

TDC1 Asset Surveyor

Operation Manual

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*Trimble Navigation Limited
Mapping & GIS Systems
645 North Mary Avenue
P.O. Box 3642
Sunnyvale, CA 94086
U.S.A.*

*1-800-827-8000 in North America
+1-408-481-8000 International
Fax: +1-408-481-2000*

*Trimble Navigation Europe Limited
Trimble House, Meridian Office Park
Osborn Way, Hook
Hampshire RG27 9HX
ENGLAND
+44-1256-760-150
Fax: +44-1256-760-148
Voicemail: +44-1256-761-130*

*Trimble Navigation Singapore PTE Limited
300 Beach Road
#34-05 The Concourse
Singapore 199555
SINGAPORE
+65-296-2700
Fax: +65-296-8033*

*Trimble Japan K.K.
Sumitomo Hamamatsu-cho, Building 10F
1-18-16 Hamamatsu-cho Minato-ku
Tokyo 105
JAPAN
+81-3-5472-0880
Fax: +81-3-5472-2326*

*Trimble Navigation New Zealand Limited
11 Birmingham Drive
P.O. Box 8729 Riccarton
Christchurch
NEW ZEALAND
+64-3-339-1400
Fax: +64-3-339-1417*

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Preface

Welcome to the *TDC2 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 capture GIS/GPS data.

Scope and Audience

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.

The following sections provide you with a guide to this manual, as well as other documentation that you may have received with this product.

Organization

This manual contains the following:

- Chapter 1, Quick Setup, provides simplified versions of the steps found in Chapters 3, 4 and 5, to be used in the field to ensure proper setup of equipment.
- Chapter 2, Introducing the Asset Surveyor, gives a brief introduction to the Asset Surveyor software and the components that are used with it.
- Chapter 3, Before Leaving the Office, covers the things you need to do when preparing to go out in the field to collect data.
- Chapter 4, In the Field, provides a step by step guide to using the Asset Surveyor software in the field.
- Chapter 5, Back in the Office, tells you what you need to do once you have collected some data and returned to the office.
- Appendix A, Pro XRS System, provides information on setting up the Pro XRS system and the Pro XRS receiver.
- Appendix B, Pro XR System, provides information on setting up the Pro XR system and the Pro XR receiver.
- Appendix C, Pro XL System, provides information on setting up the Pro XL system and the Pro XL receiver.
- Appendix D, Basic Series, provides information on how to set up the Pathfinder Basic and Basic Plus handheld GPS receivers.
- Appendix E, Centurion and Trimpack III, provides information on how to set up the Centurion or Trimpack receivers to work with Asset Surveyor.
- Appendix F, Series 4000, provides information on how to set up a Series 4000 receiver to work with Asset Surveyor.
- Appendix G, 4600LS, provides information on how to set up a 4600LS Surveyor system single frequency GPS receiver.

- Appendix H, Using Carrier Phase Data, describes the methods to capture GIS data with carrier phase data for greater accuracy.
- Appendix I, Laser Rangefinders, describes the supported laser rangefinders that can be used with the Asset Surveyor software.
- Appendix J, External Sensors, lists examples of external devices that can be used with Asset Surveyor.
- Appendix K, The ASSETED Utility, describes the PC-based utility ASSETED program, where users can choose and define coordinate systems to be used in conjunction with the Asset Surveyor software.
- Appendix L, NMEA Output Messages, provides details of the various NMEA-0183 output packets which are available from selected Trimble GPS receivers.

How to Use this Manual

Please read the release notes which may accompany this manual. They contain last-minute information regarding the Asset Surveyor software and your Trimble GPS receiver.

Check the Trimble Bulletin Board System (BBS) and the Trimble Internet site on a regular basis for application notes and new software release information.

Before using the Asset Surveyor software, you should also read the *GPS Mapping Systems General Reference* manual and the *Receiver Manual* for your Trimble GPS system.

Related Information

The following sections discuss other sources of information that introduce, extend, or update this manual.

Other Manuals

Asset Surveyor Software User Guide

The *Asset Surveyor Software User Guide* 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.

Pathfinder Office Manuals

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

README File

The diskette that you receive containing the Asset Surveyor software has a README file on it. It contains information added after the manuals went to print. Check to see whether there is important information in the README, before you upgrade or run the software for the first time.

Release Notes

Release Notes are provided with the Asset Surveyor software. They can describe new features of the product, the installation procedure, information not included in the manuals, and corrections to the manuals.

Update Notes

There is a warranty activation sheet with your product. By sending in your warranty activation sheet, you are automatically sent update notes as they become available. When you receive these packages, read them. They contain 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.

Other Information

This section outlines sources that provide information not necessarily related to this product.

Bulletin Board Service

Use the Trimble Bulletin Board Service (BBS) to obtain daily satellite status reports, technical tips, almanacs, and other bulletins from Trimble. Check it regularly for application notes, new software releases, and other information. Use it to exchange email for Trimble support personnel or other Trimble customers. By arrangement with our customer support technicians, you can transmit problem data files using the BBS.

To access this service, you need a personal computer (PC), a modem, and telecommunications software.

The BBS is in the United States and is reached as follows:

Phone +1-408-481-7800 (set at 8-N-1).

World Wide Web

For an interactive look at Trimble visit our site on the World Wide Web (<http://www.trimble.com>).

FTP Site

Use the Trimble FTP site to send or receive files. The address is <ftp://ftp.trimble.com>. You can also access the FTP site from the Trimble World Wide Web site (<http://www.trimble.com/support/support.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 dealer*.

If you need further assistance, contact the Trimble Technical Assistance Center (TAC). You can fax or phone them, or send an email. A support technician can help determine the cause of the problem and provide technical assistance. The phone numbers are:

1-800-SOS-4TAC (North America)
+1-408-481-6940 (International)
+1-408-481-6020 (fax)

TAC phones are answered from 6 am to 5.30 pm Pacific Standard Time.

The TAC email address is trimble_support@trimble.com

When you contact TAC, have the following information available:

1. The Trimble product name, any software or firmware version number(s), and if appropriate, the serial number.
2. Your specific question or problem. Please detail background information, such as the configuration of your data logger or receiver, and the exact type, make, and configuration of your computer. If you have received error messages, please specify the exact wording.

If you need to send a data file along with your inquiry, please compress the file using PKZIP Software by PKWARE, Inc., and name the file with the extension .ZIP.

Use one of the following methods to send the file:

- Attach the file to your email inquiry.
- Put the file on the Trimble BBS or the Trimble FTP site and include the filename in your email inquiry.

Reader Comment Form

Thank you for purchasing this Trimble product. At the end of this manual you will find a reader comment form. We appreciate any feedback you have about this manual. If this form is not available, comments and suggestions can be sent to the address in the front of this manual. All comments and suggestions become the property of Trimble Navigation Limited.

Document Conventions

Italics identify software menus, menu commands, dialog boxes, and the dialog box fields.

SMALL CAPITALS identify DOS commands, folders, filenames, and filename extensions.

Courier represents messages printed on the screen.

Courier Bold represents information that you must type in a software screen or window.

Helvetica Bold represents a software command button.

Return or **Ctrl**+**C** is an example of a hardware function key or key combination that you must press on your PC.

Key Symbols

The Asset Surveyor GPS/GIS data collection software uses both *hard* (i.e. physical) keys on a keypad and *soft* (i.e. visual) keys on the datalogger's screen. This manual illustrates these two classes of keys using different symbols.

Hard (physical) keys on the TDC1 keypad are indicated as follows:

Enter, **⬠**, **F1**, etc.

Softkeys on the TDC1 screen are indicated as follows:

CREATE, **DEL**, **EDIT**, etc.

A softkey is activated by pressing the corresponding function key (**F1** ... **F5**) on the TDC1's keypad.

Warnings, Cautions, Notes, and Tips

Warnings, cautions, notes, and tips draw attention to important information, and indicate its nature and purpose.



Warning – Warnings alert you to situations that could cause personal injury or unrecoverable data loss.



Caution – Cautions alert you to situations that could cause hardware damage or software error.



Note – Notes give additional significant information about the subject to increase your knowledge, or guide your actions.



Tip – Tips indicate a shortcut or other time- or labor-saving hint that can help you make better use of the product.

1 Quick Setup

The instructions in this chapter are a simplified version of the various steps found in Chapters 3, 4, and 5 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 TDC1 with the Asset Surveyor software. For full details on configuration and data capture, refer to the *TDC1 Asset Surveyor Software User Guide*.



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

1.1 Before Leaving the Office

Before leaving the office you should carry out the following steps:

1. Install the Asset Surveyor software on the TDC1 if it is not already installed (See Chapter 3 of the *TDC1 Asset Surveyor Software User Guide*).
2. Install the Pathfinder Office software on your office computer (refer to the *Pathfinder Office Getting Started Guide*).
3. Using the Pathfinder Office software, prepare any data dictionaries you require, and transfer them to the TDC1. You may also want to transfer any waypoint and coordinate system files to the datalogger.
4. Check that you have all the required equipment, and that it is operational. Set up and connect your GPS system (the appendix for your GPS receiver lists the equipment and shows you how to connect it).
5. If the GPS receiver has an ON/OFF switch, turn it on (the Series 4000, Basic 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 will appear. If communication fails, an error message will pop-up on the screen.

