TSC1 Asset Surveyor
Operation Manual

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About This Manual

Welcome to the *TSC1 Asset Surveyor Operation Manual*. This manual describes how to operate the Asset Surveyor™ software, in conjunction with a range of Trimble GPS receivers for GIS data collection and update. The Asset Surveyor software provides all the functionality you need to efficiently collect GIS/GPS data.

Even if you have used other Global Positioning System (GPS) products before, we recommend 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 our web site for an interactive look at Trimble and GPS at:

- www.trimble.com

Related Information

Other manuals in this set include:

- *TSC1 Asset Surveyor Software User Guide*

  This manual describes how to install, set up, and use the Asset Surveyor software.

- *Mapping Systems General Reference*

  The *Mapping Systems General Reference* explains general GPS and GIS concepts, as well as the Trimble Survey and Mapping Bulletin Board.

- GPS Pathfinder Office Documentation

  The GPS Pathfinder Office Getting Started Guide contains a tutorial chapter that shows you how to use many features that are common to the GPS Pathfinder Office software and the Asset Surveyor software.

As well as being supplied in hardcopy, these manuals are also available in portable document format (PDF). These are available from the Asset Surveyor installation CD-ROM.

- Readme.txt file – a Readme.txt file contains information added after the documentation was completed. To read this file, double-click it or use a text editor to open it.

- 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.

- ftp.trimble.com – use the Trimble FTP site to send files or to receive files such as software patches, utilities, service bulletins, and FAQs. Alternatively, access the FTP site from the Trimble web site at www.trimble.com/support/support.htm.

- Trimble training courses – consider a training course to help you use your GPS system to its fullest potential. For more information, visit the Trimble web site at www.trimble.com/support/training.htm

- RTCM – for information on RTCM SC-104 contact:

  Radio Technical Commission for Maritime Services
  P.O. Box 19 087
  Washington, D.C. 20036
  U.S.A.

Technical Assistance

If you have a problem and cannot find the information you need in the product documentation, *contact your local Distributor.* Alternatively, request technical support using the Trimble web site at:

- www.trimble.com/support/support.htm

Your Comments

Your feedback about the supporting documentation helps us to improve it with each revision. To forward your comments, do one of the following:

- Send an e-mail to ReaderFeedback@trimble.com.

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

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Document Conventions

The document conventions are as follows:

Convention	Definition
Italics	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.
⏎Enter	Is an example of a hardware key (hard key) that you must press on the TSC1 keypad.
[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].
Del	Is an example of a softkey. The operation of softkeys is explained in Softkeys, page 24.

Quick Setup

In this chapter:

- ■ Introduction
- ■ Before leaving the office
- ■ In the field
- ■ Back in the office
- ■ Rover configuration
- ■ Base station configuration

Introduction

The instructions in this chapter are a simplified version of the various steps found in Chapters 4, 5, and 6 of this manual. The purpose of the simplified version is to provide quick setup guides with reasonable default values that can be distributed to field crews to ensure proper setup of rover or base station receivers.

Data is logged to the TSC1™ datalogger with the Asset Surveyor™ software. For more information on configuration and data collection, refer to the *TSC1 Asset Surveyor Software User Guide*.

Note – The steps outlined in this chapter do not include steps required to collect data using carrier phase information. For instructions on how to collect high accuracy features, see Chapter 7, Carrier Phase Data Collection.

Before Leaving the Office

1. Install the GPS Pathfinder® Office software on your office computer (refer to the *GPS Pathfinder Office Getting Started Guide*).

2. Using the GPS Pathfinder Office software, prepare any data files or data dictionaries you require, and transfer them to the TSC1 datalogger. If you want to update GPS or attribute information on features stored in a GIS, import the data files and data dictionary into the GPS Pathfinder Office software and then transfer them to the TSC1 datalogger. You may also want to transfer any waypoint and coordinate system files to the datalogger.

3. Check that you have all the required equipment, and that it is operational. Set up and connect your GPS system (the appendix in this manual that discusses your GPS receiver lists the equipment and shows you how to connect it).

4. If the GPS receiver has an On/Off switch, turn it on (the Series 4000™, GPS Total Station® 4700, GPS Total Station 4800, Site Surveyor 4400™, and 4600LS™ receivers have an On/Off switch).

    Start the Asset Surveyor software to check that it and the GPS receiver are communicating correctly. If communication is established, the GPS status line appears. If communication fails, an error message appears on the screen.

5. Check all critical settings in the Asset Surveyor software. You should also check non-critical and display settings, especially if the system has been used by someone else recently. For more information on how to configure the Asset Surveyor software, refer to the *TSC1 Asset Surveyor Software User Guide*.

6. Turn everything off and pack it into carrying cases if you have to travel a significant distance to the survey site. Pack spare sets of batteries if you expect to operate the receiver for any length of time.

In the Field

1. Travel to the survey site, remembering to carry all the required equipment with you.

2. Reassemble the system.

3. If the GPS receiver has an On/Off switch, turn it on. Then start the Asset Surveyor software if it is not already on.

   Wait until the GPS receiver acquires enough satellites to start computing GPS positions, before beginning to work. The number of satellites being tracked displays on the status line.

4. Create a new data file, associating the correct data dictionary with it. Alternatively, reopen an existing data file.

5. Begin collecting data. Collect, review and update all the features necessary.

6. Close the data file.

7. Disconnect and repack the components of the system. Remember to turn off the GPS receiver if it has an On/Off switch. Return to your office.

Back in the Office

1. Transfer the data files from the TSC1 datalogger to the PC using the GPS Pathfinder Office software.

2. Use the GPS Pathfinder Office software for differential correction, plotting, and exporting the data file(s) to a GIS.

3. Recharge the TSC1 datalogger and GPS receiver batteries.

Rover Configuration

Use the following procedure to set up your system in a rover configuration.

From the *Utilities* menu, select *Factory defaults*. This resets the Asset Surveyor software to its default configuration and then restarts the datalogger.

Now change some of the configuration settings as follows:

Main menu

1.	*Configuration*	Highlight *Configuration* then press the 🔲Enter key

Configuration menu

2.	*GPS rover options*	Press 🔲Enter
3.	*Logging options*	Press 🔲Enter

Logging options screen

4.	*Point feature*	Synchronized with the base station
5.	*Line/area*	Synchronized with the base station
6.	*Not in feature*	Synchronized with the base station
7.	*Minimum positions*	3
8.	*Allow GPS update*	'Warn first'
9.	*Warning distance*	'Any'
10.	To accept	Press 🔲Enter

Position filters **screen**

11.	*Position mode*	'Manual 3D' or 'Overdet. 3D' depending on canopy density
12.	*PDOP mask*	4 or 6 (depending on receiver)
13.	To accept	Press ⏎Enter

Antenna options **screen**

14.	*Height*	Height to antenna's phase center
15.	*Measure*	'Vertical'
16.	*Type*	For a list of antenna types, see the *TSC1 Asset Surveyor Software User Guide*
17.	*Confirm*	Select 'Per feature', 'Per file', or 'Never'
18.	To accept	Press ⏎Enter

GPS rover options **menu**

19.	To return to the *Configuration* menu	Press ⌫Esc

Configuration **menu**

20.	*Communication options*	Press ⏎Enter
21.	*Real-time input options*	Press ⏎Enter

Real-time input options **screen**

22. RTCM age limit   5 or 10 (depending on your radio)

23. To accept   Press ⌨Enter

24. To return to the
     Configuration menu   Press ⌨Esc

Configuration **menu**

25. To exit the
     Configuration menu   Press ⌨Esc

Data Collection

Use the following procedure to set up your system for rover data
collection.

Main menu

1.   Select *Data collection* and press ⌨Enter

Data collection **menu**

2.   Create a data file   Select *Create new file*:
                              Press ⌨Enter and then press ⌨Enter
     -or-   -or-
     Open an existing   Select *Open existing file*.
     data file   Press ⌨Enter
                              Select an existing file to append
                              to or update, and press ⌨Enter

3.   To exit *Data collection* Press ⌨Esc and press ⌨Yes to
                              confirm exit

Base Station Configuration

Use the following procedure to set up your system in a base station configuration.

Main menu

1. *Configuration*   Highlight *Configuration* then press the ⏎ (Enter) key

Configuration menu

2. *GPS base station options*   Press ⏎ (Enter)

3. *Logging options*   Press ⏎ (Enter)

Logging options screen

4. *Measurements*   One to five seconds (depending on rover interval and free space)

5. To accept   Press ⏎ (Enter)

6. To return to the *Configuration* menu   Press ⌫ Esc

Configuration menu

7. To exit the *Configuration* menu   Press ⌫ Esc

Base Station Data Collection

Use the following procedure to set up your system for base station data collection.

Main menu

1. *Data collection*   Press ⏎Enter

Data collection menu

2. *Create base file*   Press ⏎Enter

Create File screen

3. Create file   Press ⏎Enter

Antenna options screen

4. *Height*   Height to antenna's phase center

5. *Measure*   'Vertical'

6. *Type*   For a list of antenna types, see the *TSC1 Asset Surveyor Software User Guide*

7. To accept   Press ⏎Enter

Reference Position **screen**

8. Enter reference position — Type lat/lon (or north/east) and altitude, and press ⏎Enter

   -or-   -or-

   Use an existing waypoint — Press �託WayPt⌧, select the waypoint and press ⏎Enter

   -or-   -or-

   Use an approximate position — Press ⌧Here⌧ and press ⏎Enter

   -or-   -or-

   Leave as is and set in the GPS Pathfinder Office software — Press ⏎Enter

Base Station **screen**

9. To exit *Base station* — Press ⏎Enter and press ⌧Yes⌧ to confirm exit.

Introduction to the Asset Surveyor Software

In this chapter:

- Introduction
- The Asset Surveyor software
- System components

Introduction

This chapter introduces you to the Asset Surveyor software.

The Asset Surveyor Software

The Asset Surveyor software is designed for fast and accurate geographic data collection and maintenance. It software operates on the TSC1 datalogger and acts as the ***controlling software***. It communicates with the GPS receiver to set specific GPS parameters required for optimal accuracy, and to record GPS positions to store on the TSC1 datalogger. User-definable settings, such as *PDOP mask*, are easy to configure and are immediately communicated to the receiver.

The Asset Surveyor software displays a status line at the bottom of the screen so that you can check the current GPS status to make sure you are working under conditions that enable optimal accuracy. The status line displays the number of satellites being tracked, and the PDOP. If the PDOP ever goes above the mask or there are too few satellites, a message flashes on the status line. A warning tone is also sounded when these conditions occur and a different (success) tone is sounded when GPS logging resumes.

The Asset Surveyor software is easy to use, so you can focus on the information you want to collect in the field. The following introduces you to the main functions of the Asset Surveyor software:

- Data collection – using a data dictionary created in the GPS Pathfinder Office software, the Asset Surveyor software improves the speed and accuracy with which you can collect GPS and GIS information in the field. For each type of job, you can transfer a different custom-made data dictionary into the datalogger. When a data file is open, the Asset Surveyor software uses the chosen data dictionary to prompt you for attribute information.

- Data update – the Asset Surveyor software also lets you make changes to features you have already logged during data collection. You can review and update existing features in a new or existing rover file, or in a file of features imported from a GIS. You can also add new features to the file.

- External sensor interface – use this to record and store input from other sensors, such as echo sounders.

- Navigation – use to view distance and bearing to known coordinates; used in conjunction with waypoints or existing features so you can update their position or attributes.

- Waypoints – use to store points by name so you can navigate to them.

- Map – use the map display to graphically display your GPS position, features, waypoints, and a background, and to show your navigation path.

- Multiple coordinate systems – you can use both latitude, longitude, and height (above Mean Sea Level or above ellipsoid) and northing, easting, and elevation (for example UTM or U.S. State Plane coordinates are supported).

- Languages – the Asset Surveyor software can be operated in different languages. The currently available languages are English, French, German, Portuguese, Russian and Spanish.

You can access all of the Asset Surveyor software functions from the *Main menu*. They are accessed through the following menu entries:

- Data collection

- File manager

- Configuration

- Utilities

- Navigation

- Map

- Receiver status

- Satellite information

When you are collecting data with the Asset Surveyor software, the two menu options you use most are *Data collection* and *Configuration*. The *Data collection* menu lets you create and update data files and enter or change attributes. The *Configuration* menu lets you configure the GPS receiver to log only positions that meet your requirements.

The *File manager* menu provides access to a number of options for managing your data files, including the transfer of files between the TSC1 datalogger and your office computer.

The *Utilities* menu contains useful miscellaneous operations, including support for creating, deleting, and editing waypoints, and measuring between waypoints.

The *Navigation* menu provides two useful modes for navigating to a waypoint or feature: the Road and the Direction Dial. The *Map* menu provides a graphical map to help you navigate and update data.

The *Receiver status* and *Satellite information* menus provide access to important GPS information such as the details of the satellites being tracked by your GPS receiver.

For more information about these features and other options available in the Asset Surveyor software, refer to the *TSC1 Asset Surveyor Software User Guide*.

System Components

The Asset Surveyor software combines GPS mapping instrumentation with graphical geographic data logging and export software. It lets you record precise position and attribute information in digital form, with a range of GPS receivers, which you can import into the GIS or CAD system of your choice using the GPS Pathfinder Office software. In this way, you can quickly inventory resources.

GPS Receiver

The GPS receiver provides precise GPS positions for point, line, and area features collected by the Asset Surveyor software. A GPS receiver consists of a receiver, antenna, batteries, and cables.

The GPS receiver uses information from four or more GPS satellites to calculate an accurate 3D position. The accuracy of the position can vary from 2 to 5 meters to submeter and centimeter, depending on the GPS receiver being used.

The following Trimble GPS receivers can be used with the Asset Surveyor software on the TSC1 datalogger:

- GPS Pathfinder Pro XRS

- GPS Pathfinder Pro XR

- GPS Pathfinder Pro XL

- Series 4000

- Site Surveyor 4400

- GPS Total Station 4700

- GPS Total Station 4800

- 4600LS Surveyor

For each GPS receiver, the required equipment varies. Each GPS system can be augmented with a number of accessories. The appendixes detail the equipment used in each system and any optional accessories. They also show you how to connect the GPS receiver to the TSC1 datalogger for operation in the field.

The GPS Pathfinder Office Software

The GPS Pathfinder Office software runs under the following Microsoft operating systems:

- Windows 95

- Windows 98

- Windows 2000

- Windows NT

It provides all of the tools you need for managing a data collection or maintenance project.

The GPS Pathfinder Office software lets you:

- plan the best times to collect GPS positions, using the Quick Plan™ mission planning utility

- create separate projects, which lets you manage the data associated with these projects effectively and conveniently

- construct and edit data dictionaries, which can be used to control the data collection operation and make sure that the collected data is complete, accurate, and compatible with your GIS, CAD package, or database

- import data from a GIS, CAD, or database format, creating data files that you can transfer to a datalogger and update in the field

- transfer files to and from GPS receivers and handheld dataloggers

- process the GPS positional data to improve its accuracy

- display and edit collected data in the office, optionally overlaying this data onto a vector or raster background map

- export the collected, processed, and edited data to a GIS, CAD, or database format

- produce a scaled plot as a paper record of the data

The Asset Surveyor software version 5.20 needs version 2.80 or later of the GPS Pathfinder Office software to make best use of the data collected in the field. The GPS Pathfinder Office software is used to transfer GPS data to a PC, and then differentially correct, view, and edit the data. The software also exports the data in a format suitable for your GIS or CAD system.

For more information on the GPS Pathfinder Office software, refer to the GPS Pathfinder Office documentation.

Introduction to the TSC1 Datalogger

In this chapter:

- Introduction
- What is the TSC1?
- Turning the TSC1 datalogger on and off
- Screen
- Memory
- Rebooting
- Data capacity
- Operating temperature and humidity ranges
- Power sources
- Ports
- Servicing

Introduction

This chapter contains hardware specifications and gives instructions on operating, storing, and maintaining the TSC1 datalogger.

What is the TSC1?

The Trimble System Controller (TSC1) is a powerful handheld field computer with a full alpha-numeric keyboard, a 200 x 240 pixel liquid crystal display (LCD) and two serial communications ports. The TSC1 datalogger contains a proprietary processor based on the Motorola CPU32 core, capable of executing up to 20 MHz. It also has a built-in real-time clock, which is maintained when the unit is powered down.

The TSC1 datalogger has 2 MB of DRAM (working memory) and 2 MB of flash disk memory for data storage, capable of storing about 35,000 GPS positions. A portion of the flash disk memory is allocated to program space, and this is where the Asset Surveyor program files, language files, and help files reside.

This chapter describes the features and operation of the TSC1 datalogger using the Asset Surveyor software. For a detailed description of how to use the TSC1 datalogger with the Asset Surveyor software, refer to the *TSC1 Asset Surveyor Software User Guide.*

Figure 3.1 and Figure 3.2 show different views of the TSC1 datalogger. Use them to become familiar with the terms used in this manual.
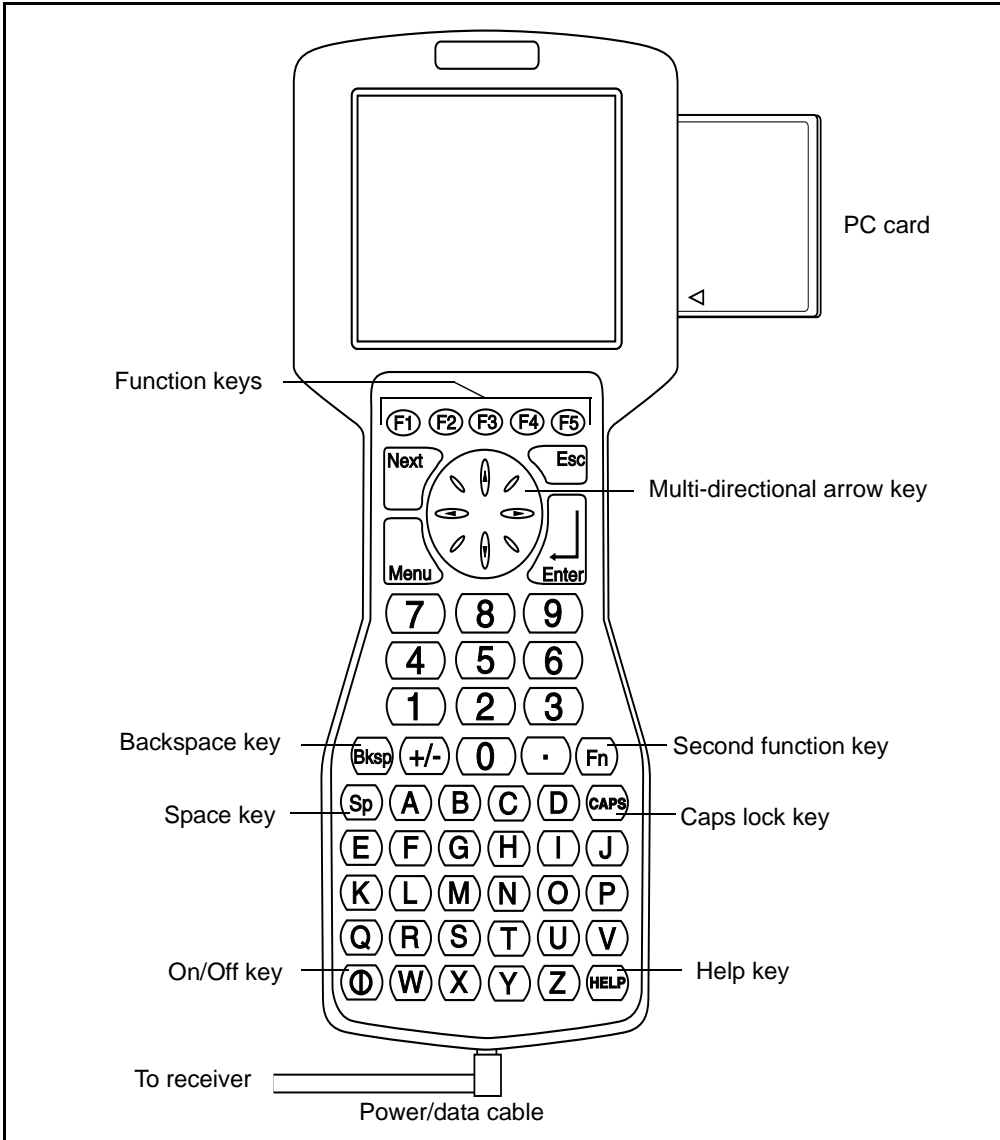
Figure 3.1   Front view of the TSC1 datalogger
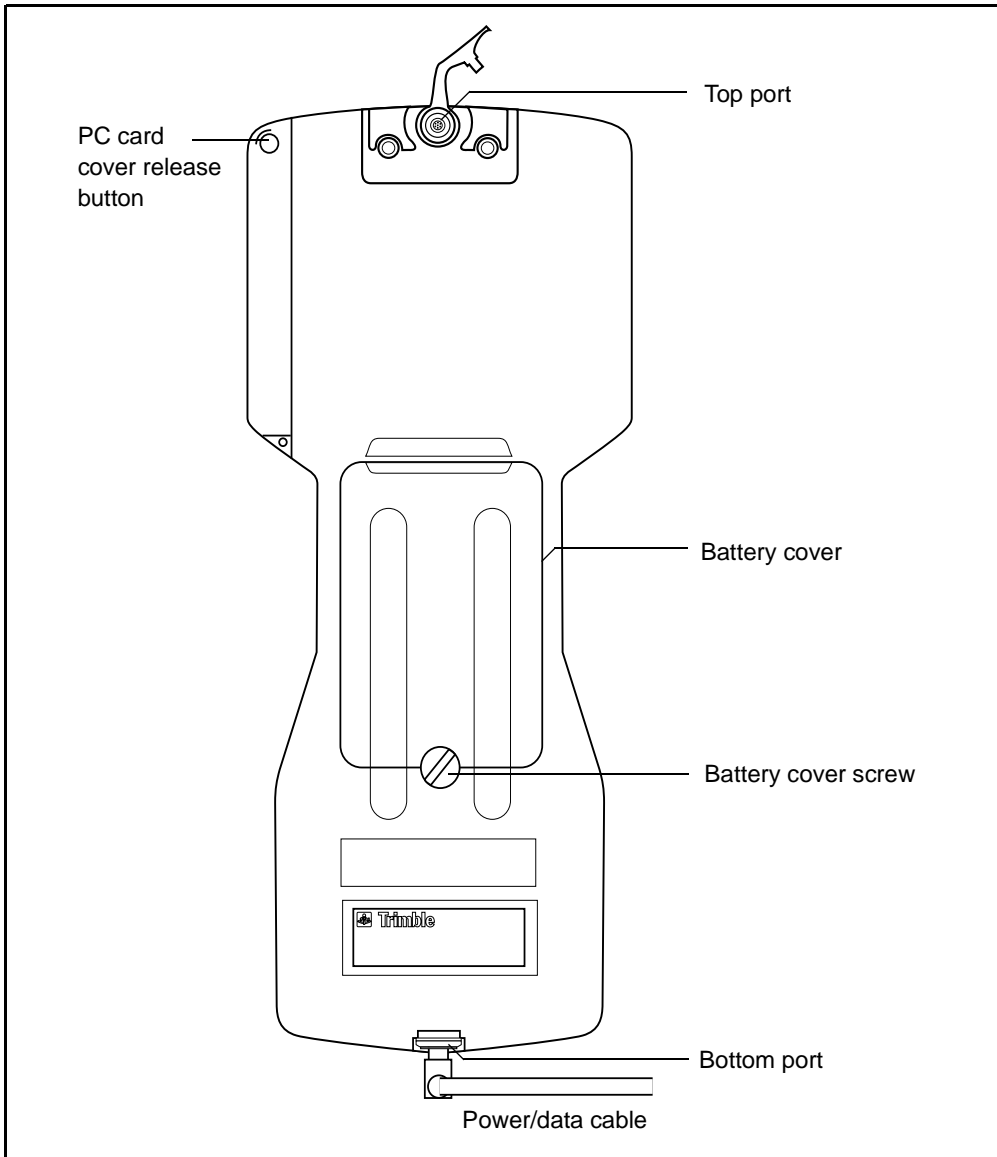
Figure 3.2   Back view of the TSC1 datalogger

Turning the TSC1 Datalogger On and Off

To turn on the TSC1 datalogger, make sure that power is supplied (see Power Sources, page 30). Then press the green on/off key marked (⏻).

To turn off the TSC1 datalogger, hold down (⏻) for one second.

For the location of the (⏻) key and other keys on the TSC1 keypad, see Figure 3.1.

Hard Keys

Hard keys are the physical keys on the TSC1 keypad, such as (1), (A), (Enter), (◉), (▼), and (Esc). Use these keys to enter data and to access different screens.

Alternate Keys

Alternate keys give some hard keys a second function. Some of the second functions are displayed on the hard keys in small yellow lettering. To use a second function, press the (Fn) hard key and then press the alternate hard key.

Table 3.1 shows some of the functions that you can access using alternate keys.

Table 3.1   Useful second functions

Keys	Function
(Fn) (▼)	Page down
(Fn) (▲)	Page up
(Fn) (◉)	Home
(Fn) (◉)	End
(Fn) (Next)	Previous screen

Table 3.1 Useful second functions (Continued)

Keys	Function
Fn E	Contrast up
Fn F	Contrast down

Softkeys

Softkeys are displayed on the bottom line of the TSC1 screen. A softkey corresponds to the adjacent hard key: F1, F2, F3, F4, F5. Press the hard key to activate the softkey on the screen. For example, to activate the Pause softkey, press F1. See Figure 3.3.
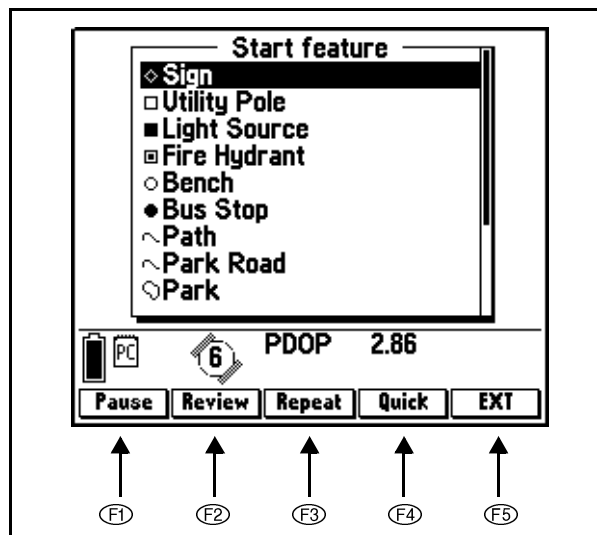
Figure 3.3   How function keys correspond to softkeys

Softkeys relate to particular forms or fields and only appear when these forms or fields are accessed. For example, the Seg softkey only appears when a line feature is opened for data collection, as this functionality applies to line features only.

Menu Key

To return to the *Main menu* at any time, press the ⌷Menu⌷ hard key. Use this key in conjunction with the ⌷Next⌷ key to move around the Asset Surveyor screens quickly.

Next Key

To simplify the task of moving around menus, the ⌷Next⌷ hard key offers quick access to open screens (windows).

Help Key

Press the ⌷HELP⌷ hard key at any time to obtain further information about a topic. When you press it, the *Help* menu appears. To exit the *Help* module, press ⌷Esc⌷ from the *Help* menu.

Screen

The TSC1 datalogger has an LCD screen. This screen responds to heat, and prolonged exposure to full sunlight can cause it to darken. If this happens, turn the screen away from direct sunlight until it returns to normal.

⚠ **Warning –** Repeated exposure to direct sunlight can cause the screen to degrade.

Contrast

To increase the screen contrast, press ⌷Fn⌷ ⌷E⌷.

To decrease the screen contrast, press ⌷Fn⌷ ⌷F⌷.

Backlight

To switch the screen backlight between on and off, press ⌈Fn⌉ ⌈L⌉.

Disconnecting from the Receiver

To disconnect the TSC1 datalogger from the receiver, close any file that is open and turn off the TSC1 datalogger. You can then disconnect the TSC1.

If you accidentally disconnect the TSC1 while collecting data, simply reconnect and, when the receiver has acquired enough satellites to compute GPS positions again, continue collecting data.

Memory

The TSC1 datalogger has 2 MB of internal memory for data storage.

While some dataloggers use battery-backed static memory, the TSC1 datalogger uses flash memory. With flash memory, you do not need a backup battery to preserve data when the system is turned off. Since backup battery failure is a common cause of data loss, this means that the TSC1 datalogger provides exceptionally secure data storage.

You can supplement the internal flash memory by using PC cards, which are inserted in the side of the datalogger. PC cards are available in various sizes. Trimble supplies 16 MB PC cards.

Choosing a PC Card

Only Type I or Type II ATA format PC cards are supported by the TSC1 datalogger at present. Trimble supplies a 16 MB card (part number 33050-16).

In addition to the cards supplied by Trimble, PC cards from the following manufacturers have been tested successfully in the TSC1 datalogger:

- Epson

- IBM

- SanDisk

- Viking

Rebooting

If the Asset Surveyor software fails to respond to any keystrokes, you may have to reboot the system. To do this, turn off the TSC1 datalogger and turn it back on again. If this does not work, hold down ⏻ for five seconds, then release it. Press it again to turn on the TSC1 datalogger. If this does not work, perform a warm boot.

Note – If the software fails to respond to keystrokes, check that the TSC1 datalogger is receiving power.

Warm Boot

A warm boot shuts down the hardware and restarts the Asset Surveyor software. It also resets the software to the factory default settings.

If you ever have to perform a warm boot, transmit any data from the TSC1 datalogger to your PC as soon as possible, to safeguard against further problems, and to avoid any possibility of data loss.

Note – You do not lose data when you perform a warm boot, but you do lose all your configuration settings.

To perform a warm boot:

1. Make sure that the TSC1 datalogger is off, using a five-second power down if necessary.

2. While holding down the (Bksp) key, press and release the (⏻) key. This powers on the TSC1 datalogger.

   The TSC1 datalogger should restart after a few seconds and the Asset Surveyor software should run.

If the warm boot fails, perform a cold boot.

Cold Boot

A cold boot *erases the internal memory* and restarts the Asset Surveyor software. It does not affect the PC card.

⚠️ **Warning –** *All* data in the TSC1 datalogger's memory, including any data dictionaries and extra coordinate system files you have downloaded onto the TSC1 datalogger, is lost after a cold boot. Only perform a cold boot if a warm boot has previously failed, or if you *know* that the TSC1 has no data in its memory.

To perform a cold boot:

1. Make sure that the TSC1 datalogger is off, using a five-second power down if necessary.

2. Hold down (Fn) and (F5) together.

3. While holding them down, press and release the (⏻) key (which turns on the TSC1 datalogger).

4. When the following message appears on the screen:

   Force Reformat Internal Media

   release (Fn) and (F5). After a few minutes, the Asset Surveyor software starts.

Data Capacity

The TSC1 datalogger is supplied with 2 MB of internal memory for data storage, which in most cases provides enough capacity for your data logging requirements. Table 3.2 provides estimates of the data logging capacities of the TSC1 datalogger under various data collection scenarios. Although the TSC1 can hold a large volume of data, Trimble recommends that you transfer data files to your office PC daily.

Table 3.2   Data capacities for rover and base files

File type	Logging interval	Carrier logging	Logging time
Rover	1 second	On	2 - 2.5 hours
	1 second	Off	6 hours
	5 seconds	On	10 hours
	5 seconds	Off	30 hours
Base	5 seconds		14 hours
	15 seconds		35 hours

Note – For the highest accuracy of differentially corrected positions, Trimble recommends that the rover position interval be set to a multiple of the base station interval.

Tip – If you must log data for longer periods, you can increase the GPS logging intervals.

If you require more memory for data storage than is available in the TSC1 datalogger's internal memory, use a PC card.

Physical Specifications

Table 3.3 lists the specifications of the TSC1 datalogger.

Table 3.3   TSC1 physical specifications

Property	Specification
Size	266 mm x 116 mm x 42 mm (10.5 in x 4.6 in x 1.65 in)
Weight	844 gms (1.86 lbs)
Power	<1 W
Operating temperature	from –20°C to +65°C (–4°F to 150°F)
Storage temperature	from –30°C to +80°C (–22°F to +176°F)
Humidity	95 % non-condensing
Casing	UV-resistant plastic, resistant to wind-driven rain and dust
Memory	2 MB internal flash memory
Communications	2 x RS232 serial ports
Display	240 x 200 Graphics LCD display with backlight

Power Sources

The TSC1 datalogger is supplied with a Lithium-ion battery (part number 29518). This is a 7.4 V 1.2 AH rechargeable battery.

⚠️ **Warning –** Only use Trimble-approved batteries in the TSC1 internal battery compartment. Otherwise, the unit may be damaged.

The receiver, or another external power source, provides the power for the TSC1 datalogger, except when the TSC1 is running off its internal battery.

Battery Status

The status line displays the status of the TSC1 battery and of any external power source (usually a receiver), depending on the source currently being used. For a list of items that appear in the status line, refer to the *TSC1 Asset Surveyor Software User Guide*.

You can also view the power status by selecting *Configuration / Hardware (TSC1)*. The *Internal battery* and *External battery* fields show how much power remains, and indicate whether the source being used by the TSC1 datalogger is internal or external.

The values for the *Internal battery* and *External battery* fields are expressed as percentages, and are calculated by comparing the reported voltage against the possible range for the power source in question.

For example, the percentage displayed for the *External battery* field is computed by comparing the reported voltage against the possible voltage range (v_{min} to v_{max}) for camcorder batteries, as follows:

$$\text{External battery \%} = (\text{voltage} - v_{min}) / (v_{max} - v_{min}) \times 100$$

The percentage displayed for the *Internal battery* field is computed by comparing the reported voltage against the possible range for the lithium-ion battery, as follows:

$$\text{Internal battery \%} = (\text{voltage} - v_{min}) / (v_{max} - v_{min}) \times 100$$

Note – The percentage reported for new batteries may be less than 100%. The calculation of the battery percentage assumes a range typical of a new battery, so used batteries may report percentages well under 100%. This is because repeated recharging of batteries normally results in a reduced potential maximum voltage.

Low Battery Warnings

When the Asset Surveyor software detects that the internal battery voltage is low, the following message appears:

The internal battery is low

This usually occurs when the voltage level has dropped to about 10%. You can continue to use the TSC1 datalogger for a short period, but replace or recharge the battery as soon as possible.

When the Asset Surveyor software detects that the main battery voltage is so low that it cannot function, the following message appears:

Internal battery is dead

The TSC1 datalogger shuts down. You must then replace or recharge the battery.

Note – When the internal battery can no longer function, no data is lost, as data in the TSC1 datalogger is stored in the flash memory.

Recharging the TSC1 Battery

You can recharge the datalogger's lithium-ion battery in one of two ways:

- using a Trimble Support Module (TSM™) power supply
- using a low voltage power supply (such as a camcorder battery)

Using a Trimble Support Module (TSM)

To charge the TSC1 battery using a TSM, connect the TSC1 datalogger to a TSM as shown in Figure 3.4.

1	P/N 38246-00	Trimble Support Module (TSM)
2	P/N 14284	TSM extension cable
3	P/N 32287-00	TSC1 data/power cable
4	TSC1 datalogger	
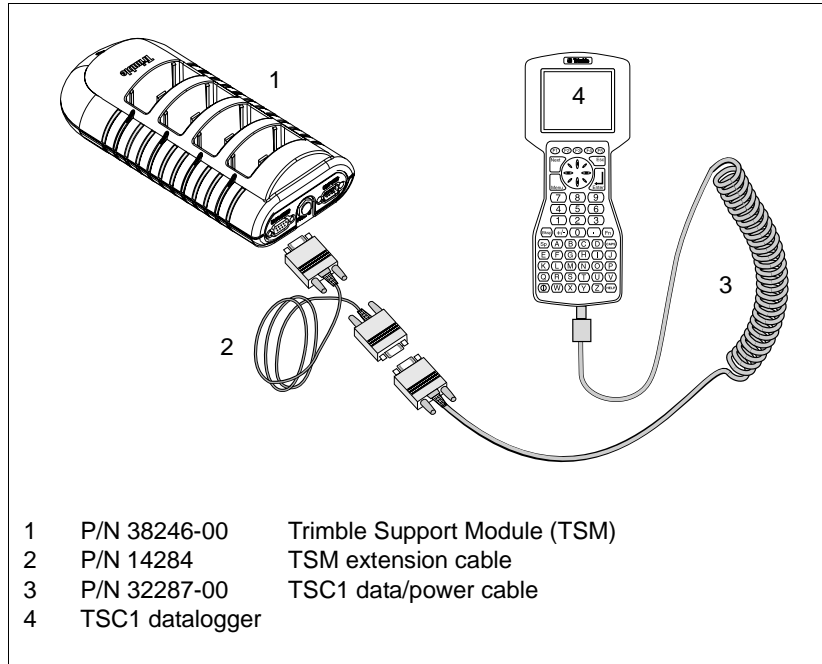
Figure 3.4   Cabling for charging a TSC1 battery using a TSM

1. Plug the TSM into the wall current (mains),

2. Connect the TSM to the extension cable (P/N 14284). Attach this to the TSC1 data/power cable (P/N 32287-00). This cable connects to either the top or bottom port of the TSC1 datalogger.

The battery recharges fully in approximately three hours.

Using a low voltage power supply

You can recharge the TSC1 battery using a power source of less than 15 V.

1. Connect the TSC1 datalogger to a GPS receiver with an external power source, or directly to a camcorder battery.

2. Open *Configuration / Hardware (TSC1)* and set the *Low voltage charging* field to 'On'.

3. The TSC1 battery will charge off the external power source until it reaches maximum capacity.

Alternative Power Sources

If it can, the TSC1 datalogger draws power from the GPS receiver's power source. This is used in preference to the lithium-ion battery.

Ports

The TSC1 datalogger has two data/power ports. One port is at the bottom of the unit, the other is at the top on the back. Both ports function in the same way. Figure 3.2 on page 22 shows where these ports are located on the TSC1 datalogger.

The Asset Surveyor software automatically detects which port is connected to an external device. Whichever port is connected first is the one that is used.

Servicing

The TSC1 datalogger does not need to be serviced. To clean the TSC1 datalogger, use a soft cloth moistened with water and a mild soap.

If your TSC1 datalogger develops a fault, transfer any data to your PC and reset the TSC1 with a cold boot as described on page 28. If you cannot transfer the data, do *not* perform a cold boot. Contact your local dealer for advice.

Contact your dealer for repairs, replacement parts, service information, and technical assistance. If you need more help, see the section on Technical Assistance in the beginning of this manual. You can also contact Trimble at the address listed inside the front cover.

Note – Other Trimble software (such as the Trimble Survey Controller™ software) can also be installed on a TSC1 datalogger. Please see your Trimble dealer for details.

Before Leaving the Office

In this chapter:

Introduction

This chapter explains what to do before you take the Asset Surveyor software out into the field.

Planning

Obtaining the desired accuracy requires good planning. The Quick Plan software lets you plan the best times to collect GPS data. The following information is useful when planning for data collection:

- The number of visible satellites

- Where the satellites travel

- The PDOP (Position Dilution of Precision)

The more satellites that are visible, the better. PDOP provides an indication of the expected accuracy of your GPS positions based on the relative positions of the satellites. Lower PDOP values provide more accurate data.

The Quick Plan software provides many different graphical representations of satellite availability and PDOP:
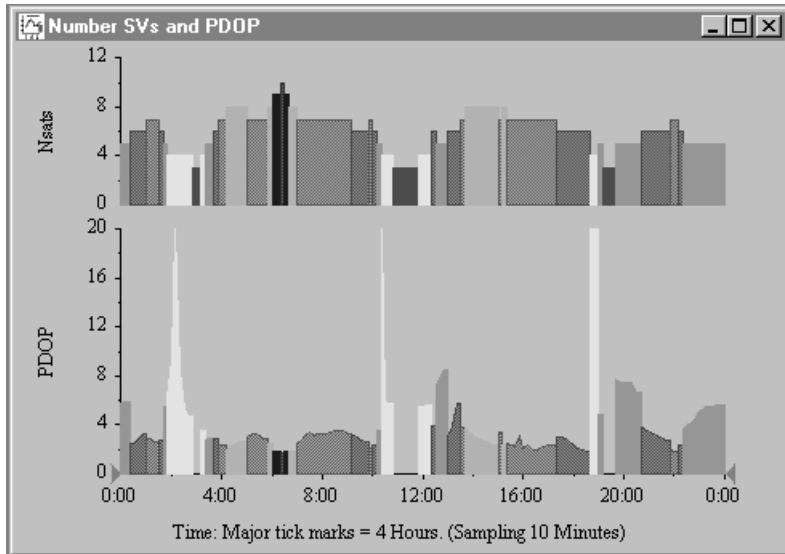
These help you check whether there are any times of the day when there are insufficient satellites, or the PDOP is too high. For instructions on using the Quick Plan software, refer to the Quick Plan documentation.

You need at least four satellites and a low PDOP for a 3D position. If you are operating in Overdetermined mode, you need five or more satellites.

Updating the Almanac

The almanac is a set of data that is used to predict satellite orbits over a moderately long period of time (about a month).

To produce reasonably accurate results, Quick Plan requires an almanac that is less than a month old. Therefore, it is important to obtain a current almanac (if your computer does not have one) before using Quick Plan.

Trimble Series 4000™ and Trimble GPS Pathfinder receivers all acquire the current almanac from satellites during regular operations, and maintain it in memory. You can copy the almanac from a Series 4000 receiver to your computer by importing the ephemeris and storing it in an .eph file. You can import the almanac from a GPS Pathfinder receiver to an .ssf file.

For instructions on how to transfer an almanac file to your PC, refer to the Quick Plan documentation.

Projects

With the GPS Pathfinder Office software, you can organize your work into projects. Dividing your work into projects assists you with file management; you can set up projects for different groups of data. For example, if you are a consultant or contractor, you could create a project for each client, each major task, each city you work in, or each month.

When you create a project, the GPS Pathfinder Office software asks you to enter information about the project, including the name and folder path. The project folder path tells the GPS Pathfinder Office software where to find and store data files belonging to the project. The GPS Pathfinder Office software lets you specify three folders for storing files for different purposes (backup, export, and base files).

Creating a Project

Start the GPS Pathfinder Office software. The GPS Pathfinder Office application window appears with the *Select Project* dialog open:
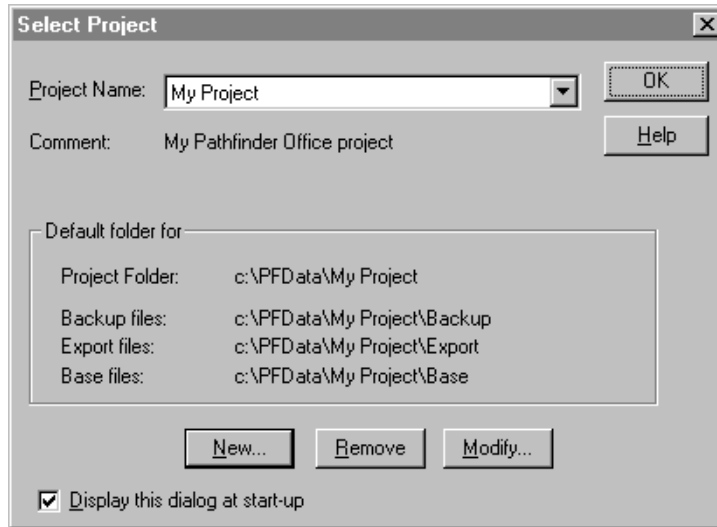
The folder structure is flexible. The folders you specify are only defaults; you can change them and store your data elsewhere if you want. The folders for backup, export and base files do not have to be folders of the project folder. They can be a shared folder on a network so that all users can access their files, or they can be in the project folder itself.

For more information about creating a project, refer to the GPS Pathfinder Office documentation.

Data Dictionaries

A data dictionary is a description of the features and attributes relevant to a particular project or job. It is used in the field to control the collection of features (objects) and attributes (information about those objects). A data dictionary includes a list of features that are collected in the field, and for each feature, a list of attributes that describe that feature. A data dictionary structures data collection. It does not contain the actual information collected in the field (positions and actual attribute values for each occurrence of a feature).

Understanding how to put together a data dictionary is very important. Design your data dictionary with your GIS in mind. In particular, be familiar with any format restrictions imposed by the GIS, otherwise you may not be able to import the data you collect. Constructing a haphazard data dictionary can greatly increase the amount of time and work required to enter the data you collect into a GIS or database.

Data dictionaries are project independent. The GPS Pathfinder Office software does not automatically store the data dictionary (.ddf) files in the project folder. You may want to create a folder specifically for data dictionary files. For more information on the creation of data dictionaries, see the Data Dictionary Editor documentation, or the *Mapping Systems General Reference.*

To start the Data Dictionary Editor utility, select *Utilities* / *Data Dictionary Editor* from the GPS Pathfinder Office menu bar. The *Data Dictionary Editor* dialog appears, letting you create a new data dictionary. The following screen snap is an example of features and attributes that can be created for your data dictionary:
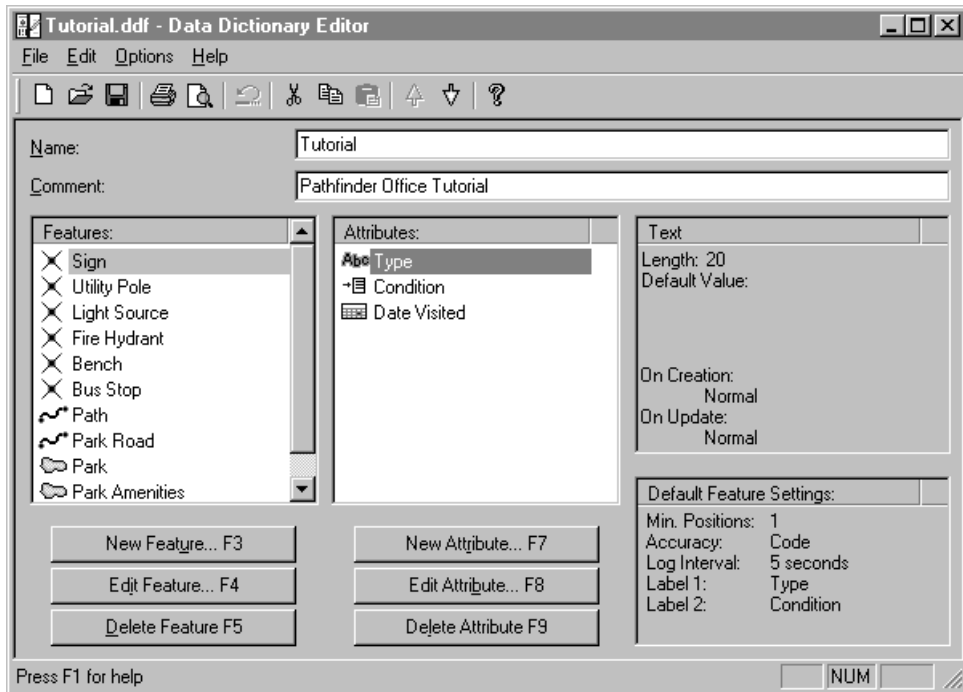
Once you have finished designing your data dictionary you can transfer it to the TSC1 datalogger. For more information on how to transfer your data dictionary to the TSC1 datalogger, see Data Transfer, page 49.

Waypoints

A waypoint is a three-dimensional point which can be given a name and a location, either prior to field work or in the field. Waypoints are useful for navigation purposes and can be used as references for sites. This makes returning to the same site possible at a later date.

Waypoints can be created using the Waypoint Manager utility in the GPS Pathfinder Office software and are stored as .wpt files. Like data dictionaries, waypoints are project independent, and are not stored automatically in the project folders. You may want to create a folder specifically for waypoint files. For more information on creating waypoints, see the GPS Pathfinder Office documentation.

For more information on how to transfer waypoint files to the TSC1 datalogger, see Data Transfer, page 49.

Coordinate Systems

Coordinate systems are three-dimensional reference frames used to describe the location of objects in space. Trimble's GPS receivers provide you with your position in relation to the coordinate system you have configured. Coordinate systems for use with the Asset Surveyor software can be created using the Coordinate System Manager™ utility in the GPS Pathfinder Office software and transferred to the TSC1 datalogger.

For more information on how to transfer coordinate system files to the TSC1 datalogger, see Data Transfer, page 49.

Data Files

As well as logging new features, the Asset Surveyor software can update features you have already collected in previous sessions. You can open an existing data file and add new features to it, or update features already logged to the file. The *Data collection* module of the Asset Surveyor software shows you which features you have updated and which you have yet to visit. You can select a feature you have already logged and navigate to that feature to check its condition and attributes, and optionally re-record its GPS position.

You can review or update data files which have been:

- created on your TSC1 datalogger but not yet transferred from the datalogger to the GPS Pathfinder Office software

- transferred from the GPS Pathfinder Office software back to the datalogger

- imported from a GIS into the GPS Pathfinder Office software and then transferred to the datalogger

You can transfer any data (.ssf) file to the TSC1 datalogger from the GPS Pathfinder Office software, before or after differentially correcting the file. For more information on transferring data files from the GPS Pathfinder Office software to the TSC1 datalogger, see Data Transfer, page 49.

Importing Data from a GIS

Keeping information up to date is an important aspect of maintaining a GIS. With the Export utility in the GPS Pathfinder Office software, you can add new features to your GIS. However, to update features you have already transferred to the GIS, you need to import them from the GIS back into the GPS Pathfinder Office software, then transfer the resulting data (.ssf) files to the TSC1 datalogger.

You can import data in the following GIS formats:

- •   ArcView Shapefile

- •   dBASE

- •   MapInfo MIF

- •   Microsoft Access MDB

Even if your GIS does not use any of these formats, it may be able to export data in one of the formats.

To ensure that the data you export from the GIS can be used easily in the Asset Surveyor software, Trimble recommends that you import data as follows:

1. Import the data dictionary from the GIS to the GPS Pathfinder Office software:

   a. Select *Utilities / Import* from the GPS Pathfinder Office menu bar.

      The following dialog appears:
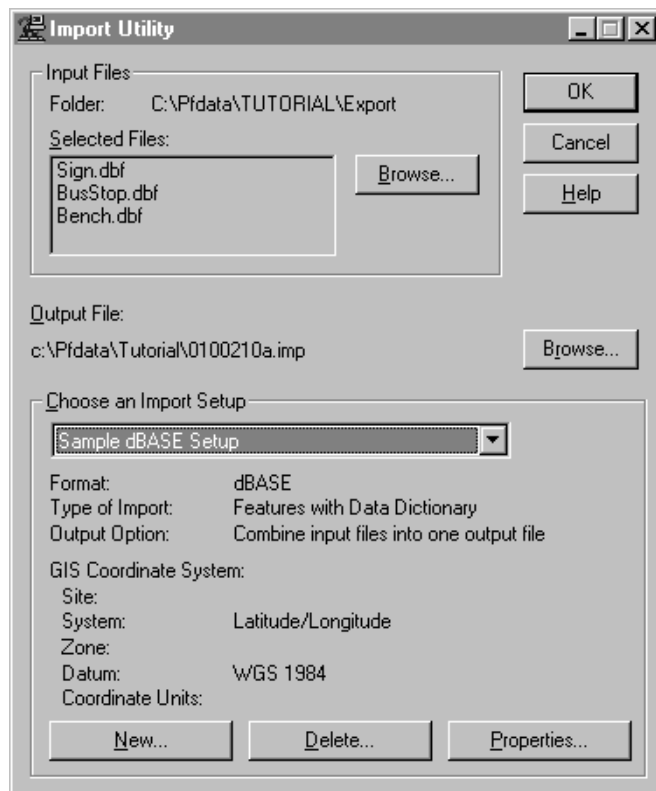
   b. In the *Input Files* group, click **Browse**, locate the GIS, select all the data files you want to import the data dictionary from, and click **Open**.

      c.   From the *Choose an Import Setup* group, select the option that corresponds to the GIS file format.

      d.   Click **Properties**. The *Import Setup Properties* dialog appears.

      e.   Make sure that the *Data* tab is selected, and in the *Type of Data to Import* group, select the Data Dictionary File Only option.

      f.   Click **OK** to close the *Import Setup Properties* dialog.

      g.   Click the second **Browse** button, select a name and location for the imported data dictionary, and click **Save**.

      h.   Click **OK** in the *Import Utility* dialog to import the data dictionary.

2.   In the Data Dictionary Editor utility in the GPS Pathfinder Office software, review the data dictionary, making changes where necessary.

    You may want to make data entry mandatory on some attributes, or make other attributes protected to prevent accidental editing or deletion of important information.

3.   Import the features from the GIS, validating them against the data dictionary you have already imported. Do the following:

      a.   Select *Utilities* / *Import* from the GPS Pathfinder Office menu bar.

      b.   In the *Input Files* group, click **Browse**, locate the GIS, select all the data files you want to import features from, and click **Open**.

      c.   In the *Choose an Import Setup* group, make sure the option that corresponds to the GIS file format is selected.

      d.   Click **Properties**. The *Import Setup Properties* dialog appears.

e.   Make sure that the *Data* tab is selected, and in the *Type of Data to Import* group, select the Features with External Data Dictionary option.

f.   Click **Dictionary File**, browse for the Data Dictionary file you imported in step 1, and click **Open**.

g.   Click **OK** to close the *Import Setup Properties* dialog.

h.   Click the second **Browse** button, select a name and location for the imported data file, and click **Save**.

i.   Click **OK** in the *Import Utility* dialog to import the data file.

4.   Transfer the .ssf data file to the TSC1 datalogger. For more information, see Data Transfer, page 49.

Data Transfer

Once you have created data dictionaries, waypoints, or coordinate systems on your office PC, or imported data from an existing GIS into the GPS Pathfinder Office software, you need to transfer this information to the TSC1 datalogger.

The Data Transfer utility in the GPS Pathfinder Office software provides all the functionality you require to efficiently transfer data between the TSC1 datalogger and your office PC.

Tip – Transferring large data files to a PC card connected directly to your computer is faster than transferring them to the TSC1 datalogger.

Connecting the TSC1 Datalogger

A TSC1 datalogger can be connected to the PC for data transfer using the data download cable for a direct connection.

If the battery charger is not connected to the cable, the TSC1 datalogger's internal batteries power the transfer process between the TSC1 datalogger and the PC.

To connect the TSC1 datalogger to the PC:

1. Connect one end of the TSC1 data cable (PN 32287-00) to the null modem cable (PN 18532) and the other end to the TSC1 datalogger.

2. Connect the null modem cable to the serial port on the PC, as shown in Figure 4.1.
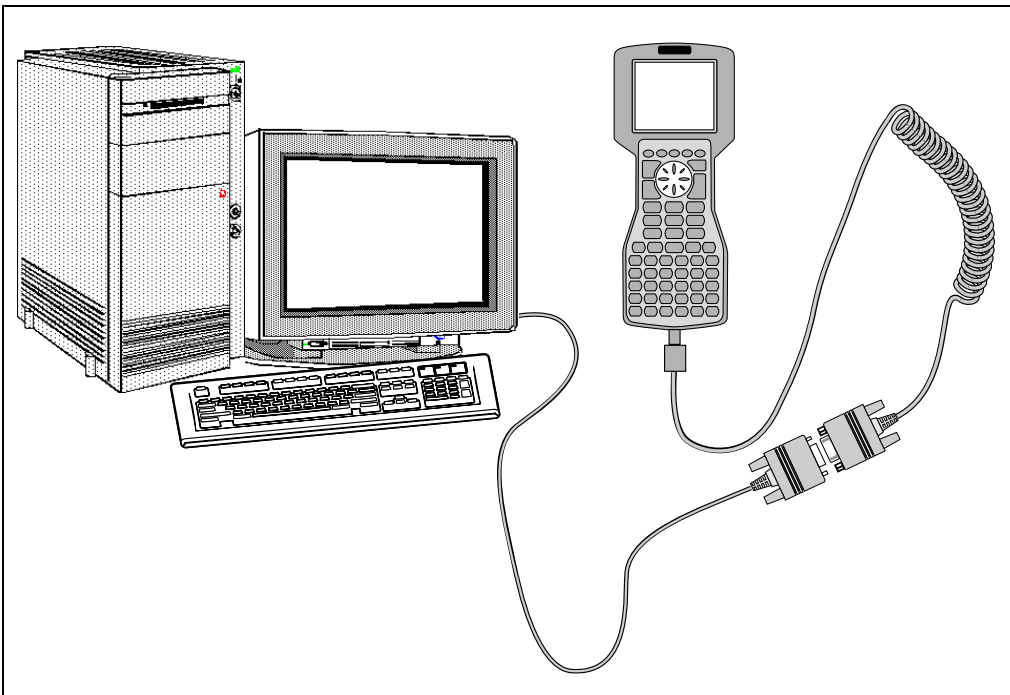
Figure 4.1   Connecting the TSC1 datalogger to the PC

Transferring Files to the TSC1 Datalogger

Some of the files that you have stored on your PC may need to be transferred to your TSC1 datalogger.

To transfer files to the TSC1 datalogger:

1. Select *File manager* from the Asset Surveyor *Main menu*, then select *File transfer*. The Asset Surveyor software is now ready to transfer data files.

2. In the GPS Pathfinder Office software on your office computer, select *Utilities* / *Data Transfer*.

    The following dialog appears:
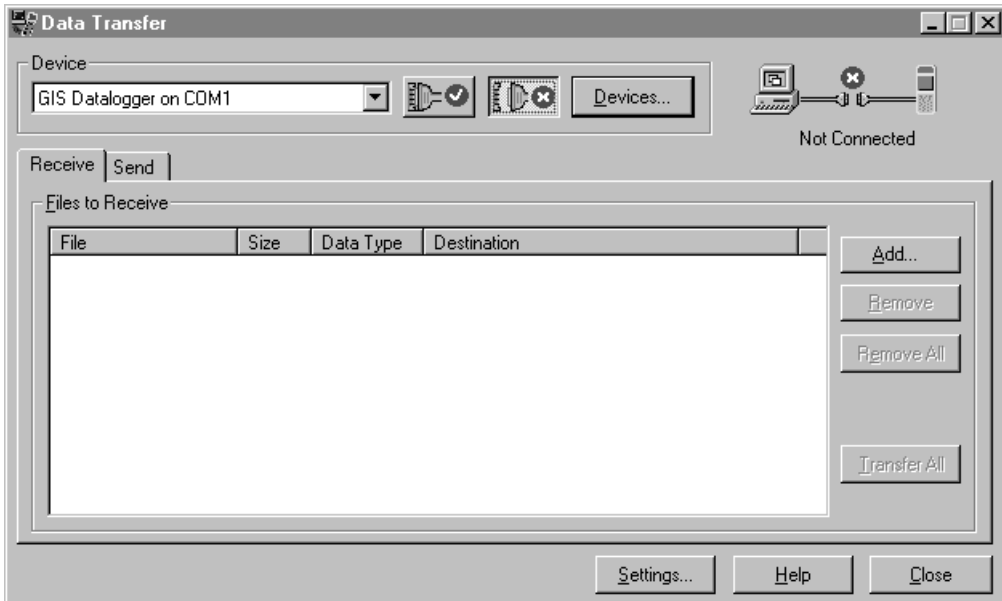
3. From the *Device* list, select the device name that represents the TSC1 datalogger.

You can use one of the predefined names (GIS Datalogger on COM 1 or GIS Datalogger on COM 2, depending on which serial (COM) port the support module is connected to) or you can set up a new device definition.

The Data Transfer utility automatically connects to the datalogger.

4.   In the *Send* tab, click **Add**.

The *Open* dialog appears.

5.   In the *Files of type* field, select the format of the files that you want to send. For example, select Data Dictionary (*.ddf) to send Data Dictionary files.

6.   In the list of files, highlight the file or files you want to transfer and click **Select**.

The *Open* dialog disappears, and the files you selected appear in the *Files to Send* list.

7.   If necessary, repeat Step 4 through Step 6 to select other files to send.

8.   Click **Transfer All**.

The selected files are transferred to the Asset Surveyor software.

9.   A message showing summary information about the transfer appears. Click **Close**.

10. To close the Data Transfer utility, click **Close**.

Configuring the System

Before you take your TSC1 datalogger out into the field and use it to collect data, you need to check the critical configuration settings in the Asset Surveyor software.

The Asset Surveyor software can be configured in a large number of ways. The configuration settings are divided into three classes:

- **Critical settings:** A configuration setting is considered *critical* if it affects the quality and usability of GPS positions logged by the Asset Surveyor software. It is *crucial* that you check all critical settings before collecting data or navigating with the Asset Surveyor software.

- **Non-critical settings:** Settings that affect the behavior of the Asset Surveyor software but do not have a potentially negative impact on GPS positions are termed *non-critical*. You should still check each non-critical setting before collecting data or navigating with the Asset Surveyor software, but if you do not do so, it does not affect the quality of GPS positions logged.

- **Display settings:** Many settings have no impact on the data that is collected, but merely alter the way data is displayed. You do not need to change any display settings unless you want data displayed in a way that differs from the Asset Surveyor software's default settings.

Critical Settings

The critical configuration settings are listed in Table 4.1. For each setting, the default (and suggested) value is indicated. For a detailed description of each setting, refer to the chapter on configuration in the *TSC1 Asset Surveyor Software User Guide*.

All critical settings can be checked or changed by selecting *GPS rover options* or *GPS base station options* from the *Configuration* menu. The *Configuration* menu is accessed from the *Main menu.*

Table 4.1   Critical configuration settings

Setting	Default value	Configuration menu entry
Logging intervals (rover)		GPS rover options / Logging options
Point feature	5 seconds	
Line and area features	5 seconds	
Not in feature	None	
Velocity	None	
Logging intervals (base)		GPS base station options / Logging options
Measurements	5 seconds	
Minimum positions (point feature)	3	GPS rover options / Logging options
Position mode (rover)	Manual 3D	GPS rover options / Position filters
Elevation mask (rover)	15°	GPS rover options / Position filters
SNR mask (rover)	6.0	GPS rover options / Position filters
PDOP mask and switch (rover)	6.0	GPS rover options / Position filters
Position mode (base)	Manual 3D	GPS base station options / Position filters
Elevation mask (base)	10°	GPS base station options / Position filters
SNR mask (base)	4.0	GPS base station options / Position filters
PDOP mask and switch (base)	8.0	GPS base station options/ Position filters

The settings listed in Table 4.1 are critical for the following reasons:

- If a *Logging interval* is set incorrectly, the Asset Surveyor software does not log data as often as you require, and may possibly not log certain data at all.

- If the *Minimum positions* setting is incorrect, you may not log sufficient GPS positions for point features to achieve your desired level of accuracy.

- If the *Position mode* setting is incorrect, the Asset Surveyor software may log 2D positions (which are generally much less accurate than 3D positions) when 3D positions are required. If it is necessary to log only overdetermined positions (5 or more satellites) to achieve a desired level of accuracy, then use Overdetermined 3D mode.

- If the *Elevation mask* is set too low, your GPS rover may use satellites which are not visible to, or usable by, the base station. This may make it impossible to differentially correct the data you have logged.

- If the *SNR mask* is set too low, your GPS rover may log positions that are inaccurate due to low signal quality.

- If the *PDOP mask* is set too high, your GPS rover may log inaccurate positions due to poor satellite geometry.

For more information about each critical setting, refer to the *TSC1 Asset Surveyor Software User Guide*.

Tip – When using a Pro XL™, Pro XR™, Pro XRS™, 4600LS™, Site Surveyor 4400™, GPS Total Station® 4700, GPS Total Station 4800, or Series 4000™ receiver, you can obtain submeter accuracy with a single position, and can therefore reduce the *Minimum positions* setting to 1 if you want to minimize the amount of time spent recording each point feature.

Non-critical Settings

The non-critical configuration settings are listed in Table 4.2. For each setting, the default (and suggested) value is indicated.

All non-critical settings can be found under entries in the *Configuration* menu. Table 4.2 also indicates under which entry in the *Configuration* menu you find the setting. The *Configuration* menu is accessed from the *Main menu.*

Table 4.2   Non-critical configuration settings

Setting	Default value	Configuration menu entry
Antenna options	Integrated GPS/Beacon, 0.0m	GPS rover options GPS base station options
Initial position	?	GPS rover options
2D altitude	?	GPS rover options
Carrier phase Minimum time	10 minutes	GPS rover options / Logging options
Reference position	?	GPS base station options
Dynamics code	Land	GPS rover options / Logging options
Audible click	Yes	GPS rover options / Logging options
Log DOP data	Yes	GPS rover options / Logging options GPS base station options / Logging options
Log PPRT data	Yes	GPS rover options / Logging options
Log QA/QC data	Yes	GPS rover options / Logging options
Allow GPS update	Warn first	GPS rover options / Logging options
Warning distance	Any	GPS rover options / Logging options
Apply real-time	Auto	GPS rover options / Position filters
RTK mode	On	GPS rover options / Position filters
Log RTK only	Yes	GPS rover options / Positions filters
Real-time input options	Custom, 9600, 8, 1, N, Any, 20s	Communications options

Table 4.2   Non-critical configuration settings (Continued)

Setting	Default value	Configuration menu entry
Integrated DGPS	Beacon, Auto range	Communication options / Real-time input options
RTK protocol (roving receiver)	CMR	Communication options / Real-time input options
Real-time output options	Off, Custom, 9600, 8, 1, N	Communication options
RTK protocol (base receiver)	CMR	Communication options / Real-time output options
NMEA/TSIP output options	None	Communications options
Time	N/A	Time and date
Date	N/A	Time and date
Attributes	Default	Quickmarks
Confirm	No	Quickmarks
Offsets	Off	Constant offset
LCD contrast	30%	Hardware (TSC1)
Auto shutoff	20 minutes	Hardware (TSC1)
Beep volume	High	Hardware (TSC1)

Display Settings

The display configuration settings are listed in Table 4.3. For each setting, the default (and suggested) value is indicated.

