may be hard to see on the chart recording). If you get a chart recording that looks quite different from the figure below, check all connections, chart recorder settings and the Transceiver Module for possible malfunctions.



Ramp output on A side

If you are unable to achieve a proper ramp output, replace the chart recorder or the Transceiver Module to determine which one is faulty.

Set the chart recorder and DIP switch SW2-1 to their original settings before proceeding with the tests.

Detection signal readings

Detection signal readings are taken from the Transceiver Module analog output connectors. You measure the detection signal of a zone in relation to the threshold setting of that zone. The reading that you take at the analog output connector is really the level of the detection signal above or below the threshold setting. An analog voltage of ±2.5 V above and below the threshold value represents the detection signal in the zone. On this relative scale, 0 V always corresponds to the threshold setting.

Detection signal readings, taken from the analog output connectors, are converted from voltage readings into decibels (dB) using the scale factor:

1 V = 20 dB

Procedure

1. Set the HOLD switch to the down position.

2. Release the tamper switch.

3. To measure the detection signal in zone A, connect the multimeter or chart recorder to the left-hand analog output connector. To measure the detection signal in zone B, use the right-hand analog output connector.

4. Convert the voltage reading into decibels by referring to the table on the next page. Note that:

   1 V = 20 dB
   1 dB = 0.05 V

Voltage	Detection signal (Relative to threshold)
+2.50 Vdc	+50 dB
+2.25	+45
+2.00	+40
+1.75	+35
+1.50	+30
+1.25	+25
+1.00	+20 Above Threshold
+0.75	+15 (Alarm Condition)
+0.5	+10
+0.25	+5
+0.15	+3
+0.1	+2
+0.05 Vdc	+1 dB
0.0 Vdc	ALARM THRESHOLD
-0.05 Vdc	-1 dB
-0.1	-2
-0.15	-3
-0.25	-5
-0.5	-10
-0.75	-15
-1.00	-20 Below Threshold
-1.25	-25 (No Alarm Condition)
-1.50	-30
-1.75	-35
-2.00	-40
-2.25	-45
-2.50 Vdc	-50 dB

Measured analog voltage versus detection signal

Measuring the threshold value

A generalized scale is marked on the Transceiver Module front panel around each threshold adjustment control. The scale allows you to set an approximate threshold value. You can obtain a precise reading of the threshold value by taking measurements at the analog output connectors.

Procedure

1. To read the threshold value for zone A, connect the meter to the left-hand analog output connector. To read the threshold value for zone B, use the right-hand analog output connector.

2. Release the tamper switch.

3. Press and hold the RESET switch. Obtain a voltage reading for the threshold value.

   Note: If you do not hold down the RESET switch when you take the voltage reading, you will be measuring the detection signal instead of the threshold value.

4. Convert the voltage reading into decibels by referring to the table that follows. The following formula applies:

   $$\text{Threshold Value (dB)} = 20 + \frac{\text{Voltage Reading (volts)}}{0.05}$$

Voltage	Threshold
-0.25	15
0.00	20
0.25	25
0.50	30
0.75	35
1.00	40
1.25	45
1.50	50
1.75	55
2.00	60
2.25	65
2.50	70

Measuring the clutter level

Clutter is a measure of the signal present on the receive cable when there are no intruders in the detection field. It is measured in units from 0 to 63.

Procedure

1. To measure the clutter in zone A, connect the multimeter or chart recorder to the left-hand analog output connector. To measure the clutter in zone B, use the right-hand analog output connector.

2. Set the HOLD switch to the down position.

   Do not press the RESET switch

3. Hold the tamper switch closed.

4. Convert the voltage reading to a clutter level using the formula:

   Clutter Level = Voltage x 10

   For example:

   0.1 Vdc = 1 clutter unit
   0.5 Vdc = 5 clutter units
   1.2 Vdc = 12 clutter units

   The maximum clutter measurement that can be made in this way is 25 clutter units (2.5 Vdc). If the clutter level is greater than 25 units, the Transceiver Module will still indicate 25 units. If the clutter level is greater than 50 units, a negative voltage results.

Summary of test signals

The following table lists the Transceiver Module switch settings required to obtain various test output signals via the A and B analog output connectors. Refer to the previous sections in this chapter for formulas to convert voltage readings to decibels.

Analog output		**Switch settings**			
Connector 'A'	**Connector 'B'**	**RESET**	**TAMPER***	**HOLD**	**Switch SW2-1**
zone A detection signal	zone B detection signal	released	open	down	—
zone A detection signal peak	zone B detection signal peak	released	open	up	—
zone A threshold	zone B threshold	depressed	open	—	—
zone A clutter	zone B clutter	released	closed	down	—
1 volt reference	1 volt reference	depressed	closed	down	—
0 volt reference	0 volt reference	depressed	closed	up	—
ramp ±2.5 V	ramp ±0.01 V	released	closed	up	closed

* The tamper switch is 'open' when the internal or external tamper switch is released and a tamper alarm condition prevails. The tamper switch is 'closed' when the internal or external tamper switch is manually held closed and no tamper alarm condition results.

Note: Leave the HOLD switch in the down position after calibration is complete. Return DIP switch SW2-1 to the desired position (see 'Jam alarm annunciation', p. 2-5).

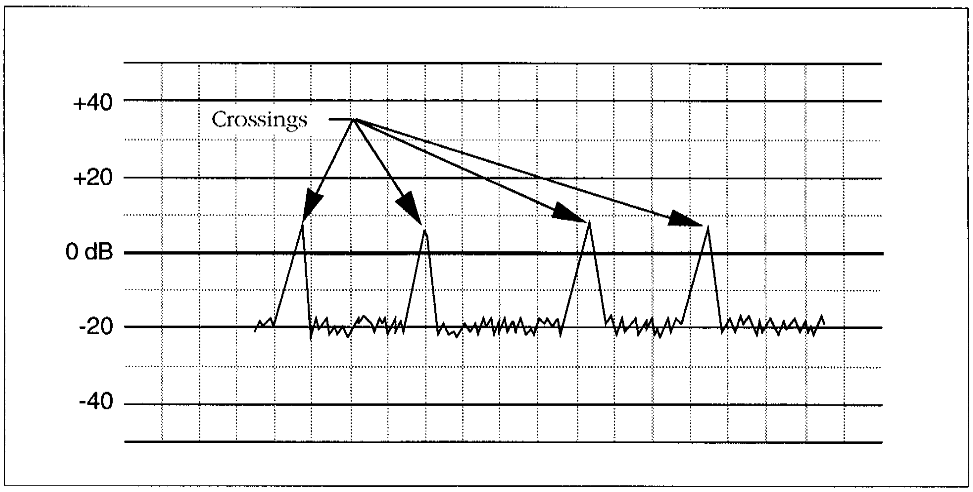
Calibrating the system

Introduction

The procedures in this chapter will enable you to calibrate your Transceiver Modules so that the alarm thresholds are set correctly for each zone.

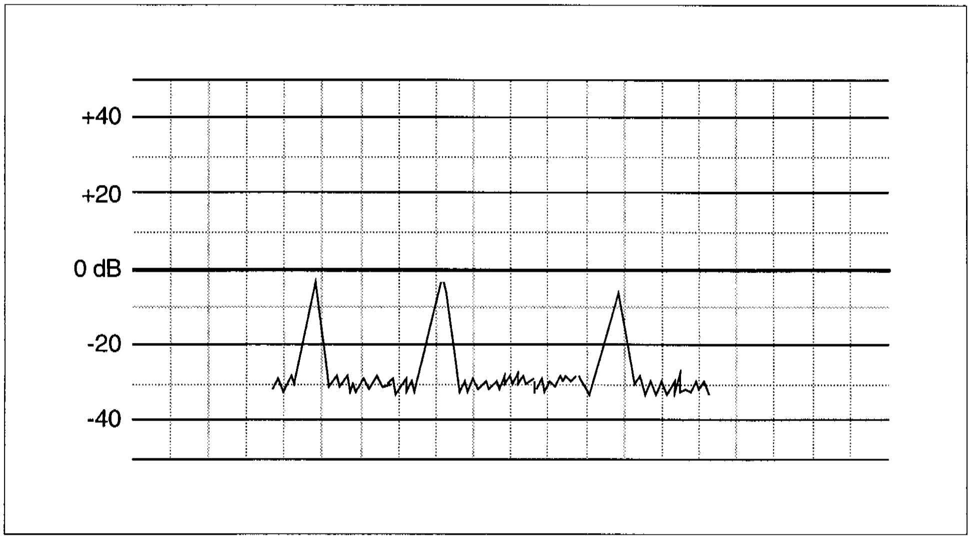
How alarms are generated

When an intruder crosses the detection field, the detection signal increases. When the detection signal equals or exceeds the threshold that you set on the Transceiver Module, it signals a sensor alarm condition for zone A or zone B.

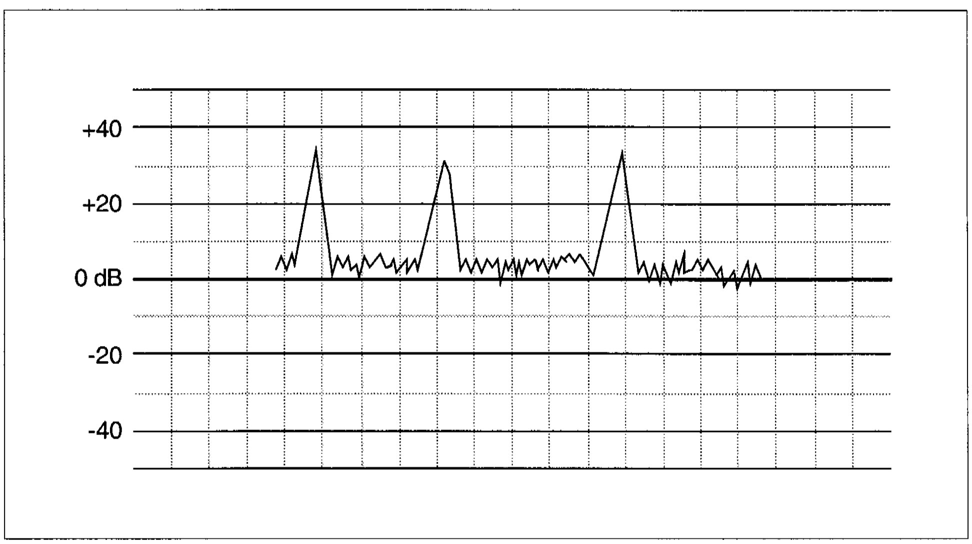


Threshold set properly: crossings exceed the threshold

If the threshold is set too high, the detection signal can never equal the threshold, so no alarms are generated. If the threshold is too low, the system may often be in alarm or will signal alarms for nuisance conditions, such as birds or small animals crossing the detection field.

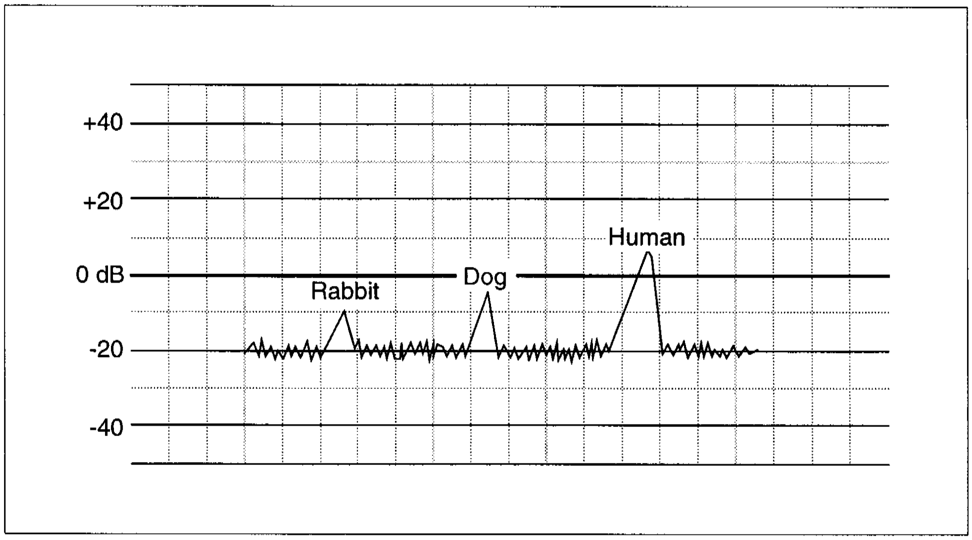


Threshold set too high: no alarms



Threshold set too low: continuous alarm

You must set the threshold so the detection signal generated during a walk test or any random crossing is at least 5 dB above the threshold. The 5 dB margin allows the system to detect human intruders, while rejecting common sources of nuisance alarms. You can use a greater margin if desired, but nuisance alarms will likely increase.



Threshold set properly: humans are detected but animals are not

The best method for setting the threshold level is to have an assistant walk along the cable path while you observe a chart recording of the detection signal. The resulting plot of the walk test shows the detection signal throughout the zone. Estimate the average of the three lowest points on the plot, then set the threshold 5 dB below that average.

Calibrating the system

Required tools and equipment

- standard screwdriver
- 13 mm (1/2 in) wrench
- pen or marker
- chart recorder with the following features:
  - 0 Vdc centre scale
  - chart speed of approximately 25 mm/min (1 in/min)
  - range of -2.5 Vdc to +2.5 Vdc

  (See chapter 3, **Test procedures**, for a list of recommended models.)

If you do not have a chart recorder, or if you are calibrating the system alone, you can calibrate it by following the instructions under 'Calibration using the HOLD switch', p. 4-13.

Points to remember

- Do not press the RESET button when anyone is in the detection field. Wait outside the detection field for at least one minute after pressing RESET. This gives the Transceiver Module time to settle to the ambient detection level.

- If walk crossings of a zone do not generate alarms, you must turn the threshold down. If the detection signal is too high, you must raise the threshold.

- The tamper switch must be released when you change the threshold setting. (You cannot change the threshold without being in a current tamper alarm state.)

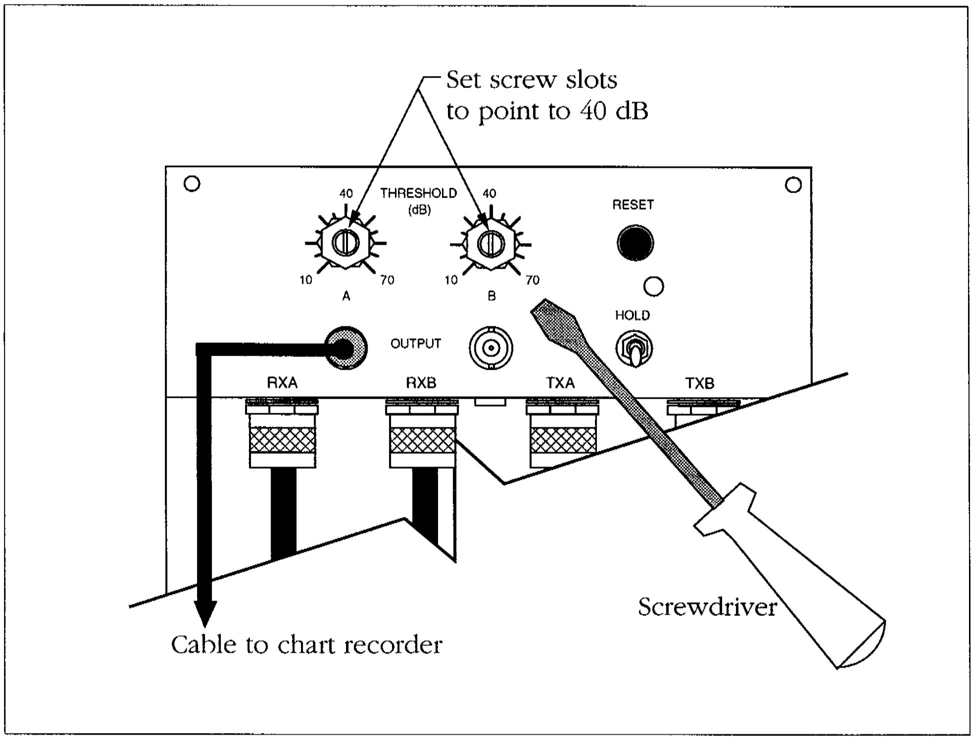
- If the sensor cables in a zone pass through more than one burial medium (soil, gravel, concrete, or asphalt), refer to the section on 'Multiple mediums in a zone', 4-12.

Preliminary steps

1. Set up the Transceiver Module with the transmit and receive cables of zone A connected to the TXA and RXA connectors and the transmit and receive cables of zone B connected to the TXB and RXB connectors. Ensure that the Transceiver Module or its enclosure is grounded to earth ground. If the Transceiver Module monitors only one zone, ensure that decouplers are connected to the unused transmit and receive connectors.

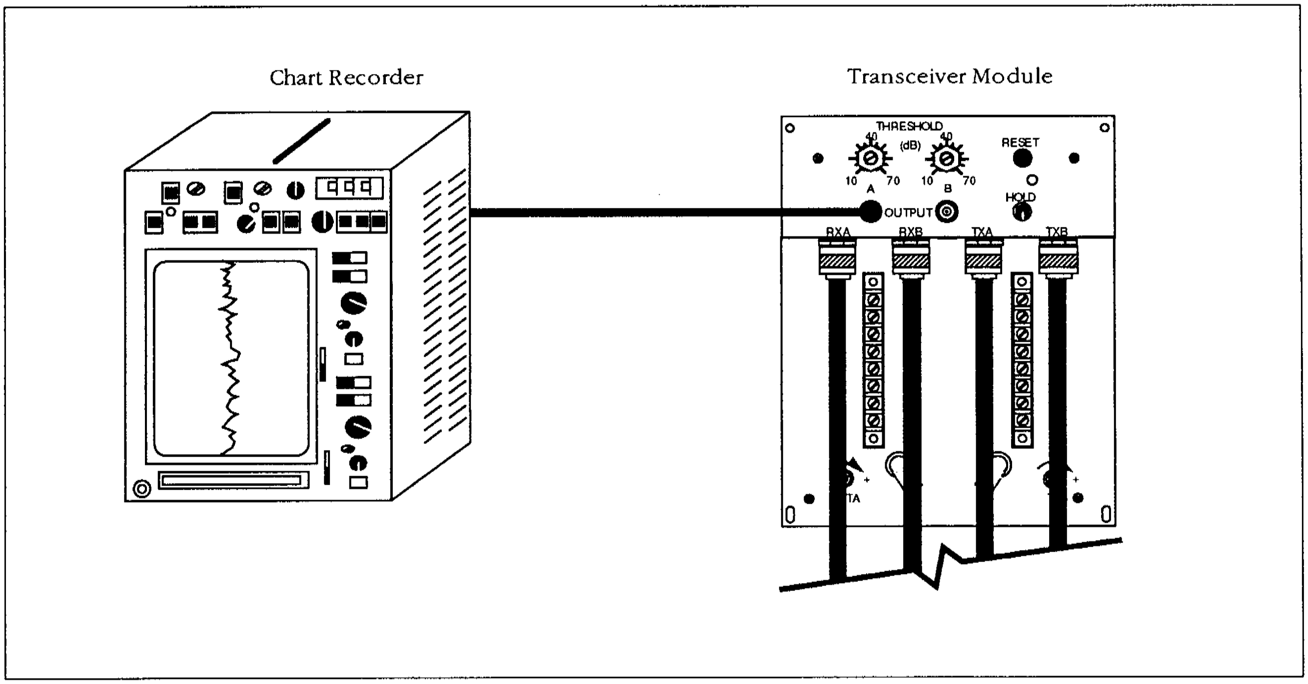
2. Apply power to the Transceiver Module by turning on the local 12 Vdc TM power supply. Wait at least one minute before taking any readings.

3. Set an initial temporary threshold level by loosening the locking nuts on the A and B threshold adjustment controls on the Transceiver Module front panel. Using a screwdriver, turn the threshold adjustment controls so that the screw slots point towards 40 dB.