6. 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. See Chapter 5 of the *TDC1 Asset Surveyor Software User Guide* for details of how to configure Asset Surveyor.
7. 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.

1.2 In the Field

When you are ready to work in the field carry out the following steps:

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.

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, re-open an existing data file).
5. Begin capturing data. Capture 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.

1.3 Back in the Office

When you are finished working in the field and are back in the office, carry out the following steps:

1. Transfer the data files from the TDC1 to the PC using the Pathfinder Office software.
2. Use the Pathfinder Office software for differential correction, plotting, and exporting the data file(s) to a GIS.
3. Recharge the TDC1 datalogger and GPS receiver batteries.

1.4 Rover Configuration

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

From the *Utilities* menu, select *Factory defaults*. This will reset the Asset Surveyor software to its default configuration and then restart the data collector.

You should now change some of the configuration settings as follows:

From Anywhere

1. *Configuration* press the **Func** key
then press the **GPS** key

Configuration menu

2. *GPS* press **Enter**
3. *Configure GPS* menu (if rover file not open)
4. *Rover options* press **Enter**

Rover options screen

5. *Point feature* synchronized with the base station
6. *Line/area* synchronized with the base station
7. *Not in feature* synchronized with the base station
8. *Pos mode* Manual 3D or Overdet. 3D
depending on canopy density
9. *PDOP mask* 4 or 6 (depending on receiver)
10. *Minimum posns* 3 or 180 at a one second logging
interval (depending on receiver)
11. *RTCM* **RTCM**

RTCM screen

12. *Warning time* 5 or 10 (depending on your radio. Try 5 first)
13. To accept press

Rover options screen

14. To accept press
15. To return to the *Configuration* menu press

Configuration menu

16. To exit the *Configuration* menu press

1.4.1 Data Capture

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

Main menu

17. *Data capture* press

Data capture menu

18. Create a data file

-or-

Add to an existing data
file

select *Create rover file*.

press and then press

-or-

select *Reopen rover file*,

press

select an existing file

to append to, and press

Feature menu

19. To exit *Data capture*

press and answer

to confirm exit

1.5 Base Station Configuration

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

From Anywhere

1. *Configuration* press the **Func** key
then press the **GPS** key

Configuration menu

2. *GPS* press **Enter**

Configure GPS menu (if base file not open)

3. *Base stn options* press **Enter**

Base Stn options screen

4. *Measurements* One to five seconds (depending on rover interval and free space)
5. To accept press **OK**
6. To return to the *Configuration* menu press **Clear**

Configuration menu

7. To exit the *Configuration* menu press **Clear**

1.5.1 Base Station Data Capture

Use the following procedure to setup your system for base station data capture.

Main menu

1. *Base station* press

Create File screen

2. *Create file* press

Antenna screen

3. *Height* height to antenna's phase center
4. *Measure* Vertical
5. *Type* See the *TDC1 Asset Surveyor Software User Guide* for a list of antenna codes
6. *To accept* press

Reference Position screen

7. Enter reference position type lat/lon (or north/east) and altitude, and press
- or-
- Use an existing waypoint and press
- or-
- Use an approximate position and press and press
- or-
- leave as is and set in the Pathfinder Office software and press

Base Station screen

8. To exit *Base station* press and press to confirm exit

2 Introducing the Asset Surveyor

This chapter introduces you to Asset Surveyor. The topics covered in this chapter include:

- The Asset Surveyor data collection software
- The system components

2.1 The Asset Surveyor Data Collection Software

The Asset Surveyor software is designed for fast and accurate geographic data capture. The software operates on the TDC1 data collector. The Asset Surveyor software acts as the *controlling software*, communicating with the GPS receiver to set specific GPS parameters required for optimal accuracy, and to record GPS positions to store on the TDC1 data collector. 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 you can check the current GPS status to ensure you are working under conditions which will 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 what information you want to collect in the field. The following introduces you to the main functions of the Asset Surveyor software:

- Data capture—using a data dictionary created in the 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 data collector. When opening a file, the Asset Surveyor software uses the chosen data dictionary to prompt you for attribute information.
- External sensor interface—to record and store input from other sensors, such as echo sounders (this interface is referred to as ESP, an External Sensor Port).
- Navigation—to view distance and bearing to known coordinates; used in conjunction with waypoints.
- Waypoints—to store points by name so you can navigate to them.
- Multiple coordinate systems—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 the Asset Surveyor software functions through the *Main menu* or from special key combinations.

They are grouped in the following areas:

- *Data capture*
- *Navigation*
- *File transfer*
- *Utilities*
- *Base station*
- *GPS operations*
- *Configuration*

When collecting data with Asset Surveyor, the two menu options you will use most are *Data capture* and *Configuration*. *Data capture* provides you with the ability to create data files, enter attributes and manage your data files. *Configuration* enables you to configure the GPS receiver to log only positions which meet your requirements. The *File transfer* option is also important and is used to transfer data between the data collector and your office computer.

The *Utilities* option of the Asset Surveyor software contains useful programs that support setting up external sensors, creating, deleting, and editing waypoints, and measuring between waypoints.

The *Navigation* option is used to display instructions for navigating to a waypoint. The *Base station* option is for using the Asset Surveyor software to control a GPS receiver that is being used as a temporary base station. The *GPS operations* menu displays important GPS information, such as the receiver status and satellite information.

For more information about these features and other options available in the Asset Surveyor software, consult the *TDC1 Asset Surveyor Software User Guide*.

2.2 System Components

The Asset Surveyor software uses GPS mapping instrumentation with comprehensive graphical geographic data acquisition 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 Pathfinder Office. In this way, you can quickly inventory resources.

2.2.1 GPS Receiver

The GPS receiver provides precise GPS positions for point, line, and area features captured by the Asset Surveyor software. A GPS receiver consists of a receiver, antenna, batteries, and cables. However, some receivers do not have separate parts for each component, for example the Trimble Pathfinder Basic Series consist of an antenna and receiver in one unit. You can however, connect an external antenna to these receivers.

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 receivers can be used with Asset Surveyor on the TDC1:

- Pathfinder Pro XRS
- Pathfinder Pro XR
- Pathfinder Pro XL
- Series 4000 receivers
- Military-grade Centurion and Trimpack III
- 4600LS Surveyor
- Pathfinder Basic series

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

2.2.2 Pathfinder Office Software

The Pathfinder Office software runs under Microsoft Windows 95 or Microsoft Windows NT. It provides all of the tools you need for managing a data collection project, handling data from the entire range of Mapping and GIS data capture systems that use Trimble GPS receivers.

The Pathfinder Office software lets you:

- plan the best times to collect GPS positions, using the powerful Quick Plan Mission Planning utility.
- create separate projects, which let you manage the data associated with these projects effectively and conveniently.
- construct and edit data dictionaries, which can be used to control the data capture operation and which ensure that the captured data is complete, accurate, and compatible with your GIS, CAD package, or database.
- transfer files to and from GPS receivers and hand-held dataloggers.
- process the GPS positional data to improve its accuracy.
- display and edit captured data in the office, optionally overlaying this data onto a vector or raster background map.
- export the captured, processed, and edited data to a GIS, CAD, or database format.
- produce a scaled plot as a paper record of the data.

Asset Surveyor version 3.30 needs Pathfinder Office to make best use of the data collected in the field. Pathfinder Office software is used to transfer GPS data to a PC, and then differentially correct, view, and edit the data. Pathfinder Office software also exports the data in a format suitable for your GIS or CAD system. Using Asset Surveyor version 3.10 or later with PFINDER will result in incorrect data conversion.

Version 3.03 (or earlier) of Asset Surveyor can also be used with Pathfinder Office; however the transfer times from TDC1 to a PC are slower.

For details on the Pathfinder Office software, see the Pathfinder Office documentation and the Pathfinder Office release notes.

3 Before Leaving the Office

This chapter explains what you should do before you take Asset Surveyor out in the field. The topics covered in this chapter include:

- Planning
- Projects
- Data dictionaries
- Waypoints
- Coordinate systems
- Data transfer
- Checking the configuration settings
- Assembling your equipment
- Obtaining base station data

3.1 Planning

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

- the number of visible satellites
- where the satellites will 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.

Quick Plan provides many different graphical representations of satellite availability and PDOP. Figure 3-1 show graphs of the number of satellites and the expected PDOP values for a given day.