All display settings can be found under one of the entries in the *Configuration* menu. Table 4.3 also indicates under which entry in the *Configuration* menu you find the setting. The *Configuration* menu is on the *Main menu.*

Table 4.3   Display configuration settings

Setting	Default value	Configuration menu entry
Coordinate system	Latitude/Longitude WGS 1984	Coordinate system
	Meters (m)	
Coordinate units	Meters (m)	Coordinate system
Altitude units	MSL	Coordinate system
Altitude reference	DMA 10x10 (Global)	Coordinate system
Geiod model		Coordinate system
Units		
Distance units	Meters	Units and display
Velocity units	Km/Hour	Units and display
Angle units	Degrees	Units and display
Angle format	DD.MMSSss	Units and display
Order	North/East (Latitude/Longitude)	Units and display
North reference	True	Units and display
Magnetic declination	Auto	Units and display
Null string	?	Units and display
Language	English	Units and display
24-hour clock	No	Time and date
Date format	MM/DD/YYYY	Time and date
Layers	Show	Map display options
Scale display	Show	Map display options
Coordinate display	Show	Map display options

Table 4.3   Display configuration settings (Continued)

Setting	Default value	Configuration menu entry
Background file	None	Map display options
Direction dial options		
Dial info panels	Turn, Heading, Velocity, Time	Navigation options
Close-up range (DGPS)	5 meters	Navigation options
Close-up range (RTK)	2 meters	Navigation options
Close-up style	Target-centered	Navigation options
Road options		
Dial info panels	Turn, Heading, Velocity, Time	Navigation options
Road scale	Normal	Navigation options

GPS Hardware Check List

Before setting out to collect data with the Asset Surveyor software and your Trimble GPS receiver, check that you have all the necessary GPS hardware, batteries, cables, and so on. It is very easy to forget a crucial piece of equipment, and this can be frustrating or costly if you have driven or flown to a remote site before setting up your system and discovering the item is missing.

Your GPS receiver's *Operation Manual* provides cabling diagrams for the Trimble GPS systems of which the TSC1 datalogger is a component.

Tip – Set up your entire GIS/GPS data collection system and test it, to make sure that everything is connected correctly, that your batteries are charged, and that your TSC1 datalogger and GPS receiver are communicating correctly, ***before*** you leave your office. After testing the system, remember to turn off the GPS receiver and any other equipment (such as radios) before proceeding to the start point of your survey. Leaving equipment powered on is likely to waste battery life, especially if it will be some time before you need to use the equipment.

Getting Base Station Data

To record high accuracy data you must be able to differentially correct your data. You need to locate a source of base station data or set up your own base station. The base station is used to collect base data or to output RTCM corrections for differentially correcting the positions of the features that you observe with the roving receiver in the field. Many organizations and universities operate active community base stations for differential corrections from which you can obtain data. However, to achieve C/A code submeter accuracy, the base station must be another 12-channel Pro XR system, Pro XRS system, 12-channel Pro XL, 4600LS Surveyor, Site Surveyor 4400, GPS Total Station 4700, GPS Total Station 4800, or Trimble Series 4000 receiver.

In the Field

In this chapter:

- Introduction
- Starting the Asset Surveyor software
- Using GPS
- Logging data to a file
- Updating data
- Using the map
- Navigating with the Asset Surveyor software
- Managing data files

Introduction

This chapter provides instructions and examples of collecting and updating data, navigating and performing other tasks with the Asset Surveyor software. It provides a general description of each aspect. For more information, refer to the *TSC1 Asset Surveyor Software User Guide*.

Starting the Asset Surveyor Software

Tip – As you read this chapter, you may like to follow the description of the Asset Surveyor software's capabilities on your TSC1 datalogger. Your GPS receiver must be connected and operational, although you need not be outdoors. You may also like to refer to Chapter 5 of the *TSC1 Asset Surveyor Software User Guide* for the appropriate details regarding the configuration of your TSC1 datalogger.

This chapter describes the Asset Surveyor software as it is preconfigured. If you have re-configured various Asset Surveyor settings, the software's behavior may differ from what is described in the manual.

As described in Chapter 2 of the *TSC1 Asset Surveyor Software User Guide*, you normally start the Asset Surveyor software by simply turning your TSC1 datalogger on. If, when you turn your TSC1 datalogger on, the Asset Surveyor software is not running, follow the instructions in Chapter 2 of the *TSC1 Asset Surveyor Software User Guide* to start the Asset Surveyor software.

When you first start the Asset Surveyor software, the *Main menu* appears on the screen of the TSC1 datalogger:
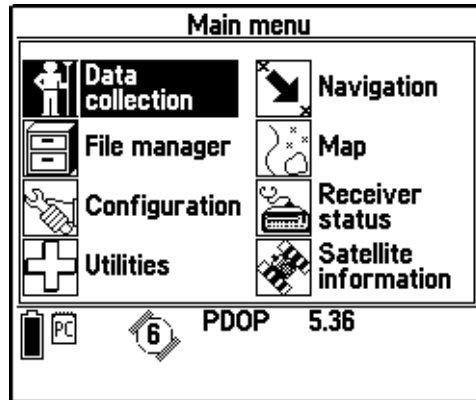
From this menu, you can choose one of the eight main Asset Surveyor operations, as shown in the above screen.

Using GPS

Once the Asset Surveyor software has started running on your TSC1 datalogger, it is ready to communicate with the GPS receiver and start collecting data.

Activating GPS

If you connect a supported Trimble GPS receiver to your TSC1 datalogger using the correct cabling and batteries, the Asset Surveyor software starts to communicate with the GPS receiver immediately after the TSC1 datalogger is turned on.

If, for some reason, the Asset Surveyor software cannot communicate with the GPS receiver, it displays the following message:

```
┌──────No GPS detected──────┐
│ Check cabling, batteries etc. Do you │
│        wish to retry GPS now?        │
│                                      │
│                                      │
│                                      │
│                                      │
│ ──────────────────────────────────  │
│                                      │
│ ┌─────┐                    ┌─────┐   │
│ │ Yes │                    │ No  │   │
│ └─────┘                    └─────┘   │
└──────────────────────────────────────┘
```
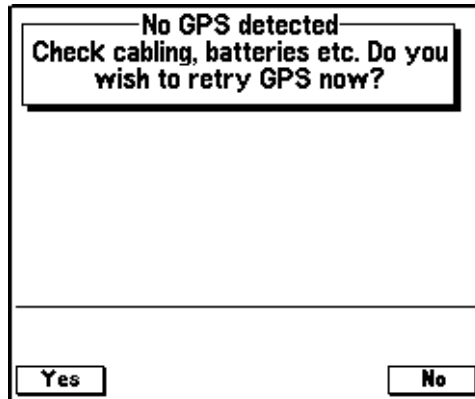
If this message is displayed, check that:

- the cabling is connected firmly and correctly
- the batteries are connected and charged
- your GPS receiver is turned on (if appropriate)

Then press ⌐Yes┐ to the above question.

If the Asset Surveyor software and the GPS receiver still do not establish communication, consult your receiver's *Operation Manual* or the appropriate appendix at the back of this manual for cabling and configuration details specific to the GPS receiver you are trying to use.

The GPS status line

Once communication with a GPS receiver is established, the Asset Surveyor software beeps and displays the GPS status line. The GPS status line (just above the line of softkeys) provides you with up-to-date information regarding the status of the GPS receiver.

Various messages periodically flash on the GPS status line. For example, if you have your TSC1 datalogger and GPS receiver operating while you are indoors, the receiver cannot track any satellites, so the GPS status line flashes the message:


```
                              Too few SVs
```
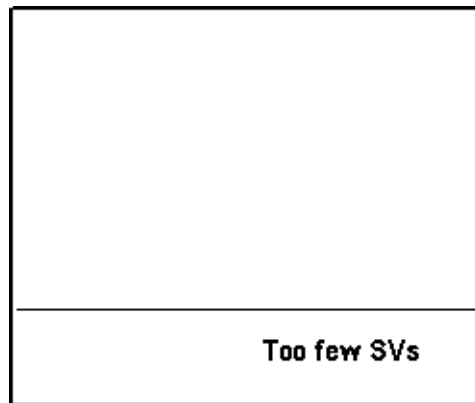
Most messages that appear on the GPS status line inform you of a condition that is preventing the computing or logging of GPS positions. When such a condition arises, the Asset Surveyor software emits a warning beep and starts to flash the appropriate message. When the condition ceases, the Asset Surveyor software emits a success beep to indicate that you can proceed with your data collection session. It also removes the flashing message from the status line.

Controlling GPS

The Asset Surveyor software acts as a control panel for your Trimble GPS receiver. Some receivers are even turned on and off by the Asset Surveyor software. A GPS receiver is controlled primarily by the way it is configured. The Asset Surveyor software lets you configure the GPS receiver from the *Configuration* module. You can select a number of forms from the *GPS rover options* menu:
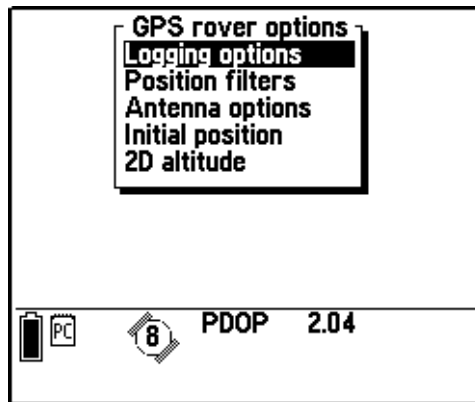
Select *Logging options* to display the following form. This is where you set the options for how you want to log the GPS data:
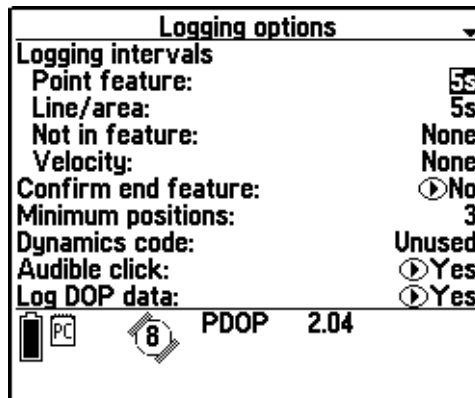
Note – The entire contents of this form do not fit onto the screen at once. You must move through the form (using ⊽) in order to check all of the fields in the form.

Once the Asset Surveyor software is communicating with a Trimble GPS receiver, your interaction with the GPS receiver takes place through four of the *Main menu* operations:

- *Navigation*

- *Map*

- *Receiver status*

- *Satellite information*.

Press ⌊Menu⌌ at any time to display the *Main menu*.

Your current GPS position

To view your current or most recent GPS position, select the *Map* entry from the *Main menu*, then press the ⌊Mode⌌ softkey. The position is displayed, as shown below:

```
                GPS position
Latitude:          37°24'44.70106"N
Longitude:        122°00'02.43660"W
Altitude (MSL):             28.26m
Datum:                   WGS 1984
Zone:                         N/A



 ▮ PC      ◈8   PDOP   1.81

 Mode                         WayPt
```

When the Asset Surveyor software cannot obtain a current GPS position from the GPS receiver (for example, due to a high PDOP value, or insufficient satellites), the title of this form changes to *OLD position*, and flashes on and off.

Press `WayPt` to create a waypoint for the current position.

To cycle back to the graphical map mode from the *GPS position* form, press `Mode`. For a description of this mode, refer to Chapter 8 of the *TSC1 Asset Surveyor Software User Guide*.

Current GPS status

If you select the *Receiver status* entry from the *Main menu*, the Asset Surveyor software displays information regarding the status of the GPS receiver. For example:

```
                    Receiver status
Mode:                               Manual 3D
SVs:                     1,30,14,15,21,25,29
HDOP:                                     1.3
VDOP:                                     1.7
Status:                           Doing fixes
Carrier time:                             N/A
Battery:                                 100%
Receiver type:                        4000SSE
Navigation version:                      7.25
Signal processor version:                3.07
 ▌ PC       (7)    PDOP    2.19
```

Satellite information

If you select the *Satellite information* entry from the *Main menu*, the Asset Surveyor software displays information about the satellites the receiver is tracking. There are two graphical modes and a text mode. The software opens the module in the last mode you used or, if you have not used this module before, opens the *Skyplot* screen.

The skyplot is a graphical representation of the position of each satellite in the GPS receiver's tracking set:
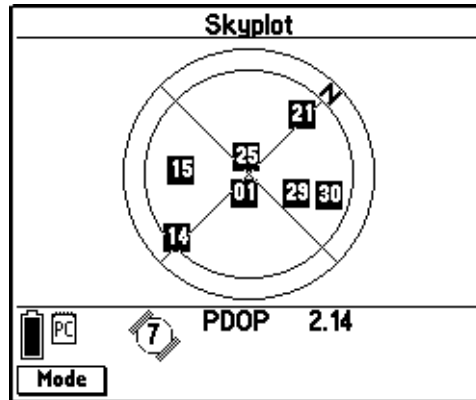
Press ⌐Mode¬ to switch to the *SNR levels* screen. This screen shows a bar graph of the signal-to-noise ratio (SNR) of the satellites being tracked. Press ⌐Mode¬ to display the *Satellite information* form. This form displays five columns of information, and spans as many pages as required to display information for all satellites in the receiver's current tracking set. Press ⌐Mode¬ again to return to the skyplot.

For a description of the modes in this module, refer to Chapter 10, Satellite Information, in the *TSC1 Asset Surveyor Software User Guide*.

Deactivating GPS

Normally, you do not need to disconnect the GPS receiver; you can just turn the TSC1 datalogger off when you have finished using it.

However, if you want to use the Asset Surveyor software for a while without using GPS (for example, to review and edit data) and want to preserve the GPS receiver's batteries, you may choose to deactivate the receiver. You must also disconnect communications with the receiver before transferring files to or from the PC.

When you select *Disconnect GPS* from the *Utilities* menu, the Asset Surveyor software ceases communications with the GPS receiver and shuts down all GPS logging operations. Before doing so, it asks you to confirm the action:

```
┌─────────────────────────────────────────┐
│       ┌─ Please confirm ──────┐          │
│       │ Are you sure you want to │        │
│       │    disconnect from GPS?  │        │
│       └──────────────────────────┘       │
│                                          │
│                                          │
│                                          │
│  ───────────────────────────────────     │
│ ┌─────┐                        ┌─────┐   │
│ │ Yes │                        │ No  │   │
│ └─────┘                        └─────┘   │
└─────────────────────────────────────────┘
```
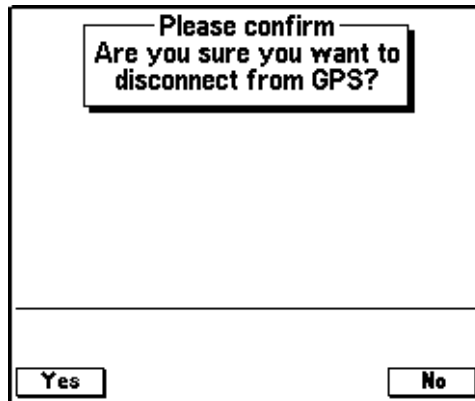
If you press ⌈ Yes ⌉, the Asset Surveyor software closes down its GPS operations, and the GPS receiver is turned off, if possible.

To reactivate the GPS receiver, select *Connect GPS* from the *Utilities* menu, or select *Navigation*, *Receiver status* or *Satellite information* from the *Main menu*.

An Accurate Clock

Each of the GPS satellites contains a number of very precise atomic clocks. Your GPS receiver uses timing information transmitted by the satellites to determine its position. Your own GPS receiver can therefore also serve as a very accurate time source.

The Asset Surveyor software aligns the internal clock of the datalogger to UTC (Universal Time Coordinated) time, which is based on GMT (Greenwich Mean Time), while you are connected to a GPS receiver, so it can display the current time to the precise second, anywhere on earth. When not connected to GPS, the TSC1 datalogger's clock drifts somewhat, but is still reasonably accurate. Whenever you next connect to a GPS receiver, the Asset Surveyor software immediately realigns the TSC1's clock to UTC time.

To view the local time to GPS accuracy, select the *Time and date* entry from the *Configuration* menu. The *Time and date* configuration form appears:

```
┌─────────────────────────────────────┐
│           Time and date             │
│ 24-hour clock:              ⊙No     │
│ Time:              04:05:07 pm      │
│ Date format:      ⊙MM/DD/YYYY       │
│ Date:             09/23/1999 Thu    │
│                                     │
│                                     │
│                                     │
│ ▯🖳    ◈6◈   PDOP   2.52            │
└─────────────────────────────────────┘
```

Until you have connected to a GPS receiver and obtained an accurate time, the Asset Surveyor software simply uses the internal clock of the TSC1 datalogger. Initially, the Asset Surveyor software does not know the time zone of the area in which you are operating. When you set the time and date to within 7½ minutes of the actual local time (some time zones are only 15 minutes 'wide'), the Asset Surveyor software automatically aligns it precisely using GPS time (and the known offset to UTC time). From this point on, the Asset Surveyor software, together with your GPS receiver, can serve as the most precise timepiece you are ever likely to own.

Logging Data to a File

The Asset Surveyor software logs GPS positions, offsets, external sensor data, and attributes for GIS features to data files. You can have a number of data files on your TSC1 datalogger at once, but you can only log GPS data to one data file at a time.

Note – You can view a second rover or background file as the background for the map, but you cannot select or edit any features from this file.

Data files are classified as rover, base, or background files. A rover file contains feature and attribute information, together with the GPS, offset and external sensor data associated with each feature. A base file contains only GPS base station data. To create base files, select the *Create base file* entry from the *Data collection* menu.

A background file is a data file that you may want to view on the map, but which you do not want to edit. Importing such a file as a background file means it is safe from accidental updates.

If you select *Data collection* from the *Main menu*, the Asset Surveyor software displays the *Data collection* menu:
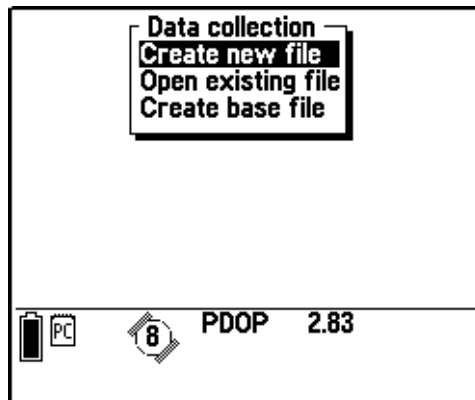
You can perform a variety of operations from this menu, including:

- creating a new rover file and opening it for logging of data

- creating a new base station file and opening it to log data

- reopening an existing rover file to log new data, or review and update existing data

- opening a data file transferred from a geographical information system (GIS) to review and update existing data, or log new data

The following section describes how to create a new rover file.

Creating a New Data File

When you select *Create new file* from the *Data collection* menu, the Asset Surveyor software displays the *Create new file* form:

```
          Create new file
Filename:              R092304A
Data dictionary:       ⏵Tutorial
Storage disk:             ⏵TSC1
Free space:               954kB




 ▯ ⌼            ⟨5⟩   PDOP   3.49

 Time
```

You can accept the default file name suggested by the Asset Surveyor software, or type a new name into the *Filename* field. You can also change the data dictionary that is associated with the data file. If you have a PC card installed, you can choose whether to store the data file on the card or on the TSC1 datalogger. Press Time to switch between UTC and local time for the default file name.

Pressing ⌨ creates the new data file. The Asset Surveyor software automatically opens this data file for logging.

Note – For information on how to collect carrier phase features, refer to Chapter 7, Carrier Phase Data Collection.

When you create a new data file, the Asset Surveyor software starts to log data to this file. It displays a menu of geographic features that can be recorded; these features are determined by the data dictionary associated with the data file.

An example of a menu of features is the following:
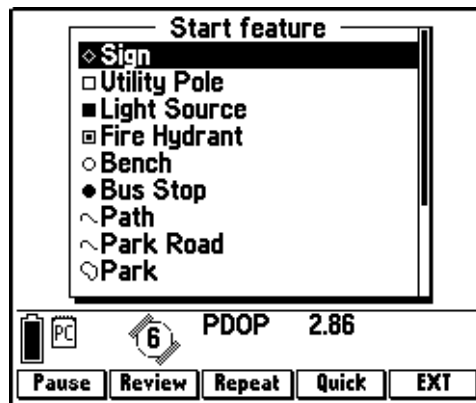
Collecting New Features

When you select a feature from the *Start feature* menu, the Asset Surveyor software starts logging data for the feature. A feature's data includes:

- its GPS position(s)

- an optional offset to the GPS position(s)

- its attributes, manually entered using the options provided by your chosen data dictionary

- any external sensor data recorded for that feature

Provided a GPS receiver is connected and operational, the Asset Surveyor software records GPS positions automatically for the feature, as determined by the way in which you have configured the GPS interface. It starts recording GPS positions when you select the feature and continues recording positions until you save the feature.

If you have configured and activated an external sensor, external sensor data is also recorded automatically. External sensor data is recorded until you save the feature.

If you have configured and activated a laser rangefinder, you can record an offset for the feature by aiming and firing the rangefinder. Alternatively, you can measure and enter the offset manually.

By taking care of GPS and external sensor data collection, and by integrating the recording of an optional offset to each feature, the Asset Surveyor software lets you concentrate on entering attribute values for the feature.

Each feature is defined as a point, a line, or an area. The way the data collection software logs GPS positions for points, lines, and areas differs. Figure 5.1 shows examples of geographical features.

Points
- Well sites
- Power poles
- Accident sites

Lines
- Streams
- Roads
- Pipelines

Areas
- Parks
- Wetlands
- Timber stands
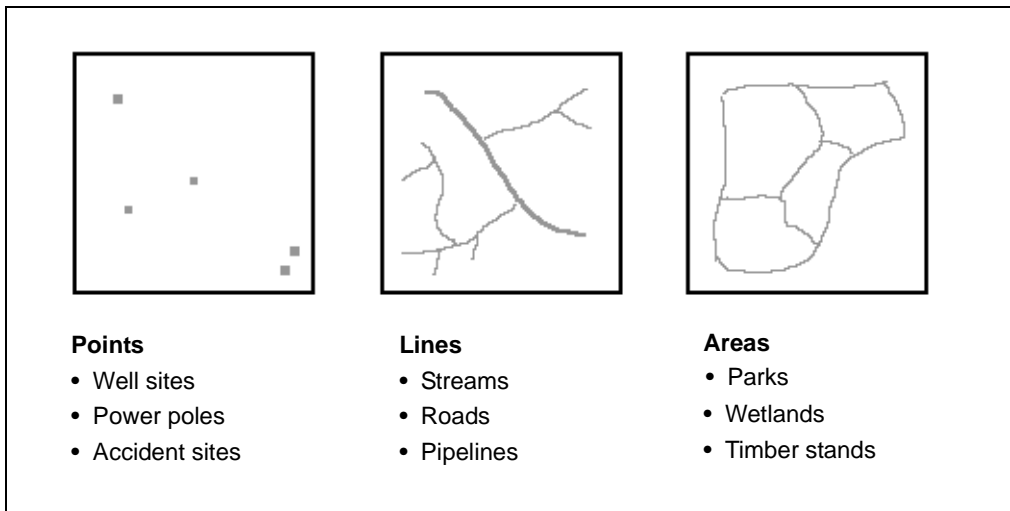
Figure 5.1   Examples of geographical features

- **Point features**: You can remain stationary at a point for a period of time. The Asset Surveyor software records a number of GPS positions during this time, based on the configured logging intervals. After differential correction of these GPS positions, they are averaged together (in the GPS Pathfinder Office software) to produce an accurate position for the point feature.

  You can also record point features using a technique known as quickmarking. To record a quickmark, you press a key on the TSC1 datalogger at the moment you travel past the feature. The Asset Surveyor software computes a single instantaneous position for the feature. Positions obtained by quickmarking are less accurate, even after differential correction, than averaging a number of GPS positions together, but quickmarking lets you collect many features very quickly.

- **Line features**: In order to record a line feature, you travel along the line. As you do so, the Asset Surveyor software periodically records GPS positions. These positions are joined together to form a line.

- **Area features**: In order to record an area feature, you travel around the perimeter of the area, and the Asset Surveyor software periodically records GPS positions. These positions are joined together to form the perimeter of the area. The first and last GPS positions are joined together to close the area, so there is no need to return right to the start point.

For applications in which higher accuracy is required, you can configure the Asset Surveyor software to record GPS carrier phase data, provided your GPS receiver can compute such data. You can then process this data with the GPS Pathfinder Office software to yield accuracy of a few decimeters, or down to centimeter level using the GPS Pathfinder Pro XR/XRS Centimeter Option.

In general, you must finish collecting one feature before you can collect another. The exception to this rule is the ability to collect point features within line or area features, by either nesting or quickmarking point features.

Point features

When you are collecting a point feature, there are several softkeys at the bottom of the attribute entry form. You can press these to perform various operations while you are entering attribute values for the point feature, or while waiting for the Asset Surveyor software to complete the logging of GPS positions for that point feature.

An example of the attribute entry form for a point feature is the following:

```
┌──────────────────────────────────────┐
│        «Fire Hydrant (New) »          │
│ Color:                           ◉█   │
│ Number of Spouts:                 2   │
│ Last Inspection Date:             ?   │
│                                       │
│                                       │
│                                       │
│                                       │
│                                       │
│ ▐ PC   ⟨6⟩    PDOP   2.84          2  │
│ ┌─────┐┌──────┐┌─────┐┌───────┐       │
│ │Pause││Review││ EXT ││ Offset│       │
│ └─────┘└──────┘└─────┘└───────┘       │
└──────────────────────────────────────┘
```

The '?' value is the configurable 'Null string'. It indicates that no value has been entered or supplied as a default for the corresponding attributes.

The ⎡EXT⎤ softkey provides access to external sensor configuration and control. Press ⎡Offset⎤ to view, enter, or edit the (optional) offset for this point feature. The ⎡Pause⎤ softkey lets you pause GPS position logging.

Press ⎡Review⎤ to switch to the *Review data* list. This is a list of features, notes, and messages logged to this file so far. You can view or edit the GPS positions, offsets, and attributes of features in the file from this list. To switch from review mode back to the attribute form for the new point feature, press ⎡New⎤.

Note – For more information on how to collect carrier phase point features, see Chapter 7, Carrier Phase Data Collection.

Line features

When you are collecting a line feature, there are several softkeys at the bottom of the attribute entry form. You can press these to perform various operations while you are entering attribute values for the line feature and traveling to the end of the line, logging GPS positions.

An example of the attribute entry form for a line feature follows:

```
          «Path (New) »
Surface Type:                ⊙▯
Width (meters):              2.0




  ▮ ▣    ⟨6⟩   PDOP  2.96        1
  Pause  Review  Nest   Seg      →
```

If, while traveling along the line feature, you come across a point feature which you want to record, you can record it either as a nested point feature by pressing ⌷Nest⌷, or as a quickmark by pressing ⌷Quick⌷. The nesting of point features is described in Nested point features, page 84, and quickmarking is described in Quickmarked point features, page 85.

Press ⌷Vertex⌷ to start logging positions for an averaged vertex. Instead of logging a single position while in motion, when you log averaged vertices you record a number of positions while stationary. The software averages these positions together to calculate a single, more accurate position. For more information, see Recording averaged vertices, page 90.

To segment a line feature, press [Seg]. This ends the current line feature and immediately starts another feature of the same type. The new line feature has, by default, the same attribute values as the previous line segment. These can be edited to reflect the properties of the new line segment. The last GPS position of the first line is the same as the first GPS position of the second line, so that the two line segments join up in the GPS Pathfinder Office software and your GIS. The offset of the new line segment defaults to the offset of the previous line segment, if any.

The [Seg] function makes it easy to record a line as several segments, each with differing attribute values, without any discontinuities between the segments.

To view, enter or edit the optional offset for this line feature, press [Offset].

Press [Review] to switch to the *Review data* list. This is a list of features, notes, and messages logged to this file so far. You can view or edit attributes of features on the list. To switch from Review mode back to the attribute form for the new line feature, press [New].

Note – For more information on how to collect carrier phase line features, see Chapter 7, Carrier Phase Data Collection.

Area features

When you are collecting an area feature, there are several softkeys at the bottom of the attribute entry form. You can press these to perform various operations while you are entering attribute values for the area feature and traveling around the area's perimeter, logging GPS positions.

An example of the attribute entry form for an area feature is the following:

```
            «Park (New) »
Name:                           ▉
Parcel Owner:                   ?




   ▌PC    ◁6▷   PDOP   2.99        1
 Pause  Review   Nest   Quick    →
```

If, while traveling around the area feature, you come across a point feature that you want to record, you can record it as a nested point feature by pressing [Nest], or as a quickmark by pressing [Quick]. For more information, see Nested point features, page 84, and Quickmarked point features, page 85.

To view, enter, or edit the (optional) offset for this area feature, press [Offset].

Press [Vertex] to start logging positions for an averaged vertex. Instead of logging a single position while in motion, when you log averaged vertices you record a number of positions while stationary. The software averages these positions together to calculate a single, more accurate position. For more information, see Recording averaged vertices, page 90.

Press [Review] to switch to the *Review data* list. This is a list of features, notes, and messages logged to this file so far. You can view or edit attributes of features on the menu. To switch from review mode back to the attribute form for the new area feature, press [New].

Note – For more information on how to collect carrier phase area features, see Chapter 7, Carrier Phase Data Collection.

Reviewing features

While you have a data file open you can add new features, or open existing features for review and update their attributes, offsets, or even their GPS positions. At any time when a data file is open you can switch from data entry to review, and back to data entry.

When you open a new rover file, the default mode is data entry and the *Start feature* form appears. Press the ⌷Review⌷ softkey in this form, or in the attribute form for a new feature, to switch to Review mode. The *Review data* list appears, listing all the notes and features logged to the data file so far. You can select a feature and press ⌷Enter⌷ to open the attribute form for the feature. In the *Review data* list, or in the attribute form of a feature opened from the *Review data* list, the ⌷New⌷ softkey switches you back to Data Entry mode.

Note – When you have two features open you can edit the attributes or offsets for both features, but you can only log GPS positions to the feature which was opened first.

Switching between Data Entry and Review mode is like switching between modules. You do not lose any unsaved data when you switch, and when you switch back, you return to the form and field you were working with. This means you can open a new feature and open an existing feature for review at the same time.

You can use the ⌷Review⌷ softkey to check data you have logged so far in a new file, or you can open an existing file for review and use the ⌷New⌷ softkey to add any new features to the file. For more information on updating features, see Updating Data, page 94.

Carrier Phase mode

For applications in which accurate data is required, you can configure the Asset Surveyor software to record GPS carrier phase data, provided your GPS receiver is capable of computing such data. You can subsequently process this data with the GPS Pathfinder Office software to yield accuracy of a few decimeters.

Note – For more information on how to collect carrier phase features see Chapter 7, Carrier Phase Data Collection.

Pausing and resuming

If you need to move away from a point feature (for example, to see the top of a power pole more clearly) or need to avoid an obstacle when recording a line or area feature, press ⌊Pause⌋ to avoid recording inappropriate GPS positions. Logging of GPS positions for the feature halts, and the ⌊Pause⌋ softkey changes to ⌊Resume⌋. Return to the position you want to record and press ⌊Resume⌋ to continue logging GPS positions. Normally, the Asset Surveyor software logs GPS positions while you enter attributes, but you can separate these two activities and perform them in either order using ⌊Pause⌋ and ⌊Resume⌋.

Tip – Each time you resume logging while collecting a line or area feature, the Asset Surveyor software logs a GPS position immediately (irrespective of the logging interval for line/area features). You can use this feature to force the Asset Surveyor software to log a GPS position when you come to a corner or a point of interest. Press ⌊Pause⌋ and then ⌊Resume⌋ to cause the current GPS position to be logged. After ⌊Resume⌋ is pressed, the Asset Surveyor software continues logging GPS positions at the configured line/area logging interval.

Repeating features

You normally start collecting a feature by selecting it from the menu of features (that is, by highlighting it and pressing ⌨Enter, or using a first-letter search). However, you can also start collecting a feature by highlighting it on the *Start Feature* menu and pressing Repeat:

The difference between normal selection of a feature and selecting Repeat is in the attribute values that are entered by default when the feature is created. If you select the feature by the 'normal' method, the default attribute values are determined by the data dictionary, which specifies a default value for each attribute belonging to each feature. If you select a feature using Repeat, the attribute values are copied from the last recorded feature of that type.

Tip – The Repeat softkey lets you record a sequence of similar features very efficiently. You do not have to re-enter the values for all of the attributes; you can just page through, checking that each attribute value is correct for the current feature, and only changing those that differ.

☀ **Tip –** The feature that is repeated is normally the last feature of that type that was collected. However you can repeat the attributes of any feature in the file. To repeat a feature, press ⌞Review⌟ to switch to the *Review data* list, highlight the feature on the list, and press ⌞Enter⌟ to open it and check its attributes. If necessary, you can then press ⌞Esc⌟ to close the feature, but you do not have to close it before repeating it. Press ⌞New⌟ to return to the *Start feature* form and press ⌞Repeat⌟.

Note – Offsets, except those configured as constant offsets, are not repeated when you press ⌞Repeat⌟.

Nested point features

When you press ⌞Nest⌟ on the attribute entry form for a line or area feature, the Asset Surveyor software displays a menu of point features that can be nested within that line or area, for example:
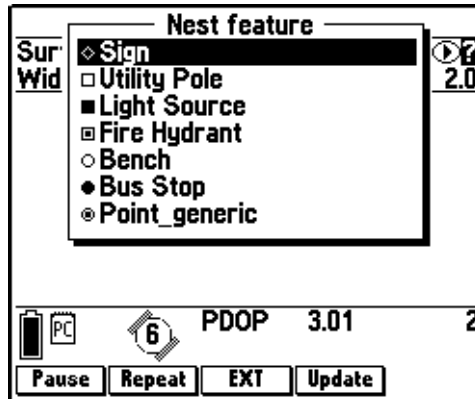
When you select a point feature from this menu, the Asset Surveyor software lets you enter attributes for it, and all GPS positions that are logged subsequently are associated with it (rather than with the line or area feature within which the point is nested). When you save the point feature, the Asset Surveyor software again logs positions for the outer line or area feature.

To nest the updating of an existing point feature, press ⎡Update⎤ on the *Nest feature* menu. A menu of existing point features appears. Highlight a feature on the menu and press ⌐⌐Enter⌐ to update the attributes or GPS position of the point feature. For more information on updating features, see Updating Data, page 94.

You can nest as many point features within a line or area feature as necessary. For more information on nesting, and for more information on how to nest points that do not lie right on a line or on an area's perimeter, refer to Chapter 3, Data Collection, in the *TSC1 Asset Surveyor Software User Guide*.

Quickmarked point features

If you have a large number of point features to collect, and you do not require the best possible GPS position accuracy for these point features, you can record them by quickmarking. This technique does not require you to remain stationary at a feature at all; you simply travel past the feature and at the moment you pass each feature you press a key on the TSC1 datalogger. The Asset Surveyor software instantly computes a single GPS position for the feature.

When you press ⎡Quick⎤ on the *Start Feature* menu, the Asset Surveyor software displays a menu of point features, for example:
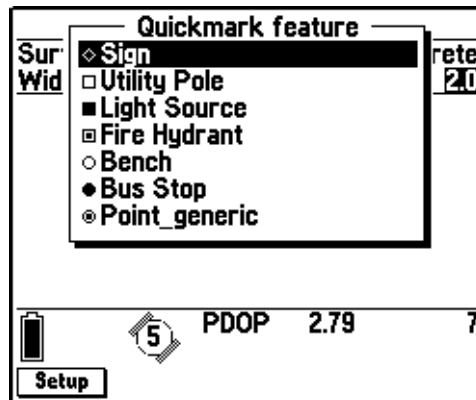
Each time you select a feature from this menu, the Asset Surveyor software records a quickmark position for that feature, along with the default attribute values.

Quickmarking is particularly useful when features lie along the roadside (for example, street furniture, power poles, or bridges).

You can record quickmarks instead of normal (averaged) point features, and you can record quickmarks within line or area features. For more information on quickmarking and for more information of how to configure and edit attributes for quickmarked features, refer to Chapter 3, Data Collection, in the *TSC1 Asset Surveyor Software User Guide*.

$-\stackrel{\cdot}{\bigcirc}\stackrel{\cdot}{-}$ **Tip –** If you are usually unable to travel right over top of each feature, configure a constant offset for quickmark features, as described in the following section. You can then travel past each feature at the specified distance and record it as an offset quickmark.

Offsets and laser rangefinders

The offset feature in the Asset Surveyor software lets you record the position of a geographical feature, without actually having to position your GPS receiver directly over that feature. You may often find this facility very useful because it may be difficult, inconvenient, or even impossible, to position a GPS receiver over a feature and obtain GPS positions.

Some examples where offsets might be used are:

• when collecting a tree feature. It is typically easier to stand some distance (for example, ten paces to the north) from the tree and record its attributes, firstly to ensure good GPS reception and secondly so as to be able to see the tree clearly and assess its condition. You can then specify an offset to the tree of '10 m south'. This ensures that the tree will be positioned correctly in your GIS. This is an example of an offset point feature.

• when driving along a road recording power poles using quickmarks. You can specify an offset of '3.5 m to the right', so that the poles are positioned 3.5 m to the right of your direction of travel. This is an example of collecting offset quickmark features.

• when collecting road centerlines. It is generally easier (and safer) to specify an offset of '2 m to the left' than to actually drive along the center line, especially in the case of a highway with a central dividing strip. This is an example of collecting offset line features.

• when collecting a building as an area feature. It is generally easier to ensure GPS coverage by walking around the building at a distance of 5 m from the building, and to specify an offset of '5 m to the right' (if you walk clockwise around the building), so that in your GIS the outline of the building is accurately recorded. This is an example of an offset area feature.

The Offset softkey provides access to the offset entry form for the feature you are currently in. An offset for a point feature consists of a bearing (an angle from either true or magnetic north), a range (slope distance), and an inclination (angle above or below the horizon), as illustrated below:

A point feature offset can also be displayed and entered as a horizontal distance, a vertical distance (above the horizontal), and a bearing:

```
        Point offset
Bearing:                      ▓
Horizontal distance:    0.000m
Vertical distance:      0.000m




▐ PC    ◁6▷   PDOP   2.47        57
Reset  Format
```

You can switch between these two modes of offset display and entry by pressing Format .

An offset for a quickmark, line feature, or area feature consists of a direction (left or right) relative to the direction of travel at the time the feature is recorded, a range (slope distance), and an inclination (angle above or below the horizon), as shown below:

```
         Line offset
Direction:                  ◑▓
Slope distance:         0.000m
Inclination:              0.0°




▐ PC    ◁6▷   PDOP   2.46         2
Reset  Format
```

A line, area, or quickmark offset can also be displayed and entered as a horizontal distance, a vertical distance (above the horizontal) and a direction:

```
                  Line offset
Direction:                        ⊙🄼
Horizontal distance:          0.000m
Vertical distance:            0.000m




 ▐🄿🄲     ⟨6⟩    PDOP   2.49        2
 Reset  Format
```

You can toggle between these two modes of offset display and entry by pressing Format .

*Note – All Asset Surveyor features (points, lines, areas, or quickmarks) can have only **one** offset associated with them. You cannot have two or more offsets for a single feature. This means that to record a line feature with a given offset and then change the offset part-way through the line feature, you need to segment the line at that point (each segmented line feature has its own offset). You must carefully plan how to collect an area feature using offsets, as the same offset value must apply to the entire area feature.*

🔆 **Tip –** Because an offset is a three-dimensional modification to your GPS position, you can use offsets to record the full three-dimensional position of completely inaccessible features such as the top of a tree or a ledge part-way up a cliff.

Every feature recorded with the Asset Surveyor software has an offset associated with it. If you are able to actually position your GPS receiver over the feature, as is generally the case, the offset is zero.

If every feature that you record is an offset from your position at the time you record it, you can configure a constant offset, which is automatically applied to that class of features. Just modify the feature offset for specific features that are exceptions to the general rule.

Offsets can be measured and entered manually using a compass and a tape measure, or simply by pacing out the distance from the feature to the point at which you are measuring it. The Asset Surveyor software also supports the collection of offsets for features using a laser rangefinder. This allows very efficient collection of offsets without the need to manually enter distances, bearings, or inclinations.

Recording averaged vertices

The averaged vertices feature in the Asset Surveyor software lets you record several positions for a single location within a line or area feature. These positions are averaged together to calculate the position of this vertex. Averaging positions is more accurate than recording a single position for a vertex.

To record an averaged vertex, press Vertex in the attribute entry form. This opens the *Vertex* form:

```
┌─────────────────────────────────┐
│        «Path (New): Vertex 1»     │
│ Surface Type:                  ⊙▯│
│ Width (meters):               2.0│
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│ ▮ PC    ◈6◈   PDOP  2.49       2│
│ Pause  Review    EXT             │
└─────────────────────────────────┘
```

This form contains the same fields as the attribute entry form, so you can enter or edit attribute values for the line feature. You can also use softkeys to switch to the *Review data* list, pause or resume logging, or configure or activate an external sensor, but you cannot record quickmarked or nested features, segment the current feature, or edit the feature's offset.

You must remain stationary whenever you are logging averaged positions for a vertex. When you have logged as many positions as you require for the vertex, close the *Vertex* form. You are returned to the attribute entry form. Repeat this procedure at each vertex of the line or area feature.

Tip – If you want to record only averaged vertices in a feature, pause logging before you open the feature. When you open the *Vertex* form, logging starts, and when you close the *Vertex* form, logging returns to the paused state, so no positions are logged unless you log an averaged vertex or manually resume logging.

Entering Attributes

When you select a feature to collect, whether it is a point, line or area feature, the Asset Surveyor software displays the attribute entry form for that feature.

The default attribute values for the feature are derived either from the data dictionary or from the previous feature of that type (if you selected it using ⎡Repeat⎤, or if the attribute is auto-incrementing). You can enter new attribute values or edit existing values using the keypad on the TSC1 datalogger.

You can also configure an external sensor to automatically fill in one attribute value per feature. For more information, refer to Chapter 5, Configuring the Asset Surveyor Software, in the *TSC1 Asset Surveyor Software User Guide*.

Saving a Feature

As with any standard Asset Surveyor form, you save the attribute entry form's contents by pressing ⌨. You normally do not press ⌨ the moment you finish entering attributes for the feature, because, while the feature is 'active', any GPS positions and external sensor data associated with that feature are being collected.

If this is a point feature, remain stationary at that feature until the configured minimum positions have been logged, and then press ⌨. If it is a line or area feature, continue to walk or drive along the feature (or around its perimeter, if it is an area feature). Only when you have traversed it completely should you press ⌨.

If you want to abandon a new feature, press ⌨. This permanently deletes the feature and discards all data it contains. When you press ⌨ while updating an existing feature, the feature reverts to its initial values and only the changes you have made are discarded.

Entering a Note

Whenever you are logging data to a file, you can enter a note by selecting the *Note* entry from the *Utilities* menu. The Asset Surveyor software lets you type any characters into a note, which can be up to 100 characters long:
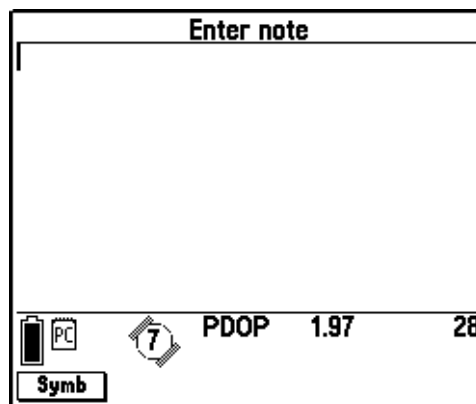
When you have finished entering the note, press ⏎. The Asset Surveyor software stores the note in the current data file. If you decide that you want to abandon the note, press [Esc] instead of ⏎.

Exiting Data Collection

When you have finished collecting data, press [Esc] on the *Start feature* menu or the *Review data* list. The Asset Surveyor software asks you to confirm this action. It then exits to the *Data collection* menu. Once you have exited data collection, the Asset Surveyor software ceases logging GPS or external sensor data.

Updating Data

When you are logging data, you may need to return to a feature to change attributes, edit offsets, record its GPS position again, or delete it. The Asset Surveyor software lets you review features in a rover file at any time, even if you have not finished logging new features. You can review features collected so far in a new rover file, or you can reopen an existing file for review. You can even add new features to an existing file.

The Asset Surveyor software also lets you review and edit the data from your geographical information system (GIS) database. Use the Import utility in the GPS Pathfinder Office software to convert data from your GIS format to the .ssf file format. Then transfer the imported data file to your datalogger. For more information, see Importing Data from a GIS, page 46. Once the file has been transferred to the datalogger you can open and review it like any other rover file.

Opening an Existing File

You can review and optionally edit an Asset Surveyor data file by selecting *Open existing file* from the *Data collection* menu. The *Open existing file* form appears:

The fields in this screen show details of the selected file in the *File* field. This makes it easy to identify the file you want to update.

> **Tip –** A file stored on a PC card takes longer to open than a file stored in the main memory of the TSC1 datalogger. This includes background files as well as foreground data files. Move files you use frequently from the PC card to the TSC1 datalogger to speed up opening.

The *Update status* field indicates whether the selected file has been reviewed in the Asset Surveyor software.

Update status is …	when …
Imported	you have transferred the file from the GPS Pathfinder Office software to the Asset Surveyor software and have not yet made any changes to it
Not Transferred	the file is new and you have not yet transferred it to the GPS Pathfinder Office software
	OR
	you transferred the file from the GPS Pathfinder Office software, have made changes to it since, and have not yet transferred it back to the GPS Pathfinder Office software
Transferred	you have transferred the file to the GPS Pathfinder Office software, and have not edited it or appended to it since
File is corrupt	the file is damaged and the Asset Surveyor software failed to rebuild it successfully

When you have found the file you want, press ⏎. If you have chosen to confirm antenna information for every feature or every file, the Asset Surveyor software displays the *Antenna options* form. Make any changes required in this form and press ⏎ to open the file and display the *Review data* list.

The Asset Surveyor software displays each feature and note in the data file on a single line of the *Review data* list. The last feature or note in the form is highlighted:

```
┌──── Review data «TUTORIAL» ────┐
│ 108:○ Bench                  □  │
│ 109:◌ Park Amenities         □  │
│ 110:○ Bench                  □  │
│ 111:○ Bench                  □  │
│ 112:▣ Fire Hydrant          □  │
│ 113:∿ Path                   □  │
│ 114:∿ Path                   ■  │
├────────────────────────────────┤
│ Surface Type: Turf             │
│ Width (meters): 2.0            │
├────────────────────────────────┤
│ ▮ PC    ⟨7⟩   PDOP   2.44      │
├────────────────────────────────┤
│ Target │ New │ Sort │ Filters │ → │
└────────────────────────────────┘
```
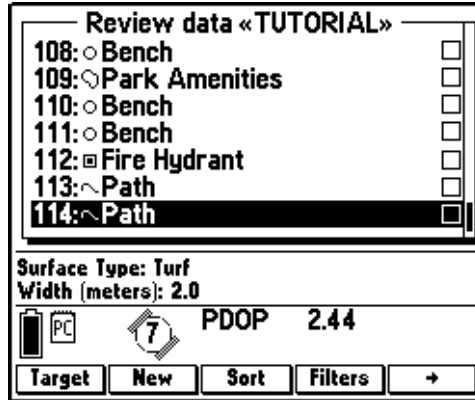
Reviewing

The *Review data* list shows a history of logging operations on the selected file. It lists each feature and note in the file, as well as logging notes indicating when the file was closed and opened again, or when carrier lock was lost or regained.

To review and edit any feature or note in this list, highlight it and press ⏎. You can display other information using the softkeys.

💡 **Tip –** If you open an existing file, the *Review data* list appears. If you open a new file, the *Start feature* form appears, but you can review the file by pressing the Review softkey.

Feature icons

Each entry in the file appears with a numeric identifier, an icon, and the feature type. If an entry is a note or a logging message, the note icon 🖹 and the text of the note or message appear.

If the entry is a feature, the feature symbol for the feature type, as assigned in the data dictionary, is displayed. The line ↶ and area ↷ icons appear beside line and area features respectively.

If the feature is a point, the point symbol configured for it appears. The Asset Surveyor software has a set of nineteen symbols which can be used to identify point features. The *Point feature symbols* form lists all the point features in the selected data dictionary and the symbol associated with each one. You can use this form to change the symbol assigned to any point feature.

To open the *Point feature symbols* form, do one of the following:

- Press ⎡Options⎤ in the *Map* screen, then ⎡Symbols⎤ in the *Map display options* form.

- Select *Map display options* in the *Configuration* module, then press ⎡Symbols⎤ in the *Map display options* form.

- Select *Data dictionaries* in the *File manager* module to display the *Select data dictionary* form, highlight the data dictionary you want to use, press ⎡Enter⎤, then press ⎡Symbols⎤.

The ⎡Symbols⎤ softkey is only available from the *Map display options* form when a data file is open. It is always available in the *Select data dictionary* form, because you can select which data dictionary to use. Point feature symbols are specific to the data dictionary, not a data file, and are displayed with any other rover files which also use that dictionary.

Labels

When a feature is selected in the *Review data* list, two labels appear below the list, showing attribute information from the selected feature. Each label consists of the attribute name followed by its value. By default, the two attributes used are the first two attributes added to the feature in the data dictionary.

If the selected feature type has no attributes, or you have chosen not to display labels for this feature type, no label information appears and the *Review data* list covers the space where the labels would appear.

You can select any two attributes from each feature type as its labels. These labels appear when the feature is selected in the *Review data* list or in the *Map* screen. To select the attributes you want to use as labels for each feature, do one of the following:

- Press Options in the *Map* screen, press Labels in the *Map display options* form, select a feature from the list, and press Enter.

- Select *Map display options* in the *Configuration* module, press Labels in the *Map display options* form, select a feature from the list, and press Enter.

- Select *Data dictionaries* in the *File manager* module to display the *Select data dictionary* form, highlight the data dictionary you want to use, press Enter, press Labels, select a feature from the list, and press Enter.

Update status

To the right of each feature entry in the *Review data* list there may be an icon representing its update status. If the feature has been imported from the GPS Pathfinder Office software but not changed, an empty box appears. If you have made changes to the feature, the box contains a check mark ☑. You can also display the *Update check marks* layer in the *Map* module so you can easily identify which features you have visited and which you still need to review.

Note – *Changing a feature means editing its attributes or offsets, updating its GPS position, or marking the feature as visited with the* ⌐Mark⌐ *softkey.*

New features have no update icon. A new feature is one which the GPS Pathfinder Office software has no record of, either because it is logged in a new file which has not yet been transferred to the GPS Pathfinder Office software, or because it has been appended to a file transferred from the GPS Pathfinder Office software and the file has not yet been transferred back to the PC.

If the selected feature in the *Review data* list can be updated, it is displayed in inverse video (white text with a black background).

If a feature cannot be opened, for example because it is already open for update, it appears with a box around it:

```
┌──── Review data «TUTORIAL» ────┐
│24:○Bench                      □│
│25:○Bench                      □│
│26:○Bench                      □│
│27:◇Sign                       □│
│28:◠Path                       □│
│29:▣Fire Hydrant               □│
│30:◇Sign                       □│
├────────────────────────────────┤
│Surface Type: Turf              │
│Width (meters): 2.0             │
├────────────────────────────────┤
│▮ PC    ◈7◈   PDOP   2.43        │
├────────────────────────────────┤
│ Target │ New │ Sort │ Filters │ → │
└────────────────────────────────┘
```
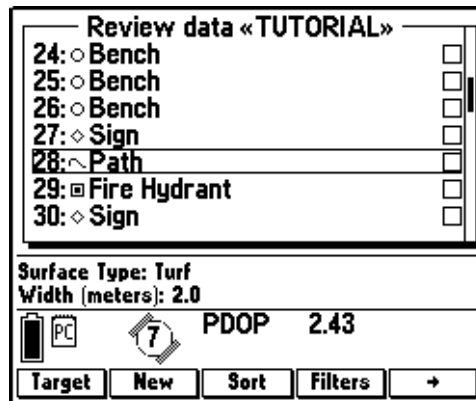
While you are updating existing features, you can also add new features. At any time when a data file is open you can switch from Data Entry mode to Review mode, and back to Data Entry mode. To switch to data entry, press ⌐New⌐ in the *Review data* list. To switch to Review mode, press ⌐Review⌐ in the *Start feature* form.

Switching between Data Entry and Review mode is like switching between modules. You do not lose any unsaved data when you switch, and when you switch back, you return to the form and field you were working with. This means you can open an existing feature for review and start a new feature at the same time.

Position

Press ▭Pos▭ to open the *Averaged position* form for the highlighted feature. If the feature is a line or area, the Asset Surveyor software displays the *Which position* form first, so you can select which point of the feature to display details for. For a line feature, you can view the position information for the start or end of the line. If the feature is an area, you can choose to see the position details of the start/end point, or the centroid (the calculated center of the area).

The average latitude, longitude, and height of the feature, or the selected point in the feature, appear in the *Averaged position* form, with the datum and zone they were recorded in:

```
            Averaged position
Feature:               Fire Hydrant
Latitude:           37°24'41.03555"N
Longitude:         121°59'54.32697"W
Altitude (MSL):             1.47m
Datum:                   WGS 1984
Zone:                         N/A




 ▐▌ PC     ◇7◇   PDOP    2.43
 WayPt   Offset
```

You cannot edit this position information here. For more information on how to change the GPS position of an existing feature, see Updating position, page 110.

You can use this form to view or change the offset from the GPS position to the feature. Press ⌐Offset⌐ to open the offset form for the feature type (for example, *Point offset* for a point feature), then enter the offset details. You can enter the offset as a bearing, slope distance, and inclination, or as a bearing, horizontal distance, and vertical distance. Press ⌐Format⌐ to switch between the two options. Press ⌐Enter⌐ to confirm the offset and return to the *Averaged position* form.

To make a waypoint at the position shown, press ⌐WayPt⌐. The caption of the form changes to *Create waypoint #*, where # represents the next available waypoint number.

Waypoints created in the Asset Surveyor software are assigned sequential numbers as identifiers, but are usually referred to by name:

```
                Create waypoint 1
Name:                        Fire Hydrant
Latitude:              37°24'41.03555"N
Longitude:            121°59'54.32697"W
Altitude (MSL):                   1.47m
Datum:                        WGS 1984
Zone:                              N/A



  ▊ ᴾᶜ      ⟨7⟩    PDOP   2.46
```

You can change the name of the waypoint, which defaults to the feature name. You can also edit its latitude, longitude, or altitude. To confirm the new waypoint and return to the *Averaged position* form, press ⌐Enter⌐.

Info

Press ⌐Info⌐ in the *Review data* list to open the information form for the highlighted feature. The name of the form is the feature type, and the fields displayed depend on the feature type. The *Number of positions* and *Real-time positions* fields are displayed for all feature types:

For line features, the *Length (2D)* and *Length (3D)* fields show the two-dimensional and three-dimensional lengths of the line. For area features, the *Area (2D)* field shows its two-dimensional area, while *Perimeter (2D)* and *Perimeter (3D)* show the distance around the perimeter of the area in two dimensions and in three dimensions.

You cannot change any information displayed in this form. However, if you update the GPS position for the feature, this information changes accordingly. For more information, see Updating position, page 110.

File Operations

Some of the softkeys available on the *Review data* list represent operations on the selected file instead of an individual feature.

Sorting

You can sort the features in the open file into various orders to make updating or reviewing them easier. In the *Review data* list, press ⌐Sort¬ to display the *Sort by* menu:

```
                      ┌──── Sort by ────┐
                      │Feature          │
                      │Time             │
                      │Update status    │
                      │Deletion status  │
                      │Distance from GPS (2D)│
                      │Distance from cursor (2D)│
                      └─────────────────┘


           ▐ PC    ⟨7⟩   PDOP   2.03        6
```
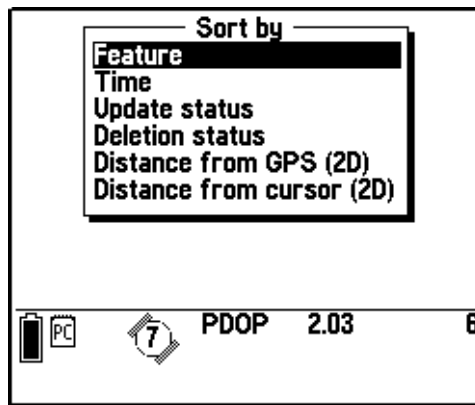
Select a sort order and press ⌐Enter¬ to apply the sort to the file.

The *Sort by Feature type* option rearranges features to match the order of features in the data dictionary. Logging messages and notes appear last.

The *Sort by Time* option sorts entries in their original chronological order.

The *Sort by Update status* option orders features by whether they have been updated. Features with the Updated status are first, then Imported features, and finally New features.

The *Sort by Deletion status* option orders Undeleted features before Deleted features.

The *Sort by Distance from GPS (2D)* option arranges the list to display the features that are closest to the current GPS position first, followed by more distant features, then messages and notes. The height of a feature is ignored when calculating its distance from the GPS position.

The *Sort by Distance from cursor (2D)* option arranges the list to display the features which are closest to the location of the map cursor first, followed by more distant features, then messages and notes. The height of a feature is ignored when calculating its distance from the map cursor. This option is only available when the *Map* module is open and the map cursor is activated. For more information on the map cursor, see Using the Map, page 116.

Filtering

When you filter the *Review data* list, the Asset Surveyor software hides or shows features in the list according to the setup you choose.

To view the list of filter types, press the ‾Filters‾ softkey. Highlight any entry in the list and press 🔲 to enable this filter. A check mark (✔) appears to the left of any enabled filter option. To clear a check mark, highlight the option and press 🔲 again:
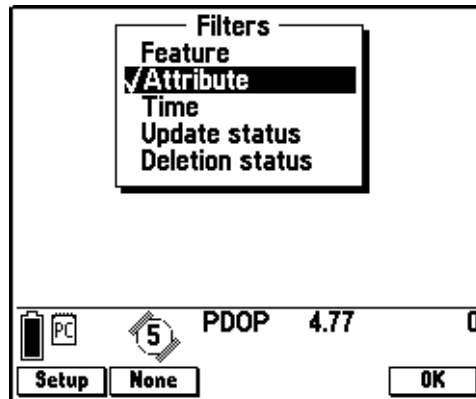
To specify the filtering details of a filter, highlight the filtering option you require and press [Setup]. The filtering options displayed depend on the filter you selected:

Note – Filtering affects the whole system, including searching, Start and Target menus, and the Map module.

If you choose to filter by feature, the *Feature type filtering* form lists each feature type in the data dictionary as a field. You can set the value of each field to 'Show' or 'Hide', or use the [ShowAll] or [HideAll] softkeys to set all fields to the same value.

The *Attribute filtering* form contains a number of fields representing each of the feature types, attributes, and attribute values in the data dictionary that is associated with the open data file. After selecting a field from the *Feature type* field, and an attribute for that field from the *Attribute* field, use the *Attribute value* field to specify a value to filter on, and the *Operator* field to select the comparison operation. If there is no attribute or a text attribute selected, the default operator is 'Containing', but you can select 'Not containing'. For other attribute types the default value is 'Equals', but you can select 'Not equal to', 'Greater than' or 'Less than'. Features not matching these parameters will be hidden.

If you select the *Update status* or *Deletion status* filter, the form lists each update status (New, Imported, or Updated) or deletion status (Deleted or Undeleted) as a field. You can set each field's value to 'Show' or 'Hide' or use the softkeys to set all fields to the same value.

The *Time filtering* form lets you set a start and end date and time. The start date and time defaults to the date and time you began logging to the selected file. The end time and date are initially blank, but you can fill them in with any date and time that is later than the start value. Softkeys for the current date (Today) and time (Now) are provided when you edit fields, so that data entry is faster. Features with start times outside this time period will be hidden.

When you have finished selecting filters and setting up the filtering options for each, return to the *Review data* list or the *Map* screen by pressing Esc or OK . The software applies all selected filters to the list of features, and the text *(Filtered)* appears after the filename in the caption to indicate that some features may now be hidden.

Note – You cannot enable the Feature and Attribute filters at the same time. If you check both, a warning message appears when you try to apply the filters, and you are unable to exit the Filters form until you have disabled at least one of the two filters. All other filters can be applied in addition to any existing filter.

Searching

In a large data file, locating a particular feature to update can be time consuming, and it is easy to miss the feature you are looking for as you scroll through many pages of features. The search option lets you locate features by specifying an attribute value. Press ⌊Search⌋ to display the *Search* form.

Specifying search criteria is similar to filtering by attribute. You select a feature type and attribute of that feature type, and then specify a value and comparison operation:

```
          Search TUTORIAL
Direction:            ⬭Forwards
Feature type:         ⬭◇Sign
Attribute:            ⬭Condition
Operator:             ⬭Equals
Attribute value:      ⬭Good



  ▮ PC      ◇7◇   PDOP   2.32

  Reset
```

When you press ⌊Enter⌋ to start the search, the first feature in the *Review data* list that matches the search criteria is highlighted. The search criteria are retained so if you press ⌊Search⌋ again to show the *Search* form, then ⌊Enter⌋, you can jump to the next feature matching the previously configured search requirements.

Updating Features

To update attributes of a feature, simply highlight the feature in the *Review data* list or in the *Map* screen, press ⏎, and edit it in the update form that appears. In practice, you may need to navigate to the feature before you can check its attributes. To update its GPS position, you must return to the exact position of the feature. You can use the *Map* module or the *Navigation* module to guide you back to the location of any feature.

Target

In the *Review data* list, you can make a feature the navigation Target by highlighting it in the menu and pressing ⎣Target⎦. The Target icon appears beside the selected feature, and the *Navigation* module and *Map* screen change to navigate towards this point:
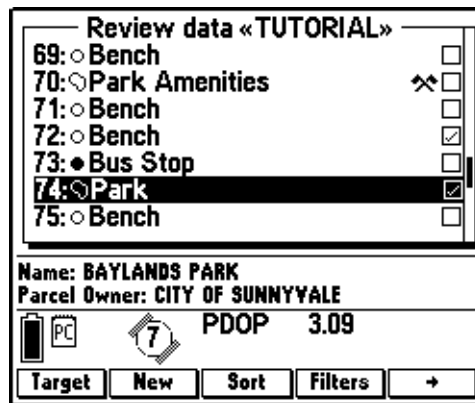
In the *Map* module and the *Navigation* module, you can select a Start position as well as a Target. The Start and Target can be either a feature or a waypoint. For more information on selecting Start and Target positions, see Using the Map, page 116, and Navigating with the Asset Surveyor Software, page 125.

Updating attributes

After locating the feature in the *Review data* list or map, and pressing ⏎ to display its attributes, you can edit any field in the form in the usual way. The Asset Surveyor software does not restrict the attributes you can edit, although the data dictionary may specify that changing attribute values is not permitted. Press ⏎ again to close the update form and confirm your changes:

```
            «Sign (Imported) »
Type:                  SPEED LIMIT
Condition:                ▶Good
Date Visited:          04/19/1996 Fri




  [▯] [PC]    ◈6◈   PDOP   2.97
  [  Log  ][  New  ][  Mark  ][  EXT  ][  Offset  ]
```

Updating offsets

After locating the feature in the *Review data* list or the map, and pressing ⏎ to display its attributes, press `Offset` to open the *offset* form for this feature type. Edit offset values as usual, then press ⏎ twice to close the update form and the feature and confirm your changes.

You can also edit offsets from the feature's *position* form. In the *Review data* list, select the feature, press `Pos`, then press `Offset`.

Updating position

If the position recorded for a feature is not precise enough, or no positions have been recorded, you can record a new position for the feature whether you update its attributes or not. To record a new position, press ⎣ Log ⎦ in the update form. The software asks you to confirm that you want to update the positions for this feature. Choose ⎣ Yes ⎦ to start logging GPS data. The ⎣ Log ⎦ softkey changes to the ⎣ Pause ⎦ softkey, as described in Pausing and resuming, page 82. When you have reached the end of a line or area feature, or have recorded enough positions for a point feature, press ⎣Enter⎦ to save the new GPS data for the feature. To abandon the update and restore the original position(s) to the feature, press ⎣Esc⎦ instead.

Marking a feature as Updated

If you make changes to the attributes or position recorded for a feature, the status of the feature changes to Updated. However, sometimes you may want to simply flag the feature as Updated, to show that it has been visited and checked, without changing any other information about it. To mark a feature as updated, open the feature for editing and press the ⎣ Mark ⎦ softkey:
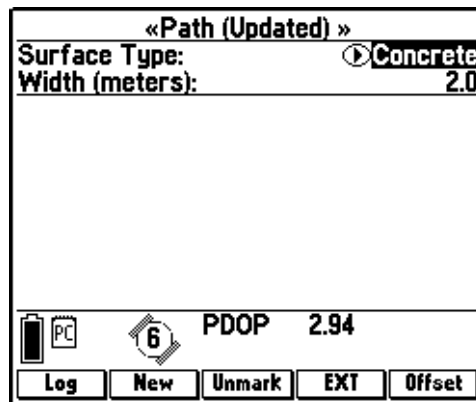
The feature status changes to Updated but no other information changes.

If a feature has already been marked, the ⎡Unmark⎤ softkey appears in the attribute form instead. Press this softkey to reset the feature status to Imported. You cannot use ⎡Unmark⎤ to reset features which have been updated by changing attributes, offsets, or GPS positions.

Updating two features at a time

You can have up to two features open at the same time: either a new feature and an existing feature, or two existing features. However, because you can only log GPS position information for one point at a time, the Asset Surveyor software only lets you record GPS positions for one of the open features. The second feature may be viewed, and its attributes updated, but you cannot change its position information until you close the other feature. The text *(edit only)* appears in the title of the attribute entry form for the second feature.

The edit-only feature need not be the last feature you opened. You can open a feature (and optionally edit its attributes) without updating its GPS position, then open another feature and begin logging GPS data for it. The first feature you opened then becomes edit-only, and cannot be updated in full until you close the second feature.

A new feature can only be opened for full update, and is never edit-only. Even if you have paused logging, opening a new feature makes any other open feature edit-only. However, you must always stop logging for one feature before you begin logging for another one. If you are already logging GPS positions for an existing feature, the Asset Surveyor software will not let you open a new feature until you close the existing one.

Saving or discarding updates

When you have finished updating attributes or the GPS position of a feature, press ⌷Enter to confirm the new data, or ⌷Esc to cancel the changes. If you press ⌷Esc, you must confirm that you want to abandon the changes. If you do abandon them, the feature reverts to its initial values.

