

SiteNet™ 450

Operation Manual



Part Number 45423-00-ENG
Revision A
October 2001

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

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

Changes and modifications not expressly approved by the manufacturer or registrant of this equipment can void your authority to operate this equipment under Federal Communications Commission rules.

Broadcast frequency, transmit power, channel spacing and antenna gain are regulated by countries-of-use. These are unique on a per-country basis. The broadcast frequencies, channel spacing, and country-of-use for the radio-modem must be specified at time of order. Contact your local Trimble representative for further information. Specifications and descriptions are subject to change without notice.

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About this Manual

Welcome to the *SiteNet 450 Operation Manual*. This manual describes how to install, set up, and use the SiteNet™ 450 radio-modem.

Even if you have used other radio-modems before, Trimble recommends that you spend some time reading this manual to learn about the special features of this product.

If you are not familiar with GPS, visit Trimble's website (www.trimble.com) for an interactive look at Trimble and GPS.

Related Information

Other sources of related information are:

- Release notes – the release notes describe new features of the product, information not included in the manuals, and any changes to the manuals.
- Update notes – there is a warranty activation sheet with this product. Send it in to automatically receive update notes containing important information about software and hardware changes. Contact your local Trimble Dealer for more information about the support agreement contracts for software and firmware, and an extended warranty program for hardware.
- Look at the Trimble website support page at www.trimble.com/support/ for additional information such as: technical tips, service bulletins, and FAQs. Also, you can download software patches, firmware and utility programs.
- Trimble training courses – consider a training course to help you use your GPS system to its fullest potential. For more information, visit the Trimble website at www.trimble.com/support.

Technical Assistance

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- Complete the Reader Comment Form at the back of this manual and mail it according to the instructions at the bottom of the form.

If the reader comment form is not available, send comments and suggestions to the address in the front of this manual. Please mark it *Attention: Technical Publications Group*.

Document Conventions

The document conventions are as follows:

Convention	Definition
<i>Italics</i>	Identifies software menus, menu commands, dialog boxes, and the dialog box fields.
Helvetica Narrow	Represents messages printed on the screen.
Helvetica Bold	Identifies a software command button, or represents information that you must type in a software screen or window.
"Select <i>Italics</i> / <i>Italics</i> "	Identifies the sequence of menus, commands, or dialog boxes that you must choose in order to reach a given screen.
Ctrl	Is an example of a hardware function key that you must press on a personal computer (PC). If you must press more than one of these at the same time, this is represented by a plus sign, for example, Ctrl + C .

Getting Started

In this chapter:

- Introduction
- Hardware Specification
- SiteNet 450 Description

Introduction

The SiteNet 450 radio-modem broadcasts raw GPS data in Compact Measurement Record (CMR) format from a reference receiver to one or more roving receivers for precise machine positioning.

The SiteNet 450 is compatible with Trimble's TRIMTALK™ 450 and TRIMMARK™ radios for broadcasting and receiving Radio Technical Commission for Maritime Services (RTCM) or CMR data.

Trimble recommends that you use the CMR+ format whenever possible.

Hardware Specification

The SiteNet 450 meets stringent hardware requirements, such as the Caterpillar EC-1 specification. The SiteNet 450 features:

- Integrated low-profile antenna for machine installations.
- Physical connection by means of the same 8-pin male Bendix connector previously used on TRIMCOMM™ radios. For a description of the connector pinout, see Pinout Information, page 44.

In addition, the SiteNet 450 is designed for use with unconditioned power 10.5 VDC to 20 VDC.

In a SiteVision™ GPS system or a BladePro 3D® GPS system, 12 VDC is provided through the Trimble GPS receiver, using the standard SiteNet 450 machine cable.

Note – As used in this manual, *CMR* as well as *CMR Plus* formats are both represented by *CMR*.

SiteNet 450 Description

The SiteNet 450 is a multi-channel, ultra high frequency (UHF) radio unit and data modem packaged in a rugged, waterproof, metal case and is designed to withstand severe environmental stress.

Features

- Low latency CMR transmission
- Compatible with TRIMTALK 450 and TRIMMARK radio networks
- Upgradeable software
- Selectable frequencies
- License-free operation in some European countries
- Ruggedized, waterproof casing
- Typical 3–5 km range
- Low power consumption
- One CAN (J1939) port
- Two RS-232 interfaces
- Low-profile antenna for machine applications

Options

- 5 dB gain whip antenna for infrastructure applications
- AC/DC converter
(AC: 100–250 V, 50–60 Hz) (DC: 16 V, 1.56 A)
- DC adapter cable for infrastructure radios
- Machine mounting kit (for more information, see Mounting the SiteNet 450 on a Machine, page 21)

Frequency Band

Broadcast frequency, transmit power, channel spacing and antenna gain are regulated by countries-of-use. These are unique on a per-country basis. The broadcast frequencies, channel spacing, and country-of-use for the radio-modem must be specified at time of order. For more information, contact your local Trimble representative.

Note – *Specifications and descriptions are subject to change without notice.*

Configuring the SiteNet 450

In this chapter:

- Introduction
- Default Settings
- Configuration

Introduction

The SiteNet 450 radio-modem contains both a data modem and a radio. It can be used in a variety of configurations to form a complete wireless data network. One configuration is as a base radio broadcasting directly to a Trimble 4700™, 4800™, or 5700™ rover GPS receiver that contains an internal radio-modem. Alternatively, an SiteNet 450 can operate as a repeater or as a receiving radio for a machine control system.

Default Settings

The SiteNet 450 serial output ports are configured at the factory with the following settings:

- 38400 baud
- 8 data bits, no parity
- 1 stop bit

The SiteNet 450 is preconfigured as a rover. It retrieves these parameters at power up. They can be changed using the WinFLASH utility.

Configuration

WinFLASH is a utility programme used to configure the SiteNet 450. You need Microsoft Windows 95/98/2000 or Windows NT to run *WinFLASH* on your PC. For more information about the installation of *WinFLASH*, read the README.TXT file provided on the *WinFLASH* CD.

Connecting to the SiteNet 450

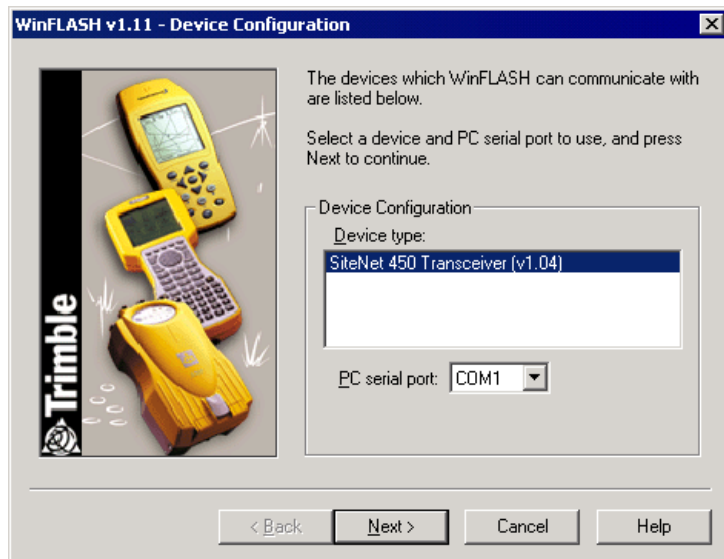
1. Connect a SiteNet 450 service cable to the SiteNet 450.
2. Connect the I/O DB-9 connector of the service cable to a serial port on your PC.

Note – Figure 3.7 on page 28 shows an infrastructure cable (PN 38968-25) connected to the SiteNet 450. Figure 3.10 on page 31 shows the service cable (PN 40942-xx) connected to the SiteNet 450 and a PC.