Adjusting the threshold setting

4. Connect a chart recorder to the analog output connector of the zone you wish to calibrate. Refer to chapter 3, **Test Procedures**, for instructions on using your chart recorder.

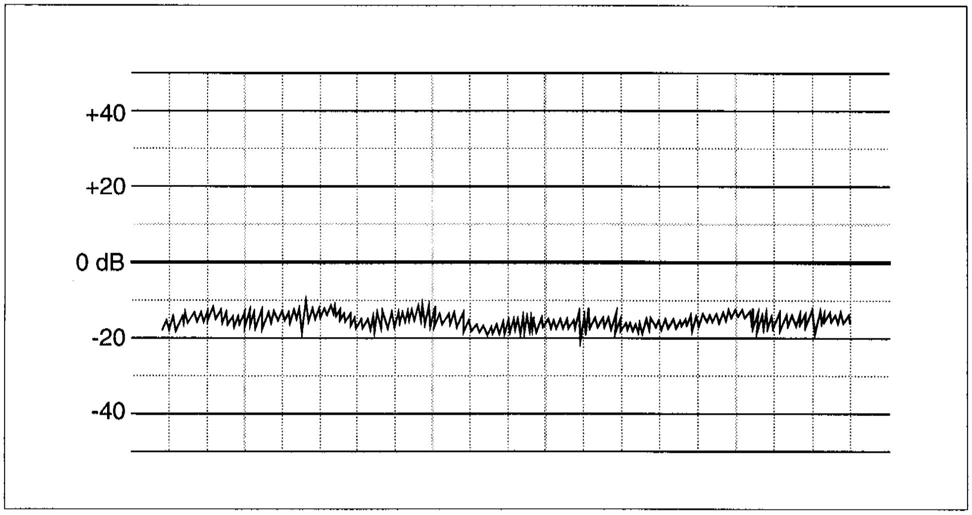


Connecting a chart recorder

5. Turn on power to the chart recorder. Set the chart recorder scale and zero position so it registers from -2.5 Vdc to +2.5 Vdc. Set the chart speed to 25 mm (1 in) per minute.

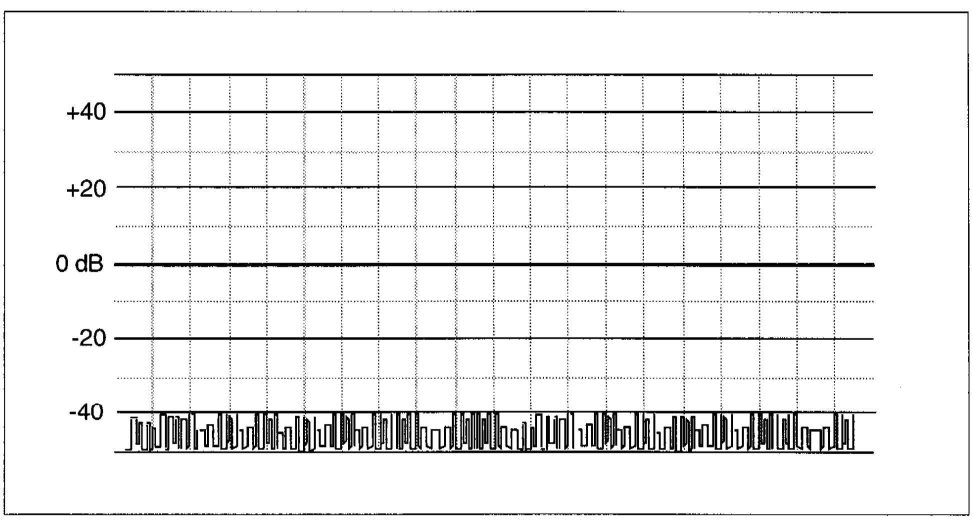
6. Make sure no one is in the detection field of the zone being calibrated. Press the RESET button and release it. Wait for one minute. The chart recorder should trace a line below 0 dB. If it doesn't, check the scale and zero position setting on your chart recorder.

   The plot of the detection signal should appear fairly constant with only minor fluctuations. These fluctuations are caused by background noise.



Normal background noise

If the background noise level is very low, the plot of the detection signal will appear as large steps well below the threshold. This condition is desirable and won't affect the calibration procedure or system operation.



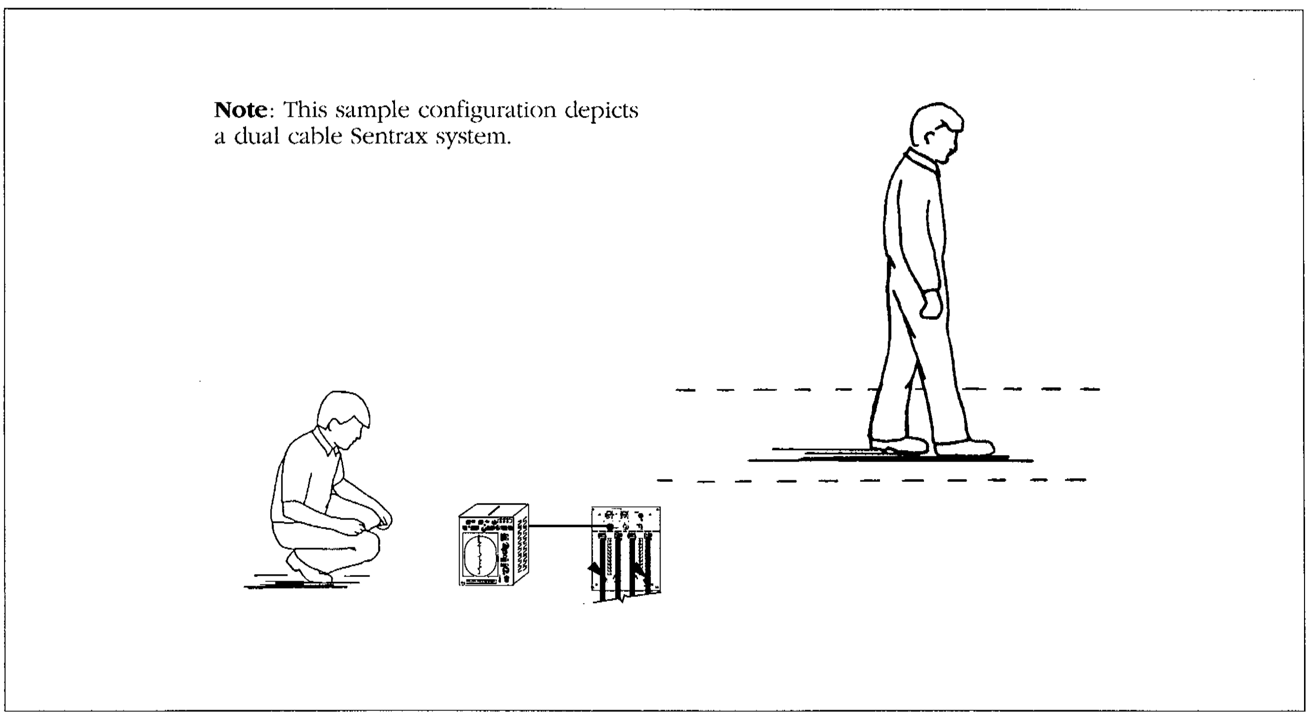
Low background noise

Conducting the walk test

1. Watch the chart recording as the walk test is conducted. Use a pen to mark the chart to indicate:

   - when the walk test starts and stops
   - when your assistant enters or leaves the detection field
   - when your assistant crosses a transition from soil to concrete, concrete to asphalt, etc.
   - when your assistant rounds a corner in the cable path

2. Have your assistant walk at a moderate pace, heel to toe, along the length of the zone, while remaining along the centre line of the detection zone. When they reach the end of the zone, they should walk at least 10 m (33 ft) away from the detection field and stop. After waiting for one minute, have them turn around and walk back down the centre of the cables. After completing the walk, have your assistant move at least 10 m (33 ft) away from the detection field. Press and release the RESET button.



Walk test

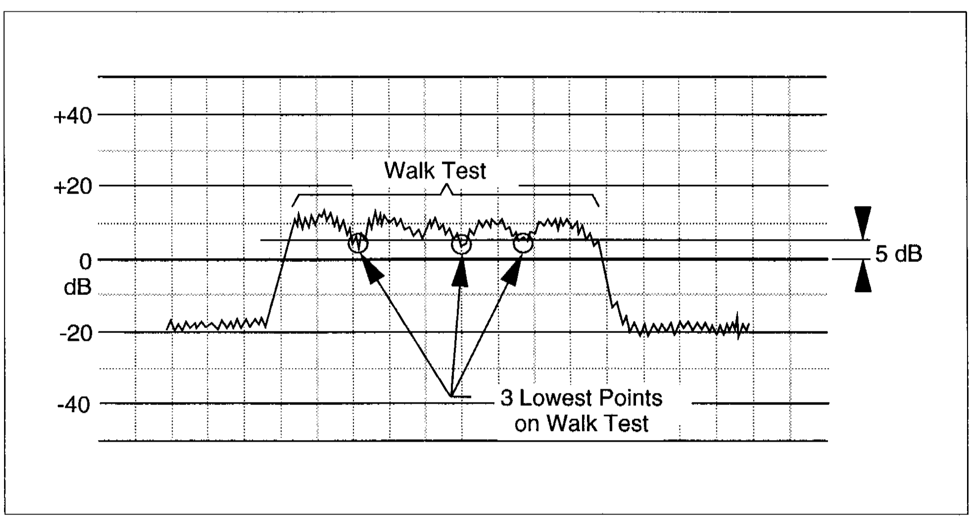
3. Shut off the chart recorder. Record on the chart all information relating to the walk test:

   - the Transceiver Module address number
   - the zone being calibrated
   - threshold setting used during the test
   - clutter value and attenuation recorded during the test
   - locations of corners and changes in the burial medium
   - the zero volt level, voltage, and time scales used during the test, date and time

4. Examine the chart recording. Identify the minimum and maximum detection signal levels generated when your assistant was in the zone. The minimum and maximum should be less than 18 dB apart. If a walk test produces detection signals that vary by more than 18 dB, there is a greater likelihood that either nuisance alarms or areas of no detection will occur. Refer to the section on 'Adjusting Sensitivity', p. 4-14, for instructions on raising or lowering the sensitivity in zones that have large variations in the detection signal.

5. Calculate (in decibels) the average value of the three lowest points on the chart recording of the walk test. Compare this average to the current threshold setting. If the average is less than 5 dB above the threshold, lower the threshold. If the average is more than 5 dB above the threshold, raise the threshold. (For detailed information about threshold values, see the section on 'Optimum threshold setting', p. 4-10.)

   Note: Make sure the tamper switch is released when you change the Transceiver Module's threshold setting.



Sample walk test chart recording

6. Repeat the walk test several times. After each test ensure that the detection field is clear, then press the RESET button. Adjust the threshold setting if necessary after each test until an average minimum detection signal of 5 dB above the threshold is obtained.

Optimum threshold setting

The threshold value you use on each Transceiver Module determines the probability that the system will be able to detect an intruder. Lowering the threshold increases the probability of detection, but it also increases the likelihood that nuisance alarms will occur.

The following table shows the relationship between threshold margin and probability of detection. 'Threshold margin' is the difference between the threshold value and the detection signal generated by a 70 kg (154 lb) person crossing the detection field at the least sensitive point in a zone.

Threshold Margin (dB)	Probability of Detection				Application
	70 kg (154 lb) Human Walking	20 kg (44 lb) Human Walking	10 kg (22 lb) Mammal	5 kg (11 lb) Mammal	
12	>99%	94%	41%	<1%	Direct assessment recommended
10	>99%	82%	29%	<1%	Direct assessment recommended
5	**>99%**	**53%**	**<1%**	**<1%**	**Maximum margin recommended for sites without direct assessment**
2	>99%	35%	<1%	<1%	For sites without direct assessment desiring low FAR*
0	>99%	24%	<1%	<1%	For sites requiring very low FAR

* FAR = False Alarm Rate
Direct assessment means that an operator has direct visual contact with the zone, through guards posted on the perimeter or CCTV coverage.
Performance figures in this table depend on close adherence to recommended installation procedures.

Threshold margin versus probability of detection

Finishing up

1. Ensure that crossings through the detection field report as sensor alarms on your alarm annunciation equipment. Follow the troubleshooting procedures in this manual if no alarms report, or if the system generates unexplained tamper or fail alarms.

2. Check the containment of each zone. Have your assistant walk along one side of the zone, staying approximately 3.5 m (11 ft, 6 in) away from the nearest cable. The chart recording should indicate less than 0 dB (0 V) and no alarms should occur. Repeat the walk, but on the other side of the cable path.

   If alarms are generated during this test, raise the threshold slightly and repeat the test. Then perform a normal walk test (down the centre of the cables) to ensure that you haven't set the threshold too high.

3. Verify your final threshold setting by having your assistant cross the detection field at random points along the zone. The detection signal should increase above the threshold whenever your assistant enters the detection field.

4. Repeat the calibration procedures for the Transceiver Module's other zone.

5. Lock the nuts on the threshold adjustment controls.

6. Record the threshold value for each zone on the **DIP-Switch and Jumper Settings** form that is kept near the Transceiver Module. Check that all DIP-switch and jumper settings are recorded accurately.

7. If the external tamper switch is used, make sure the external tamper plug is pushed all the way into the jack. Check that the tamper switch generates a tamper alarm when the enclosure is opened.

8. Adjust the test targets as instructed under 'Calibrating the test targets', p. 4-20.

Multiple mediums in a zone

This section covers calibration instructions for sites in which the sensor cables in a zone pass through more than one burial medium: soil, gravel, concrete, or asphalt.

1. If the cable path goes through more than one medium in a zone, do not bury or seal the cables after laying them. Instead, lay the cables in the slots in asphalt/concrete, but do not seal the slots. In soil or gravel, lay the cables on 7.5 cm (3 in) of sand, then cover them with another 7.5 cm (3 in) of sand, as instructed in the **Buried cable systems Installation Guide** (A2DA0102).

2. Do a walk test as explained in the previous section.

3. Examine the chart recording. The chart recording will show the relative detection signal level in the various burial mediums. Determine if there are any high spots or low spots, or if the range of the detection signal is more than 18 dB.

4. Follow the instructions in the section on 'Adjusting Sensitivity', p. 4-14, to remedy any high spots, low spots, or excessive signal range. For example, if the preliminary walk test shows that the detection field passing through asphalt is very sensitive compared with the rest of the zone, you may have to reduce the sensor response over the asphalt area.

   Note: It is normal for the detection field to be somewhat less sensitive in soil than it is in concrete/asphalt.

5. After all of the necessary adjustments have been made to ensure a successful calibration, seal/bury the cables in the slots or trenches.

6. Calibrate the Transceiver Module as explained in this chapter. The walk test should produce a fairly uniform detection signal over the entire zone.

Calibration using the HOLD switch

To calibrate the Transceiver Module without a chart recorder, follow the procedure below:

1. Follow the procedure under 'Preliminary steps', p. 4-5. If you do not have a chart recorder, connect a voltmeter to the A or B analog output connector.

2. Set the HOLD switch in the up position.

3. Cross the detection field in the appropriate zone (A or B). Walk across the cables, turn around, then walk back across the cables at the same location. Return to the Transceiver Module, staying at least 3 m (10 ft) away from the cables.

4. Read the detection signal peak voltage displayed on the voltmeter. Convert it to decibels using the formula 1 V = 20 dB. Press the RESET switch and wait for one minute.

   Note: The Alarm-A and Alarm-B relays latch when the detection field is crossed and the HOLD switch is up. To unlatch the relays, press the RESET switch or change the HOLD switch to the down position.

5. Make several crossings at various points along the perimeter. Read the voltmeter after each crossing. Record on a perimeter site plan the decibel value obtained on each crossing.

6. Set the threshold so it is 5 dB below the average of the three lowest detection signal readings you obtained. If the detection signals in a zone vary by more than 18 dB, follow the instructions in the section on 'Adjusting Sensitivity', p. 4-14.

7. When finished, set the HOLD switch in the **down** position.

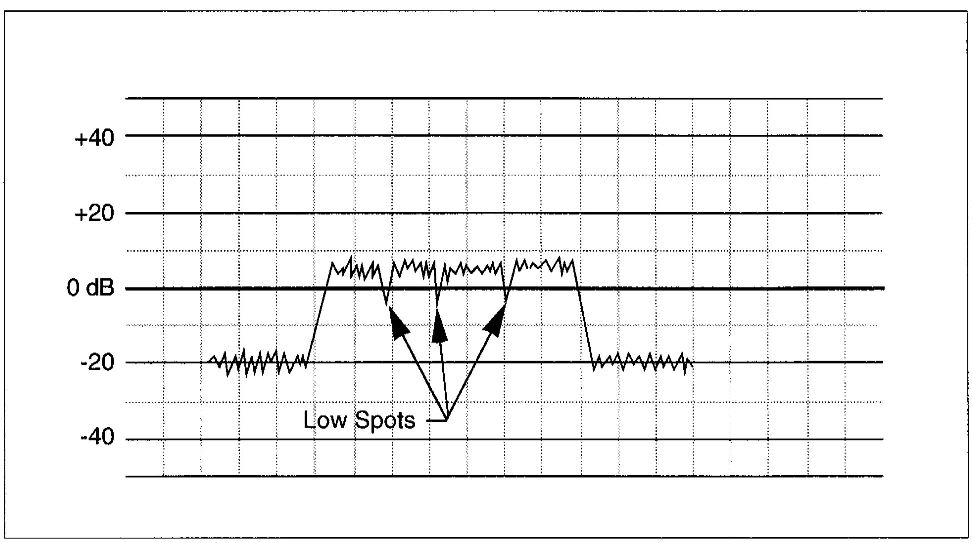
Adjusting sensitivity

At some sites, you may find that the sensitivity varies at different points in the zone. These are referred to as 'low spots' and 'high spots'. You may also find that a walk test produces a chart recording in which the minimum and maximum detection signals are more than 18 dB apart. It is impossible to predict which areas of a zone will be more or less sensitive, or which zones will have an excessively large range, until the system calibration has been attempted.

Two people, each carrying two-way radios, one located at the Transceiver Module or chart recorder and the other located in the field, can very quickly locate spots of high and low sensitivity along the cable path. This section tells you how to identify problem areas and how to correct them, and also how to reduce the Transceiver Module's received detection signal using the attenuation jumper.

Low spots

Examine the chart recordings from your walk tests. Places on the chart where the signal dips below 0 dB are 'low spots' in the zone. These are areas where the detection field is not as strong as it is in other areas of the zone.



Low spots

Low spots can present problems because intruders may not be detected in these areas. If you lowered the threshold for the zone so the low spot is 5 dB above the threshold, the rest of the zone would be too sensitive and nuisance alarms would occur. Follow the procedures below if your chart recordings have any low spots.

1. For this test, calibrate the zone ignoring low sensitivity areas. Have your assistant perform another walk test. Watch the plot as your assistant proceeds along the cable path. When an area of low sensitivity is encountered, have the assistant mark the spot on the ground temporarily.

2. Keep the chart recorder running and have your assistant walk through the detection field at the point where the low spot occurs.