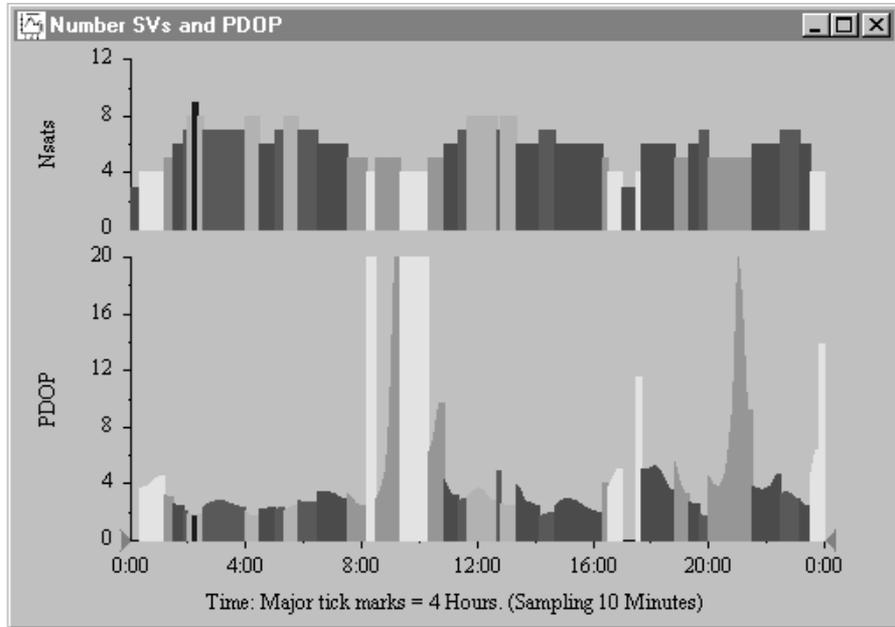


Figure 3-1 Number of Satellites and PDOP Values

These help you check whether there will be any times of the day when there are insufficient satellites or the PDOP is too high. For instructions on using Quick Plan, see the Pathfinder Office 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).

Quick Plan requires an almanac that is no more than a month old to produce reasonably accurate results. 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 download the almanac from a Series 4000 receiver to your computer by downloading the ephemeris and storing it in an EPH file. You can download the almanac from a GPS Pathfinder receiver to an SSF file.

For instructions on how to download an almanac file to your PC, see the Pathfinder Office documentation.

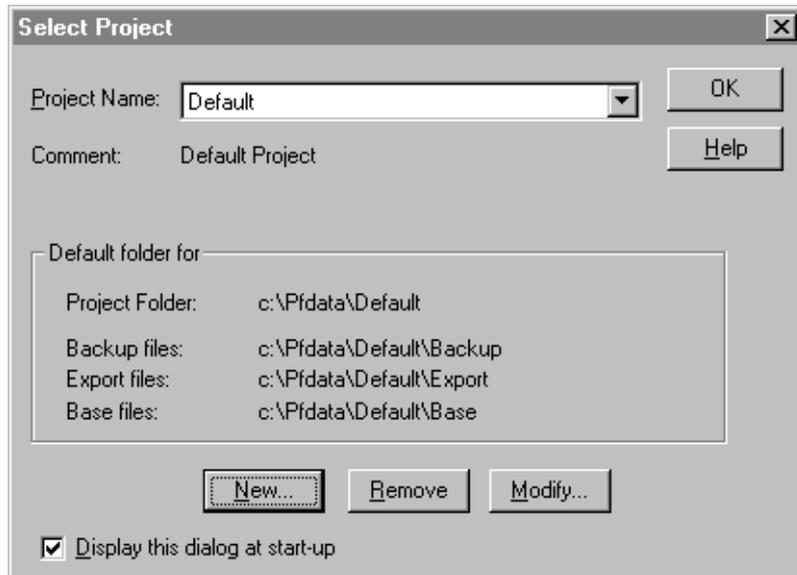
3.2 Projects

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

3.2.1 Creating a Project

Start the Pathfinder Office software. The Pathfinder Office desktop 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 wish. The folders for backup, export and base files do not have to be folders of the project folder, they could be a shared folder on a network, so that all users can access their files, or they can be in the project folder itself.

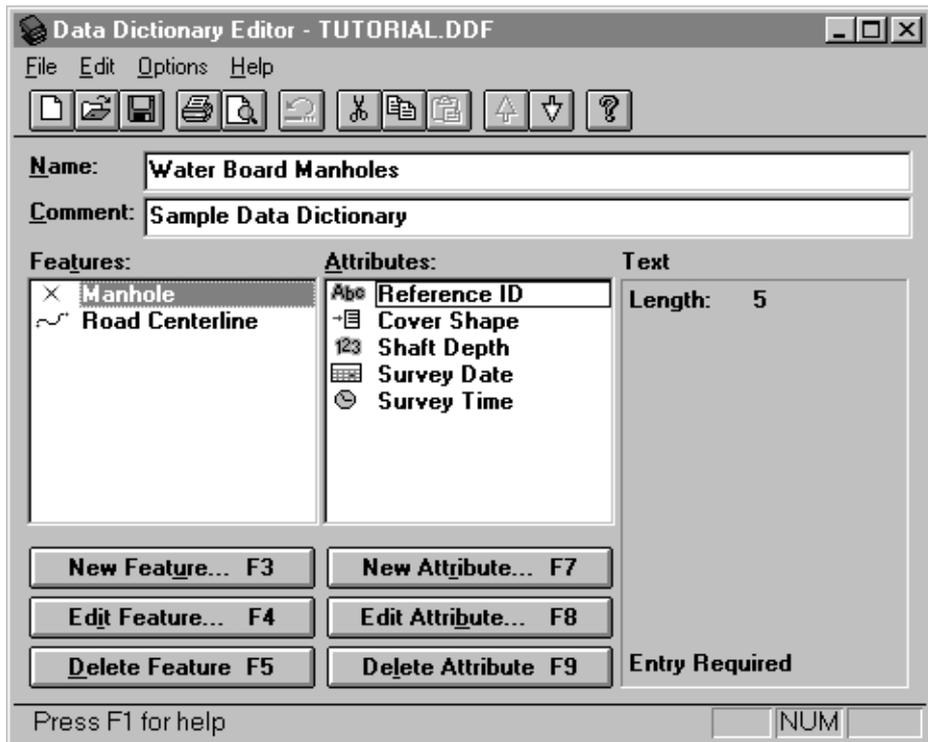
For more information about Creating a Project, see the Pathfinder Office documentation.

3.3 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 capture of features, or objects, and attributes, or information about those objects. A data dictionary includes a list of features that will be captured in the field, and for each feature, a list of attributes that describe the feature. A data dictionary structures data capture; it does not contain the actual information captured 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 capture. 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

To start the Data Dictionary Editor, select *Utilities / Data Dictionary Editor* from the Pathfinder Office Menu bar. The *Data Dictionary Editor* dialog appears allowing you to create a new data dictionary. The following dialog shows an example of features and attributes that can be created for your data dictionary:



Data dictionaries are project independent. Pathfinder Office does not automatically store the data dictionary (.DDF) files in the project folder. You may wish to create a folder specifically for data dictionary files. For a detailed discussion on the creation of data dictionaries, see the Pathfinder Office documentation, or the *Mapping Systems General Reference*.

Once you have completed designing your data dictionary you can transfer it to the TDC1. For instructions on how to transfer your data dictionary to the TDC1, see Data Transfer, page 3-10.

3.4 Waypoints

A waypoint is a 3D 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 a reference for a particular site. This makes returning to the same site possible at a later date. Waypoints can be created using the Waypoint Manager in Pathfinder Office and are stored as .WPT files. Like data dictionaries, waypoints are project independent, and are not stored automatically in the project folders. You may wish to create a folder specifically for waypoint files. For more details on creating waypoints see the Pathfinder Office documentation.

For instructions on how to transfer waypoint files to the TDC1, see Data Transfer, page 3-10.

3.5 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 Asset Surveyor can be chosen, or created using ASSETED, and saved as the ASCOORD.DAT file, as explained in Appendix K, The ASSETED Utility.

For instructions on how to transfer ASCOORD.DAT to the TDC1, see Data Transfer, page 3-10.



Note – The Coordinate System Manager™ software in Pathfinder Office is used to create coordinate systems for use in Pathfinder Office, not with Asset Surveyor on the TDC1.

3.6 Data Transfer

Once you have created data dictionaries, waypoints or coordinate systems on your office PC, you will need to transfer this information to the TDC1 data collector. The Data Transfer Utility in Pathfinder Office provides all the functionality you require to efficiently transfer data between the TDC1 and your office computer. The following section outlines how to transfer data from the office PC to the TDC1 data collector.

Connecting the TDC1 Data Collector

A TDC1 can be connected to the PC for data transfer using either the Office Support Module™ (OSM-PF) or a cable for a direct connection.

The OSM-PF setup for transferring data to the TDC1 data collector provides external power, which lengthens the life of the internal batteries in the data collector.

The direct connection setup for connecting the TDC1 data collector to the PC uses the internal batteries in the data collector to power the transfer process. Do not use this method if the batteries are low.

To connect the TDC1 to the PC using the OSM-PF:

1. Connect one end of the OSM-PF to PC data cable to the serial port on the PC and the other end to the OSM-PF port labeled Data I/O.
2. Connect the TDC1 data collector directly to the 12-pin Hirose connector on the cable from the OSM-PF.