When a feature is updated, the updated icon ☑ is displayed in the *Review data* list beside the feature to indicate it has been updated:
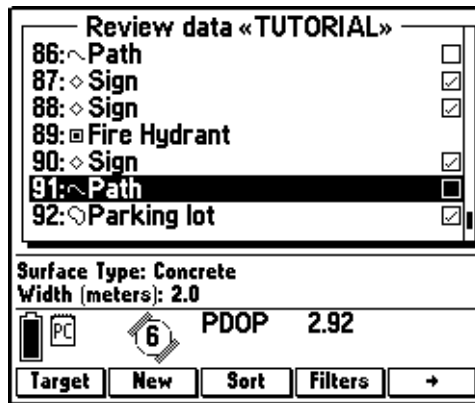
If you have enabled the *Update check marks* layer in the *Map* module, a check mark appears above the changed feature in the map:
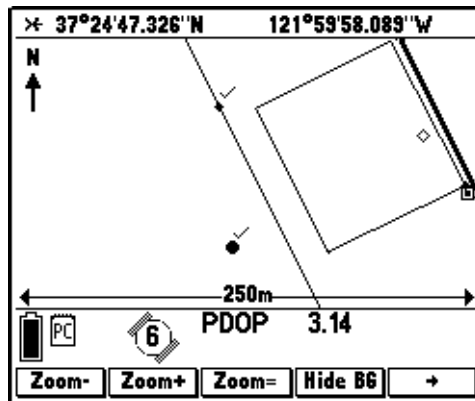
Collecting New Features

While you are updating features you have already collected, you may find new features you need to include in your data. To switch to the *Start feature* form, press ⌐New⌐ in the *Review data* list. Then select a feature, enter attributes, and record GPS positions as usual. Press ⌐Review⌐ to switch back to the *Review data* list at any time and continue updating existing features.

Note – To postprocess GPS positions, you must accurately record the date and time each position was recorded. The Asset Surveyor software does not let you log new features to any file with the update status Not Transferred if it contains positions recorded more than a week ago.

If the Asset Surveyor software displays the following message:

```
┌──────── Error! ────────┐
│ Unable to append to a file over one │
│           week old           │
└──────────────────────────┘
```
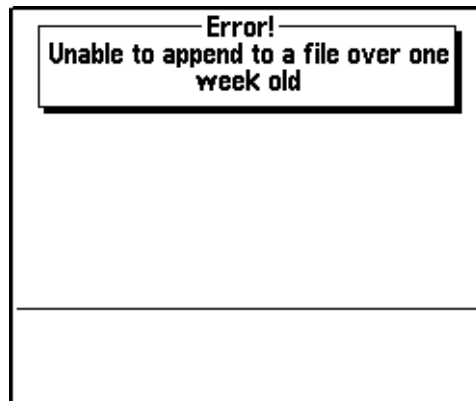
you can update the attributes or offsets of existing features in the file, but you cannot update their GPS positions or add new features to the file.

Tip – If you want to log new features to a file that is displaying this error message, transfer the file to the GPS Pathfinder Office software, then transfer it back to your datalogger. The status of the file changes to Imported and the Asset Surveyor software lets you add new features.

Deleting and Undeleting Features

When the *Review data* list is open, the ☐Del☐ softkey is available. Press it to delete the currently selected feature or note. The Asset Surveyor software displays a message asking you to confirm that you want to delete the feature. If you press ☐Yes☐, the Asset Surveyor software marks the feature as deleted and displays a line through the selected feature or note and its icon:

```
┌─── Review data «TUTORIAL» ───┐
│ 88:○Bench                   □ │
│ 89:○Bench                   ■ │
│ 90:⊖Bench───────────────────⊟ │
│ 91:♡Park Amenities          □ │
│ 92:♡Park Amenities──────────⊟ │
│ 93:♡Parking lot             □ │
│ 94:●Bus Stop                □ │
├──────────────────────────────┤
│ Condition: Good              │
│ Date Visited: 02/15/2000     │
│ ▮    ⟨7⟩   PDOP   2.44       │
├──────────────────────────────┤
│ Search │ Pos │ Info │ Del │ → │
└──────────────────────────────┘
```
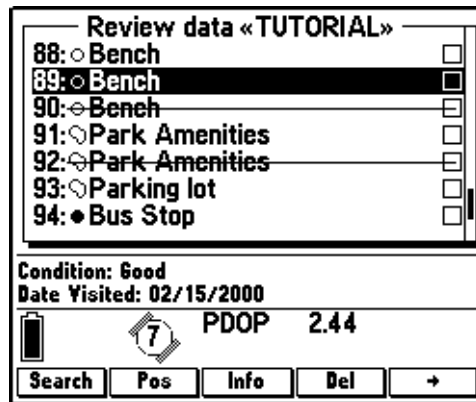
When a deleted item is highlighted in the list, the ☐Undel☐ softkey is displayed instead of the ☐Del☐ softkey. To restore a deleted feature or note, highlight it and press ☐Undel☐.

A deleted feature can still be undeleted after you close the file. You can open the file in the Asset Surveyor software, or in the GPS Pathfinder Office software after transferring, and restore any feature marked as deleted.

Exiting Data Update

When you have finished reviewing data and adding new features, close the current file by pressing $\boxed{\text{Esc}}$ on the *Review data* list or the *Start feature* menu. The Asset Surveyor software asks you to confirm your intention.

Tip – Do not use $\boxed{\text{Esc}}$ when you want to close the new feature form and return to the *Review data* list. The new feature form and the *Review data* list are different data collection modes, rather than separate forms that open in sequence. Closing one form closes the other form (and the file) as well. Use the $\boxed{\text{Review}}$ softkey to switch to the *Review data* list. To switch from the *Review data* list to the new feature form, press $\boxed{\text{New}}$.

Using the Map

You can use the *Map* module to check your current GPS position, to navigate to waypoints or features, to view the update status of features, and to open features for update. The map shows the features in the data file selected in the *Data collection* module. To open the map, return to the *Main menu* by pressing [Menu], then select *Map*. You can use the [Next] key to switch between the map and other open modules.

Mode

The *Map* module can operate in a graphical mode, or in a text mode.

The graphical mode displays the position of each feature in the data file, by drawing the boundaries of line and area features and displaying the symbol assigned to each point feature type. It can also show a background map, and navigation information such as waypoints and the GPS trail.

Note – When the Map module is performing calculations, an hourglass ⧖ appears in the top right corner of the screen. It remains visible until calculations are complete and the map is ready to display again.

The default mode is graphical. Use the [Mode] softkey to switch
between modes:
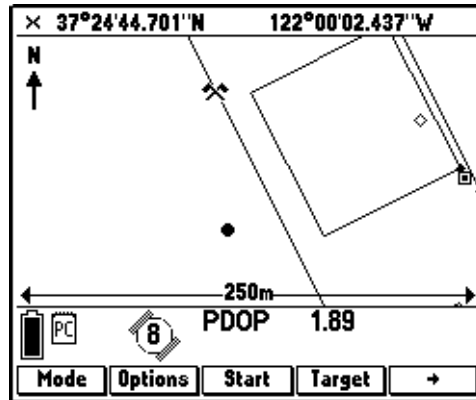
In text mode, the coordinates of the current GPS position are
displayed. You can create a waypoint by pressing [WayPt], but you
cannot view or edit any other information:
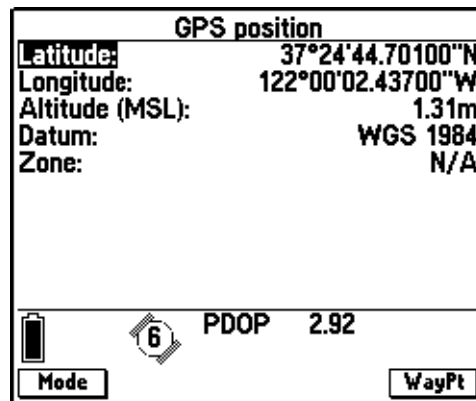
The rest of this section refers to the graphical mode.

Zooming

Use the ⌊Zoom+⌋ and ⌊Zoom-⌋ softkeys to reduce or enlarge the scale of the map. The maximum zoom scale is 25 cm, and the minimum is 2000 km.

When you press the ⌊Zoom=⌋ key, the software zooms to the extent of the map, automatically selecting the zoom scale at which all features and waypoints in the map can be shown.

When you open the *Map* module, the software automatically zooms to include the contents of the data (foreground) and background files, any waypoints defined, and the current or, if the receiver is not connected, the old GPS position. If there is no data file open, or there is only a single GPS position, the *Map* screen uses a default display scale of 250 meters, centered on the GPS position.

Display Options

Press the ⌊Options⌋ softkey to display the *Map display options* form, where you can customize the map display. These settings are stored and applied to each data file you open, so the map displays in the same way for all files until you change it.

Tip – You can also use the *Map display options* command in the *Configuration* module to open this screen.

In the *Map display options* form you can choose to show or hide any of five map layers, the scale arrow, and the coordinate display:

The layers you can show or hide are:

Layer	Description
Features	Point, line, and area features logged in the current data file. You can also hide only selected feature types using the Filters softkey.
Update check-marks	Check marks which appear over a feature to indicate that it has been updated.
Not in feature	Marks indicating GPS positions that have been logged but which are not part of a feature.
GPS trail	A trail of dots behind the GPS cursor showing its recent positions.
Navigation	Navigation aids such as waypoints, Target and Start positions, and point or line features that contain a Start or Target.

The scale arrow shows the current zoom scale. It is displayed over any features on the map, so hiding it can make the map easier to read. The coordinate display shows the coordinates of the GPS position or the map cursor location. It occupies a separate area at the top of the screen, so when it is hidden the visible area of the map increases.

You can also select a background file to display on the map. To display a menu of files you can use as backgrounds, select the *Background file* field. The menu includes all rover files on the TSC1 datalogger or PC card, and background files that have been transferred from the GPS Pathfinder Office software.

‑☀‑   **Tip –** A file stored on a PC card takes longer to open than a file stored in the main memory of the TSC1 datalogger. This includes background files as well as foreground data files. Move files you use frequently from the PC card to the TSC1 to speed up opening.

If you select a background file, display the background by pressing Show BG in the *Map* screen. When the background is enabled, this softkey changes to Hide BG . Press it to hide the background. By default, the background is displayed.

The Symbols softkey in the *Map display options* form lets you customize the symbols (icons) used for different point features. You can assign one of ten icons to any point feature type in the data dictionary, and the same icon can be used for more than one feature. By default, the software assigns symbols to point features to minimize the number of features that share a symbol.

The Labels softkey in the *Map display options* form lets you customize the attributes from each feature type that are used as labels. The values of the two label attributes are displayed when a feature is selected. By default, the attributes selected as labels are the first two attributes added to the feature type in the data dictionary.

The Filters softkey opens a menu of filter types and lets you select and define filters, so only the features you want to see are displayed. The same *Filter by* menu can be opened using the Filters softkey in the *Review data* list. Information on applying filters can be found in the section on File Operations, page 103.

Navigating Using the Map

Usually you will use the *Navigation* module to guide yourself to a Target, which may be either a waypoint or a feature you want to update. You can also use the *Map* module to:

- orient yourself in the area you are working in

- get a general indication of the location of a feature you want to find

- find or select features or waypoints to navigate to

- plot a course from one place to another

Cursor

In the *Map* screen, the GPS cursor ✕ shows the current GPS position reported by the receiver. It is always enabled in the *Map* screen, although it may not always be within the visible part of the map. You can use the ⌈Options⌋ softkey to hide or display the GPS trail, the heading showing the direction you are traveling in and other options on the map display. The GPS trail is a line of dots showing up to 60 previous GPS positions.

Note – The Map screen and the GPS position will be affected by the accuracy of your GPS source. Unless you have a real-time source, or are viewing a file that has been differentially corrected, positions shown on the map are only accurate to within about 100 meters.

If you use any of the arrow keys on the datalogger, the map cursor ╬ appears at the center of dotted horizontal and vertical cursor lines. The *Coordinates* display, if it is enabled, now shows the position of the map cursor. Use the arrow keys to move the cursor crosshairs. When you position the crosshairs directly over a point feature or any part of a line or area feature, the feature becomes selected.

Note – If the open data file contains more than 5000 features, the map cursor is not visible and cannot be used to highlight or select features or waypoints.

Tip – Use the [Esc] key to hide the map cursor and the arrow keys to show it again. When the map cursor is hidden, [Esc] closes the *Map* module.

Panning

When the map cursor is visible, you can use the arrow keys to move it around, and to pan to another part of the map. When you move the map cursor to the edge of the screen, the map automatically pans so the map cursor is in the center of the screen. The map cursor remains at the same GPS position and the map scale does not change.

Tip – If you press [Fn] while you press an arrow key, the map pans one screen width or height in the direction of the arrow. For example, press [Fn] ☞ to pan one screen width to the right.

Highlighting and selecting features

The feature that is highlighted in the *Review data* list is also the highlighted feature on the map. A *highlighted* line or area appears in bold, while a highlighted point feature appears in reversed colors. For example, when the point feature symbol ⊞ is selected it appears as ⊞.

When you position the map cursor directly over the center of a point feature, or any part of a line or area feature, the feature's ID number and name appear beside the map cursor. If labels have been configured, the two label values appear below the name and ID.

When a feature's label is visible, the feature is *selected* as well as highlighted:
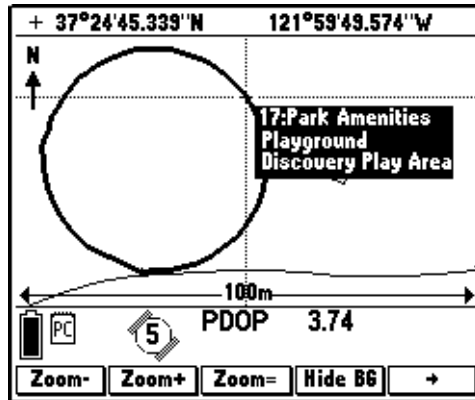
To open the selected feature for update, press ⬅Enter. Pressing ⬅Enter when a feature is highlighted but not selected has no effect. You must select a feature before you can open it from the *Map* screen for update or review, but you can set a feature or waypoint that is only highlighted, not selected, as the Start or Target.

A feature remains highlighted even when you move the cursor off it, but it is no longer selected and its label disappears. When you highlight another feature, the previously highlighted feature returns to its normal state.

Note – Highlighting a feature on the Review data list changes the highlighted feature on the map, and changing the highlighted feature on the map changes the highlighted feature in the Review data list.

Target and Start

If a feature in the *Review data* list is selected as the navigation Target, the Target waypoint icon ✖ appears over it on the map. This is the same as the normal waypoint icon except that it is larger. If the Target is off the screen, the bearing to go arrow ⚐ appears to show you the direction the Target is in.

You can also use the map to select a Target. Use the cursor to highlight the feature or waypoint you wish to navigate to and press ⌐Target⌐, or press ⌐Target⌐ and choose your destination from the *Select target* menu that appears.

In the map you can also select a place to start navigating from by pressing ⌐Start⌐. The Start is marked with the Start icon ◣ . The Start, like the Target, may be a waypoint, a point feature, the start or end of a line or area feature, or the center of an area feature.

When you select both a Start and a Target, and the *Navigation* layer of the map is enabled, a dashed 'cross-track' line appears between the Start and Target, representing the direct route between the two locations. You can use this trail as a basic navigation guide to reach the Target.

Navigating with the Asset Surveyor Software

You can use the Asset Surveyor software together with a Trimble GPS receiver to determine and record your current position. You can also use the Asset Surveyor software and a GPS receiver to *navigate* to a position of interest. Navigation is normally associated with ensuring that you follow a prescribed course when traveling from A to B, but you can also use navigation to revisit features that have been previously surveyed, and to identify a specific feature that may require maintenance.

The *Navigation* module has two graphical modes. In both modes, text information appears on the right in the *Info* panels. You can configure the data that appears in the *Info* panels, and you can choose to display different text information in the different graphical modes.

When you select the *Navigation* entry from the *Main menu*, the software displays the last navigation mode you used. If you have not used the *Navigation* module before, the *Direction Dial* screen appears. You can switch between this screen and the *Road* screen with the Mode softkey.

Target and Start

To navigate you need to select a Target and then, optionally, a Start position. The Target and Start position can be features from the open data file, or waypoints. Press Target or Start in the *Navigation* module to display a list of features and waypoints you can choose from.

If you already have a selected Target, it is the highlighted item in the list and is also marked with the Target icon . If there is no Target selected yet, the feature that is highlighted in the map is highlighted in the list.

In the example below, the Bus Stop feature is the highlighted feature.
To choose another Target, highlight a feature or waypoint in the list
and press ⏎. The Target changes to this position:

```
┌────────── Select target ✕ ──────────┐
│ 111:◇ Sign                        □ │
│ 112:♡ Park Amenities              □ │
│ 113:⌒ Path                        □ │
│ 114:⌒ Park Road                   □ │
│ ▓115:● Bus Stop▓                  ■ │
│ 116:♡ Park                        □ │
│ Base 1                              │
│ Field Site                      ✕   │
│ None                                │
├─────────────────────────────────────┤
│ ▐▌ ▣      ⑥    PDOP    3.31          │
│ ┌────────┐                          │
│ │ Create │                          │
│ └────────┘                          │
└─────────────────────────────────────┘
```
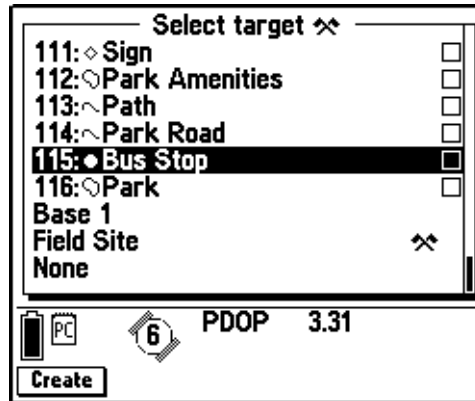
If you select an area or line feature, you must then specify the start or
end point, or the center of the area, as the position to use.

Once you have selected a Target, the Distance to Go appears at the
bottom of the *Navigation* screen. This is the distance remaining
between the current GPS position and the Target.

—✷— **Tip –** If you set a feature or waypoint as the Target, and then change its
GPS position, you must select it as the Target again to make the map and
navigation displays use the new position.

You can also create a new waypoint, which you can then set as the
Target, from the currently highlighted feature, the GPS position, or the
location of the map cursor. Press ⌐Create⌐ in the *Target* menu to create a
waypoint. For more information, see Waypoints, page 135.

Selecting the Start is similar to selecting the Target. Press ⌐Start⌐,
highlight a feature or waypoint, and press ⏎. The Start is marked
with the Start icon ⮞ . You can also create waypoints from the *Select
start* menu.

Tip – The Start is useful for calculating the cross-track error and other navigation information.

Heading Lock

In the *Navigation* module, the software uses the angle between the last two GPS positions to calculate your heading. If you are not moving, or are moving too slowly, the software cannot calculate the heading. When this happens the heading is locked. This may occur in the *Direction Dial* screen or in the *Road* screen.

When the heading is locked the message Heading locked starts flashing in the message area, alternating with the message Start moving. The dial or road, the heading arrow on the map, and any values in the *Info* panels that depend on the heading, freeze. *Info* panels that depend on the heading include Bearing, Turn, ETA, and Time to Go. When you start moving fast enough for the Asset Surveyor software to calculate a reliable heading, the heading display becomes active again.

Note – When you are using autonomous GPS, the heading is locked when your velocity drops below 0.65 meters/second (2.34 kilometers/hour). With differential GPS the minimum velocity is 0.35 meters/second (1.26 kilometers/hour).

Navigation Options

Press the ⌷Options⌷ softkey in the *Navigation* module to open the *Navigation options* form. You can use this form to set options for both the *Direction Dial* screen and the *Road* screen. You do not have to be in a navigation mode to change its options; for example, you can open the *Navigation options* form from the *Direction Dial* screen and use it to change the road scale for the *Road* screen.

Use the *Navigation options* form to select a close-up range and style for the *Direction Dial* screen, a road scale for the *Road* screen, and *Info* panels for both.

Direction Dial Screen

The default navigation mode is the *Direction Dial* mode:
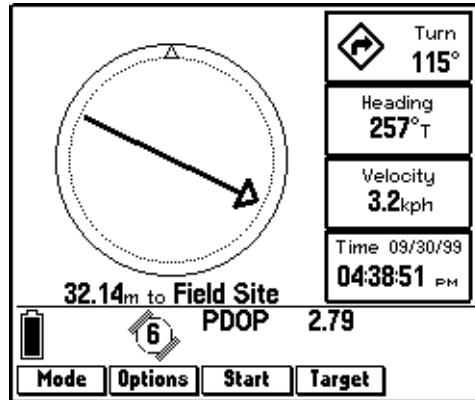
The direction dial includes an arrow, which always points in the direction of the Target you have selected. This is the *bearing to go*. The triangle at the top of the dial represents your current direction of travel (your *heading*). This triangle never moves, but by moving in the direction of the arrow you can line the arrow up with the triangle. When the two are aligned, you are heading in the direction of the Target.

Note – Since the Direction Dial and Road displays are calculated from the direction of movement (heading), they will not be correct if you move backwards.

The four *Info* panels can be configured to display relevant text-based navigation information next to the direction dial. Press the Options softkey to display the *Navigation options* form where you can set options, including the *Info* panels, for both graphical modes.

When you move close to the Target, the bull's-eye (◎) appears on the edge of the *Direction Dial* screen, in the approximate location of the Target. This feature has two purposes: to guide you more exactly in the direction of the Target, and to warn you that the display is about to switch to the *Close-up* screen.

Close-up screen

When you get close to the Target, the proximity alarm sounds and the *Direction Dial* screen is replaced by the *Close-up* screen:
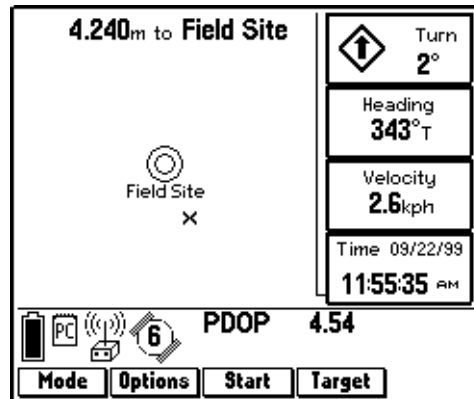
The ✕ represents your current GPS position, and the bull's-eye represents the Target. Depending on whether you use GPS-centered or Target-centered close-up style, the ✕ (GPS-centered) or the bull's-eye (Target-centered) is fixed in the middle of the display and the other symbol moves as you change position.

To navigate to the Target, move so that the ✕ is directly over the bull's-eye. You can use the distance information at the top of the screen to gauge how far you have to travel. The top of the screen represents your heading at the time the *Close-up* screen was activated, and remains fixed while you are in this screen. If you change direction, the position of the ✕ or bull's-eye will change but the screen will not show your change of direction in any other way.

Note – In the Close-up screen, heading information is not updated, so any of the Info panels which relate to your heading or velocity, such as Bearing, Turn, ETA, and Time to Go, are frozen.

Tip – Because the *Close-up* screen does not show your direction, it is best to maintain your original heading and move sideways or backwards as if you were staking out a survey point, rather than turn around.

Close-up style

The *Close-up* screen has two navigation styles. In the ***GPS-centered*** close-up style, the GPS position is fixed in the center of the screen, and you navigate so that the bull's-eye representing the Target moves to the center of the screen. This is the ***GPS-centered*** close-up style. In the ***Target-centered*** style, the bull's-eye is fixed in the center and the ✕ moves around as you move, until the ✕ lies over the bull's-eye ◎ and you have reached the Target:
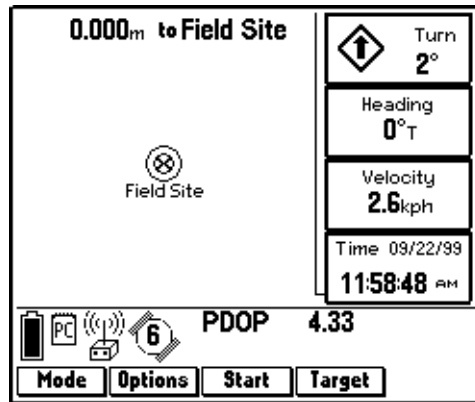
The default style is the Target-centered style. You may choose either as your preferred style. Use the Options softkey to select a close-up style.

Close-up range

You can specify the distance from the Target at which the software changes from the *Direction Dial* screen to the *Close-up* screen. If you set this distance to zero, the *Close-up* screen never appears. Press the Options softkey to open the *Navigation options* form where you can set the close-up range.

When the display changes from the *Direction Dial* screen to the *Close-up* screen, a proximity alarm sounds.

Road Screen

The *Road* screen can be accessed by pressing the ⌐Mode⌐ softkey from the *Direction Dial* screen or, if you used the *Road* screen last time you opened the *Navigation* module, by selecting the *Navigation* option from the *Main menu*.

In the *Road* screen you navigate by 'walking' along a road. A stick figure represents your current GPS position, and the Target icon ✖ shows the point you are navigating to. The stick figure is always in the center of the screen:
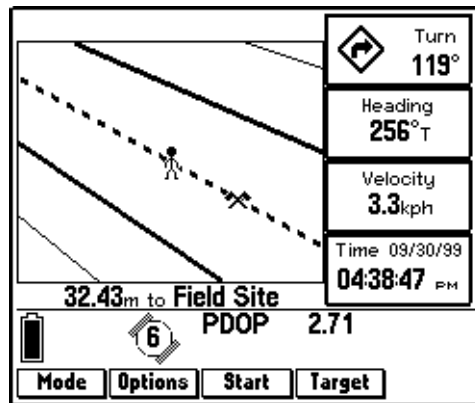
As in the *Direction Dial* screen, your **heading** is represented by the top center of the screen (the triangle in the direction dial). Your **bearing to go** is shown by the direction of the road. The direction of the road rotates as you change your heading.

To navigate to the Target, turn in the direction of the road until it is pointing straight ahead and the center line is parallel to the sides of the screen. Then move towards the Target, keeping the road pointing straight ahead where possible. As you move closer to the Target the screen zooms in so the road appears wider.

☼ **Tip –** If you have lined up the road so that it points straight ahead but the Target is at the bottom of the screen, you have turned in the wrong direction and are heading away from the Target. Turn 180° so that the Target is at the top of the screen. The *Turn Info* panel can be a helpful indicator of the direction you need to move in.

The four *Info* panels can also be configured to display relevant text-based navigation information next to the road. To set options for both graphical navigation modes, press the Options softkey. The *Navigation options* form appears.

Road scale

The road scale determines the actual distance the width of the road represents. If you have selected a Start position, the center of the road represents the direct path from Start to Target. If you stray to one side of this direct path, the display moves the road sideways so the stick figure is walking off the center line or off the road itself. The distance you have strayed is called the ***cross-track error***. The width of the road in the display shows you the amount of cross-track error in your path. The road width shown depends on the road scale you choose and how far you are from the Target.

You can make the road narrower or wider, depending on how accurately you want to navigate. When you stray sideways from the direct path, the stick figure is displayed as being off the road. The wider the road scale, the more you can stray before the stick figure leaves the road.

If you want to stay very close to the path you are following, set a narrow road scale. If you only want to go in the general direction of the Target, and following the path exactly is not important, set a wide scale. To set the road scale, use the Options softkey.

Note – The road scale only adjusts the width of the road when a Start point has been selected. This is because it is computed using the cross-track error.

Info Panels

In both the *Direction Dial* screen and the *Road* screen, up to four text-based *Info* panels can appear on the right of the screen. *Info* panels are visible at all times. You do not have to switch to a text mode to see text navigation information.

You can choose up to four *Info* panels for each navigation mode. Each mode can use different panels from the other. Any panel can be left blank by selecting the 'None' option.

Some *Info* panels can only show useful data when you have selected a Target or are moving with sufficient velocity.

Table 5.1 shows the *Info* panels you can display in the *Navigation* module.

Table 5.1   Info panels
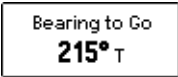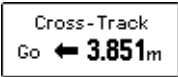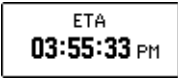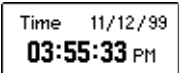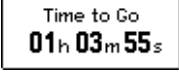
Panel	What it shows
Altitude Altitude **38.851**m MSL	Your current altitude. If you are using two-dimensional GPS, the altitude shown is the value entered in the *2D altitude* field. The altitude reference used (HAE or MSL) is also shown.
Bearing to Go Bearing to Go **215°** T	The compass bearing (angle) that you need to follow in order to take the shortest path between the current GPS position and the Target. The bearing is displayed with a 'T' if it is relative to true north or an 'M' if it is relative to magnetic north.
Cross-Track Cross-Track Go ← **3.851**m	The direction and distance to the cross-track line, an imaginary straight line linking the Start and Target by the shortest route. The numeric value indicates how far, and the arrow shows which direction (left or right), you need to travel to get back on line.
ETA ETA **03:55:33** PM	The Estimated Time of Arrival at the Target, based on your current heading and velocity.

Table 5.1 Info panels (Continued)

Panel	What it shows
Go North/East Go **N** **1.196**m Go **E** **3.851**m	The northerly and easterly distance components of the bearing to go to the Target. It is given as two Cartesian distances, with one value representing the north/south distance and one representing the east/west distance from the current GPS position to the Target.
Go Up/Down Go Up **13.234**m	The difference in altitude between the current altitude and the altitude of the Target. If you are using 2D GPS then the current altitude used is the value entered in the *2D altitude* field.
Heading Heading **215°** T	Your current direction of travel. The heading is the angle between the last two GPS positions computed. If you are stationary or moving very slowly, the heading display freezes until you start moving again. The heading is displayed with a 'T' if it is relative to true north or an 'M' if it is relative to magnetic north.
Time Time 11/12/99 **03:55:33** PM	The current GPS time and date. The value is the GPS time plus the local variation from GMT, taken from the 'Time and Date' setting.
Time to Go Time to Go **01**h **03**m **55**s	The expected time to reach the Target. This value is calculated from your heading and velocity.
Turn Turn **43°**	The size and direction of the turn required to head towards the Target. The arrow indicates whether you need to veer to the left or to the right, and how big a turn is required, while the numeric value indicates the angle between the bearing to the Target and the current heading.
Velocity Velocity **3.85** kph	Your velocity. It is two-dimensional, taking into account your horizontal velocity but not your altitude.

You can select the *Info* panels to be displayed from the *Navigation options* form. Press the ⌊Options⌋ softkey to access this form.

Waypoints

An Asset Surveyor waypoint is a named three-dimensional position. A waypoint can be used to record a geographic point such as a position of interest, a survey mark, an excavation site, or a previously surveyed feature.

The Asset Surveyor software maintains a single waypoint file, which contains a list of waypoints:

```
┌─────── Review waypoint ───────┐
│ Base camp                     │
│ Field site                    │
│ Base                          │
│ Pole 2436                     │
│ Pole 4561                     │
│ Pole 9237                     │
│ Pole 3822                     │
│ Pole 0762                     │
│ Pole 1477                     │
└───────────────────────────────┘

 Create │  Edit  │Measure│  Del  │ DelAll
```
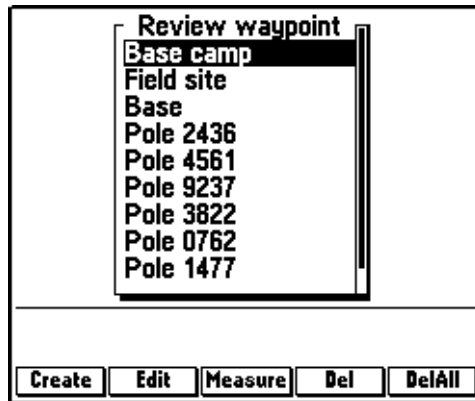
Waypoints can be used for navigation, and can be transferred to and from the GPS Pathfinder Office software.

Creating waypoints

You can add a waypoint from various modules and screens of the Asset Surveyor software. You can create a waypoint from:

- an existing feature
- the current GPS position
- the map cursor position
- coordinates typed in manually

A file of waypoints can also be transferred from the GPS Pathfinder Office software.

These are some of the ways you can create a waypoint:

- In the *Map* module, press ⌈Start⌉ or ⌈Target⌉ and then ⌈Create⌉. Either type in coordinates or press ⌈Here⌉ to use the current GPS position. The default coordinates are the coordinates of the current GPS position or the map cursor position if it is active.

- In the *Navigation* module, press ⌈Start⌉ or ⌈Target⌉ and then ⌈Create⌉. Either type in coordinates or press ⌈Here⌉ to use the current GPS position. The default coordinates are the coordinates of the current GPS position or the map cursor position if it is active.

- In the *Data Collection* module, open a file for review. In the *Review data* list, select a feature, press ⌈Pos⌉ and then, for a line or area feature, select a single point in the feature. GPS details for the point appear in the *Averaged position* form. Press ⌈WayPt⌉ to create a waypoint at this position.

- In the *Utilities* module, choose the *Waypoints* menu option, then press ⌈Create⌉. Either type in coordinates or press ⌈Here⌉ to use the current GPS position. The default coordinates are the coordinates of the current GPS position or the map cursor position if it is active.

Editing and reviewing waypoints

Whenever a list of waypoints is displayed, the ⌈Edit⌉, ⌈Measure⌉, ⌈Del⌉, and ⌈DelAll⌉ softkeys appear. You can edit a waypoint from the *Select start* or *Select target* menus in the *Map* and *Navigation* screens, or from the *Review waypoint* list in the *Utilities* module. By pressing the appropriate softkey you can:

- edit the name or position of a selected waypoint

- measure the distance between any two waypoints

- delete a selected waypoint

- delete all waypoints

Managing Data Files

Because the data storage space on the TSC1 datalogger is finite, you must eventually delete, move, or copy data files from the TSC1 datalogger. Use the *File manager* menu, accessed from the *Main menu*.

⚠ **Warning –** Before deleting the original data files from the TSC1 datalogger, always check that files that have been transferred to your PC were transferred correctly. Once a data file has been deleted from the TSC1, it cannot be recovered.

Deleting Files

When you select the *Delete file(s)* entry from the *File manager* menu, the Asset Surveyor software displays a list of data files similar to the following:
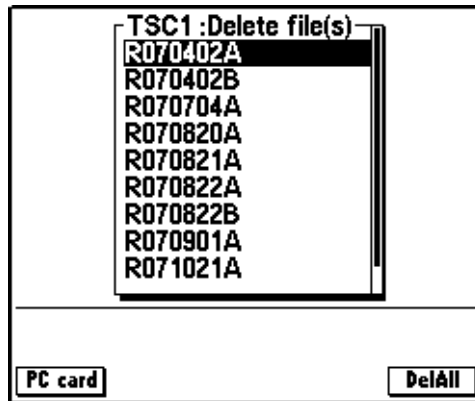
You can select a particular data file from this list to delete it, or you can press ⌐DelAll⌐ to delete all data files. The Asset Surveyor software always asks you to confirm that you really want to delete one or more data files, and asks you to confirm again for each data file that has not yet been transferred to your PC.

If you have a PC card installed, you can press PCcard to display a list of files stored on the PC card. Follow the same process as above to delete any files from the PC card.

If you want to delete data files to make space on your TSC1 datalogger, it is useful to know how much storage space individual data files consume. Select *Open existing file* from the *Data collection* menu to view some useful statistics on the highlighted data file, including its size and the amount of data storage space remaining on the TSC1 datalogger or PC card.

Renaming Files

When you select the *Rename file* entry from the *File manager* menu, the Asset Surveyor software displays a list of data files similar to the following:
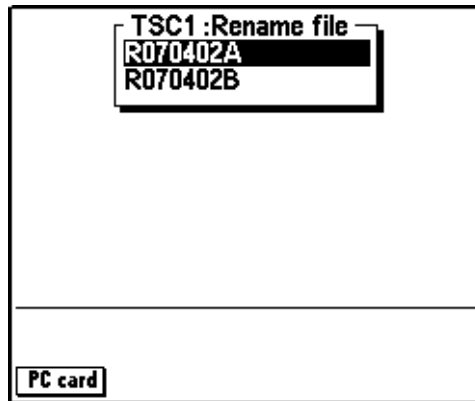
You can select a particular file from this list (or press PCcard to select a file on a PC card) to rename it.

Copying Files to and from the PC Card

When you select the *Copy file(s)* entry from the *File manager* menu, the Asset Surveyor software displays a list of data files:

```
┌──TSC1 :Copy file(s)─┐
│ R070402A            │█
│ R070402B            │
│ R070704A            │
│ R070820A            │
│ R070821A            │
│ R070822A            │
│ R070822B            │
│ R070901A            │
│ R071021A            │
└─────────────────────┘

┌────────┐            ┌─────┐
│PC card │            │ All │
└────────┘            └─────┘
```
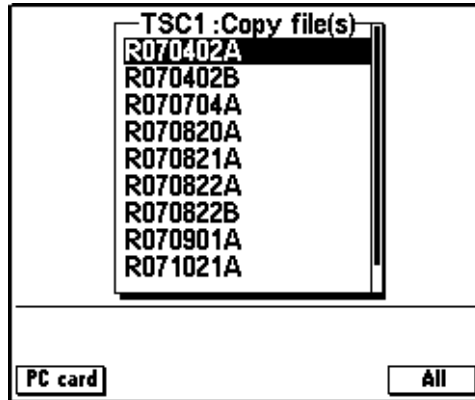
You can select a particular file from this list to copy it to the PC card (or vice versa), or you can copy all the files listed by pressing `All`. The Asset Surveyor software always asks you to confirm that you really want to copy all the files. If it detects a file with the same name in the destination folder, it asks you to confirm that you want to overwrite the file:

```
┌──────────── Error!─────────────┐
│ Duplicate filename "R070402A" . Do │
│      you wish to overwrite?      │
└────────────────────────────────┘




─────────────────────────────────

┌───────┐                 ┌─────┐
│ Yes   │                 │ No  │
└───────┘                 └─────┘
```
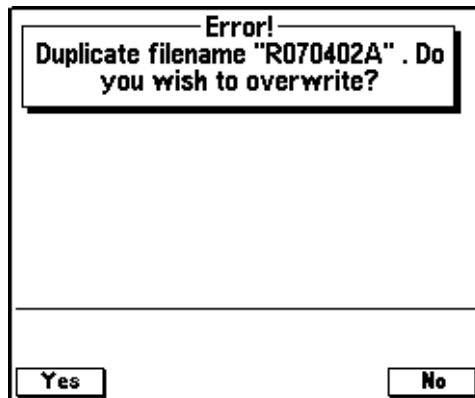
Moving Files to and from the PC Card

When you select the *Move file(s)* entry from the *File manager* menu, the Asset Surveyor software displays a list of data files similar to the following:
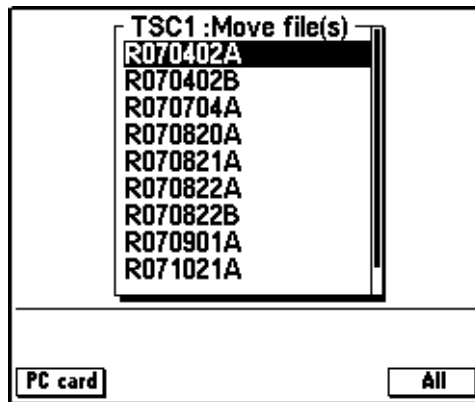
You can select a particular file from this list to move it to the PC card (or vice versa), or you can press ⬚ All ⬚ to move all files. The Asset Surveyor software always asks you to confirm that you really want to move all the files, and asks you to confirm again if it detects a file with the same name which is about to be overwritten.

Note – Moving a file from the TSC1 datalogger to the PC card (or vice versa) results in the original file being removed from the source (TSC1 or PC card).

Back in the Office

In this chapter:

- Introduction
- Transferring data to the PC
- Transferring data From the PC
- Postprocessed differential correction
- Displaying data
- Exporting data to a GIS
- Batch Processor

Introduction

This chapter covers what to do with your data once you have collected it in the field. The topics include:

- Transferring data to the PC

- Transferring data from the PC

- Postprocessing data to differentially correct it

- Displaying data

- Exporting data to a GIS

- Batch processing data

Transferring Data to the PC

Instructions for transferring rover data from the datalogger are given below. If you have used Asset Surveyor as a temporary base station then follow the same instructions as for the rover files. If you have an alternative source of base station data, you must transfer those files to the PC on which the GPS Pathfinder Office software is installed.

Transferring Data from the Datalogger

After data has been collected, it must be transferred (using the GPS Pathfinder Office software's Data Transfer utility) from the TSC1 datalogger to the PC. The procedure for transferring the data from the datalogger is straightforward. Connect your TSC1 datalogger to the PC, as shown in Figure 6.1, then transfer the data.

Data stored on a PC card can be transferred through the TSC1 datalogger, as described below. Alternatively, if you have a PC card slot on your office computer, you can transfer your data files directly into the GPS Pathfinder Office software from this slot.

Transferring data

The rover or base station data that you have stored on your TSC1 datalogger (or PC card) needs to be transferred to your PC. This is accomplished through the *File manager* / *File transfer* option accessed from the Asset Surveyor *Main menu*.

Tip – Transferring files from a PC card connected directly to your computer is faster than transferring them from the TSC1 datalogger.

To transfer data files from the TSC1 datalogger to the PC:

1. Connect your TSC1 datalogger to the PC.

2. On the TSC1 datalogger select *File manager* from the Asset Surveyor *Main menu*.

3. From the *File manager* menu, select *File transfer.* The Asset Surveyor software is ready to transfer data files:

```
              File transfer
Connect cable to PC
```
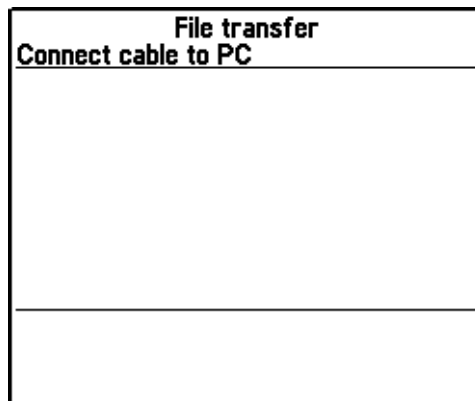
To connect the TSC1 datalogger to the PC:

1. Connect one end of the TSC1 data cable (PN 32287-00) to the null modem cable (PN 18532) and the other end to the TSC1 datalogger.

2. Connect the null modem cable to the serial port on the PC. See Figure 6.1.
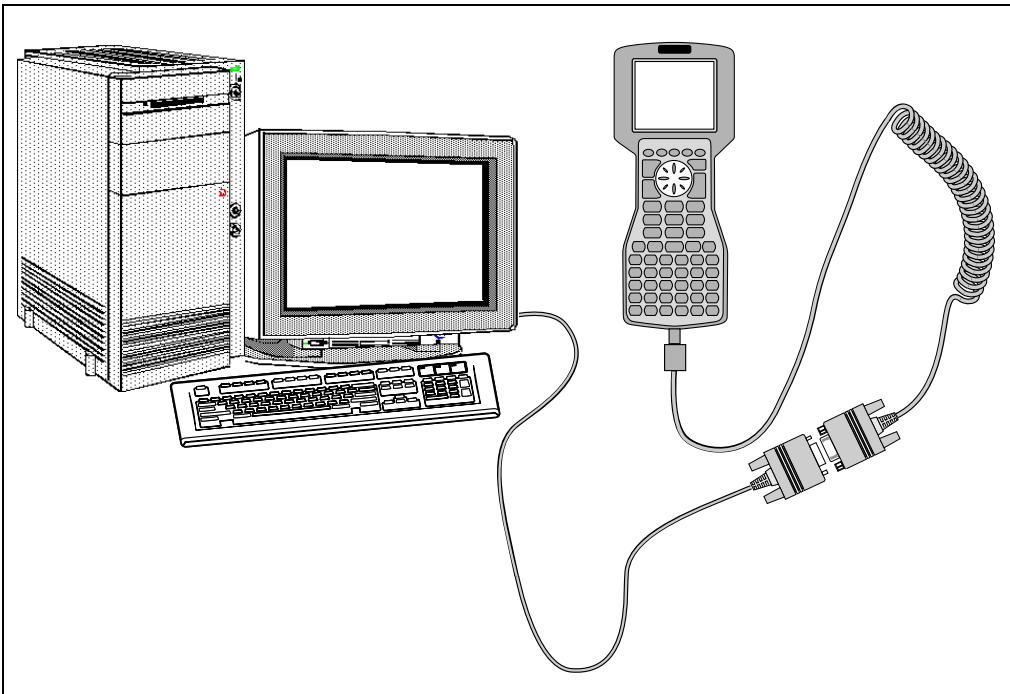
Figure 6.1   Connecting the TSC1 datalogger to the PC

To transfer files from the TSC1 datalogger to the PC:

1. In the GPS Pathfinder Office software on your office computer, select *Utilities* / *Data Transfer*.

   The *Data Transfer* dialog appears:
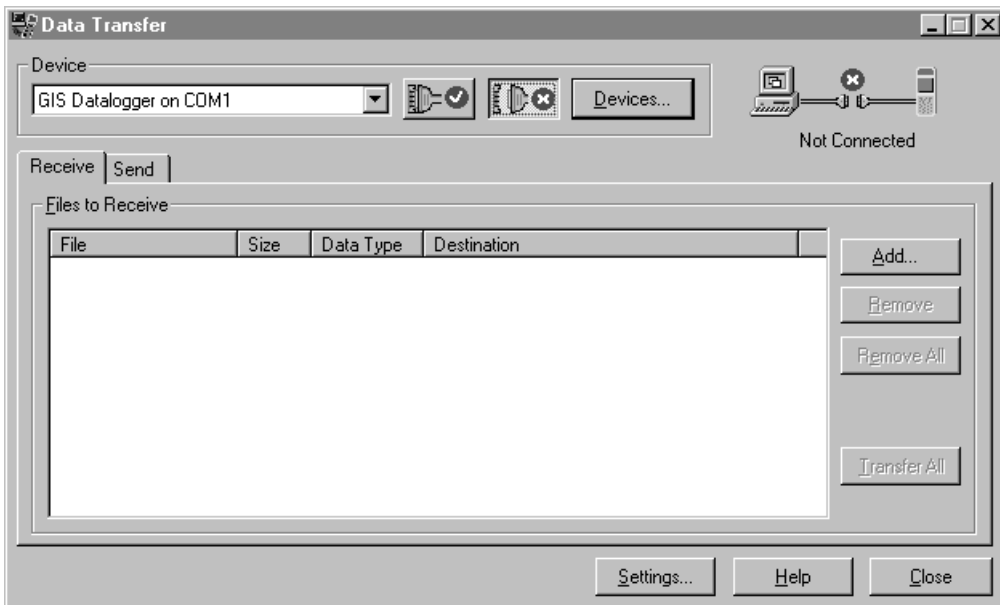
2. From the *Device* list, select the device name that represents the TSC1 datalogger.

   You can use one of the predefined names (either GIS Datalogger on COM 1 or GIS Datalogger on COM 2, depending on which serial (COM) port the support module is connected to). Alternatively, set up a new device definition.

   The Data Transfer utility automatically connects to the datalogger.

3. Make sure the *Receive* tab is selected.

4. Click **Add**.

   The *Open* dialog appears.

5. In the *Files of type* field, select the format of the files you want to transfer. For example, select Data File (*.ssf) to transfer Data files.

6. In the list of files, highlight the file or files you want to transfer and click **Select**.

   The *Open* dialog disappears, and the files you selected appear in the *Files to Receive* list.

7. If necessary, repeat steps 5 through 7 to select other files to receive.

8. Click **Transfer All**.

   The selected files are transferred from the Asset Surveyor software.

9. A message box showing summary information about the transfer appears. Click **Close** to close it.

10. To close the Data Transfer utility, click **Close**.

To transfer data files directly from the PC card slot to the PC:

1. Insert the PC card into the slot on your office computer.

2. In the GPS Pathfinder Office software on your office computer, select *Utilities* / *Data Transfer*.

   The *Data Transfer* dialog appears.

3. Add a new device definition for the PC card:

   a. Click **Devices** to open the *Devices* dialog, then click **New**.

   b. Select the GIS PC Card option, then click **OK** to start the Add Device wizard, which guides you through adding a device definition for the PC card.

   c. Follow the steps in the wizard. When the wizard finishes, click **Close** in the *Devices* dialog to return to the main *Data Transfer* dialog.

      For more information on adding a device definition, refer to the Data Transfer Help.

4. From the *Device* list, select the device name that you just set up.

> **Tip –** Any device definition you set up is saved. The next time you transfer files to or from the PC card, you do not need to set up a new device definition. Instead you can simply select this device name from the *Device* list.

The Data Transfer utility automatically connects to the PC card.

5. Make sure the *Receive* tab is selected, then click **Add**.

The *Open* dialog appears.

6. In the *Files of type* field, select the format of the files you want to transfer. For example, select Data File (*.ssf) to transfer Data files.

7. In the list of files, highlight the file or files you want to transfer and click **Select**.

The *Open* dialog disappears, and the files you selected appear in the *Files to Receive* list.

8. If necessary, repeat steps 5 through 7 to select other files to receive.

9. Click **Transfer All**.

The selected files are transferred from the PC card.

10. A message box showing summary information about the transfer appears. Click **Close** to close it.

11. To close the Data Transfer utility, click **Close**.

For more information on transferring files to and from the PC, see the GPS Pathfinder Office documentation.

Transferring Data From the PC

When you return to the field to review or update data, you must first transfer the files you need to the TSC1 datalogger. The process is similar to the process for transferring files from the TSC1 to the PC.

To transfer data files from the PC to the TSC1 datalogger:

1. Connect your TSC1 datalogger to the PC.

2. On the TSC1 datalogger select *File manager* from the Asset Surveyor *Main menu*.

3. From the *File manager* menu, select *File transfer*. The Asset Surveyor software is ready to transfer data files:

4. In the GPS Pathfinder Office software on your office computer, select *Utilities / Data Transfer*.

The *Data Transfer* dialog appears:

5. From the *Device* list, select the device name that represents the TSC1 datalogger.

    You can use one of the predefined names (GIS Datalogger on COM 1 or GIS Datalogger on COM 2, depending on which serial (COM) port the support module is connected to) or you can set up a new device definition.

    The Data Transfer utility automatically connects to the datalogger.
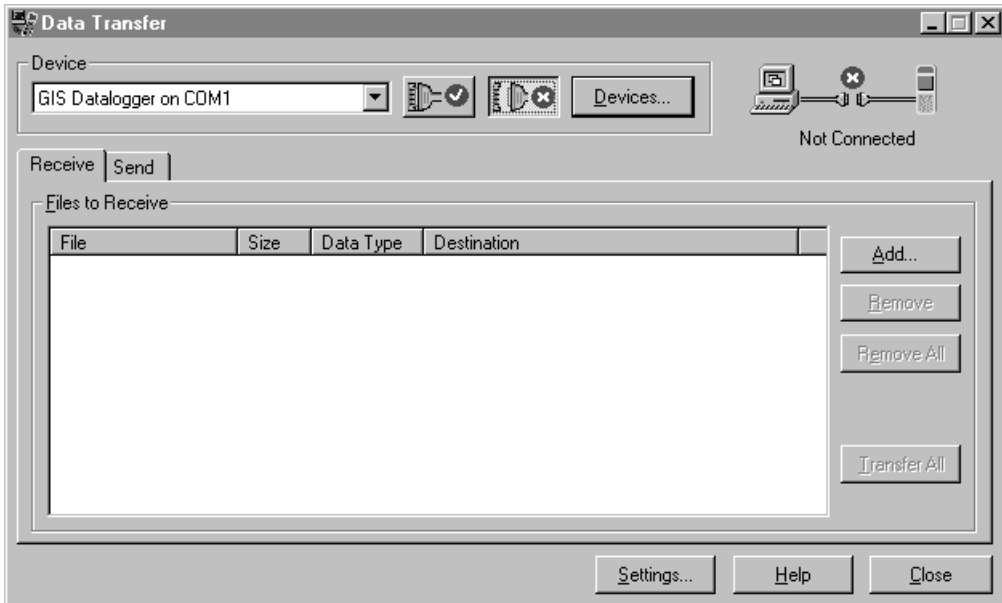
6. Select the *Send* tab.

7. Click **Add**.

    The *Open* dialog appears.

8. In the *Files of type* field, select the format of the files you want to transfer. For example, select Data File (*.ssf) to transfer Data files.

9. In the list of files, highlight the file or files you want to transfer and click **Select**.

   The *Open* dialog disappears, and the files you selected appear in the *Files to Send* list.

10. If necessary, repeat steps 5 through 7 to select other files to send.

11. Click **Transfer All**.

   The selected files are transferred to the Asset Surveyor software.

12. A message box showing summary information about the transfer appears. Click **Close** to close it.

13. To close the Data Transfer utility, click **Close**.

To transfer data files from the PC to the PC card:

1. Insert the PC card into the slot on your office computer.

2. In the GPS Pathfinder Office software on your office computer, select *Utilities* / *Data Transfer*.

   The *Data Transfer* dialog appears.

3. From the *Device* list, select the device name that represents the PC card.

   The Data Transfer utility automatically connects to the PC card.

   If there is no device definition for the PC card, you need to add a new device definition. For more information on adding a device definition, refer to the Data Transfer Help.

4. Make sure the *Send* tab is selected, then click **Add**.

   The *Open* dialog appears.

5. In the *Files of type* field, select the format of the files you want to transfer. For example, select Data File (*.ssf) to transfer Data files.

6. In the list of files, highlight the file or files you want to transfer and click **Select**.

    The *Open* dialog disappears, and the files you selected appear in the *Files to Send* list.

7. If necessary, repeat steps 5 through 7 to select other files to send.

8. Click **Transfer All**.

    The selected files are transferred to the PC card.

9. A message box showing summary information about the transfer appears. Click **Close** to close it.

10. To close the Data Transfer utility, click **Close**.

For more information on transferring files to and from the PC, see the GPS Pathfinder Office documentation.

Postprocessed Differential Correction

The data collected by GPS receivers is subject to errors. The vast majority of these errors can be removed from the data by differential correction.

When this is applied to the data file, submeter C/A code position accuracy can be achieved using a GPS Pathfinder Pro XR™, Pro XRS™, Pro XL™, 4600LS™, Site Surveyor 4400™, GPS Total Station® 4700, GPS Total Station 4800, or Series 4000™ receiver.

⚠ **Warning –** If you are going to permanently average positions, adjust the 2D records, or manipulate the file in other ways in addition to differential correction, perform differential correction first.

⚠ **Warning –** Although there are no real advantages of collecting carrier data over code data at distances greater than 35 km, the GPS Pathfinder Office software does not restrict the user with distance limits between the rover and base when processing in Carrier Only mode. However, when processing in Smart mode, the GPS Pathfinder Office software will not process carrier data collected more than 75 km from the base.

Starting Differential Correction

The Differential Correction utility enables you to remove errors in the GPS data caused by atmospheric effects and other factors. It improves the accuracy of GPS positions from approximately 10 meters to submeter, depending on the receiver and data collection technique used.

Select *Utilities* / *Differential Correction* from the GPS Pathfinder Office menu bar to start the Differential Correction utility:
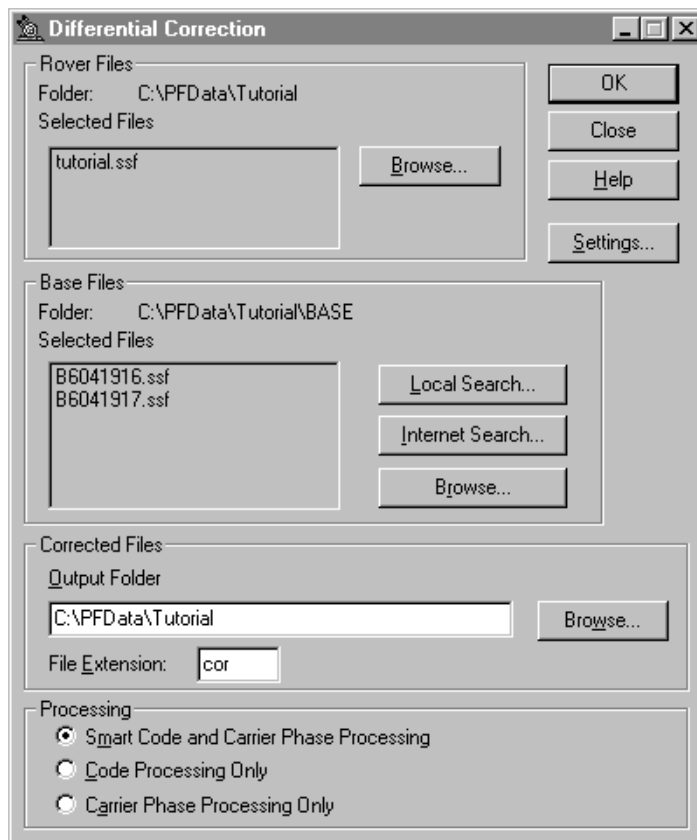
Displaying Data

The GPS Pathfinder Office *Map* window is the primary means of viewing field data. It lets you make graphical queries and measurements on the data that you collect in the field. The *Map* window provides an easy way to verify the integrity of your field data before you enter it into a GIS database. For more information on each *Map* window function, see the GPS Pathfinder Office Help.

To display your data:

1. Select *File* / *Open* from the GPS Pathfinder Office menu bar.

2. From the *Open Data File* dialog, select the data file(s) you want to view. The current project folder is the default path:
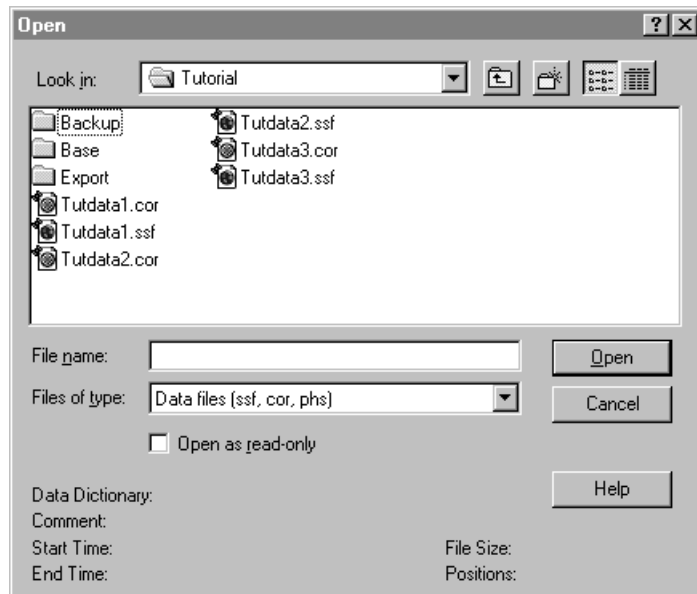
3. To change projects, use *File* / *Select Project* from the GPS Pathfinder Office menu bar. Once you have selected the data file you want, click **Open**.

The *Map* window now displays this data file:
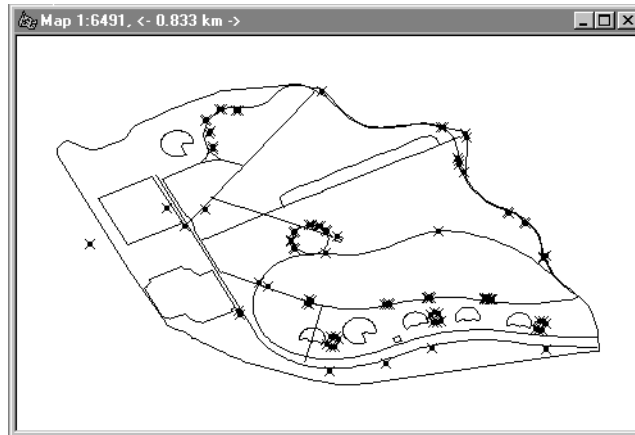
You can define what elements you want to view on this screen, and display positions and features simultaneously or separately by using the commands under *Layers* in the *View* menu.

In addition, you can specify the colors, symbols and line styles for each feature. For example, poles can be one symbol and color, and trees can be a different symbol and color. Instructions for assigning colors, symbols, and line styles to features are given in the *View menu* topic in the GPS Pathfinder Office Help.

4. To query a position, select *Data* / *Position Properties* from the GPS Pathfinder Office menu bar.

5. To measure between positions and features, select *Data* / *Measure* from the GPS Pathfinder Office menu bar.

To gain more proficiency with the GPS Pathfinder Office *Map* window display, refer to the *View menu* topic of the GPS Pathfinder Office Help. This section discusses the functionality of this powerful display module in detail.

Exporting Data to a GIS

The Export utility converts .ssf format files into another format that can be read by a GIS or CAD system. It lets you export the following data to a variety of other formats:

- point features

- line features

- area features

- feature attributes

- raw GPS positions

- note records

- velocity records

- external sensor records

To export data to a GIS:

1. Select *Utilities* / *Export* from the GPS Pathfinder Office menu bar to run the Export utility:
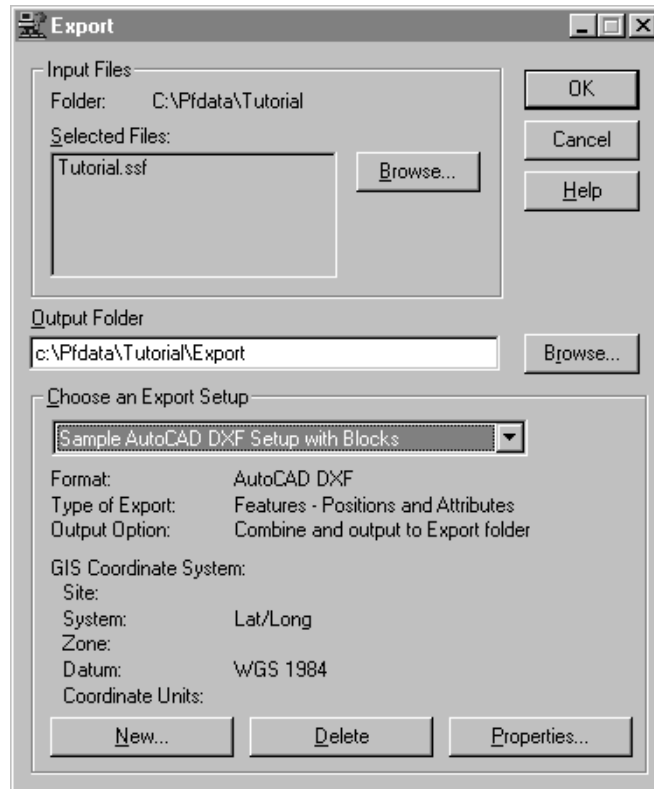
By default, the last used set of files are selected as input files. For example if you had just differentially corrected a set of .ssf files, the corrected files would be selected by default.

2. If you want to change the list of selected input files, click **Browse** (in the *Input Files* group) to find the files you want to export.

3. The default output folder is the Export folder in the current GPS Pathfinder Office project. If you want to change the output folder, click **Browse** (next to the *Output Folder* field) and select the folder you want to store the exported files in:
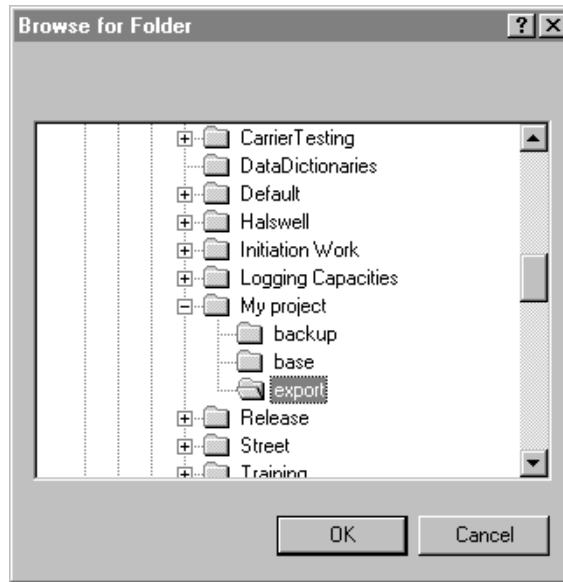
4. From the *Choose an Export Setup* field, select the export setup that you want to use for exporting the data.

   The Export utility supports a number of existing GIS and CAD products such as ARC/INFO, AutoCAD, MGE ASCII loader, and MapInfo. You can also export data into ASCII format. For more information on how to customize export formats, see the Export utility Help.

5. Click **OK** after choosing an export setup. A progress bar appears, tracking the status of the export process.

Batch Processor

The Batch Processor utility is designed to help you increase productivity by automating repetitive tasks that must be performed when you return from the data collection session. You can come back from the field at the end of the day, start the Batch Processor utility running, and go home. When you arrive back at work the next morning, your data has been transferred from the TSC1 datalogger, differentially corrected, formatted for your particular GIS system, and possibly even imported and processed by your GIS software, depending on the power of its own batch or macro language.

For more information, refer to the Batch Processor Help.

Carrier Phase Data Collection

In this chapter:

- ■ Introduction
- ■ Before you begin
- ■ Configuring the Asset Surveyor software
- ■ In the field
- ■ Back In the office

Introduction

When you need to collect a feature with a precision better than 50 cm, you can configure the Asset Surveyor software to log carrier phase data.

As this is an important feature, this chapter introduces you to the basic concepts involved, and then describes in detail how to collect and use carrier phase data.

Before You Begin

The following sections discuss some of the concepts associated with using carrier phase data.

Why Use This Feature?

In a conventional GPS session, the Asset Surveyor software logs independent GPS positions. If enough satellites are visible and the PDOP is low, it continues to log reliable positions.

In a GPS session where the Asset Surveyor software logs carrier phase data, positions collected in the field can be postprocessed to generate more precise positions once you are back at the office. Because measurements are collected from each individual satellite, the positions generated during postprocessing are ***more precise*** than positions logged in the field.

Planning

You require a clear view of the sky at all times when collecting carrier phase data, so avoid obstacles such as trees, bridges, and tall buildings. Choose a time of day when you can expect to track a maximum number of satellites with the best possible geometry.

Note – Always make sure that you collect ***sufficient useful data*** *while you are in the field. This is discussed more fully in the following section.*

Collecting Sufficient Data

Always make sure that at least four satellites remain visible for enough time to provide sufficient useful data for postprocessing.