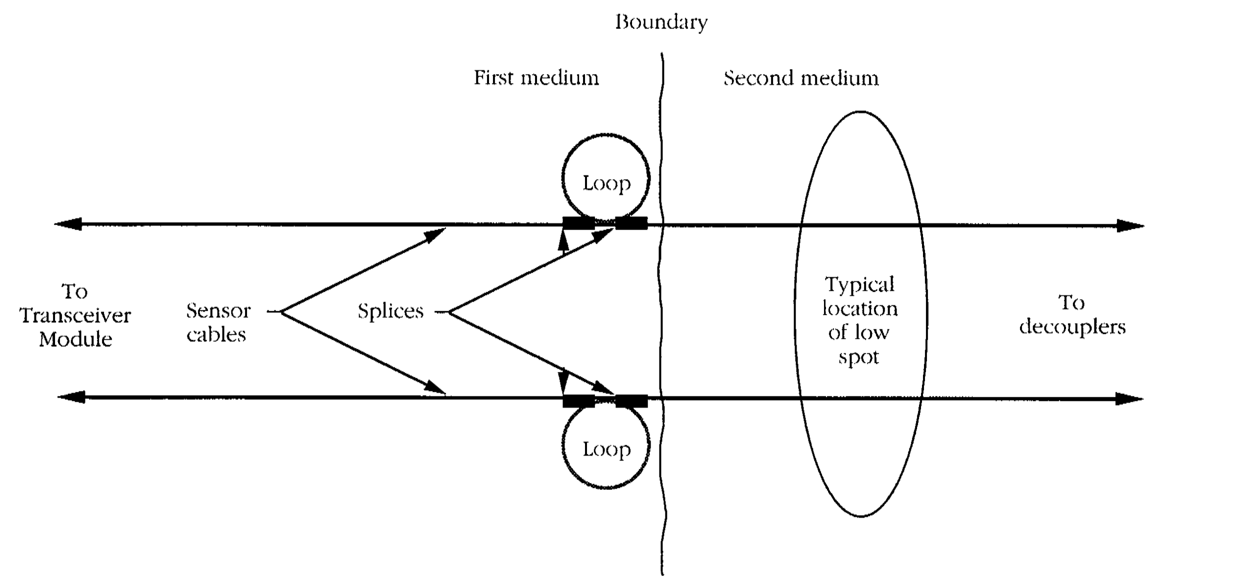
3. If an alarm is generated (detection signal greater than 0 dB), the zone does not require adjustment. Have your assistant make several crossings near the low spot to ensure that alarms are always generated.

4. If no alarm is generated, you can do the following:

   - Locate and remove, if possible, any buried pipes or metal objects near the cables. Buried pipes and metal objects can reduce the sensitivity of the detection field if they are too close to the cables. They should be removed if they cause low spots.

   - If the cables are in trenches in soil or gravel, gradually raise the cables closer to the ground surface where the low spot occurs. This must be done over the full length of the low spot, starting 1 m (3 ft, 3 in) before the low spot. Raising the cables will sometimes cause the low spot to move farther down the cables. After raising the cables, perform a walk test to ensure the low spot hasn't moved. If it has, repeat the procedure.

Small-area low spots can occur in the first 2 m (6 ft, 7 in) of the new medium where the cables cross from one burial medium to another. You can reduce the effect of the low spot by splicing in loops of non-leaky cable. Each loop must be made from 3 m (9 ft, 10 in) of lead-in cable and must be buried in a single, horizontal loop in the ground, at the same depth as the sensor cable. The centre of the loop must be within 0.5 m (20 in) of the change in medium, on the side nearest the Transceiver Module. In the case of Sentrax cables, loops must be installed on both cables. You will need four connectors for each loop.



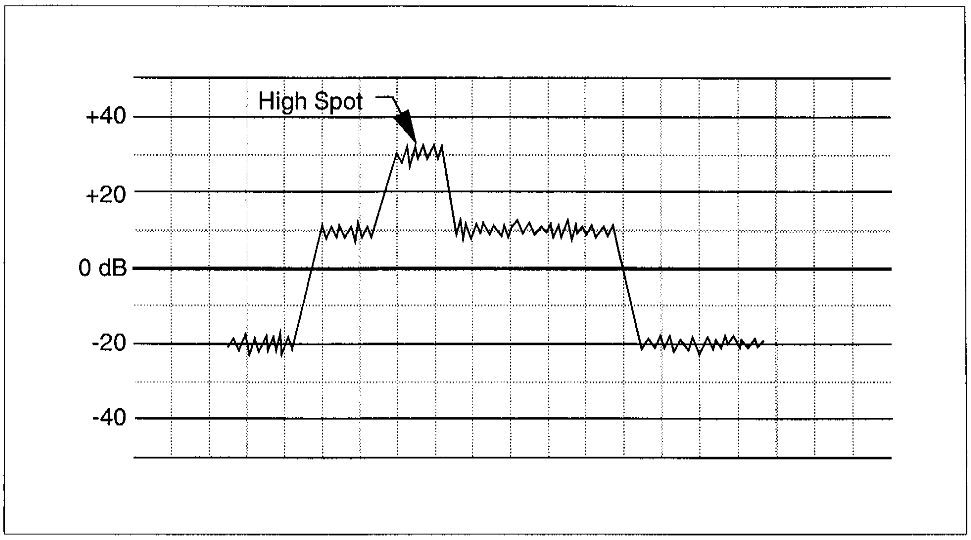
Notes:
1. This sample configuration depicts a Sentrax system.
2. Each loop is made of 3 m (9 ft, 10 in) of sensor or lead-in cable. Bury the loops at the same depth as the sensor cables. Make each loop as close to a circle as possible. The loops' centres must be within 0.5 m (20 in) of the boundary, on the side nearest to the Transceiver Module.

Using cable loops at a change in the medium

Adjust the location of the loop(s) to minimize the low spot. If the low spot persists despite your efforts to correct it, you could simply leave it alone. Alternately, you may wish to increase your protection near the low spot by installing a supplementary sensor (e.g., a microwave sensor).

High spots

After proper calibration, look for places on the chart recording where the detection signal exceeds 23 dB above the threshold. The increased sensitivity in these areas can result in increased nuisance alarms.



High spots

High spots don't always have adverse effects on system operation. Human intruders are detected in these areas, but smaller targets such as small animals might also be detected if they are near the high spot. A high spot can cause zone containment nuisance alarms if it is within 4 m (13 ft) of:

- areas of high pedestrian traffic
- a frequently used road

If there is an area of high volume pedestrian traffic near the high spot, leave the chart recorder running and walk along the pedestrian path near the high spot. Determine whether any alarms are generated.

If there is a road near the high spot, leave the chart recorder running and keep traffic moving down the road near the high spot. Determine whether any alarms are generated. If no alarms are generated, you could simply leave the high spot alone.

Nuisance alarms arising from environmental influences such as rainfall could be the result of a high spot. The sensitivity in this area could be lowered in order to reduce the rate of alarm.

If alarms are generated (the detection signal exceeds 0 dB), you can bury cables installed in soil a few inches deeper in the area near the high spot to reduce the sensitivity of the detection field.

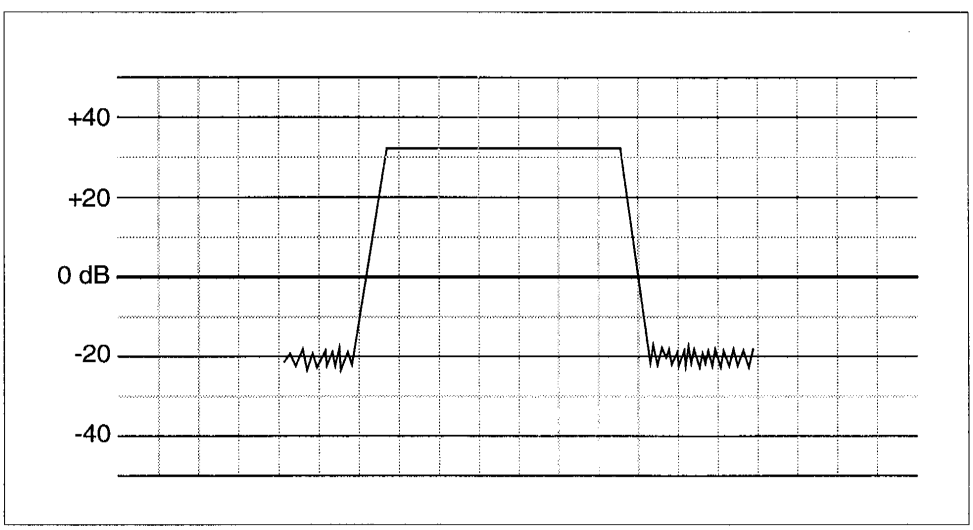
Reducing the sensitivity in a zone

The sensitivity of a detection field can be reduced in one of three ways:

- any cable buried in soil can be buried a few inches deeper in the area near the high spot
- for any cable installed in asphalt, install ferrite beads 30.5 cm (12 in) apart on the cable for the length of the high spot. If the cable end is inaccessible, you will have to cut the cable, install the beads, then rejoin the cables using a splice kit.
- for any cable buried in soil or gravel, a 10-gauge insulated wire 1.3 cm (1/2 in) can be buried above the cables for the length of the high spot. The wire must be a uniform distance directly above the sensor cable.

Saturation

A flattened peak or plateau on the chart recording in a walk test means that part or all of the zone is saturated. This means the detection field is too sensitive and proper calibration is not possible. Saturation usually occurs only in areas with light, sandy soil.



Saturation

If saturation occurs over a short distance (less than 20 m [66 ft]), you can adjust the detection field using the procedures for reducing a high spot. If a large portion of the zone is saturated, you must reduce the Transceiver Module's sensitivity by installing the attenuation jumper.

1. Locate the attenuation jumper inside a small opening on the right-hand side of the Transceiver Module.

2. Remove the black plastic jumper using needle-nose pliers. Re-insert the jumper so it connects the two pins.

3. The detection signal in both zones is now reduced by 14 dB. You must recalibrate both zones.

If you want to attenuate only one zone, you can install an attenuator kit on the receive (lead-in) cable at the Transceiver Module. The attenuator kit, when installed in this manner, reduces the detection signal by 10 dB over the whole zone.

Calibrating the test targets

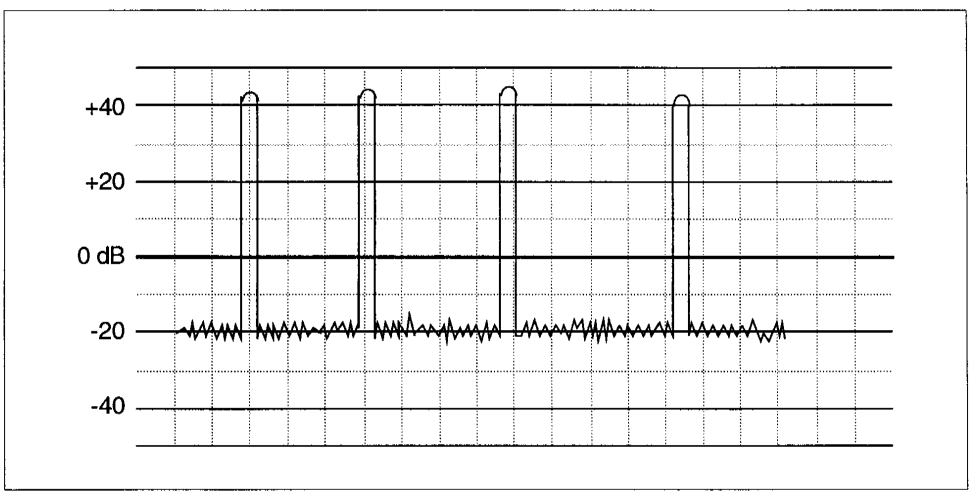
After the zone has been calibrated, the test targets must be adjusted so that they generate a detection signal between 10 and 20 dB above the threshold.

1. Ensure that there is no one in the detection field.

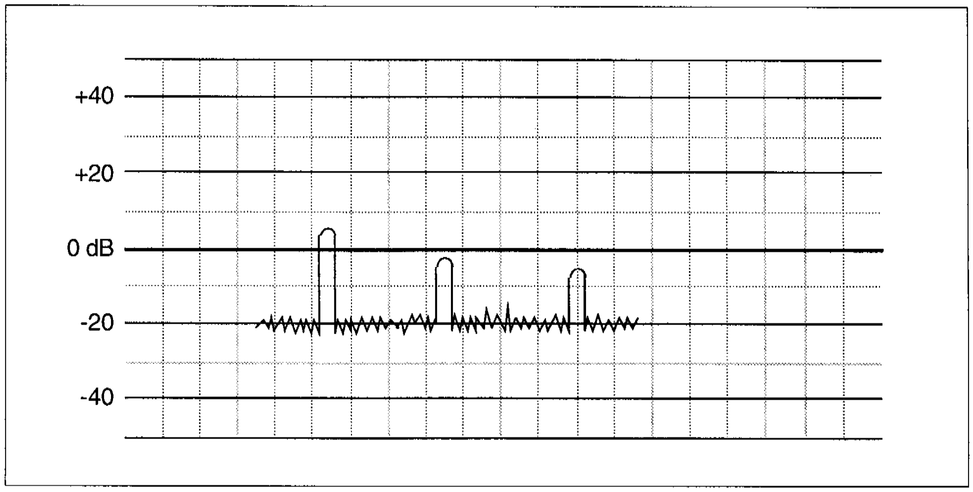
2. Connect the chart recorder to the Transceiver Module and turn it on.

3. Have the assistant short terminals 5 and 6 on the TM front panel for 1 second.

4. Observe the chart recording. Compare it to the figures below. If the test-target response is too high, loosen the lock nuts and turn the test-target calibration control counterclockwise. If the test-target response is too low, turn the test-target calibration control clockwise.

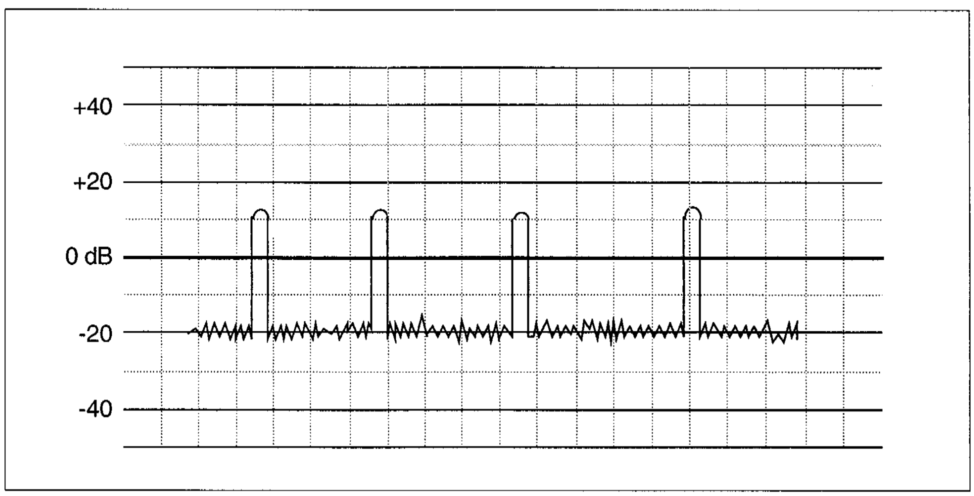


Test-target response too high



Test-target response too low

5. Reactivate the test targets and adjust the test-target calibration controls until the test-target response is between 10 and 20 dB above the threshold.



Test targets adjusted correctly

6. Ensure that you adjust the test-target response for both zones A and B.

7. Tighten the lock nuts.

Recalibration

When all of the zones and test targets have been calibrated, no further adjustments are required. You should, however, recalibrate the Transceiver Modules at sites that have large seasonal variations in climate. The detection field's sensitivity can change when the ground freezes or thaws, or when its moisture content changes significantly. If the ground freezes deeper than 20 cm (8 in), sensitivity can increase by as much as 10 dB. To avoid a possible increase in nuisance alarms, recalibrate the Transceiver Modules after the seasons change.

Nuisance alarms

Introduction

Nuisance alarms are alarms that are caused by objects or disturbances other than a valid intruder. Nuisance alarms can be caused by wildlife or environmental conditions. To troubleshoot nuisance alarms, collect information on the alarms, determine their source, and then eliminate the cause. Refer to the 'False alarm troubleshooting' flowchart that begins on page 6-9.

Troubleshooting data

Before contacting Senstar, your dealer, or attempting any equipment repair, collect the following information:

1. Obtain or sketch a site plan that shows:

   - location of any obstacles near the perimeter, including metal fences or buried metallic objects with the distance to the nearest sensor cable indicated
   - variations in ground conditions
   - cable spacing
   - location, frequency, and address number of each Transceiver Module
   - location of decouplers and cable splices

2. Record the Transceiver Module serial numbers.

3. Record the location, frequency, duration, and time of occurrence of the alarms.

4. Observe the affected zones to determine whether the nuisance alarms coincide with any of the following conditions:

   - wildlife entering the detection field
   - vehicles or pedestrians in the general area of the detection field
   - opening and closing of gates or other activities in or near the zone
   - extreme weather conditions such as heavy rain, wind, or lightning
   - wind moving a fence or gate located in or near the detection field

5. Perform a walk test on the zones that are generating nuisance alarms and obtain a chart recording of each zone to verify calibration. Indicate the zone numbers, threshold (dB), chart speed, voltage scale, and zero-volt level on the chart.

   Note: The zone may require recalibration at this time.

6. Record the clutter levels of the affected zones. Take care not to disturb the detection field with your presence. Refer to 'Measuring the clutter level', p. 3-10 for instructions.

7. Activate the test targets from the Transceiver Module front panel and obtain a chart recording of the signal. Ensure the zone number, threshold (in dB), chart speed, voltage scale, and zero-volt level is indicated on each chart.

8. If the detection field has increased in size or if the threshold level is too low, a Transceiver Module may be detecting objects beyond what is thought to be the range of the detection field. Perform a containment walk around the zone to ensure the detection field is contained within the desired boundary. To perform a containment walk:

   a. Walk along one side of the zone, staying approximately 3.5 m (11 ft, 6 in) away from the nearest cable. The chart recording should indicate less than 0 dB (0 Vdc).

   b. Repeat step (a), but on the other side of the cable path. Repeat the test for other problem zones.

9. Test the sensor cables for leakage and integrity. Refer to 'Cable tests', p. 2-11 for instructions.

10. Exchange the Transceiver Module with a properly configured Transceiver Module. If the noise remains in the zone, then it is a zone/ environment problem. If the noise follows the Transceiver Module, then the Transceiver Module is the problem. Return the Transceiver Module to Senstar with a description of the problem.

Possible sources of nuisance alarms

This section lists possible nuisance alarm sources and suggests ways of preventing nuisance alarms. Use the information collected in 'Troubleshooting data', p. 5-2, along with details given in this section.

Incorrect threshold setting

A threshold may have been set incorrectly or the site conditions may have changed due to a natural phenomenon. System sensitivity can increase by as much as 10 dB when the ground freezes, increasing the possibility of nuisance alarms. If nuisance alarms occur during freeze or thaw periods of the year, recalibrate the system.

Wildlife, pedestrians, and vehicles

False alarms can coincide with the presence of pedestrians or vehicles near the perimeter. You can perform a containment walk to reveal the size of the detection field and indicate whether containment problems exist. Containment problems are sometimes difficult to remedy, and may be caused by poor site planning and installation practices. A physical barrier, such as a fence, may be required to prevent wildlife, pedestrians, and vehicles from coming too close to the perimeter.

Water

Rainfall

Rainfall usually increases the detection signal in every zone. Invalid alarms can be caused by surface water moving through the detection field. If you suspect that flowing water is causing invalid alarms, change DIP switch SW2-2 in the Transceiver Module to the closed position.

Puddles

Puddles more than 1 m (3 ft) wide by 1 cm (3/8 in) deep, stirred up by the wind, can cause nuisance alarms. You can eliminate the nuisance alarm source by moving the cable(s) away from areas prone to having puddles or by filling the puddle with sand or soil. Another solution is to landscape the area so it will drain properly. Be careful not to change the cable burial depth if you change the surface terrain. Change DIP switch SW2-2 in the Transceiver Module to the closed setting if surface or underground water causes false alarms.

Subsurface water

False alarms can be caused by underground water flowing through the detection field. This problem most often occurs if the sensor cables are buried in coarse gravel. You can prevent this problem during installation by mixing sand with coarse gravel to fill in the voids. If you suspect that underground water is causing false alarms, change DIP switch SW2-2 in the Transceiver Module to the closed setting.