3. Provide power to the radio through the power lead of the service cable.

Starting WinFLASH

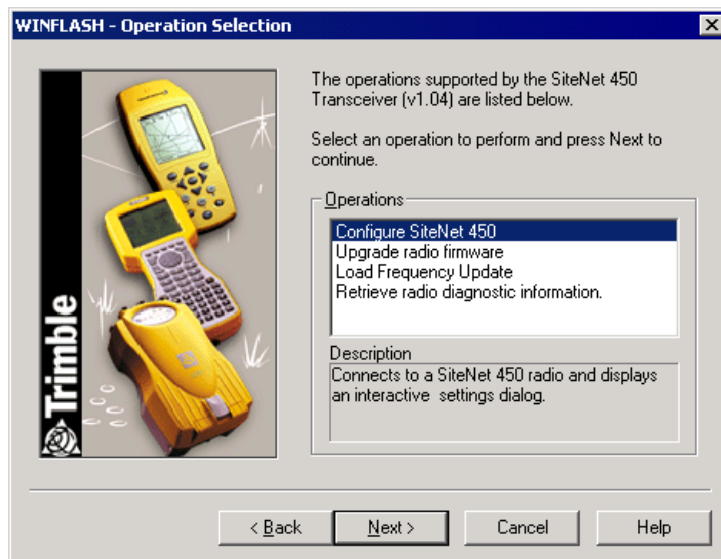
1. To start *WinFLASH*, click the WinFLASH icon. The WinFLASH main window appears:



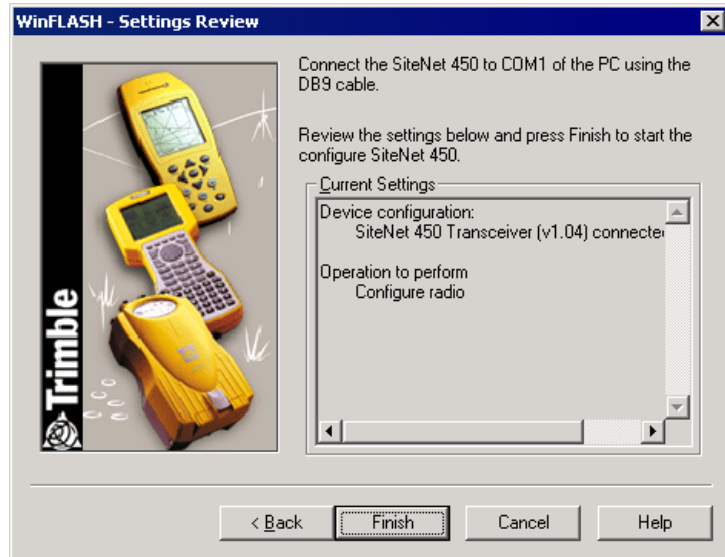
2. Follow the directions in the *WinFLASH* window to connect the radio-modem to the PC.

Note – WinFLASH is used to configure many different Trimble products. If you have other Trimble products you may have to make a selection in this window. Select the SiteNet 450 Transceiver (v1.04) option.

3. Select the appropriate PC serial port (COM port) and click **Next**. The *Operation Selection* window appears.

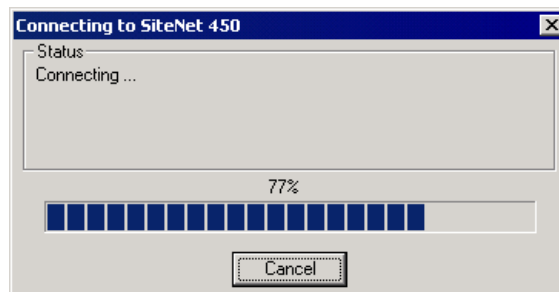


4. Select *Configure SiteNet 450* and click **Next**. The *WinFLASH-Settings Review* window appears:

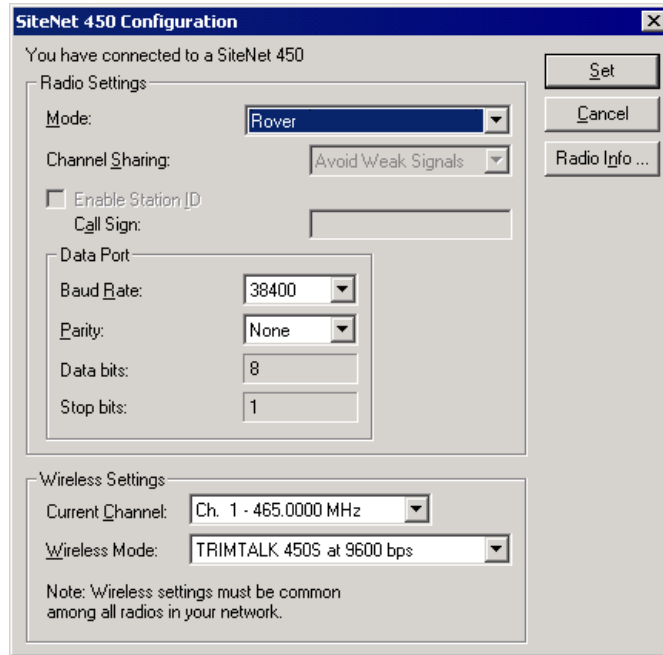


5. Click **Finish**.

A connection status window appears, counts to 100%, and then displays the SiteNet 450 configuration menu.



When a successful connection is established, the *SiteNet 450 Configuration* window replaces the *WinFLASH* window:



Configuring the SiteNet 450

To configure the SiteNet 450:

1. Select the appropriate operating *Mode* depending on intended use, for example Rover.
2. Select the *Channel Sharing* configuration (base modes only, not selectable for a repeater or rover). The options are:
 - *Off*: The carrier detect mode is OFF. The SiteNet 450 will ignore other transmissions on your frequency and continue to transmit data.

Note – *Channel Sharing set to Off may be illegal in your country-of-use. You may be subject to penalties or fines based upon the specific licensing requirements for your country-of-use. Please consult your radio license documentation or licensing agency for operational guidelines.*

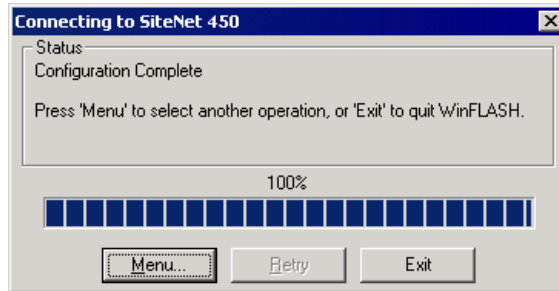
- *Avoid Weak Signals:* The carrier detect mode is ON. The radio ceases to transmit if it detects another radio transmission on its frequency. It resumes transmission when the channel is free of radio traffic.
 - *Avoid Strong Signals:* The carrier detect mode is ON, but the radio stops transmitting only when there is a strong signal present. (Receive level > -90 dBm.)
3. Select the *Enable Station ID* check box and enter your Call Sign. This is a Federal Communications Commission requirement for U.S. licensed users. It sets your radio to transmit your Call Sign every 15 minutes in Morse Code.
 4. In the *Data Port* field, set the *Baud Rate* and *Parity*. These are the communications parameters between the receiver and radio.

Note – *The default GPS port parameters for the SiteNet 450 are 38400 baud rate with parity none.*

5. In the *Wireless Settings* field, select the appropriate *Current Channel* option. This field determines the radio operating frequency.
6. Select the *Wireless Mode* setting. This setting determines the over-the-air communications parameters.