Number of satellites

To provide sufficient carrier phase data to achieve the required precision, the Asset Surveyor software needs to log data from at least four satellites for the minimum time specified. However, you must log data from at least five satellites for the postprocessing software to indicate the precision. These five satellites together provide the necessary redundancy for the precisions required—but you can use more.

'Loss of lock' occurs when the number of available satellites drops below four. If you minimize the number of times that loss of lock occurs during the session, you greatly increase the precision of the postprocessed results.

As you start a session, the Asset Surveyor software starts to record carrier phase data. As soon as four or more satellites are available, a counter starts. When the specified *Minimum time* has elapsed, all of the carrier phase data recorded during *that* period can be used during postprocessing.

Time

When you specify the *Minimum time* for which four or more satellites must be available, you are effectively setting a precision warning level below which you consider the recorded data to be insufficient.

According to the precision you require, you choose a setting from the following options:

- 10 minutes (the default)

- 20 minutes

- 30 minutes

- 45 minutes

For more information on configuring the *Minimum time,* see Configuring the Asset Surveyor Software, page 172.

Counter

A counter in the Asset Surveyor software starts to measure time as soon as four or more satellites are available.

When the counter reaches the *Minimum time* specified, a 'success beep' sounds and a message is displayed in the status line. This indicates that the current 'block' contains **sufficient** useful data.

If you lose lock before the end of the *Minimum time*, the data collected until then may not provide the required precision during postprocessing. Consequently, the counter is automatically reset to zero when loss of lock occurs. It only restarts when lock is regained.

*Note – The counter is active **only** if the Asset Surveyor software is logging carrier phase data from four or more satellites—it does not simply record the time that has elapsed since the beginning of the file.*

Time and precision

The precision of positions generated during postprocessing depends on a combination of the number of satellites used, the distance between base and rover, and the length of time for which data is recorded from those satellites. Collecting data for longer generally gives more precise positions.

Assuming that enough satellites are available, Figure 7.1 shows the relationship between the time taken to collect carrier phase measurements and the precision of the positions generated during postprocessing.
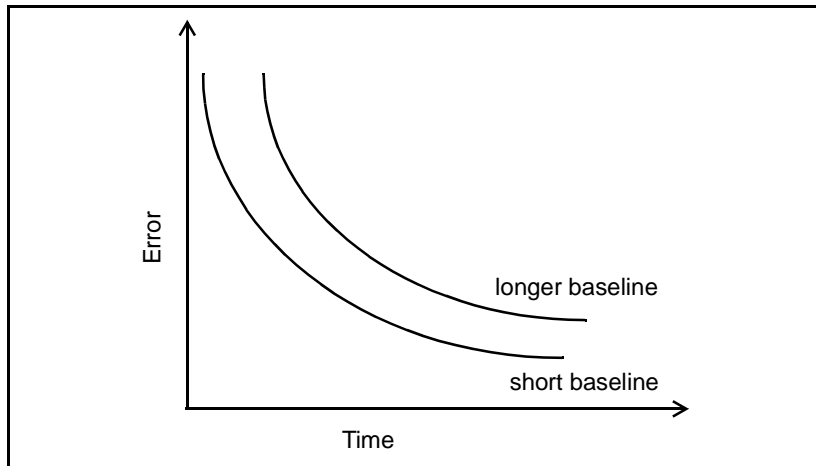
Figure 7.1   Precision achieved relative to time elapsed

What Is a Block of Data?

When you start a file, the Asset Surveyor software starts to record carrier phase measurements. Useful data is not stored as one continuous stream, however, but as a series of 'blocks'.

The beginning and end of each block is determined by the number of available satellites. As soon as four (or more) satellites are available, a new block begins. This block continues until lock is lost. When lock is regained, a new block begins.

The Asset Surveyor software continues to create blocks of data throughout the file. These blocks together constitute the measurement data for the entire session.

Opening and reopening files

The files that you create in the Asset Surveyor software are independent of each other, so carrier phase data collected in one is of no use to another.

If you use the Asset Surveyor software to collect carrier phase data, you need to collect sufficient data *every* time you open a file—this is true whether you open a new file or reopen an existing one. Always make sure that you collect sufficient data for each file.

Figure 7.2 shows how the Asset Surveyor software creates distinct blocks of carrier phase data as the number of satellites changes.
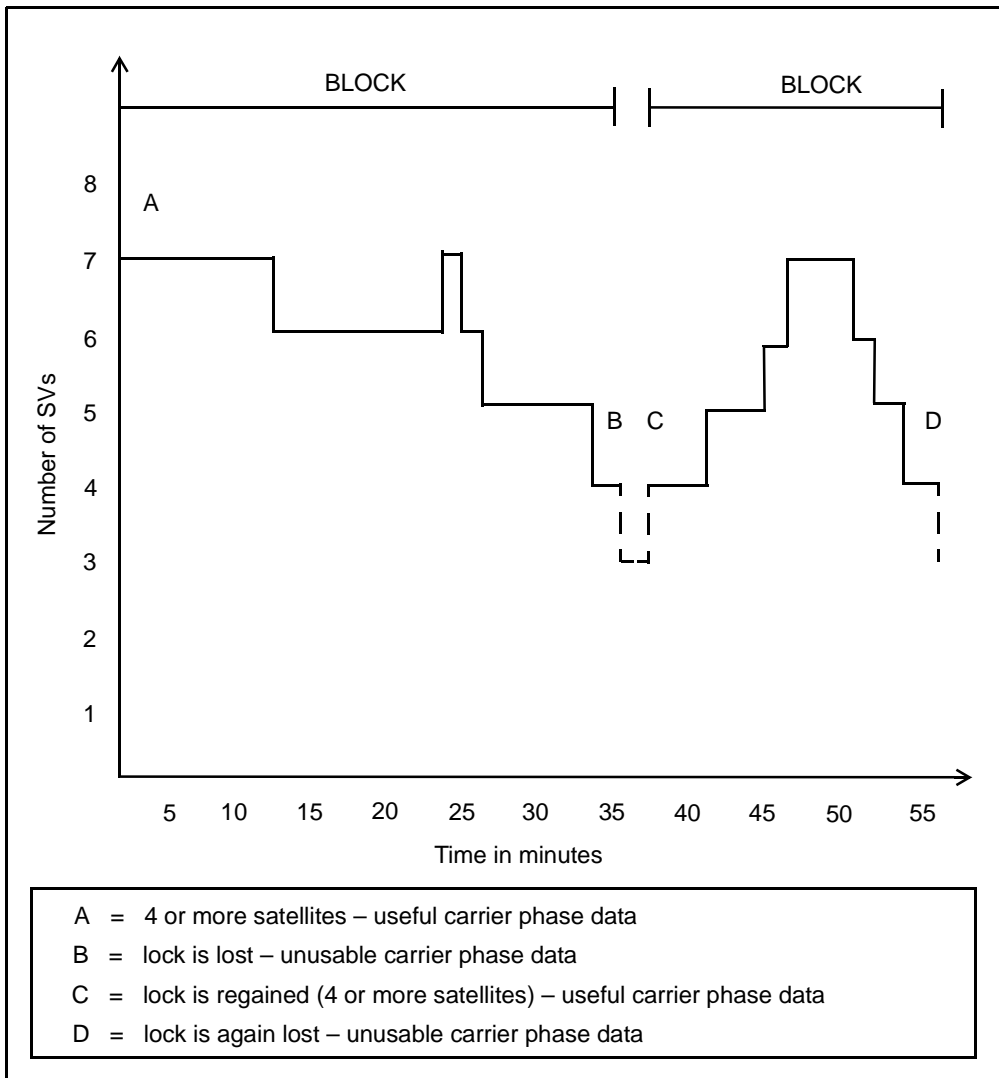
Figure 7.2   Blocks of carrier phase data relative to satellite lock

In Figure 7.2, the counter begins at time zero and stops at 35 minutes when lock is lost (B). This creates the first block of carrier phase data. If you specified a minimum time of 30 minutes, for example, this first block contains sufficient useful data. It should produce positions that meet the precision you require.

Between B and C, the required minimum number of satellites is not met. The counter does not start, and the carrier phase data collected during this period is not used.

When four satellites are again available (C), the Asset Surveyor software creates a new block and the counter begins to measure again from time zero. In this example, this happens 38 minutes after the start of the session. Lock is lost at 55 minutes (D)—after only 17 minutes worth of data has been collected. Since you specified a minimum time of 30 minutes for this session, this block contains insufficient continuous data.

This is likely to result in data that may not produce positions that meet the precision you require.

Recording Features

While the Asset Surveyor software logs carrier phase measurements in the background, you start to record features—these can be points, lines, or areas.

Decide carefully when to start and stop recording feature data.

Before you start the first feature in your file, wait until four or more satellites are available. Once you are receiving carrier phase data from at least four satellites, the Asset Surveyor counter starts.

Ending a feature before minimum time is reached

Once the counter is running, you can choose to end the feature and stay where you are until the minimum time is up. When the success beep sounds, you can move to the next feature. Using this method, you can be sure that you have sufficient data to generate precise positions.

Alternatively, if you think you are unlikely to lose lock, you can move to the next feature *before* sufficient carrier phase data has been collected.

Note – This is possible because all features recorded during a block achieve the precision associated with that block (see Figure 7.3). In earlier versions of the Asset Surveyor software, a point feature could only use carrier phase data collected while that point feature was being recorded. Data collected before or after that did not affect the feature.

As long as a block eventually contains sufficient useful data, you can generate precise positions for any feature that falls within it.

Figure 7.3 shows how individual features benefit from blocks of carrier phase data stored at the time they were recorded.
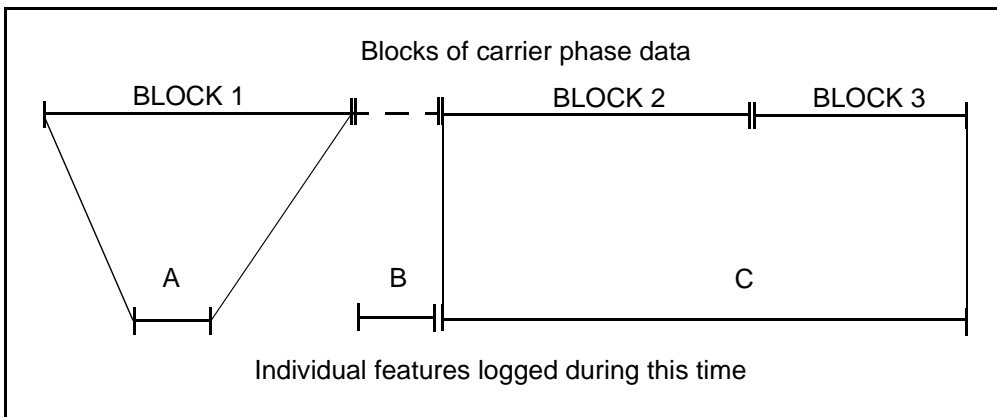
Figure 7.3   Features relative to blocks

In this example, Block 1 contains sufficient carrier phase data. Feature A was started after the counter started for Block 1 and ended before the success beep, but during postprocessing it derives the full benefit of all data recorded for Block 1.

Feature B was unwisely recorded during a period when no useful data was recorded. You probably need to record this feature again.

Feature C was started when the counter started for Block 2. Logging to this feature continued after the success beep. Then there was a loss of lock and a new block of carrier phase data started. The feature was ended before the success beep sounded for this block of data, and the file was closed. In this case, the portion of the feature collected up until the loss of lock, indicated by the end of Block 2 in Figure 7.3, should achieve the desired precision. However, the second portion of the data, associated with Block 3, may not achieve the desired precision.

⚠ **Warning –** Only move to the next feature before the minimum time is up if loss of lock is unlikely.

As you record features, be aware of the following:

- the number of satellites available

- the position of these satellites—if they are to stay visible, they should be high rather than low on the horizon

- any obstruction likely to cut off your view of the satellites as you move

Read any messages that appear on the screen. They indicate how useful the current data is.

The review screen also shows if loss of lock has occurred so you can measure that feature again if necessary. If it is clear that a block contains insufficient data, you can collect any features that are affected before leaving the site.

You may sometimes decide that enough time has elapsed to provide a useful measurement, even though the specified time has not been met. This depends on the precision required.

Postprocessing

Postprocess all data using an office PC running the Differential Correction utility in the GPS Pathfinder Office software.

In addition to carrier phase data, the Asset Surveyor software also logs code phase data in the field.

During postprocessing, the Differential Correction software uses the carrier phase data to generate positions of high precision. It computes positions and stores the results over the top of the code phase data— the code phase data only serves to assist with the arrangement of the new positions.

Finally, the software computes the estimated precision of the generated positions. This helps you to evaluate your GPS results.

Configuring the Asset Surveyor Software

If you decide to use carrier phase data, configure the Asset Surveyor software as follows:

1.   From the *Configuration* menu, select *GPS rover options*. The *GPS rover options menu* appears:

```
┌─GPS rover options┐
│Logging options   │
│Position filters  │
│Antenna options   │
│Initial position  │
│2D altitude       │
└──────────────────┘
```

2.   Select *Logging options*:
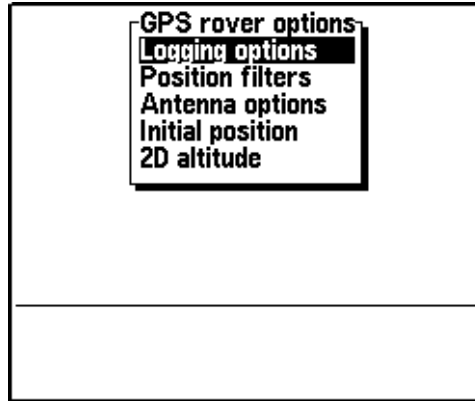
```
          Logging options        ▼
Logging intervals
   Point feature:              5s
   Line/area:                  5s
   Not in feature:           None
   Velocity:                 None
Confirm end feature:         ⊙No
Minimum positions:             3
Carrier phase
   Carrier mode:            ⊙Off
   Minimum time:         ⊙10mins
```
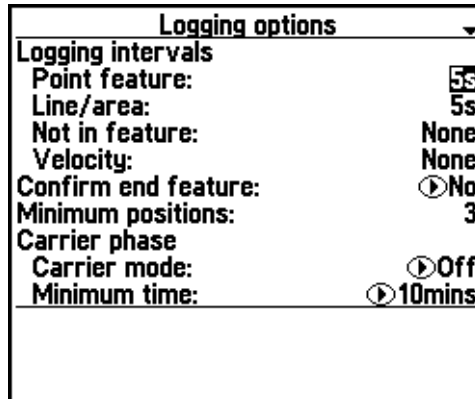
3. Set the *Carrier mode* field to 'On' or 'Off' (the default), depending on your requirements.

   When *Carrier mode* is 'On', the Asset Surveyor software logs carrier measurements that are synchronized with each position collected. Select 'On' when high accuracy data is required.

   If further features in a file do not require high accuracy data logged, and you want to save storage space on the TSC1 datalogger, you can set *Carrier mode* to 'Off'.

/!\ **Warning –** Setting *Carrier mode* to 'Off' causes the carrier lock to be lost. If you later set *Carrier mode* back to 'On', you must make sure that the carrier lock is maintained for the *Minimum time* for further features to achieve the desired accuracy.

   If you attempt to switch the *Carrier mode* from 'On' to 'Off' during a data collection session, and the *Minimum time* has not yet been achieved, the following warning message appears:

   ```
   ┌─────── Please confirm ───────┐
   │ The Minimum time has not yet been │
   │ achieved. Are you sure you want to │
   │      turn Carrier mode off?        │
   └────────────────────────────────────┘



   ┌────────┐                    ┌──────┐
   │  Yes   │                    │  No  │
   └────────┘                    └──────┘
   ```
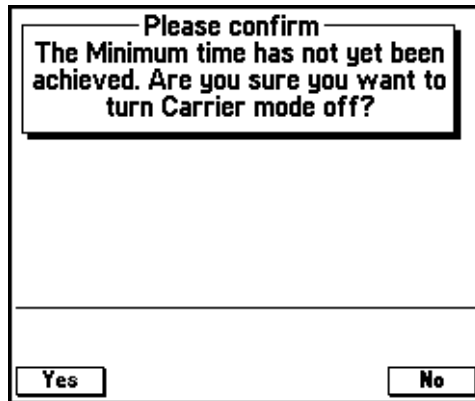
   This message reminds you that the *Minimum time* has not been reached, and that setting *Carrier mode* to 'Off' may result in preceding features not meeting the required precision.

If, during a data collection session, you attempt to switch the *Carrier mode* from 'On' to 'Off' *after* the *Minimum time* has been achieved, the following warning message appears:

```
┌──────────Please confirm──────────┐
│  Carrier mode should be left on if  │
│ further features will require carrier │
│ precision. Are you sure you want to │
│       turn Carrier mode off?        │
│                                     │
│                                     │
│                                     │
│ ┌─────┐                   ┌────┐  │
│ │ Yes │                   │ No │  │
│ └─────┘                   └────┘  │
└───────────────────────────────────┘
```
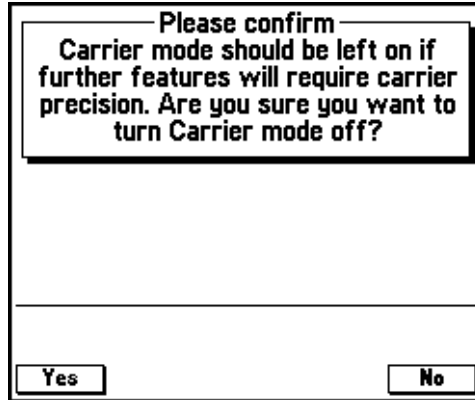
This message reminds you that the *Carrier mode* should be left set to 'On' if further features require carrier precision.

4.   Set the *Minimum time* field to the minimum time you require.

Note – Trimble recommends that you set the Position mode field in the Position filters form to 'Overdetermined 3D' when logging carrier phase data. This ensures that five satellites are used to generate each position. This also ensures that precision statistics can be computed by the postprocessing software.

In the Field

You are now ready to go into the field. The techniques you use are slightly different from those you use to collect just code-phase GPS positions.

Opening a Data File

You can either create a new file or open an existing file.

When you select *Create new file* from the *Data collection* menu, the Asset Surveyor software displays the *Create new file* form:

```
┌─────────────────────────────────────┐
│          Create new file            │
│ Filename:               R092304A    │
│ Data dictionary:      ⊙Tutorial     │
│ Storage disk:            ⊙TSC1      │
│ Free space:              954kB      │
│                                      │
│                                      │
│                                      │
│                                      │
│  ▯ Pc    ◈5⟩  PDOP   3.49           │
│ ┌──────┐                             │
│ │ Time │                             │
│ └──────┘                             │
└─────────────────────────────────────┘
```

Accept the default file name suggested by the Asset Surveyor software or type a new name into the *Filename* field. You can also change the data dictionary that is associated with the data file. If you have a PC card installed, you can choose whether to store the data file on the card or on the TSC1 datalogger. Press ⌶Time⌶ to switch between UTC and local time for the default file name.

Press ⏎Enter to create the new data file. The Asset Surveyor software opens this data file for logging.

When you select *Open existing file* from the *Data collection* menu, the *Open existing file* form appears:

```
┌─────────────────────────────────┐
│         Open existing file    ▾  │
│ File:                 ⊙TUTORIAL  │
│ Update status:          Imported │
│ Data dictionary:        Tutorial │
│ № of features:               114 │
│ Storage disk:               TSC1 │
│ File size:                 100kB │
│ Free space:                693kB │
│ File start                       │
│   Time:               05:12:17 pm│
│   Date:          09/23/1999 Thu  │
│ ▌▐ PC   ⟨7⟩  PDOP   2.41         │
│                                  │
└─────────────────────────────────┘
```

When you select a different file in the *File* field, the other fields change to show information about the selected file. This makes it easy to identify the file you want to update. When you have found the file you want, press ⏎.

If you did not set the *Position mode* to 'Overdetermined 3D' (see the note on page 174) the following warning appears:

```
┌──────────── Warning ────────────┐
│ Carrier phase data collection works│
│   best when in Overdetermined 3D │
│              mode.               │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│ ──────────────────────────────  │
│                                  │
│                                  │
└──────────────────────────────────┘
```

Decide whether or not to open the *Position filters* form from the *GPS rover options* menu and change the *Position mode*.

Starting to Log Data

When you open (or reopen) a carrier phase data file, the *Antenna options* form appears:

```
                Antenna options
Height:                          0.000m
Measure:                    ⟩Vertical
Confirm:                    ⟩Per feature
Type:            ⟩Integrated GPS/Beacon
Part number:               ⟩29653-00
Measurement method
  To:       ⟩bottom of antenna mount
```

Make sure that the *Height* and *Type* fields contain the correct details for the antenna you are using.

For more information about antenna types and configuring the *Antenna options* form, refer to the *TSC1 Asset Surveyor Software User Guide*.

Press ⌨︎ to proceed.

The Asset Surveyor software now starts to log data to the file you have opened. You must now choose which feature you want to record.

Starting a Feature

Choose a geographic feature from the list that appears, for example:

Items in this list are determined by the data dictionary you specified earlier (see page 175).

Antenna Options form

When you choose a feature, the *Antenna options* form appears. It appears every time you begin a new feature. Make sure that it contains the correct details, then press <kbd>Enter</kbd> to proceed.

Tip – If the antenna configuration is unlikely to change during the session, you can set the *Confirm* field to 'Per file' or 'Never'. If you do this, the *Antenna options* screen does not appear every time you begin a new feature.

The Asset Surveyor software now starts to log data for the feature.

Note – Quickmarks cannot be processed as carrier phase features. Quickmarks collected in a file containing carrier data are processed as code-corrected features.

Logging Carrier Phase Data

As you log carrier phase data, the Asset Surveyor software displays the time elapsed since the current block of data started. This is referred to as 'carrier time'.

The carrier time appears in the status line at the configured feature logging interval and shows the amount of data in minutes and seconds:

```

                          3:55 Carrier time
```
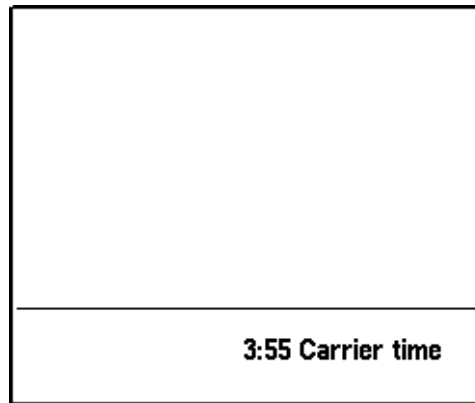
(This value also appears in the *Carrier time* field in the *Receiver status* screen.)

When the Asset Surveyor software has logged carrier phase data continuously for the time specified in the *Minimum time* field, the success beep sounds and the following message appears in the status line:

Minimum time achieved!
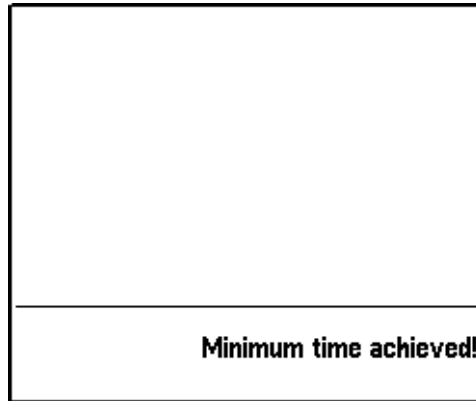
You have logged sufficient carrier phase data to achieve the precision required for the features collected since the counter was last reset, and until it is again reset.

Trimble recommends that you occupy the first feature for the full time specified in the *Minimum time* field before you move on to other features. This is discussed in Ending a feature before minimum time is reached, page 168.

If you attempt to close a file before the *Minimum time* is up, the Asset Surveyor software asks you to confirm that you want to close the file:

```
┌────────── Please confirm ──────────┐
│  Insufficient carrier data; do you  │
│     want to close this file now?    │
└─────────────────────────────────────┘


─────────────────────────────────────────

 Yes                                   No
```
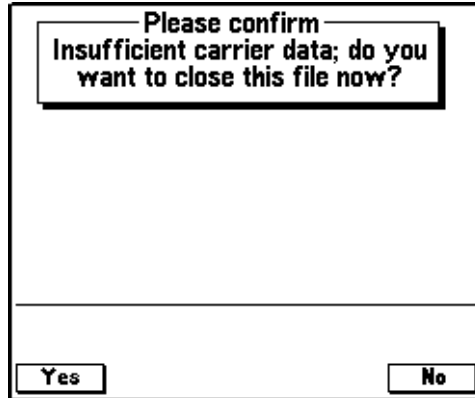
You can choose to close the file anyway, accepting a possible loss of accuracy, or you can keep the file open until more carrier phase data has been logged.

As you proceed, the Asset Surveyor software also warns you whenever your GPS receiver loses lock. A message appears in the status line, for example:

```



─────────────────────────────────────────

                           Carrier lost 0:35
```
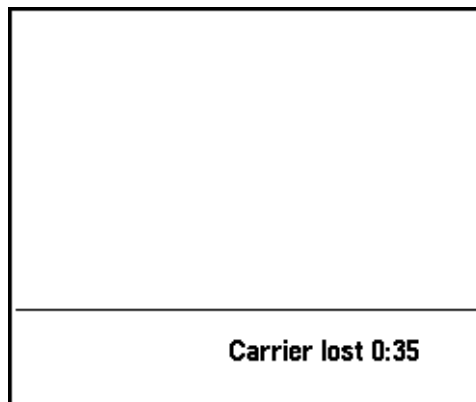
The Carrier lost message tells you how long the last continuous block of carrier data was when carrier lock was lost.

When the counter is reset, the *Carrier time* field shows 00:00.

In addition, the Asset Surveyor software writes a note to the data file, for example:

```
                      Review note
Carrier lock lost:
Carrier time 0:35
09:40:11 am (UTC time)



 Symb
```
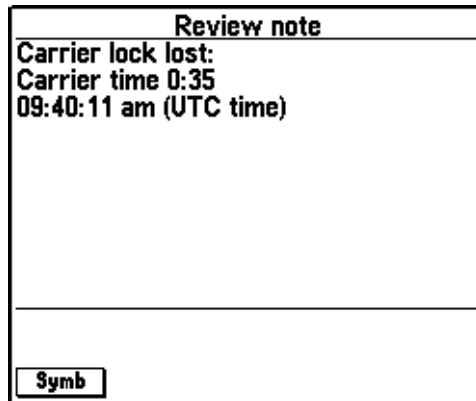
This records when the carrier time was reset, and the amount of carrier phase data collected for the block. You can review this note in the field, or back in the office (using the GPS Pathfinder Office timeline).

If the *Minimum time* has not been reached, you can choose whether to reoccupy the affected features or move on.

Back In the Office

To transfer your data from the datalogger to your office PC, see Transferring Data to the PC, page 142.

Then process your files using the GPS Pathfinder Office software. For more information on processing data files, refer to the GPS Pathfinder Office documentation.

Centimeter Processing Option

You can purchase an option for the GPS Pathfinder Office software which enables the processing of carrier phase data to centimeter precision levels. For data to be processed using the centimeter option it must satisfy the following requirements:

- features must be collected within a continuous carrier block of at least 45 minutes in duration

- the baseline (distance between the base and rover) for the data must be less than 10 km

- data must be collected using a Pathfinder Pro XR or Pro XRS receiver.

RTK Mapping

In this chapter:

- Introduction
- Introduction to RTK
- Before you begin
- In the field
- Back in the office

Introduction

This chapter introduces the basic principles of using Real-Time Kinematic (RTK) techniques to collect data for use in GIS and CAD systems. It identifies procedures and techniques to ensure that the equipment is used appropriately to achieve the specified levels of accuracy from the RTK system.

Introduction to RTK

If you need to collect features with a very high level of precision, you can configure the Asset Surveyor software to collect RTK data.

GPS data collection for geographic information systems (GIS) has generally been carried out using GPS receivers that achieve submeter levels of accuracy by applying differential correction techniques for postprocessed and real-time data collection. However, RTK techniques allow you to collect positions with centimeter levels of accuracy.

With an RTK system, this level of accuracy can now be obtained for mapping purposes, along with the same powerful feature and attribute data collection.

To obtain these higher levels of accuracy, you need to apply more rigorous data collection techniques than those used for differential data collection. While the basic GPS correction concepts are the same for both RTK and differential data collection, the tolerances associated with RTK data collection are more precise. Errors which could be overlooked for differential operations now become important and must be accounted for carefully in order to obtain the centimeter levels of accuracy achievable with the RTK system.

While the RTK system computes very precise GPS positions and displays reliable precision estimates, these positions are only accurate when compared to each other. To achieve high levels of absolute accuracy (when comparing with existing data sources), it is important to calibrate the data against existing good quality control points. An accurate location for the base station is also important, as are accurate heights for both the base and roving receiver antennas.

Real-Time Kinematic Data Collection

RTK data collection is a combination of specialized GPS and radio-modem equipment that has been utilized by the land survey community for precisely defining positions on or near the earth's surface. The RTK system, in conjunction with appropriate surveying techniques, is designed to derive positions in the field to centimeter levels of accuracy for both the horizontal and vertical components of a coordinate.

RTK operates using relative measurement techniques, in the same way that differential GPS (DGPS) operates. There is a base station (also referred to as a reference station) and a roving receiver. The position of the rover is determined relative to the base station (illustrated in Figure 8.1). The base station is set up as a stationary receiver over a known or assumed reference point for the duration of the data collection session. (A known reference mark is generally a well-defined survey mark in terms of a local or national coordinate system.) The roving receiver is moved to features that are to be collected or updated.
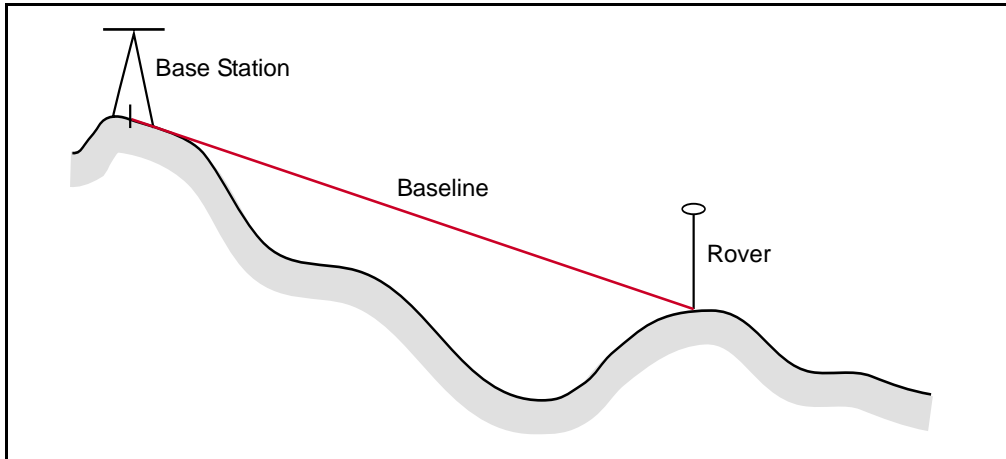
Figure 8.1   Relative measurement between base station and rover

When the data from these two receivers is combined, the result is a three-dimensional vector between the base station and the rover, called a baseline, which enables a position to be computed. RTK data collection uses a radio to transmit the base data to the rover for the duration of the data collection session. As each GPS position is computed, a correction can be applied to significantly improve the level of accuracy of the feature being observed.

Note – Postprocessed techniques (which require data to be stored and corrected some time after the data collection process has been completed) are not discussed here. RTK systems are designed to operate for RTK data collection only.

RTK data collection requires the simultaneous observation of the same five (or more) satellites by both the base station and rover. You can have as many rovers as you like simultaneously collecting data; however, all rovers must be able to see the same satellites as the base station.

The difference between RTK and differential data collection techniques are specifically related to the information that the receiver (or combination of receivers) is able to interpret from the signals that are sent by the satellites.

The following section briefly describes satellite signals and the way in which GPS receivers use these signals, to provide basic information for understanding the differences between RTK and differential data collection techniques.

Satellite Signals and GPS Receivers

Each satellite transmits two unique codes. The first and more simple code is called the *C/A (coarse acquisition) code*. The second code is called the *P (precise) code*. These codes are modulated onto two carrier waves, *L1* and *L2*. The L1 wave carries both the C/A and the P-code, while the L2 wave carries only the P-code.

GPS receivers are categorized as being either *single-frequency* or *dual-frequency*. Single-frequency receivers observe the L1 carrier wave, while dual-frequency receivers can observe both the L1 and L2 carrier waves.

Submeter differential receivers such as the Pro XR and Pro XRS are single frequency receivers. RTK receivers such as the GPS Total Station 4700, GPS Total Station 4800, Series 4000, and Site Surveyor 4400 track both frequencies, which lets more precise centimeter-level positions be computed.

Code and phase measurements

There is a time difference between when the code is generated in the satellite and when it is received at the GPS antenna. Code measurements, as described in the *Mapping Systems General Reference* manual, make it possible to record this time difference. The measurements are multiplied by the speed of light, making it possible to determine the distance from the satellite to the GPS receiver's antenna—this distance is also referred to as the *range*.

High accuracy GPS receivers measure the phase difference between the carrier waves. The wavelengths of both the L1 and L2 waves are known, so satellite ranges can be determined by adding the phase difference of the L1 and L2 signals to the total number of waves that occur between each satellite and the antenna.

Determining the fractional component of the signals is relatively simple. However, determining the full number of carrier wave cycles between the antenna and the satellite is more complex. The determination of the integer number of waves is referred to as the *integer ambiguity search* or, more simply, *search*. For Real-Time Kinematic operations that require centimeter-level accuracy, the integer is determined during a process called *initialization*.

The initialization process for RTK techniques is, in essence, solving ambiguities that exist between the base and roving receivers and the satellites they are observing. The resultant solution of these ambiguities is referred to as either being *Fixed* or *Float* as defined in Table 8.1.

Table 8.1   Fixed versus Float solutions

Fixed solution	Float solution
A fixed solution is obtained when the integer values of the wave lengths are able to be computed with confidence. A fixed solution achieves centimeter levels of precision.	A float solution is obtained when a definitive integer value for the wave lengths cannot be computed with confidence. Float solutions result from unmodeled atmospheric, orbital and other errors. A float solution is not as precise as a fixed solution.

RTK Correction Messages

During an RTK data collection session, the base station broadcasts correction messages using the radio modem. There are two types of message that can be broadcast: CMR and RTCM 2.1. These messages are configured in the Asset Surveyor software using *Configuration / Communication options*.

⚠ **Warning –** If you are using a 4400 Site Surveyor receiver, a GPS Total Station 4700 receiver, or a GPS Total Station 4800 receiver as the rover, it can automatically detect which signal is being broadcast. If you are using a Series 4000 receiver as the rover, you must configure the same message type at both the base and the rover, otherwise messages are not received by the rover.

CMR

A Compact Measurement Record (CMR) is the most efficient message to broadcast as it is very compact. CMR only supports RTK data collection; you cannot use it to provide corrections for real-time differential data collection (such as when using a Pro XR).

All Trimble Series 4000, 4400, and 4800 receivers support CMR records. This is the default setting in the Asset Surveyor software.

RTCM 2.1

The Radio Technical Commission for Maritime Services (RTCM) 2.1 message is a less compact message that contains an RTCM SC-104 format message with an embedded CMR message. As a result of this, a single RTK base station could be set up to provide real-time correction messages for simultaneous RTK and real-time differential data collection. Therefore, rovers that receive RTCM 2.1 messages can collect either RTK or real-time differential data by setting the RTK mode in the software appropriately.

In the Asset Surveyor software, select *Configuration / GPS rover options / Positions filters*.

Note – Your receiver must have the RTCM output option installed in order to use RTCM 2.1.

Accuracy Considerations

Your RTK system has been designed to achieve centimeter levels of accuracy. There are a number of important tools incorporated within the system to help achieve this. However, to ensure ultimate quality, it is imperative that good data collection procedures are followed.

In considering accuracy requirements, it is important to determine whether or not the data being collected is to be associated with data collected by other means. In most instances, the data collected by your RTK system is required for incorporation into an existing GIS. This GIS usually stores its current data in terms of a common underlying coordinate system, such as a national grid or local coordinate system.

The following factors have an effect on ensuring the required levels of accuracy are obtained:

- precision estimates
- calibrating to existing control points
- geoid models

Precision estimates

Your RTK system computes values that provide an estimate of the quality of the GPS position that is being derived. These values provide estimates of the precision associated with the location of the phase center for your roving receiver's GPS antenna.

You can make valuable use of these precision estimates during your RTK data collection activities. They can be used when configuring your roving receiver to indicate precision tolerances (or *masks*). A position is not logged if it does not fall within the assigned tolerances.

Separate precision tolerances can be set for the horizontal and vertical components of the position. Precision tolerances are further split to enable separate settings to be made for positions collected as a result of static or roving techniques. Static and roving techniques are described later in Data Collection, page 197.

In the Asset Surveyor software, the precision settings are set in the *RTK precision options* form. To open this form, press ⌐RTK¬ in the *Position filters* form.

During the RTK data collection process, the precision estimate values are constantly displayed and updated in terms of a position's horizontal and vertical components. You can also log the precision estimates (QA/QC) associated with each position using the *Log QA/QC* functionality.

In the Asset Surveyor software, the *Log QA/QC* field is found in the *Logging options* form, accessed from *Configuration* / *GPS rover options*.

The Asset Surveyor software is set by default to log precision estimates if available. The precision values for a position can be queried in the GPS Pathfinder Office software and can also be exported as attributes for point features and Not in Feature positions.

While these values provide a very good indication of the quality of the GPS signal and the computed position's precision, they should not be used in isolation when considering a position's accuracy.

Calibrating to existing control points

To achieve maximum possible accuracy, it is important to search survey records for horizontal and vertical control points that may be used to provide a control framework for a local site calibration. Trimble recommends that you contact a practising surveyor or survey company for reliable information related to the control points.

Differences can exist between GPS positions and positions that have been surveyed using conventional means, such as a theodolite and EDM. These differences are commonplace and occur because GPS positions are referenced to a mathematical representation of the earth (called an *ellipsoid*), while conventionally surveyed positions are referenced to a gravitational model of the earth (called a *geoid*). The ellipsoid surface is very smooth and regular, while the geoid surface is uneven, as illustrated by Figure 8.2.
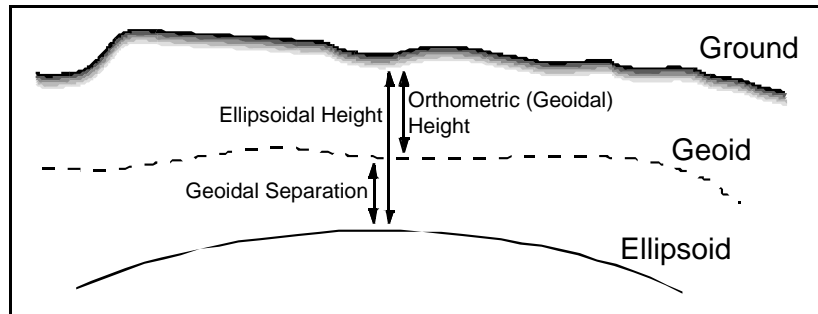
Figure 8.2   Geoid-ellipsoid separation

The differences between the geoid and ellipsoid result in a perceived degradation of accuracy between the GPS positions and the 'known' survey marks. The inaccuracies can be accommodated through a process called *calibration*. A calibration applies a least squares adjustment to derive a 'best fit', by moving the GPS-derived positions slightly to reflect the positions of the existing survey control more appropriately, as illustrated by Figure 8.3. This is achieved by observing or collecting GPS positions over known survey marks, then creating a local site using the GPS Pathfinder Office software.
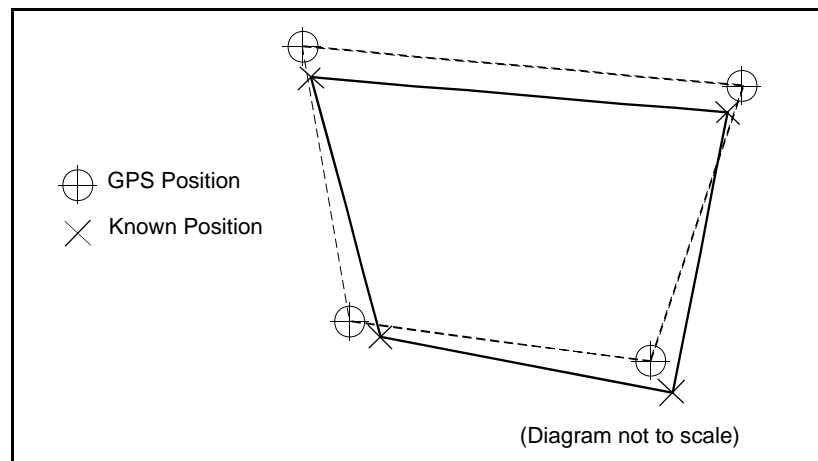
Figure 8.3   Local site calibration schematic

Note – You cannot derive a Local Site Calibration using the Asset Surveyor software.

For best results, assuming the control is free of errors, local control points should be evenly distributed over the data collection area as well as extending beyond the perimeter of the site. A minimum of three known points is recommended for a horizontal adjustment, while a minimum of four known points is recommended for a vertical adjustment.

A local site is the result of plane and height adjustments. The plane adjustment consists of a rotation, translation, and scale change of the mapping plane. The height adjustment defines a plane that is inclined relative to the mapping plane. A mapping plane is an underlying coordinate system that already has defined datum and map projection parameters.

Creating a local site is a simple way to compute the parameters (rotation, translation, and scale) associated with a plane adjustment for a localized area, or site. Vectors define the relative movements of positions for known coordinates. A least squares adjustment is then applied to the vectors to derive a best fit solution for the parameters of the plane adjustment.

Some important points to remember when creating a local site are:

• A local site is created from a specific coordinate system and zone; it is linked permanently to that zone. Make sure that the current coordinate system and zone are the same as that of your existing database.

• A local site can only be created in terms of a cartesian coordinate system (that is, not from a latitude/longitude projection). This is because a local site is defined in linear units, such as meters, as opposed to non-linear units, such as degrees.

- A local site created in the GPS Pathfinder Office software must be transferred to your datalogger for use in the field. For more information on transferring a local site, refer to the GPS Pathfinder Office documentation.

- Local sites can be created and edited using the Coordinate System Manager. For more information about creating and editing sites, refer to the GPS Pathfinder Office documentation.

Geoid models

The geoid, as mentioned above, is a surface of constant gravitational potential which approximates mean sea level. A geoid model (also called a geoid grid file) is a table of separations between the geoid and the ellipsoid. Heights of GPS positions are computed relative to the WGS-84 ellipsoid. Using a geoid model, the separation between the geoid and the ellipsoid is calculated and added to the ellipsoid height, to compute the elevation of the point above the geoid, often referred to as height above mean sea level (MSL).

You can incorporate a geoid model into your local site as a Height Adjustment. The geoid-ellipsoid separations are taken from the geoid file you choose, then used to display elevations, which are shown on the screen.

The benefits of this function are that you can display elevations (which are only as accurate as your geoid model) without having to calibrate on elevation benchmarks. This is very useful when there is no local control or benchmarks, as it enables you to work on the ground rather than on the ellipsoid.

Remember elevations that are derived from geoid models are only as accurate as the geoid model used to determine them.

⚠ **Warning –** The Asset Surveyor software references a geoid model with a grid separation of 10 degrees x 10 degrees for standard derivations of elevation above mean sea level, which is too coarse for RTK operations. Use a local site calibration if absolute accuracy is desired.

Trimble recommends that geoid models be applied when collecting data over large sites, such as entire cities and towns, and in terrain that undulates significantly. It is also useful to realize that Local Height Adjustments can be applied relative to a geoid.

Data Collection

RTK data collection follows the same basic principles as standard GPS data collection for GIS or Mapping applications, as described in the *Mapping Systems General Reference*. RTK differs from standard GIS data collection with respect to the techniques employed to collect the positional component of a feature.

Collection techniques can be described in terms of two distinct methods:

- static

- roving

These terms refer specifically to the way that the GPS antenna is being physically supported and the way that the positions are being logged.

Static data collection

In the Asset Surveyor software, data can only be collected in static mode for point features when *Apply real-time* is set to 'Yes' in the *Position filters* form, and one of the following is true:

- you are using a Series 4000 receiver and *RTK mode* is set to 'On'

- you are using a Site Surveyor 4400 receiver, GPS Total Station 4700, or GPS Total Station 4800, and *Log RTK only* is set to 'Yes'

Upon beginning a point feature (and setting the antenna height, if *Confirm (Antenna Height)* is set to 'Per feature'), the RTK receiver automatically enters into static mode. When in static mode, only one position is logged for a point feature. The position is checked as part of the static collection technique by comparing it with the positions of two previous epochs of data (in other words, three epochs in total are used). If all three epochs of data fall within the precision tolerances specified, then the position is recorded against the feature and the position counter in the status bar increases from 0 to 1. The feature remains open, so the attributes can continue to be collected, until the feature is ended or canceled.

It is important to minimize antenna movement (or 'pole wobble') so that movement is less than the precision tolerances that have been set. The finer the precision requirements, the steadier the antenna must be.

Note – Positions logged as static positions ignore the Point feature logging intervals and Minimum positions settings in the Logging options form in the Asset Surveyor software.

Tip – Because you need to hold the antenna as steady as possible, Trimble recommends that the position is recorded before the feature's attributes are recorded. Alternatively, logging can be paused before beginning the feature, then resumed when the position is ready to be recorded.

If the precision estimate values do not fall within the specified tolerances, but a position still needs to be logged, press ☐Log☐ to override the tolerances. The position with the best static precision attained while the feature has been opened is then logged.

Roving data collection

With the exception of point features collected in Static mode, all RTK positions are collected in Roving mode. This includes positions that are recorded as Not in Feature.

Note – Point features are always logged in Roving mode if Apply real-time (Corrections) is set to 'Automatic'.

Positions logged in Roving mode use the *Logging intervals* and *Minimum positions* settings in the *Logging options* form in the Asset Surveyor software. Point features logged in Roving mode will therefore record and average the positions collected while the feature is open.

Note – The GPS Pathfinder Office software applies smart averaging which means that if a feature contains autonomous positions as well as RTK positions then the autonomous positions are ignored when computing the averaged positions for the feature.

Positions within line and area features, and positions collected as Not in Feature, which are required to be collected as RTK positions, are only logged if the estimated precision for those positions falls within the *RTK Roving Precision Tolerances* set in the *Position filters* form.

Before You Begin

Before you begin your data collection in the field, there are a number of factors that you need to consider to ensure smooth operation.

Moving the base station

If your roving receiver moves outside the range of the base station, you may want to move the base station to a new location. Make sure that each new base coordinate is in the same terms as the initial base coordinate. That is, make sure that they are referenced to the same coordinate system and a that control survey has been conducted to ensure that all base coordinates have their relative errors reduced with reference to each another.

Note – When using multiple base stations for a single data collection project, Trimble recommends that a qualified surveyor be employed to conduct a control survey of the base station reference positions.

Coordinates published by a reliable source and coordinates determined by control surveys should be homogeneous.

If subsequent base coordinates are not in the same terms, you will need to regard data associated with each base as a separate project. That is, data collected in terms of one base station cannot be assumed to be accurate with respect to data collected in terms of a second base station.

Extending base station coverage with radio repeaters

You can extend the range of a base station by using radio repeaters to rebroadcast the base signal over a wider area. For more information on radio repeaters, see Radio repeaters, page 203.

Setting Up a Base Station

Planning is important if you want to collect data successfully. Before commencing data collection, plan a field methodology that enables you to successfully achieve the goals of the data collection process.

You must start the base receiver before the roving receiver. If different field crews set up the base and roving receivers, the roving crew must be sure that the base has been started before they start to collect features. Obviously, radio corrections are not available until the base is started. It is a good idea to plan a schedule before leaving the office and use walkie-talkie radios or mobile phones to communicate between the base and rover crews.

Selecting a site for the base station

When selecting a site for the base station, it is important to consider the following factors:

- The base station should be positioned in an environment that is free of multipath, has minimal sources of radio interference, and has a clear and uninterrupted view of the sky. If possible, the base station should be at the approximate elevation of the rovers.

- Make sure that the area you want to map is entirely within range of the base radio. If it is not, you can place radio repeaters in order to gain full site coverage. Alternatively, you could move your base station to different locations throughout your data collection session, but ensure that these locations are homogeneous, that is, that they are from the same control network.

- Ensure that a reasonably clear line of sight is maintained between the base and rover radios, although this depends on the radios being used. Try to keep the base antenna as high as possible.

When you set up a base station, it is important that you know the coordinates of the reference position as accurately as possible. The reference position is usually a definable point, such as an existing survey mark. Every ten meters of error in a base station coordinate can introduce up to 1 ppm scale error for every rover position that is observed relative to the base station (based on distance between the base and rover antennas).

There are several recognized methods that you can use to determine base station coordinates (in descending order of accuracy):

- published or precisely-determined coordinates

- coordinates derived using a reliable differential (RTCM) broadcast

- an autonomous position generated by the receiver

Note – Although local coordinates can be keyed in for the reference positions, these are transformed by the field software to be in terms of WGS-84. If accurate WGS-84 coordinates are available, then you can use these in preference to local coordinate values.

Tip – In the U.S., NAD83 coordinates are equivalent to WGS-84 coordinates.

Warning – Although you can use an autonomous position generated by the receiver, this is a very inaccurate method. Only use it if the data to be collected is contained within a small area and the data does not need to be tied in or referenced to an existing set of data.

Equipment Setup and Use

With the RTK system, the way you set up and use the equipment can have significant effects on the reliability of the data being collected.

This section describes the equipment you need and shows you how to set it up. Setting up of both the base station and rover is very similar.

For trouble-free hardware integration, use the diagrams provided. They show you how to connect the GPS receivers, a TSC1 datalogger, the batteries, and radios.

Note – If you are using a mix of Series 4000 and 4400 receivers, Trimble recommends that you use the Series 4000 receiver as the base receiver.

Radios

Trimble provides a comprehensive range of radio solutions that have been tested and proven. TRIMTALK radios are powered from the receiver's supply using a common data/power cable—receiver and radio utilize the same power source. This configuration simplifies battery issues.

⚠ **Warning –** In some countries there may be legal regulations for the use of particular radio frequencies. Trimble recommends that you ensure that you have a legal entitlement to use radios at a particular frequency.

Radio repeaters

Real-time data collection methods rely on trouble-free radio transmission. Sometimes the conditions or topography of a site adversely affect radio transmission, resulting in limited coverage. Occasionally, in these cases, radio repeaters are used to receive the base transmission and then rebroadcast it on the same frequency.

Trimble provides four radio solutions that you can use with the RTK system. Table 8.2 lists these radio solutions, and shows the number of repeaters that you can use with each.

Table 8.2   Radio repeater options

Radio	Number of repeaters
TRIMTALK 450	1
TRIMTALK 900	1, 2, 3, 4, or 5
TRIMTALK 450S (12 kHz)	1
TRIMTALK 450S (25 kHz)	1 or 2
TRIMMARK	1 – Refer to the TRIMMARK documentation
Pacific Crest / Satel / Clarion	Refer to the manufacturer's specifications

Antennas

The Series 4000 or Site Surveyor 4400 RTK system comes standard with two dual frequency, compact L1/L2 geodetic antennas (P/N 16046-10). The base antenna is usually attached to a tripod and the rover antenna to a range pole.

The antenna of the GPS Total Station 4800 RTK system is integrated into a self-contained unit.

For all systems it is imperative to accurately measure the height of both the base and rover antennas, as an error in these measurements will result in a corresponding error in your final results. This is especially true with respect to the vertical component of a three-dimensional position.

The antenna receives GPS signals at the Antenna Phase Center (APC). You cannot measure directly to the APC as it is inside the plastic housing. The best way to measure the antenna height is to measure the vertical height from the survey mark on the ground to a specified part of the antenna housing. This type of measurement is called an *uncorrected* measurement. The Asset Surveyor software then corrects to the true vertical height to the APC.

When you enter a value for the antenna height, also ensure that you specify the correct measurement method that was used in the *Measurement Method* field. The software then corrects the antenna height value according to the antenna that you have selected.

Note – If you use a fixed height range pole at the rover, you do not need to measure it. Simply enter the fixed height in the Antenna height field and select Vertical as the measure option.

Figure 8.4 shows how to measure the height of an antenna mounted on a range pole. Alternatively you could be using a fixed height range pole, in which case the height would be a constant value.
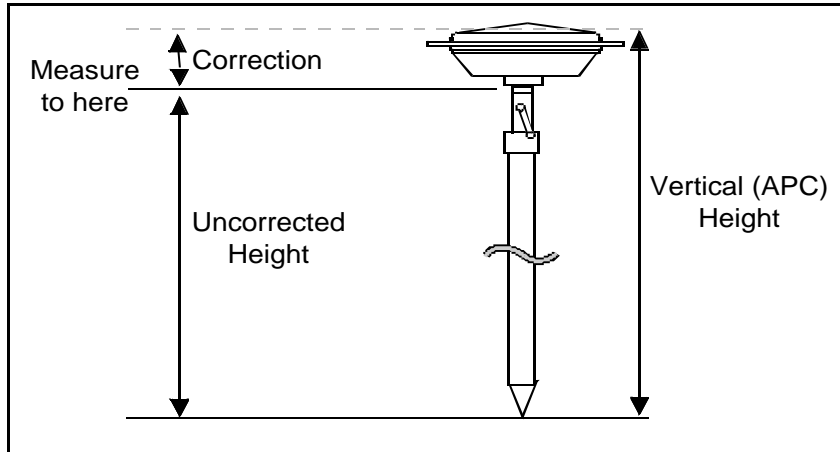
Figure 8.4   Measuring the height of a Compact L1/L2 antenna on range
pole

For example, on a Compact L1/L2 antenna, measure to the bottom of
the plastic antenna housing and enter this value as the antenna height,
with *Measurement method* set to 'Bottom of antenna mount'. The
software then calculates the APC based on the antenna type you have
selected and, in this case, adds 62.5 mm to the measured value. This
APC height is used to calculate the ground height for points.

Using a ground plane

Ground planes are usually only used at the base receiver. They reduce the incidence of multipath. If you use a ground plane, select the option with ground plane as the antenna type, for example 'Compact L1/L2 w/GP'. To measure the uncorrected height of the antenna with a ground plane, measure to the underside of the notch in the ground plane, as shown in Figure 8.5.
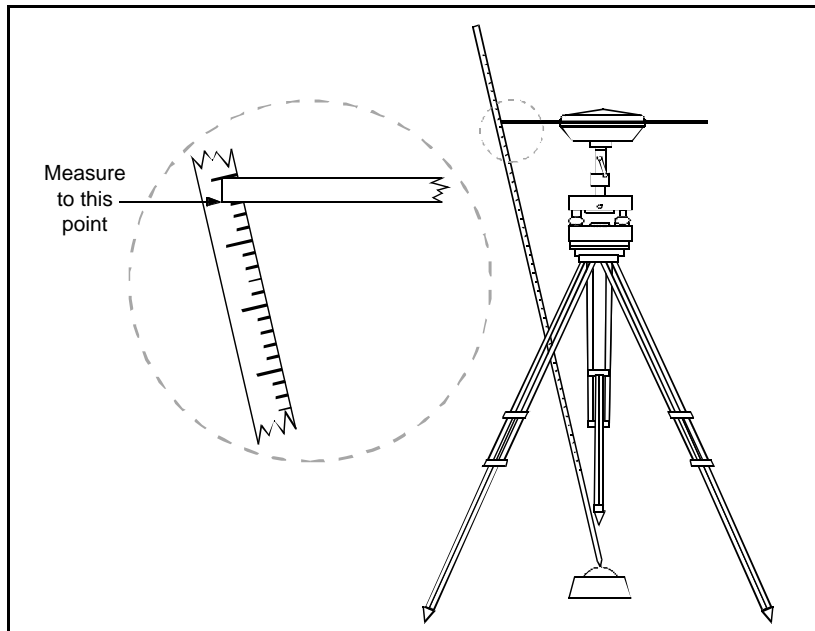
Figure 8.5   Measuring the height of a Compact L1/L2 Antenna with ground plane

Tip – Measure the height to three notches around the perimeter of the ground plane and record the average as the uncorrected antenna height. This will take into account any errors due to a tripod that has not been accurately leveled.

Batteries

The following batteries and accessories come with a Series 4000 or
Site Surveyor 4400 RTK system:

- 12V 10AH battery for powering the base receiver
  (P/N 13542-10)

- 12V 2.3AH camcorder batteries for powering the roving
  receiver (P/N 17466)

- A camcorder battery cable (P/N 18294). This cable connects
  both batteries in series. To utilize both batteries connect the
  cable to the port labeled PWR 2&3 on Series 4000 or 4400
  receivers. The receiver port auto-switches to the second battery
  when the voltage of the first battery falls below the required
  level. Even though the two batteries are connected in series,
  only one is used at a time.

The following batteries and accessories come standard with a GPS
Total Station 4800 RTK system:

- 6AH battery for powering the base receiver (P/N 32364-00)

- 3 PowerLiTE batteries for powering the roving receiver
  (P/N 31030-00)

*Note – Radios come with their own batteries, or they are powered
directly from the receiver. The type of battery depends on which radio
solution is purchased.*

If you already own the GPS receivers and batteries, the following information will help to determine which type of batteries to use:

• When setting up a base receiver, make sure that the chosen power source can provide an uninterrupted supply for the duration of the survey. This is particularly important if your base receiver is normally left unattended. Generally, a 6 AH or 10 AH battery will do, but for some applications a heavy-duty battery and general purpose battery cable may be the only reliable option.

• For roving receivers, make sure that the batteries are light enough to be carried for long periods. Camcorder batteries provide a reliable supply while adding minimal weight.

Setting Up a Base Station with the Asset Surveyor Software

This section describes how to set up and start an RTK base station, using the Asset Surveyor software.

Base station assembly: Series 4000 and Site Surveyor 4400 receivers

1. Set the GPS antenna over the ground mark using a tripod, a tribrach, and a tribrach adapter.

2. Connect the GPS antenna to the GPS receiver port labelled ANTENNA. Use the N-type to 5-pin lemo cable (P/N 14553-00), as shown in Figure 8.6.
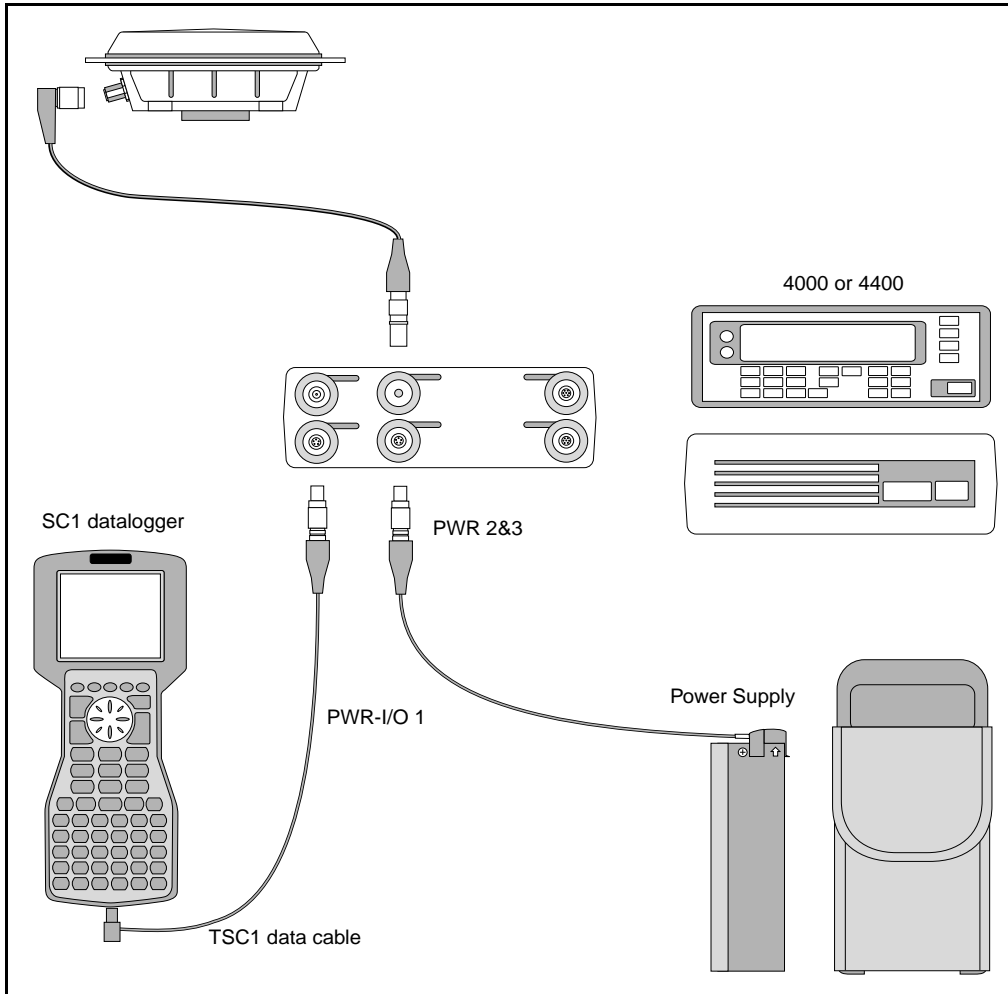
Figure 8.6   RTK base station setup for Asset Surveyor with the Series 4000 and Site Surveyor 4400 receivers

3. Assemble and erect the radio antenna, then connect the radio antenna to the radio using the cable attached to the antenna, as shown in Figure 8.7.
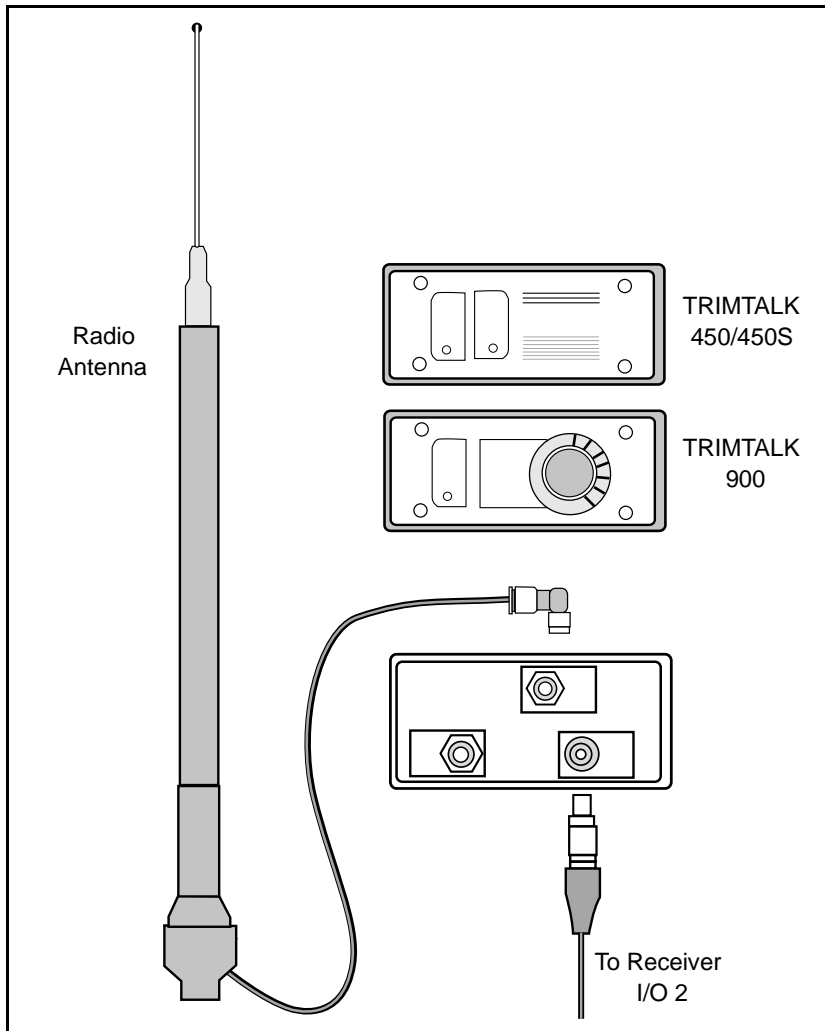
Figure 8.7   Radio and antenna setup

4. Connect the radio to the GPS receiver port labeled I/O 2. If you are using a Trimble radio, use the 7-pin lemo to 5-pin lemo cable. If you are using a radio provided by a third party, use the appropriate cable.

5. Connect the power source to the GPS receiver port labeled PWR 2&3.

If you are using a third-party radio solution, make sure that the radio is connected to the power source.