Water filling and emptying a non-metallic pipe in the detection field can also cause alarms. You can remedy this problem by covering the pipe with a one-piece metallic shield; instructions are in the **Buried cable systems Installation Guide (A2DA0102).**

Wind

Wind does not affect the detection field, but strong winds moving a metal fence or gate in the detection field can cause alarms. To test a fence in or near the detection field, shake it with a non-conductive object such as a wooden pole. If shaking the fence causes an alarm, tension the fence, move the cable or, if possible, move the fence or replace the fence with a suitable, non-metallic fabric. Verify the zone calibration and, if possible raise the threshold level on the Transceiver Module.

Metallic objects

Metallic objects in the zone

Metallic objects, such as pieces of wire more than 30 cm (1 ft) in length, a measuring tape, metal conduit, etc., left on the ground surface in the zone can cause nuisance alarms. Check for metal objects in the zone. If a metal object is discovered, remove it and verify the calibration of the zone.

Intermittent electrical contacts

Wind or ground vibrations acting on corroded or loose joints in metal structures such as fences or gates too close to the detection field can cause invalid alarms. Loose joints can cause intermittent disturbances in the detection field.

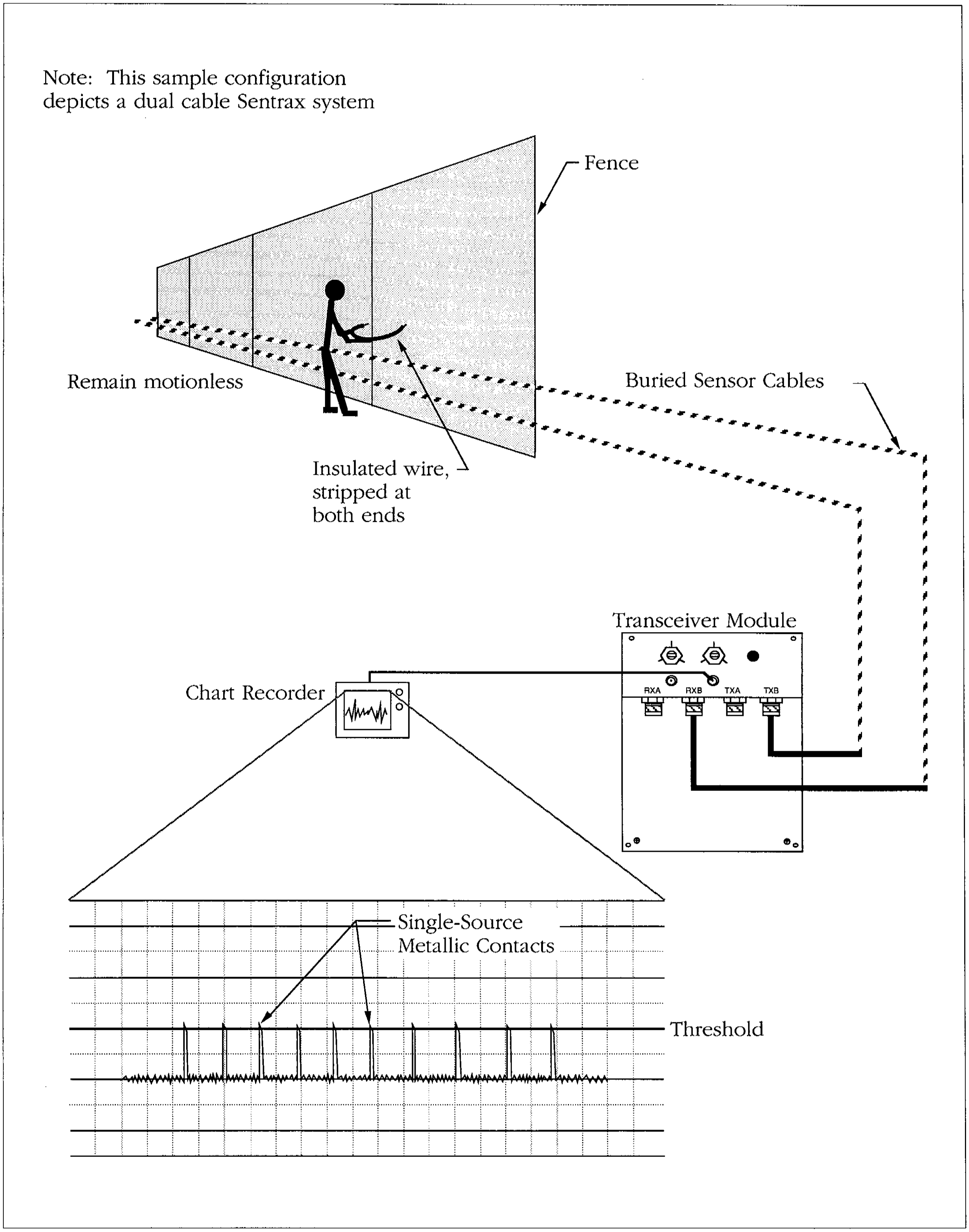
To test a zone for this problem, wait until the detection signal in the zone is low, (ie, much less than threshold level), and then perform the following procedure:

1. Connect a chart recorder to the Transceiver Module analog output connector of the zone. Refer to 'Setting up the equipment', p. 3-3. Start the chart recorder.

2. Keep your body outside of the detection field, or if inside the detection field, remain stationary. Use a piece of wire to create momentary shorts across various joints in the fence.

3. Observe the chart recording. Intermittent electrical connections will appear as sudden sharp increases (spikes) in the detection signal.

4. If spikes appear on the chart recording, weld wire conductors to electrically connect the metal parts that caused the problems.



Testing for intermittent electrical contacts

Intermittent metallic contacts underground

In general, metallic objects located underground do not cause false alarm activity. This is due to the rigidity by which the metallic object is being held to the earth. It is possible, however, that metal pipes, concrete reinforcing bars, or other metal objects buried in the detection field that become mechanically coupled due to vibrations in the ground can create intermittent electrical connections and cause false alarms. Observe the clutter level in the problem zone. An excessive number of clutter adjustments, (ie, more than 10 per hour), can accompany this false alarm source. Check the zone for buried metal objects with a metal detector.

Radio-frequency intereference from another Transceiver Module

Rf interference can occur between two adjacent Transceiver Modules that are using the same frequency or that are not synchronized with each other. Fail alarms can indicate rf interference from adjacent Transceiver Modules.

If you are using sensor-cable synchronization, make sure DIP switch SW3-4 is open. Alternately, connect a synchronization cable between terminals 9 and 10 on adjoining Transceiver Modules, as described in the **Buried cable systems Installation Guide** (A2DA0102).

External radio frequency interference

A transmitter operating in the 40.68 MHz range near the perimeter could cause invalid alarms. This type of interference is difficult to identify because sensitive monitoring equipment is required. Contact local regulatory agencies for assistance in determining if any such sources exist near the perimeter. If possible, have suspect sources turned off to see if the alarms stop. If such a source is found, collect as much information about it as possible and contact Senstar.

Faulty cable connector

A faulty cable connector could cause nuisance alarms. Perform the following procedure if you suspect a faulty connector:

1. Observe the clutter level of the zone. Unusually high clutter values (more than 25) often accompany a faulty connector or a defective decoupler.

2. Disconnect the connectors and examine them for corrosion, moisture or mechanical damage.

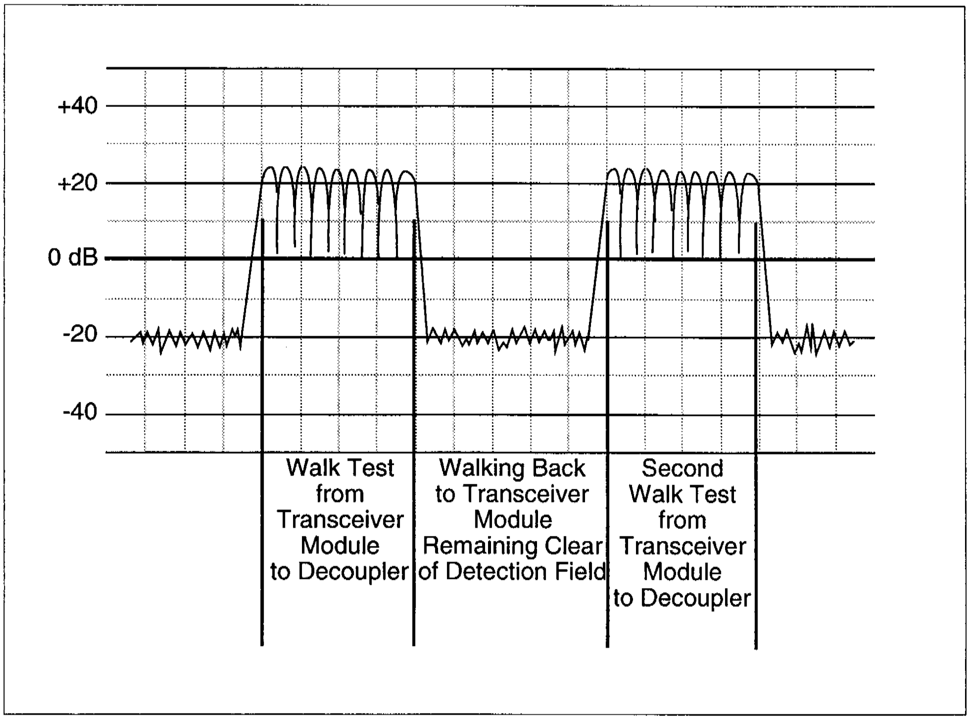
3. Check that the connector centre pins are at the correct depth and are straight.

4. Look inside the barrel of the female connectors to ensure that the centre pin elements are not spread or damaged.

5. Perform an electrical continuity test on the cables.

Faulty decoupler

If a decoupler is not connected or if its terminating resistor is faulty, the rf signal will be reflected back along the cables. This problem is indicated if a walk test produces a chart recording like the one shown below. This plot shape means the decoupler resistor circuit is open. This plot shape can also be produced if the walk test is done incorrectly, so repeat the walk test several times to confirm the results. If walk tests consistently produce plots like these, replace the decoupler or the cable connector at the decoupler location.



Zone with a faulty or disconnected decoupler

Damaged cable

Nicks or breaks in the jacket of the sensor cable can allow moisture to penetrate the cable, causing false alarms. The tests outlined in 'Cable tests', p.2-11, will help you to identify cables that are shorted or open.

Faulty transceiver module

False alarms can be caused by a faulty Transceiver Module. Exchange the Transceiver Module with a properly configured Transceiver Module. If the noise remains in the zone, then it is a zone/environment problem. If the noise follows the Transceiver Module, then the Transceiver Module is the problem. Return the Transceiver Module to Senstar with a description of the problem.

Unidentifiable sources of nuisance alarms

In the event that the source of the nuisance alarms cannot be identified, collect the information as described in, 'Troubleshooting data', p.5-2 and send it to Senstar or your authorized Sentrax/S∞Trax dealer. Senstar and its dealers have experienced technical staff available to perform further testing and nuisance alarm troubleshooting.

System troubleshooting

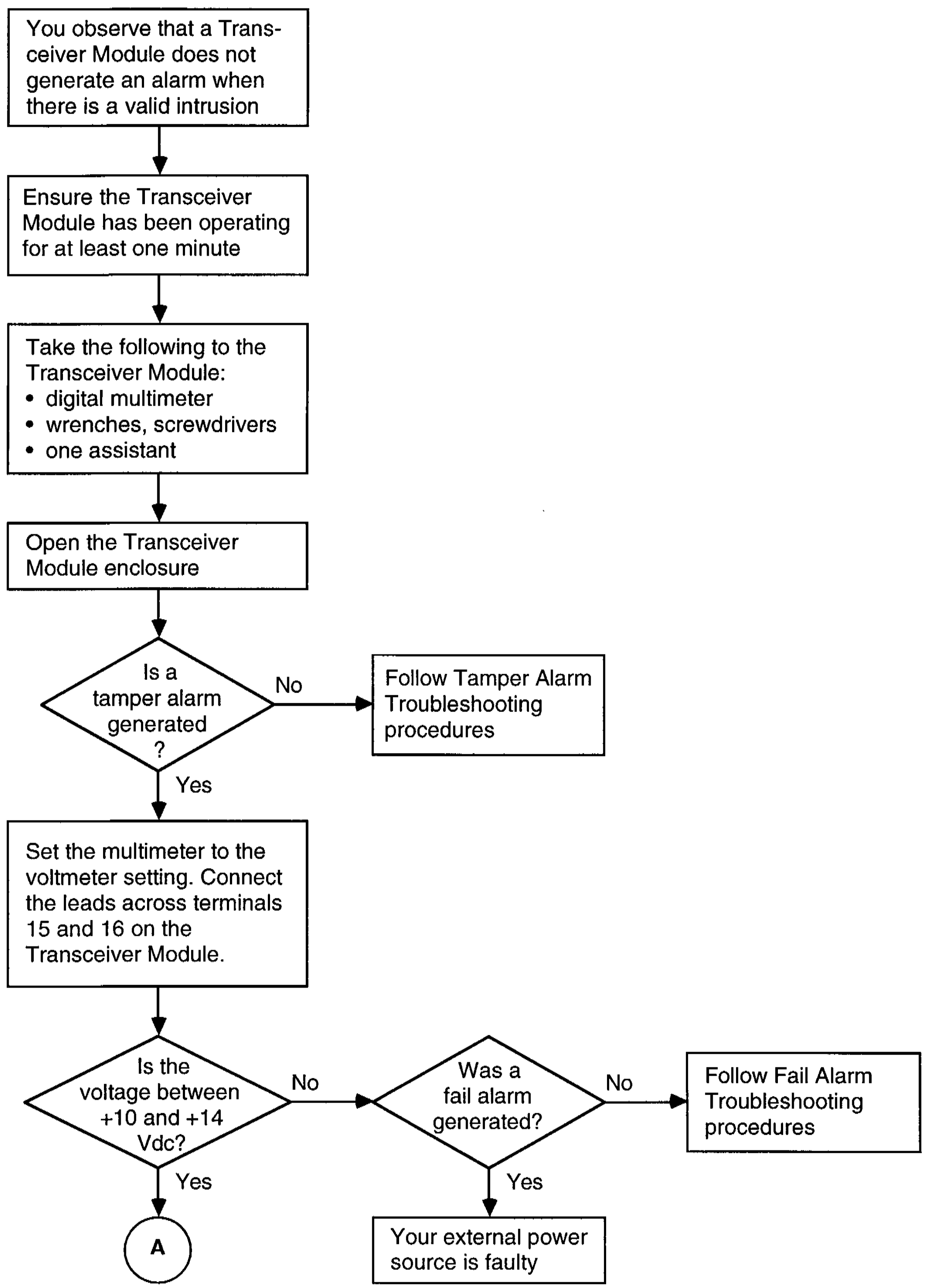
Introduction

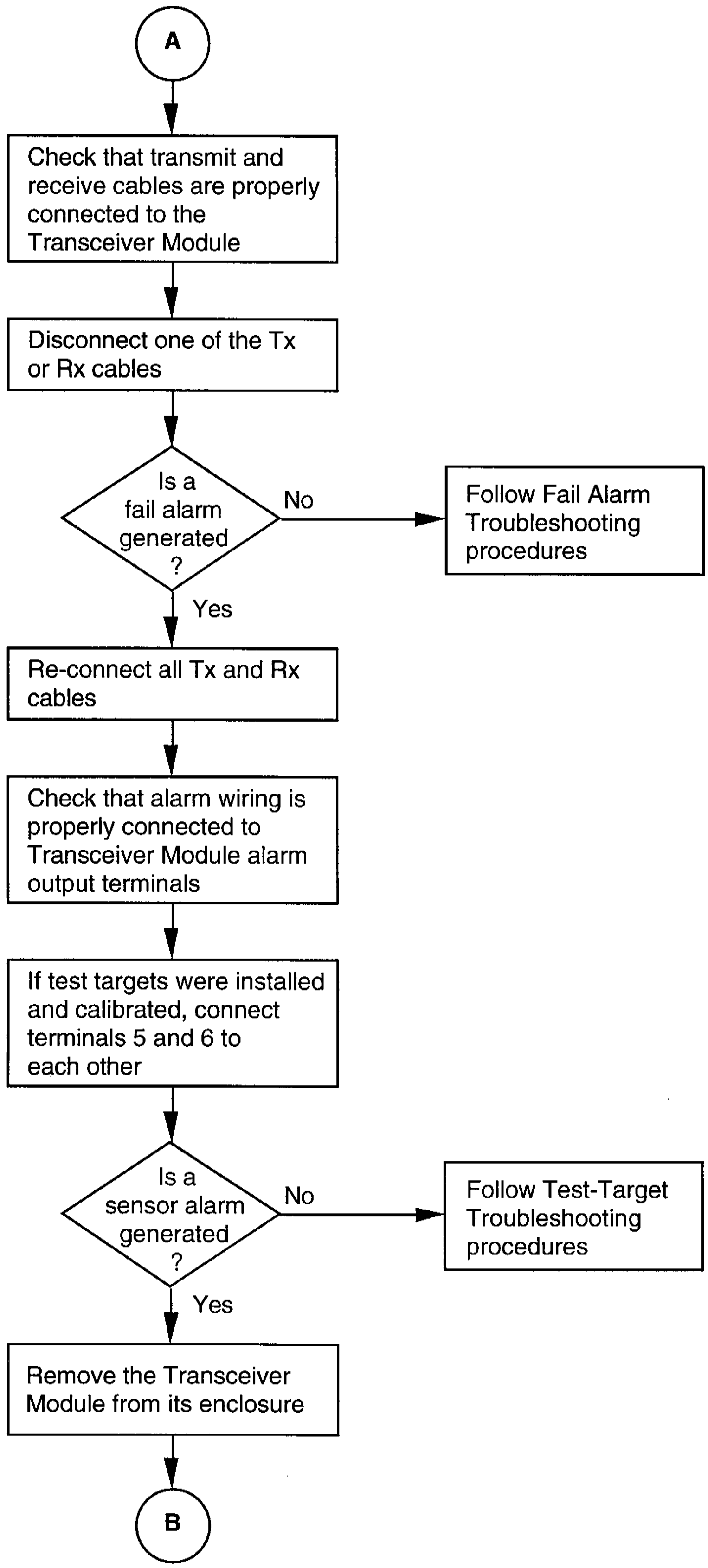
This chapter shows you how to diagnose faults in the Sentrax®/S∞Trax™ systems and determine probable causes. The chapter contains the troubleshooting charts listed in the table below:

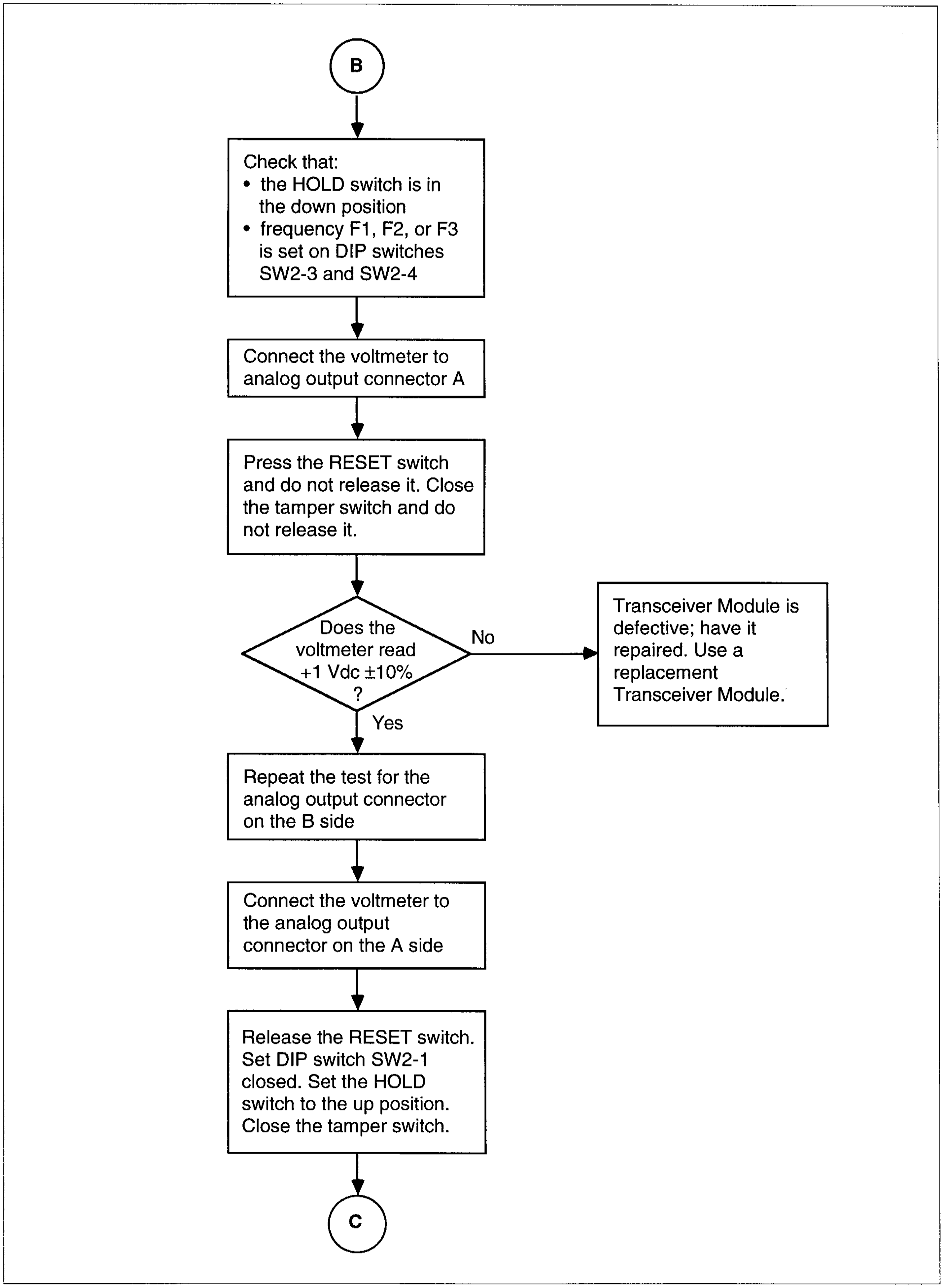
Symptom	Refer to
A sensor alarm is **not** generated when there is a valid intrusion	No alarm troubleshooting, page 6-2
A sensor alarm is generated but there is no visible cause	False alarm troubleshooting, page 6-9 and to chapter 5, **Nuisance alarms**
Activating the test targets does not generate an alarm, or test targets operate intermittently	Test-target troubleshooting page 6-15
Unexpected tamper alarm is generated	Tamper alarm troubleshooting, page 6-16
A fail alarm is generated	Fail alarm troubleshooting, page 6-18

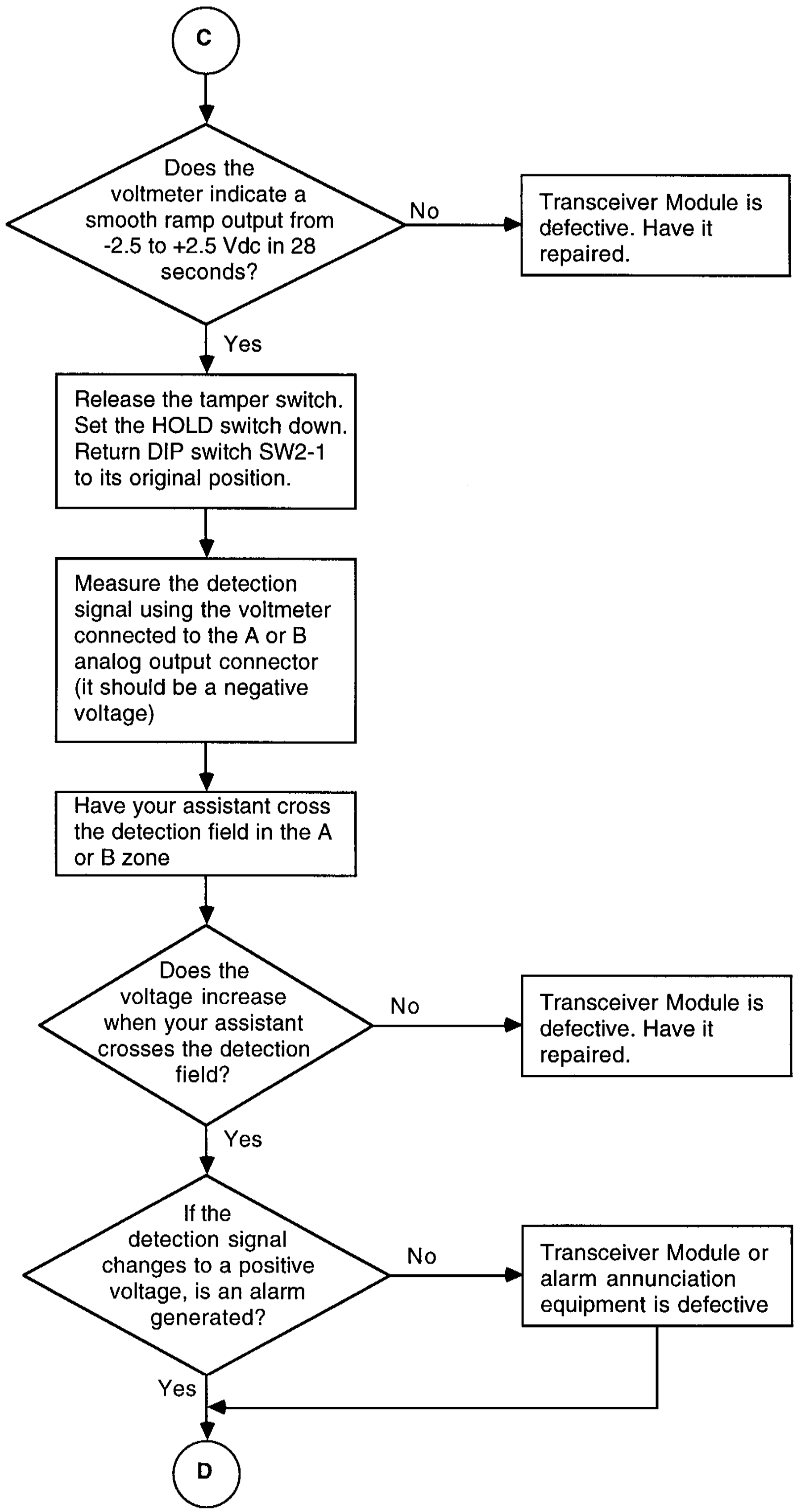
Fault finding table

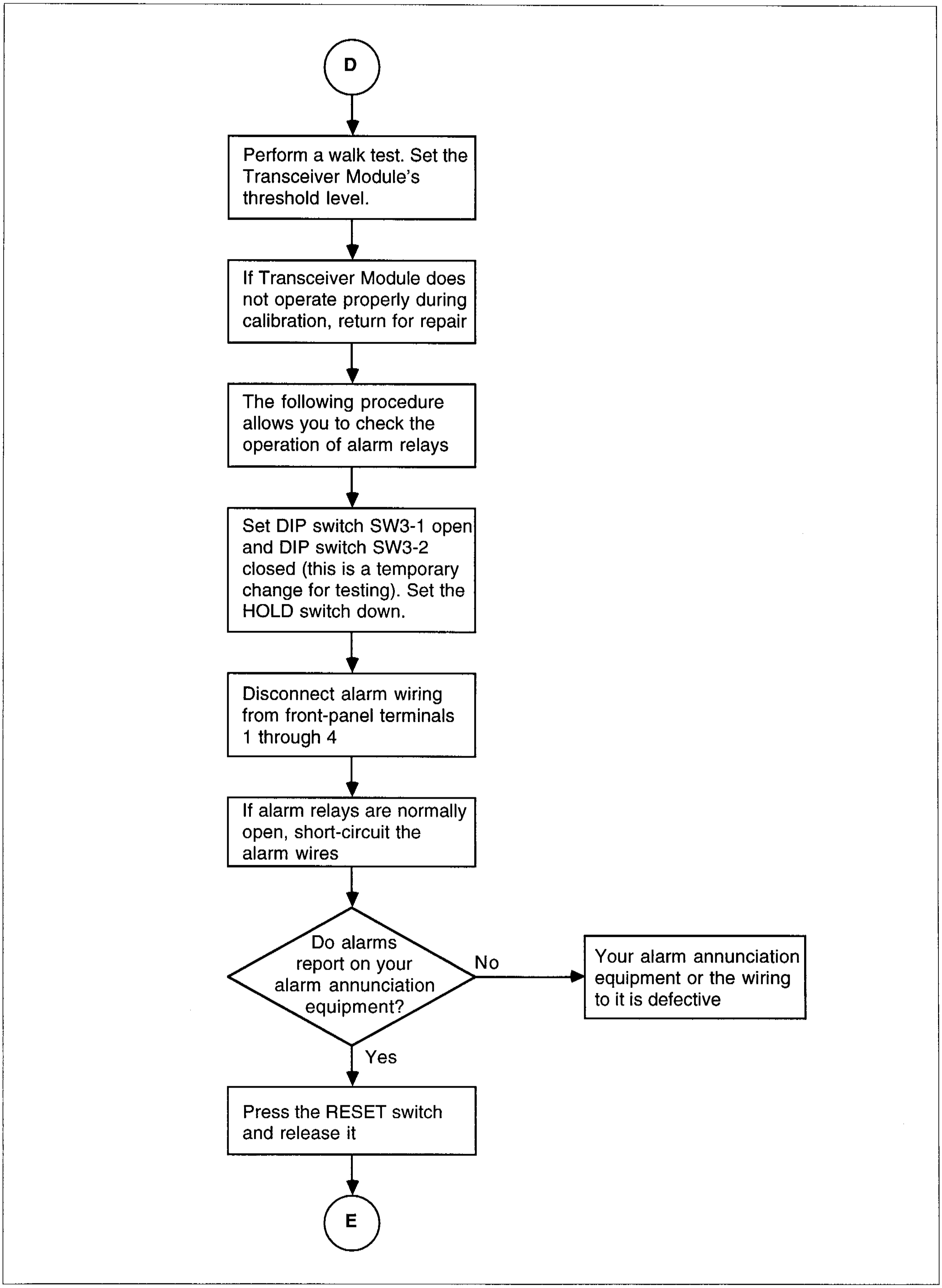
No alarm troubleshooting

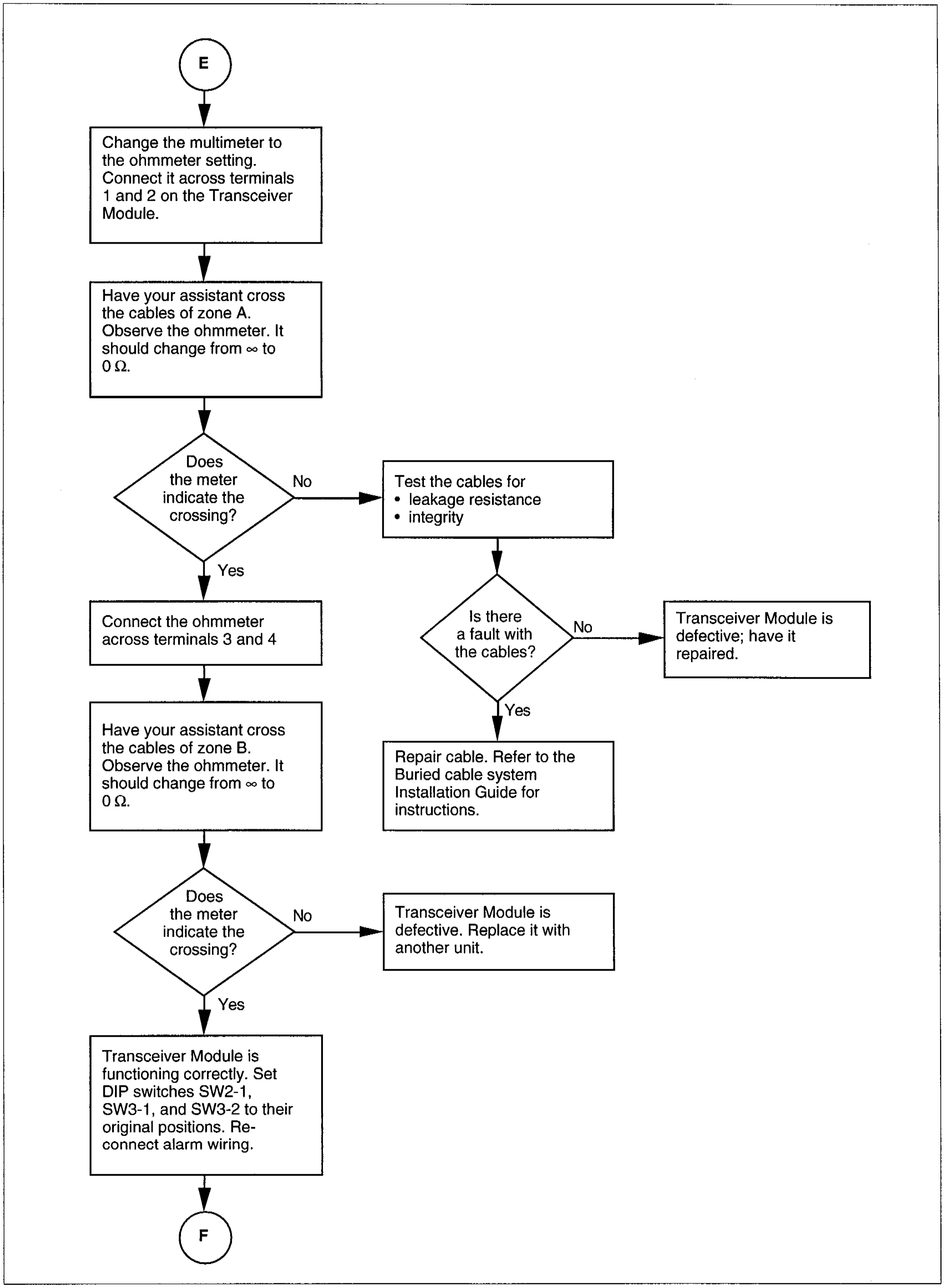


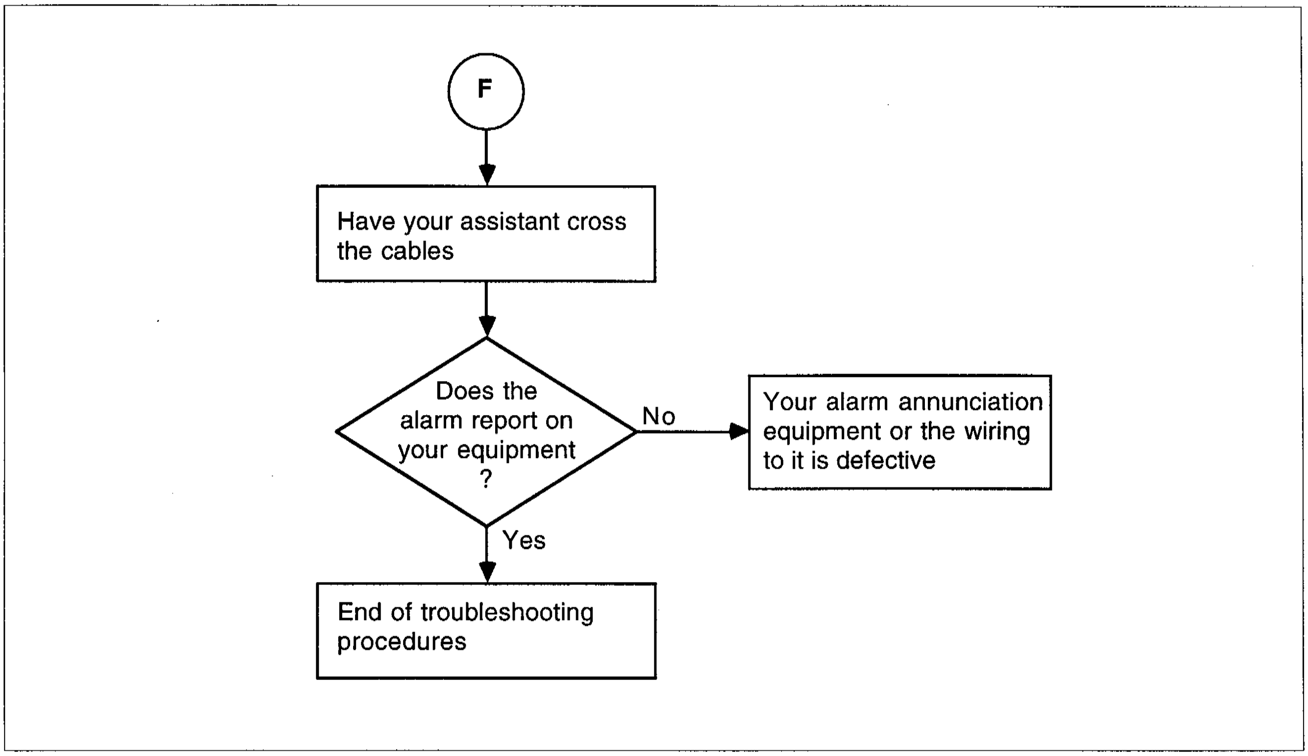

A
Check that transmit and receive cables are properly connected to the Transceiver Module
Disconnect one of the Tx or Rx cables
Is a fail alarm generated ?
No
Follow Fail Alarm Troubleshooting procedures
Yes
Re-connect all Tx and Rx cables
Check that alarm wiring is properly connected to Transceiver Module alarm output terminals
If test targets were installed and calibrated, connect terminals 5 and 6 to each other
Is a sensor alarm generated ?
No
Follow Test-Target Troubleshooting procedures
Yes
Remove the Transceiver Module from its enclosure
B


B
Check that:
• the HOLD switch is in the down position
• frequency F1, F2, or F3 is set on DIP switches SW2-3 and SW2-4
Connect the voltmeter to analog output connector A
Press the RESET switch and do not release it. Close the tamper switch and do not release it.
Does the voltmeter read +1 Vdc ±10% ?
No
Transceiver Module is defective; have it repaired. Use a replacement Transceiver Module.
Yes
Repeat the test for the analog output connector on the B side
Connect the voltmeter to the analog output connector on the A side
Release the RESET switch. Set DIP switch SW2-1 closed. Set the HOLD switch to the up position. Close the tamper switch.
C