3. Plug the OSM-PF AC power cord into an AC outlet. See Figure 3-2.

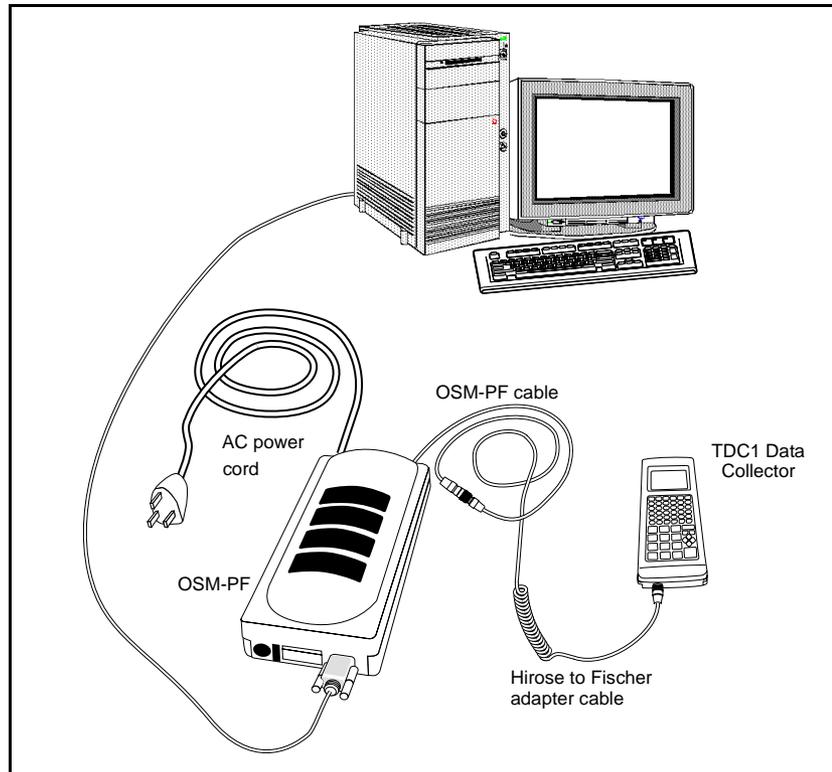
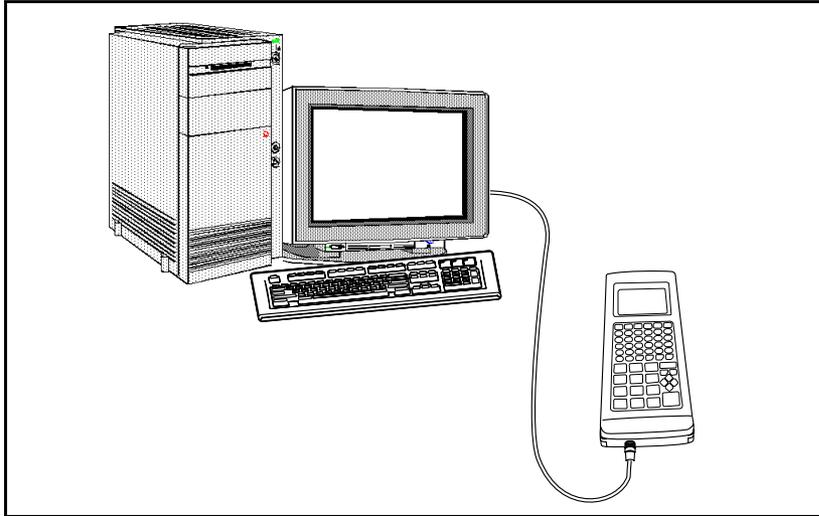


Figure 3-2 Connecting the TDC1 to the PC with the OSM-PF

To connect the TDC1 to the PC using the direct connection:

1. Connect the DE-9 (female) end of the TDC1-to-PC data cable to the PC.
2. Connect the 12-pin Hirose end of the cable to the TDC1. See Figure 3-3.

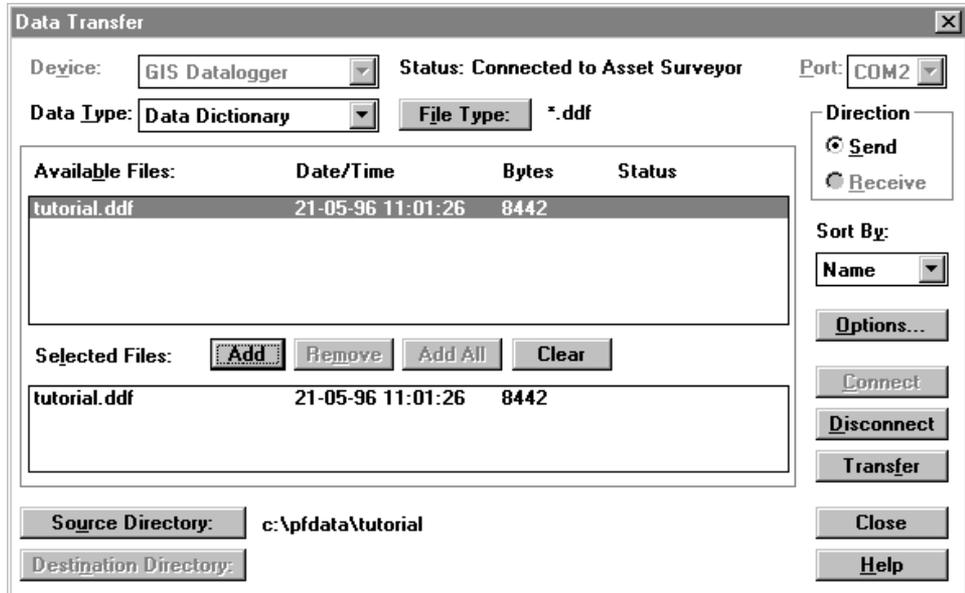
**Figure 3-3 Direct Connection between TDC1 and PC**

3.6.1 Transferring files to the TDC1 data collector

Some of the files that you have stored on your PC may need to be transferred to your TDC1 data collector. This is accomplished through the *File transfer* option at the Asset Surveyor *Main menu*.

To Transfer files to your TDC1:

1. On the data collector select *File transfer* from the Asset Surveyor *Main menu*. The Asset Surveyor software is now ready to transfer data files.
2. On the PC start the *Data Transfer Utility* from Pathfinder Office. The following dialog appears:



3. Select the appropriate file type in the *Data Type* field.
4. Choose *Send* in the *Direction* field.

5. Select the source folder where the files are located. By default, the source folder for sending files will be the last folder used to transfer a file. If the source folder is incorrect, press **Source Directory** to change to the correct source folder.
6. Select one or more files to be transferred by highlighting the file name in the *Available Files* field and pressing **Add**.
7. Press **Transfer**. All the files in the *Selected Files* field are transferred.

3.7 Configuring the System

Before you take your TDC1 out into the field and use it to collect data, there are a number of actions you should perform. These include checking the critical configuration settings in the Asset Surveyor software itself.

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 Asset Surveyor. It is **crucial** that you check all critical settings before capturing data or navigating with Asset Surveyor.
- *Non-critical settings.* Settings which affect the behavior of Asset Surveyor but do not have a potentially detrimental impact on GPS positions are termed **non-critical**. You should still check each non-critical setting before capturing data or navigating with your Asset Surveyor, but forgetting to do so will not affect the quality of GPS positions logged.
- *Display settings.* Many settings have no impact on the data which is captured, but merely alter the way data is displayed. You need not alter any display settings unless you prefer to have data displayed in a way which differs from Asset Surveyor's default settings.

The next three sections briefly outline the three classes of settings, and refer you to the *TDC1 Asset Surveyor Software User Guide*, which provide detailed descriptions of each setting.

3.7.1 Critical Settings

The critical configuration settings are listed in Table 3-1. For each setting, the default (and suggested) value is indicated, and a page reference to a detailed description of that setting in the *TDCI Asset Surveyor Software User Guide*.

All critical settings can be checked or changed by selecting GPS *Rover options* or GPS *Base stn options* from the *GPS* menu, which is accessed from the *Configuration* menu. You can pop up the *Configuration* menu by pressing .

Table 3-1 Critical Configuration Settings

Setting	Default value	See page in User Guide
Logging intervals		
Point feature	5 seconds	5-5
Line and area features	5 seconds	5-5
Not in feature	None	5-5
Velocity	None	5-6
Measurements	5 seconds (for a base)	5-50
Minimum positions (point feature)	3	5-8
Minimum time (carrier phase)	10 minutes	5-10
Position mode	Manual 3D	5-14
Elevation mask	15° (for a rover) 10° (for a base)	5-17 5-52
Signal-to-noise ratio mask	6.0 (for a rover) 4.0 (for a base)	5-18 5-52
PDOP mask and switch	6.0 (for a rover) 8.0 (for a base)	5-19 5-53

The settings noted in the previous table are critical for the following reasons:

- If a *Logging interval* is set incorrectly, Asset Surveyor will 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, Asset Surveyor 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 (five or more satellites) to achieve a desired level of accuracy, then *Overdet. 3D* mode should be used.
- If the *Minimum time* is set too low, you may not get the desired amount of carrier phase information to calculate higher accuracy features.
- If the *Elevation mask* is set too low, your GPS rover may use satellites which are not visible 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 which 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 further details about each critical setting, consult the referenced pages of the *TDC1 Asset Surveyor Software User Guide*.



Note – When using Asset Surveyor with a Pro XR, Pro XRS, Pro XL or 4600LS you can obtain decimeter-level accuracy by collecting carrier phase features. For more information on how to capture carrier phase information see Chapter H, Using Carrier Phase Data.