Base station assembly: GPS Total Station 4800

1.   Set the 4800 unit over the ground mark using a tripod, a tribrach, and a tribrach adapter, as shown in Figure 8.8.
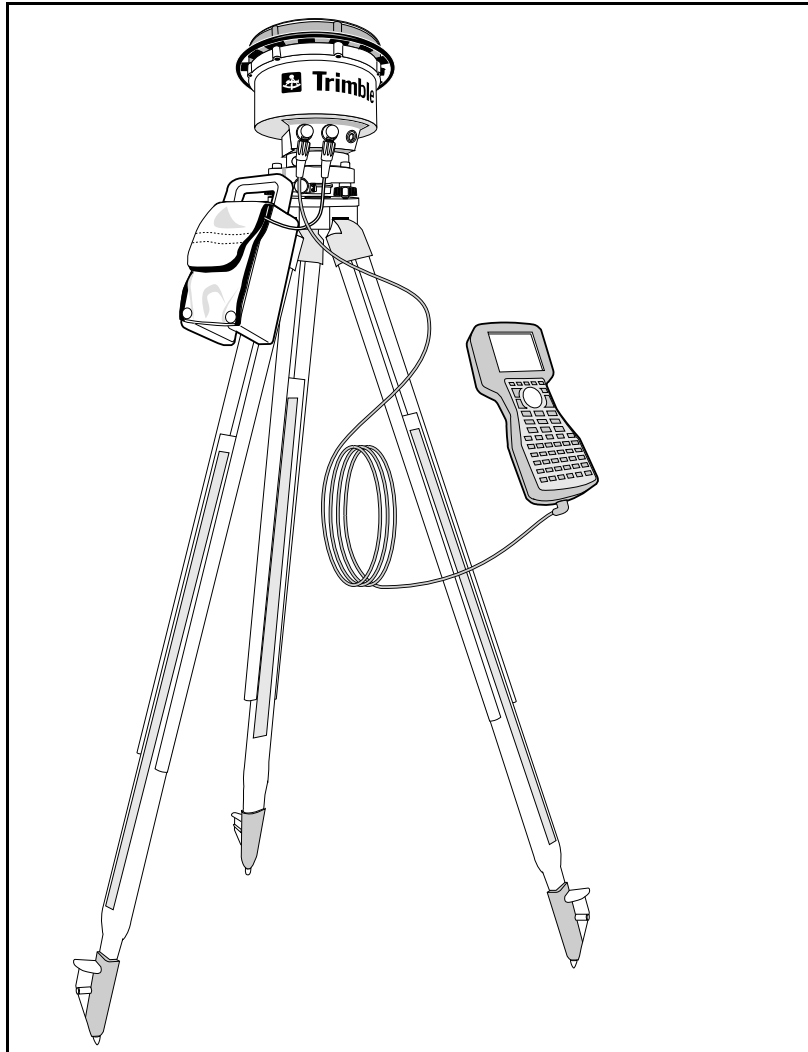
Figure 8.8   RTK base station setup for Asset Surveyor with GPS Total Station 4800

2.   Assemble and erect the radio antenna, then connect the radio antenna to the radio using the cable attached to the antenna, as shown in Figure 8.9.
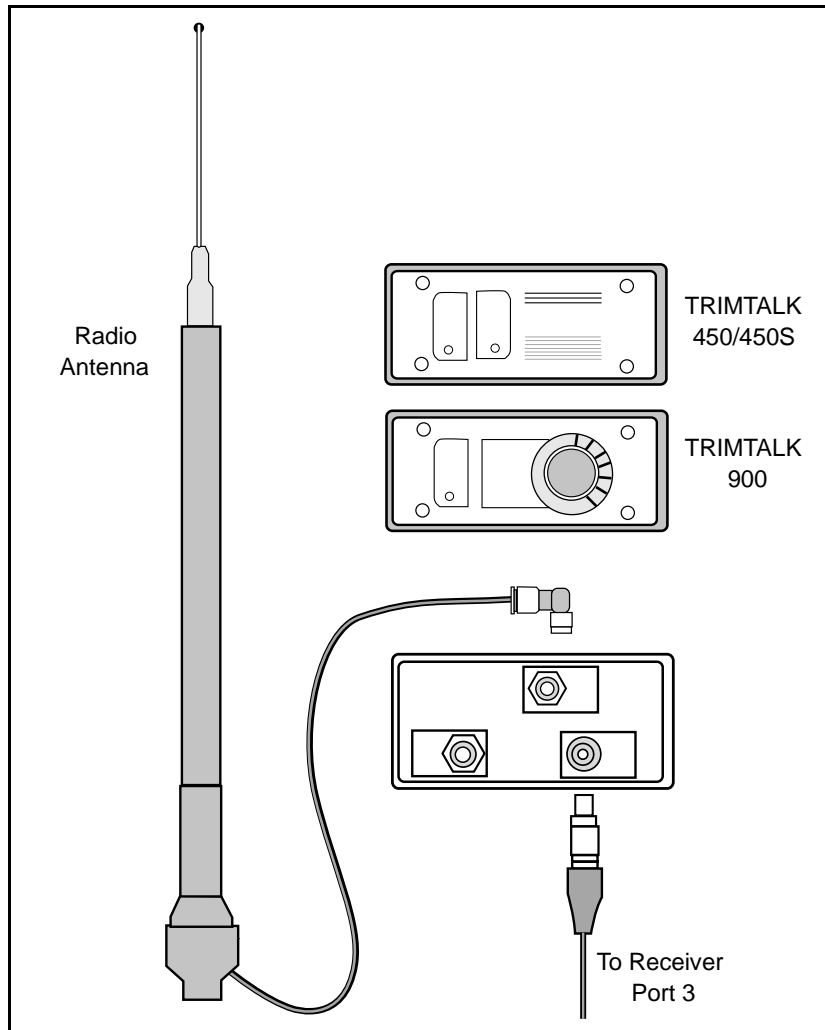
Figure 8.9   Radio and antenna setup

3. Connect the radio to Port 3 on the 4800. If you are using a Trimble radio, use the 7-pin lemo to 5-pin lemo cable. If you are using a radio provided by a third party, use the appropriate cable.

4. If you are using an external power source (that is, a source other than the lithium ion PowerLiTE battery) connect this source to Port 2 on the 4800 unit.

Communication settings

It is important to select the correct communication settings for your base and rover receivers. All communication settings are grouped in the *Communication options* menu.

Tip – Set up and test these settings in the office before you go out in the field to collect data. Once they are configured correctly, you should not have to configure them again unless you change your hardware configuration.

To configure the communications settings:

1. Start the Asset Surveyor software.

2. Select *Configuration* / *Communication options* / *Real-time output options*.

The *Real-time output options* form appears:

```
     Real-time output options    ▾
Real-time output mode:        ⓘ Off
Radio type:              ⓘ Custom
Baud rate:               ⓘ 9600
Data bits:                  ⓘ 8
Stop bits:                  ⓘ 1
Parity:                  ⓘ None
RTCM options
  Station:                     1
  Message type:         ⓘ Type 1
  Message interval:           5s


  RTK
```

3.   Set *Real-time output mode* to 'On'.

4.   Select the type of radio you are using in the *Radio type* field.
     The fields below it, *Baud rate*, *Data bits*, *Stop bits*, and *Parity*,
     are set automatically.

     If the type of radio you are using does not appear in the list,
     select 'Custom' in the *Radio type* field and set the other radio
     settings as appropriate.

5.   Press the ⌐RTK⌐ softkey. The *RTK protocol* form appears:

```
            RTK protocol
RTK record type:             ⓘ CMR
```

6. Select the type of correction record to broadcast in the *RTK record type* field. This will depend on whether the rovers using this base station are all RTK, or a combination of RTK and real-time differential. By default, 'CMR' is selected. For more information on RTK correction messages, see RTK Correction Messages, page 190.

7. Connect the TSC1 datalogger to the GPS receiver port labeled PWR-I/O 1 (Port 1 on the 4800 unit) using the 7-pin lemo to 5-pin lemo cable (P/N 32901). For the 4800, use the 7-pin lemo to 7-pin lemo cable (P/N 31288).

Note – If you are using a Series 4000 receiver as the base receiver, you may want to configure and start the base station using the receiver's front panel. In this case, there is no need to connect the TSC1 datalogger to the base receiver.

A summary of the recommended settings within the *Position filters* form and *RTK precision options* form, to ensure RTK operation, is shown in Table 8.3.

Table 8.3   Recommended RTK settings in Asset Surveyor

Command	Recommended setting
Apply real-time	On
RTK mode (4000 only)	On
Log RTK only (4400/4800)	Yes
RTK Static precision	
Horizontal	0.05m
Vertical	0.05m
RTK Roving precision	
Horizontal	0.1m
Vertical	0.15m

To ensure RTK corrections are applied, *Apply real-time* must be set to either 'Yes' or 'Auto'. If *Apply real-time* is set to 'Auto', then RTK static and roving precisions cannot be accessed using the ⌐ RTK ⌐ softkey). This option is directly associated with real-time applications, whether they are for RTK or differential applications. For more information on the use of this setting, refer to the *TSC1 Asset Surveyor Software User Guide*.

When connected to a Series 4000 receiver, set the *RTK mode* field to 'On' to ensure a centimeter level of precision is achieved. This option is only available if an RTK capable GPS receiver is connected. If *RTK mode* is set to 'Off', then the RTK static and roving precisions cannot be accessed.

Note – RTK precision settings do not apply when Apply real-time is set to 'Auto'.

When connected to a Site Surveyor 4400 receiver or GPS Total Station 4800, set the *Log RTK only* field to 'Yes' to ensure a centimeter level of precision is achieved. This option is only available if an RTK capable GPS receiver is connected and *Apply real-time* is set to 'Yes'. If *Log RTK only* is set to 'No', then the RTK static and roving precisions cannot be accessed.

The *RTK Static* and *Roving precision* settings are used to specify tolerances within which the GPS positions must fall before they are logged. The settings can be selected from a short list of options or keyed in as a user-defined setting. Static and roving techniques are discussed more extensively in Data Collection, page 197.

Starting the base station

When you have assembled the base station, you must configure and start it. Use the Asset Surveyor software to do this. Alternatively, if you are using a Series 4000 receiver, you may want to start the base station directly from the receiver's front panel. If you choose the latter option, refer to your Series 4000 documentation for details.

To start the base station using the Asset Surveyor software:

1.   Start the Asset Surveyor software.

2.   Select *Data collection* / *Create base file.*

3.   The *Antenna options* form appears. Enter the antenna height, antenna type, and measurement method. If you are using a compact L1/L2 antenna with a ground plane, the antenna type is 'Compact L1/L2 w/GP'. Press ⏎ when you are done.

     Note – Enter an accurate antenna height for the base station. If the height is inaccurate, RTK data collected with reference to the base station may be erroneous, especially in terms of the vertical coordinate. For more information on measuring antenna heights, see Antennas, page 204.

4.   The *Reference position* form appears. Enter the position of the known point manually, or select a waypoint that is at the correct position. Press ⏎ when you are finished.

     The *Real-time base station* status form appears, indicating that RTK corrections are now being generated by the receiver and broadcast over the radio-modem link. As a check, you may hear a regular signal being broadcast from the radio, or a light may flash to indicate that signals are being broadcast.

5.   Detach the TSC1 cable from the back of the base receiver.

Setting up a Rover with the Asset Surveyor Software

This section describes how to set up a rover unit and start it running using the Asset Surveyor software.

To set up a roving receiver for RTK data collection, using a Trimble Series 4000 or 4400 receiver:

1. Use a backpack to carry the GPS receiver and the radio, and mount the GPS antenna on the range pole.

2. Connect the GPS antenna to the GPS receiver port labelled ANTENNA. Use the N-type to lemo cable (P/N 14553-00) as shown in Figure 8.6.

3. Assemble the radio antenna and fix it to the outside of the backpack. Connect the radio antenna to the radio using the cable attached to the antenna.

4. Connect the radio to the GPS receiver port labeled I/O 2. Use the appropriate cable, for a Trimble radio, this is the 7-pin lemo to 5-pin lemo cable.

5. Connect the power source to the GPS receiver port labeled PWR 2&3.

6. If you are using a third-party radio solution, make sure that the radio is connected to a power source.

7. Connect the TSC1 datalogger to the GPS receiver port labeled PWR-I/O 1. Use the 7-pin lemo to 5-pin lemo cable (P/N 32901).

To set up a roving receiver for RTK data collection, using a Trimble GPS Total Station 4700:

1. Use a backpack to carry the GPS receiver and the radio, and mount the GPS antenna on the range pole.

2. Connect the GPS antenna to the GPS receiver port labelled ANTENNA. Use the N-type to lemo cable (P/N 14553-00) as shown in Figure 8.6.

3. Assemble the radio antenna and fix it to the outside of the backpack. Connect the radio antenna to the radio using the cable attached to the antenna.

4. If you are using an external power source (that is, source other than the lithium ion PowerLiTE battery) connect this source to Port 2 on the 4700 unit.

5. If you are using a third-party radio solution, make sure that the radio is connected to a power source and use the appropriate cable to connect the radio to Port 3 on the 4700 unit.

6. Connect the TSC1 datalogger to Port 1 on the 4700 unit using the 7-pin lemo to 7-pin lemo cable (P/N 31288).

To set up a roving receiver for RTK data collection, using a Trimble GPS Total Station 4800:

1. If you are using an external power source (that is, source other than the lithium ion PowerLiTE battery) connect this source to Port 2 on the 4800 unit.

2. If you are using a third-party radio solution, make sure that the radio is connected to a power source and use the appropriate cable to connect the radio to Port 3 on the 4800 unit.

3. Connect the TSC1 datalogger to Port 1 on the 4800 unit using the 7-pin lemo to 7-pin lemo cable (P/N 31288).

In the Field

Once you have prepared and configured your equipment, you can go into the field to collect RTK data.

Starting the Rover

When you have assembled the rover, it must be started in order to commence data collection. Only start the rover once the base station has been started. Make sure that you have a clear view of the sky in order to successfully initialize for RTK. Trimble recommends that you move around in order to minimize the effects of multipath.

To start the rover:

1.   Start the Asset Surveyor software.

2.   Select *Configuration* / *GPS rover options* / *Real-time input options*.

    The *Real-time input* form appears:

```
┌─────────────────────────────────────┐
│          Real-time input             │
│ Preferred correction source          │
│   Choice 1:        ⊙External source  │
│   Choice 2:        ⊙Integrated beacon│
│   Choice 3:    ⊙Use uncorrected GPS  │
│ General real-time settings           │
│   RTCM age limit:            ⊙50s    │
│                                      │
│                                      │
│                                      │
│  ─────────────────────────────────   │
│                                      │
│ ┌──────┐                             │
│ │ Setup│                             │
│ └──────┘                             │
└─────────────────────────────────────┘
```

3.   In the *Choice 1* field, select 'External source'.

4.   Make sure the *Choice 1* field is highlighted and press ⸢Setup⸣.

The *External source* form appears:

```
┌─────────────────────────────────┐
│        External source          │
│ Radio type:          ⊙Custom    │
│ Correction type:       ⊙RTK     │
│ RTK options                     │
│   RTK record type:     ⊙CMR     │
│ Baud rate:            ⊙9600     │
│                                 │
│                                 │
│                                 │
│ ───────────────────────────     │
│                                 │
│ ┌──────┐                        │
│ │ Port │                        │
│ └──────┘                        │
└─────────────────────────────────┘
```

5. In the *Radio type* field, select the type of radio you are using.

    If the type of radio you are using does not appear in the list, select 'Custom' in the *Radio type* field and set the other radio settings as appropriate.

    Note – If you are using a 4800 unit, select the '4800 (Internal)' option in the Radio type field. The Frequency field will then be made available (instead of the four serial parameter fields), enabling you to specify the frequency you would like the 4800 unit's internal radio to operate at.

6. In the *Correction type* field, select 'RTK'.

7. In the *RTK record type* field, select the type of correction record that is being broadcast for the base station. By default, 'CMR' is selected. For more information, see RTK Correction Messages, page 190.

8. In the *Baud rate* field, select the baud rate you want the receiver and radio to communicate at.

9. Press ⌐Port⌐ to open the *General port settings* form, where you can configure the data bits, stop bits, and parity settings.

Note – These port settings also apply when transmitting NMEA or TSIP messages. When you change general port settings for one of these options, you also change the settings for the other option.

10. Press ⌧ when you are finished.

    The roving receiver begins to perform an on-the-fly (OTF) initialization. The OTF initialization procedures are indicated in the status line. When the status line reads RTK=Fixed (or RTK=Float, if this meets your precision requirements), you can start to collect RTK data. For more information on fixed and float solutions, see Table 8.4.

11. Create a new data file, associating the correct data dictionary with it. Alternatively, reopen an existing data file.

12. Begin collecting data. Collect all the features and associated attributes.

13. Close the data file, and exit the Asset Surveyor software.

RTK Status in the Asset Surveyor Software

The status of RTK initialization is displayed in the status bar of the Asset Surveyor software:
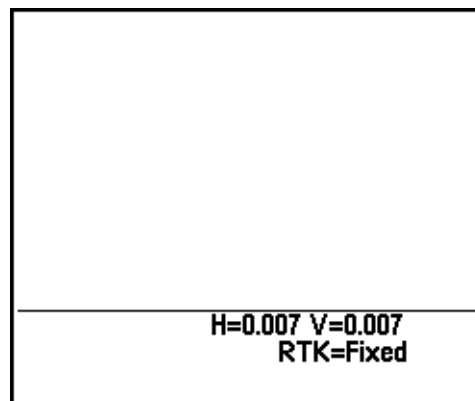
The status bar has two parts in which RTK status information is displayed. The bottom part of the status bar indicates the current mode of operation along with messages explaining the status of initialization. The mode of operation indicates the state of the current RTK position being sent from the GPS receiver.

Table 8.4 lists the RTK status modes.

Table 8.4   RTK status modes in Asset Surveyor

Mode message	Description
Float	The receiver is computing Float solutions. Solutions are precise to better than plus or minus a meter.
Fixed	The receiver is computing Fixed solutions. Solutions are precise to between 2 and 5 cm, depending on whether you are in roving or static mode.

The top part of the status bar displays precision estimates indicating the horizontal and vertical precision of the current position as computed at the phase center of the antenna. The values displayed here provide a level of quality assurance, which, when monitored closely, offers information related to the appropriateness for RTK data collection within the current environment.

For example, as the precision values rise, it is likely that environmental or satellite conditions are not as ideal for data collection as when they are low. Use the precision estimate values to help make judgments with respect to the reliability of a position for collection.

Recording Less Accurate Positions if the RTK Radio Link Fails

At some stage the radio link between your base station and rover may fail, either because the batteries of the base station receiver or radio are flat, or due to some interference in the signal. By default, no positions are logged until the radio link is re-established.

However, if necessary, you can configure the rover to switch to collecting less accurate positions (the same type of positions that you would collect using a non-RTK receiver such as the GPS Pathfinder Pro XR).

To let your roving receiver record positions when the radio link fails, in the *Real-time input* form set the *Choice 2* field to 'Use uncorrected GPS'.

Note – RTK precision settings do not apply when Apply real-time is set to 'Auto'.

Recording Non-RTK Data Files

If you do not have access to an RTK base station, or do not want to collect RTK quality positions, you can still collect data files using an RTK receiver. The types of positions that you collect are the same as if you were using a non-RTK receiver such as the Pro XR.

If your roving receiver has the RTCM option installed, you can record real-time differentially corrected positions as long as you have a radio link to an RTCM base station. If not, you can collect uncorrected (autonomous) positions and differentially correct them in the GPS Pathfinder Office software to obtain positions with submeter accuracy.

To collect real-time, differentially corrected positions, set the *Choice 1* field in the *Real-time input* form to 'External source' and set the *Correction type* field in the *External source* form to 'RTCM'.

Note – The Trimble 4400, 4700, and 4800 receivers always send the best available positions (that is, RTK positions will be sent if available.)

Using RTK and Non-RTK Rovers with the Same Base Station

You may have several field crews collecting data at the same time. Even if not all of them are using RTK receivers, they can all use the same base station. To do this you need to configure the base station to transmit RTCM 2.1 messages instead of CMR messages. Note that you must have the RTCM option installed on your base receiver in order to do this.

To allow the base station to service both RTK and non-RTK rovers, open the *RTK protocol* form (press the ⌐RTK⌐ softkey in the *Real-time output options* form) and set the *RTK record type* field to 'RTCM 2.1'.

Note – If you are using one or more Series 4000 receivers as rovers, the RTK record type setting of the rovers must match the base setting. Follow the above instructions for each rover using a 4000 receiver.

Back in the Office

For information on how to transfer your data from the datalogger to your office PC, see Transferring Data from the Datalogger, page 142.

Once you have transferred your data, you can view, query, and export your data using the GPS Pathfinder Office software. This section explains how to identify RTK positions, display precision estimates, and export your RTK data.

RTK Positions in the GPS Pathfinder Office Software

An individual position can be queried in the GPS Pathfinder Office software using the *Position Properties* dialog:
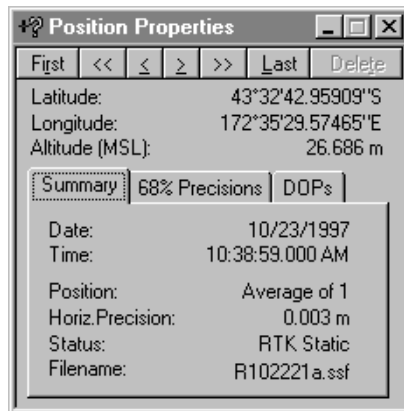
For more information on using this dialog, refer to the GPS Pathfinder Office Help.

The *Position Properties* dialog displays the position status of each position in the *Summary* tab. For an RTK position the status is either RTK Fixed or RTK Float, depending on the solution type achieved.

If you need to confirm that your positions meet your requirements, review each position in the *Position Properties* dialog. This dialog also displays the precision values for each position in the *Positions* tab. The precision is 68%, 95%, or 99%, depending on your preferred setting.

For more information on interpreting and configuring precision estimate data, refer to the GPS Pathfinder Office Help.

Exporting RTK Data

The Export utility of the GPS Pathfinder Office software provides tools for filtering the data exported, based on the quality of the positions, and for exporting the precision estimate values for each feature.

Including RTK positions for export

To include all RTK positions within the data set to be exported, select the check box associated with *RTK Float* and *RTK Fixed* in the *Filter by GPS Position Info* box. If, for example, you only want RTK positions to be exported, then ensure all check boxes are cleared except for the *RTK Float* and *RTK Fixed* check boxes. Select only *RTK Fixed* if you want only the most precise RTK positions. Positions derived using an *RTK Float* solution are less precise than those derived using an *RTK Fixed* solution. For more information on Fixed and Float solutions, see Code and phase measurements, page 189.

Filtering by RTK precision

Because RTK positions can have precision estimates associated with them, you can filter your RTK data set by identifying precision tolerances within which the precision of a position must fall before it will be exported. To enable filtering based on the RTK precision values, select the *Filter by RTK Precision (68% confidence)* option on the *Position Filter Criteria* dialog.

Note – Select Options / Units (in the GPS Pathfinder Office main program) to change the confidence level from the default 68%.

Precision estimates associated with RTK positions are displayed using the confidence level set in the *Units* dialog of the GPS Pathfinder Office main program (here 99%). The data can be filtered based on a combination of the horizontal and vertical precision components of a position.

⎯☼⎯   **Tip –** Use *Filter by RTK Precision* in conjunction with RTK data collected that had *Apply real-time* (*Corrections*) set to 'Auto'. This type of data is unable to utilize the RTK precision tolerance settings in the Asset Surveyor software. The *Filter by RTK Precision* is therefore able to provide the same functionality as having *Apply Real-time* set to 'Yes'.

The default values for *Horizontal Precision* and *Vertical Precision* are set to 'Any'. This means that all RTK data will be exported. Data that has been collected which is not RTK data is not exported if *Filter by RTK Precision* is selected.

Exporting RTK Precision Estimates

RTK precision estimates can be exported as attributes for features, provided that QA/QC data was logged during data collection.

You can choose to export both horizontal and vertical precision estimates for point features, and both an average and a worst horizontal and vertical precision estimate for line and area features. For more information on how these attributes are exported, refer to the Export utility Help.

To export RTK precision estimates as attributes:

1. Start the Export utility of the GPS Pathfinder Office software.

2. Select the Export Setup that you want to use for exporting of data, and click **Change Setup Options**.

3. Select the *Attributes* tab in the *Export Setup* dialog.

4. Select the appropriate precision check boxes for point, line, and area features. RTK precisions are exported for all selected features.

Pro XRS System

In this chapter:

- Introduction
- Turning the receiver on
- Turning the receiver off
- Configuring the receiver to work with the Asset Surveyor software
- Operational aspects specific to the GPS Pathfinder Pro XRS
- Cabling diagram
- Equipment list
- Activating satellite differential (DGPS) service

Introduction

The GPS Pathfinder Pro XRS system is an advanced high-performance geographic data-acquisition tool that uses differential GPS to provide submeter (50 cm RMS) positional accuracy on a second-by-second basis. The Pro XRS GPS receiver is available with 12 channels. The Pro XRS receiver uses Trimble's The Choice technology, offering users unsurpassed flexibility in choosing a source for real-time corrections. This breakthrough technology combines a GPS receiver, an MSK beacon differential receiver, and a satellite differential receiver all in a single housing. The beacon component is a fully-automatic dual channel MSK radiobeacon receiver for receiving DGPS (Differential GPS) broadcasts conforming to the IALA (International Association of Lighthouse Authorities) standard.

Turning the Receiver On

When the receiver and TSC1 datalogger are connected as shown in the cabling diagram later in this section, you do not need to explicitly turn on the GPS Pathfinder Pro XRS receiver. When the TSC1 datalogger is turned on, the Asset Surveyor software immediately turns on the Pro XRS receiver and starts communicating with it.

Note – The TSC1 datalogger draws power from the receiver's battery when the receiver is turned on.

Turning the Receiver Off

When you turn off the TSC1 datalogger or explicitly disconnect the GPS receiver, the Pro XRS receiver is automatically turned off. It ceases drawing current from the system battery when turned off.

Configuring the Receiver to Work with the Asset Surveyor Software

No special configuration of the Pro XRS receiver is required to get the Asset Surveyor software and Pro XRS receiver to communicate, beyond the usual *GPS rover options* that you need to configure in the Asset Surveyor software. The following section describes the settings required to obtain submeter accuracy from your Pro XRS receiver.

Operational Aspects Specific to the GPS Pathfinder Pro XRS

The following sections outline the operational aspects specific to the GPS Pathfinder Pro XRS system.

< 50 cm Accuracy

To achieve postprocessed accuracy with the Pro XRS receiver of better than 50 cm (RMS) +1 ppm times the distance between the base station and the rover, you must have the appropriate EVEREST firmware installed on the receiver, and use the following *Position filters* configuration settings in the Asset Surveyor software. Table A.1 lists the recommended settings.

Table A.1   Recommended settings

Setting	Recommended value
Position mode	Overdet. 3D or Manual 3D
PDOP mask	6.0 or less
SNR mask	6 or more
Elevation mask	15 degrees or more

You must also be using a base station which is logging or transmitting (in RTCM messages) synchronized measurements, and which is equipped with an EVEREST capable Pro XR, Pro XRS, 4600LS, Site Surveyor 4400, GPS Total Station 4700, GPS Total Station 4800 or Series 4000 GPS receiver. Your roving receivers must be within 500 km of your base station.

Note – Using receivers without the appropriate EVEREST firmware installed results in a degradation in accuracy.

RTCM Input

The Pro XRS receiver supports RTCM Version 2 input. Connect your RTCM link directly to the cable labeled 'RTCM'.

The Pro XRS receiver with integrated Beacon/GPS antenna receives and demodulates MSK DGPS radiobeacon signals from radiobeacon transmission stations (for example, USCG). No special configuration is required to receive these signals.

The Pro XRS receiver extends the use of real-time differential corrections to many areas where other sources of real-time differential corrections (for example, radiobeacons) are currently unavailable. The satellite differential receiver requires a subscription to a differential service and provides multiple vendor support.

A built-in virtual reference station (VRS) permits the satellite corrections to be uniformly associated with the increasing distance from the fixed reference stations. For more information on the Pro XRS GPS receiver, refer to the *Pro XR/XRS Receiver Operation Manual*.

RTCM Output

The Pro XRS receiver supports RTCM output as a receiver firmware option. The Asset Surveyor software can configure and control a real-time base station provided the receiver is a Pro XL, Pro XR, Pro XRS, Series 4000, Site Surveyor 4400, GPS Total Station 4700, or GPS Total Station 4800 and has the appropriate firmware option installed.

The Pro XRS receiver can be operated as an Unattended Real-time Base Station without a datalogger if you have the appropriate cable. The Unattended Real-time Base Station power cable (P/N 32247) supplies power to the Pro XRS receiver on Port B so that you may remove the datalogger when using the Pro XRS receiver as an Unattended Real-Time Base Station. Contact your local Trimble sales office to order this accessory.

If you require the data for postprocessed differential correction, you must have the TSC1 datalogger connected to the Pro XRS base station at all times.

If you are using a Trimtalk™ 450, 450S, or 900, a Trimmark™ I or II, or a new Pacific Crest RFM96W with the Pro XRS receiver you must purchase the RTCM OUT cable (P/N 32871) which connects to the Pro XRS receiver on Port A, replacing the NMEA/RTCM cable (P/N 30232-00). If you are using an old Pacific Crest RFM96W with the Pro XRS receiver you must purchase the RTCM OUT cable (P/N 33346). The RTCM OUT cable has a Lemo connector on the other end for connection to the radios listed above.

Note – A Lemo adapter cable, supplied by Pacific Crest, is required to connect the RTCM OUT cable (P/N 32871) to the RFM96W radio.

If you are using a non-Trimble radio with the Pro XRS receiver, you must have your own cable to connect from your radio to the supplied NMEA/RTCM cable in Port A.

Overdetermined Positions

The Pro XRS receiver supports the computation of overdetermined GPS positions.

Carrier Phase Mode

The Pro XRS receiver can be operated in carrier phase mode. You enable carrier phase mode from *GPS rover options / Logging options*.

If you are using the integrated GPS/Beacon/Satellite antenna (P/N 33580-50), then 'Integrated GPS/Beacon/Sat DGPS' must be selected from the *Type* field menu in the *Antenna options* form. If you are using a compact dome antenna, then 'Compact Dome' must be selected.

Alternatively, you can enter the part number straight off the antenna itself (that is, for the 'Integrated GPS/Beacon/Sat DGPS', you would select P/N 33580-50, or for the Compact Dome, you would select P/N 16741- 00).

PPRT Positions (Postprocessed Real-Time)

The Pro XRS receiver can be configured to collect PPRT positions, enabling the user to differentially correct real-time collected data.

Receiver Outputs

The Pro XRS receiver supports TSIP and NMEA output. It also supports (without any need for configuration of the Asset Surveyor software) 1 PPS output.

Cabling Diagram

In order to use the Asset Surveyor software with a GPS Pathfinder Pro XRS receiver, connect up the system as shown in Figure A-1.

1	P/N 33580-50	Integrated GPS/Beacon/Satellite antenna
2	P/N 22628	Antenna cable
3	P/N 33302-50	12-channel Pro XRS receiver
4	P/N 17466	Camcorder batteries
5	P/N 30232-00	NMEA/RTCM cable
6	P/N 30231-00	Data/Power cable
7	P/N 24333	Dual Battery cable
8	P/N 32287-00	TSC1 data cable
9	TSC1 datalogger	
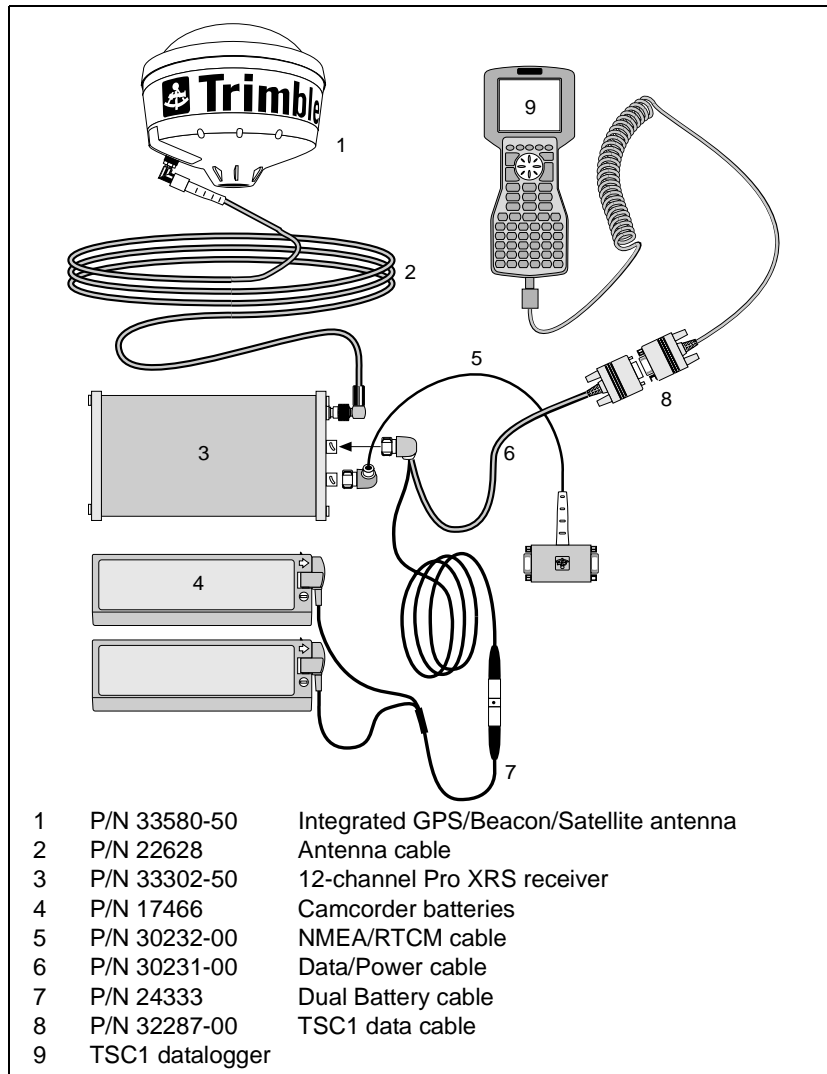
Figure A.1   Cabling for the GPS Pathfinder Pro XRS receiver

Equipment List

Table A.2 lists the equipment that can be used when operating a GPS Pathfinder Pro XRS receiver in conjunction with the Asset Surveyor software running on your TSC1 datalogger.

Table A.2   Full equipment list

Part name	Part number
Backpack Assembly for Pro XRS System with TSC1	31446-27
Integrated GPS/Beacon/Satellite antenna	33580-50
3 x 1/16" antenna spacing plate	18375
1 foot range pole (x3)	31165
6 inch range pole	31166
GPS Pathfinder pouch belt for accessories	13274
Pro XRS hard travel case	31789-00
RTCM output cable	32871
Unattended real-time base station power cable	32247
External sensor cable	14284

Activating Satellite Differential (DGPS) Service

The following sections provides step-by-step instructions on activating the satellite DGPS component of your Pro XRS GPS receiver.

Activating the OmniSTAR Satellite DGPS Service

To activate the OmniSTAR satellite differential service, perform the following steps:

Step 1 – Prepare the Pro XRS GPS receiver

1. Connect Asset Surveyor to the Pro XRS receiver.

2. Open the *Receiver status* form from the *Main menu*. Write down the *OmniSTAR ID* as displayed.

Step 2 – Call OmniSTAR

Tell OmniSTAR:

1. Your location (for example, Sunnyvale, California, USA).

2. The OmniSTAR ID you copied from the *OmniSTAR ID* field in the *Receiver status* form.

OmniSTAR will:

3. Tell you the OmniSTAR satellite and frequency for your local area.

4. Give you a 24-digit activation code, or advise you that on-air activation will be implemented.

   *Note – For on-air activation to be successful you must configure the Asset Surveyor software for OmniSTAR activation and be receiving the appropriate OmniSTAR satellite signal, as described below in Step 3, **before** OmniSTAR initiates the activation.*

5. Place you on an activation verification list.

Note – Phone numbers and further details on how to access the Fugro-OmniSTAR service are contained in the OmniSTAR booklet that accompanies this product.

Step 3 – Configure the Pro XRS GPS receiver

1. Connect Asset Surveyor to the Pro XRS receiver and begin tracking GPS satellites with a clear view of the sky.

2. Open the *Real-time input* form (select *Configuration/GPS rover options/Real-time input*).

3. Set one of the *Choice* fields to 'Integrated satellite'.

4. With this *Choice* field highlighted, press ⎡Setup⎤ to open the *Integrated satellite* form, where you can configure this real-time source.

5. Set the *Service provider* field to 'OmniSTAR'.

6. Enter the satellite you want to receive corrections from in the *Satellite* field. The *Frequency* and *Data rate* fields are automatically set once the *Satellite* field has been configured.

7. Press ⎡Enter⎤.

8. The message Do you have a 24-digit code to enter? appears. Do one of the following:

   – if OmniSTAR has supplied you with a 24-digit activation code, press the ⎡Yes⎤ softkey, and then proceed to step 8

   – to enter the selected configuration and start the on-air activation process, press the ⎡No⎤ softkey

9. Enter the 24-digit code you received from OmniSTAR into the *Activation code entry* form and press ⎡Enter⎤ to start the activation process.

⚠ **Warning –** Make sure that the 24-digit code is typed correctly. Typographic errors will prevent successful activation.

Step 4 – Wait 45 minutes

Wait up to 45 minutes for the activation process to complete.

Note – If the activation process does not complete within 45 minutes, call Fugro-OmniSTAR and report your problem.

Note – The 45 minute wait period is for activation only. Once activated, OmniSTAR corrections begin less than 15 seconds after configuring the Pro XRS receiver to receive them.

Activating the Racal-LandStar Satellite DGPS Service

To activate the Racal-LandStar satellite differential service, perform the following steps:

Step 1 – Prepare the Pro XRS GPS receiver

1. Connect Asset Surveyor to the Pro XRS receiver and begin tracking GPS satellites with a clear view of the sky.

2. Open the *Receiver status* form from the *Main menu*. Write down the *LandStar ID* as displayed.

Step 2 – Call Racal-LandStar

Tell Racal-LandStar:

1. Your location (for example, Sunnyvale, California, USA).

2. The LandStar ID you copied from the *LandStar ID* field in *Receiver status*.

Racal-LandStar will:

3. Tell you the LandStar satellite and frequency for your local area.

4. Place you on an activation verification list.

Note – Phone numbers and further details on how to access the Racal-LandStar service are contained in the LandStar booklet that accompanies this product.

Step 3 – Configure the Pro XRS GPS receiver

1. Open the *Real-time input* form (select *Configuration/GPS rover options/Real-time input*).

2. Set one of the *Choice* fields to 'Integrated satellite'.

3. With this *Choice* field highlighted, press ⌈Setup⌉ to open the *Integrated satellite* form, where you can configure this real-time source.

4. Set the *Service Provider* field to 'LandStar'.

5. Enter the satellite you want to receive corrections from in the *Satellite* field. The *Frequency* field is automatically set once the *Satellite* field is configured.

6. Set the *Station preference* field to 'Virtual' or 'Closest', depending on your requirements.

7. Press ⌐Enter⌐ to start the activation process.

Step 4 – Wait 45 minutes

Wait up to 45 minutes for the activation process to complete.

Note – If the activation process is not completed within 45 minutes, call Racal-LandStar and report your problem.

Note – The 45 minute wait period is for activation only. Once activated, Racal-LandStar corrections begin less than 15 seconds after configuring the Pro XRS receiver to receive them.

Pro XR System

In this chapter:

■ Introduction

■ Turning the receiver on

■ Turning the receiver off

■ Configuring the receiver to work with the Asset Surveyor software

■ Operational aspects specific to the GPS Pathfinder Pro XR

■ Cabling diagram

■ Equipment list

Introduction

The GPS Pathfinder Pro XR system is an advanced high-performance geographic data-acquisition tool that uses differential GPS to provide submeter (50 cm RMS) positional accuracy on a second-by-second basis. The Pro XR GPS receiver is available with either 8 or 12 channels. The Pro XR receiver has a fully-automatic dual channel MSK radiobeacon receiver for receiving DGPS (Differential GPS) broadcasts conforming to the IALA (International Association of Lighthouse Authorities) standard.

Turning the Receiver On

When the Pro XR receiver and TSC1 datalogger are connected as shown in the cabling diagram later in this section, there is no need to explicitly turn on the GPS Pathfinder Pro XR receiver; when the TSC1 datalogger is turned on the Asset Surveyor software immediately turns on the Pro XR and starts communicating with it.

Note – The TSC1 datalogger draws power from the receiver's battery when the receiver is turned on.

Turning the Receiver Off

When you turn off the TSC1 datalogger or explicitly disconnect the GPS receiver, the Pro XR receiver is automatically turned off. It ceases drawing current from the system battery when turned off.

Configuring the Receiver to Work with the Asset Surveyor Software

No special configuration of the Pro XR receiver is required to get the Asset Surveyor software and Pro XR to communicate, beyond the usual *GPS rover options* that you need to configure in the Asset Surveyor software. The following section describes the settings required to obtain submeter accuracy from your Pro XR receiver.

Operational Aspects Specific to the GPS Pathfinder Pro XR

The following sections outline the operational aspects specific to the GPS Pathfinder Pro XR system.

<50 cm Accuracy

To achieve accuracy with the receiver of better than 50 cm (RMS) +1ppm times the distance between the base station and the rover, you must have the appropriate EVEREST firmware installed on the receiver, and use the following *GPS rover options* configuration settings in the Asset Surveyor software. Table B.1 lists the recommended settings.

Table B.1   Recommended settings

Setting	Recommended value
Position mode	Overdet. 3D or Manual 3D
PDOP mask	6.0 or less
SNR mask	6 or more
Elevation mask	15 degrees or more

You must also be using a base station which is logging or transmitting (in RTCM messages) synchronized measurements, and which is equipped with an EVEREST capable Pro XR, Pro XRS, 4600LS, Site Surveyor 4400, GPS Total Station 4700, GPS Total Station 4800 or Series 4000 GPS receiver. Your roving receivers must be within 500 km of your base station.

Note – Using receivers without the appropriate EVEREST firmware installed results in a degradation in accuracy.

RTCM Input

The Pro XR receiver supports RTCM Version 2 input. Connect your RTCM link directly to the cable labeled 'RTCM'.

The Pro XR receiver with integrated Beacon/GPS antenna receives and demodulates MSK DGPS radiobeacon signals from radiobeacon transmission stations (for example, USCG). No special configuration is required to receive these signals.

RTCM Output

The Pro XR receiver supports RTCM output as a receiver firmware option. The Asset Surveyor software can configure and control a real-time base station provided the receiver is a Pro XL, Pro XR, Pro XRS, Series 4000, Site Surveyor 4400, GPS Total Station 4700 or GPS Total Station 4800 and has the appropriate firmware option installed.

The Pro XR receiver can be operated as an Unattended Real-Time Base Station without a datalogger if you have the appropriate cable. The Unattended Real-Time Base Station power cable (P/N 32247) supplies power to the Pro XR receiver on Port B so that you may remove the datalogger when using the Pro XR as an Unattended Real-Time Base Station. Contact your local Trimble sales office to order this accessory.

If you require the data for postprocessed differential correction, you must have the TSC1 datalogger connected to the Pro XR base station at all times.

If you are using a TRIMTALK™ 450, 450S, or 900, a TRIMMARK™ I or II, or a Pacific Crest RFM96W with the Pro XR you must purchase the RTCM OUT cable (P/N 32871) which connects to the Pro XR on Port A, replacing the NMEA/RTCM cable (P/N 30232-00). The RTCM OUT cable has a Lemo connector on the other end for connection to the radios listed above.

Note – A Lemo adapter cable, supplied by Pacific Crest, is required to connect the RTCM OUT cable (P/N 32871) to the RFM96W radio.

If you are using a non-Trimble radio with the Pro XR, you must have your own cable to connect from your radio to the supplied NMEA/RTCM cable in Port A.

Carrier Phase Mode

The Pro XR receiver can be operated in carrier phase mode. You enable carrier phase mode from *GPS rover options / Logging options.*

If you are using the integrated GPS/Beacon antenna (P/N 29653-00), then 'Integrated GPS/Beacon' must be selected from the *Type* field menu in the *Antenna options* form. If you are using a compact dome antenna, then 'Compact Dome' must be selected.

Alternatively, you can enter the part number straight off the antenna itself (that is, for the Integrated GPS/Beacon antenna, you would select P/N 29653-00, or for the Compact Dome, you would select P/N 16741-00).

Overdetermined Positions

The Pro XR receiver supports the computation of overdetermined GPS positions.

PPRT Positions (Postprocessed Real-Time)

The Pro XR receiver can be configured to collect PPRT positions, enabling you to differentially correct real-time collected data.

Receiver Outputs

The Pro XR receiver supports TSIP and (in firmware version 2.07 and later) NMEA output. It also supports (without any need for configuration of the Asset Surveyor software) 1 PPS output.

Cabling Diagram

In order to use the Asset Surveyor software with a GPS Pathfinder
Pro XR receiver, connect the system as shown in Figure B.1.

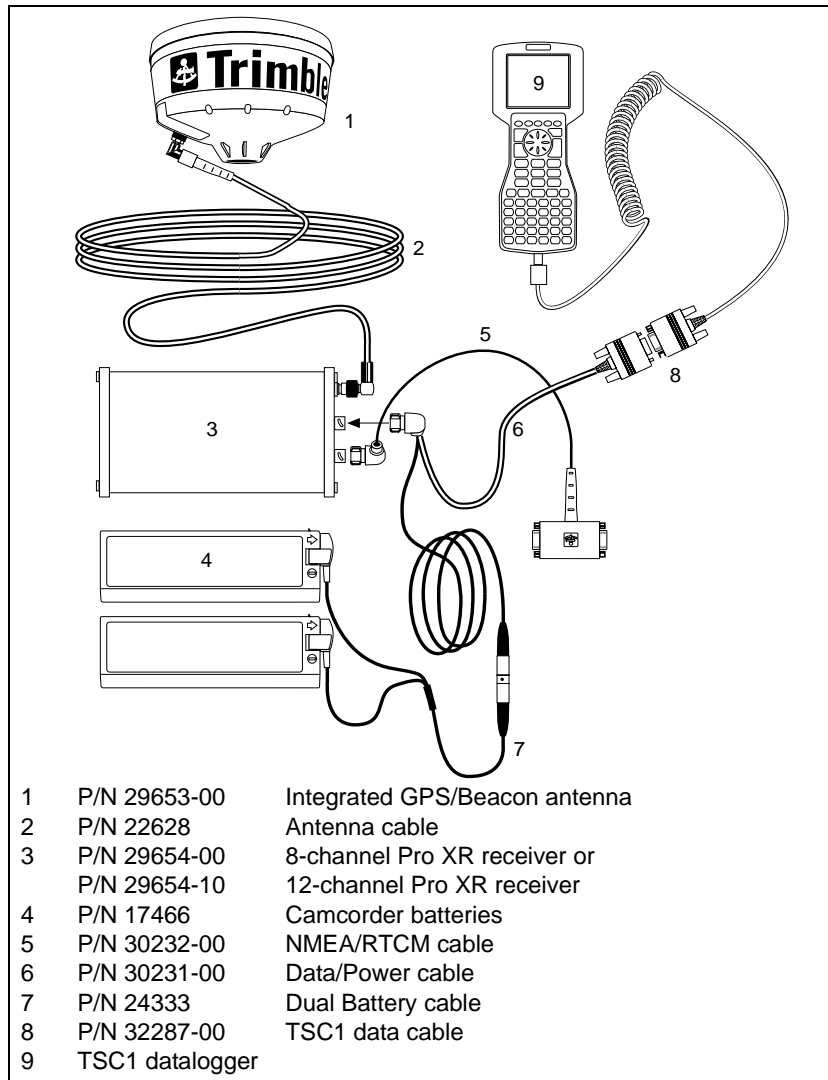| 1	P/N 29653-00	Integrated GPS/Beacon antenna
2	P/N 22628	Antenna cable
3	P/N 29654-00	8-channel Pro XR receiver or
	P/N 29654-10	12-channel Pro XR receiver
4	P/N 17466	Camcorder batteries
5	P/N 30232-00	NMEA/RTCM cable
6	P/N 30231-00	Data/Power cable
7	P/N 24333	Dual Battery cable
8	P/N 32287-00	TSC1 data cable
9	TSC1 datalogger	

Figure B.1   Cabling for the GPS Pathfinder Pro XR receiver

Equipment List

Table B.2 lists the equipment that you can use in the field when operating a GPS Pathfinder Pro XR receiver in conjunction with the Asset Surveyor software running on your TSC1 datalogger.

Table B.2   Equipment list

Part name	Part number
Backpack Assembly for Pro XR System with TSC1	31446-27
Integrated GPS/MSK Beacon antenna	29653-00
3 x 1/16" antenna spacing plate	18375
1 foot range pole (x3)	31165
6 inch range pole	31166
GPS Pathfinder pouch belt for accessories	13274
Pro XR hard travel case	13000-50
RTCM output cable	32871
Unattended real-time base station power cable	32247
External sensor cable	14284

Pro XL System

In this chapter:

- ■ Introduction
- ■ Turning the receiver on
- ■ Turning the receiver off
- ■ Configuring the receiver to work with the Asset Surveyor software
- ■ Operational aspects specific to the GPS Pathfinder Pro XL
- ■ Cabling diagram
- ■ Equipment list

Introduction

The GPS Pathfinder Pro XL™ system is based around a high-performance GPS receiver employing Trimble's Maxwell Technology. The Pro XL GPS receivers have either 8 or 12 channels, and provide differentially corrected C/A code positions accurate to better than one meter on a second-by-second basis.

Turning the Receiver On

When the receiver and TSC1 datalogger are connected as shown in the cabling diagram later in this section, there is no need to explicitly turn on the GPS Pathfinder Pro XL receiver; when the TSC1 datalogger is turned on the Asset Surveyor software immediately turns on the Pro XL and starts communicating with it.

Note – The TSC1 datalogger draws power from the receiver's battery when the receiver is turned on.

Turning the Receiver Off

When you turn off the TSC1 datalogger, or explicitly disconnect the GPS receiver, the Pro XL receiver is automatically turned off. It ceases drawing current from the system battery when turned off.

Configuring the Receiver to Work with the Asset Surveyor Software

No special configuration of the Pro XL receiver is required to get the Asset Surveyor software and Pro XL receiver to communicate beyond the usual *GPS rover options* that you need to configure in the Asset Surveyor software. The following section describes the settings required to obtain submeter accuracy from your Pro XL receiver.

Operational Aspects Specific to the GPS Pathfinder Pro XL

The following sections outline the operational aspects specific to the GPS Pathfinder Pro XL system.

Submeter Accuracy

To achieve accuracy with the Pro XL receiver of better than 1 meter (RMS) +2 ppm times the distance between the base station and the rover, you must use the following *GPS rover options* configuration settings in the Asset Surveyor software.

You must also be using a base station which is logging or transmitting (in RTCM messages) synchronized measurements, and which is equipped with a Pro XL, Pro XR, Pro XRS, 4600LS, Site Surveyor 4400, GPS Total Station 4700, GPS Total Station 4800 or Series 4000 GPS receiver. Your roving receivers must be within 200 km of your base station. Table C.1 lists the recommended settings.

Table C.1   Recommended settings

Setting	Recommended value
Position mode	Overdet. 3D or Manual 3D
PDOP mask	4.0 or less
SNR mask	6 or more
Elevation mask	15 degrees or more

RTCM Input

The Pro XL receiver supports the RTCM input. Both RTCM version 1 and RTCM version 2 are supported. Connect your RTCM link directly to the cable labeled 'RTCM'.

RTCM Output

The Pro XL receiver supports RTCM output as a non-standard receiver firmware option. The Asset Surveyor software can configure and control a real-time base station, provided the receiver is a Pro XL, Pro XR, Pro XRS, Series 4000, Site Surveyor 4400, GPS Total Station 4700 or GPS Total Station 4800 and has the appropriate firmware option installed. Connect your RTCM output link directly to the cable labeled 'RTCM'.

Overdetermined Positions

The Pro XL receiver supports the computation of overdetermined GPS positions.

Carrier Phase Mode

The Pro XL receiver can be operated in carrier phase mode. You enable carrier phase mode from *GPS rover options / Logging options*.

Receiver Outputs

The Pro XL receiver supports TSIP and (in firmware version 2.07 and later) NMEA output. It also supports (without any need for configuration of the Asset Surveyor software) 1 PPS output.

Cabling Diagram

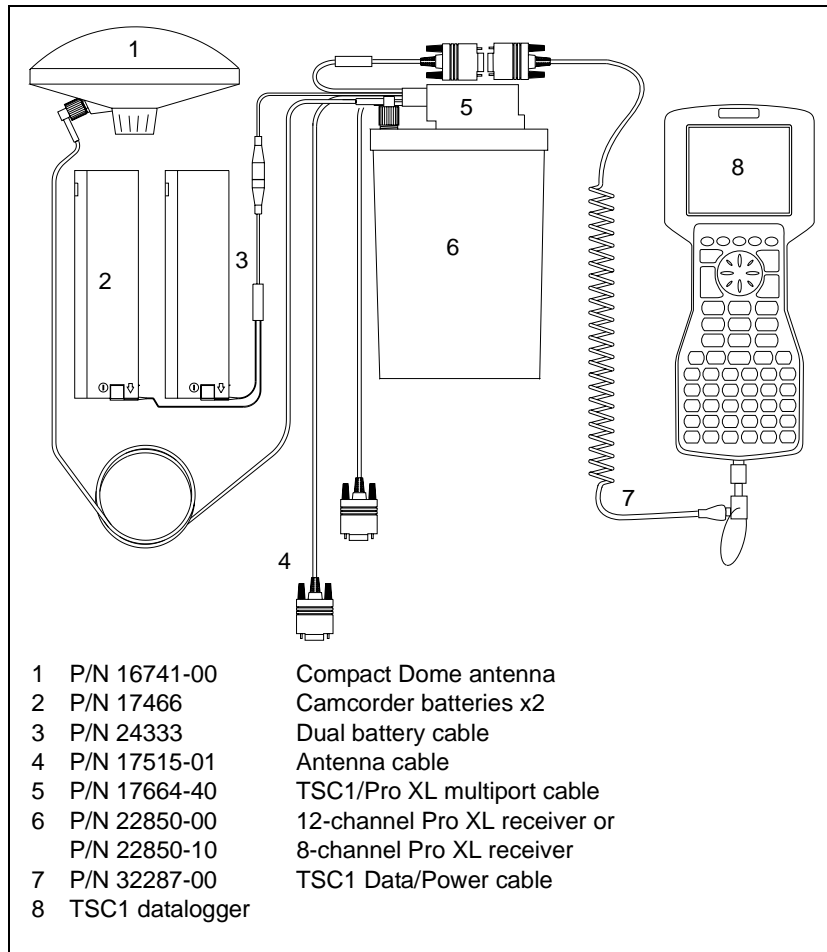To use the Asset Surveyor software with a GPS Pathfinder Pro XL receiver, connect the system as shown in Figure C.1.

1	P/N 16741-00	Compact Dome antenna
2	P/N 17466	Camcorder batteries x2
3	P/N 24333	Dual battery cable
4	P/N 17515-01	Antenna cable
5	P/N 17664-40	TSC1/Pro XL multiport cable
6	P/N 22850-00	12-channel Pro XL receiver or
	P/N 22850-10	8-channel Pro XL receiver
7	P/N 32287-00	TSC1 Data/Power cable
8	TSC1 datalogger	

Figure C.1   Cabling for the GPS Pathfinder Pro XL receiver

Equipment List

Table C.2 lists the equipment that you can use in the field when operating a GPS Pathfinder Pro XL receiver in conjunction with the Asset Surveyor software running on your TSC1 datalogger.

Table C.2   Equipment list

Part name	Part number
Compact dome antenna	16741-00
Magnetic mount	12920-00
3 x 1/16" antenna spacing plate	18375
2 foot range pole	24287
Quick release adapter	19847
Quick release	19493
Vehicle power to TA3-F (battery adapter)	12918-00
GPS Pathfinder pouch belt for accessories	13274
Pro XL hard travel case	13000-30

D

Series 4000

In this chapter:

- Introduction
- Turning the receiver on
- Turning the receiver off
- Configuring the receiver to work with the Asset Surveyor software
- Operational aspects specific to Series 4000 GPS receivers
- Cabling diagram
- Equipment list

Introduction

The Trimble Series 4000 family of high-precision GPS receivers are designed primarily for land survey applications, where they can be used to obtain very high accuracy (in the millimeter range) using Control Survey and RTK techniques.

The Series 4000 GPS receivers also provide submeter accuracy when used for GIS data collection. Using a Trimble GIS Surveyor system (with EVEREST capable Series 4000 receivers as both the base station and rover) you can achieve accuracies of less than 50 centimeters with just a few measurements.

The Series 4000 receivers have a different internal architecture to the GPS Pathfinder receivers, as befits their optimization for land survey applications. The picture below shows the front panel of the Series 4000 receivers:
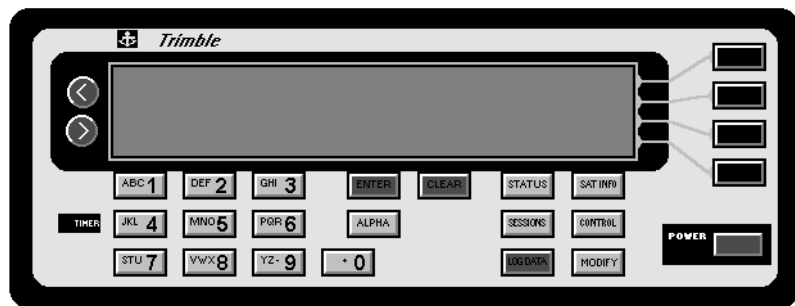
When used in conjunction with an Asset Surveyor system, there are a number of minor differences between the behavior of a Series 4000 receiver and that of a GPS Pathfinder receiver.

For Maxwell Technology Series 4000 GPS receivers with the EVEREST firmware option installed (for example, the 4000SSE, 4000SE System Surveyor II and 4000SSi), the postprocessed differentially corrected accuracy (CEP) is specified as 50 cm +1 ppm, subject to the following conditions: at least five satellites, PDOP less than four, a base station with the EVEREST firmware installed, and a baseline length of less than 1,000 km.

For Maxwell Technology Series 4000 GPS receivers (for example, the 4000SSE, 4000SE System Surveyor II and 4000SSi), the postprocessed differentially corrected accuracy (CEP) is specified as submeter, subject to the following conditions: at least five satellites, PDOP less than four, a GIS Surveyor Base Station, and a baseline length of less than 200 km.

For older non-Maxwell 4000SE receivers, the postprocessed differentially corrected accuracy (CEP) is specified as one to three meters.

Turning the Receiver On

The Asset Surveyor software cannot turn on a Series 4000 GPS receiver; you must turn on the Series 4000 receiver by pressing the POWER button in the lower-right corner of the receiver's front panel.

When a Series 4000 receiver is turned on, it may first display one or more messages describing how it was previously powered off (if it suddenly lost power, or ran out of internal memory). For example:
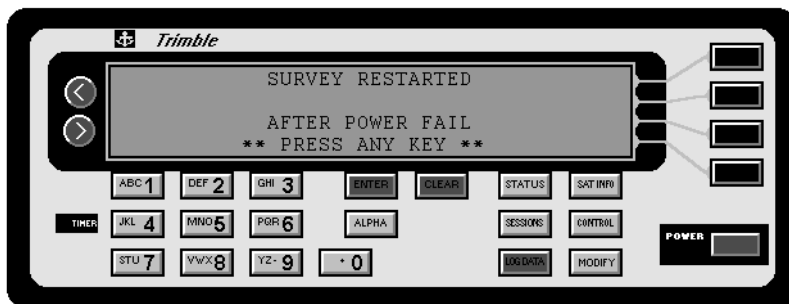
To clear these messages, press the CLEAR button on the 4000 receiver's front panel.

If, when the Series 4000 receiver was last turned off, it was in the process of recording a survey to its internal memory, then it may attempt to restart the survey when the receiver is turned back on. Unless you want to continue recording a survey into the receiver's memory, stop the previous survey before proceeding.

Eventually, the Series 4000 receiver displays the following menu on its screen:
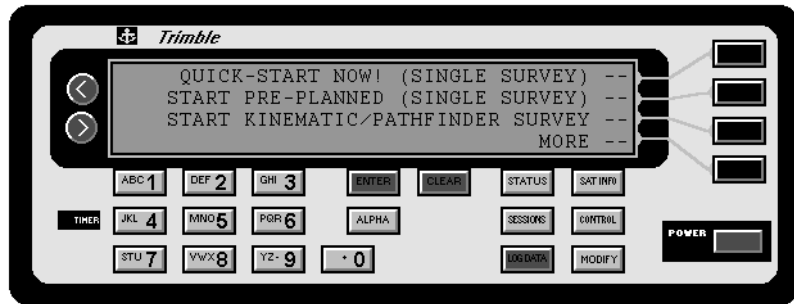
Press the [CLEAR] button to avoid starting a survey logging in the Series 4000 receiver's memory and proceed to the receiver's main status screen:
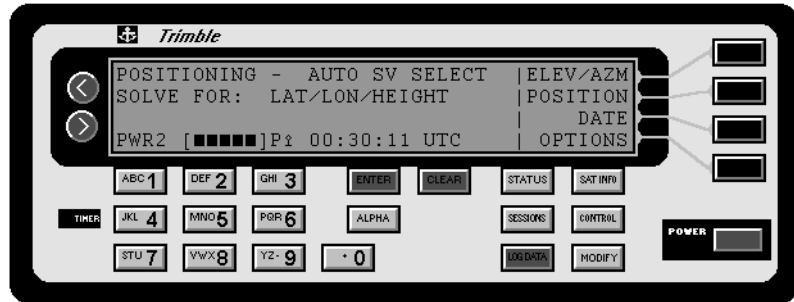
Once you have connected the TSC1 datalogger and Series 4000 receiver as shown later in this section, you can turn on the TSC1 datalogger to start the Asset Surveyor software communicating with the Series 4000 receiver.

If you have changed any of the Series 4000 receiver's Control settings, you may have to re-configure the receiver before it can communicate with the Asset Surveyor software. For more information, see Configuring the Receiver to Work with the Asset Surveyor Software, page 261.

Note – The standard Series 4000 datalogger cabling provides power to the TSC1 datalogger when it is communicating with the Series 4000 GPS receiver.

Turning the Receiver Off

When you turn off the TSC1 datalogger or select *Disconnect* from the *Utilities* menu, the Asset Surveyor software turns off the Series 4000 GPS receiver to avoid depleting the receiver's batteries. The TSC1 datalogger then runs on its own internal batteries.

Note – The TSC1 datalogger cannot turn the Series 4000 receiver back on. You must turn the receiver on using the POWER *button on the receiver's front panel.*

Configuring the Receiver to Work with the Asset Surveyor Software

The Asset Surveyor software configures most aspects of the Series 4000 receiver which concern it when communications between the Asset Surveyor software and the receiver are established.

You usually do not need to configure any settings on the Series 4000 receiver's front panel.

Note – The earliest version of the Series 4000 receiver navigation firmware with which the Asset Surveyor software works is version 5.64. If you try to use the Asset Surveyor software with an earlier version, the Asset Surveyor software displays the message 4000 Nav. firmware needs updating. *In this event, contact your Trimble dealer to obtain an upgrade to the firmware in your Series 4000 GPS receiver.*

If you have reconfigured the Series 4000 receiver's serial ports, input/outputs, and other settings, then the Asset Surveyor software may be unable to establish communications with the Series 4000 receiver. If a failure to communicate occurs, check the cabling and retry. If the Asset Surveyor software fails to communicate with the Series 4000 a second time, use the following procedure to reset the Series 4000 receiver to Default controls (that is, the default or factory settings).

1.   If necessary, get to the following screen on the Series 4000 receiver's front panel:
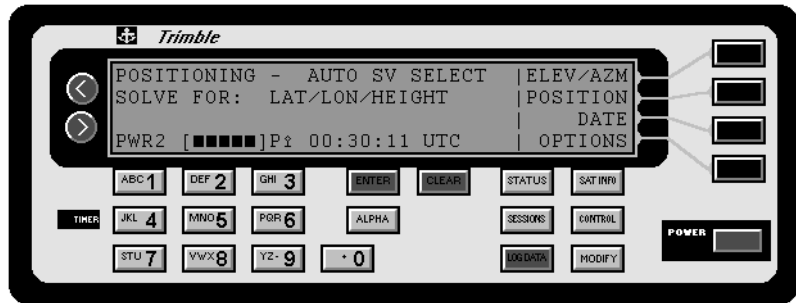
Tip – Press the $\boxed{\text{CLEAR}}$ button repeatedly to return to this screen.

2.   Press the $\boxed{\text{CONTROL}}$ button. A screen similar to the following appears:
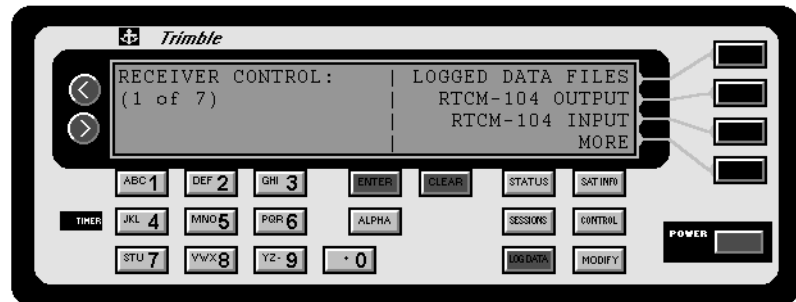
3.   Page through the various control options by pressing MORE until DEFAULT CONTROLS appears:
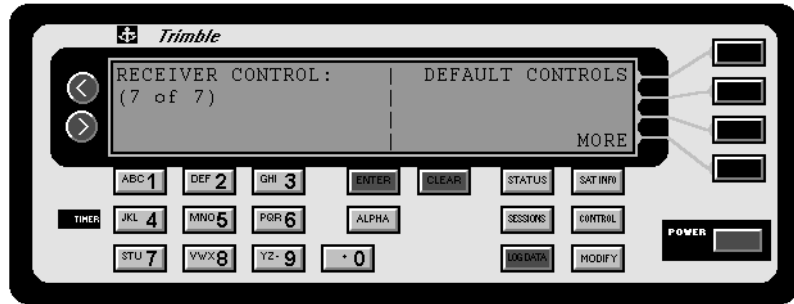
Note – The list of controls vary depending on the firmware options installed in your Series 4000 receiver. The DEFAULT CONTROLS entry is usually on the last page of controls.

4.   Press DEFAULT CONTROLS.

The Series 4000 receiver asks you to confirm that you want to reset all controls to the factory defaults:

5.   Press YES. The Series 4000 receiver resets all controls to their factory defaults and restarts.

The Asset Surveyor software should now be able to communicate with the Series 4000 receiver. If it cannot, the most likely cause of the problem is incorrectly connected or faulty cabling. Check that you have connected the receiver and TSC1 datalogger as shown in the cabling diagram later in this section. If the cabling is connected correctly and the Asset Surveyor software still cannot communicate with the Series 4000 receiver, contact your Trimble Assistance Center to have the cabling checked.