Note – *These settings must be the same for all radios in the same network.*

7. To update the configuration, click **Set**. The *Connecting to SiteNet 450* dialog appears:

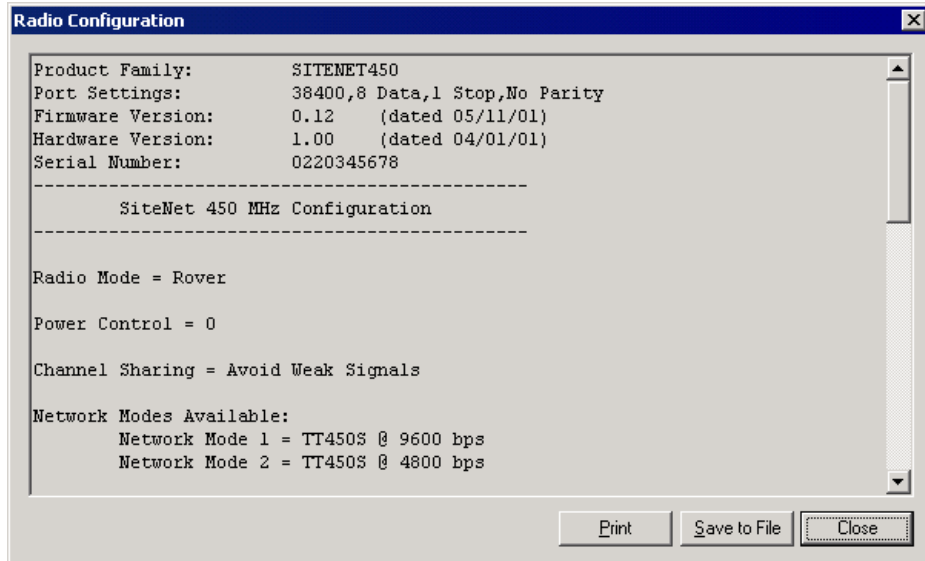


8. You can return to the main menu, or exit WinFLASH.



Tip – Setting the wireless mode to the highest possible setting reduces battery consumption on your base or repeater. For example, 9600 bps consumes half the power of 4800 bps for the same data format and time of operation.

9. Click **Radio Info** to view a text listing of all radio information, including its current configuration:



Tip – You can print or save to file the radio configuration information for future reference or e-mail to your support provider to help with troubleshooting radio problems.

Frequency List Updates

The SiteNet 450 can be programmed with a list of up to 20 frequencies, stored in nonvolatile memory. This list is preconfigured based on the frequencies requested when the SiteNet 450 was ordered. Governmental regulations require that only manufacturers or authorized dealers can create this frequency list. All frequencies programmed into a SiteNet 450 must comply with the host country regulations.

When you need to change the frequency list (add, delete, or replace frequencies), contact your Trimble dealer and provide the radio-modem's serial number and an updated list of the frequencies you require. Once you are provided with the frequency file, you may upgrade the radio using the WinFLASH utility.

Software Updates

SiteNet 450 software upgrades are available at the Trimble World Wide Web (www.trimble.com). Use the WinFLASH utility to upgrade the SiteNet 450 software.

Installing the SiteNet 450 Network

In this chapter:

- Introduction
- Physical Description
- Mounting the SiteNet 450 on a Machine
- Cabling Configurations
- Antenna Description

Introduction

Before setting up the equipment in the field, verify that each radio-modem is set to the same channel and wireless data rate. Also verify that the radio-modem's *Data Port* settings are 38400 and parity none. Set the serial port settings for both base and rover GPS receivers to 38400 bps, 8 bits, parity none, and 1 stop bit. For more information about general GPS receiver setup information, refer to the GPS receiver manual. If these settings are not available, use the WinFLASH utility to set the radio-modem's serial port settings to those of the GPS receiver.

Note – *High-power signals from a nearby high-power radio station or radar transmitter can overwhelm the radio-modem circuits. This does not harm the instruments, but can prevent them from functioning correctly. To avoid problems, try not to use the radio-modems within 400 meters (1300 feet) of powerful radar, television, or other transmitters. Low-power transmitters such as those in portable phones and walkie-talkies normally do not interfere with SiteNet 450 radio-modem operations unless they are tuned to the same channel. Always monitor frequency before and during operation. Transmit only on a clear channel.*

Also, to avoid possible interference with GPS reception, keep the base radio-modem antenna as far as possible from the GPS antenna. A minimum of 3 meters (10 feet) is recommended.

For more information about the precautions when using certain frequencies that can interfere with GPS operation, refer to *Selecting Communications Radios*, page 47. This is a copy of Trimble's publication *Using Radio Communication systems with GPS Surveying Receivers* (PN 1-612-0082-2/94).

Installation as a Repeater

To achieve coverage to all points in a survey area, a SiteNet 450 network may include up to two repeaters under certain conditions. The repeaters retransmit data packets in a way that avoids interference

with the base and each other. The operation of the repeaters is transparent to the rovers. The rover will use the data packets from the base or repeater, whichever it receives first.

The option to include a repeater in a network depends on the selected wireless data rate and the broadcast information content. Table 3.1 illustrates when a repeater may be used in a network for various wireless data rates, RTK formats, and RTK epoch rate.

Table 3.1 Repeater use in networks

Wireless data rate (bps)	DGPS	CMR at 1 Hz	RTCM 2.x at 1 Hz
4800	1	1	0
9600	2	2	1

2 - Two repeaters may be used
 1 - One repeater may be used
 0 - No repeaters may be used

Physical Description

The SiteNet 450 radio-modem is encased in a rugged, waterproof metal case. It has an antenna mount on the top cap, and a connector and LED on the bottom cap. The physical aspects of SiteNet 450 hardware are outlined below, followed by details covering interface connections and antenna installations.

Connectors and Indicators

The SiteNet 450 bottom cap is fitted with an 8-pin male Bendix connector and an LED indicator light. See Figure 3.1.

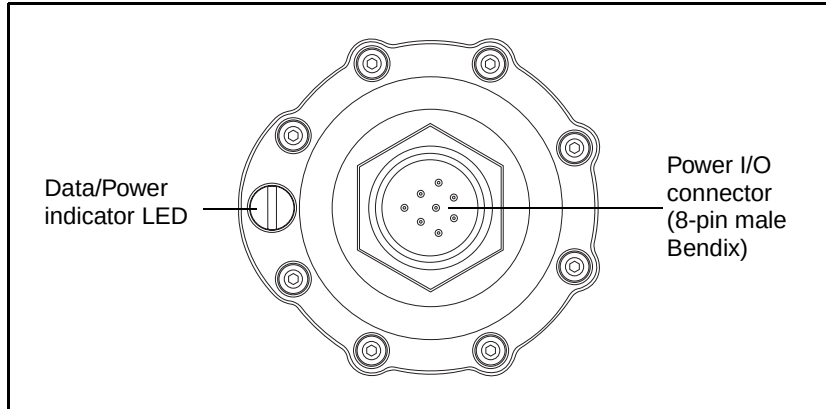


Figure 3.1 SiteNet 450 bottom cap

The LED can be orange and/or green depending on the situation, as shown in Table 3.2.

Table 3.2 Operational status

LED Color	Status
Orange (solid)	Power is available.
Orange and green (both solid)	Transmitting, receiving, or repeating.
	VCO
	Low battery
	High temperature
	Unknown error
	Data overload
	Very low battery
	High temperature shutdown
No color	Dead battery

Note – The top cap of the SiteNet 450 has an antenna contact tip. The tip is designed for maximum efficiency and very low loss. Please take care not to damage this tip. Keep the low-profile antenna or flexible antenna base screwed on to the top of the radio when storing the SiteNet 450, see page 33.

Figure 3.2 shows the top cap.

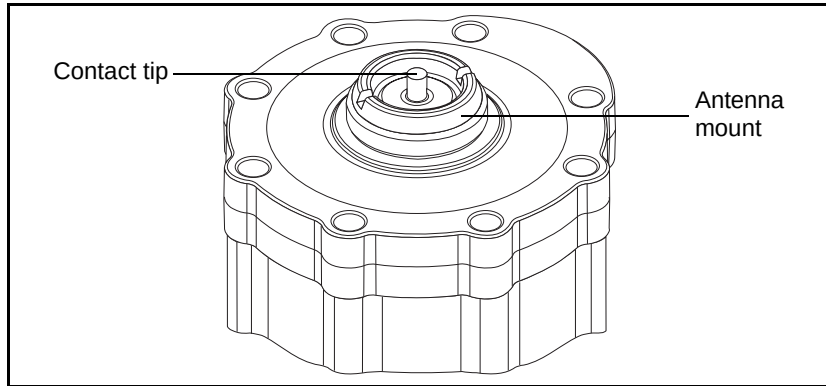


Figure 3.2 SiteNet 450 top cap

Mounting the SiteNet 450 on a Machine

When mounting the SiteNet 450 on a machine consider the following:

- Reduce damage by minimizing shock and vibration to the SiteNet 450: Mount the radio-modem on a solid part of the cab.
- Locate the best antenna position: Mount the entire antenna above the roofline so that it has an uninterrupted view. This improves the performance of the SiteNet 450.
- Prevent signal interference: Position the antenna away from other antennas (particularly if the other antenna is a two-way radio), rotating beacons and strobe lights.