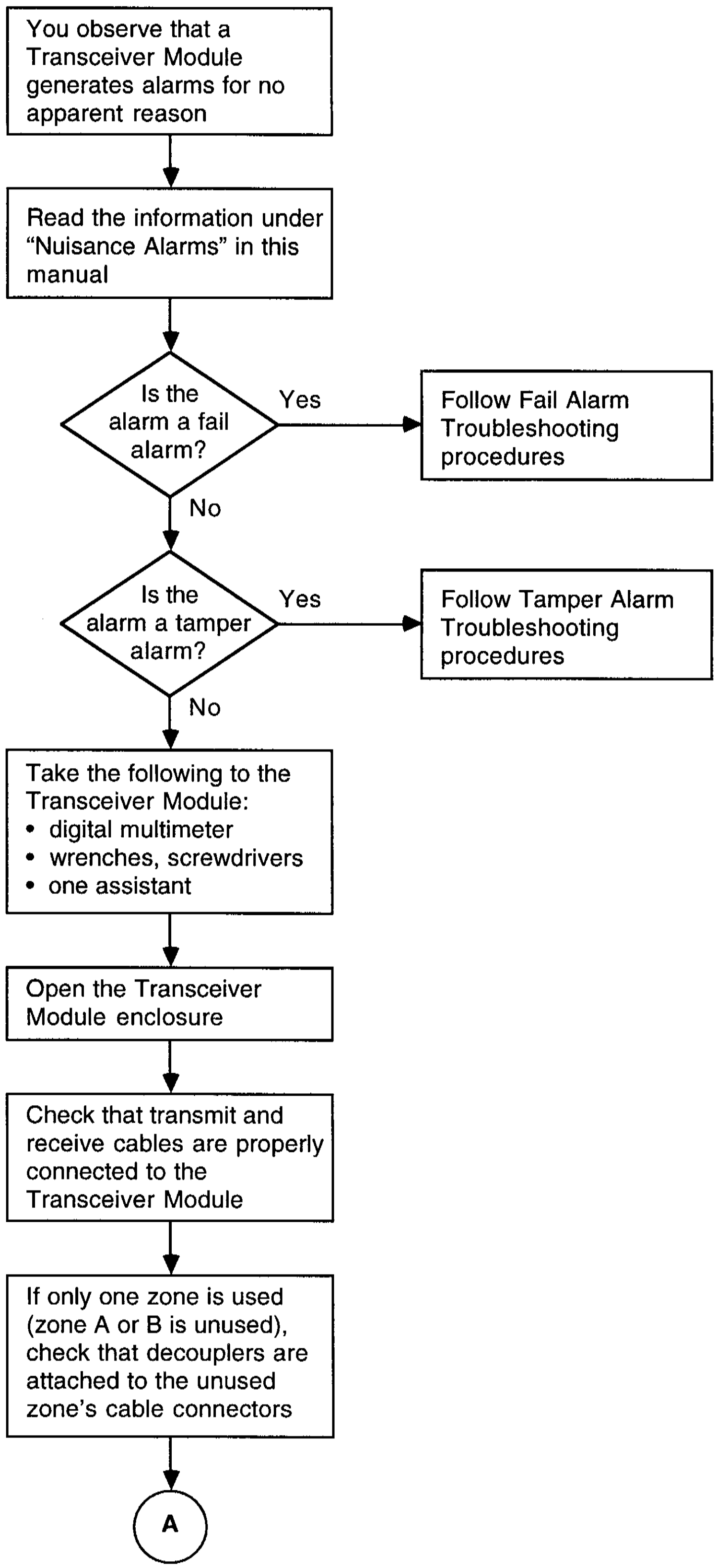

C
Does the voltmeter indicate a smooth ramp output from -2.5 to +2.5 Vdc in 28 seconds?
No
Transceiver Module is defective. Have it repaired.
Yes
Release the tamper switch. Set the HOLD switch down. Return DIP switch SW2-1 to its original position.
Measure the detection signal using the voltmeter connected to the A or B analog output connector (it should be a negative voltage)
Have your assistant cross the detection field in the A or B zone
Does the voltage increase when your assistant crosses the detection field?
No
Transceiver Module is defective. Have it repaired.
Yes
If the detection signal changes to a positive voltage, is an alarm generated?
No
Transceiver Module or alarm annunciation equipment is defective
Yes
D

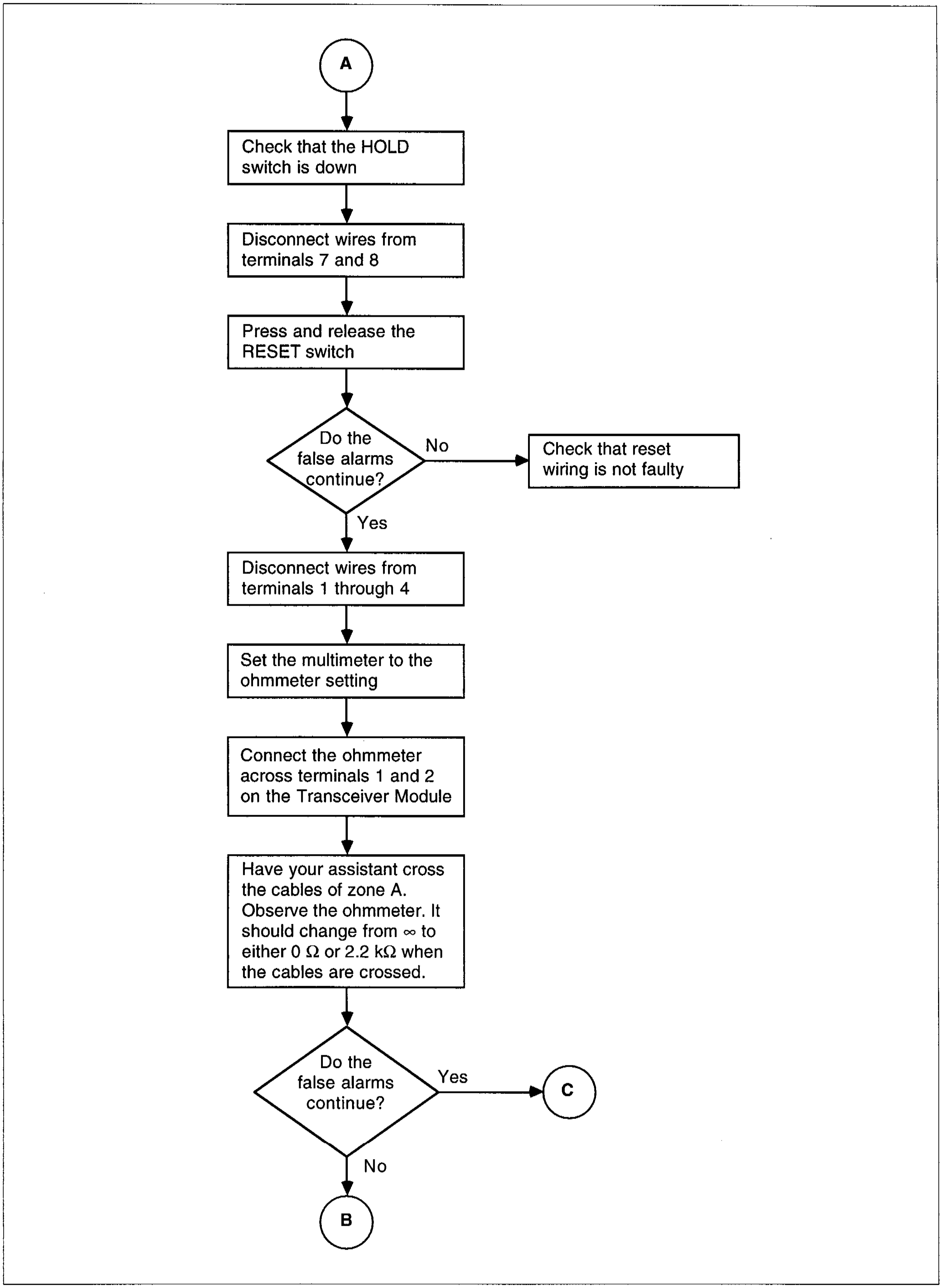

D
Perform a walk test. Set the Transceiver Module's threshold level.
If Transceiver Module does not operate properly during calibration, return for repair
The following procedure allows you to check the operation of alarm relays
Set DIP switch SW3-1 open and DIP switch SW3-2 closed (this is a temporary change for testing). Set the HOLD switch down.
Disconnect alarm wiring from front-panel terminals 1 through 4
If alarm relays are normally open, short-circuit the alarm wires
Do alarms report on your alarm annunciation equipment?
No
Your alarm annunciation equipment or the wiring to it is defective
Yes
Press the RESET switch and release it
E

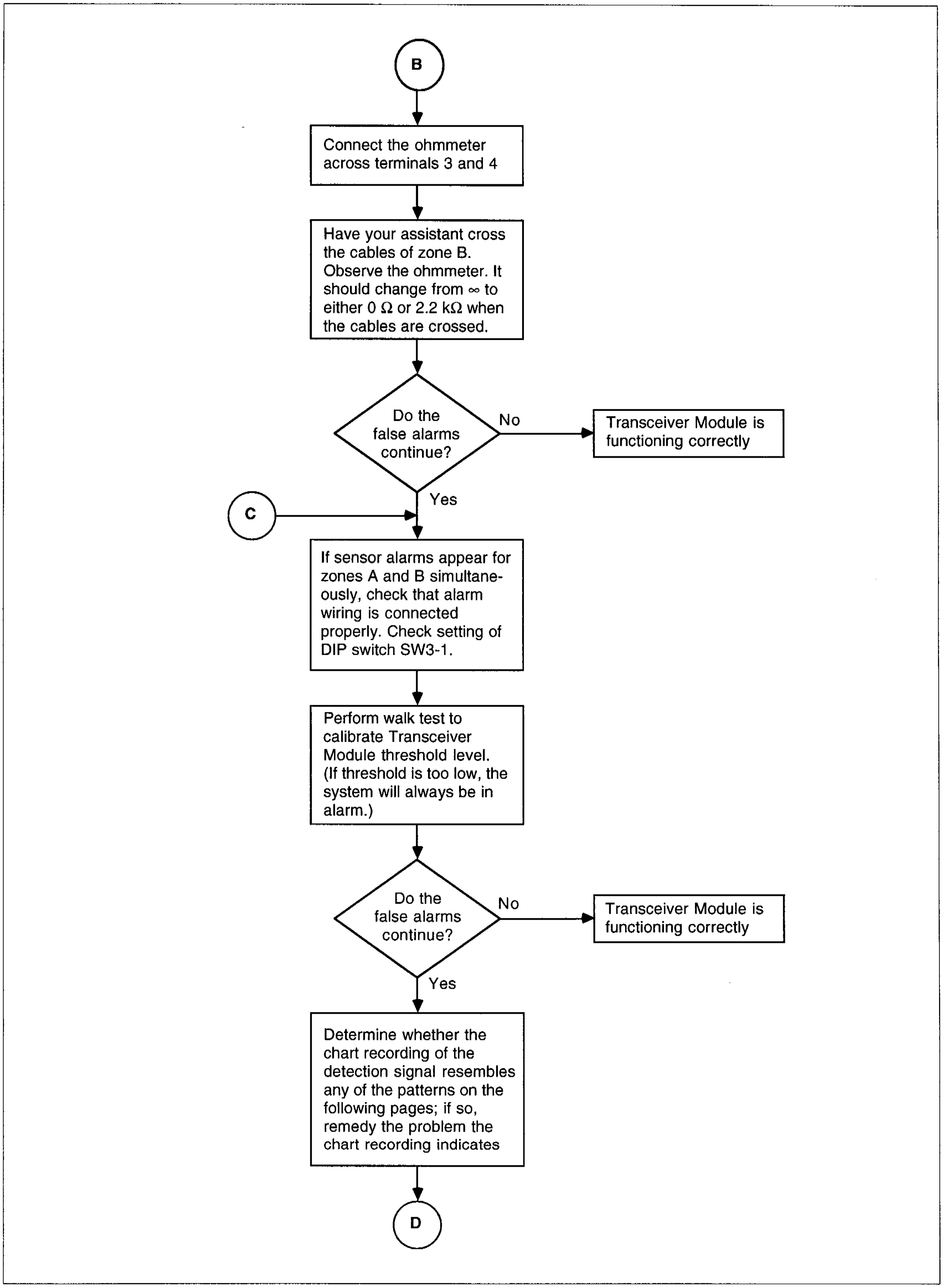

E
Change the multimeter to the ohmmeter setting. Connect it across terminals 1 and 2 on the Transceiver Module.
Have your assistant cross the cables of zone A. Observe the ohmmeter. It should change from ∞ to 0 Ω.
Does the meter indicate the crossing?
No
Test the cables for
• leakage resistance
• integrity
Is there a fault with the cables?
No
Transceiver Module is defective; have it repaired.
Yes
Repair cable. Refer to the Buried cable system Installation Guide for instructions.
Yes
Connect the ohmmeter across terminals 3 and 4
Have your assistant cross the cables of zone B. Observe the ohmmeter. It should change from ∞ to 0 Ω.
Does the meter indicate the crossing?
No
Transceiver Module is defective. Replace it with another unit.
Yes
Transceiver Module is functioning correctly. Set DIP switches SW2-1, SW3-1, and SW3-2 to their original positions. Reconnect alarm wiring.
F


F
Have your assistant cross the cables
Does the alarm report on your equipment ?
No
Your alarm annunciation equipment or the wiring to it is defective
Yes
End of troubleshooting procedures

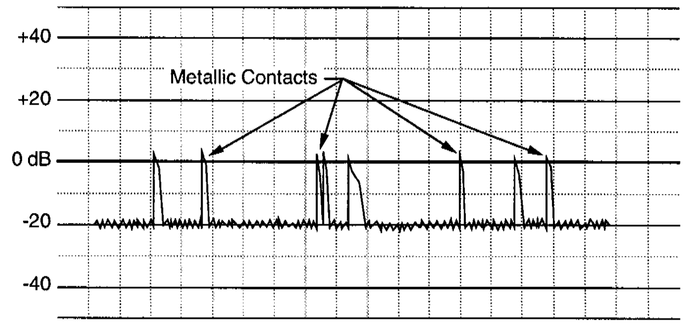
False alarm troubleshooting



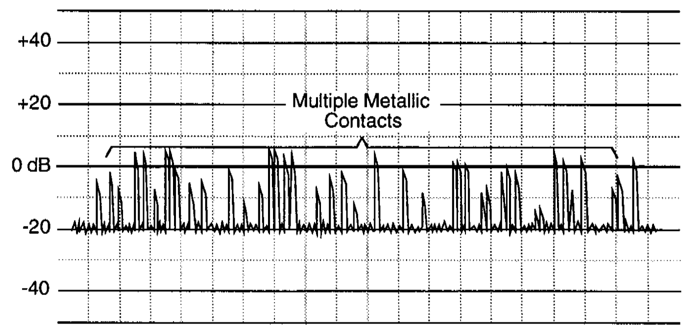

A
Check that the HOLD switch is down
Disconnect wires from terminals 7 and 8
Press and release the RESET switch
Do the false alarms continue?
No
Check that reset wiring is not faulty
Yes
Disconnect wires from terminals 1 through 4
Set the multimeter to the ohmmeter setting
Connect the ohmmeter across terminals 1 and 2 on the Transceiver Module
Have your assistant cross the cables of zone A. Observe the ohmmeter. It should change from ∞ to either 0 Ω or 2.2 kΩ when the cables are crossed.
Do the false alarms continue?
Yes
C
No
B


B
Connect the ohmmeter across terminals 3 and 4
Have your assistant cross the cables of zone B. Observe the ohmmeter. It should change from ∞ to either 0 Ω or 2.2 kΩ when the cables are crossed.
Do the false alarms continue?
No
Transceiver Module is functioning correctly
Yes
C
If sensor alarms appear for zones A and B simultaneously, check that alarm wiring is connected properly. Check setting of DIP switch SW3-1.
Perform walk test to calibrate Transceiver Module threshold level. (If threshold is too low, the system will always be in alarm.)
Do the false alarms continue?
No
Transceiver Module is functioning correctly
Yes
Determine whether the chart recording of the detection signal resembles any of the patterns on the following pages; if so, remedy the problem the chart recording indicates
D

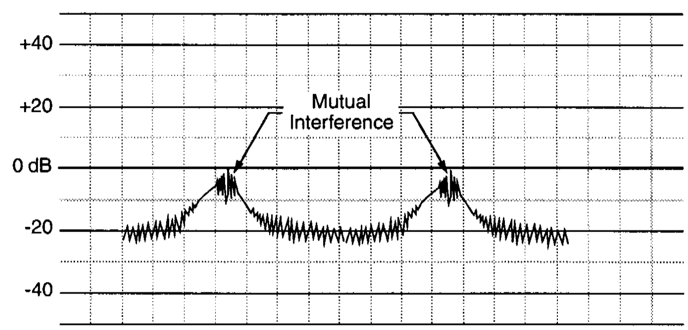
Single metallic contact (such as a fence or gate) in a zone



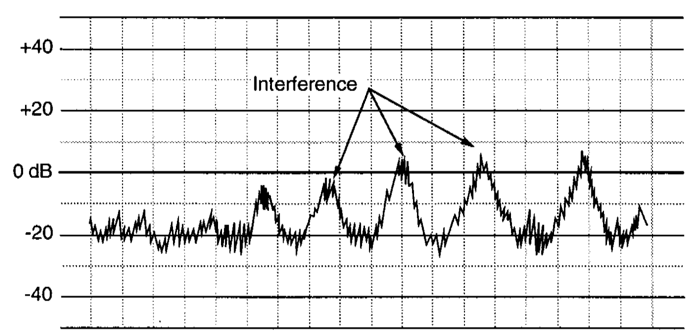
Multiple metallic contacts in a zone



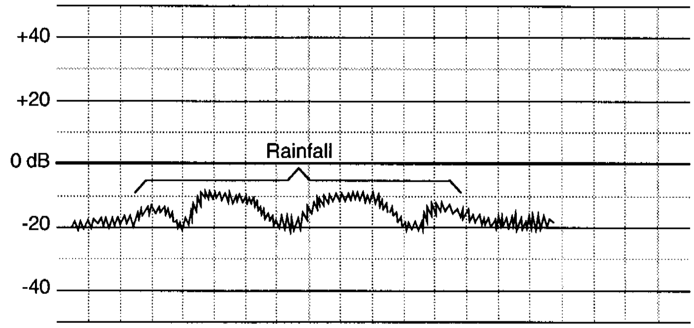
Rf interference from two Transceiver Modules operating in synch at the same detection frequency



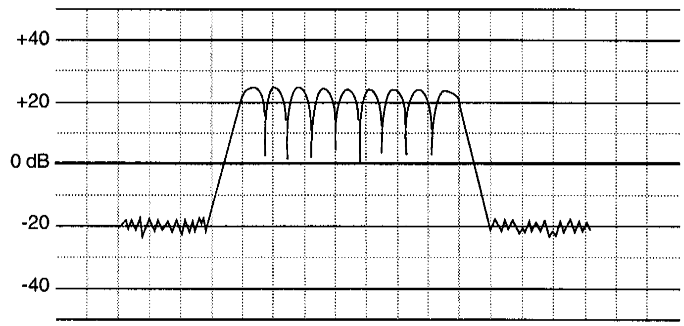
Rf interference from another unsynchronized Transceiver Module

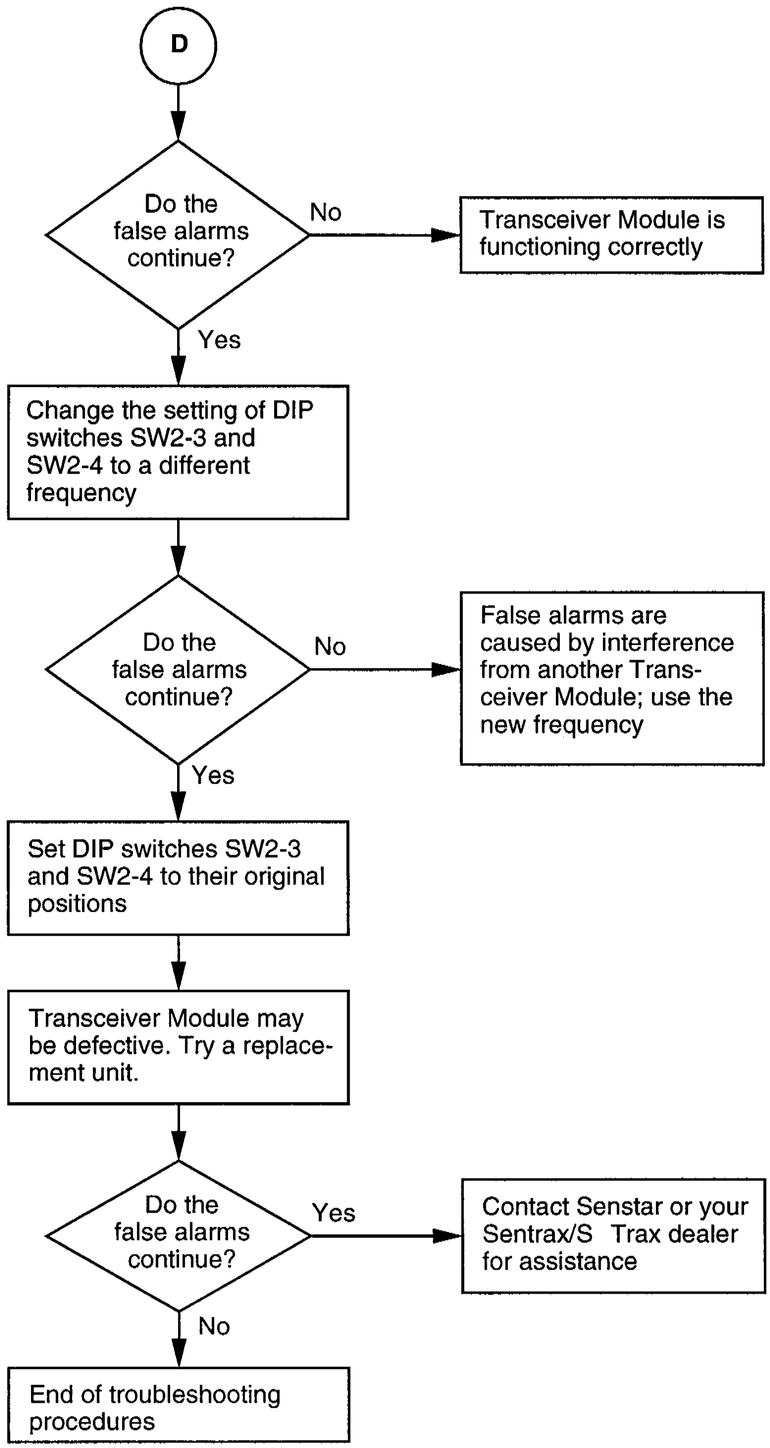


Rainfall in a zone (if this causes alarms, set DIP switch SW2-2 to the closed position)