*Note – Some versions of the Series 4000 GPS receiver firmware do not reset the baud rate and serial parameters when you reset to DEFAULT CONTROLS. You may have to **manually** reset the receiver's Port 1 to 9600-8-ODD-1 before the Asset Surveyor software can communicate with the GPS receiver.*

Operational Aspects Specific to Series 4000 GPS Receivers

There are a number of aspects in which the Series 4000 GPS receivers differ from the GPS Pathfinder receivers.

Real-Time Input

The Series 4000 receiver with the Asset Surveyor software supports the RTCM version 2.1 and CMR formats for RTK/RTCM input.

Real-Time Output

The Series 4000 receiver with the Asset Surveyor software supports the RTCM version 2.1 and CMR formats for RTK/RTCM output.

Overdetermined Positions

The Series 4000 receiver can compute overdetermined GPS positions.

Carrier Phase Mode

You cannot operate a Series 4000 receiver in carrier phase mode in conjunction with the Asset Surveyor software. You can, however, use a Series 4000 receiver to perform static surveys, provided your receiver has the appropriate firmware options installed.

Base Station Operation

The Series 4000 GPS receiver may be operated as a real-time base station in conjunction with the Asset Surveyor software on the TSC1 datalogger as described in the *TSC1 Asset Surveyor Software User Guide*.

Note – The Series 4000 receiver cannot be used to log a base station file for the purpose of postprocessed differential correction. It can only be used as a real-time base station emitting RTK/RTCM corrections.

2D Modes

The Series 4000 receivers operate in overdetermined 2D mode, meaning that they can use 4 or more satellites to compute a 2D position. In the Auto 2D/3D context, the receiver typically switches to computation of 3D positions whenever 4 or more satellites are available. It does, however, remain in 2D mode if the 3D PDOP exceeds the configured *PDOP mask*, but the overdetermined 2D PDOP is below the *PDOP mask*.

Other Configuration Options

Some options that can be configured on GPS Pathfinder receivers are fixed to specific values by the Series 4000 receivers:

- The *SNR mask* is fixed at 4.0 by the Series 4000 receivers.

- The *PDOP switch* is fixed at the same value as the *PDOP mask* by the Series 4000 receivers.

- The *Dynamics code* is fixed at *Land* by the Series 4000 receivers.

In the *Position filters* configuration form, these three fields have the value 'Unused' when connected to a Series 4000 GPS receiver. In this context they cannot be edited.

The maximum *PDOP mask* which can be set on a Series 4000 GPS receiver by the Asset Surveyor software is 25.4. If you configure the *PDOP mask* in the Asset Surveyor software to a greater value, Asset Surveyor sets the Series 4000 receiver's PDOP mask to 25.4.

Receiver Status

When the PDOP value exceeds the configured PDOP mask, the Series 4000 receiver stops supplying an up-to-date VDOP or HDOP value to the Asset Surveyor software. In this case, these values are shown as 0.0 in the *Receiver status* form.

Almanacs

The Asset Surveyor software does not record an almanac when connected to a Series 4000 receiver, and does not send an almanac to the receiver on startup. The Series 4000 receivers maintain their own internal almanac to make sure acquisition of satellites is rapid.

In order to obtain an almanac for use in Mission Planning, you can start a survey on the Series 4000 receiver's front panel and extract this data from the receiver's internal memory as described in *RTK for Mapping and GIS General Reference*.

Receiver Outputs

Provided the appropriate receiver firmware options have been installed, a Series 4000 receiver can support ASCII, NMEA, and 1 PPS outputs. All of these are configured from the receiver's front panel, and not with the Asset Surveyor software.

Velocities

The velocity values that the Asset Surveyor software logs from a Series 4000 receiver cannot be differentially corrected.

Cabling Diagram

In order to use the Asset Surveyor software with a Series 4000 GPS receiver, connect the system as shown in Figure D.1.

1	P/N 22020-00	Compact L1/L2Antenna
2	P/N 14553-01	Antenna Cable
3	P/N 21000-51	Series 4000 receiver
4	P/N 18827	Radio link
5	P/N 21184	Battery Cable
6	P/N 17466	Camcorder Batteries
7	P/N 32901	TSC1 Data cable
8	TSC1 datalogger	
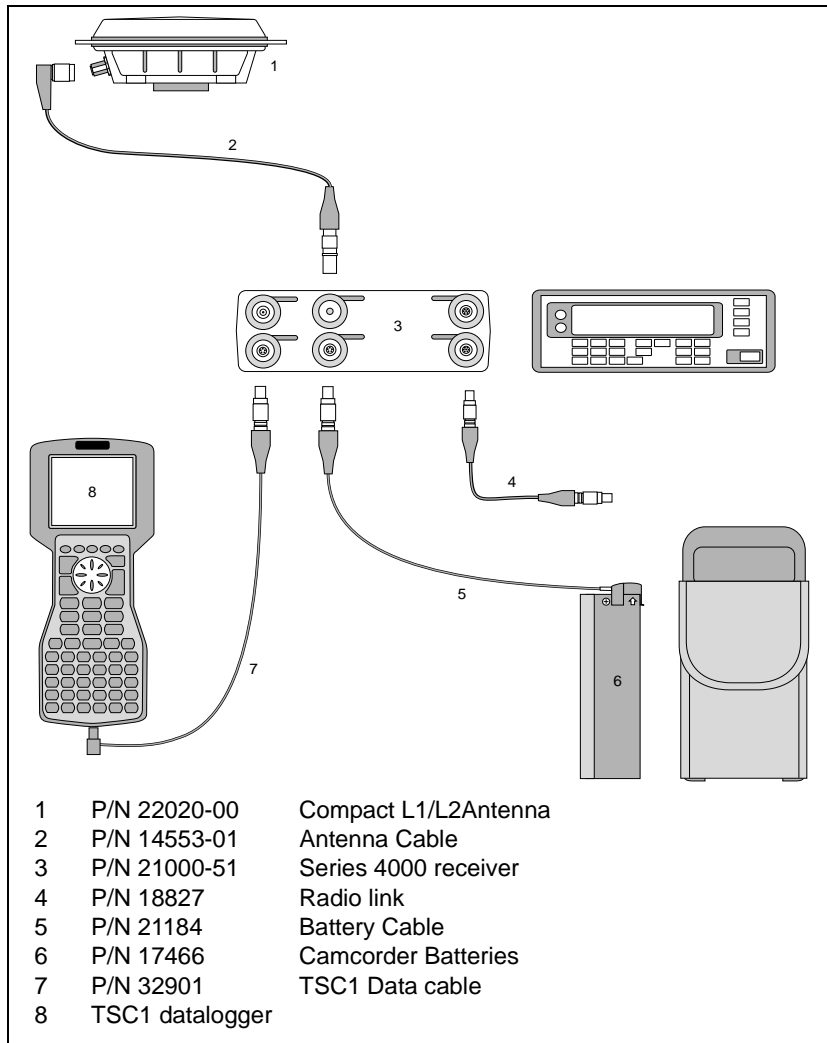
Figure D.1   Cabling for the Series 4000 receiver

Equipment List

Table D.1 lists the equipment that you can use in the field when operating a 4000SE, 4000SSE, or 4000SSi in conjunction with the Asset Surveyor software running on your TSC1 datalogger.

Table D.1   **Equipment list**

Part name	Part number
4000SE, 4000SSE or 4000SSi	Various
Backpack with rigid frame	20966
Range pole	18555
Battery cable assembly	21184
4 x 12 V Camcorder batteries	17466
Hard carry case	18607
TSC1 Data cable	32901

Site Surveyor 4400 Receiver

In this chapter:

- Introduction
- Turning the receiver on
- Turning the receiver off
- Configuring the receiver to work with the Asset Surveyor software
- Operational aspects specific to the Site Surveyor 4400 receiver
- Cabling diagram
- Equipment list

Introduction

The Trimble Site Surveyor 4400 receiver is a low latency, fast update GPS engine designed to provide centimeter level positioning for Real-Time Kinematic (RTK) surveys. The Site Surveyor 4400 receiver features on-the-fly initialization for RTK mapping operations. The Site Surveyor 4400 also provides differentially corrected C/A code positions accurate to better than one meter on a second-by-second basis.

Turning the Receiver On

Press the large green button on the Site Surveyor 4400 front panel. After a second, the green LED labeled 'ON' turns on.

Turning the Receiver Off

Hold down the large green button on the Site Surveyor 4400 front panel for a few seconds. The three LEDs turn off.

Configuring the Receiver to Work with the Asset Surveyor Software

No special configuration of the Site Surveyor 4400 receiver is required in order to use the Asset Surveyor software and Site Surveyor 4400 receiver together beyond the usual *GPS rover options* that you need to configure in the Asset Surveyor software. The minimum Site Surveyor 4400 receiver firmware should be version 2.31. The minimum Asset Surveyor software should be version 4.00.

The following section describes the settings required to obtain submeter accuracy from your Site Surveyor 4400 receiver.

Operational Aspects Specific to the Site Surveyor 4400 Receiver

The following sections outline the operational aspects specific to the Site Surveyor 4400 receiver.

Submeter Accuracy

If order to achieve accuracy with the Site Surveyor 4400 receiver of better than 1 meter (RMS) +2 ppm times the distance between the base station and the rover, you must use the following *GPS rover options* configuration settings in the Asset Surveyor software. Table E.1 lists the recommended settings.

Table E.1   Recommended settings

Setting	Recommended value
Position mode	Overdet. 3D or Manual 3D
PDOP mask	4.0 or less
SNR mask	6 or more
Elevation mask	15 degrees or more

You must also be using a base station which is logging or transmitting (in RTCM messages) synchronized measurements, and which is equipped with a Pro XR, Pro XRS, Pro XL, 4600LS, Site Surveyor 4400, GPS Total Station 4700, GPS Total Station 4800 or Series 4000 GPS receiver. Your roving receivers must be within 200 km of your base station. Finally, if you are performing differential correction by postprocessing your data, you must use the Differential Correction utility from the GPS Pathfinder Office software suite.

Real-Time Input

The Site Surveyor 4400 receiver with TSC1 Asset Surveyor supports the RTCM version 2.1 and CMR formats for RTK/RTCM input.

Real-Time Output

The Site Surveyor 4400 receiver supports the RTCM version 2.1 and CMR formats for RTK/RTCM output. The Asset Surveyor software can configure and control a real-time base station provided the receiver has the appropriate firmware option installed.

Overdetermined Positions

The Site Surveyor 4400 receiver supports the computation of overdetermined 3D GPS positions.

Carrier Phase Mode

The Site Surveyor 4400 receiver receiver cannot be operated in carrier phase mode.

Receiver Outputs

The Site Surveyor 4400 receiver with TSC1 Asset Surveyor supports NMEA output. It also supports (without any need for configuration of the Asset Surveyor software) 1 PPS output as a non-standard option.

Base Station Operation

The Site Surveyor 4400 receiver may be operated as a real-time base station in conjunction with the Asset Surveyor software on the TSC1 datalogger as described in the *TSC1 Asset Surveyor Software User Guide*.

Note – The Site Surveyor 4400 receiver cannot be used to log a base station file for the purpose of post-processed differential correction. It can only be used as a real-time base station emitting RTK/RTCM corrections.

External Sensors

You can use external sensors and laser rangefinders with the Site Surveyor 4400 receiver and TSC1 datalogger.

Cabling Diagram

In order to use the Asset Surveyor software with a Site Surveyor 4400 receiver, connect the system as shown in Figure E.1.

1	P/N 22020-00	Compact L1/L2Antenna
2	P/N 14553-01	Antenna Cable
3	P/N 29887-11	Site Surveyor 4400 receiver
4	P/N 18827	Radio link
5	P/N 21184	Battery Cable
6	P/N 17466	Camcorder Batteries
7	P/N 32901	TSC1 Data cable
8	TSC1 datalogger	
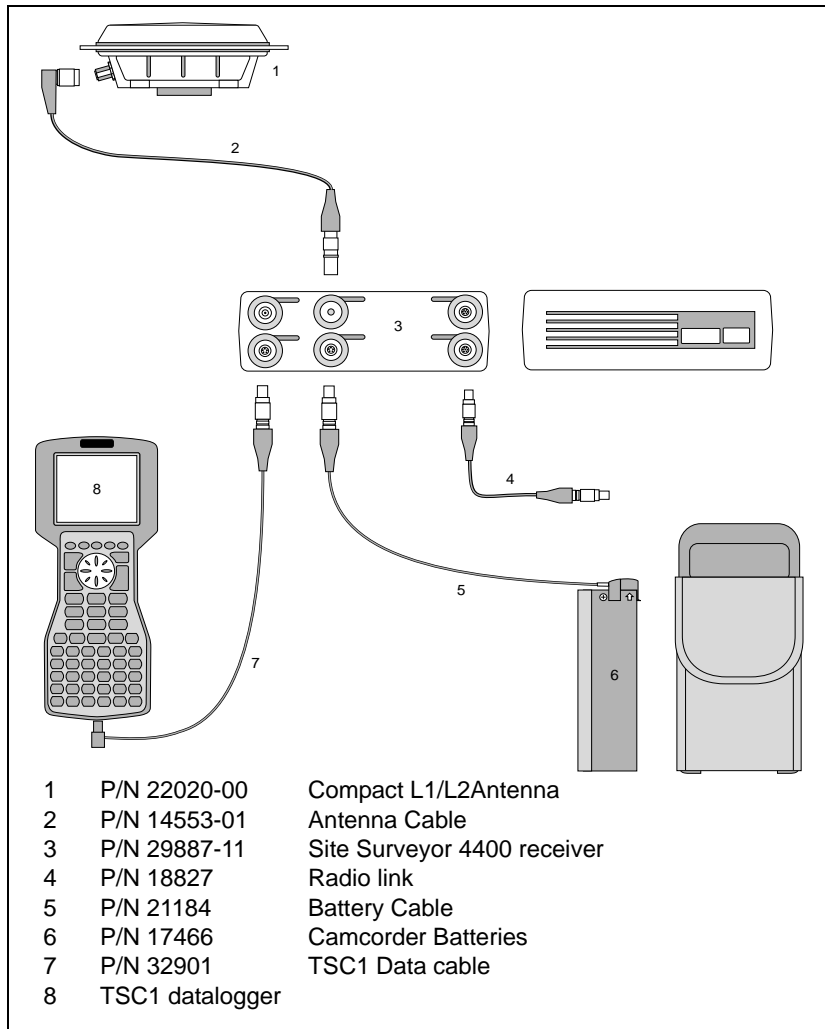
Figure E.1   Site Surveyor 4400 receiver with TSC1 Asset Surveyor

Equipment List

Table E.2 lists the equipment that you can use in the field when operating a Site Surveyor 4400 receiver in conjunction with the Asset Surveyor software running on your TSC1 datalogger.

Table E.2   Equipment list

Part name	Part number
Site Surveyor 4400	29887-11
Backpack with rigid frame	20966
Range pole	18555
Battery cable assembly	21184
4 x 12 V Camcorder batteries	17466
Hard carry case	18607
TSC1 Data cable	32901

4600LS Surveyor

In this chapter:

- ■ Introduction
- ■ Turning the receiver on
- ■ Turning the receiver off
- ■ Configuring the receiver to work with the Asset Surveyor software
- ■ Operational aspects specific to the 4600LS Surveyor
- ■ Cabling diagrams
- ■ Equipment list

Introduction

The 4600LS Surveyor is based around a high-performance single frequency GPS receiver. The 4600LS Surveyor provides differentially corrected C/A code positions accurate to better than one meter, on a second-by-second basis.

Turning the Receiver On

Press the large green button on the 4600LS Surveyor control panel. After a second, the green LED above the light-bulb symbol turns on.

Turning the Receiver Off

Hold down the large green button on the 4600LS Surveyor control panel for a few seconds. The three LEDs turn off.

Configuring the Receiver to Work with the Asset Surveyor Software

No special configuration of the 4600LS Surveyor is required in order to use the Asset Surveyor software and 4600LS Surveyor together beyond the usual *GPS rover options* that you need to configure in the Asset Surveyor software. The minimum 4600LS Surveyor firmware should be version 1.10.

The following section describes the settings required to obtain submeter accuracy from your 4600LS Surveyor.

Operational Aspects Specific to the 4600LS Surveyor

The following sections outline the operational aspects specific to the 4600LS Surveyor.

Submeter Accuracy

To achieve accuracy with the 4600LS Surveyor of better than 1 meter (RMS) +2 ppm times the distance between the base station and the rover, you must use the following *GPS rover options* configuration settings in the Asset Surveyor software. Table F.1 lists the recommended settings.

Table F.1   Recommended settings

Setting	Recommended value
Position mode	Overdetermined 3D or Manual 3D
PDOP mask	4.0 or less
SNR mask	6 or more
Elevation mask	15 degrees or more

You must also be using a base station that is logging or transmitting (in RTCM messages) synchronized measurements, and that is equipped with a Pro XR, Pro XRS, Pro XL, 4600LS, Site Surveyor 4400, GPS Total Station 4700, GPS Total Station 4800 or Series 4000 GPS receiver. Your roving receivers must be within 200 km of your base station. Finally, if you are performing differential correction by postprocessing your data, you must use the Differential Correction utility from the GPS Pathfinder Office software.

RTCM Input

The 4600LS Surveyor receiver with TSC1 Asset Surveyor supports the RTCM version 2.0 format only.

Overdetermined Positions

The 4600LS Surveyor receiver supports the computation of overdetermined 3D GPS positions.

Carrier Phase Mode

The 4600LS Surveyor receiver can be operated in carrier phase mode. You enable carrier phase mode from *GPS rover options / Logging options.*

The antenna name must be selected from the *Type* field in the *Antenna options* form, or the antenna part number selected from the *Part number* field.

Receiver Outputs

The 4600LS Surveyor with Asset Surveyor does not transmit any receiver output information.

Base Station Operation

The 4600LS Surveyor receiver may be operated as a base station in two different ways.

1. 4600LS Surveyor with TSC1 datalogger. This is operated in the manner described in the *TSC1 Asset Surveyor Software User Guide*.

2. 4600LS Surveyor stand-alone base station. You can operate the 4600LS Surveyor as a stand-alone base station providing that:

    –   you use the Differential Correction utility in the GPS Pathfinder Office software when differentially correcting any rover files using this base data.

    –   you set the *Elevation mask* on the rover units to 20° (the default elevation mask on the 4600LS is 15°).

External Sensors

You can use external sensors and laser rangefinders with the 4600LS Surveyor receiver and TSC1 datalogger.

Cabling Diagrams

To use the Asset Surveyor software with a 4600LS Surveyor receiver, connect the system as shown in Figure F.1, Figure F.2, and Figure F.3.
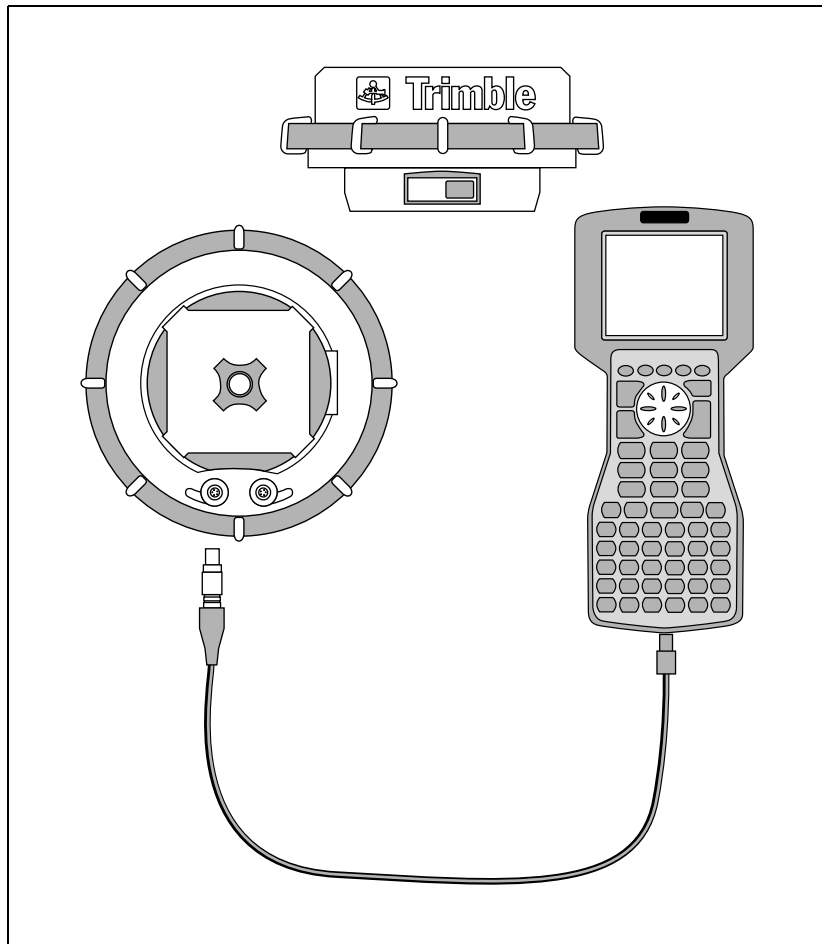
Figure F.1   4600LS Surveyor with TSC1 Asset Surveyor
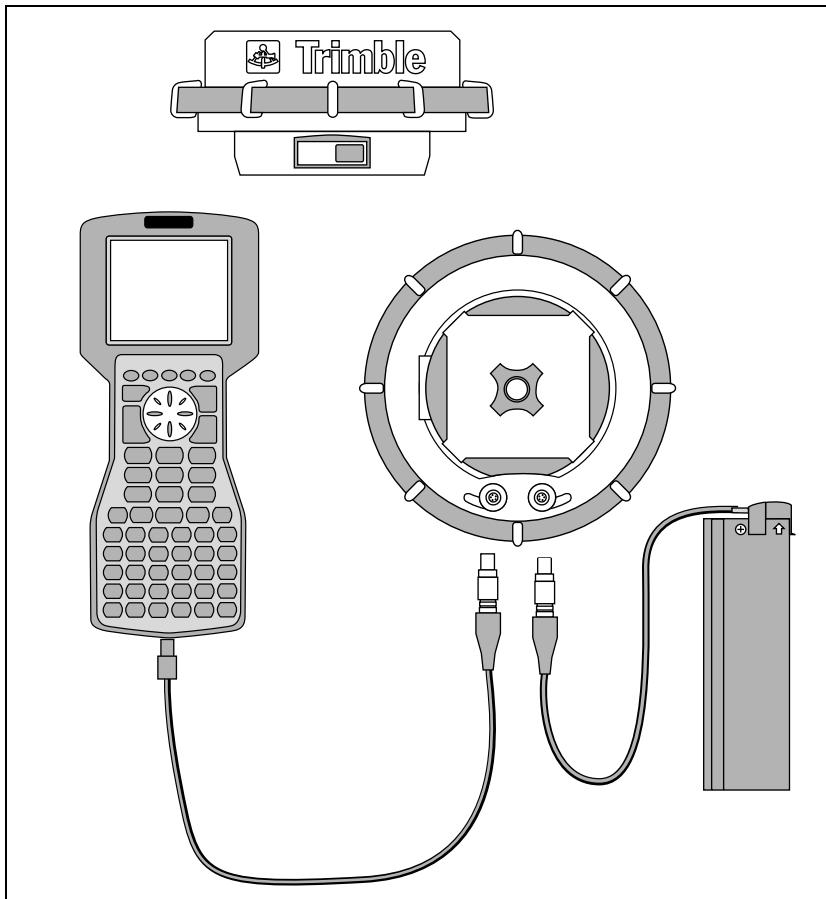
Figure F.2   Two-port 4600LS Surveyor receiver with camcorder battery and
              TSC1 Asset Surveyor

*Note – The TSC1 datalogger always connects to Port 1 on the 4600LS
Surveyor receiver.*
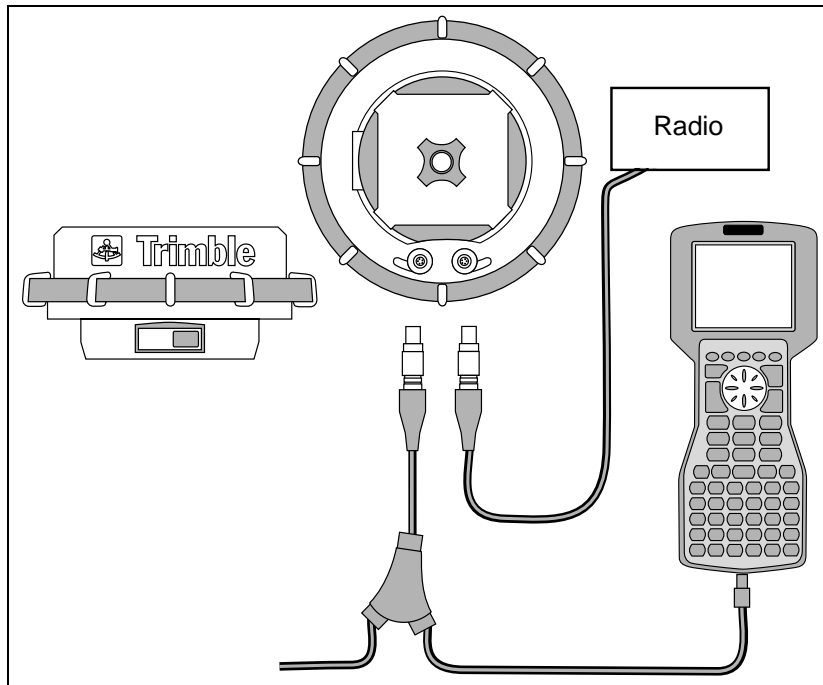
Figure F.3   4600LS Surveyor RTCM input configuration with radio, TSC1, and external power

Equipment List

Table F.2 lists the equipment that you can use in the field when operating a 4600LS Surveyor receiver in conjunction with the Asset Surveyor software running on your TSC1 datalogger.

Table F.2   **Equipment list**

Part name	Part number
8-Channel 4600LS Surveyor (Single Port)	28615-10
12-Channel 4600LS Surveyor (Single Port)	28615-15
8-Channel 4600LS Surveyor (Dual Port)	28615-20
12-Channel 4600LS Surveyor (Dual Port)	28615-25
TSC1 to 4600LS Y-Cable	32958
Radio to 4600LS Y-Cable	30119
Quick Release Adapter	19847
Quick Release	19493
Camcorder Battery Pouch Kit	28613-00

GPS Total Station 4700

In this chapter:

- Introduction
- Serial ports
- Turning the receiver on
- Turning the receiver off
- Configuring the receiver to work with the Asset Surveyor software
- Operational aspects specific to the GPS Total Station 4700
- Cabling diagram
- Equipment list

Introduction

The GPS Total Station 4700 system is a fully integrated GPS receiver, radio modem, radio antenna, and external GPS antenna. The 4700 GPS receiver is a low-latency, fast-update GPS engine designed to provide centimeter-level positioning for Real-Time Kinematic (RTK) surveys. It also features on-the-fly initialization for RTK mapping operations and provides differentially corrected C/A code positions accurate to better than one meter on a second-by-second basis.

The 4700 receiver tracks GPS satellites on both the L1 and L2 frequencies to provide precise position data for land survey and mapping applications. The 4700 receiver records GPS data and makes all raw and computed data available through bi-directional RS-232 ports.

Serial Ports

There are three serial ports on the GPS Total Station 4700 receiver:

- Port 1 is typically connected to the TSC1 datalogger. (Flow control only on Port 1.)

- Port 2 is either connected to an external power source or to a desktop computer.

- Port 3 is for connecting to an external RTK radio.

Turning the Receiver On

Press the large green button on the 4700 receiver. After a second, the green LED turns on.

Turning the Receiver Off

Hold down the large green button on the 4700 receiver for a few seconds. The LEDs turn off.

Configuring the Receiver to Work with the Asset Surveyor Software

No special configuration of the GPS Total Station 4700 receiver is required in order to use the Asset Surveyor software and 4700 receiver together beyond the usual *GPS rover options* that you need to configure in the Asset Surveyor software. The minimum Asset Surveyor software should be version 4.02.

The following section describes the settings required to obtain submeter accuracy from your 4700 receiver.

Operational Aspects Specific to the GPS Total Station 4700

The following sections outline the operational aspects specific to the 4700 receiver.

Submeter Accuracy

To achieve accuracy with the 4700 receiver of better than 1 meter (RMS) +2 ppm times the distance between the base station and the rover, you must use the *GPS rover options* configuration settings in the Asset Surveyor software listed in Table G.1.

Table G.1   Recommended settings

Setting	Recommended value
Position mode	Overdetermined 3D or Manual 3D
PDOP mask	4.0 or less
SNR mask	6 or more
Elevation mask	15 degrees or more

You must also be using a base station which is logging or transmitting (in RTCM messages) synchronized measurements, and which is equipped with a Pro XR, Pro XRS, Pro XL, 4600LS, GPS Total Station 4700, GPS Total Station 4800, Site Surveyor 4400 or Series 4000 GPS receiver. Your roving receivers must be within 200 km of your base station. Finally, if you are performing differential correction by postprocessing your data, you must use the Differential Correction utility from the GPS Pathfinder Office software suite.

Real-Time Input

The 4700 receiver with TSC1 Asset Surveyor supports the RTCM version 2.1 and CMR formats for RTK/RTCM input.

Real-Time Output

The 4700 receiver supports the RTCM version 2.1 and CMR formats for RTK/RTCM output. The Asset Surveyor software can configure and control a real-time base station provided the receiver has the appropriate firmware option installed.

Overdetermined Positions

The 4700 receiver supports the computation of overdetermined 3D GPS positions.

Carrier Phase Mode

The 4700 receiver cannot be operated in carrier phase mode with the Asset Surveyor software.

Receiver Outputs

The 4700 receiver with Asset Surveyor supports NMEA output. It also supports (without any need for configuration of the Asset Surveyor software) 1 PPS output as a non-standard option.

Base Station Operation

The 4700 receiver may be operated as a real-time base station in conjunction with the Asset Surveyor software on the TSC1 datalogger as described in the *TSC1 Asset Surveyor Software User Guide*.

Note – The 4700 receiver cannot be used with the Asset Surveyor software to log a base station file for the purpose of postprocessed differential correction. When used with the Asset Surveyor software, it can only be used as a real-time base station emitting RTK/RTCM corrections.

External Sensors

You can use external sensors and laser rangefinders with the 4700 receiver and TSC1 datalogger.

Cabling Diagram

To use the Asset Surveyor software with a 4700 receiver, connect the system as shown in Figure G.1.
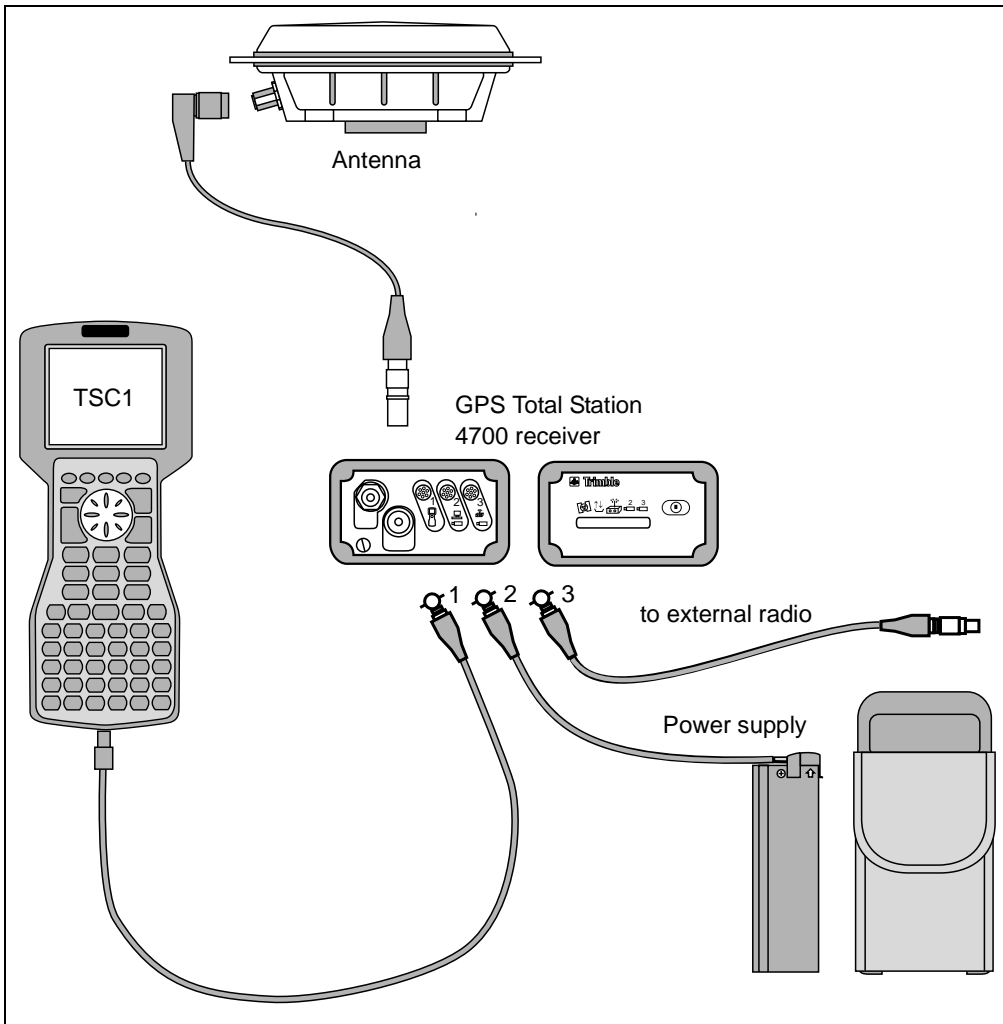
Figure G.1   4700 receiver with TSC1 Asset Surveyor

Equipment List

Table G.2 lists the equipment that you can use in the field when operating a GPS Total Station 4700 receiver in conjunction with the Asset Surveyor software running on your TSC1 datalogger.

Table G.2   Equipment list

Part name	Part number
4700 Unit	35846-xx
Rangepole	varies
Backpack	35474-00
Antenna cable	14553-01
Micro-centered antenna	33429-00
Radio antenna	varies
TSC1 data cable	31288
6 Ah battery	32364-00

GPS Total Station 4800

In this chapter:

- Introduction
- Switches and indicator LEDs
- Serial ports
- Turning the receiver on
- Turning the receiver off
- Configuring the receiver to work with the Asset Surveyor software
- Operational aspects specific to the GPS Total Station 4800
- Cabling diagram
- Equipment list

Introduction

The GPS Total Station 4800 system is a fully integrated GPS receiver, GPS antenna, radio modem, and radio antenna. The 4800 receiver is a low-latency, fast-update GPS engine designed to provide centimeter-level positioning for Real-Time Kinematic (RTK) surveys. It also features on-the-fly initialization for RTK mapping operations and provides differentially corrected C/A code positions accurate to better than one meter on a second-by-second basis.
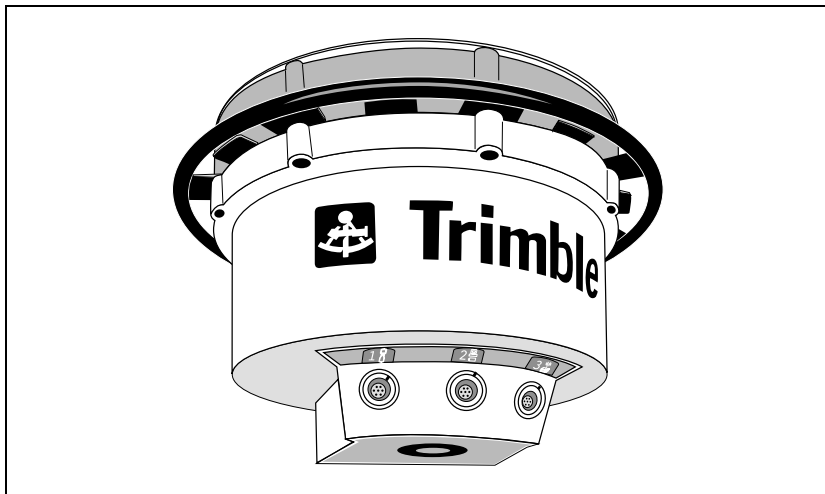
Figure H.1   4800 receiver

The 4800 unit tracks GPS satellites on both the L1 and L2 frequencies to provide precise position data for land survey and mapping applications. The 4800 unit records GPS data and makes all raw and computed data available through bi-directional RS-232 ports.

Switches and Indicator LEDs

The only operating controls on the 4800 unit are the power ON/OFF button and three LEDs, as shown in Figure H.2.
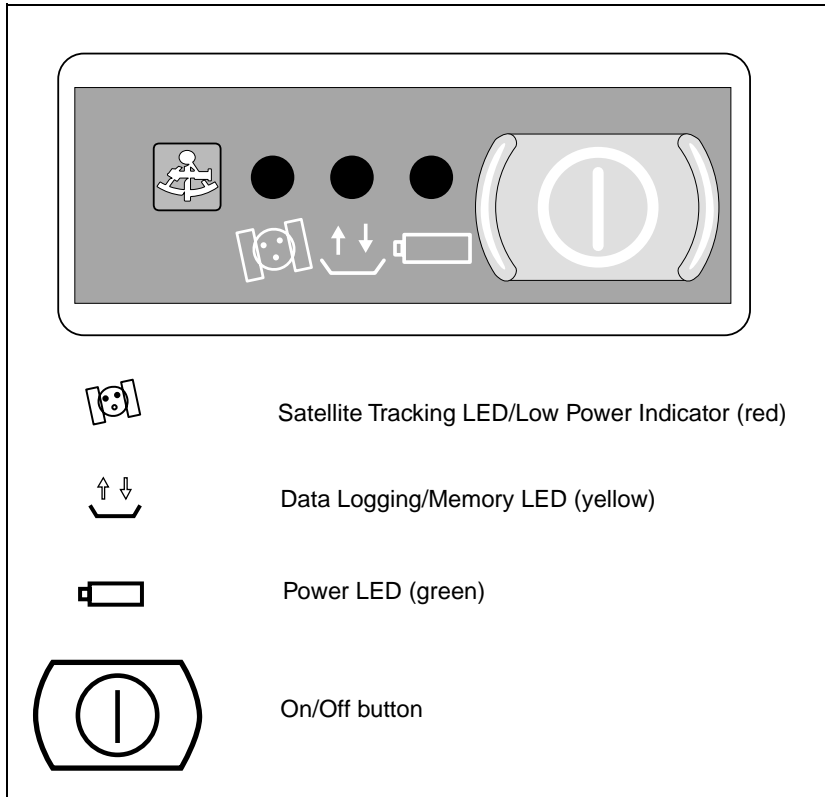
Figure H.2   4800 control panel

During typical operation, slow-blinking LEDs indicate normal operation. Fast-blinking LEDs indicate a condition that may have a negative effect on the survey or mapping job and may require your attention. A solid red LED indicates low battery power. LEDs that are off indicate that no operation is occurring.

Serial Ports

Figure H.3 shows the ports on the 4800 unit.
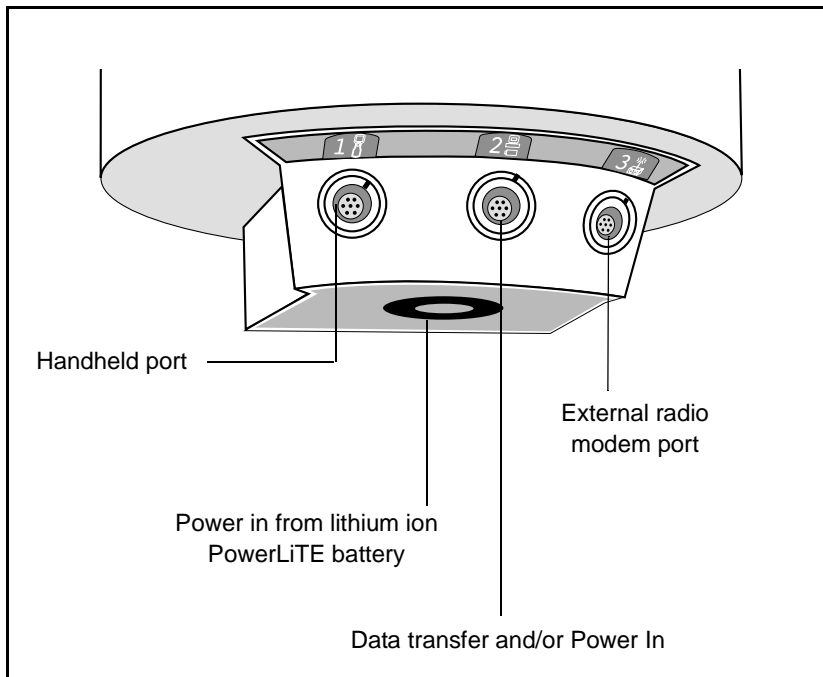
Figure H.3   4800 ports

There are three serial ports:

- Port 1 is typically connected to the TSC1 datalogger. (Flow control only on Port 1.)

- Port 2 is either connected to an external power source or to a desktop computer.

- Port 3 is for connecting to an external RTK radio.

Turning the Receiver On

Press the large green button on the 4800 unit. After a second, the green LED turns on.

Turning the Receiver Off

Hold down the large green button on the 4800 unit for a few seconds. The three LEDs turn off.

Configuring the Receiver to Work with the Asset Surveyor Software

No special configuration of the GPS Total Station receiver is required in order to use the Asset Surveyor software and 4800 receiver together beyond the usual *GPS rover options* that you need to configure in the Asset Surveyor software. The minimum Asset Surveyor software should be version 4.01.

The following section describes the settings required to obtain submeter accuracy from your 4800 receiver.

Operational Aspects Specific to the GPS Total Station 4800

The following sections outline the operational aspects specific to the 4800 receiver.

Submeter Accuracy

To achieve accuracy with the 4800 receiver of better than 1 meter (RMS) +2 ppm times the distance between the base station and the rover, you must use the following *GPS rover options* configuration settings in the Asset Surveyor software, as shown in Table H.1.

Table H.1   Recommended settings

Setting	Recommended value
Position mode	Overdetermined 3D or Manual 3D
PDOP mask	4.0 or less
SNR mask	6 or more
Elevation mask	15 degrees or more

You must also be using a base station which is logging or transmitting (in RTCM messages) synchronized measurements, and which is equipped with a Pro XR, Pro XRS, Pro XL, 4600LS, GPS Total Station 4700, GPS Total Station 4800, Site Surveyor 4400 or Series 4000 GPS receiver. Your roving receivers must be within 200 km of your base station. Finally, if you are performing differential correction by postprocessing your data, you must use the Differential Correction utility from the GPS Pathfinder Office software suite.

Real-Time Input

The 4800 receiver with TSC1 Asset Surveyor supports the RTCM version 2.1 and CMR formats for RTK/RTCM input.

Real-Time Output

The 4800 receiver supports the RTCM version 2.1 and CMR formats for RTK/RTCM output. The Asset Surveyor software can configure and control a real-time base station provided the receiver has the appropriate firmware option installed.

Overdetermined Positions

The 4800 receiver supports the computation of overdetermined 3D GPS positions.

Carrier Phase Mode

The 4800 receiver cannot be operated in carrier phase mode.

Receiver Outputs

The 4800 receiver with Asset Surveyor supports NMEA output. It also supports (without any need for configuration of the Asset Surveyor software) 1 PPS output as a non-standard option.

Base Station Operation

The 4800 receiver may be operated as a real-time base station in conjunction with Asset Surveyor on the TSC1 datalogger as described in the *TSC1 Asset Surveyor Software User Guide*.

Note – The 4800 receiver cannot be used to log a base station file for the purpose of postprocessed differential correction. It can only be used as a real-time base station emitting RTK/RTCM corrections.

External Sensors

You can use external sensors and laser rangefinders with the 4800 receiver and TSC1 datalogger.

Cabling Diagram

To use the Asset Surveyor software with a 4800 receiver, connect the system as shown in Figure H.4.

1	4800 receiver	P/N varies, depending on options
2	TSC1 Data cable	P/N 32901
3	TSC1 datalogger	
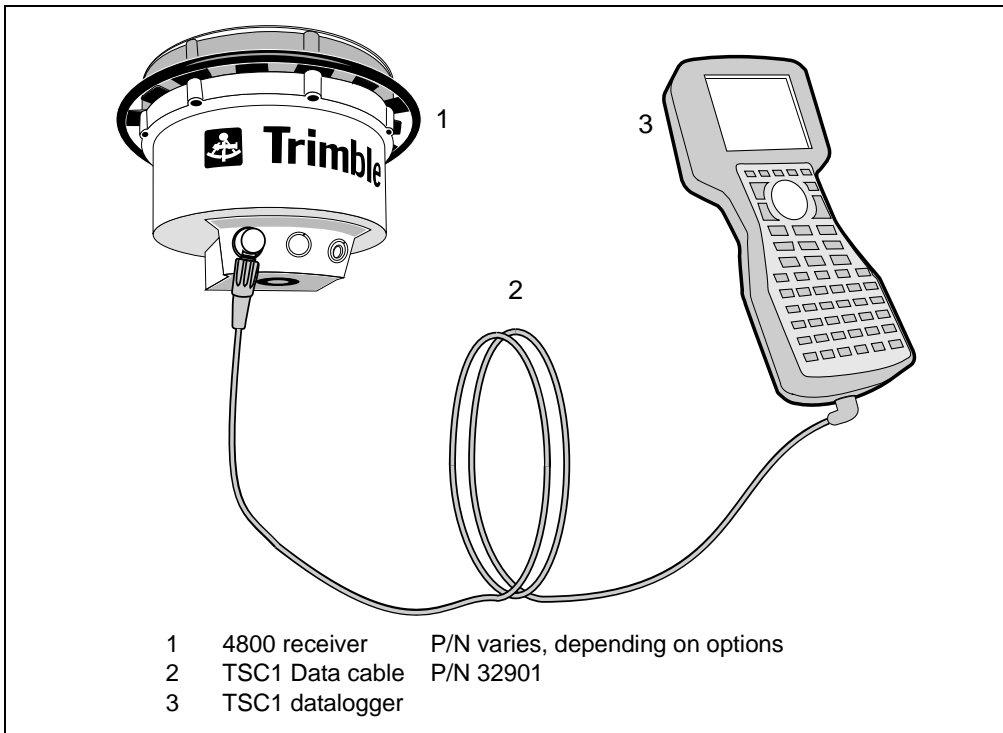
Figure H.4   4800 receiver with TSC1 Asset Surveyor

Equipment List

Table H.2 lists the equipment that you can use in the field when operating a 4800 receiver in conjunction with the Asset Surveyor software running on your TSC1 datalogger.

Table H.2   Equipment list

Part name	Part number
4800 Unit	Varies, depending on options
4800 Soft case	33849-00
6 Ah battery	32364-00
PowerLiTE pole w/ Composite bipod	34111-00
TSC1 data cable	32901

Laser Rangefinders

In this chapter:

- Introduction
- Laser Technology Criterion 300 and 400
- Laser Atlanta ProSurvey 1000
- Laser Atlanta Advantage
- LEDHA-GEO laser binoculars
- MDL LaserAce 300
- LaserCraft Contour XLR

Introduction

This appendix describes the supported laser rangefinders that can be used with the Asset Surveyor software.

Laser Technology Criterion 300 and 400

The Criterion 300 and 400 are both suitable for use with the Asset Surveyor software as automated offset recording devices. The Criterion 400 differs from the 300 in that it contains specialized software for common forestry mensuration operations.

Hardware Specifications

The Criterion 300 and 400 hardware specifications are identical.

Dimensions

The laser itself measures 9 cm × 17 cm × 22 cm (3.5" × 6.5" × 8.5"). It weighs 2.72 kg (6.0 lbs). The optional yoke (for fitting to a unipod or tripod) weighs an additional 0.45 kg (1.0 lb). The rechargeable battery pack weighs 0.91 kg (2.0 lbs), and is typically clipped to a belt or carried in a backpack.

Laser details

The laser can typically take measurements up to 450 m (1,500 ft) to most surfaces, and up to 12 km (40,000 ft) if used in conjunction with a retro-reflector. A foliage filter is available to enhance performance when shooting through light foliage and undergrowth, up to approximately 200 m.

The minimum range of the laser is 3 m (10 ft).

The laser is accurate to ±9.1 cm (0.3 ft).

Compass details

An electronic fluxgate compass is used to obtain magnetic azimuth measurements. This compass works when the unit is tilted at up to 15° to the horizontal. The compass is rated at ±0.5° under laboratory conditions. In typical GIS data collection conditions, compass accuracy is typically around ±1–2°. In environments where magnetic interference is high (for example, in a vehicle), the compass can be considerably less accurate.

Inclinometer details

A fluid tilt sensor measures vertical angles, which are used to calculate the elevation of target points. The sensor is of a damped resistance fluid type, and can take measurements up to ±60°, accurate to 0.1°.

Powering

The Criterion 300 and 400 rangefinders are powered by a rechargeable 9.6 V NiCd battery. This battery takes approximately 12–14 hours to charge fully, and the rangefinder can be run for 7.5 hours or more on a fully-charged battery.

Environmental limitations

The Criterion rangefinder can be used at temperatures ranging between –30°C and +50°C (–22°F to +122°F). The laser casing is resistant to light rain (but not immersion) and dust.

The Criterion rangefinder should be treated as precision optical equipment, and should be handled with care. It withstands reasonable drop shock, but alignment of the sighting scope should be checked after dropping.

The rangefinder should always be transported in its hard carry-case.

Accessories

The Criterion 300 and 400 laser rangefinders can be used in four ways:

- As a handheld instrument

- As a handheld instrument with a shoulder rest (stock)

- With the optional yoke and unipod. The unipod includes a bracket onto which your datalogger may be clipped

- With the optional yoke and a tripod

For most GIS data collection applications, the Criterion rangefinders are a little too heavy to be carried in one hand, and it is difficult to operate both a datalogger and handheld laser together. It can also be difficult to accurately sight on distant objects when supporting the laser by hand. The best compromise between portability and operability is usually the yoke/unipod.

Cabling for Use with the Asset Surveyor Software

The Criterion 300 and 400 laser rangefinders can be purchased with an optional download cable. The download cable connects to the Criterion's battery, and leads to a 7-pin connector.

The 7-pin connector is cabled as shown in Table I.1.

Table I.1   Cable connections

Criterion laser (5-pin Lemo)	(7-pin female D type)
5 Ground	5 Ground
4 Transmit	2 Receive
3 Receive	3 Transmit

The 7-pin connector is then plugged into the data cable (P/N 32287), which can be plugged directly into one of the ports on your TSC1 datalogger.

Cabling for the Pro XRS receiver

If you have a Pro XRS GPS receiver, connect the Criterion laser rangefinder to your receiver and datalogger as shown in Figure I.1.
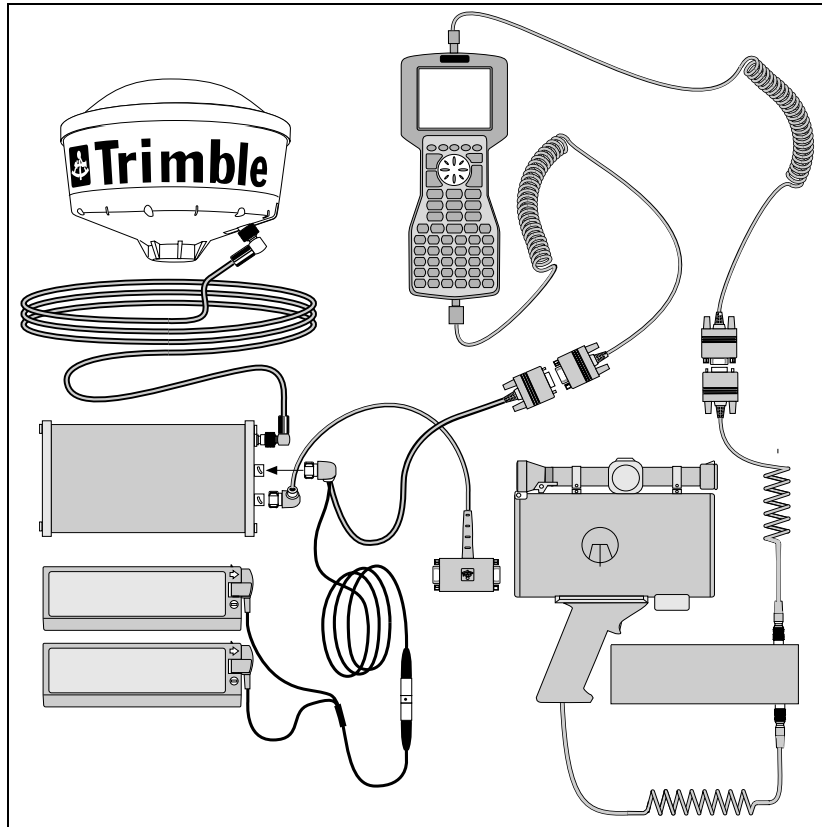
Figure I.1   Criterion laser rangefinder cabling diagram for Pro XRS with TSC1

Cabling for the Pro XR receiver

If you have a Pro XR GPS receiver, connect the Criterion laser rangefinder to your receiver and datalogger as shown in Figure I.2.
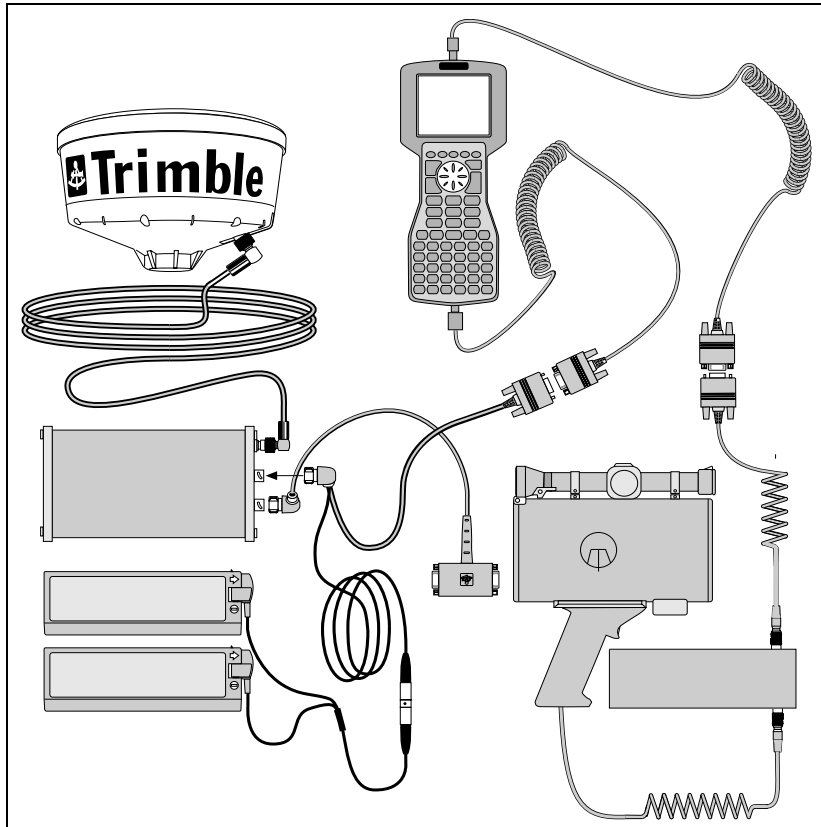
Figure I.2   Criterion laser rangefinder cabling diagram for Pro XR with TSC1

Cabling for the Pro XL receiver

If you have a Pro XL GPS receiver, connect the Criterion laser rangefinder to your receiver and datalogger as shown in Figure I.3.
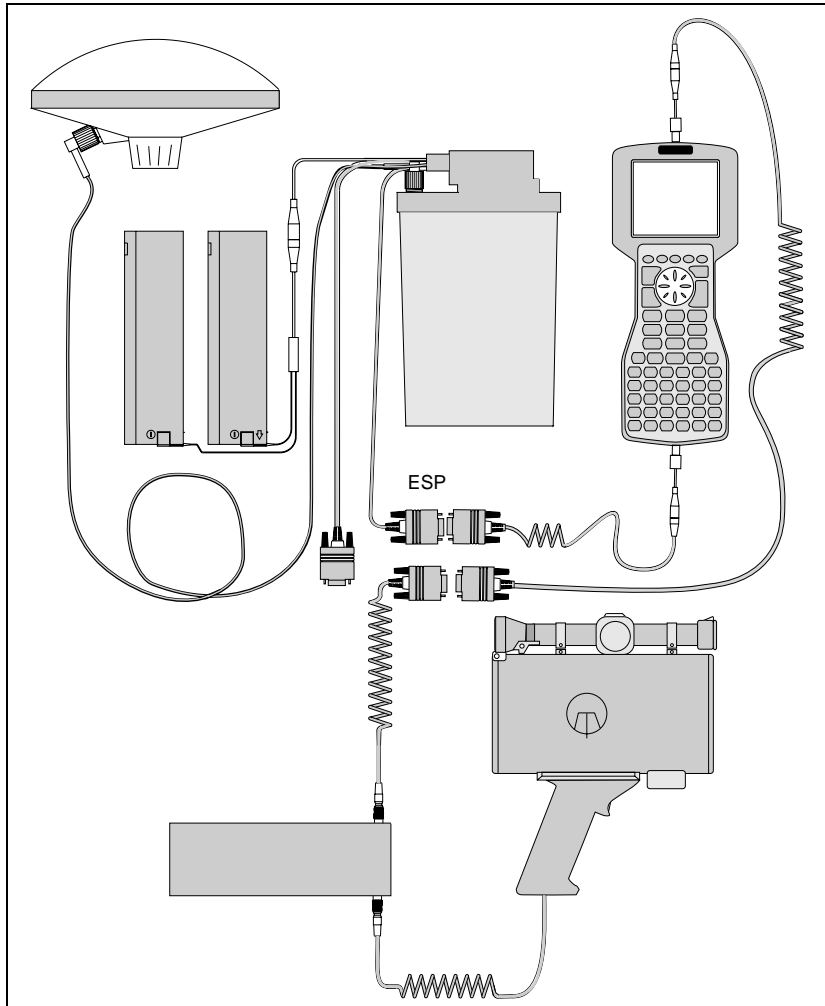
Figure I.3   Criterion laser rangefinder cabling diagram for Pro XL with TSC1

Configuration for Use with the Asset Surveyor Software

This section provides instructions for configuring the Criterion laser rangefinder itself. For more information on configuring the Asset Surveyor software to work with the Criterion laser rangefinder, see page 321.

Entering Survey mode

The Criterion 300 and 400 laser rangefinders both support a SURVEY mode of operation. In this mode they take range, azimuth and inclination measurements and can export these to your TSC1 datalogger.

The following instructions describe the procedure to enter SURVEY mode.

Note – Each time you turn the Criterion laser rangefinder on, you must re-enter SURVEY mode.

1. Turn on the Criterion by pressing the POWER button (the bottom-left button on the back of the unit).

    If you have a Criterion 400, the *main menu* appears with the TREE entry visible:

    ```
    TREE
    ```
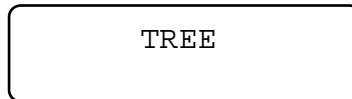
    If you have a Criterion 300, the *main menu* appears with the HEIGHT entry visible:

    ```
    HEIGHT
    ```

2.   Press the ↑ or ↓ arrow buttons until the SURVEY menu appears:

```
        SURVEY
```

3.   Press the ENTER button to select the SURVEY menu.

The first entry in the SURVEY menu is the BASIC MEASUREMENTS operation:

```
         BASIC
      MEASUREMENTS
```

4.   Press ENTER again to select BASIC MEASUREMENTS.

The following screen appears:

```
HD:-------.-- FT
AZ:------.- DEG
```

Your Criterion is now ready to be used in conjunction with a datalogger running the Asset Surveyor software, as described later in this chapter.

*Note – To return to the Criterion's main menu, press the **EXIT** button repeatedly.*

The following sections—Specifying Units, Enabling Measurement Errors, Entering a Compass Offset, and Ensuring Accurate Heights— describe further configuration that may make the Criterion laser rangefinder easier to use and/or obtain better results. They may, however, be skipped if you want to immediately proceed to test the laser rangefinder with your Trimble GPS system.
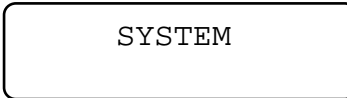
Specifying units

The Criterion laser rangefinder lets you select the units in which distances and angles are displayed on its LCD.

*Note – The units displayed on the rangefinder's LCD do **not** affect the interpretation of data by the Asset Surveyor software. They simply let you view distances and angles in whatever units are most suitable for your application.*

You can change the Criterion's units as follows:

1.   Return to the rangefinder's *main menu* (by pressing the EXIT button repeatedly).

2.   Press the ↑ or ↓ arrow buttons until the SYSTEM configuration menu appears:

```
          SYSTEM
```

3.   Press the ENTER button to select the SYSTEM menu.
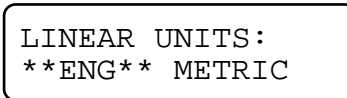
     The first entry in the SYSTEM menu is the UNITS DEC.PRECISION category:

```
          UNITS
      DEC. PRECISION
```

4.   Press ENTER again to select UNITS DEC. PRECISION.

     The following screen appears:

```
LINEAR UNITS:
**ENG** METRIC
```

     The Criterion supports ENG (that is, English) and METRIC linear distance units (that is, feet or meters).

5. Use the ← or → arrow buttons to select ENG or METRIC and then press ENTER.

6. Now press the ↓ arrow button to move on to the ANGULAR UNITS screen:

```
ANGULAR UNITS:
 **DEG**   GRAD
```

The Criterion supports DEG (that is, degrees) and GRAD (gradians) as angular units.

7. Use the ← or → arrow buttons to select DEG or GRAD and then press ENTER.

8. Press the EXIT button twice to return to the Criterion's *main menu*.

Enabling measurement error messages

Laser Technology Inc. recommends that new users of the Criterion enable measurement error messages. By default, these messages are disabled. Once measurement error messages are enabled, the rangefinder informs you whenever a measurement is invalid for some reason.

Once you become experienced with the Criterion rangefinder, you can disable measurement errors if you want.

To enable or change the measurement errors setting:

1. Select the top-level SYSTEM menu from the Criterion's *main menu*.

2. Press the ↓ arrow button to scroll down to the MEASUREMENT ERRORS entry:

```
    MEASUREMENT
      ERRORS
```

3. Press the ENTER button.

The following screen is displayed:

```
DISPLAY ERRORS?
 **YES**    NO
```

4. Use the ← or → buttons to enable or disable the display of measurement error messages and then press ENTER.

5. Press EXIT twice to return to the Criterion's *main menu*.

When a measurement error is detected, the Criterion displays an error code on its LCD. The meaning of each code is indicated in Table I.2.

Table I.2   Error messages

Message	Cause and actions
Error 1	The laser rangefinder failed to lock onto its target. Either the target was too close or it was out of range. Alternatively, the laser was not held steadily enough.
Error 2	The laser did not receive the minimum required pulses back to determine the range to the target. Hold the instrument steady and on target.
Error 3	The laser was moved off target while taking a reading. Keep the laser steady and on target.
Error 4	The tilt sensor is out of range. The maximum tilt angle permitted is ±60°.
Error 5	The fluxgate compass is outside its level range. When taking a compass reading, you must keep the instrument's tilt within a range of ±15°.

Press the CLEAR button to clear the error message.

Entering a compass offset

The Criterion laser rangefinders let you specify two compass offsets:

• A *Declination Offset*, which can be used to specify the local difference between magnetic North and true North

• A *Fixed Offset*, that can be used to make sure the alignment of the compass with the laser unit is accurate.

Your Criterion laser rangefinder has an accompanying Certificate of Calibration, which lists the preconfigured fixed compass offset, if any. It is safest not to modify this value.

You can, however, modify the declination offset to take account of local magnetic field variations. Only do this if you are operating in an area where a local phenomenon such as large mineral deposit or mountain range has a substantial and stable influence on the earth's magnetic field.

Use the following procedure to modify the declination offset:
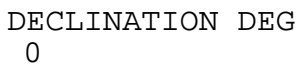
1. Select the top-level SYSTEM menu from the Criterion's *main menu*.

2. Press the ↑ or ↓ arrow buttons to scroll down to the COMPASS OFFSETS entry:

```
COMPASS
OFFSETS
```

3. Press the ENTER button.

   The following screen appears:

```
DECLINATION DEG
0
```

4. Use the numeric buttons on the right-hand side of the Criterion's control panel to enter the local magnetic declination offset (in degrees or gradians, as previously configured).

The maximum declination permitted by the Criterion laser rangefinder is 30°.

5. Press ENTER to finish entering the declination.

6. Press EXIT twice to return to the Criterion's *main menu*.

⚠ **Warning –** You probably want to use the Criterion laser rangefinder separately from your TSC1 datalogger. If so, you probably want to configure the laser's DECLINATION so that the bearings displayed by the Criterion are relative to true north. If you do so, you *must* set the Asset Surveyor software's *Magnetic declination* field to 0°, to avoid the declination being applied twice. If you use your Criterion laser rangefinder exclusively with the TSC1 datalogger, it is best to leave the laser's DECLINATION set to 0 and modify the Asset Surveyor software's *Magnetic declination* field; this enables the Asset Surveyor software to correctly convert other magnetic bearings to true north (for example, when navigating, checking the positions of satellites, and so forth).

⚠ **Warning –** If you specify a local declination offset, you *must* make sure that you clear or re-specify this offset when you move to a new location.

Ensuring accurate heights

When you take a shot to a target point with the Criterion laser rangefinder, the rangefinder generates a three-dimensional offset to that target. This is used, in conjunction with a three-dimensional GPS position, to compute the position of the target in three dimensions. In order to obtain an accurate height for the target point, your configured antenna height must take account of the difference between the height of the GPS antenna and the height of the laser rangefinder.

Using the Criterion with the Asset Surveyor Software

As mentioned previously, the practical accuracy of the fluxgate compass in typical field trials is around ±1–2°. This yields a steady reduction in accuracy as the distance between the laser and a target point increases. At a distance of 100–200 m, the average positional error when using the Criterion rangefinder is approximately 2 m (in addition to the error of your GPS measurement).

Testing

When you first connect the Criterion 300 or 400 to your Trimble GPS system, test that it is correctly configured and that all components are working correctly.