Figure 3.4 shows a typical installation.

Machine Mount Kit (PN 35087-00)

The machine mounting kit for the SiteNet 450 comprises:

- Radio mount bracket (upper)
- Radio mount bracket (lower)
- Machine mount adapter plate (with U-bolts)
- Rubber shock mount kit

Figure 3.3 shows the SiteNet 450 mounting kit and how the parts fit together.

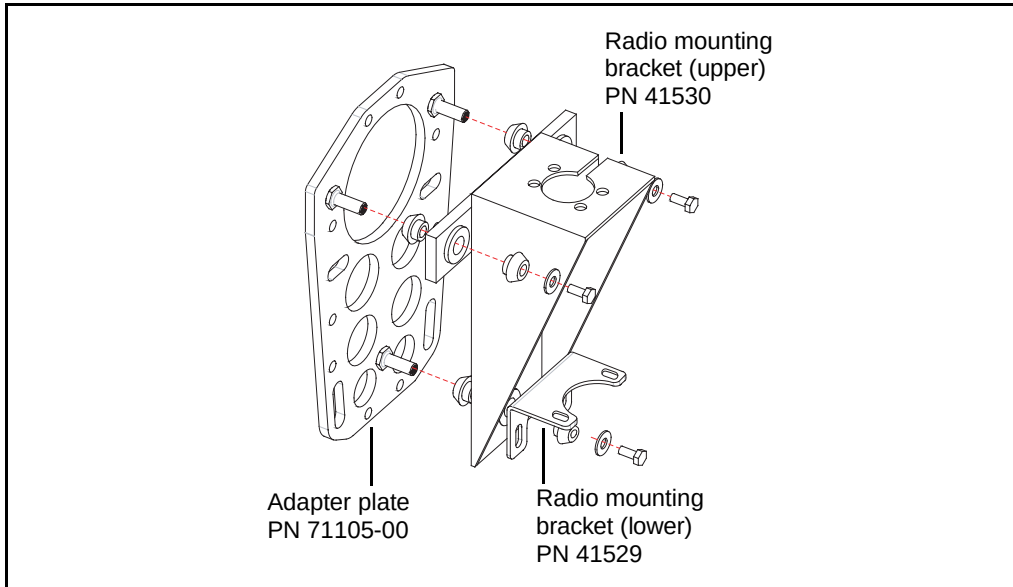


Figure 3.3 SiteNet 450 mounting kit

Mounting the SiteNet 450

To mount the SiteNet 450 onto a machine:

1. Bolt the SiteNet 450 into the radio mounting bracket (upper and lower brackets).

Ensure that the radio mounting screws are all fitted with washers and lock washers.

2. Securely mount the adapter plate to the machine. Do one of the following:
 - Use existing weld bosses (see Figure 3.4)
 - Weld some weld bosses to the cab
 - Clamp the plate to the top of a handrail at the top of the cab using the U-bolts
3. Bolt the radio mounting bracket to the adapter plate using the rubber shock mount kit. The bolts are included with the adapter plate.



Tip – Use threadlocking Loctite (PN 33803) or equivalent to secure the bolts when you assemble the shock mounts.

Figure 3.4 shows a SiteNet 450 mounted at the rear of a cab roof. Notice how this installation ensures that all of the antenna is above the cab's roof.

****NEW PHOTO FROM Joan Hollerich GOES
HERE*****THIS ONE SHOWS A 900*****



Figure 3.4 SiteNet 450 mounted at the rear of a cab roof

Cabling Configurations

The SiteNet 450 is typically configured as a rover, but the cables and adapters necessary for other configurations are also available.

Table 3.3 summarizes the cabling items available or provided with the SiteNet 450 unit or available accessories.

Table 3.3 SiteNet 450 cabling and power accessories

Item	Part number
Power and I/O cable for machine installations, 5 m (17 ft) 8-pin female Bendix connector on each end	32942-17
Infrastructure/Base Station power and I/O cable, 7.5 m (25 ft) 8-pin female Bendix, with Y-split to TA-3 power connector, DBF-9, plus 12-pin Conxall	38968-25
Machine service cable (21-pin female Bendix, with Y-split to bare power leads and dual DBF-9 connector)	36938
DC power adapter cable with TA-3 connector and battery clips	44087-00
SiteNet Base Station/Configuration cable, 30 m (99 ft)	40942-99

Power and I/O Cable for Machine Installations

The cable shown in Figure 3.5 connects the SiteNet 450 to either the MS850™ or the MS860™ GPS receiver on the machine. The GPS receiver outputs power to the SiteNet 450 through this cable.

The straight connector attaches to the bottom cap of the SiteNet 450, and the angled connector attaches to the 8-pin Bendix connector of the GPS receiver.

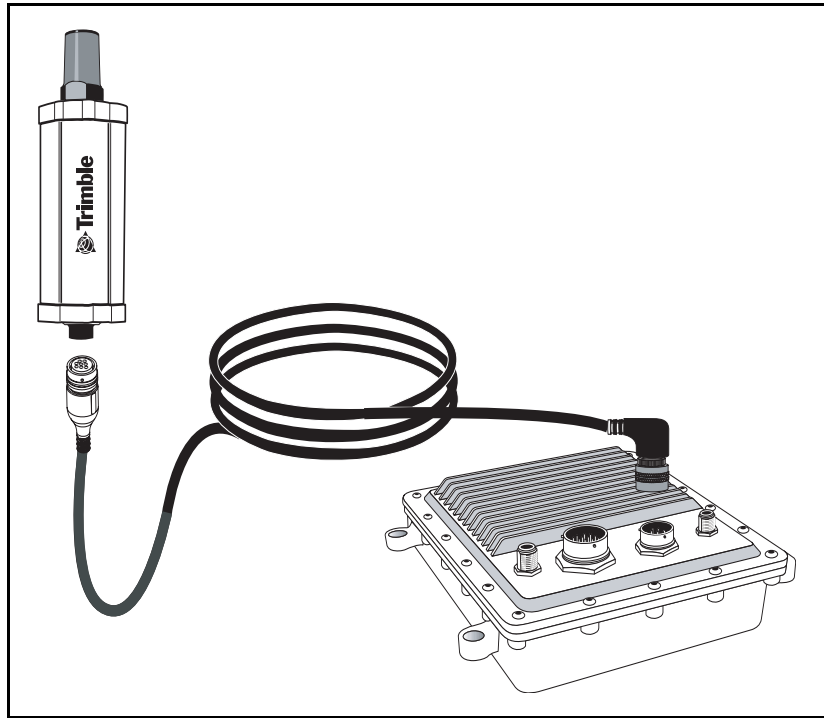


Figure 3.5 Power and I/O cable (PN 32942-17)

Infrastructure/Base Station Power and I/O Cable

The cable shown in Figure 3.6 is used for base station and repeater installations of SiteNet 450s. Cables come in the lengths shown in Table 3.4.

Table 3.4 Available cable lengths

Part number	Cable length
38968-25	7.5 m (25 ft)
40942-03	1 m (3 ft)
40942-40	12 m (40 ft)
40942-99	30 m (99 ft)

Note – Nearly all installations of infrastructure radios will require either a 7.5 m (25 ft) or a 30 m (99 ft) length.

Seal unused connectors by covering them with plastic tape.