3.7.2 Non-critical Settings

The non-critical configuration settings are listed in Table 3-2. For each setting, the default (and suggested) value is indicated, and a page reference to a detailed description of that setting in the *TDC1 Asset Surveyor Software User Guide*.

All non-critical settings can be found under one of the entries in the *Configuration* menu. Table 3-2 also indicates under which entry in the *Configuration* menu you will find each setting. You can pop up the *Configuration* menu by pressing .

Table 3-2 Non-Critical Configuration Settings

Setting	Default value	Configuration Menu Entry	See page in User Guide
Antenna options	Compact dome, 0.0m	GPS Rover options and GPS Base station options	5-36 5-53
Initial position	?	GPS Rover options	5-26
Audible click	Yes	GPS Rover options	5-22
Log DOP data	Yes	GPS Rover options and	5-23
Dynamics code	Land	GPS Rover options	5-24
RTCM input options	Auto mode, 9600,N,8,1	GPS Rover options	5-27
Receiver output options	None	GPS Rover options and GPS Base station options	5-44 5-54
Log PP data	No	GPS Rover options	5-31
P(Y) options	On/Query	GPS Rover options	5-40

Table 3-2 Non-Critical Configuration Settings (Continued)

Time	N/A	Time and date	5-85
Date	N/A	Time and date	5-86
Quickmark options	Defaults, No confirmation	Quickmarks	5-87
Offsets	Off	Constant offset	5-89
LCD contrast	2	Hardware (TDC1)	5-109
Beep volume	High	Hardware (TDC1)	5-111
Auto shutoff	20 minutes	Hardware (TDC1)	5-110
Key click	High	Hardware (TDC1)	5-111

3.7.3 Display Settings

The display configuration settings are listed in Table 3-3. For each setting, the default (and suggested) value is indicated, and a page reference to a detailed description of that setting in the *TDCI Asset Surveyor Software User Guide*.

All display settings can be found under one of the entries in the *Configuration* menu. Table 3-3 also indicates under which entry in the *Configuration* menu you will find each setting. You can pop up the *Configuration* menu by pressing [Config](#).

Table 3-3 Display Configuration Settings

Setting	Default value	Configuration Menu Entry	See page in User Guide
Coordinate system	Lat/Long WGS-84	Coordinate system	5-59
Units			
Coords units	Meters	Units and display	5-72
Height units	Meters	Units and display	5-73
Distance units	Meters	Units and display	5-73
Velocity units	Km/hour	Units and display	5-74
Angle units	Degrees	Units and display	5-74
Angles format	DD.MMSSss	Units and display	5-75
Coordinate order	North/East (Lat/Long)	Units and display	5-76
Altitude reference	Mean Sea Level	Units and display	5-77
North reference	True North	Units and display	5-78
Magnetic declination	Automatic	Units and display	5-79
Null string	?	Units and display	5-81

Table 3-3 Display Configuration Settings (Continued)

Language	English	Units and display	5-82
24-hour clock	No	Time and date	5-85
Date format	MM/DD/YYYY	Time and date	5-86

3.8 GPS Hardware Check List

Before setting out to collect data with Asset Surveyor and your Trimble GPS receiver, you should check that you have all the necessary GPS hardware, batteries, cables, and so forth. 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 missing item.

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



Tip – Trimble suggests that you always set up your entire GIS/GPS data collection system and test it, to ensure that everything is connected correctly, that your batteries are charged, and that your Asset Surveyor and GPS receiver are communicating correctly, **before** you leave your office.



Caution – 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.

Finally, you are encouraged to take with you the *Asset Surveyor Quick Reference Guide*; this provides an overview of the system as well as a number of important details which may be difficult to remember.

3.9 Obtaining Base Station Data

To record accurate 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 will 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, 12-channel Pro XL, Pro XRS, Trimble Community Base Station (CBS) receiver, 4600LS Surveyor receiver, or a Trimble Series 4000 receiver.

4 In the Field

This chapter provides instructions and examples of capturing data, navigating and performing other tasks with the Asset Surveyor software. It provides a general description of each aspect, but for details you should read Chapters 5, 6, and 7 of the *TDC1 Asset Surveyor Software User Guide*.

The topics covered in this chapter include:

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

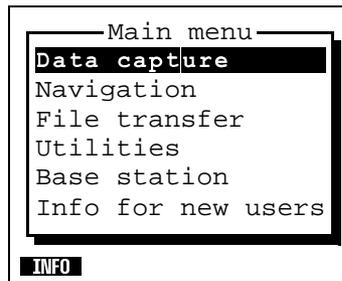
4.1 Starting the Asset Surveyor Software

As you read this chapter, you may like to follow the description of the Asset Surveyor software's capabilities on your TDC1. You will require your GPS receiver to be connected and operational, although you need not be outdoors. You may also like to refer to Chapters 6 and 7 of the *TDC1 Asset Surveyor Software User Guide* for the appropriate details.

This chapter describes the Asset Surveyor software as it is preconfigured. If you have reconfigured various Asset Surveyor settings, its behavior may differ from the text of the manual.

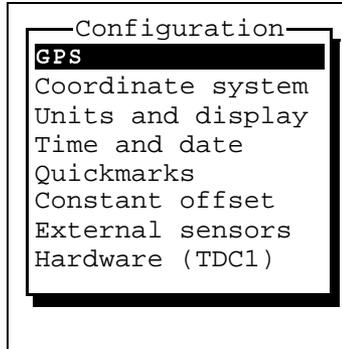
As described in Chapter 2 of the *TDC1 Asset Surveyor Software User Guide*, you normally start the Asset Surveyor software by simply turning your TDC1 on. If, when you turn your TDC1 on, the Asset Surveyor software is not running, follow the instructions in Chapter 2 of the *TDC1 Asset Surveyor Software User Guide* to start the Asset Surveyor software.

When you first start the Asset Surveyor software, the *Main menu* will appear on the TDC1's screen:



From this menu, you can choose one of the five main Asset Surveyor operations. The sixth entry in the menu (*Info for new users*, which you can also access using **INFO**) provides access to several pages of information for new users of the software.

You can configure the Asset Surveyor software by pressing . The Asset Surveyor software's *Configuration* menu is as follows:

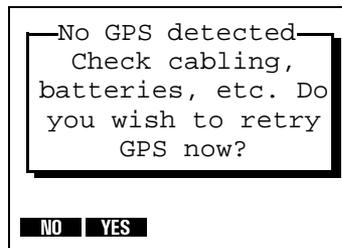


4.2 Using GPS

4.2.1 Activating GPS

If you connect a supported Trimble GPS receiver to your TDC1 using the correct cabling and batteries, Asset Surveyor will start to communicate with the GPS receiver immediately after the TDC1 is turned on.

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

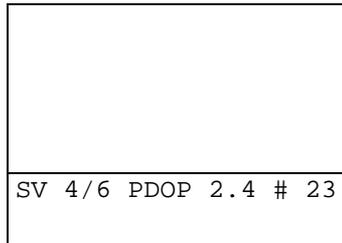


In this case, check that the cabling is connected firmly and correctly, that the batteries are connected and charged, and that your GPS receiver is switched on (if appropriate). Then press **YES** to the above question.

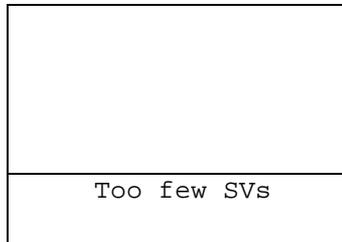
If Asset Surveyor and GPS receiver still do not establish communication, consult your receiver's *Operation Manual* or the appropriate appendix at the back of this manual for cabling and configuration details specific to the GPS receiver you are trying to use.

The GPS Status Line

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



Various messages will periodically flash on the GPS status line. If you are indoors and have your TDC1 and GPS receiver operating, the GPS status line will probably be flashing the message:



because the GPS receiver is tracking fewer satellites (probably none) than it needs to compute positions.

Most messages flashed on the GPS status line inform you of a condition which is preventing the computing or logging of GPS positions. When such a condition arises, Asset Surveyor emits a warning beep and starts to flash the appropriate message. When the condition ceases, Asset Surveyor emits a success beep to indicate that you can proceed with your survey, and removes the flashing message from the status line.

4.2.2 Controlling GPS

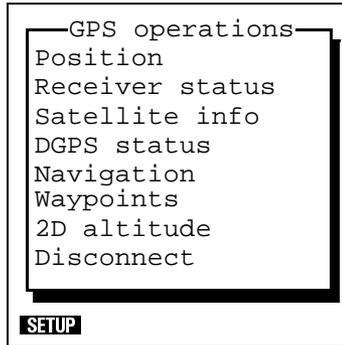
The Asset Surveyor software acts as a control panel for your Trimble GPS receiver. Some receivers are even switched on and off by Asset Surveyor. A GPS receiver is controlled primarily by the way it is configured. The GPS *Rover options* configuration form looks as follows:

Rover options	
Logging intervals	
Point feature:	5s
Line/area:	5s
Not in feature:	None
Velocity:	None
Minimum posns:	3
Carrier phase	
Minimum time:	10mins
Pos mode:	Manual 3D
Elev. mask:	15°
SNR mask:	6.0
PDOP mask:	6.0
PDOP switch:	6.0
Audible click:	Yes
Log DOP data:	Yes
Dynamics code:	Land
Initial position	
Lat:	?
Lon:	?
RTCM ANTEN P(Y) OUTPUT	



Note – The entire contents of this form will not fit onto the TDC1's screen at once; you will need to move through the form (using  or ) in order to check all of the fields in the form.