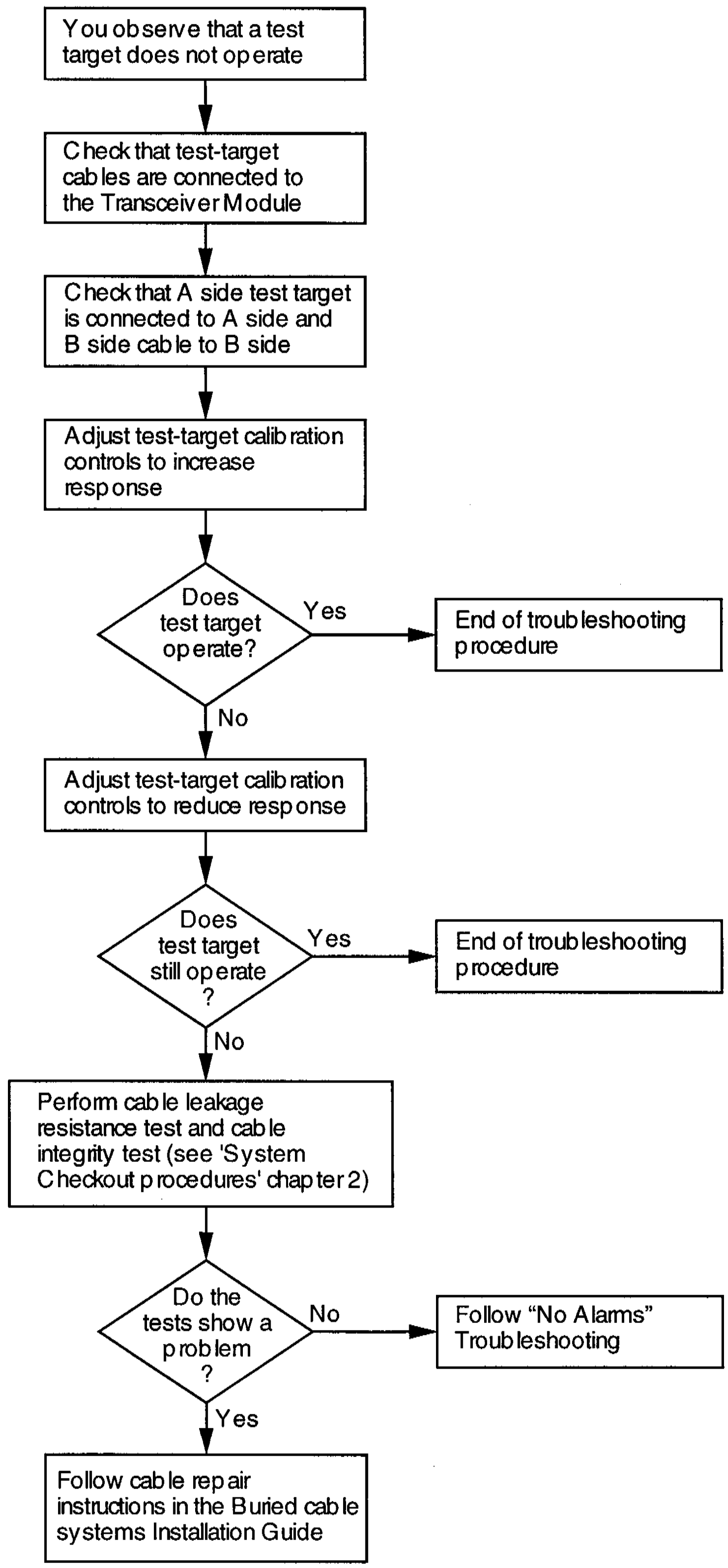


Walk test of a zone with a faulty decoupler

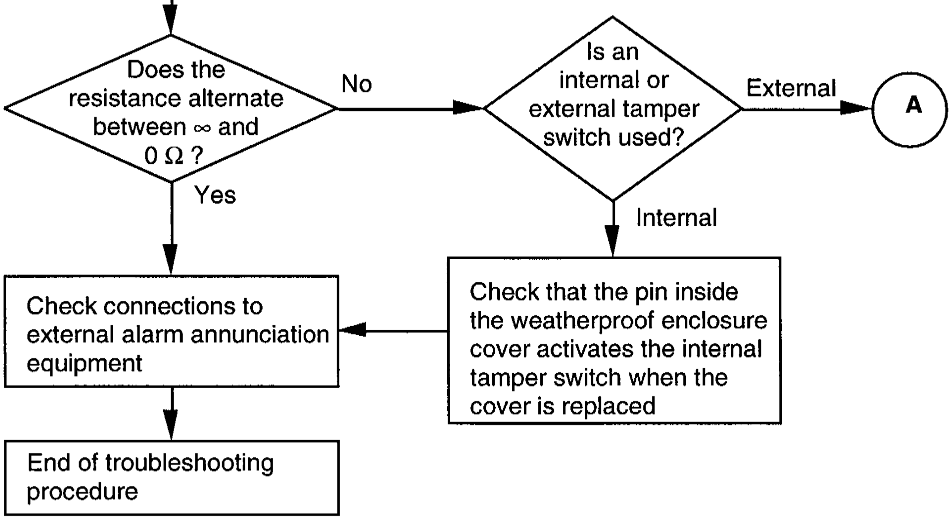


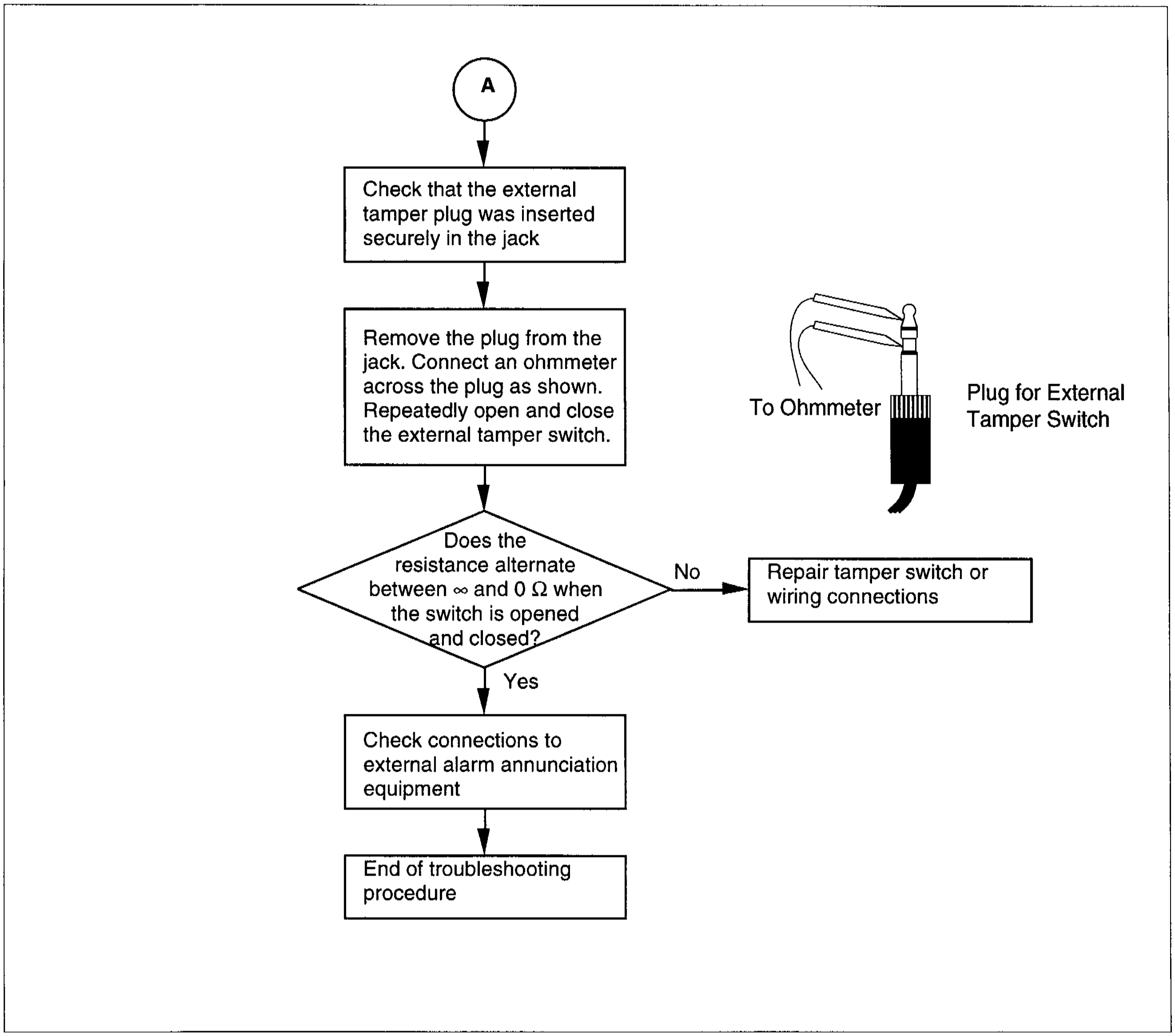

D
Do the false alarms continue?
No
Transceiver Module is functioning correctly
Yes
Change the setting of DIP switches SW2-3 and SW2-4 to a different frequency
Do the false alarms continue?
No
False alarms are caused by interference from another Trans-ceiver Module; use the new frequency
Yes
Set DIP switches SW2-3 and SW2-4 to their original positions
Transceiver Module may be defective. Try a replace-ment unit.
Do the false alarms continue?
Yes
Contact Senstar or your Sentrax/S Trax dealer for assistance
No
End of troubleshooting procedures

Test-target troubleshooting

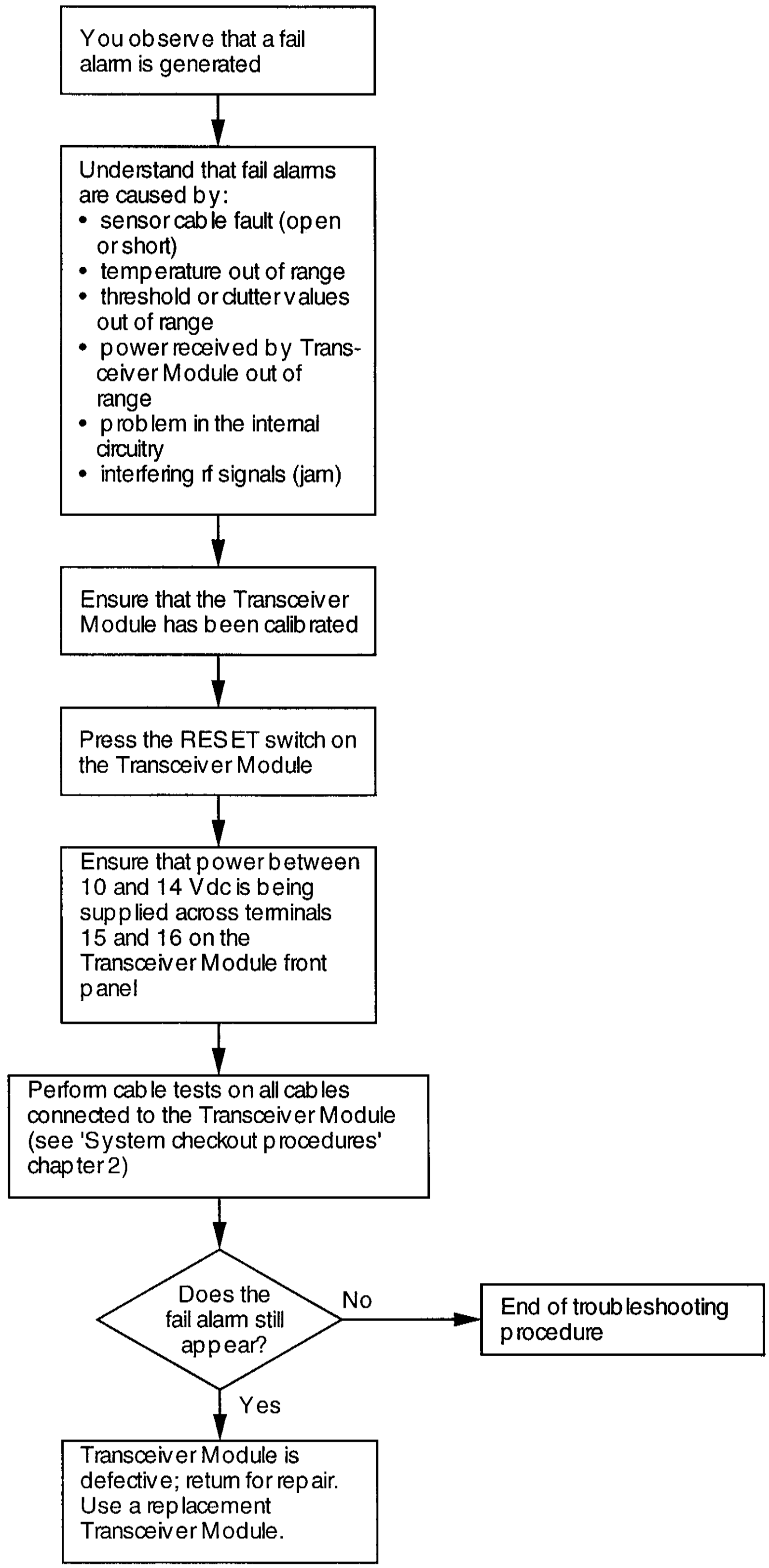


Tamper alarm troubleshooting




A
Check that the external tamper plug was inserted securely in the jack
Remove the plug from the jack. Connect an ohmmeter across the plug as shown. Repeatedly open and close the external tamper switch.
To Ohmmeter
Plug for External Tamper Switch
Does the resistance alternate between ∞ and 0 Ω when the switch is opened and closed?
No
Repair tamper switch or wiring connections
Yes
Check connections to external alarm annunciation equipment
End of troubleshooting procedure

Fail alarm troubleshooting

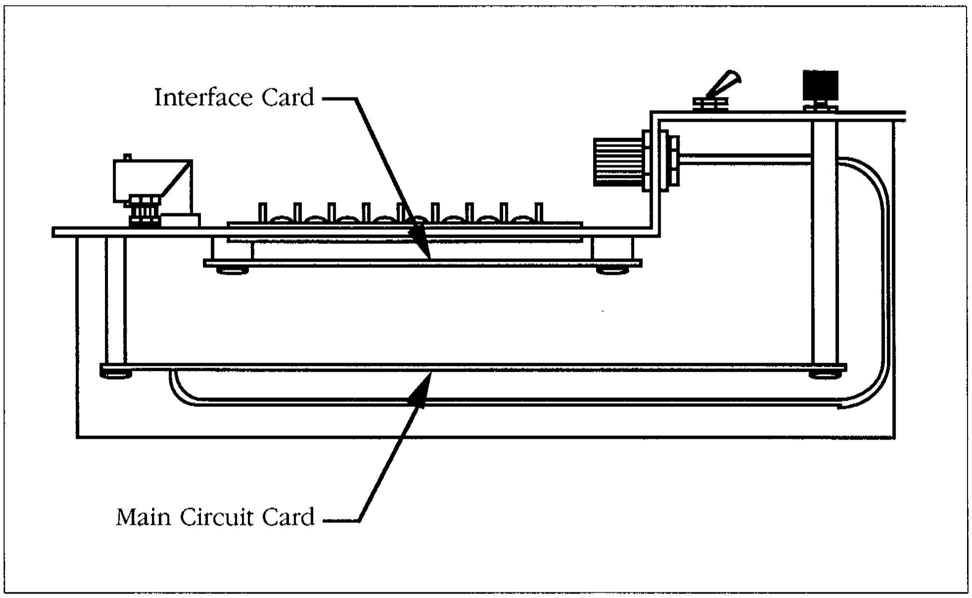


Removal and replacement of Transceiver Modules

Introduction

Follow the removal and replacement instructions in this chapter to:

- remove or replace the Transceiver Module main circuit card or interface card
- replace the main circuit card operating firmware
- replace fuses



Side view of Transceiver Module

Wear a static grounding wrist-strap when handling the main circuit card.

The Transceiver Module

Wear a static grounding wrist-strap when handling the main circuit card.

Removal

To remove the Transceiver Module from its enclosure, follow the steps outlined below:

1. Turn off the power supply to the Transceiver Module.
2. Remove the front cover of the weatherproof enclosure by loosening the six screws and clips holding it in place.
3. Ensure that all sensor and test-target cables are labelled. If cables are not labelled, affix tags to ensure proper reassembly.
4. Disconnect the sensor cables, test-target cables (if installed), and all wires attached to the front-panel terminals. If the external tamper plug is used, remove it from the jack.
5. Loosen the four Phillips-head screws that hold the Transceiver Module in its enclosure. Remove the Transceiver Module from the enclosure.
6. Locate the **DIP-Switch and Jumper Settings** form. Identify the DIP-switch and jumper settings used on the Transceiver Module, and make sure these settings are recorded on the form. Put the form back in its holder.
7. If sending the Transceiver Module for repair, include a description of the problem, chart recordings, test results, and results of troubleshooting procedures.

Contact Senstar to obtain a Return Materiel Authorization (RMA) number before returning any items for repair.

Replacement

Follow these instructions after maintenance work on the Transceiver Module is complete:

1. Locate the DIP-Switch and Jumper Settings form. Identify the DIP-switch and jumper settings marked on the form. Set the DIP switches and jumpers on the new Transceiver Module to match the settings indicated on the form. Put the form back in its holder.

2. Set the Transceiver Module in its enclosure. Tighten the four corner screws. Ensure that the ground wire is connected to a ground lug which is attached to one of the corner screws.

3. Connect the test-target cables (if used) to the A and B test-target connectors.

4. Reconnect all wires to the front-panel terminal strips. Ensure that you connect the wires to the same terminals from which they were removed.