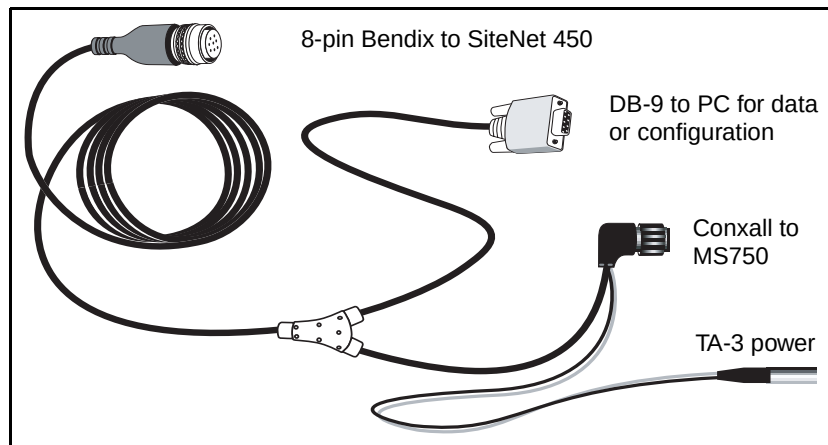


Figure 3.6 Radio power and I/O cable (PN 38968-25)

The 7.5 m (25 ft) infrastructure cable (PN 38968-25) connects directly to the SiteNet 450. The 12-pin Conxall connector connects directly to the MS750™ GPS receiver with a split to power via a TA-3 connector. This cable also splits to a DBF-9, which can be used to configure the SiteNet 450.

When you install this cable with a MS750 base station, the complete cabling configuration looks similar to that shown in Figure 3.7.

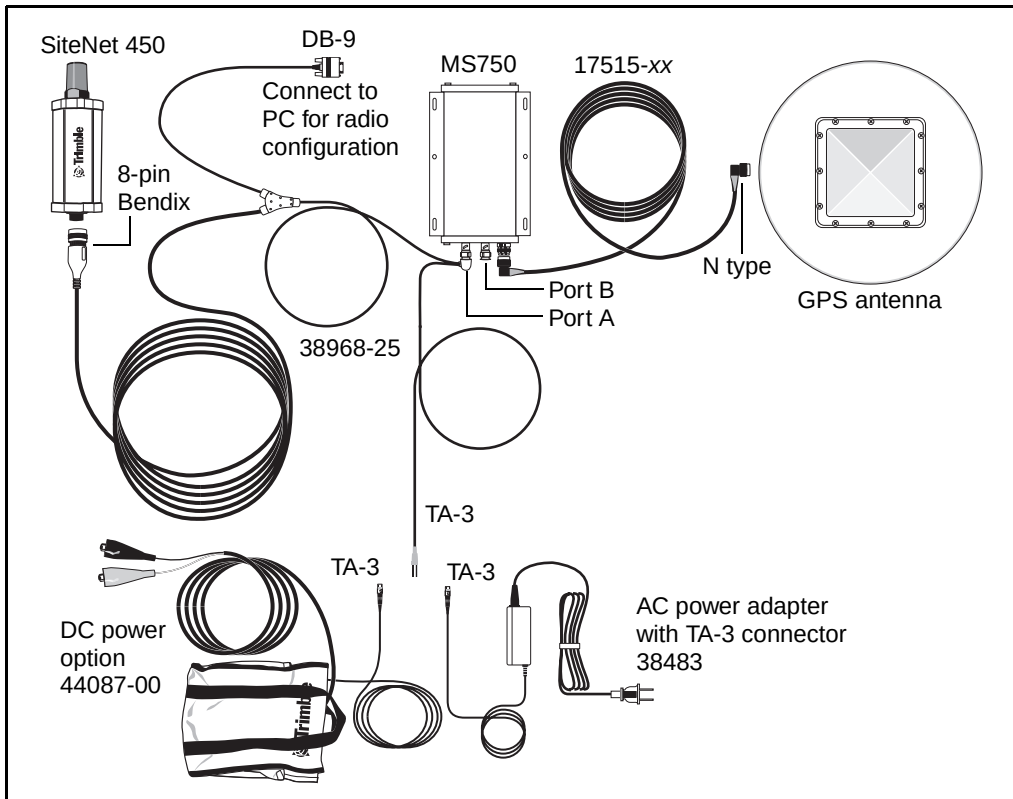


Figure 3.7 MS750 base station using cable PN 38968-25

The 30 m (99 ft) infrastructure cable (PN 40942-99) connects directly to the SiteNet 450 and splits out to power via a TA-3 connector and communications via dual female DB-9 connectors. The DB-9 connectors can connect to a GPS receiver and to a PC at the same time. This is particularly useful for troubleshooting. This cable requires its own power for the radio. It has no Conxall connector for the MS750 GPS receiver. You can connect it to the MS750 with the hammerhead connector B1/B2 cable PN 37382 that comes with the base (reference) station kit. The cable has a TA-3 connector for power to the radio only. The MS750 must be powered separately with the cables provided in the base station. See Figure 3.8.

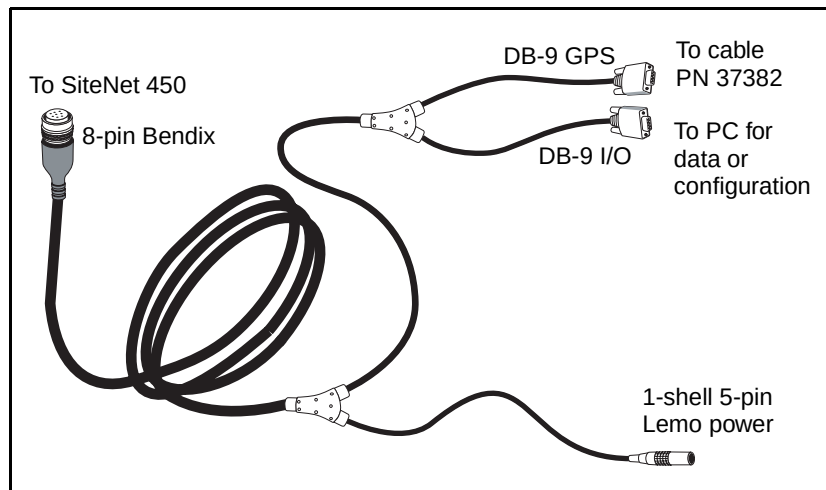


Figure 3.8 Service cable assembly (PN 40942-03, -40, -99)

The 1 m (3 ft) cable (PN 40942-03) is designed for use with a survey backpack.

When you install cable 40942-xx with a MS750 base station, the complete cabling configuration looks similar to that shown in Figure 3.9.

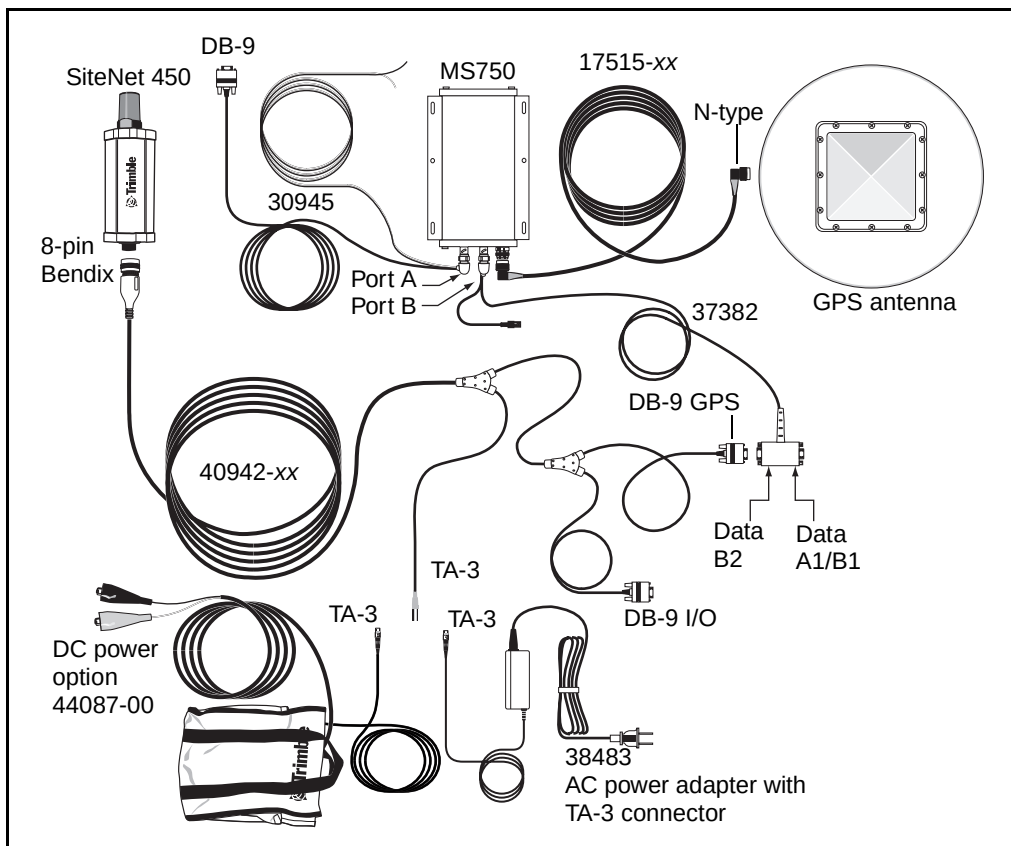


Figure 3.9 MS750 base station using cable PN 40942-xx

Machine Service Cable

Figure 3.10 shows cable 40942-xx when used to configure SiteNet 450 radios with a laptop.