The best way to achieve this is using the *External sensors* entry in the Asset Surveyor software's *Configuration* menu:
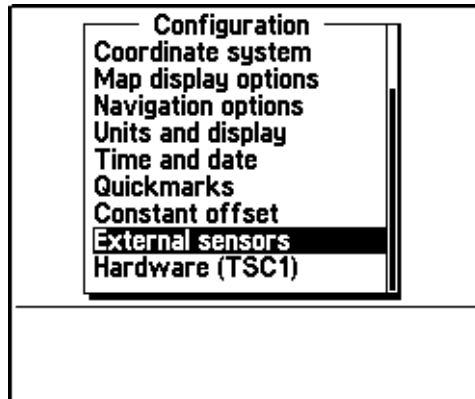
Select *External sensors* and the menu of available sensors appears:
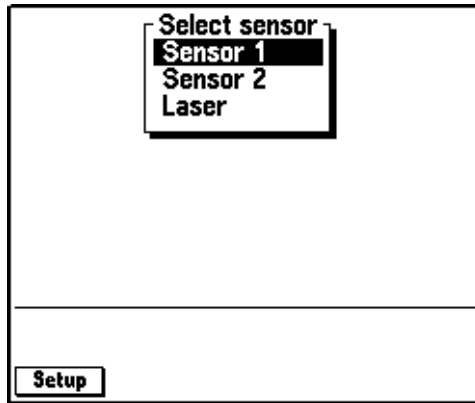
Configuring the Asset Surveyor software

Configure the special *Laser* sensor to work with the Criterion 300 or 400. To do this, highlight *Laser* from the *Select sensor* menu, and press the ⌐Setup⌐ softkey. The *Laser range-finder* configuration form appears:
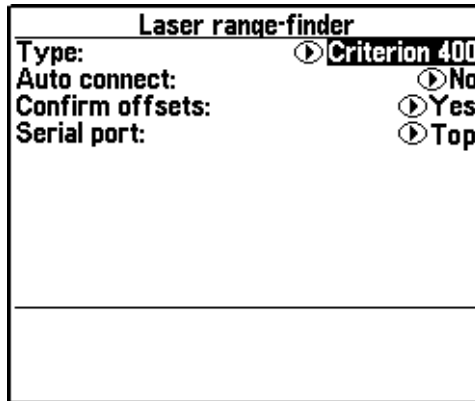
Set the *Type* field to either 'Criterion 300' or 'Criterion 400'. If you generally use a Criterion rangefinder when collecting data, and if you typically do *not* use any other type of external sensor, then set the *Auto-connect* field to 'Yes'.

Set the *Confirm offsets* field to 'On' to display the *Offset* form for the currently open feature whenever you send an offset from a laser rangefinder.

Set the *Confirm offsets* field to 'Off' to automatically record offset values to the open feature when you fire the rangefinder. The *Offset* form does not appear unless an entry is required, when it will appear automatically. The message Offset received appears briefly in the status line, but no other notification appears unless an entry is required. You can press `Offset` in the attribute entry form to open the *Offset* form if you want to confirm offset values.

Set the *Serial port* according to the port you connect the Criterion to, either 'Top' or 'Bottom'.

⚠ | **Warning –** The RS232 protocols used by the Criterion 300 and 400 rangefinders are different. You must specify the correct rangefinder in the *Type* field, otherwise the Asset Surveyor software fails to communicate with your rangefinder.

Press `Enter` to save these settings and return to the *Select sensor* menu.

Activating the laser interface

You can specify that you want the Asset Surveyor software to accept input from the laser rangefinder, by selecting the *Laser* entry from the *Select sensor* menu. When you do this, a check mark appears beside the *Laser* entry to indicate that the rangefinder interface has been activated:

```
┌ Select sensor ┐
  Geiger counter
  Tree caliper
 √Laser



  ─────────────────────

 Setup ║ Status
```

Once the rangefinder interface has been activated (and provided the *Laser* entry in the menu is highlighted), the ⌐Status⌐ softkey appears. Once the rangefinder interface has been activated, the Asset Surveyor software accepts communications from it. You can configure the Asset Surveyor software to automatically activate the laser rangefinder interface when you start data collection by setting the *Auto-connect* field to 'Yes', as described above.

If you attempt to activate the laser rangefinder interface and the serial port is already in use by another sensor, the Asset Surveyor software displays a message similar to the following:

```
┌─────────Error!─────────┐
│ Unable to open bottom serial port. │
│  This port may already be in use   │
└────────────────────────┘
```

The Asset Surveyor software does not activate the rangefinder interface.

Checking the laser interface

When the laser rangefinder is active (and highlighted in the list of external sensors), you can press ⟨Status⟩ to display a status form for the rangefinder:

```
┌───────────Criterion 400───────────┐
│ Bearing:                        ? │
│ Slope distance:            0.000m │
│ Inclination:                 0.0° │
│                                   │
│                                   │
│                                   │
│                                   │
│ ───────────────────────────────── │
│ ┌────────┐                        │
│ │ Format │                        │
│ └────────┘                        │
└───────────────────────────────────┘
```
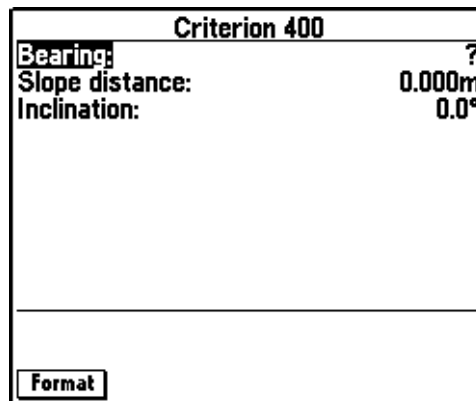
You can press ⌐Format⌐ to toggle between displaying slope distance/inclination and horizontal/vertical distance.

This form shows the most recent offset received from the laser rangefinder. If you take further readings using the rangefinder, these appear on the status form, replacing the previous reading.

You can take a reading with the Criterion rangefinder and transmit it to the Asset Surveyor software as follows:

1. Follow the instruction sequence described earlier in this chapter to set the Criterion into SURVEY mode.

2. Aim at a suitable target point at least 7 m (20 ft) away.

3. Keeping a steady hold on the instrument, aim through its scope and carefully pull the trigger, releasing it when you hear the laser acquiring lock on the target.

Tip – Readings from the Criterion's compass and inclinometer are continually averaged as long as you hold the trigger. To maximize the accuracy of these measurements, pull and hold the trigger for up to 10 seconds.

4. Hold the instrument completely still and on target until all sounds end.

    The distance and azimuth to the target point are displayed on the Criterion's LCD, for example:

    ```
    HD: 40.89 M
    AZ: 330.3 DEG
    ```

Warning – You can press the ↑ and ↓ arrow buttons to view other values such as the vertical angle and slope distance. You *must* return to the screen showing HD and AZ before performing step 5 (below), otherwise the Criterion does *not* send the full measurement details to the Asset Surveyor software.

5. Press the ENTER button on the Criterion to transmit this
    measurement to the Asset Surveyor software.

    If you were viewing the laser rangefinder status form, you
    would see the measurement arrive on the TSC1 datalogger's
    screen:

    ```
    ┌─────────────────────────────────────┐
    │          Criterion 400              │
    │ ▐Bearing:▌                 113.8°T  │
    │ Slope distance:            9.280m   │
    │ Inclination:                 7.5°   │
    │                                     │
    │                                     │
    │                                     │
    │                                     │
    │                                     │
    │                                     │
    │ ───────────────────────────────     │
    │                                     │
    │ ┌────────┐                          │
    │ │ Format │                          │
    │ └────────┘                          │
    └─────────────────────────────────────┘
    ```

The Asset Surveyor software displays the distance measurement in the
currently configured *Distance* units. The magnetic laser azimuth
(bearing) is converted to a true North azimuth. If the configured *North
reference* is *'True'*, it is immediately displayed as a true North bearing
(with a 'T' suffix); otherwise it is displayed as a magnetic North
bearing (with a 'M' suffix).

*Note – If the configured Magnetic declination is 'Auto', the Asset
Surveyor software's internal magnetic declination model is used to
convert the magnetic laser bearing to a true north bearing. Otherwise,
the manually entered declination is used for this conversion.*

✧ **Tip –** You can press the Criterion's ENTER button multiple times to send
the same measurement to the Asset Surveyor software repeatedly. Use
this technique to resend a measurement if you discover that you had not
connected all equipment or configured the Asset Surveyor software
before taking the measurement with the laser.

Collecting Data

The following sections outline data collection.

Activating the laser interface

Within *Data collection*, the laser rangefinder interface can be activated in one of two ways:

- Automatically, if you preconfigured the *Laser* sensor's *Auto-connect* field to 'Yes'.

- Manually, using the ⬚EXT softkey when logging data to a file.

Checking the laser interface

You can also use ⬚EXT softkey to access the *Select sensor* menu to reconfigure the laser rangefinder interface, or to check that the laser and the Asset Surveyor software are communicating correctly, as described above.

Recording an offset

Whenever you are collecting a point feature, you can use the Criterion laser rangefinder to record an offset to the feature. You can record an offset to a line, area, or quickmark feature only when you have pressed the ⬚Offset softkey to display the offset entry form for that feature.

🔅 **Tip –** You can turn off the Criterion when it is not being used to save its battery (for example, when walking between features or when entering attributes). The rangefinder can be used within seconds of turning it back on.

Laser Atlanta ProSurvey 1000

The ProSurvey 1000 produced by Laser Atlanta is a lightweight, handheld laser device, suitable for use with the Asset Surveyor software for the automated recording of offsets.

Hardware Specifications

The following sections detail the hardware specifications of the Laser Atlanta ProSurvey 1000.

Dimensions

The laser itself measures 8.4 cm × 25.4 cm × 27.9 cm (3.3" × 10" × 11"). It weighs 1.9 kg (4.25 lbs), excluding the power cord. The casing is made from cast aluminum.

Laser details

The laser can typically take measurements from 1.5 m to 760 m (5 ft to 2,500 ft) to uncooperative surfaces. For cooperative targets (for example, a reflector), the range of the laser is extended to 3,050 m (10,000 ft).

The laser is accurate to ±15.2 cm (6").

Compass details

A magnetic fluxgate compass is used to obtain azimuth measurements. The compass is rated at ±0.5° under laboratory conditions. In typical GIS data collection conditions, the compass tends to be accurate to around ±1–2°. In environments where magnetic interference is high (for example, in a vehicle), the compass can be considerably less accurate.

Inclinometer details

A built-in inclinometer measures vertical angles, which are used to calculate the elevation of target points. The inclinometer is accurate to 0.3°.

Powering

The ProSurvey 1000 rangefinder can be powered by either a rechargeable 12 V NiCd battery or a 12 V DC power source at 0.4 amps.

The standard ProSurvey 1000 battery charger takes approximately 15 hours to fully charge a battery (that is, overnight).

Environmental limitations

The ProSurvey 1000 rangefinder can be used at temperatures ranging between –30°C and +60°C (–22°F to +140°F). Relative humidity should not exceed 95%, non-condensing.

The ProSurvey should be stored at between –40°C and +80°C (–40°F to +176°F).

The rangefinder should always be transported in its hard carry-case.

Cabling for Use with the Asset Surveyor Software

The ProSurvey 1000 laser rangefinder can be purchased with an optional download cable. This cable provides a 9-pin connector which can be plugged directly into the ESP port of a Pro XL. For use with the Pro XR or Pro XRS, a second data cable (P/N 32287) is required as an adaptor to connect to the optional 9-pin adaptor.

Connect the ProSurvey 1000 to its battery pack, and plug the 9-pin connector into the adaptor cable and then into the TSC1 datalogger's serial port.

Cabling for the Pro XRS receiver

If you have a Pro XRS GPS receiver, connect the ProSurvey 1000 laser rangefinder to your receiver and datalogger as shown in Figure I.4.
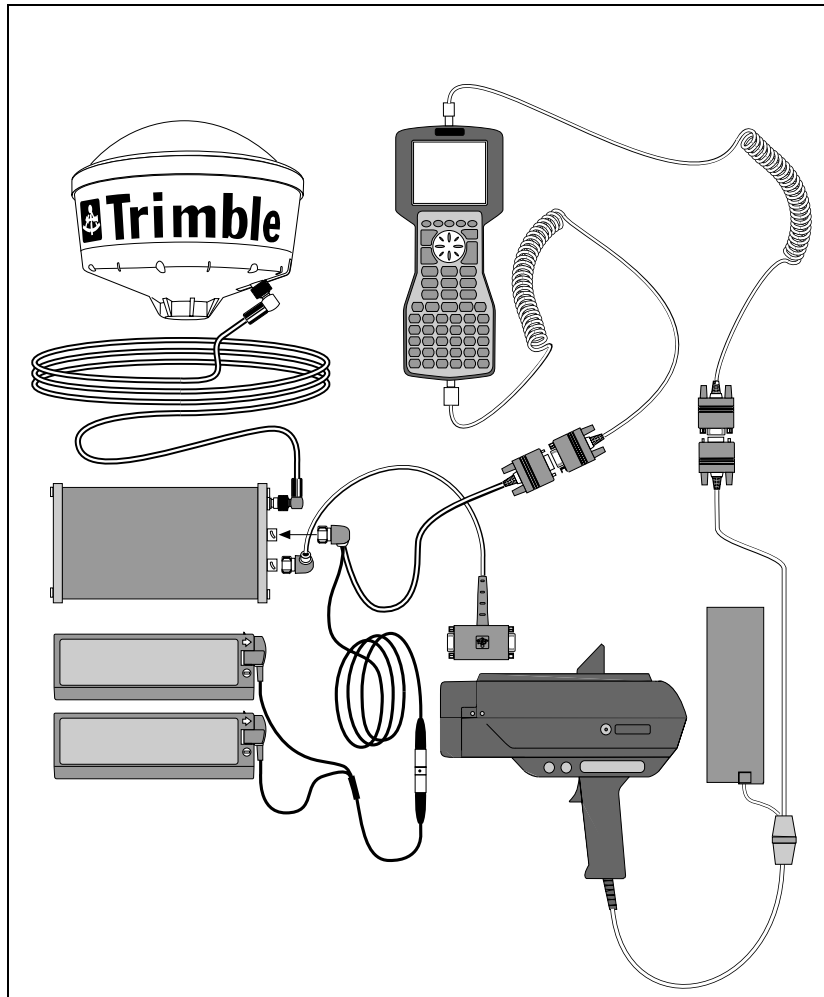
Figure I.4   ProSurvey 1000 laser rangefinder cabling diagram for Pro XRS with TSC1

Cabling for the Pro XR receiver

If you have a Pro XR GPS receiver, connect the ProSurvey 1000 laser rangefinder to your receiver and datalogger as shown in Figure I.5.
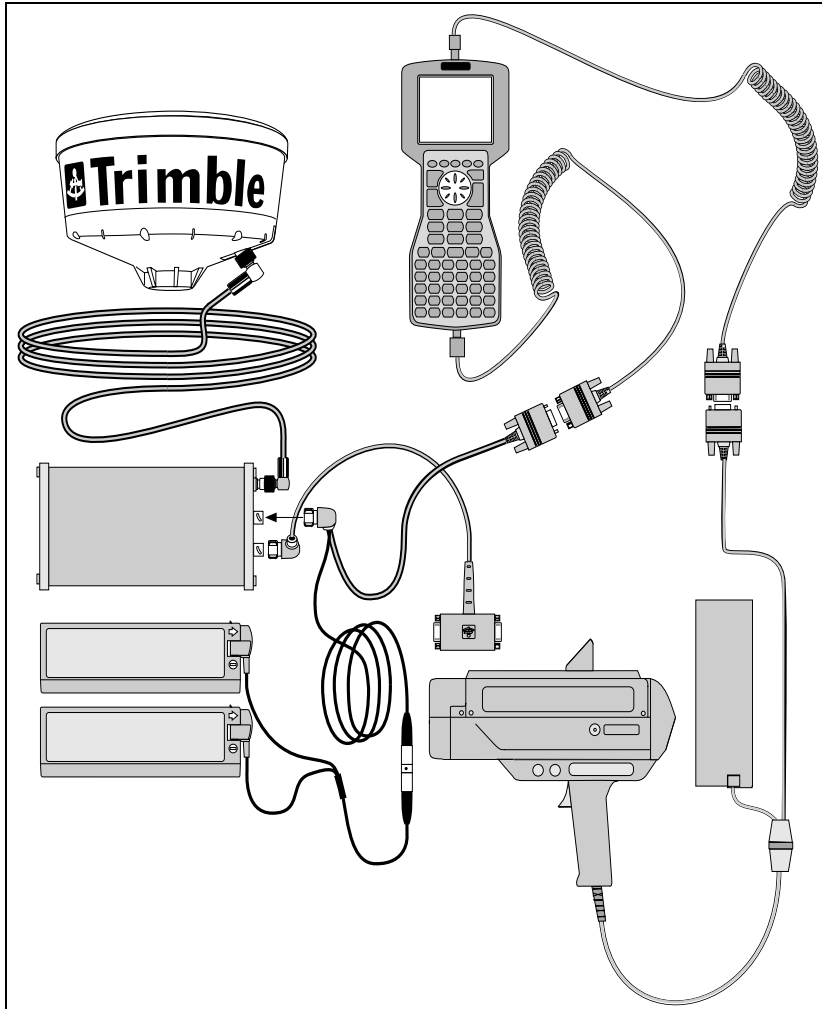
Figure I.5   ProSurvey 1000 laser rangefinder cabling diagram for Pro XR with TSC1

Cabling for the Pro XL receiver

If you have a Pro XL GPS receiver, connect the ProSurvey 1000 laser rangefinder to your receiver and datalogger as shown in Figure I.6.
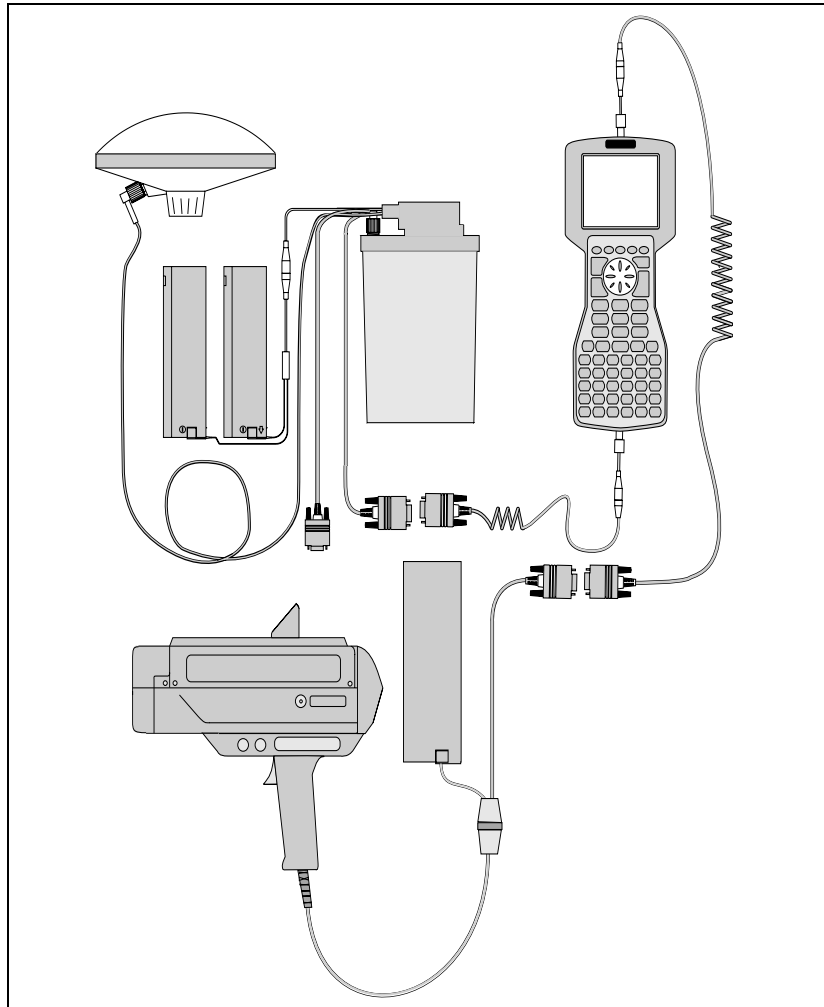
Figure I.6   ProSurvey 1000 laser rangefinder cabling diagram for Pro XL with TSC1

Configuration for Use with the Asset Surveyor Software

This section provides instructions for configuring the ProSurvey 1000 laser rangefinder itself. For more information on configuring the Asset Surveyor software to work with the ProSurvey 1000 laser rangefinder, see Using the ProSurvey 1000 with the Asset Surveyor Software, page 336.

EEPROM configuration

The ProSurvey 1000 contains an electrically erasable and programmable ROM chip (or EEPROM), which is used to hold a wealth of configurable settings. You can view and modify these settings using the LAEEPROM program, which can be obtained from Laser Atlanta.

For operation with the Asset Surveyor software, it is critical that three of the EEPROM settings be correctly configured. These are:

- range_mode, which *must* be set to Range (averaged)

- rs232_output_mode, which *must* be set to ASCII range output (on trig release)

- range_opcode, which *must* be set to New ProSurvey format

If any of these settings is incorrect, the ProSurvey 1000 does not output information about each laser shot in a form that can be interpreted by the Asset Surveyor software. The most likely symptom of this is that the Asset Surveyor software emits a warning beep each time the laser's trigger is released.

In addition, Trimble recommends that you set the hud_mode EEPROM setting to Bearing, so that you can watch the laser's compass bearing stabilize in the head-up display before taking each shot.

Calibration of the ProSurvey 1000

Whenever you use the ProSurvey 1000 after storing it for a period, or in a new environment, *calibrate* the ProSurvey's compass. This is particularly important if you feel that the site in which you are working is 'hostile' in the sense of there being local magnetic field distortions (for example, a vehicle, pipeline, overhead or underground power cable, and so forth). The purpose of calibration is to distribute compass error smoothly through a 360° circle.

Note – The calibration procedure does not modify the compass's idea of where magnetic north is. It simply distributes local distortion of the earth's magnetic field evenly through a 360° circle. This is important as it ensures that compass readings are locally consistent. If you want to account for an error in the compass's determination of magnetic north, do this by entering a new value for the Magnetic declination field in the Asset Surveyor software's Units and display configuration form.

Calibration of the compass is quick and extremely simple. Follow the instructions below:

1. Press the compass calibration control on the side of the ProSurvey 1000.

    This control is a black indented button on the right side of the unit (looking from the back), above and in front of the laser trigger.

    You are prompted in the head-up display to point the ProSurvey 1000 in approximate directions starting at 0° (due North), then turning clockwise to 45° (North East) and working around to 315° (North West) in increments of 45°.

2. Point in the indicated direction, wait for a few seconds to allow the compass to stabilize, and squeeze the laser's trigger.

    After each squeeze of the trigger, the head-up display indicates the next point of the compass.

3. After aiming in the 315° direction and squeezing the trigger, the rear panel of the ProSurvey 1000 indicates a Noise value, ranging from 0 to 9.

    The higher the value, the better the calibration. If the Noise value is below 5, perform the calibration again.

Using the ProSurvey 1000 with the Asset Surveyor Software

As mentioned previously, the practical accuracy of the fluxgate compass in typical field use is around ±1–2°. This yields a steady reduction in accuracy as the distance between the laser and a target point increases. At a distance of 100–200 m, the average positional error when using the ProSurvey 1000 is approximately 2 m (in addition to the error of your GPS measurement).

Testing

When you first connect the ProSurvey 1000 to your Trimble GPS system, test that it is correctly configured and that all components are working correctly.

Select the *Configuration* entry from the Asset Surveyor software's *Main menu*:

Select *External sensors* from the *Configuration* menu. The menu of available sensors appears:

```
┌─Select sensor─┐
│ Sensor 1      │
│ Sensor 2      │
│ Laser         │
└───────────────┘




─────────────────────────────

┌───────┐
│ Setup │
└───────┘
```

Configuring the Asset Surveyor software
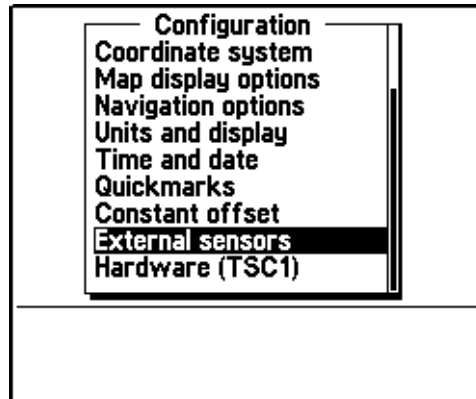
Configure the special *Laser* sensor to work with the ProSurvey 1000. To do this, press the `Setup` softkey. The *Laser range-finder* configuration form appears:

```
          Laser range-finder
Type:             ⏵ProSurvey 1000
Auto connect:             ⏵Yes
Confirm offsets:          ⏵Yes
Serial port:              ⏵Top




─────────────────────────────

```

Set the *Type* field to '*ProSurvey 1000*'. If you generally use the ProSurvey 1000 rangefinder when collecting data, and if you typically do **not** use any other type of external sensor, then set the *Auto-connect* field to 'Yes'.

Set the *Confirm offsets* field to 'On' to display the *Offset* form for the currently open feature whenever you send an offset from a laser rangefinder.

Set the *Confirm offsets* field to 'Off' to automatically record offset values to the open feature when you fire the rangefinder. The *Offset* form does not appear unless an entry is required, when it will appear automatically. The message Offset received appears briefly in the status line, but no other notification appears unless an entry is required. You can press ⌷Offset⌷ in the attribute entry form to open the *Offset* form if you want to confirm offset values.

Set the *Serial port* according to the port you connect the ProSurvey 1000 to, either 'Top' or 'Bottom'.

Press ⌷Enter⌷ to save these settings and return to the *Select sensor* menu.

Activating the laser interface

You can specify that you want the Asset Surveyor software to accept
input from the laser rangefinder, by selecting the *Laser* entry from the
Select sensor menu. When you do this, a check mark appears beside
the *Laser* entry to indicate that the rangefinder interface has been
activated:

Once the rangefinder interface has been activated (and provided the
Laser entry in the menu is highlighted), the Status softkey appears.
Once the rangefinder interface has been activated, the Asset Surveyor
software accepts communications from it. You can configure the Asset
Surveyor software to *automatically* activate the laser rangefinder
interface when you start data collection by setting the *Auto-connect*
field to 'Yes', as described above.

If you attempt to activate the laser rangefinder interface and the serial port is already in use by another sensor, the Asset Surveyor software displays a message similar to the following:

```
┌─────────── Error! ───────────┐
│ Unable to open bottom serial port. │
│  This port may already be in use   │
├────────────────────────────────────┤
│                                    │
│                                    │
│                                    │
│  _____  │
│                                    │
│                                    │
│                                    │
└────────────────────────────────────┘
```

The Asset Surveyor software does not activate the rangefinder interface.

Checking the laser interface

When the laser rangefinder is active (and highlighted in the list of external sensors), press ⌐Status⌐ to open a status form for the rangefinder:

```
┌─────────────────────────────────┐
│         ProSurvey 1000          │
│ Bearing:                      ? │
│ Slope distance:          0.000m │
│ Inclination:               0.0° │
│                                 │
│                                 │
│                                 │
│                                 │
│ ─────────────────────────────── │
│                                 │
│ ┌────────┐                      │
│ │ Format │                      │
│ └────────┘                      │
└─────────────────────────────────┘
```

You can press the ⌐Format⌐ softkey to toggle between displaying slope distance/inclination and horizontal/vertical distance.

This form shows the most recent offset received from the laser rangefinder. If you take further readings using the rangefinder, these appear on the status form, replacing the previous reading.

You can take a reading with the ProSurvey 1000 and transmit it to the Asset Surveyor software as follows:

1. Turn on the ProSurvey 1000, and optionally calibrate it (as described earlier).

2. Aim at a suitable target point. Wait for the bearing in the head-up display to stabilize.

⚠ **Warning –** If you do not wait until the bearing in the head-up display settles down before pulling the laser's trigger, then the compass measurement may be seriously inaccurate.

3. Keeping a steady hold on the instrument, aim through its scope and carefully pull the trigger.

   The distance to the target point is now displayed on the ProSurvey 1000's head-up display. The bearing and inclination are displayed on the LED.

4. Release the trigger. When you do this, the ProSurvey 1000 sends its measurement to the TSC1 datalogger.

   If you were viewing the laser rangefinder ⌐Status⌐ form, you would see the measurement arrive on the TSC1 screen:

```
          ProSurvey 1000
Bearing:                   130.9°T
Slope distance:            19.480m
Inclination:                  7.1°




_____

 Format
```

The Asset Surveyor software displays the distance measurement in the currently configured *Distance* units. The laser azimuth (bearing) is converted to a true North azimuth. If the configured *North reference* is 'True', it is immediately displayed as a true North bearing (with a 'T' suffix); otherwise it is displayed as a magnetic North bearing (with an 'M' suffix).

Note – If the configured Magnetic declination is 'Auto', the Asset Surveyor software's internal magnetic declination model is used to convert the magnetic laser bearing to a true north bearing. Otherwise, the manually entered declination is used for this conversion.

⚠ **Warning –** The ProSurvey 1000 always emits compass bearings relative to magnetic north. You *must* either specify your local magnetic declination or set the *Magnetic declination* field to 'Auto', otherwise the Asset Surveyor software does not correctly convert the magnetic compass bearings to true north.

The ProSurvey 1000 takes a few seconds to take a laser distance reading (although the bearing and inclination can be read almost immediately). If the Asset Surveyor software receives a message from the ProSurvey 1000 that lacks a distance measurement, the following warning message is displayed:

```
────── Warning ──────
Wait until a range has been recorded
   before releasing the laser trigger
```

Collecting Data

The following sections outline data collection.

Activating the laser interface

Within *Data collection*, the laser rangefinder interface can be activated in one of two ways:

• Automatically, if you preconfigured the *Laser* sensor's *Auto-connect* field to 'Yes'.

• Manually, using the ⌐EXT⌐ softkey when logging data to a file.

Checking the laser interface

You can also use the ⌐EXT⌐ softkey to access the *Select sensor* menu to reconfigure the laser rangefinder interface, or to check that the laser and the Asset Surveyor software are communicating correctly, as described above.

Recording an offset

Whenever you are collecting a point feature, you can use the ProSurvey 1000 laser rangefinder to record an offset to the feature. You can record an offset to a line, area, or quickmark feature only when you have pressed the ⌐Offset⌐ softkey to open the offset entry form for that feature.

Laser Atlanta Advantage

The Laser Atlanta Advantage is a lightweight, handheld laser device, suitable for use with the Asset Surveyor software for the automated recording of offsets.

Hardware Specifications

The following sections detail the hardware specifications of the Laser Atlanta Advantage.

Dimensions

The laser itself measures 25.4 cm (including grip) $\times$ 8.4 cm $\times$ 27.9 cm (10" $\times$ 3.3" $\times$ 11"). It weighs 1.9 kg (4.25 lbs), excluding the power cord. The casing is made from polycarbonate ABS.

Laser details

The laser can typically take measurements from 1.5 m to 760 m (5 ft to 2,500 ft) to uncooperative surfaces. For cooperative targets (for example, a reflector), the range of the laser is extended to 12,190 m (40,000 ft).

The laser is accurate to ±15.2 cm (6").

Compass details

A magnetic fluxgate compass is used to obtain azimuth measurements. The compass is rated at $\pm0.5°$ under laboratory conditions. In typical GIS data collection conditions, the compass tends to be accurate to around $\pm1°$. In environments where magnetic interference is high (for example, in a vehicle), the compass can be considerably less accurate.

Inclinometer details

A built-in inclinometer measures vertical angles, which are used to calculate the elevation of target points. The inclinometer is accurate to 0.2°.

Powering

The Advantage rangefinder is powered by a self-contained 6.3 V rechargeable Ni-Cd battery, located in the handle grip.

Environmental limitations

The Advantage rangefinder can be used at temperatures ranging between –30°C and +60°C (–22°F to +140°F). Relative humidity should not exceed 95%, non-condensing.

The Advantage should be stored at between –40°C and +80°C (–40°F to +176°F).

The rangefinder should always be transported in its hard carry-case.

Cabling for Use with the Asset Surveyor Software

The Advantage laser rangefinder can be purchased with an optional download cable. This cable provides a 9-pin connector which can be plugged directly into the ESP port of a Pro XL. For use with the Pro XR or Pro XRS, a second data cable (P/N 32287) is required as an adaptor to connect to the optional 9-pin adaptor.

Connect the Advantage to its battery pack, and plug the 9-pin connector into the GPS receiver's ESP port.

Cabling for the Pro XRS receiver

If you have a Pro XRS GPS receiver, connect the Advantage laser rangefinder to your receiver and datalogger as shown in Figure I.7.
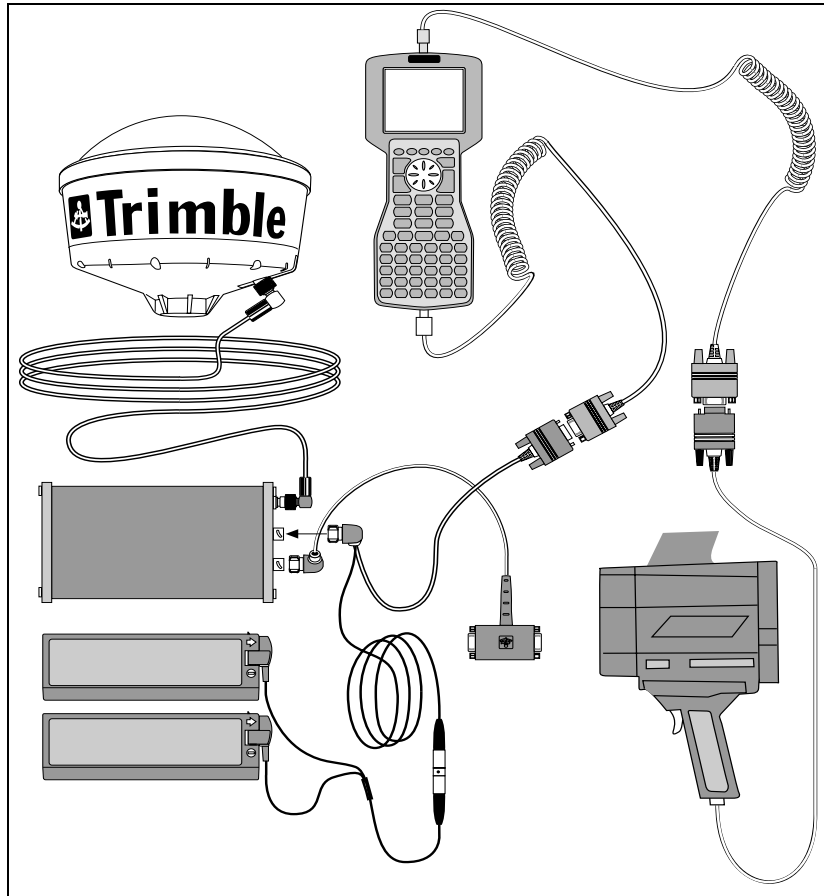
Figure I.7   Advantage laser rangefinder cabling diagram for Pro XRS with TSC1

Cabling for the Pro XR receiver

If you have a Pro XR GPS receiver, connect the Advantage laser rangefinder to your receiver and datalogger as shown in Figure I.8.
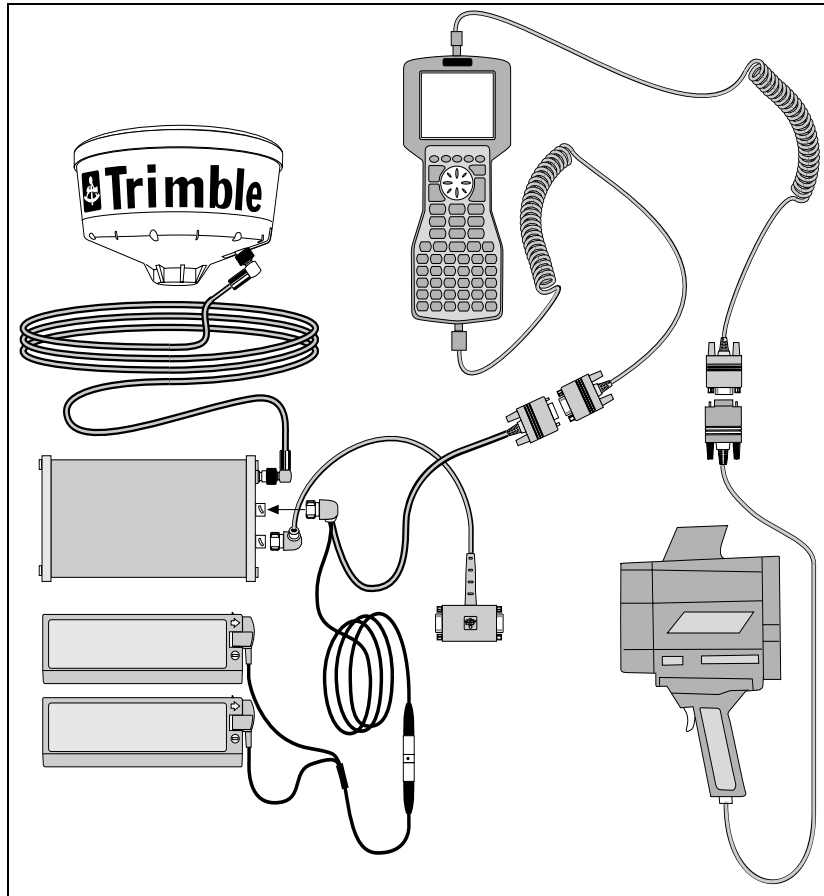
Figure I.8   Advantage laser rangefinder cabling diagram for Pro XR with TSC1

Cabling for the Pro XL receiver

If you have a Pro XL GPS receiver, connect the Advantage laser rangefinder to your receiver and datalogger as shown in Figure I.9.
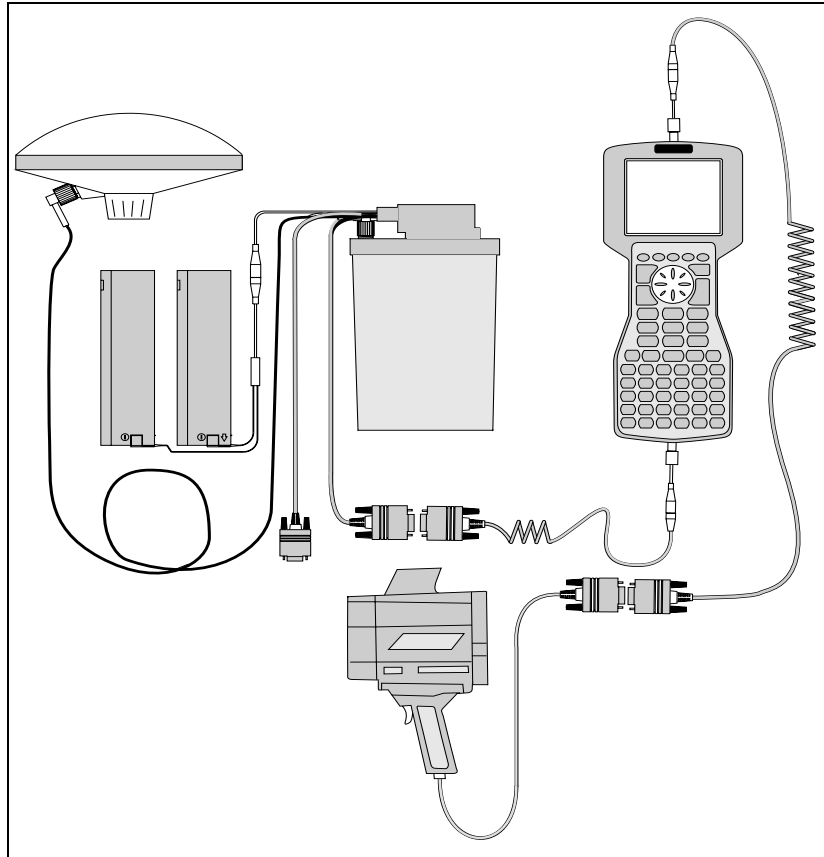
Figure I.9   Advantage laser rangefinder cabling diagram for Pro XL with TSC1

Configuration for Use with the Asset Surveyor Software

This section provides instructions for configuring the Advantage laser rangefinder itself. For more information on configuring the Asset Surveyor software to work with the Advantage laser rangefinder, see Using the Advantage with the Asset Surveyor Software, page 351.

EEPROM configuration

The Atlanta Advantage contains an electrically erasable and programmable ROM chip (or EEPROM), which is used to hold a wealth of configurable settings. You can view and modify these settings using the LAEEPROM program, which can be obtained from Laser Atlanta.

For operation with the Asset Surveyor software, two of the EEPROM settings must be correctly configured. These are:

- range_mode, which *must* be set to Standard (averaged)

- Serial Format, which *must* be set to Trimble Pro XL

If any of these settings is incorrect, the Advantage does not output information about each laser shot in a form that can be interpreted by the Asset Surveyor software. The most likely symptom of this is that the Asset Surveyor software emits a warning beep each time the laser's trigger is released.

Calibration of the Advantage

Whenever you use the Advantage after storing it for a period, or in a new environment, *calibrate* the Advantage's compass. This is particularly important if you feel that the site in which you are working is "hostile" in that there are local magnetic field distortions (for example, a vehicle, pipe-line, or overhead or underground power cable). The purpose of calibration is to distribute compass error smoothly through a 360° circle.

Calibration of the compass is quick and extremely simple. Follow the instructions below:

1. Press the compass calibration control option on the HUD (Heads Up Display).

    You are prompted in the head-up display to point the Advantage in approximate directions starting at 0° (due North),

2. Press Start.

3. In a clockwise direction moving in a 360° turn, adjust the pitch and roll of the Advantage for 60 seconds. After this, a number should appear (from 0 to 9) in the display. The higher the number, the better the calibration. If this value is below 5, perform the calibration again.

Note – The calibration procedure does not modify the compass's idea of where magnetic north is. It simply distributes local distortion of the earth's magnetic field evenly through a 360° circle. This is important as it makes sure that compass readings are locally consistent. If you want to account for an error in the compass's determination of magnetic north, do this by entering a new value for the Magnetic declination field in the Asset Surveyor software's Units and display configuration form.

Using the Advantage with the Asset Surveyor Software

As mentioned previously, the practical accuracy of the fluxgate compass in typical field use is around ±1°. This yields a steady reduction in accuracy as the distance between the laser and a target point increases. At a distance of 100–200 m, the average positional error when using the Advantage is approximately 1 m (in addition to the error of your GPS measurement).

Testing

When you first connect the Advantage to your Trimble GPS system, test that it is correctly configured and that all components are working correctly.

Select the *Configuration* entry from the Asset Surveyor software's *Main menu*:

```
┌──────── Configuration ────────┐
│ Coordinate system             │
│ Map display options           │
│ Navigation options            │
│ Units and display             │
│ Time and date                 │
│ Quickmarks                    │
│ Constant offset               │
│ External sensors              │
│ Hardware (TSC1)               │
└───────────────────────────────┘
```

Select *External sensors* from the *Configuration* menu. The menu of available sensors appears:

```
┌─ Select sensor ─┐
│ Sensor 1        │
│ Sensor 2        │
│ Laser           │
└─────────────────┘




  Setup
```
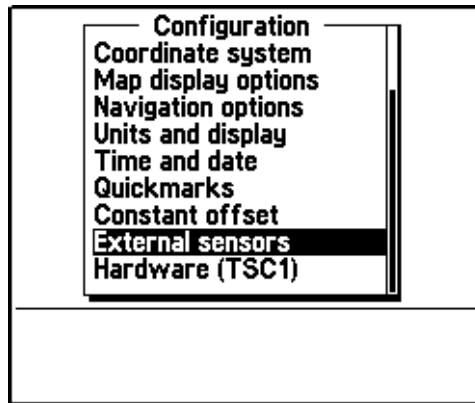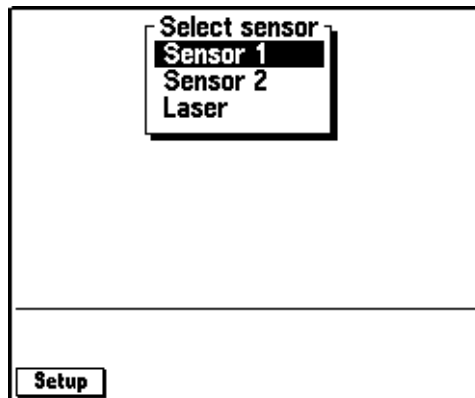
Configuring the Asset Surveyor software

Configure the special *Laser* sensor to work with the Laser Atlanta Advantage. To do this, press the ⌐Setup⌐ softkey. The *Laser range-finder* configuration form appears:

```
            Laser range-finder
 Type:            ⏵ Atlanta Advantage
 Auto connect:              ⏵Yes
 Confirm offsets:           ⏵Yes
 Serial port:               ⏵Top




 📱 🖵 📶 ⑤    PDOP    3.83
```

Set the *Type* field to '*Atlanta Advantage'*. If you generally use the Advantage rangefinder when collecting data, and if you typically do **not** use any other type of external sensor, then set the *Auto-connect* field to 'Yes'.

Set the *Confirm offsets* field to 'On' to display the *Offset* form for the currently open feature whenever you send an offset from a laser rangefinder.

Set the *Confirm offsets* field to 'Off' to automatically record offset values to the open feature when you fire the rangefinder. The *Offset* form does not appear unless an entry is required, when it will appear automatically. The message Offset received appears briefly in the status line, but no other notification appears unless an entry is required. You can press ⌐Offset⌐ in the attribute entry form to open the *Offset* form if you want to confirm offset values.

Set the *Serial port* according to the port you connect the Atlanta Advantage to, either 'Top' or 'Bottom'.

Press ⌐Enter⌐ to save these settings and return to the *Select sensor* menu.

Activating the laser interface

You can specify that you want the Asset Surveyor software to accept input from the laser rangefinder, by selecting the *Laser* entry from the *Select sensor* menu. When you do this, a check mark appears beside the *Laser* entry to indicate that the rangefinder interface has been activated:

```
┌─ Select sensor ─┐
  Geiger counter
  Tree caliper
 √Laser



  ─────────────────

 Setup │ Status
```

Once the rangefinder interface has been activated (and provided the *Laser* entry in the menu is highlighted), the `Status` softkey appears. Once the rangefinder interface has been activated, the Asset Surveyor software accepts communications from it. You can configure the Asset Surveyor software to ***automatically*** activate the laser rangefinder interface when you start data collection by setting the *Auto-connect* field to 'Yes', as described above.

If you attempt to activate the laser rangefinder interface and the serial port is already in use by another sensor, the Asset Surveyor software displays a message similar to the following:

```
┌─────────────Error!─────────────┐
│ Unable to open bottom serial port. │
│  This port may already be in use   │
└────────────────────────────────────┘
```

The Asset Surveyor software does not activate the rangefinder interface.

Checking the laser interface

When the laser rangefinder is active (and highlighted in the list of external sensors), press ⌑Status⌑ to open a status form for the rangefinder:

```
        Atlanta Advantage
Bearing:                      ?
Slope distance:         0.000m
Inclination:              0.0°




_____


 Format
```

You can press the ⌑Format⌑ softkey to toggle between displaying slope distance/inclination and horizontal/vertical distance.

This form shows the most recent offset received from the laser rangefinder. If you take further readings using the rangefinder, these appear on the status form, replacing the previous reading.

You can take a reading with the Advantage and transmit it to the Asset Surveyor software as follows:

1. Turn on the Advantage, and optionally calibrate it (as described earlier).

2. Aim at a suitable target point. Wait for the bearing in the head-up display to stabilize.

⚠ **Warning –** If you do not wait until the bearing in the head-up display settles down before pulling the laser's trigger, then the compass measurement may be seriously inaccurate.

3. Keeping a steady hold on the instrument, aim through its scope and carefully pull the trigger.

    The distance to the target point is now displayed on the Advantage's head-up display. The bearing and inclination are displayed on the LED.

4. Release the trigger. When you do this, the Advantage sends its measurement to the TSC1 datalogger.

    If you were viewing the laser rangefinder Status form, you would see the measurement arrive on the TSC1 datalogger's screen:

```
┌─────────────────────────────────────┐
│          Atlanta Advantage          │
│ Bearing:                    91.7°T  │
│ Slope distance:             6.890m  │
│ Inclination:                 -0.6°  │
│                                     │
│                                     │
│                                     │
│                                     │
│                                     │
│ ─────────────────────────────────── │
│                                     │
│ ┌────────┐                          │
│ │ Format │                          │
│ └────────┘                          │
└─────────────────────────────────────┘
```

The Asset Surveyor software displays the distance measurement in the currently configured *Distance* units. The laser azimuth (bearing) is converted to a true North azimuth. If the configured *North reference* is *'True'*, it is immediately displayed as a true North bearing (with a 'T' suffix); otherwise it is displayed as a magnetic North bearing (with an 'M' suffix).

Note – If the configured Magnetic declination is 'Auto', the Asset Surveyor software's internal magnetic declination model is used to convert the magnetic laser bearing to a true north bearing. Otherwise, the manually entered declination is used for this conversion.

⚠   **Warning –** The Advantage always emits compass bearings relative to
magnetic north. You *must* either specify your local magnetic declination or
set the *Magnetic declination* field to 'Auto', otherwise the Asset Surveyor
software does not correctly convert the magnetic compass bearings to
true north.

The Advantage takes a few seconds to take a laser distance reading
(although the bearing and inclination can be read almost immediately).
If the Asset Surveyor software receives a message from the Advantage
which lacks a distance measurement, the following warning message
is displayed:
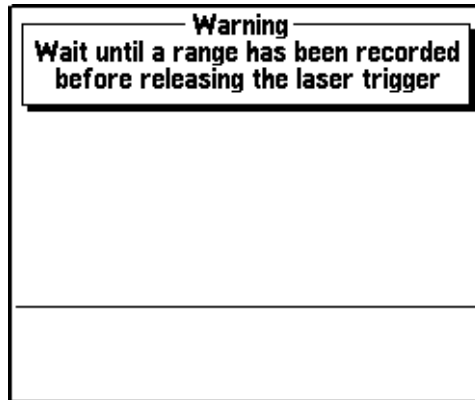
```
┌─────────── Warning ───────────┐
│ Wait until a range has been recorded │
│   before releasing the laser trigger  │
│                                        │
│                                        │
│                                        │
│ ────────────────────────────────────── │
│                                        │
└────────────────────────────────────────┘
```

Collecting Data

The following sections outline data collection.

Activating the laser interface

Within *Data collection*, the laser rangefinder interface can be activated in one of two ways:

- Automatically, if you had preconfigured the *Laser* sensor's *Auto-connect* field to 'Yes'.

- Manually, using the ⌐EXT⌐ softkey.

Checking the laser interface

You can also use the ⌐EXT⌐ softkey to access the *Select sensor* menu to reconfigure the laser rangefinder interface, or to check that the laser and the Asset Surveyor software are communicating correctly, as described above.

Recording an offset

Whenever you are collecting a point feature, you can use the Advantage laser rangefinder to record an offset to the feature. You can record an offset to a line, area, or quickmark feature only when you have pressed the ⌐Offset⌐ softkey to display the offset entry form for that feature.

LEDHA-GEO Laser Binoculars

The LEDHA-GEO produced by Jenoptik is a handheld laser device used very much like a pair of binoculars. The LEDHA-GEO is suitable for use with the Asset Surveyor software for the automated recording of offsets.

Hardware Specifications

The following sections detail the hardware specifications of the LEDHA-GEO Laser Binoculars.

Dimension

The LEDHA-GEO laser binoculars measure 25 cm x 20.5 cm x 9 cm (9.8" x 8.1" x 3.5"). They weigh 2.2 kg (4.88 lb) without the battery and 2.5 kg (5.5 lb) with the battery. The casing is made from rugged aluminum.

Laser details

The laser can typically take measurements up to 300 m (985 ft) to uncooperative surfaces. For cooperative targets (for example, a reflector), the range of the laser is extended to 3,000 m (9,840 ft). The laser is accurate to ± 10 cm (3.9").

Compass details

An internal electronic compass is used to obtain azimuth measurements. In typical GIS data collection conditions, this compass tends to be accurate to around ± 0.5 cm. In environments where magnetic interference is high (for example, in a vehicle), the compass can be considerably less accurate.

Powering

The LEDHA-GEO laser binoculars are powered by a self-contained 12 V battery. For recharging the battery, use only the charger (Pb charger) provided with the instrument. On average, recharging of a discharged battery takes approximately 5 to 7 hours.

Environmental limitations

The LEDHA-GEO laser binoculars can be used at temperatures ranging between –20°C and +50°C (–4°F and 122°F). When the temperature exceeds these limitations, the LEDHA-GEO automatically turns off.

Cabling for Use with the Asset Surveyor Software

The LEDHA-GEO laser binoculars can be purchased with an optional download cable. This cable provides a 9-pin connector which can be plugged directly into the ESP port of a Pro XL. For use with the Pro XR or Pro XRS, a second data cable (P/N 32287) is required as an adaptor to connect to the optional 9-pin adaptor.

Cabling for the Pro XRS receiver

If you have a Pro XRS GPS receiver, connect the LEDHA-GEO laser binoculars to your receiver and datalogger as shown in Figure I.10.
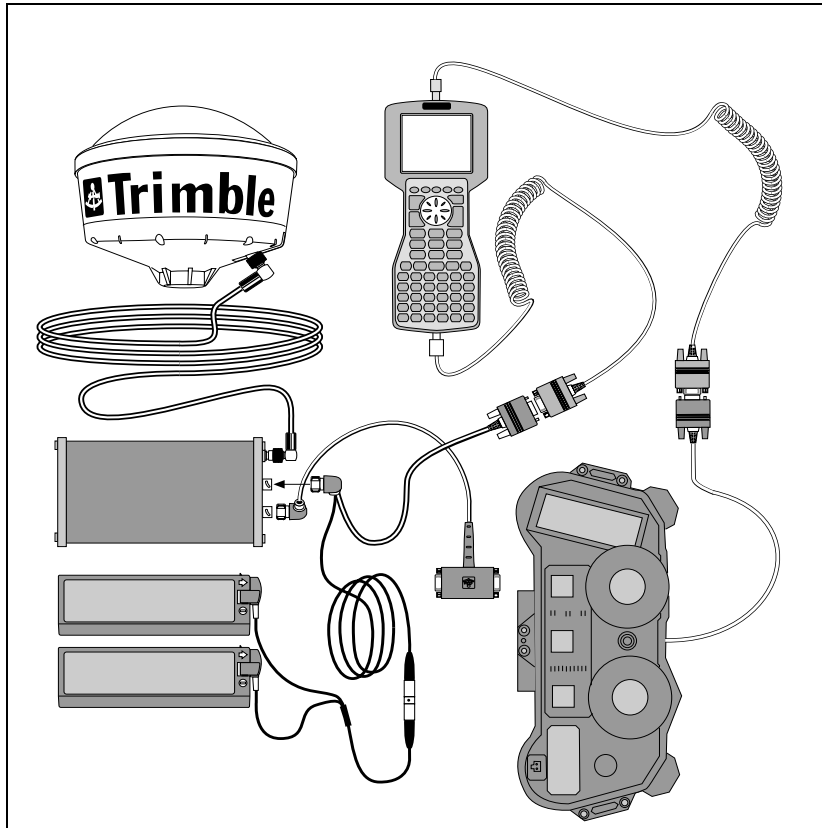
Figure I.10   LEDHA-GEO laser binoculars cabling diagram for Pro XRS with TSC1

Cabling for the Pro XR receiver

If you have a Pro XR GPS receiver, connect the LEDHA-GEO laser binoculars to your receiver and datalogger as shown in Figure I.11.
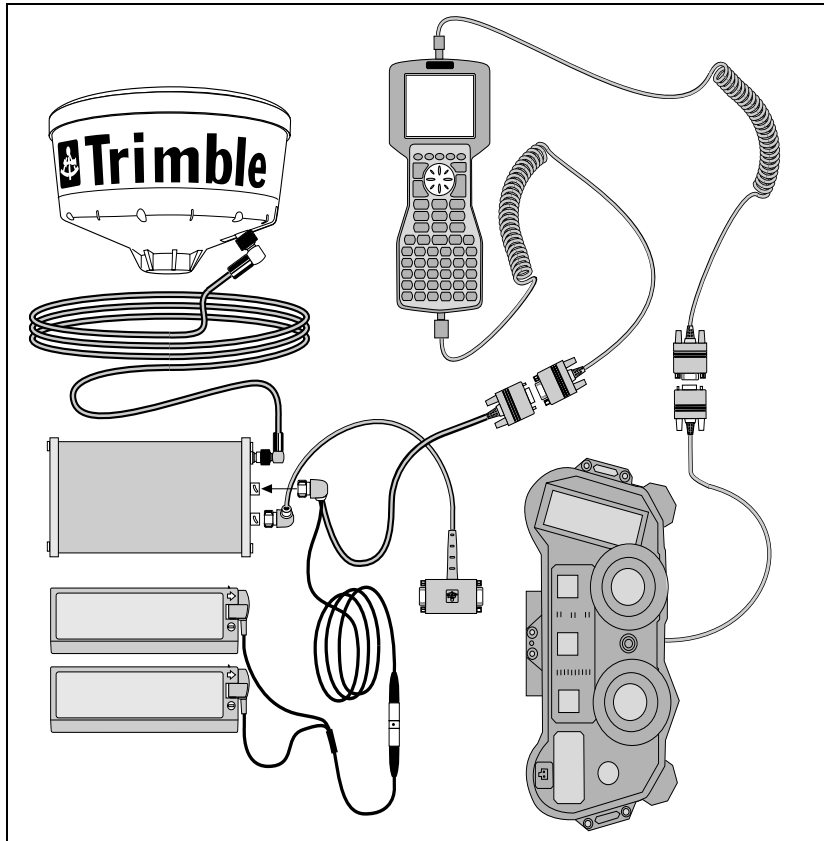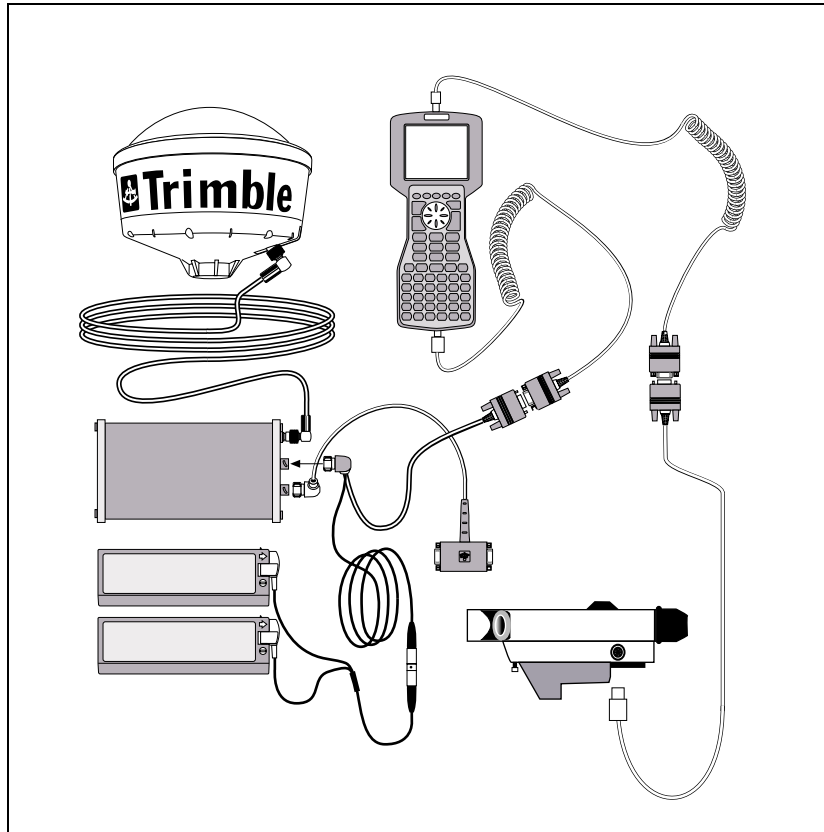

Figure I.11   LEDHA-GEO laser binoculars cabling diagram for Pro XR with TSC1

Cabling for the Pro XL receiver

If you have a Pro XL GPS receiver, connect the LEDHA-GEO laser binoculars to your receiver and datalogger as shown in Figure I.12.
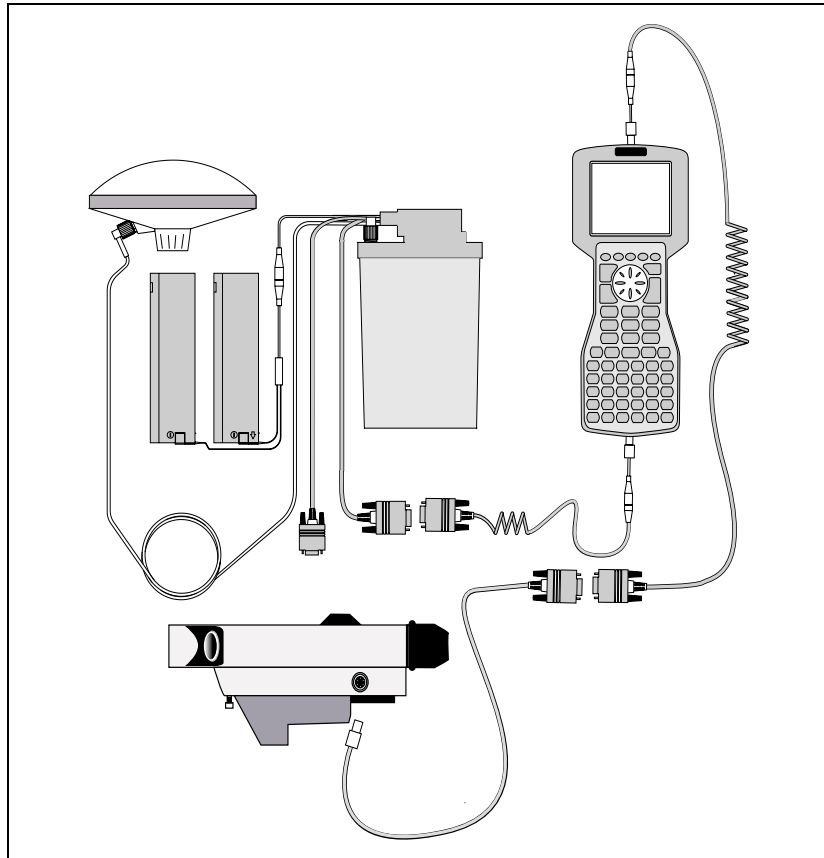

Figure I.12   LEDHA-GEO laser binoculars cabling diagram for Pro XL with TSC1

Configuration for Use with the Asset Surveyor Software

This section provides instructions for configuring the LEDHA-GEO laser binoculars for use with the Asset Surveyor software.

1. In the Asset Surveyor software's External Sensors configuration, select Laser and choose LEDHA-GEO as the type.

2. Connect the cable from the LEDHA to the datalogger.

3. Turn on the LEDHA and press the MODE button until B is selected.

4. Press PROGR until 1 is selected.

5. Turn the LEDHA off.

6. While holding down the LEDHA's **Memory** button, press MODE or PROGR to turn it on. Continue holding down the **Memory** button until the display appears in the LEDHA's viewer.

7. The configured baud rate should appear in the display, for example, baud 9k6. Using the '+' and '-' keys, change the baud rate to 4k8.

8. Press the **Memory** key to move to the next option.

9. When the Frame settings appear, change the setting to 8N1, again using the '+' and '-' keys to change the value and Memory to move to the next setting.

10. When Display appears, use '+' and '-' to set the brightness of the display.

11. The next option is the units to display for distance. Select whichever units you would like to see. This setting has no effect on the units displayed or stored by the Asset Surveyor software (this can be configured within the datalogger).

12. The next option is the Velocity units. This doesn't need to be changed because angles are not displayed within the LEDHA when taking measurements for the Asset Surveyor software.

13. Now the measurement program selection appears. You should see something like B 1 08. If the first two characters are not *B 1*, turn the LEDHA off and repeat from Step 3.

14. Use '+' and '-' to change the last two digits to 19.

15. To save the configuration turn the LEDHA off then press PROGR or MODE to turn it back on. It is now ready for operation with the Asset Surveyor software.

Using the LEDHA-GEO with the Asset Surveyor Software

The following sections outline how to use the LEDHA-GEO with the Asset Surveyor software.

Testing

When you first connect the LEDHA-GEO to your Trimble GPS system, test that it is correctly configured and that all components are working correctly.

Select the *Configuration* entry from the Asset Surveyor software's *Main menu*:

```
┌──── Configuration ────┐
 Coordinate system
 Map display options
 Navigation options
 Units and display
 Time and date
 Quickmarks
 Constant offset
 External sensors
 Hardware (TSC1)
```
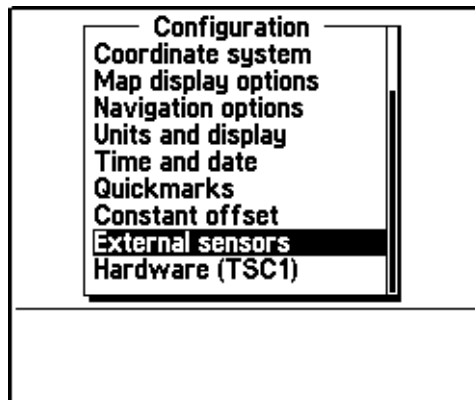
Select *External sensors* from the *Configuration* menu. The menu of available sensors appears:
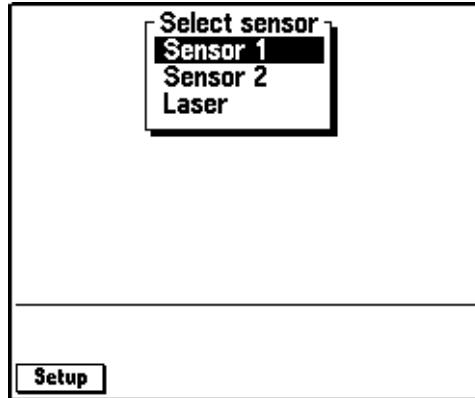
Configuring the Asset Surveyor software

Configure the special *Laser* sensor to work with the LEDHA-GEO. To do this, press the ⎡Setup⎤ softkey. The *Laser range-finder* configuration form appears:

```
┌────────────────────────────────┐
│       Laser range-finder        │
│ Type:              ⊙ LEDHA-GEO  │
│ Auto connect:          ⊙Yes     │
│ Confirm offsets:       ⊙Yes     │
│ Serial port:           ⊙Top     │
│                                 │
│                                 │
│                                 │
│  ─────────────────────────────  │
│                                 │
│                                 │
└────────────────────────────────┘
```

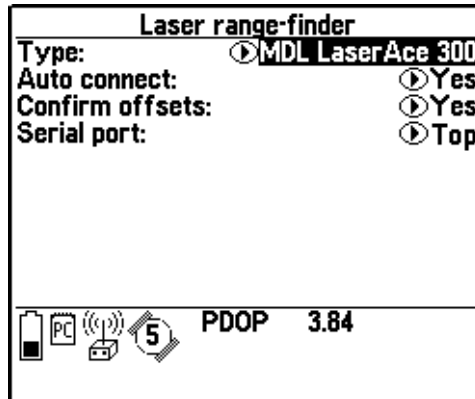Set the *Type* field to 'LEDHA-GEO'. If you generally use the LEDHA-GEO laser binoculars when collecting data, and if you typically do ***not*** use any other type of external sensor, then set the *Auto-connect* field to 'Yes'.