Once Asset Surveyor is communicating with a Trimble GPS receiver, your interaction with the GPS receiver takes place through the *GPS operations* menu. You can press **[GPS]** to pop up this menu:

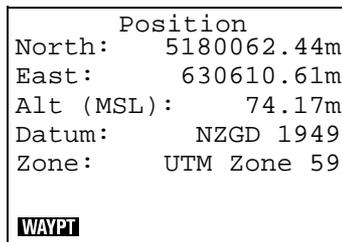


Configuring GPS

The **SETUP** softkey on the *GPS operations* menu provides a shortcut means to configure your GPS receiver. It leads to the *Rover options* and *Base stn options* configuration forms.

Your Current GPS Position

If you select the *Position* entry from the *GPS operations* menu, Asset Surveyor will display the current GPS position, if available, or the most recent GPS position, if none is currently available.



When Asset Surveyor is unable to 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.

You can press the **WAYPT** softkey to create a waypoint for the current position.

Current GPS Status

If you select the *Receiver status* entry from the *GPS operations* menu, Asset Surveyor will display information regarding the status of the GPS receiver. For example:

```
Receiver status
Mode:      Manual 3D
SVs:      4,6,22,25,15
PDOP 2.1   HDOP 1.6
VDOP 1.3   TDOP 0.3
Receiving RTCM: Yes
Carrier time:0:00:00
Receiver info
Receiver:   ProXR
Nav version: 1.04
Sig version: 0.09
Battery:    12.3V
Status: Doing fixes
```

Satellite Information

If you select the *Satellite info* entry from the *GPS operations* menu, Asset Surveyor will display information for each satellite in the GPS receiver's tracking set:

PRN	SNR	Ele	Br (T)	URA
✓14	2.1	51°	312°	32
18	0.0	25°	236°	-
25	3.6	23°	112°	32
✓29	7.1	67°	229°	4.0
✓03	8.6	68°	77°	2.8

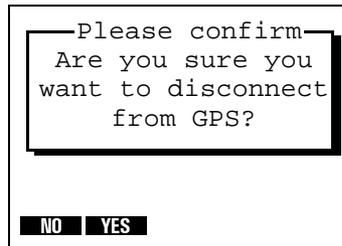
This form displays five columns of information, and spans as many pages as required to display information for all satellites in the receiver's current tracking set.

Deactivating GPS

Normally, you will not need to explicitly *Disconnect* the GPS receiver; you can just turn the TDC1 off when you have finished using it.

If you want to use the Asset Surveyor software for a while without using GPS (for example, reviewing and editing data) and want to preserve the GPS receiver's batteries, you may choose to deactivate the receiver. You must also physically disconnect the receiver before transferring files to or from the PC, as Asset Surveyor uses the same serial port for these operations as it uses to communicate with the GPS receiver.

When you select *Disconnect* from the *GPS operations* menu, Asset Surveyor will cease communications with the GPS receiver and will shut down all GPS logging operations. Before doing so, it will confirm that you have not selected this option by mistake:



If you press **YES**, the GPS receiver will be turned off, if possible, and Asset Surveyor will close down its GPS operations.



Tip – To re-activate the GPS receiver, press **GPS**.

4.2.3 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.

Asset Surveyor aligns the internal clock of the datalogger to UTC (GMT) 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 TDC1's clock will drift somewhat, but will still be reasonably accurate. Whenever you next connect to a GPS receiver, Asset Surveyor will immediately realign the TDC1's clock to UTC time.

To view the local time to GPS accuracy, select the *Time and date* entry from the Asset Surveyor software's *Configuration* menu. You can access the *Configuration* menu itself by pressing `[Config]`. The *Time and date* configuration form is as follows:

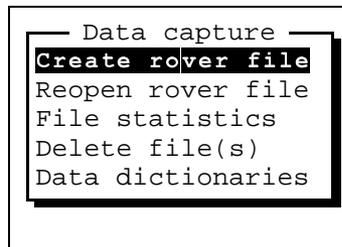
```
Time and date
24-hour clock: No
Time: 09:23:34pm
Date fmt: MM/DD/YYYY
Date: 03/28/1993 Sat
```

Until you have connected to a GPS receiver and obtained an accurate time, Asset Surveyor will simply be using the TDC1's internal clock. Additionally, Asset Surveyor 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'), Asset Surveyor will automatically align 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.

4.3 Logging Data to a File

The Asset Surveyor software logs GPS positions, offsets, ESP data and attributes for GIS features to data files. You can have a number of data files on your TDC1 at once, but you can only log data to one data file at a time. Data files are classified as either rover or base files. A rover file contains feature and attribute information, together with the GPS, offset and ESP data associated with each feature. A base file contains only GPS base station data. Base files are created by selecting the *Base station* entry from Asset Surveyor's *Main menu*.

If you select *Data capture* from the *Main menu*, Asset Surveyor will display the data file management menu:



You can perform a variety of operations from this menu, including:

- Creating a new rover file and opening it for logging of data
- Reopening a previously-created rover file for further logging of data
- Viewing statistics for existing data files
- Deleting one or more existing data files

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

4.3.1 Creating a New Data File

When you select *Create rover file*, Asset Surveyor displays the *Create file* form:

```
Create file
File:      R020315a
Data dict: Generic
Carrier mode: Off
Free space: 490 kB
TIME
```

You can accept the default file name suggested by Asset Surveyor or type a new name into the *File* field. You can also select the data dictionary which will be associated with the data file.

You can configure Asset Surveyor to record carrier phase information with each feature for greater accuracy. Pressing will create the new data file. Asset Surveyor will automatically open this data file for logging.

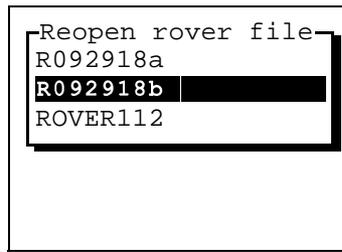
You can use the **TIME** softkey to switch between UTC and local time for the default file name.



Note – For instructions on how to capture high accuracy features see Appendix H, Using Carrier Phase Data.

4.3.2 Reopening a Data File

You can reopen an existing data file by selecting *Reopen rover file* the *Data capture* menu and selecting from the list of available rover files:



4.3.3 Starting to Log Data

When you create a new data file or reopen an existing one, Asset Surveyor starts to log data to this file. It displays a menu of geographic features which 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:



4.3.4 Starting a Feature

When you select a feature from the *Start feature* menu, Asset Surveyor will start to capture data for the feature. A feature's data includes:

- its GPS position(s).
- an optional offset to the feature.
- its attributes, which can be entered using the TDC1's keypad or using a barcode wand.
- any ESP (external sensor) data which might be recorded for that feature.

Provided a GPS receiver is connected and operational, Asset Surveyor will record GPS positions automatically for the feature, as determined by the way in which you have configured the GPS interface. It will start recording GPS positions when you select the feature, and will continue recording positions until you save the feature (see below).

If you have configured and activated an external sensor, ESP data will also be recorded automatically. ESP data will be 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 ESP data capture, and by integrating the recording of an optional offset to each feature, the Asset Surveyor software allows you to concentrate on entering attribute values for the feature.

Each feature is defined as a point, a line, or an area. The way the data capture software logs GPS positions for points, lines, and areas differs.

Figure 4-1 shows examples of geographical features:

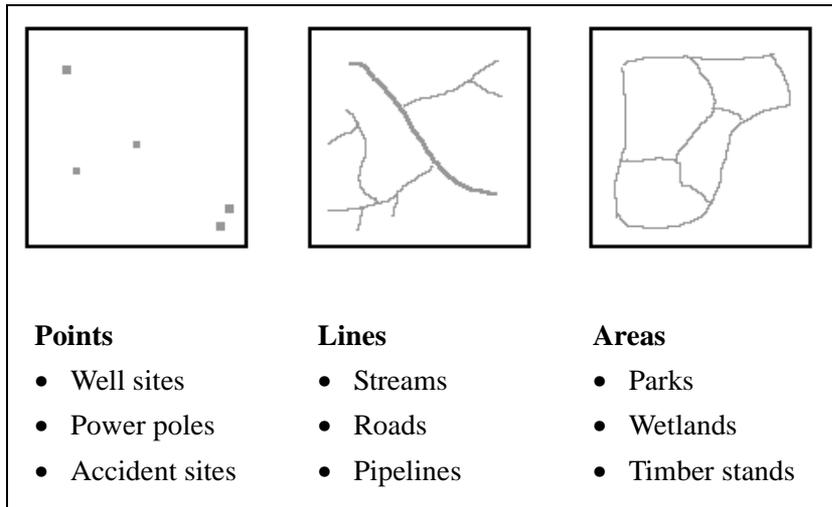


Figure 4-1 Examples of Geographical Features

- *Point features.* You can remain stationary at a point for a period of time. Asset Surveyor will record 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 Pathfinder Office) 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 TDC1 at the moment you travel past the feature. Asset Surveyor will compute a single instantaneous position for the feature. Positions obtained by quickmarking will be less accurate, even after differential correction, than averaging a number of GPS positions together, but quickmarking allows you to capture many features very quickly.