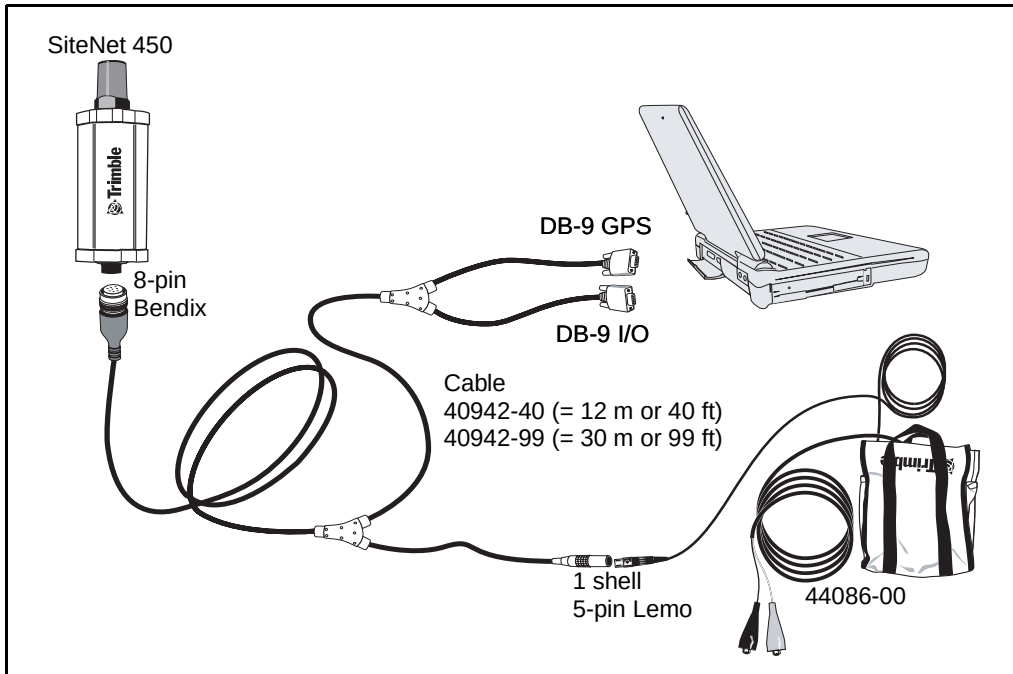


Figure 3.10 Machine service cable (PN 40942-xx)

Antenna Description

The standard SiteNet 450 antenna is a 0 dB, low-profile antenna. An optional infrastructure installation kit comes with an antenna base and 5 dB whip antenna tip. The 5 dB antenna measures 81 cm (32 in) in length, including the base. See Figure 3.11.

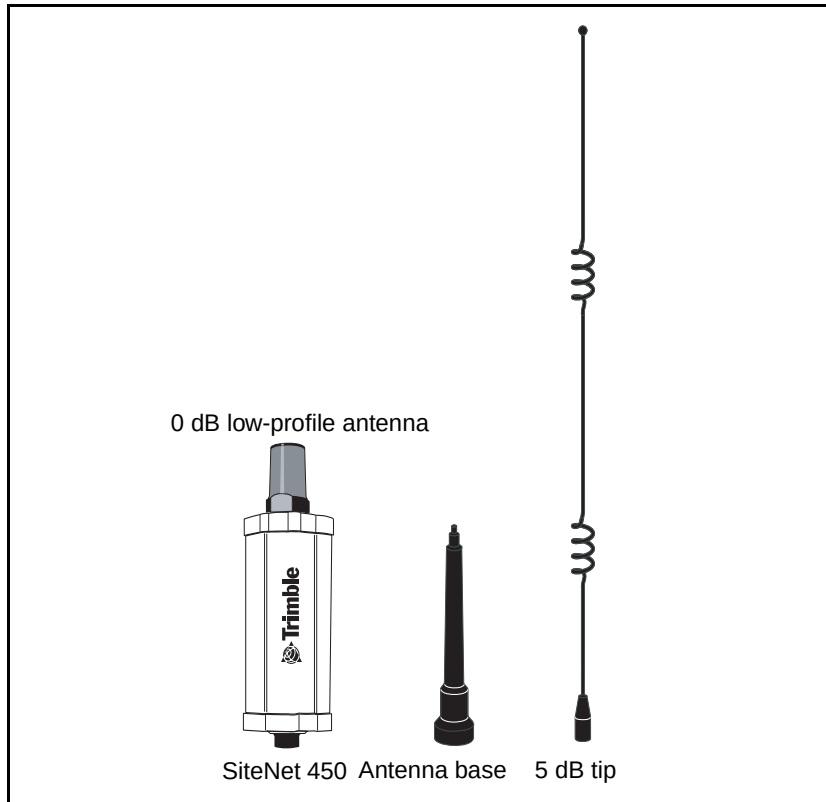


Figure 3.11 SiteNet 450 with antennas

Antenna Considerations

***Note** – Please use care when removing the radio antenna. The SiteNet 450 antenna contact tip is designed for maximum efficiency and very low loss. To maintain its integrity, do **not** remove the top cap from the radio housing.*

Make sure that you mount the base and repeater radios as high as possible. An increase in the antenna height increases your line of sight and is the most effective way to increase the radio's range. Consult your license for the legal limits on antenna height.

Line-of-Sight Obstruction

Objects placed near the antennas, especially metal objects, can severely limit antenna efficiency. If an antenna is to be mounted on a mast, make sure it is mounted so that its radiating element is completely above the top of any obstructing source, if possible.

Figure 3.12 shows the optional infrastructure antenna mounting for the SiteNet 450.

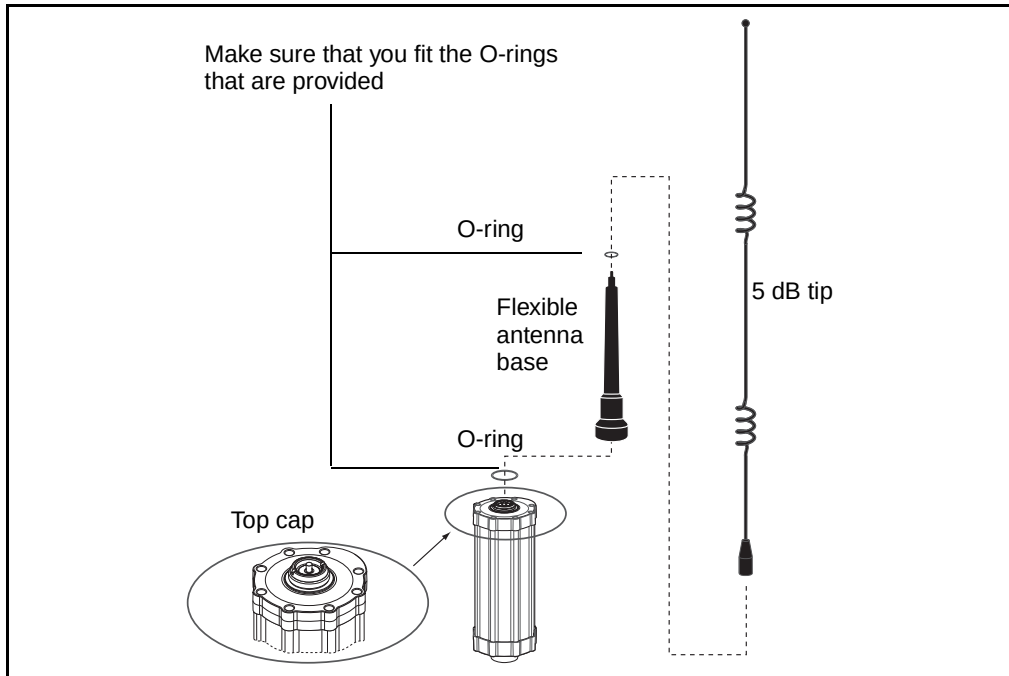


Figure 3.12 Infrastructure antenna mounting

Antenna Length

The UHF whip antenna shipped with your system is factory tuned to operate in the band you specified with your order (for example, 450–470 MHz). To ensure that your antenna is the correct length for your frequency band, refer to Figure 3.13.