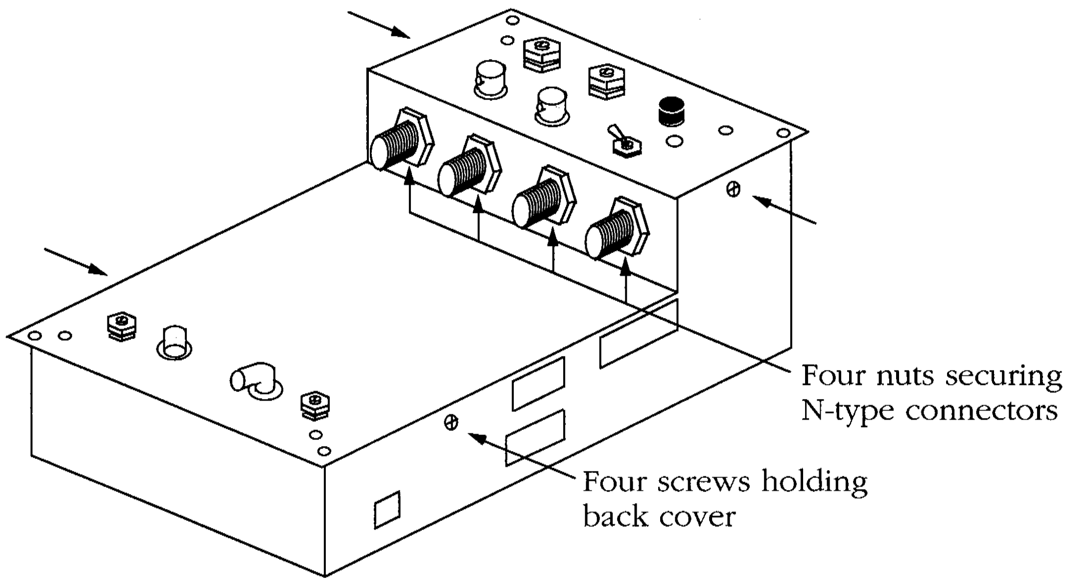
5. If an external tamper switch is used, insert the external tamper plug into the jack.

6. Reconnect the sensor cables to the corresponding connectors on the front panel.

7. Restore power. Calibrate the Transceiver Module threshold and test-target controls.

8. If using a weatherproof enclosure, replace its cover, ensure the tamper pin on the cover goes into the hole in the Transceiver Module front panel. Attach six Phillips-head screws to hold the cover in place.

The main circuit card



The main circuit card

> **Wear a static grounding wrist-strap when handling the main circuit card.**

Removal

1. Place the Transceiver Module on a clean, static-free surface.

2. Using a 19 mm (3/4 in) wrench, unscrew the nuts that hold the four N-type connectors to the front panel.

3. Using a Phillips screwdriver, undo the four screws securing the back cover. Remove the back cover.

4. Remove the four countersunk screws from the front panel. These screws hold the main circuit card to the front-panel assembly.

5. Push the four N-type connectors out of their mounting holes on the front panel. Be careful not to bend the coaxial tubes that are attached to the connectors. Lift the front-panel assembly away from the main circuit card.

6. Disconnect the three wiring harnesses from their sockets on the main circuit card. Be careful not to bend the pins on the wiring harness connectors.

Replacement

To replace the main circuit card:

1. Place the card and Transceiver Module on a clean, static-free surface.

2. Remove the nuts and washers from the four N-type connectors on the new main circuit card.

3. Reconnect all wiring harnesses removed in step 6, above. Be careful not to bend the pins on the wiring harness connectors.

4. Insert the four N-type connectors through the mounting holes on the front-panel assembly. Be careful not to bend the coaxial tubes that are attached to the connectors. Ensure that the wires are not being pinched.

5. Put the four washers and nuts on the N-type connectors and tighten the nuts with a 19 mm (3/4 in) wrench.

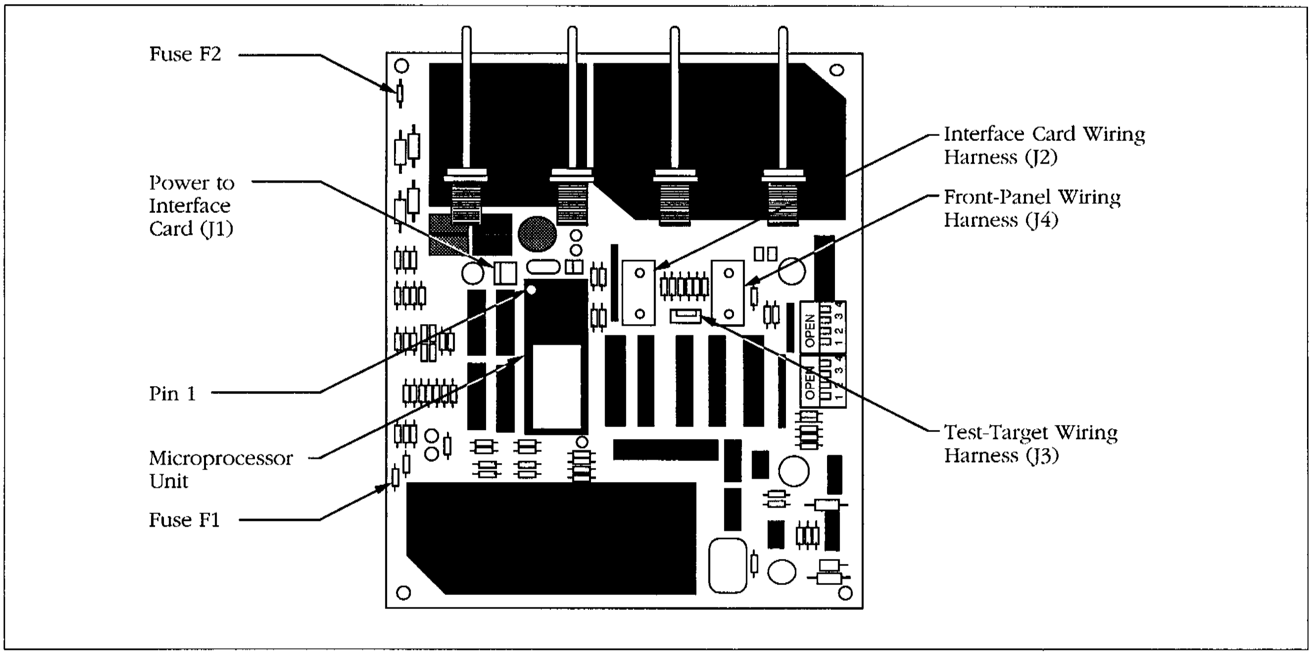
6. Attach the main circuit card to the front-panel assembly using four screws on the corners.

7. Attach the back cover to the Transceiver Module using four Phillips-head screws and washers.

8. Test the Transceiver Module to ensure its proper operation.

Changing the operating firmware

Each Transceiver Module contains operating firmware in the microprocesor unit on the main circuit card. To replace the microprocessor unit, follow the steps outlined below:



Main circuit card

Wear a static grounding wrist-strap when handling the main circuit card.

1. Remove the main circuit card from the Transceiver Module as described in 'The main circuit card, Removal', p. 7-4.

2. Locate the microprocessor unit on the main circuit card.

3. Use an IC extractor to remove the microprocessor unit from the main circuit card.

4. Insert the new microprocessor unit. Ensure the microprocessor unit is properly oriented in the socket by aligning pin 1 on the microprocessor unit with 'pin 1' on the card. Ensure all IC pins are firmly seated.

5. Replace the main circuit card by reversing the procedure outlined in 'The main circuit card, Replacement', p. 7-5.

Replacing fuses

Wear a static grounding wrist-strap when handling the main circuit card.

Main circuit card fuses

Each Transceiver Module has two 0.5-amp pico fuses on the main circuit card. Fuse F1 is in line with the receive cables; fuse F2 is in line with the transmit cables. Refer to the *Main circuit card* figure, p. 7-6, to identify the fuses' locations.

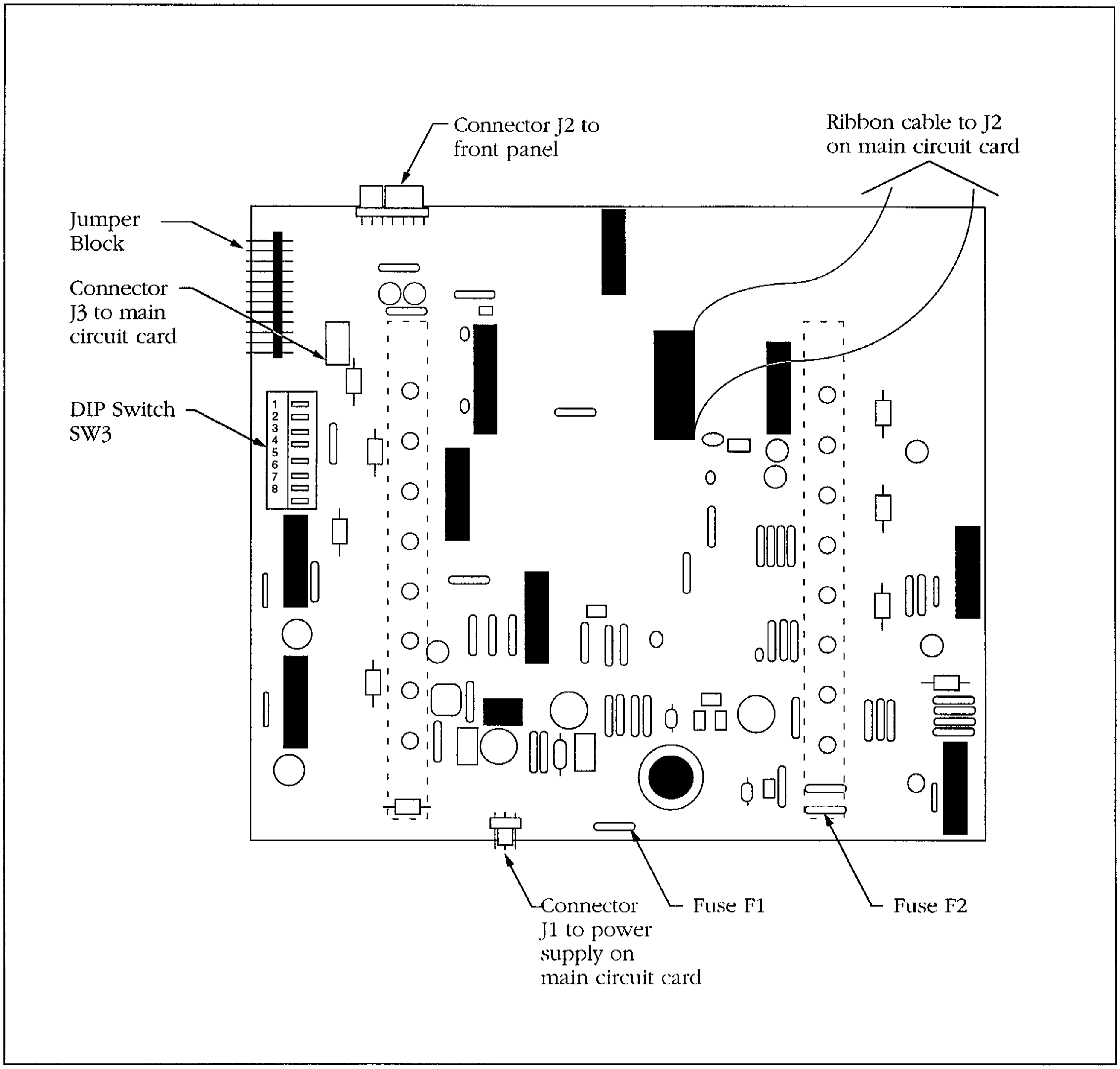
The fuses are available from Senstar. They look like 1/4 watt resistors. To remove a fuse, simply pull it from its socket on the circuit card. Trim the leads of the replacement fuse before installing it.

Interface card fuses

There are two 'pico' fuses on the interface card. The fuses look like 1/4-watt resistors. Refer to the *Interface card* figure, p. 7-10, to locate the fuses on the interface card.

To remove a fuse, simply pull it from its socket on the interface card. Trim the leads of the replacement fuse before installing it.

Fuse	Function	Type	Senstar Part Number
F1	protects +12 Vdc input to the DC/DC converter on the main circuit card	1.0 A pico fuse, 125 V rating	E0190
F2	protects +12 Vdc input to interface card	500 mA pico fuse, 125 V rating	E0005



Interface card

Glossary

Glossary

A-side zone odd-numbered zones that extend from one side of the Transceiver Module. The B-side zone extends from the opposite side

Alarm threshold see **Threshold**

Attenuator a device that reduces the strength of an electrical signal. An attenuator built into each Transceiver Module can be activated by setting a jumper on the main circuit card. If the attenuator is activated, the Transceiver Module's sensitivity is reduced in both zones

Bollard a concrete-filled post that prevents vehicles from running into field-mounted Transceiver Modules

B-side zone even-numbered zones that extend from one side of the Transceiver Module. The A-side zone extends from the opposite side

Burial depth the distance between the sensor cables and the surface of the medium in which the cables are installed

Cable fault a fail alarm condition detected by the Transceiver Module. Cable faults are either open circuits or short circuits

Cable path the route that the Sentrax/S∞Trax sensor cables follow along the perimeter of a site

Cable set one transmit and and one receive cable used in a Sentrax/S∞Trax zone. The Sentrax cable set consists of two separate coaxial cables. The S∞Trax cable set consists of one twin coaxial cable.

Cable spacing the lateral distance between the transmit and receive cables in a zone

Clutter the signal that is always present on the receive cable. It originates from the signal transmitted by the transmit cable, and is affected by the installation medium and stationary objects (vehicles, buildings, etc.) in the detection field and, in the case of Sentrax cables, cable spacing. You can measure the clutter level at the Transceiver Module. The clutter level is usually different for every zone

Containment walk a particular type of walk test performed on the perimeter to determine the extent of the detection field. See **Walk test**

dB decibel, a measure of signal strength

Decoupler a device installed in line with a sensor cable to define the end of a zone. A decoupler is a passive electronic device that stops radio-frequency signals, and therefore the detection field, from continuing along the cable path. You connect a decoupler between the sensor cables in two zones, or to a termination cable at the end of the perimeter

Detection field the area filled by radio-frequency signals around the sensor cables in which an intruder can be detected. The detection field extends above and below the ground and has an oval-shaped cross-section

Detection signal the signal received by the Transceiver Module on the receive cables. It is measured in decibels (dB) and increases when an intruder enters the detection field

Electromagnetic field the field created by the radio-frequency signals in the Sentrax/S∞Trax sensor cables. See **Detection field**

Enclosure any type of housing used to protect the Transceiver Module from the weather and from tampering

External tamper switch a customer-supplied, normally-open switch. You can connect the switch to the external tamper plug. When the switch's electrical contacts open, the Transceiver Module generates a tamper alarm

Fail alarm an alarm generated if the Transceiver Module senses a fail condition. The TM100-1 Transceiver Module annunciates fail alarms via front-panel terminals 11 and 12

Fail-safe alarm an alarm generated when the input voltage to a sensor falls outside its operational range

False alarm a sensor alarm with no observable physical cause

Ferrite beads ferrite rings that are installed at 30 cm (12 in) intervals along the lead-in cables of the Sentrax system between the detection field and the Transceiver Module. They prevent the detection field from following the lead-in cable back to the Transceiver Module

Heavy soil a clay-like soil

HOLD switch a switch on the Transceiver Module front panel. It lets you determine the maximum level of the detection signal. It is used only when calibrating or testing a Transceiver Module

Interface card a circuit card located behind the terminal strips on the Transceiver Module front panel. Circuits on the interface card perform functions relating to signals sent and received via the front-panel terminals

Intrusion alarm see **Sensor alarm**

Jam alarm an alarm raised by the Transceiver Module when it detects a device emitting signals in the same frequency range as the Transceiver Module's rf signals

Lead-in cable the portion of the sensor cable that connects the sensor cables to the Transceiver Module. Lead-in cables are completely shielded to prevent radio-frequency signals from escaping, so they prevent the detection field from forming near the Transceiver Module. Lead-in cable is 20 m (66 ft) long; sensor cable is 100, 150, or 200 m (328, 492, or 656 ft) long. See also **Ferrite beads**; **White mark**

Leaky cable a term describing the type of sensor cable used in the Sentrax/S∞Trax system. Leaky cable is like ordinary coaxial cable except that the braided shield surrounding the cable conductor is incomplete. Diamond-shaped openings in the shield allow a portion of the radio-frequency signal to escape and form the detection field around the cable. See **Sensor cable**

Light soil a sandy soil

Medium soil a normal soil such as loam, half-way between a light, sandy soil and a heavy, clay soil

Nuisance alarm an alarm that occurs when the Transceiver Module generates a sensor alarm caused by an object or disturbance other than a valid target.

Protective enclosure An optional enclosure for the Transceiver Module and the weatherproof enclosure. The protective enclosure is identical to enclosures used in many telephone and cable television installations. The protective enclosure provides additional protection against the elements and serves to camouflage the Transceiver Module

Receive cable the sensor cable that picks up radio-frequency signals emitted by the transmit cable and returns them to the Transceiver Module

Red band a mark painted on the S∞Trax sensor cable to show where the lead-in cable stops and the sensor cable begins. The lead-in cable is 20 m (66 ft) long and the sensor cable is 50, 100, or 150 m (164, 328, or 492 ft) long.

RESET switch a push-button switch on the Transceiver Module front panel. You use it to clear the Transceiver Module detection filter, display alarm threshold value or analog outputs

S∞Trax™ the brand name of a single cable leaky coaxial cable perimeter intrusion detection system manufactured by Senstar Corporation

Sensor alarm an alarm generated by the Transceiver Module when an intruder enters the detection field. The TM100-1 Transceiver Module annunciates sensor alarms via front-panel terminals 1 through 4

Sensor cable the buried intrusion-sensing element of the Sentrax/S∞Trax system. Cable is available in sets of various lengths. Each cable set contains a pair of cables: one cable transmits a radio-frequency signal and the other receives it. Sensor cables are connected to the Transceiver Module via lead-in cable. See also **Leaky cable**; **Lead-in cable**; **Zone**

Sentrax® the brand name of a dual cable leaky coaxial cable perimeter intrusion detection system manufactured by Senstar Corporation

Synchronization a process that enables the operation of electronic circuits in adjacent Transceiver Modules to be coordinated to prevent mutual rf interference

Tamper alarm an alarm that indicates tampering with a Sentrax/S∞Trax sensor. The TM100-1 Transceiver Module annunciates tamper alarms via front-panel terminals 13 and 14

Tamper switch a mechanical switch activated through a hole in the Transceiver Module front panel. A metal pin on the inside of the weatherproof enclosure cover protrudes into the hole and holds the switch closed. When the cover is removed, the switch opens and the Transceiver Module generates a tamper alarm

Terminator a device attached to the decoupler on the last zone or zones of a perimeter. They also terminate data signals that are carried on the sensor cables

Test target a special antenna buried near the sensor cables in each zone. Test targets provide a test function for the Transceiver Module and the alarm system

Test-target calibration controls two screw-type controls on the Transceiver Module front panel that let you adjust the test-target response during system set-up. The controls are labelled TTA (test target A-zone) and TTB (test target B-zone)

Threshold the level that the detection signal, received by the Transceiver Module on the receive cable, must exceed to cause an alarm condition. It is measured in decibels

Threshold adjustment controls two screw-type controls on the Transceiver Module front panel that let you adjust the threshold level. There are separate controls for zones A and B. They are calibrated in decibels

Transceiver Module a microprocessor-controlled device that serves as the sensor unit of the Sentrax/S∞Trax system. Each unit is connected to one or two sets of sensor cables and provides intrusion detection for two zones, each up to 200 m (656 ft) long. The Transceiver Module contains electronic circuitry, controls, and cable connectors. The TM100-1 Transceiver Module has terminals for the connection of external power, control, and alarm annunciation devices

Transmit cable the sensor cable that emits the radio-frequency signals generated by the Transceiver Module. The radio-frequency signals form the detection field

Walk test a procedure in which the user tests the operation of the Sentrax/S∞Trax system by walking along the centre line of the sensor cables in a zone. The results of the test are used when setting the threshold for each zone

Weatherproof enclosure a gray, metal, weatherproof box that protects the Transceiver Module

White mark a mark painted on the Sentrax sensor cable to show where the lead-in cable stops and the sensor cable starts. The lead-in cable is 20 m (66 ft) long and the sensor cable is 50, 100, 150, or 200 m (164, 328, 492, or 656 ft) long

Zone a section of a site perimeter that is protected by a single set of sensor transmit and receive cables. Each Transceiver Module can monitor two zones. The Transceiver Module can report sensor alarms separately for each zone

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