- *Line features.* In order to record a line feature, you travel along the line. As you do so, Asset Surveyor 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. As you do so, Asset Surveyor 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.

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

Point Features

When you are capturing a point feature, there are a number of 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 Asset Surveyor 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:

<<Town>>	
Name :	?
Population:	?
Gas stations:	?
Any open 24 Hrs?	No
Banks:	?
PAUSE EXT OFFSET	

The ‘?’ value is the configurable ‘Null string’, and 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, while the **OFFSET** softkey can be pressed to view, enter or edit the (optional) offset for this point feature. The **PAUSE** softkey is described on page 4-20.



Note – For instructions on how to capture decimeter level features see Appendix H, Using Carrier Phase Data.

When you are capturing a line feature, there are a number of 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 is the following:

<<Highway>>	
Name:	?
Number:	?
Interstate?:	No
Lanes:	6
PAUSE NEST SEG QUICK EXT OFFSET	

If, while traveling along the line feature, you come across a point feature which you wish to record, you can do so either as a nested point feature or as a quickmark, by pressing **NEST** or **QUICK**, respectively. The nesting and quickmarking of point features is described on page 4-22.

You can segment a line feature by pressing **SEG**. This will end the current line feature and immediately start another line feature of the same type. The new line feature will, by default, have the same attribute values as the previous line segment and these can then be edited to reflect the properties of the new line segment. The last GPS position of the first line will be the same as the first GPS position of the second line, so that the two line segments join up in Pathfinder Office and your GIS. The offset of the new line segment will default to the offset of the previous line segment, if any.

The Asset Surveyor software's **SEG** function makes it easy to record a line as several segments, each with differing attribute values, without any discontinuities between the segments.

The **OFFSET** softkey can be pressed to view, enter or edit the (optional) offset for this line feature.



Note – For instructions on how to capture decimeter level features see Appendix H, Using Carrier Phase Data.

Area Features

When you are capturing an area feature, there are a number of 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:

<<Car park>>	
Name:	?
Type:	Mall
Places:	?
Open 24 Hrs?:	Yes
Hourly fee:	0.00
PAUSE NEST QUICK EXT OFFSET	



Note – For instructions on how to capture decimeter level features see Appendix H, Using Carrier Phase Data.

If, while traveling around the area feature, you come across a point feature which you wish to record, you can do so either as a nested point feature or as a quickmark, by pressing **NEST** or **QUICK**, respectively. The nesting and quickmarking of point features is described on page 4-22.

The **OFFSET** softkey can be pressed to view, enter or edit the (optional) offset for this area feature.

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 wish to record and press **RESUME** to continue logging GPS positions. Normally, Asset Surveyor will log 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 capturing a line or area feature, Asset Surveyor will log a GPS position immediately (irrespective of the logging interval for line/area features). You can use this feature to explicitly force Asset Surveyor 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, Asset Surveyor will continue to log GPS positions at the configured line/area logging interval.

Repeating Features

You normally start capturing a feature by selecting it from the menu of features (that is, by highlighting it and pressing **Enter**, or using a first-letter search).

You can also start capturing a feature by highlighting it on the menu and pressing **REPEAT**.



The difference between normal selection of a feature and selecting **REPEAT** lies in the default attribute values given to the feature. 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 will be copied from the last recorded feature of that type.



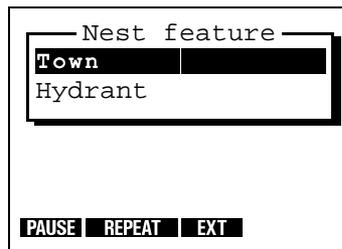
Tip – **REPEAT** enables you to record a sequence of similar features very efficiently. You do not have to re-enter the values for all of the attributes, but can just page through checking that each attribute value is correct for the current feature, and only changing those that differ.



Note – Offsets, except those configured as constant offsets, will not be repeated when the **REPEAT** softkey is pressed.

Nested Point Features

When you press **NEST** on the attribute entry form for a line or area feature, Asset Surveyor pops up a menu of point features which can be nested within that line or area. For example:



```

┌────────── Nest feature ──────────┐
│ Town                               │
│ Hydrant                            │
└───────────────────────────────────┘
┌ PAUSE  REPEAT  EXT ───────────┐

```

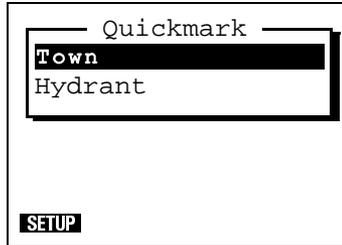
When you select a point feature from this menu, Asset Surveyor will allow you to enter attributes for the selected point feature, and all GPS positions which are logged will be associated with that point feature (rather than with the line or area feature within which the point is nested). When you save the point feature, Asset Surveyor will again log positions for the outer line or area feature. You can nest as many point features within a line or area feature as you wish. Refer to Chapter 7 of the *TDC1 Asset Surveyor Software User Guide* for further details of nesting, and for details of how to nest points which do not lie right on a line or area's perimeter.

Quickmarked Point Features

If you have a large number of point features to capture, 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 (as near as possible) and just at the moment you pass each feature you press a key on the TDC1. Asset Surveyor instantaneously computes a single GPS position for the feature.

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

When you press **QUICK**, Asset Surveyor pops up a menu of point features, for example:



Each time you select a feature from this menu Asset Surveyor will record a quickmark position for that feature, along with default attribute values.

You can record quickmarks instead of normal (averaged) point features, and you can record quickmarks within line or area features. See Chapter 7 of the *TDC1 Asset Surveyor Software User Guide* for a further discussion of quickmarking, and for details of how to configure and edit attributes for quickmarked features.



Tip – If you are typically unable to travel right over top of each feature, you should 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 Asset Surveyor's offset feature allows you to record the position of a geographical feature, without actually having to position your GPS receiver directly over that feature. You will often find this facility to be 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 capturing a tree feature, it is typically easier to stand some distance (for example, 10 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 itself clearly, and assess its condition. You can then specify an offset to the tree of '10 m South'. This ensures that the tree is 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' (presuming that you drive on the right-hand side of the road!), so that the poles will be positioned 3.5 m off the right-hand side of the road. This is an example of capturing offset quickmark features.
- When capturing 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 capturing offset line features.
- When capturing 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' (presuming that you walk clockwise around the building), so that in your GIS the outline of the building will be accurately recorded. This is an example of an offset area feature.

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:

```
Point offset
Bearing:      0.0°T
Slope dist:   0.000m
Inclination:  0.0°

RESET  FORMAT
```

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:      0.0°T
Horz. dist:   0.000m
Vert. dist:   0.000m

RESET  FORMAT
```

You can toggle between these two modes of offset display and entry by pressing the **FORMAT** softkey.

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 illustrated below:

```
Line offset
Direction:  Left
Slope dist: 0.000m
Inclination: 0.0°

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:  Left
Horz. dist: 0.000m
Vert. dist: 0.000m