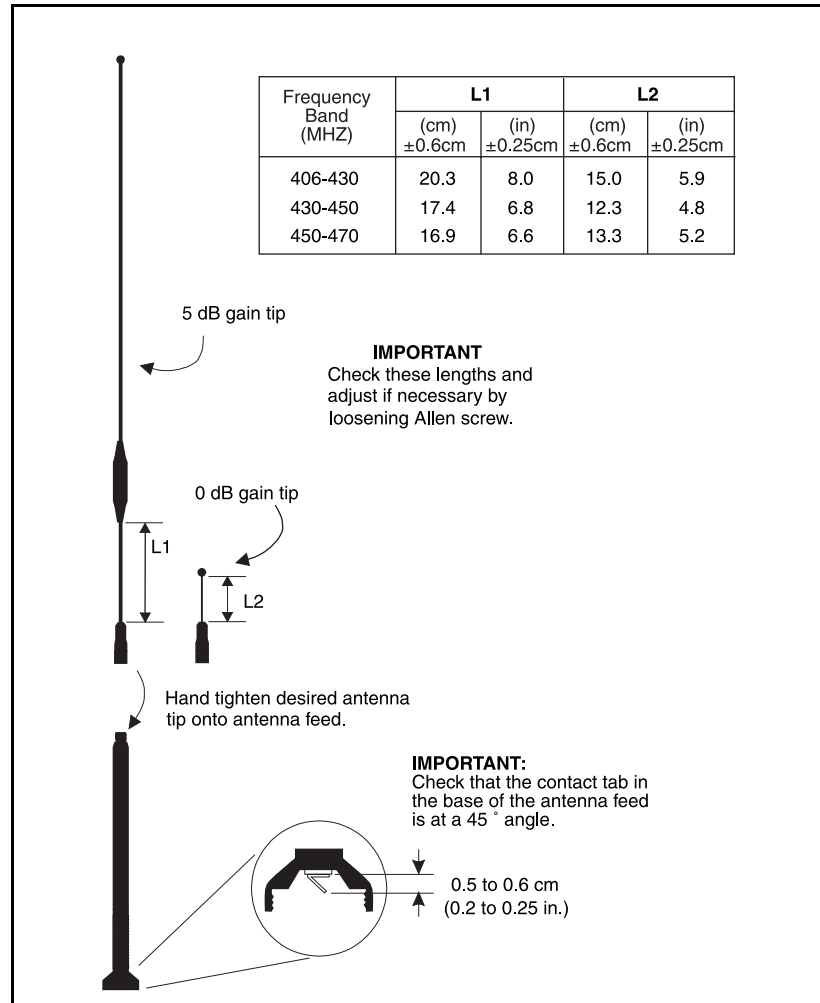


Figure 3.13 Standard UHF Omnidirectional Antennas

Regulations and Safety

In this chapter:

- Introduction
- Type Approval
- Licensing
- Safety

Introduction

Regulations regarding the use of the radio-modems vary greatly from country to country. In some countries, the unit can be used without obtaining an end-user license. Other countries require end-user licensing. Consult your local communications governing agency for licensing information.

Before operating a SiteNet 450 radio-modem, determine if authorization or a license to operate the unit is required in your country. It is the responsibility of the end user to obtain an operator's permit or license for the SiteNet 450 radio-modem for the location or country of use.

***Note** – This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.*

Type Approval



Warning – Changes or modifications to this equipment not approved in writing by Trimble Navigation Limited voids your authority to operate the equipment.

Type approval, or acceptance, covers technical parameters of the equipment related to emissions that can cause interference. Type approval is granted to the manufacturer of the transmission equipment, independent from the operation or licensing of the units. Some countries have unique technical requirements for operation in particular radio-modem frequency bands. To comply with those requirements, Trimble may have modified your equipment to be granted Type approval. Unauthorized modification of the units voids the Type approval, the warranty, and the operational license of the equipment.

Licensing

Many countries require that the operator of a radio or radio-modem obtain a license prior to operating it. Consult your local communications governing agency for licensing information. Obtaining an operator's permit or license for the SiteNet 450 for the location or country of use is the responsibility of the end user.

Before operating this radio-modem, you are legally required to obtain frequency licenses as required by the country of use. Please contact your local communications governing agency for the licensing requirements for each of these radio-modems.

Safety

Exposure to RF energy is an important safety consideration. The FCC has adopted a safety standard for human exposure to radio frequency electromagnetic energy emitted by FCC-regulated equipment as a result of its actions in General Docket 79-144 on March 13, 1986. Proper use of this radio-modem results in exposure below government limits. The following precautions are recommended:

- Do **not** operate the transmitter when someone is within 0.6 meter (2 ft) of the antenna.
- Do **not** operate the transmitter unless all RF connectors are secure and any open connectors are properly terminated.
- Do **not** operate the equipment near electrical blasting caps or in an explosive atmosphere.
- All equipment must be properly grounded according to Trimble installation instructions for safe operation.
- All equipment should be serviced only by a qualified technician.

A

Technical Specifications

In this appendix:

- Technical information
- Pinout information

Technical Information

The table shows the technical information for the SiteNet 450 radio-modem. This information is subject to change without notice.

Table A.1 Technical information

Specification	
Physical:	
Size	85 mm (3.4") W x 270 mm (10.5") H plus antenna height
Weight	0.9 kg (2.0 lb)
Environmental:	
Operating temperature	−40° to +65°C
Storage temperature	−40° to +85°C
Humidity	Exceeds MIL-STD-810E (aggravated cyclic humidity), sealed to ±34.5 kPa (±5 psi), immersible to 1 m
Vibration	8 gRMS, 20–2000 Hz random vibration
Shock:	
Operational	±40 g, 10 msec
Survival	±75 g, 6 msec
Electrical	
Power consumption:	
Nominal	250 mA (3W) ¹
Transmit	1000 mA (12 W) ¹
Protection	Reverse polarity
Input range	10.5 VDC to 20 VDC unconditioned

Table A.1 Technical information (continued)

Specification	
Connector:	
Type	8-pin male Bendix
Provides	Power, 2 serial ports, CAN interface
Indicators	Power and data LED
Radio-modem performance	
Range:	
Optimal	10 km (6 miles), line-of-sight
Typical	3–5 km (2–3 miles)
	Varies with terrain and operating conditions. A repeater may be used to extend the range.
Radio link:	
Frequency range	Single 10 MHz band per unit 430–440 MHz, 440–450 MHz, 450–460 MHz, or 460–470 MHz
Channel spacing	12.5 kHz or 25 kHz (only 440–450 MHz is available in 12.5 kHz at this time)
Transmit power	0.5 W
Channels	Up to 20 (factory pre-set) ²
Wireless data rates	12.5 kHz channel, 4800, 8000 bps 25 kHz channel, 4800, 8000, 9600 bps
Modes	Base/Repeater/Rover

¹ Power consumption, as well as the permissible number of repeaters in a network, depends on the selected wireless data rate and the broadcast information content and rate (that is, CMR vs. RTCM SC-104 Ver. 2.1 packets at 1 Hz). The 9600 bps wireless data rate is not available for units with 12.5 kHz channel spacing.