Set the *Confirm offsets* field to 'On' to display the *Offset* form for the currently open feature whenever you send an offset from a laser rangefinder.

Set the *Confirm offsets* field to 'Off' to automatically record offset values to the open feature when you fire the rangefinder. The *Offset* form does not appear unless an entry is required, when it will appear automatically. The message Offset received appears briefly in the status line, but no other notification appears unless an entry is required. You can press ⎡Offset⎤ in the attribute entry form to open the *Offset* form if you want to confirm offset values.

Set the *Serial port* according to the port you connect the LEDHA-GEO to, either 'Top' or 'Bottom'.

Press ⎡Enter⎤ to save these settings and return to the *Select sensor* menu.

Activating the laser interface

You can specify that you want the Asset Surveyor software to accept input from the laser rangefinder, by selecting the *Laser* entry from the *Select sensor* menu. When you do this, a check mark appears beside the *Laser* entry to indicate that the rangefinder interface has been activated:

Once the rangefinder interface has been activated (and provided the *Laser* entry in the menu is highlighted), the `Status` softkey appears. Once the rangefinder interface has been activated, the Asset Surveyor software accepts communications from it. You can configure the Asset Surveyor software to *automatically* activate the laser rangefinder interface when you start data collection, by setting the *Auto-connect* field to 'Yes', as described above.

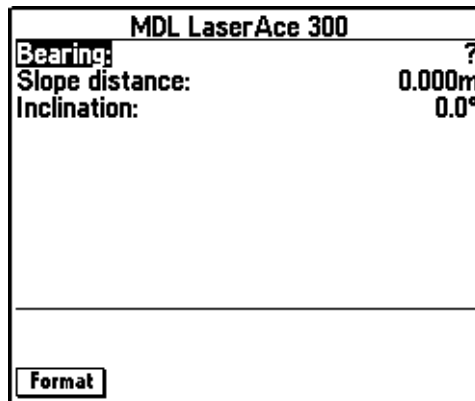If you attempt to activate the laser rangefinder interface and the serial port is already in use by another sensor, the Asset Surveyor software displays a message similar to the following:

```
┌──────────── Error! ────────────┐
│ Unable to open bottom serial port. │
│  This port may already be in use  │
└────────────────────────────────┘
```

The Asset Surveyor software does not activate the rangefinder interface.

Checking the laser interface

When the laser rangefinder is active (and highlighted in the list of external sensors), press ⌑Status⌑ to open a status form for the rangefinder:

```
┌──────────── LEDHA-GEO ────────────┐
│ Bearing:                        ?  │
│ Slope distance:            0.000m  │
│ Inclination:                 0.0°  │
│                                    │
│                                    │
│                                    │
│                                    │
│ ──────────────────────────────    │
│                                    │
│ [ Format ]                         │
└────────────────────────────────┘
```

You can press the `Format` softkey to toggle between displaying slope distance/inclination and horizontal/vertical distance.

This form shows the most recent offset received from the laser rangefinder. If you take further readings using the rangefinder, these appear on the status form, replacing the previous reading.

You can take a reading with the LEDHA-GEO and transmit it to the Asset Surveyor software as follows:

1.   Turn on the LEDHA-GEO, and optionally configure it (as described earlier).

2.   Aim at a suitable target point.

3.   Keeping a steady hold on the instrument, aim through its scope and carefully press the **Meas** button.

When the **Meas** button is pressed, the LEDHA-GEO sends its measurement to the TSC1 datalogger. (There is a delay of about 2 seconds between the time you press the **Meas** button to when the measurement is received by the TSC1 datalogger.)

If you were viewing the laser rangefinder status form, you would see the measurement arrive on the TSC1 screen:

The Asset Surveyor software displays the distance measurement in the currently configured *Distance* units. The laser azimuth (bearing) is converted to a true North azimuth. If the configured *North reference* is 'True', it is immediately displayed as a true North bearing (with a 'T' suffix); otherwise it is displayed as a magnetic North bearing (with a 'M' suffix).

Note – If the configured Magnetic declination is 'Auto', the Asset Surveyor software's internal magnetic declination model is used to convert the magnetic laser bearing to a true north bearing. Otherwise, the manually entered declination is used for this conversion.

⚠

Warning – The LEDHA-GEO always emits compass bearings relative to magnetic north. You *must* either specify your local magnetic declination or set the *Magnetic declination* field to 'Auto', otherwise the Asset Surveyor software does not correctly convert the magnetic compass bearings to true north.

The LEDHA-GEO takes a few seconds to take a laser distance reading (although the bearing and inclination can be read almost immediately). If the Asset Surveyor software receives a message from the LEDHA-GEO which lacks a distance measurement, the following warning message is displayed:

```
┌──────────── Warning ────────────┐
│ Wait until a range has been recorded │
│   before releasing the laser trigger  │
└─────────────────────────────────┘
```
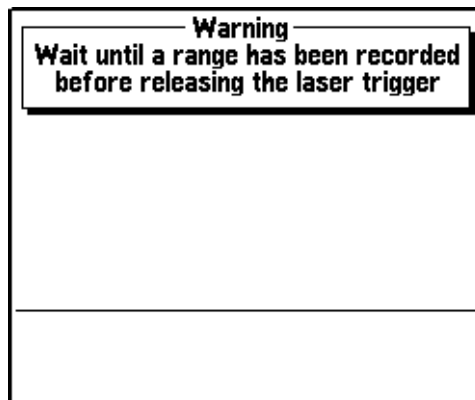
Collecting Data

The following sections outline data collection using the LEDHA-GEO with the Asset Surveyor software.

Activating the laser interface

Within data collection, the laser rangefinder interface can be activated in one of two ways:

- Automatically, if you preconfigured the *Laser* sensor's *Auto-connect* field to 'Yes'.

- Manually, using the ⌈ EXT ⌉ softkey.

Checking the laser interface

You can also use the ⌈ EXT ⌉ softkey to access the *Select sensor* menu to reconfigure the laser rangefinder interface, or to check that the laser and the Asset Surveyor software are communicating correctly.

Recording an offset

Whenever you are collecting a point feature, you can use the LEDHA-GEO laser rangefinder to record an offset to the feature. You can record an offset to a line, area, or quickmark feature only when you have pressed the ⌈ Offset ⌉ softkey to open the offset entry form for that feature.

To take a laser measurement for the Asset Surveyor software, aim the LEDHA at the target and press the **Meas** button. There is a short delay (1–2 seconds) and then the measurement appears in the Asset Surveyor software. When taking a measurement, hold the laser as steady as possible.

MDL LaserAce 300

The MDL LaserAce 300 is a lightweight, handheld laser device, suitable for use with the Asset Surveyor software for the automated recording of offsets.

Hardware Specifications

The following sections detail the hardware specifications of the MDL LaserAce 300.

Dimensions

The laser itself measures 17.5 cm $\times$ 10.6 cm $\times$ 5.6 cm (6.89" $\times$ 4.17" $\times$ 2.20"). It weighs 600 g (1.37 lbs). The casing is made from reinforced polycarbonate.

Laser details

The laser can typically take measurements of up to 300 m (985 ft) to uncooperative surfaces. For cooperative targets (for example, a reflector), the range of the laser is extended to 5,000 m (16,667 ft).

The laser is accurate to ±10.0 cm (3.9").

Compass details

A magnetic fluxgate compass is used to obtain azimuth measurements. The compass is accurate to less than $\pm1°$. In environments where magnetic interference is high (for example, in a vehicle), the compass can be considerably less accurate.

Inclinometer details

A built-in inclinometer measures vertical angles, which are used to calculate the elevation of target points. The inclinometer is accurate to $0.3°$.

Powering

The LaserAce 300 rangefinder is powered by two AA cell alkaline batteries.

Environmental limitations

The LaserAce 300 rangefinder can be used at temperatures ranging between –10°C and +45°C (+14°F to +113°F).

Accessories

The LaserAce 300 laser rangefinder can be used in four ways:

- As a handheld instrument.

- With a survey pole.

- With the optional monopod. The monopod includes an encoder module for high accuracy horizontal angle readings, a slot for a datalogger bracket, and a screw thread at the top of the monopod pole for attaching a GPS receiver or antenna.

- With the optional tripod. The laser rangefinder can be mounted on the tripod, using either a bracket or the MDL encoder module.

Cabling for Use with the Asset Surveyor Software

The LaserAce 300 laser rangefinder can be purchased with an optional download cable. This cable provides a 9-pin connector which can be plugged directly into the ESP port of a Pro XL. For use with the GPS Pathfinder Pro XR or Pro XRS, a second data cable (P/N 32287) is required as an adaptor to connect to the optional 9-pin adaptor.

Cabling for the Pro XRS receiver

If you have a Pro XRS GPS receiver, connect the LaserAce 300 laser rangefinder to your receiver and datalogger as shown in Figure I.13.
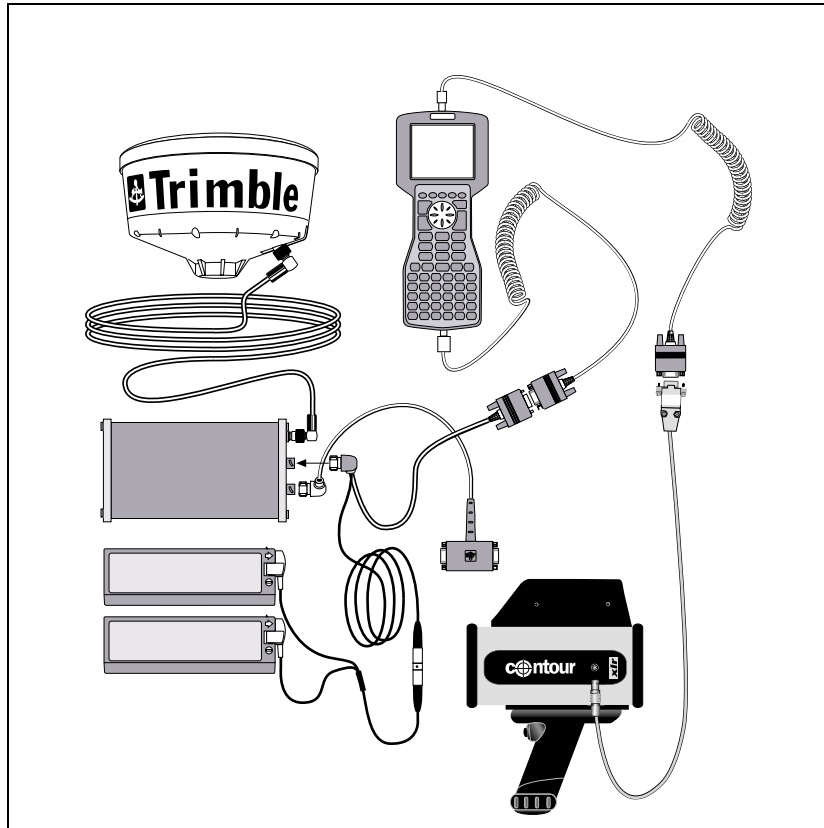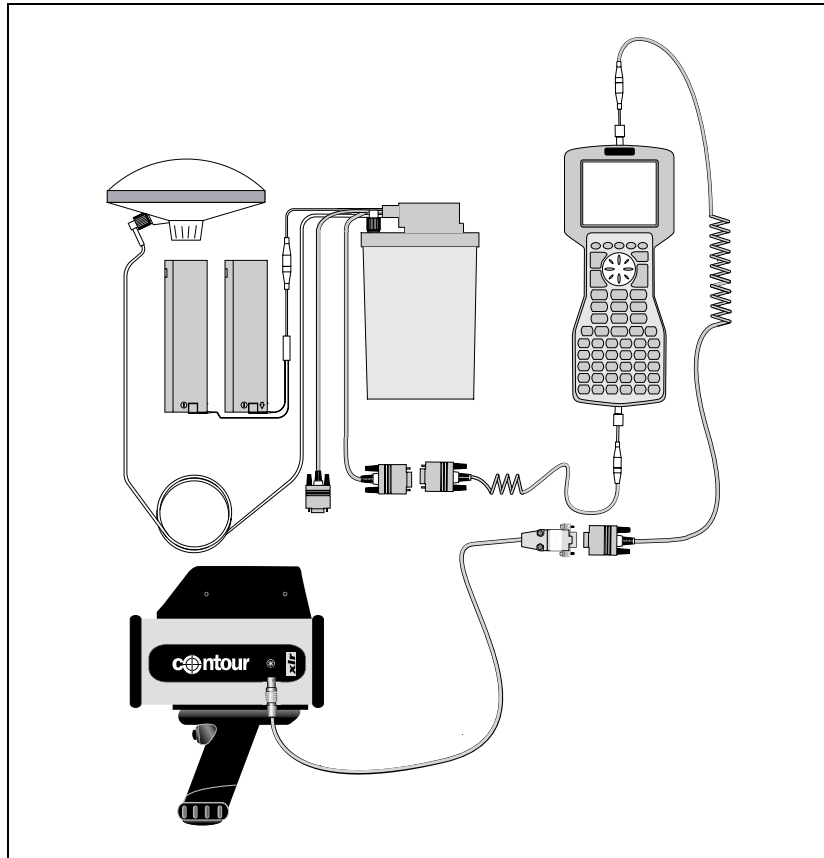

Figure I.13   LaserAce 300 laser rangefinder cabling diagram for Pro XRS with TSC1

Cabling for the Pro XR receiver

If you have a Pro XR GPS receiver, connect the LaserAce 300 laser rangefinder to your receiver and datalogger as shown in Figure I.14.

Figure I.14   LaserAce 300 laser rangefinder cabling diagram for Pro XR with TSC1

Cabling for the Pro XL receiver

If you have a Pro XL GPS receiver, connect the LaserAce 300 laser rangefinder to your receiver and datalogger as shown in Figure I.15.

Figure I.15   LaserAce 300 laser rangefinder cabling diagram for Pro XL with TSC1

Configuration for Use with the Asset Surveyor Software

This section provides instructions for configuring the LaserAce 300 laser rangefinder itself. For more information on configuring the Asset Surveyor software to work with the LaserAce 300 laser rangefinder, see Using the LaserAce 300 with the Asset Surveyor Software, page 380.

Calibration of the LaserAce 300

Whenever you use the LaserAce 300 after storing it for a period, or in a new environment, calibrate the LaserAce 300's compass. This is particularly important if you feel that the site in which you are working is hostile in the sense of there being local magnetic field distortions (for example, a vehicle, pipeline, or overhead or underground power cable). The purpose of calibration is to distribute compass error smoothly through a 360° circle.

Note – The calibration procedure does not modify the compass's idea of where magnetic north is. It simply distributes local distortion of the earth's magnetic field evenly through a 360° circle. This is important as it ensures that compass readings are locally consistent. If you want to account for an error in the compass's determination of magnetic north, do this by entering a new value for the Magnetic declination field in the Asset Surveyor software's Units and display configuration form.

Calibration of the compass is quick and simple. Follow the instructions below:

1. Press the **FIRE** button to turn on the LaserAce.

2. Press the ■ button until the display shows **Mode 3**.

3. Press the **FIRE** button.

    When the compass is ready for calibration, the display prompts you to point the LaserAce 300 in a sequence of directions starting at 0° (due North).

4. Follow the instructions on the screen to calibrate the instrument.

5. Press any button to exit Mode 3.

Using the LaserAce 300 with the Asset Surveyor Software
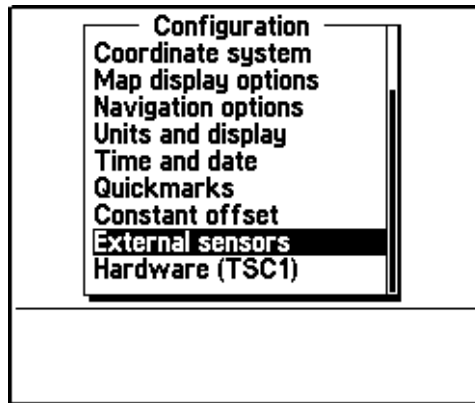
As mentioned previously, the practical accuracy of the fluxgate compass in typical field use is around ±1°. This yields a steady reduction in accuracy as the distance between the laser and a target point increases. At a distance of 100–200 m, the average positional error when using the LaserAce 300 is approximately 1 m (in addition to the error of your GPS measurement).

Testing

When you first connect the LaserAce 300 to your Trimble GPS system, test that it is correctly configured and that all components are working correctly.

Select the *Configuration* entry from the Asset Surveyor software's *Main menu*:

```
┌──── Configuration ────┐
│ Coordinate system     │
│ Map display options   │
│ Navigation options    │
│ Units and display     │
│ Time and date         │
│ Quickmarks            │
│ Constant offset       │
│ External sensors      │
│ Hardware (TSC1)       │
│                       │
│                       │
└───────────────────────┘
```

Select *External sensors* from the *Configuration* menu. The menu of available sensors appears:

```
┌─Select sensor─┐
│ Sensor 1      │
│ Sensor 2      │
│ Laser         │
└───────────────┘




─────────────────────────

┌──────┐
│ Setup│
└──────┘
```
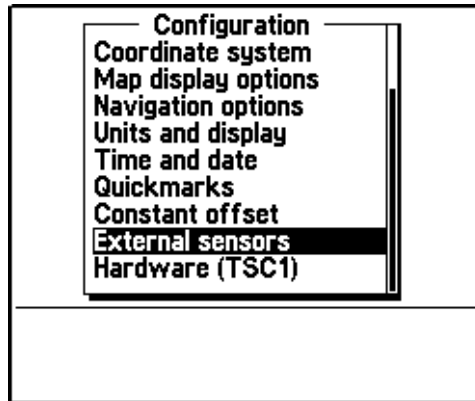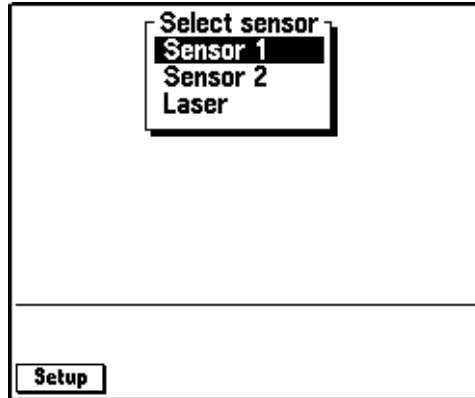
Configuring the Asset Surveyor software

Configure the special *Laser* sensor to work with the MDL LaserAce 300. To do this, press the ⌐Setup⌐ softkey. The *Laser range-finder* configuration form appears:

```
         Laser range-finder
Type:          ⏵MDL LaserAce 300
Auto connect:              ⏵Yes
Confirm offsets:           ⏵Yes
Serial port:               ⏵Top




 ▯ 🖳 ((⸱))  ⟨5⟩  PDOP   3.84
```

Set the *Type* field to '*MDL LaserAce 300*'. If you generally use the
LaserAce 300 rangefinder when collecting data, and if you typically
do **not** use any other type of external sensor, then set the *Auto-connect*
field to 'Yes'.

Set the *Confirm offsets* field to 'On' to display the *Offset* form for the
currently open feature whenever you send an offset from a laser
rangefinder.

Set the *Confirm offsets* field to 'Off' to automatically record offset
values to the open feature when you fire the rangefinder. The *Offset*
form does not appear unless an entry is required. The message Offset
received appears briefly in the status line, but no other notification
appears unless an entry is required. You can press ⌗Offset⌗ in the attribute
entry form to open the *Offset* form if you want to confirm offset
values.

Set the *Serial port* according to the port you connect the MDL
LaserAce 300 to, either 'Top' or 'Bottom'.

Press ⌗Enter⌗ to save these settings and return to the *Select sensor* menu.

Activating the laser interface

You can specify that you want the Asset Surveyor software to accept input from the laser rangefinder, by selecting the *Laser* entry from the *Select sensor* menu. When you do this, a check mark appears beside the *Laser* entry to indicate that the rangefinder interface has been activated:

```
┌─Select sensor─┐
 Geiger counter
 Tree caliper
 ✓Laser




─────────────────────

 Setup │ Status
```

Once the rangefinder interface has been activated (and provided the *Laser* entry in the menu is highlighted), the Status softkey appears. Once the rangefinder interface has been activated, the Asset Surveyor software accepts communications from it. You can configure the Asset Surveyor software to ***automatically*** activate the laser rangefinder interface when you start data collection by setting the *Auto-connect* field to 'Yes', as described above.

If you attempt to activate the laser rangefinder interface and the serial port is already in use by another sensor, the Asset Surveyor software displays a message similar to the following:

```
┌──────────── Error! ────────────┐
│ Unable to open bottom serial port. │
│ This port may already be in use │
└─────────────────────────────────┘
```

The Asset Surveyor software does not activate the rangefinder interface.

Checking the laser interface

When the laser rangefinder is active (and highlighted in the list of external sensors), press ⬚Status⬚ to open a status form for the rangefinder:

```
        MDL LaserAce 300
Bearing:                         ?
Slope distance:            0.000m
Inclination:                  0.0°




─────────────────────────────────

 Format
```

You can press the ⌈Format⌉ softkey to toggle between displaying slope distance/inclination and horizontal/vertical distance.

This form shows the most recent offset received from the laser rangefinder. If you take further readings using the rangefinder, these appear on the status form, replacing the previous reading.

You can take a reading with the LaserAce 300 and transmit it to the Asset Surveyor software as follows:

1. Turn on the LaserAce 300, and optionally calibrate it (as described earlier).

2. Aim at a suitable target point.

3. Keeping a steady hold on the instrument, aim through its scope and carefully press **FIRE**.

    The bearing, inclination, and distance to the target point are now displayed on the LaserAce 300's LED display. At the same time, the LaserAce 300 sends its measurement to the TSC1 datalogger.

    If you were viewing the laser rangefinder status form, you would see the measurement arrive on the TSC1 screen:

```
        MDL LaserAce 300
Bearing:                  91.7°T
Slope distance:           6.890m
Inclination:                -0.6°




_____

 Format
```

The Asset Surveyor software displays the distance measurement in the currently configured *Distance* units. The laser azimuth (bearing) is converted to a true North azimuth. If the configured *North reference* is 'True', it is immediately displayed as a true North bearing (with a 'T' suffix); otherwise it is displayed as a magnetic North bearing (with an 'M' suffix).

Note – If the configured Magnetic declination is 'Auto', the Asset Surveyor software's internal magnetic declination model is used to convert the magnetic laser bearing to a true north bearing. Otherwise, the manually entered declination is used for this conversion.

⚠ **Warning –** The LaserAce 300 always emits compass bearings relative to magnetic north. You must either specify your local magnetic declination or set the *Magnetic declination* field to 'Auto', otherwise the Asset Surveyor software does not correctly convert the magnetic compass bearings to true north.

The LaserAce 300 takes a few seconds to take a laser distance reading (although the bearing and inclination can be read almost immediately). If the Asset Surveyor software receives a message from the LaserAce 300 which lacks a distance measurement, the following warning message is displayed:
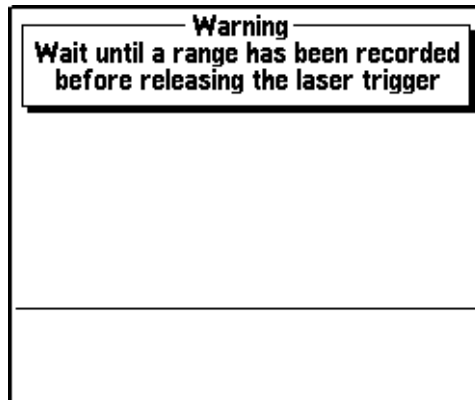
```
┌──────────── Warning ────────────┐
│ Wait until a range has been recorded │
│   before releasing the laser trigger │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│──────────────────────────────── │
│                                  │
│                                  │
└──────────────────────────────────┘
```

Collecting Data

The following sections outline data collection.

Activating the laser interface

Within *Data collection*, the laser rangefinder interface can be activated in one of two ways:

- Automatically, if you preconfigured the *Laser* sensor's *Auto-connect* field to 'Yes'.

- Manually, using the ⌑EXT⌑ softkey.

Checking the laser interface

You can also use the ⌑EXT⌑ softkey to access the *Select sensor* menu to reconfigure the laser rangefinder interface, or to check that the laser and the Asset Surveyor software are communicating correctly, as described above.

Recording an offset

Whenever you are collecting a point feature, you can use the LaserAce 300 laser rangefinder to record an offset to the feature. You can record an offset to a line, area, or quickmark feature only when you have pressed the ⌑Offset⌑ softkey to display the offset entry form for that feature.

LaserCraft Contour XLR

The LaserCraft Contour XLR is a lightweight, handheld laser device, suitable for use with the Asset Surveyor software for the automated recording of offsets.

Hardware Specifications

The following sections detail the hardware specifications of the LaserCraft Contour XLR.

Dimensions

The laser itself measures 18.8 cm $\times$ 10.8 cm $\times$ 25.4 cm (7.4" $\times$ 4.25" $\times$ 10"). It weighs 1.36 kg (3 lbs). The casing is made from reinforced polycarbonate.

Laser details

The laser can typically take measurements of up to 400 m (1312 ft) to uncooperative surfaces. For cooperative targets (for example, a reflector), the range of the laser is extended to 1,850 m (62,000 ft).

The laser is accurate to $\pm$15.0 cm (6").

Compass details

A magnetic fluxgate compass is used to obtain azimuth measurements. The compass is accurate to less than $\pm$0.5°. In environments where magnetic interference is high (for example, in a vehicle), the compass can be considerably less accurate.

Inclinometer details

A built-in inclinometer measures vertical angles, which are used to calculate the elevation of target points. The inclinometer is accurate to 0.3°.

Powering

The Contour XLR rangefinder is powered by an internal 9.6 V NiMH battery.

Environmental limitations

The Contour XLR rangefinder can be used at temperatures ranging between –10°C and +45°C (+14°F to +113°F).

Accessories

The Contour XLR laser rangefinder can be used in four ways:

- As a handheld instrument.

- With a survey pole.

- With the optional monopod. The monopod includes an encoder module for high accuracy horizontal angle readings, a slot for a datalogger bracket, and a screw thread at the top of the monopod pole for attaching a GPS receiver or antenna.

- With the optional tripod. The laser rangefinder can be mounted on the tripod, using either a bracket or the MDL encoder module.

Cabling for Use with the Asset Surveyor Software

The Contour XLR laser rangefinder can be purchased with an optional download cable. This cable provides a 9-pin connector which can be plugged directly into the ESP port of a Pro XL. For use with the GPS Pathfinder Pro XR or Pro XRS, a second data cable (P/N 32287) is required as an adaptor to connect to the optional 9-pin adaptor.

Cabling for the Pro XRS receiver

If you have a Pro XRS GPS receiver, connect the Contour XLR laser rangefinder to your receiver and datalogger as shown in Figure I.16.
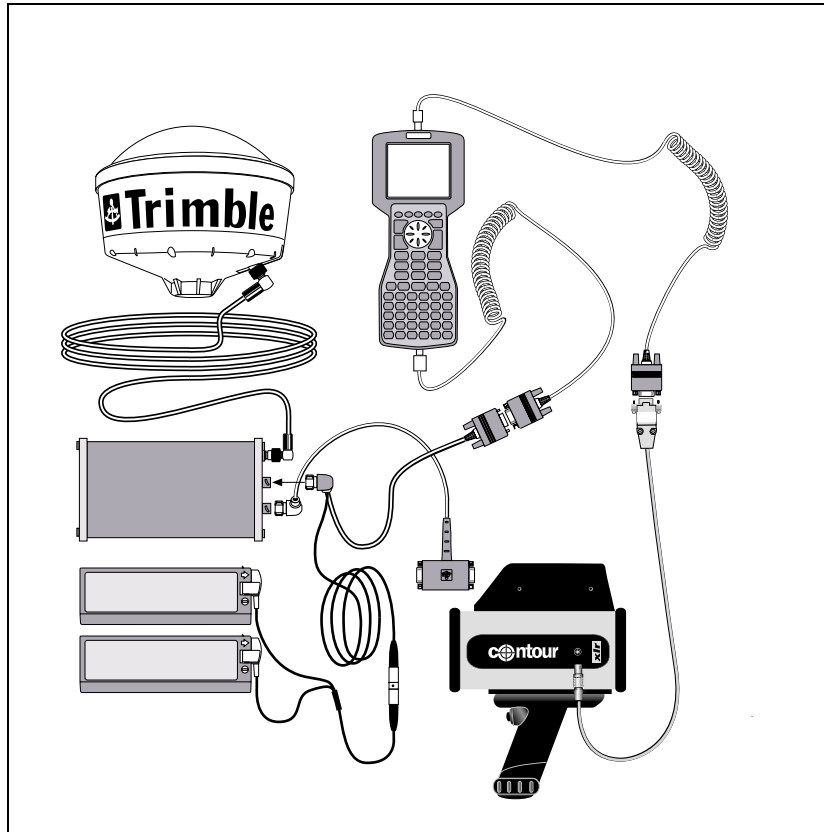
Figure I.16   Contour XLR laser rangefinder cabling diagram for Pro XRS with TSC1

Cabling for the Pro XR receiver

If you have a Pro XR GPS receiver, connect the Contour XLR laser rangefinder to your receiver and datalogger as shown in Figure I.17.

Figure I.17   Contour XLR laser rangefinder cabling diagram for Pro XR with TSC1

Cabling for the Pro XL receiver

If you have a Pro XL GPS receiver, connect the Contour XLR laser rangefinder to your receiver and datalogger as shown in Figure I.18.

Figure I.18   Contour XLR laser rangefinder cabling diagram for Pro XL with TSC1

Configuration for Use with the Asset Surveyor Software

This section provides instructions for configuring the Contour XLR laser rangefinder itself. For more information on configuring the Asset Surveyor software to work with the Contour XLR laser rangefinder, see Using the Contour XLR with the Asset Surveyor Software, page 394.

Calibration of the Contour XLR

Whenever you use the Contour XLR after storing it for a period, or in a new environment, calibrate the Contour XLR's compass. This is particularly important if you feel that the site in which you are working is hostile in the sense of there being local magnetic field distortions (for example, a vehicle, pipeline, or overhead or underground power cable). The purpose of calibration is to distribute compass error smoothly through a 360° circle.

Note – The calibration procedure does not modify the compass's idea of where magnetic north is. It simply distributes local distortion of the earth's magnetic field evenly through a 360° circle. This is important as it ensures that compass readings are locally consistent. If you want to account for an error in the compass's determination of magnetic north, do this by entering a new value for the Magnetic declination field in the Asset Surveyor software's Units and display configuration form.

Calibration of the compass is quick and simple. Follow the instructions below:

1.   Turn on the Contour XLR.

2.   Press the Menu key.

3.   Press the Down arrow key until the entry Comp appears in brackets, and then press Enter.

4.   Press the Down key until CAL is selected, and then press Enter.

     The display shows the message Initializing – please wait.

5. When the display shows the message Rotate unit for calibration, pull and hold the trigger.

6. Slowly rotate through 360° twice, taking 1–2 minutes per revolution. While turning, slowly pitch and roll the unit up and down and side to side.

    As the Contour XLR is rotated, the data point count on the display increases. When the count reaches 275, calibration is complete.

7. Release the trigger.

    The Contour XLR returns to the previous operating mode.

Using the Contour XLR with the Asset Surveyor Software

As mentioned previously, the practical accuracy of the fluxgate compass in typical field use is around ±0.5°. This yields a steady reduction in accuracy as the distance between the laser and a target point increases. At a distance of 100–200 m, the average positional error when using the Contour XLR is approximately 1 m (in addition to the error of your GPS measurement).

Testing

When you first connect the Contour XLR to your Trimble GPS system, test that it is correctly configured and that all components are working correctly.

Select the *Configuration* entry from the Asset Surveyor software's *Main menu*:

```
┌─── Configuration ───┐
│ Coordinate system   │
│ Map display options │
│ Navigation options  │
│ Units and display   │
│ Time and date       │
│ Quickmarks          │
│ Constant offset     │
│ External sensors    │
│ Hardware (TSC1)     │
└─────────────────────┘
```

Select *External sensors* from the *Configuration* menu. The menu of available sensors appears:

```
┌─ Select sensor ─┐
│ Sensor 1        │
│ Sensor 2        │
│ Laser           │
└─────────────────┘

 Setup
```
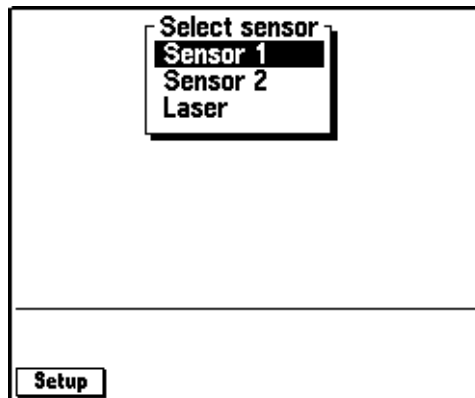
Configuring the Asset Surveyor software

Configure the special *Laser* sensor to work with the LaserCraft
Contour XLR. To do this, press the ⌷Setup⌷ softkey. The *Laser
range-finder* configuration form appears:

```
          Laser range-finder
Type:                ⊙Contour XLR
Auto connect:              ⊙Yes
Confirm offsets:           ⊙Yes
Serial port:               ⊙Top




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```

Set the *Type* field to '*Contour XLR'*. If you generally use the Contour
XLR rangefinder when collecting data, and if you typically do ***not*** use
any other type of external sensor, then set the *Auto-connect* field to
'Yes'.

Set the *Confirm offsets* field to 'On' to display the *Offset* form for the
currently open feature whenever you send an offset from a laser
rangefinder.

Set the *Confirm offsets* field to 'Off' to automatically record offset
values to the open feature when you fire the rangefinder. The *Offset*
form does not appear unless an entry is required. The message Offset
received appears briefly in the status line, but no other notification
appears unless an entry is required. You can press ⌷Offset⌷ in the attribute
entry form to open the *Offset* form if you want to confirm offset
values.

Set the *Serial port* according to the port you connect the LaserCraft
Contour XLR to, either 'Top' or 'Bottom'.

Press ⌷Enter⌷ to save these settings and return to the *Select sensor* menu.

Activating the laser interface

You can specify that you want the Asset Surveyor software to accept input from the laser rangefinder, by selecting the *Laser* entry from the *Select sensor* menu. When you do this, a check mark appears beside the *Laser* entry to indicate that the rangefinder interface has been activated:

```
┌ Select sensor ─┐
  Geiger counter
  Tree caliper
 √Laser




 ─────────────────────

 Setup   Status
```

Once the rangefinder interface has been activated (and provided the *Laser* entry in the menu is highlighted), the Status softkey appears. Once the rangefinder interface has been activated, the Asset Surveyor software accepts communications from it. You can configure the Asset Surveyor software to ***automatically*** activate the laser rangefinder interface when you start data collection by setting the *Auto-connect* field to 'Yes', as described above.

If you attempt to activate the laser rangefinder interface and the serial port is already in use by another sensor, the Asset Surveyor software displays a message similar to the following:

```
┌─────────Error!─────────┐
│ Unable to open bottom serial port. │
│  This port may already be in use   │
└────────────────────────┘
```

The Asset Surveyor software does not activate the rangefinder interface.

Checking the laser interface

When the laser rangefinder is active (and highlighted in the list of external sensors), press ⌷Status⌷ to open a status form for the rangefinder:

```
           Contour XLR
Bearing:                        ?
Slope distance:            0.000m
Inclination:                 0.0°




─────────────────────────────────

 Format
```

You can press the ⌐Format⌐ softkey to toggle between displaying slope distance/inclination and horizontal/vertical distance.

This form shows the most recent offset received from the laser rangefinder. If you take further readings using the rangefinder, these appear on the status form, replacing the previous reading.

You can take a reading with the Contour XLR and transmit it to the Asset Surveyor software as follows:

1. Turn on the Contour XLR, and optionally calibrate it (as described earlier).

2. Aim at a suitable target point.

3. Keeping a steady hold on the instrument, aim through its scope and carefully press **FIRE**.

    The bearing, inclination, and distance to the target point are now displayed on the Contour XLR's LED display. At the same time, the Contour XLR sends its measurement to the TSC1 datalogger.

    If you were viewing the laser rangefinder status form, you would see the measurement arrive on the TSC1 screen:

The Asset Surveyor software displays the distance measurement in the currently configured *Distance* units. The laser azimuth (bearing) is converted to a true North azimuth. If the configured *North reference* is '*True*', it is immediately displayed as a true North bearing (with a 'T' suffix); otherwise it is displayed as a magnetic North bearing (with an 'M' suffix).

Note – If the configured Magnetic declination is 'Auto', the Asset Surveyor software's internal magnetic declination model is used to convert the magnetic laser bearing to a true north bearing. Otherwise, the manually entered declination is used for this conversion.

⚠ **Warning –** The Contour XLR always emits compass bearings relative to magnetic north. You must either specify your local magnetic declination or set the *Magnetic declination* field to 'Auto', otherwise the Asset Surveyor software does not correctly convert the magnetic compass bearings to true north.

The Contour XLR takes a few seconds to take a laser distance reading (although the bearing and inclination can be read almost immediately). If the Asset Surveyor software receives a message from the Contour XLR which lacks a distance measurement, the following warning message is displayed:
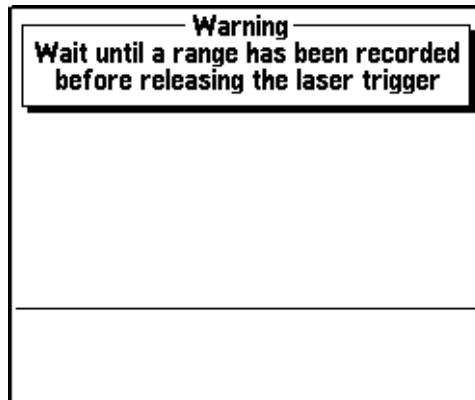
```
┌──────────── Warning ────────────┐
│ Wait until a range has been recorded │
│   before releasing the laser trigger  │
├──────────────────────────────────┤
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
└──────────────────────────────────┘
```

Collecting Data

The following sections outline data collection.

Activating the laser interface

Within *Data collection*, the laser rangefinder interface can be activated in one of two ways:

- Automatically, if you preconfigured the *Laser* sensor's *Auto-connect* field to 'Yes'.

- Manually, using the ⌐EXT⌐ softkey.

Checking the laser interface

You can also use the ⌐EXT⌐ softkey to access the *Select sensor* menu to reconfigure the laser rangefinder interface, or to check that the laser and the Asset Surveyor software are communicating correctly, as described above.

Recording an offset

Whenever you are collecting a point feature, you can use the Contour XLR laser rangefinder to record an offset to the feature. You can record an offset to a line, area, or quickmark feature only when you have pressed the ⌐Offset⌐ softkey to display the offset entry form for that feature.

External Sensors

In this chapter:

- Introduction
- Criterion laser rangefinder (used for measuring heights)
- Digital cameras
- Echo sounders

Introduction

This appendix provides examples of how to configure and use a variety of external sensors. Some of these examples refer to real sensors while others use hypothetical sensors to illustrate different aspects of the Asset Surveyor software's external sensor capability.

Note – Trimble provides no specific endorsement of the products named in the following sections. Additionally, Trimble provides no warranty or guarantee as to the ongoing performance of the named sensors with any Trimble GPS system. The named sensors have each been tested by Trimble, but as we have no control over different hardware or software versions, we cannot accept any responsibility for ensuring that these sensors continue to work with Trimble equipment.

Criterion Laser Rangefinder (used for Measuring Heights)

The Criterion 300 and 400 laser rangefinders can be used to automatically record offsets for features. They can also be used as external sensors for measuring the heights of geographical features (for example, trees, buildings, and so forth).

When operating in HEIGHT mode, the Criterion 300 rangefinder emits data messages of the following form:

$PLTIC3,HT,<height>,<units>*<checksum>

CR

LF

For example, a height of 16.68 meters is transmitted as:

$PLTIC3,HT,16.68,M*2B

CR

LF

You can configure an Asset Surveyor external sensor interface to recognize these messages and to strip off the message packaging. It is not possible for the Asset Surveyor software to actually verify the checksum (2B in the example above), as these vary from message to message.

Note – You can configure the Criterion to display and transmit heights in feet, in which case 'F' would appear in the RS232 message example above in place of the letter 'M'.

Note – The data messages emitted by the Criterion 400 differ slightly from those emitted by the Criterion 300 in that they begin with the prefix $PLTIT instead of $PLTIC3. If you are using a Criterion 400, be sure to substitute $PLTIT for $PLTIC3 when configuring your external sensor interface. The following examples refer specifically to the Criterion 300.

Data Dictionary Configuration

In order to make the best use of the heights transmitted by the Criterion rangefinders, set up a data dictionary with a Height attribute in each feature whose height concerns you. The Height attribute should be a numeric attribute with two decimal places and appropriate maximum and minimum values.

Note – The attribute's name does not have to be Height. It is, however, good practice for each attribute's name to reflect the nature of the data that you plan to record into it. The attribute name must be the same for each type of feature whose height you want to record using your rangefinder.

Asset Surveyor Configuration

Now configure an external sensor interface to receive height data from the Criterion.

1. From the Asset Surveyor *Configuration* menu, select *External sensors*:
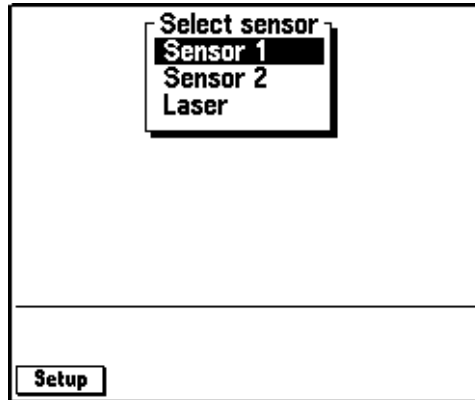
```
┌─ Select sensor ┐
│ Sensor 1       │
│ Sensor 2       │
│ Laser          │
└────────────────┘


───────────────────────────────

 Setup
```

2. Select *Sensor 1* from this menu by highlighting *Sensor 1* and pressing ⬚Setup⬚. The configuration form for external sensor number 1 appears:

```
            Sensor 1            ▾
Auto connect:              ⊙No
Name:                 Sensor 1
Channel:                     0
Connect:                     ?
Disconnect:                  ?
Data request:                ?
Intervals
 Point feature:           None
 Line/area:               None
 Not in feature:          None


 Comms
```
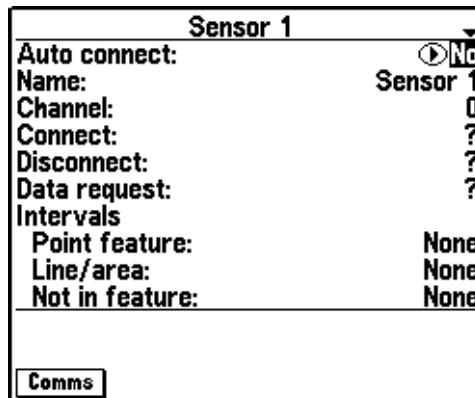
3. Change the fields in this form as shown below:

```
         Sensor 1          ▾
Auto connect:         ⏺ Yes
Name:          Height Sensor
Channel:                   0
Connect:                   ?
Disconnect:                ?
Data request:              ?
Intervals
  Point feature:         All
  Line/area:             All
  Not in feature:        ▨l

 Comms
```

```
         Sensor 1          ▴
Attribute:            Height
Data received
  Prefix:        $PLTIC3,HT,
  Suffix:               ,M*
  Max bytes:              ?
  Timeout:           0.100s
Audible click:       ⏺ Yes
Status line:          ⏺No

 Comms
```

Note – By using a prefix of $PLTIC3,HT, and a suffix of ,M*,
you cause the Asset Surveyor software to remove the packaging
characters which surround the actual height measurement. The
checksum, carriage-return and linefeed characters are then
ignored by the Asset Surveyor software.

4. Press ⌷Comms⌷ to open the configuration form for serial
    communications (RS232) parameters, and enter the following
    values:

```
                    Sensor 1
Serial port:                      ⊙ Top
Baud rate:                        ⊙ 4800
Data bits:                        ⊙ 8
Stop bits:                        ⊙ 1
Parity:                           ⊙ None
```

5. Press ⌷Enter⌷ to save the communications settings, then press ⌷Enter⌷
    to save the sensor configuration details. The Asset Surveyor
    software returns you to the *Select sensor* configuration menu,
    and renames the first entry to the name that you specified for the
    sensor:

```
         ┌ Select sensor ┐
         │ Height Sensor │
         │ Sensor 2      │
         │ Laser         │
         └───────────────┘




  ─────────────────────────────

  ┌ Setup ┐
```

> ☀ **Tip –** After configuring an external sensor interface, it is recommended that you always test this interface. Select the external sensor from the list by pressing the ⌨Enter key. A check mark appears beside the sensor name. Press Status to test this interface.

Using the Criterion to Record Heights

You can use the configured external sensor interface together with a Criterion 300 to record heights as attributes, by following this procedure:

1. Create a new rover data file.

    When the Asset Surveyor software opens this file, it automatically activates the pre-configured external sensor interface (as the *Auto-connect* field was set to 'Yes' in the previous section).

    The Asset Surveyor software can now communicate with the Criterion 300 rangefinder and you can begin to record heights.

2. Start a feature.

    One of your feature's attributes has the name *Height*, and it is this attribute which is used to store heights recorded by the Criterion 300.

3. Enter attribute values for the feature while the Asset Surveyor software logs GPS positions.

    It is usually easiest to manually enter attributes before taking a recording with an external sensor. By following a set procedure like this you are less likely to forget to record or enter a particular piece of information.

4. Follow the procedure described in the *Criterion 300/400 Operator's Guide* for recording a height with the Criterion 300.

The procedure essentially involves taking a distance measurement to the object in question, then taking an angle measurement to the base and top of the object.

5. Press the ENTER button on the Criterion's keypad to send the height to your TSC1 datalogger.

   Provided you have configured your external sensor interface correctly, and have connected and operated the Criterion 300 correctly, a value like 15.4 appears as the *Height* attribute for your feature.

6. Press <kbd>Enter</kbd> to save the feature.

   From this point on, the Asset Surveyor software treats the *Height* attribute as if it had been entered manually. It has no special properties.

Switching between Recording Laser Offsets and Heights

You can use a Criterion laser rangefinder both for measuring offsets ***and*** for measuring the heights of objects. However, in order for the Asset Surveyor software to process these different types of data, you must indicate whether the Criterion is being used as an offset sensor or as a height sensor. You do this by alternately activating and deactivating the *Height sensor* and *Laser* entries in the *Select sensor* menu (accessible under the <kbd>EXT</kbd> softkey when collecting data).

⌖ **Tip –** Do not configure both the *Height sensor* and the *Laser* to auto-connect; if you do this, only the *Height sensor* is activated and an error message appears when the Asset Surveyor software attempts to automatically activate the *Laser* interface.

Digital Cameras

Certain digital cameras can be controlled through an RS232 port. A message can be sent to the camera to trigger the taking of a photograph, and the camera may respond with a message that can be used subsequently to identify the photographic image that was recorded by the camera.

A hypothetical camera communicates at 9600 baud with 8 data bits, 1 stop bit and odd parity. It is triggered either by pressing a button on the camera itself or by sending the ASCII character '*' to the camera. When the camera is mounted on a vehicle it is typically easier to trigger the camera with an RS232 message. Each time the camera takes a photograph (whether triggered manually or with an RS232 message), it stores the digital image to its internal memory and emits the following message to its RS232 port:

$PIC,nn

CR

LF

where *nn* indicates the number of the stored image (1 to 64).

You can configure an Asset Surveyor external sensor to trigger the taking of a photograph whenever you press the ⌐Read⌐ softkey, and to store the number of the digital image as an attribute called *Photo* as follows:

1.   From the Asset Surveyor *Configuration* menu, select *External sensors*:
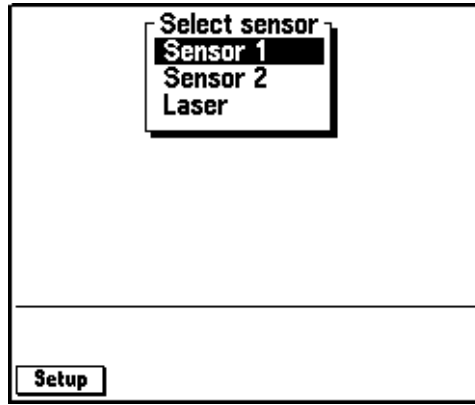
2.   Select *Sensor 1* from this menu by highlighting *Sensor 1* and pressing ⌐Setup⌐. The configuration form for external sensor number 1 appears:
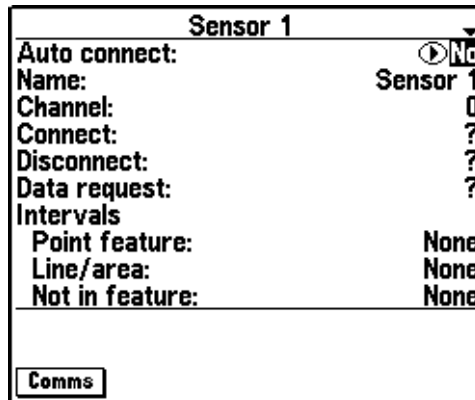
3. Change the fields in this form as shown below:

```
┌─────────────────────────────────┐
│           Sensor 1           ▾ │
│ Auto connect:          ⏵ Yes  │
│ Name:            Digital camera │
│ Channel:                     0 │
│ Connect:                     ? │
│ Disconnect:                  ? │
│ Data request:                * │
│ Intervals                      │
│   Point feature:          None │
│   Line/area:              None │
│   Not in feature:         None │
│                                │
│  ┌───────┐                     │
│  │ Comms │                     │
│  └───────┘                     │
└─────────────────────────────────┘
```

```
┌─────────────────────────────────┐
│           Sensor 1           ▴ │
│ Attribute:              Photo  │
│ Data received                  │
│   Prefix:               $PIC,  │
│   Suffix:              \0D\0A  │
│   Max bytes:                ? │
│   Timeout:            0.100s  │
│ Audible click:        ⏵ Yes   │
│ Status line:          ⏵No     │
│                                │
│  ┌───────┐                     │
│  │ Comms │                     │
│  └───────┘                     │
└─────────────────────────────────┘
```

4. Press ⌞Comms⌟ to display the configuration form for serial communications (RS232) parameters, and enter the following values:

```
                    Sensor 1
Serial port:                    ⊙▶ Top
Baud rate:                      ⊙▶ 9600
Data bits:                       ⊙▶ 8
Stop bits:                       ⊙▶ 1
Parity:                         ⊙▶ Odd



           _____


```

5. Press ⌞Enter⌟ to save the communications settings, then press ⌞Enter⌟ to save the sensor configuration details.

The Asset Surveyor software returns you to the *Select sensor* configuration menu, and renames the first entry to the name that you specified for the sensor:

```
        ┌ Select sensor ┐
        │ Digital camera │
        │ Sensor 2       │
        │ Laser          │
        └────────────────┘




     _____


  [ Setup ]
```

Echo Sounders

Echo-sounders are widely used to measure the depth of a body of water at a particular point, together with such phenomena as the level of sedimentation and the biomass (quantity of marine life). Most echo sounders emit measurements as they are taken (typically one or more per second).

The most common mapping application for an echo sounder is to map the seabed, and in this case you configure the Asset Surveyor software to log each message from the echo sounder as an UNINTERPRETED_SENSOR_DATA record (which is not associated with a feature).

A hypothetical echo sounder might measure the sea's depth and transmit this information once per second at 4800 baud, with 8 data bits, 2 stop bits and no parity. Each measurement is emitted as a message with the following format:

XXXX.X

where *XXXX.X* is the depth of the sea at the point the measurement was taken. There are no delimiting characters that identify the start or end of each message, so the Asset Surveyor software must rely on timing information and the maximum length of 6 characters to isolate each message.

You can configure an Asset Surveyor external sensor interface to log a depth message from this hypothetical echo sounder every 5 seconds as follows:

1. From the Asset Surveyor *Configuration* menu, select *External sensors*:
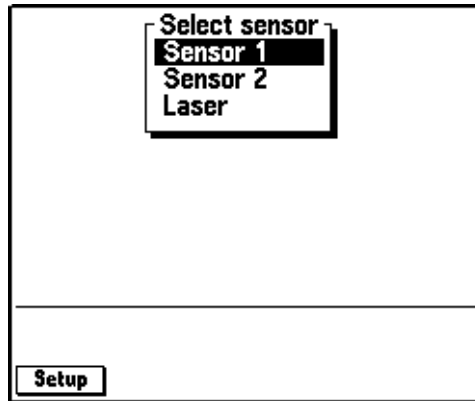
```
┌ Select sensor ┐
│ Sensor 1      │
│ Sensor 2      │
│ Laser         │
└───────────────┘




─────────────────

 Setup
```

2. Select *Sensor 1* from this menu by highlighting *Sensor 1* and pressing ⎡Setup⎤. The configuration form for external sensor number 1 appears:

```
           Sensor 1              ▾
Auto connect:            ⊙No
Name:                Sensor 1
Channel:                    0
Connect:                    ?
Disconnect:                 ?
Data request:               ?
Intervals
  Point feature:         None
  Line/area:             None
  Not in feature:        None


 Comms
```
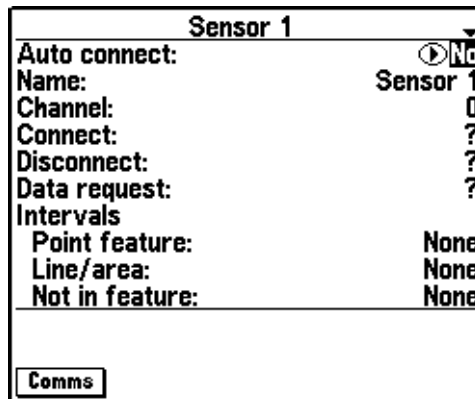
3.   Change the fields in this form as shown below:

```
┌─────────────────────────────────┐
│          Sensor 1             ▼ │
│ Auto connect:           ⓘ Yes   │
│ Name:              Echo sounder │
│ Channel:                      0 │
│ Connect:                      ? │
│ Disconnect:                   ? │
│ Data request:                 ? │
│ Intervals                       │
│   Point feature:           None │
│   Line/area:               None │
│   Not in feature:          5.0s │
│                                 │
│                                 │
│ ┌───────┐                       │
│ │ Comms │                       │
│ └───────┘                       │
└─────────────────────────────────┘
```

```
┌─────────────────────────────────┐
│          Sensor 1             ▲ │
│ Attribute:               None   │
│ Data received                   │
│   Prefix:                     ? │
│   Suffix:                 \0D\0A │
│   Max bytes:                  8 │
│   Timeout:               0.100s │
│ Audible click:            ⓘNo   │
│ Status line:              ⓘNo   │
│                                 │
│                                 │
│                                 │
│ ┌───────┐                       │
│ │ Comms │                       │
│ └───────┘                       │
└─────────────────────────────────┘
```

Note – By configuring the Asset Surveyor software to log a measurement every 5 seconds, it is able to discard any intervening messages and is more likely to be able to keep pace with the echo sounder.

Tip – When logging sensor data for mapping as independent UNINTERPRETED_SENSOR_DATA records, it is often convenient to configure the sensor interface to display a status line. This assures you that data is being logged continuously from the sensor.

> ☼ **Tip –** You can maximize the TSC1 datalogger's ability to process external sensor data by disabling the optional *Audible click* and the *Status line*, and by minimizing the amount of additional GPS information which is logged at the same time.

4.   Press ⌐Comms⌐ to display the configuration form for serial communications (RS232) parameters, and enter the following values:

```
                    Sensor 1
Serial port:                     ⦿ Top
Baud rate:                       ⦿ 4800
Data bits:                       ⦿ 8
Stop bits:                       ⦿ 2
Parity:                          ⦿ None




_____
```

5.   Press ⌐Enter⌐ to save the communications settings, then press ⌐Enter⌐ to save the sensor configuration details.

The Asset Surveyor software returns you to the *Select sensor* configuration menu, and renames the first entry to the name that you specified for the sensor:

```
┌─ Select sensor ─┐
│ Echo sounder    │
│ Sensor 2        │
│ Laser           │
└─────────────────┘


─────────────────────────

 Setup
```
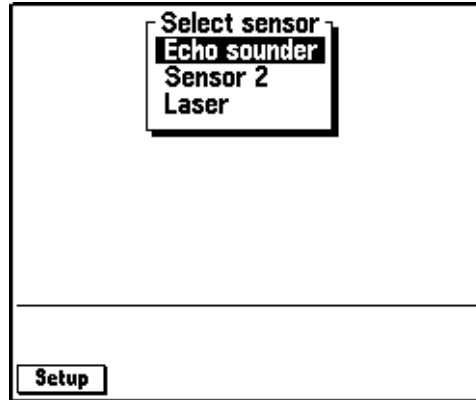
💡 **Tip –** Configure and activate the Asset Surveyor software's external sensor interface *before* turning on the echo sounder. If you turn on the echo sounder before activating the software's sensor interface, the first measurement from the sensor may be interpreted incorrectly. This is because the Asset Surveyor software has no way to distinguish a partial message from a complete one due to the lack of a prefix or suffix on each message.

NMEA Output Messages

In this chapter:

- ■ Introduction
- ■ Common message elements
- ■ Messages

Introduction

NMEA output is available from some Trimble GPS receivers. This appendix describes the NMEA messages that are available from the Pro XL, Pro XR, and Pro XRS receivers.

All messages conform to the NMEA-0183 Version 2.0 format. All begin with $ and end with a carriage return and a line feed. Data fields follow comma (,) delimiters and are variable in length. Null fields still follow a comma (,) delimiter but contain no information.

The optional checksum field is the last field in a message and follows the asterisk (*) delimiter. The checksum is the 8-bit *exclusive* OR of all characters in the message, including the commas, between but not including the $ and asterisk delimiters. The hexadecimal result is converted to two ASCII characters (0–9, A–F). The most significant character appears first.

The supported messages include:

- **ALM:** GPS week number, SV health, and complete almanac data for one SV. One message per SV, up to a maximum of 32.

- **GGA:** Time, position, and fix related data.

- **GLL:** Position fix, time of position fix, and status.

- **GSA:** GPS receiver operating mode, SVs used for navigation and DOP values.

- **GSV:** Number of visible SVs, PRN numbers, elevation, azimuth, and SNR values.

- **RMC**: Recommended minimum specific GPS/TRANSIT data.

- **VTG:** Actual track made good and speed over ground.

- **ZDA:** UTC day, month, year, and local time zone offset.

Common Message Elements

Each message consists of:

- A message ID consisting of *$GP* followed by the message type. For example, the message ID of the ALM message is *$GPALM*.

- A comma.

- A number of fields that depends on the message type, separated by commas.

- An asterisk.

- A checksum.

Here is an example of a simple message with six fields plus the message ID and checksum:

$GPZDA,004405.25,30,09,1994,00,00*6B

Latitude and Longitude

Latitude is represented as *ddmm.mmmm* and longitude is represented as *dddmm.mmmm*, where:

- *dd* or *ddd* is degrees

- *mm.mmmm* is minutes and decimal fractions of minutes

Direction

Direction; north, south, east, or west; is represented by a single character: *N*, *S*, *E*, or *W*.

Time

Time values are presented in Universal Time Coordinated (UTC) and are represented as *hhmmss*, where:

- *hh* is hours, from 00 to 23

- *mm* is minutes

- *ss* is seconds

Messages

When NMEA-0183 output is enabled, the following messages can be produced to aid integration with other sensors.

ALM: GPS Week, SV Health, and Almanac for One SV

$GPALM,1,1,21,768,00,5d94,08,08b7,fd4f,
a10d2e,747f49,57ab38,c0b629,ffa,000*43

The fields include:

- Total number of ALM messages for this cycle

- Message sequence number

- SV PRN number, 01 to 32

- GPS week number

- SV health status

- Eccentricity

- Almanac reference time

- Inclination angle

- Rate of right ascension

- Root of semimajor axis

- Argument of perigee

- Longitude of ascension node

- Mean anomaly

- a_{f0}, clock parameter

- a_{f1}, clock parameter

GGA: Time, Position, and Fix Related Data

$GPGGA,004407.00,3723.477595,N,12202.251222,
W,2,07,1.2,19.1,M,-25.7,M,3,0003*55

The fields include:

- UTC of position fix

- Latitude

- Direction of latitude (N or S)

- Longitude

- Direction of longitude (E or W)

- GPS quality indicator:

    – 0 = fix not valid

    – 1 = GPS fix

    – 2 = Differential GPS fix

- Number of SVs in use, 00 to 12

- HDOP

- Antenna height, MSL reference

- *M* is fixed text indicating that the unit of measure for altitude is meters

- Geoidal separation

- *M* is fixed text indicating that the unit of measure for geoidal separation is meters

- Age of differential GPS data record, Type 1 or Type 9, null when DGPS not used

- Differential reference station ID, 0000 to 1023, null when *any reference station ID* is selected and no corrections have been received

GLL: Position Fix, Time of Position Fix, and Status

$GPGLL,3723.477595,N,12202.251222,W,004407.00,A*1E

The fields include:

- Latitude

- Direction of latitude (N or S)

- Longitude

- Direction of longitude, (E or W)

- UTC of position

- Status: Fixed text A, indicates that data is valid

GSA: GPS Receiver Operating Mode, SVs used for Navigation, and DOP Values

$GPGSA,A,3,25,15,01,14,29,21,20,,,,,,1.9,1.2,1.5*30

The fields include:

- Fix Mode:
    - M = Manual, forced to operate in 2D or 3D
    - A = Automatic, 3D/2D

- Fix Status:
    - 1 = Fix not available
    - 2 = 2D
    - 3 = 3D

- Fields 3 to 14 = PRNs of SVs used in position fix (null for unused fields)

- Field 15 = PDOP

- Field 16 = HDOP

- Field 17 = VDOP

GSV: Number of Visible SVs, PRN Numbers, Elevation, Azimuth, and SNR Values

$GPGSV,2,1,08,01,32,054,47,14,33,308,45,15,61,261, 52,20,07,054,41*7F

The fields include:

- Total number of messages of this type in this cycle

- Message number

- Total number of visible satellites

- SV PRN number

- Elevation in degrees, 90

- Azimuth, degrees from true north, 000

- SNR (C/N_0) 00 to 99 dB, null when not tracking

- 8 to 11 = Information about second SV, same format as fields 4 to 7

- 12 to 15 = Information about third SV, same format as fields 4 to 7

- 16 to 19 = Information about fourth SV, same format as fields 4 to 7

RMC: Recommended Minimum Specific GPS/TRANSIT Data

$GPRMC,004407.00,A,3723.477595,N,12202.251222,W,1.2,7.4,071 196,2.0,E*hh

The fields include:

- • UTC of position
- • Status: Fixed text A, indicates that data is valid
- • Latitude
- • Direction of latitude (N or S)
- • Longitude
- • Direction of longitude (E or W)
- • Speed over ground in knots
- • Track made good in degrees True
- • UT date
- • Magnetic variation degrees (Easterly var. subtracts from true course)
- • E or W
- • Checksum

VTG: Actual Track Made Good and Speed Over Ground

$GPVTG,7.4,T,,,000.1,N,000.1,K*2E

The fields include:

- • Track made good
- • Fixed text T indicates that track made good is relative to true north
- • Fields 3 and 4 are null, not used
- • Speed over ground in knots
- • Fixed text N indicates that speed over ground is in knots
- • Speed over ground in kilometers/hour (km/h)
- • Fixed text K indicates that speed over ground is in km/h

ZDA: UTC Day, Month, Year, and Local Time Zone Offset

$GPZDA,004405.25,30,09,1994,00,00*6B

The fields include:

- Time, in UTC
- Day, 01 to 31
- Month, 01 to 12
- Year
- Local time zone offset from GMT, 00 to 23
- Local time zone offset from GMT in minutes

Fields 5 and 6, together, yield the total offset. For example, if field 5 is –5 and field 6 is –15, local time is 5 hours and 15 minutes earlier than GMT.

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Reader Comment Form

TSC1 Asset Surveyor Operation Manual   **March 2001**
P/N: 34182-20-ENG   **Revision A**

We appreciate your comments and suggestions for improving this publication. Contributors of particularly helpful evaluations will receive a thank-you gift.

I use the following Trimble product_____

for _____

Please circle a response for each of the statements below:

1 = Strongly Agree   2 = Agree   3 = Neutral   4 = Disagree   5 = Strongly Disagree

The manual is well organized.	1	2	3	4	5
I can find the information I want.	1	2	3	4	5
The information in the manual is accurate.	1	2	3	4	5
I can easily understand the instructions.	1	2	3	4	5
The manual contains enough examples.	1	2	3	4	5
The examples are appropriate and helpful.	1	2	3	4	5
The layout and format are attractive and useful.	1	2	3	4	5
The illustrations are clear and helpful.	1	2	3	4	5

The manual is: too long   just right   too short

Please answer the following questions:

Which sections do you use the most? _____

What do you like best about the manual? _____

_____

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