² Broadcast frequency, transmit power, channel spacing, and antenna gain are regulated by countries-of-use. These are unique on a per-country basis. The broadcast frequencies, channel spacing, and country-of-use for the radio-modem must be specified at time of order. Contact you local Trimble representative for more information.

Pinout Information

Figure A.1 shows the pinout information for the 8-pin male Bendix connector on the base of the SiteNet 450 radio-modem.

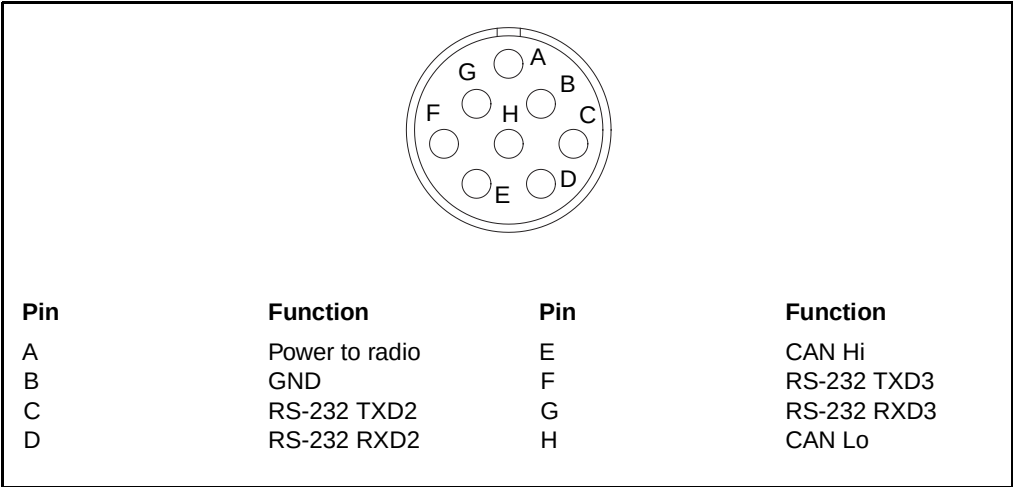


Figure A.1 SiteNet 450 connector (8-pin Mil-Spec)

Using Radios with GPS

In this appendix:

- Introduction
- Selecting Communications Radios
- Useful Field Procedures
- Summary

Introduction

Note – For more information, refer to the Trimble publication “Using Radio Communication Systems with GPS Surveying Receivers” (PN 1-612-0082-2/94).

“GPS receiver, antenna, tripod, tribrach, tape, cones, flagging, radio...”, such is the checklist of most GPS surveyors preparing for a day of observations. But a truly successful survey is not just a matter of making sure that you have all of the equipment; you must also ensure that you optimize the usage of these new tools for the highest productivity.

The GPS receiver is trying to measure very faint radio signals from satellites orbiting at 22,000 kilometers in space. There are many factors that can hinder the receiver’s ability to perform. For example, placing your hand over the antenna or setting up the antenna under a tree are factors that have already proven to interfere with GPS signal reception.

As GPS receivers developed, their processors have become more sensitive to incoming data flow. This provides an increase in accuracy by extracting more information out of the GPS radio signal. But with this gain in accuracy, there is an increased susceptibility to other radio signals. The receiver is now more sensitive to the incoming GPS signal, and consequently it is also more sensitive to other incoming radio signals. This means that communications radios, such as those commonly used by surveyors, can sometimes create difficulty with the GPS signal reception.

There are some very simple steps you can follow to remove the effects of radio interference on the GPS receiver. First, you should be aware of the type of communications equipment you buy and understand its characteristics. Secondly, a little care in using communications radios can greatly decrease your chances of experiencing any interference with satellite tracking.

Selecting Communications Radios

If you do not already have communications radios, and are thinking of buying them to supplement your survey activities, there are a number of factors to keep in mind before purchasing:

- Some frequencies can cause interruptions of GPS tracking.
- Some communications equipment creates spurious signals not related to their frequency that can interfere with satellite tracking.
- Powerful communications transmitters can create such a strong radio signal that the GPS signal cannot be identified.

Most communication transmitters emit overtones of their assigned frequency. If these overtones line up with the GPS frequency, they can filter into the GPS equipment and interfere with the satellite tracking. Some communication transmitters emit more of these overtones than others. But the number of overtones can be difficult to determine and it is not the most important factor when considering this nuisance parameter. To avoid being effected by transmitter overtones, avoid those frequencies that lie within the GPS frequency range.

Table B.1 shows frequency bands that you should avoid when using GPS surveying receivers.

Table B.1 RF bands to avoid

From this frequency	To this frequency
781.210	794.210
607.300	620.300
520.806	529.473
404.866	413.533
390.605	397.105
312.484	317.684
303.650	310.150
260.403	264.736
242.920	248.120
223.202	226.917
202.433	206.766
195.302	198.552
173.602	177.228
156.242	158.842
151.825	155.075
142.038	144.401
134.955	137.844
130.201	132.368
120.186	124.060
110.418	113.458

Some communication transmitters and receivers also emit spurious signals. These are extremely difficult to predict. The only way to know if your receiver is being effected by spuriously emitted signals is to test the communication equipment with the GPS receiver. If you plan to buy a new radio, test it with your existing GPS equipment to determine if any problems exist.

Communications equipment that uses more power is more likely to create signals from which the GPS signal cannot be extracted. This typically occurs from signals emitted from the radio transmitter box and not its antenna. Non-GPS signals enter the GPS system through the GPS antenna and not through the receiver. Therefore, most of the effects of non-GPS signals can be minimized by physically separating your radio and GPS equipment.

Useful Field Procedures

There are a few useful field procedures you can follow to minimize the effects of your radio. Since most of the radio signal in the GPS band is emitted directly from the radio transmitter box and received via the GPS antenna, make sure the GPS antenna is separated from the radio transmitter by 2-3 meters (7-10 feet). If you are still experiencing difficulties at this distance, the GPS signal may be getting overpowered by the radio transmissions. In this case, you can either separate the equipment even more or shield the radio transmitter.

As you move farther away from the source of the transmission, radio signal strength drops as a square of the distance. Therefore, if there is a problem, separate the GPS antenna and radio even more to lessen the strength of the radio signal received at the GPS antenna.

If you are using a geodetic antenna, you can use the antenna's ground plane to shield the radio waves. In fact, you can shield the antenna from the radio signal by moving behind nearby objects such as a car or tree. If you cannot move away from the GPS antenna, move the radio below the level of the GPS antenna ground plane. This is not ideal, but may help in those cases where you are left with no alternative.

Summary

Using communications radios with GPS receivers requires some special considerations. By striving to extract the utmost accuracy from the GPS system, receiver designs have made greater use of the radio spectrum. However, the methods used to increase performance and accuracy also make GPS receivers more susceptible to receiving other radio signals.

Radio signals in the GPS band arise from a few different sources. Some radio transmitters produce overtones of their frequency, which lie within the GPS P-code frequency range. Others create random, spurious signals, which affect GPS signal reception. Still other radio systems use high power levels to boost communication range and create noise that limits the GPS signal tracking. These are all characteristics to avoid when purchasing or using communications equipment in conjunction with GPS.

Before using radios on a full-fledged survey job, it is a good idea to test the communications equipment to determine if it effects the GPS signal reception in any way. Testing radios with the GPS equipment is especially important if you are considering purchasing new radios. Make sure to always:

- choose the communication frequency of your radios carefully so they do not transmit on or create harmonics in the frequency range of GPS.
- test them with your GPS receivers.
- if problems arise, put some distance between the radio transmitter case and the GPS antenna. Also, shielding the radio transmitter should minimize the effects of radio signals on the GPS signal reception.

Radio signal strength drops as a function of distance. The greater the separation between the GPS antenna and the radio transmitter, the less likely you are to experience interruptions in satellite tracking.

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PN 45423-00-ENG

October 2001
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