RESET  FORMAT
```

You can toggle between these two modes of offset display and entry by pressing the **FORMAT** softkey.



Note – All Asset Surveyor features (be they points, lines, areas or quickmarks) can have only **one** offset associated with them. It is not possible to have two or more offsets for a single feature. In particular, this means that in order to record a line feature with a given offset and then to change the offset part-way through the line feature, it is necessary to segment the line at that point (each segmented line feature has its own offset). You must carefully plan how to capture an area feature using offsets, as the same offset value must apply to the entire area feature.



Tip – An offset is a 3-dimensional modification to your GPS position, so you can use offsets to record the full 3-dimensional position of completely inaccessible features such as the top of a tree, a ledge part-way up a cliff, and so forth.

Every feature recorded with Asset Surveyor 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 will be 0.

If every feature which you record tends to be offset from your position at the time you record it, you can configure a constant offset, which will be automatically applied to that class of feature. You can always modify the constant offset for specific features which 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. Asset Surveyor also supports the capture of offsets for features using a laser rangefinder. This allows very efficient capture of offsets without the need to manually enter distances, bearings or inclinations.

4.3.5 Entering Attributes

When you select a feature to capture, whether it is a point, line or area feature, Asset Surveyor will pop up 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**). You can enter new attribute values or edit existing values using the TDC1's keypad, and you can optionally enter values for menu attributes using a barcode wand.

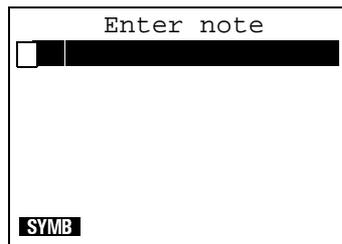
You can also configure an ESP external sensor to automatically fill in one attribute value per feature. See Chapter 5 of the *TDC1 Asset Surveyor Software User Guide*.

4.3.6 Saving a Feature

As with any standard Asset Surveyor form, you save the attribute entry form's contents by pressing . You will probably not press the moment you finish entering attributes for the feature, because, while the feature is 'active', any GPS positions and ESP data which are logged will be associated with that feature. If this is a point feature, you should remain stationary at that feature until the configured minimum number of positions have been logged, before pressing . If it is a line or area feature you should 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 .

4.3.7 Entering a Note

Whenever you are capturing data to a file, you can press to enter a textual note. Asset Surveyor allows you to type any characters at all into a note, which can be up to 80 characters long.



When you have finished entering the note, press and Asset Surveyor will store the note in the current data file. If you decide that you no longer wish to save the note, press instead of .

4.3.8 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 using the Differential Correction Utility in Pathfinder Office to yield accuracy of a few decimeters.



Note – For detailed information on how to capture carrier phase features see Appendix H, Using Carrier Phase Data.

4.3.9 Exiting Data Capture

When you have finished capturing data to a file, press **Clear** on the *Start feature* menu. Asset Surveyor will confirm that you want to exit data capture (and didn't just press **Clear** by accident) and then exit to the data file management menu. Once you have exited data capture, Asset Surveyor will cease logging GPS or ESP data.

4.4 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 Asset Surveyor and a GPS receiver to *navigate* to a position of interest.

Navigation is traditionally associated with ensuring that an aircraft or ship follows a prescribed course when traveling from A to B, but you can also use navigation to re-visit features which have been previously surveyed, and to identify a specific feature which may require maintenance.

You can navigate by selecting the *Navigation* entry from either the *Main menu* or the *GPS operations* menu.

The Asset Surveyor software provides three navigation forms, called **NAV1**, **NAV2** and **NAV3**, which present navigation information in three quite different ways. The following is an example of the form:

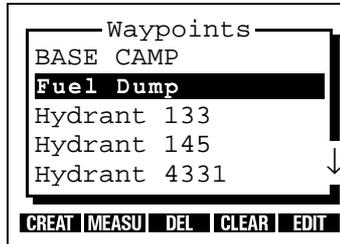
```
TOWN > BASE CAMP
Go:      North 2.478m
Go:      East 1.276m
Heading:      34°T
Time:      00h42m 4km/h
Change course: 5°→
NAV1 NAV2 NAV3 START END
```

Each of the navigation forms also shows your current heading and velocity.

4.4.1 Waypoints

An Asset Surveyor waypoint is a named three-dimensional position. A waypoint can be used to record a geographic point of interest such as 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:



You can add waypoints to this list by typing in their coordinates, by loading them in from Pathfinder Office, by creating a waypoint from the current GPS position, or by creating a waypoint from a feature in an Asset Surveyor data file.

Waypoints can be used for navigation, and can be output to Pathfinder Office.

4.5 Reviewing and Editing Data

You can review and optionally edit an Asset Surveyor data file by pressing **View**. If you press **View** while capturing data to a file, you can review that data file. If you press **View** outside of data capture, you can select any data file to review.

The Asset Surveyor software displays each feature and note in the data file on a single line of the review form, and begins by highlighting the last feature or note in the form. For example:

```
Review <<R100509a>>
1: Logging started ..
2:           Town
3:           Gas station
4:           Bank
5:           Highway
6:           Car park
SEARCH POS DEL UNDEL
```

You can review (and optionally edit) any feature or note in this list by highlighting it and pressing **Enter**.



Note – You can edit attribute information, offsets and the contents of notes, but you cannot edit the GPS position(s) of a feature.

You can also perform a variety of operations using the softkeys on the review form, such as searching, deleting and un-deleting features and notes. You can also view the recorded GPS positions of each feature, and can save a feature's position as a waypoint.

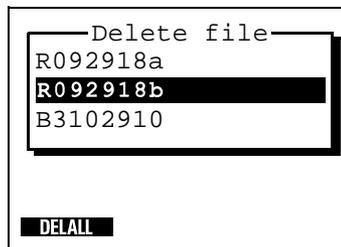
4.6 Managing Data Files

Because the TDC1's data storage space is finite, you will eventually have to delete captured data files from the TDC1.



Caution – You should always check that files which have been transferred to your PC were transferred correctly before deleting the original data files from the TDC1. Once a data file has been deleted from the TDC1, it cannot be recovered.

The *Data capture* menu includes a *Delete file(s)* entry. When you select this entry, Asset Surveyor will display a menu of data files:



You can select a particular data file from this menu to delete it, or you can press **DELALL** to delete all data files. Asset Surveyor always asks you to confirm that you really wish to delete one or more data files, and asks you to confirm again for each data file which has not yet been transferred to your PC.

If you wish to delete data files to make space on your TDC1, it is useful to know how much storage space individual data files are consuming. Selecting *File statistics* from the *Data capture* menu provides some useful statistics on the highlighted data file, including its size and the amount of data storage space remaining on the TDC1.

5 Back in the Office

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

- Transferring data to the PC
- Postprocessing data to differentially correct it
- Displaying data
- Exporting data to a GIS

5.1 Transferring Data to the PC

Instructions for transferring rover data from the data collector 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, then you will need to transfer those files to the PC on which the Pathfinder Office software is installed.

5.1.1 Transferring Data from the Data Collector

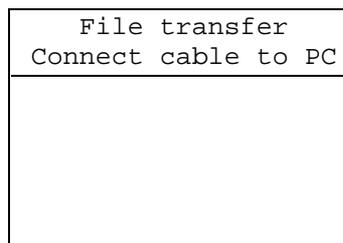
After data has been collected, it must be transferred (using the Pathfinder Office Data Transfer Utility) from the data collector to the PC. The procedure for transferring the data from the data collector is straightforward. First connect your data collector to the PC, as shown in Figure 3-2, page 3-11, then transfer the data.

Transferring Data

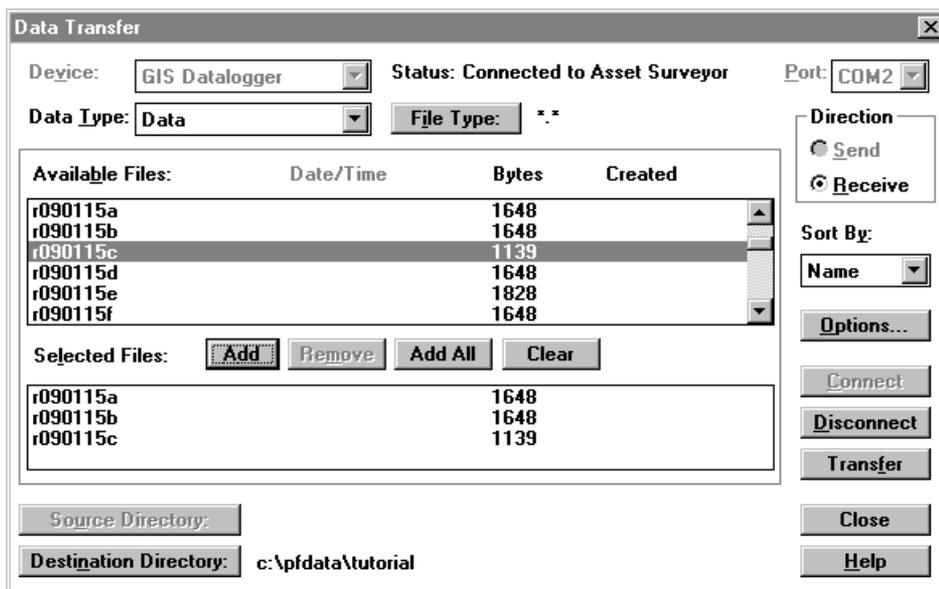
The rover or base station data that you have stored on your TDC1 data collector needs to be transferred to your PC. This is accomplished through the *File transfer* option at the Asset Surveyor *Main menu*.

To transfer the data files:

1. Connect your datalogger to the PC.
2. On the data collector select *File transfer* from the Asset Surveyor *Main menu*. The Asset Surveyor software is ready to transfer data files.



3. Select *Utilities / Data Transfer* from the Pathfinder Office menu bar. The following dialog appears if the connection to your GIS datalogger is successful. If you are unable to connect to your datalogger, check the cabling, then press **Connect**.



A list of data files by type specified in the *Data Type* field will appear in the *Available Files* dialog. Select one or more files to be transferred by highlighting the files in the *Available Files* field and pressing **Add**.

4. Press **Transfer**. All the files in the *Selected Files* field are transferred.

For further details of how to transfer files to and from the PC, see the Pathfinder Office documentation.

5.2 Postprocessed Differential Correction

The data collected by GPS receivers is subject to errors, ranging from very small satellite clock errors to very large errors that are intentionally induced upon the system by the GPS Control Segment. The vast majority of these errors can be removed from the data by differential correction.

When this is applied to the data file, C/A code positions with an accuracy of 50 centimeters or less can be achieved using a Pro XR, Pro XRS, or Series 4000 receiver and, accuracies of less than a meter with the Pro XL or 4600 LS receivers.



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, you should perform differential correction first.

5.2.1 Starting Differential Correction

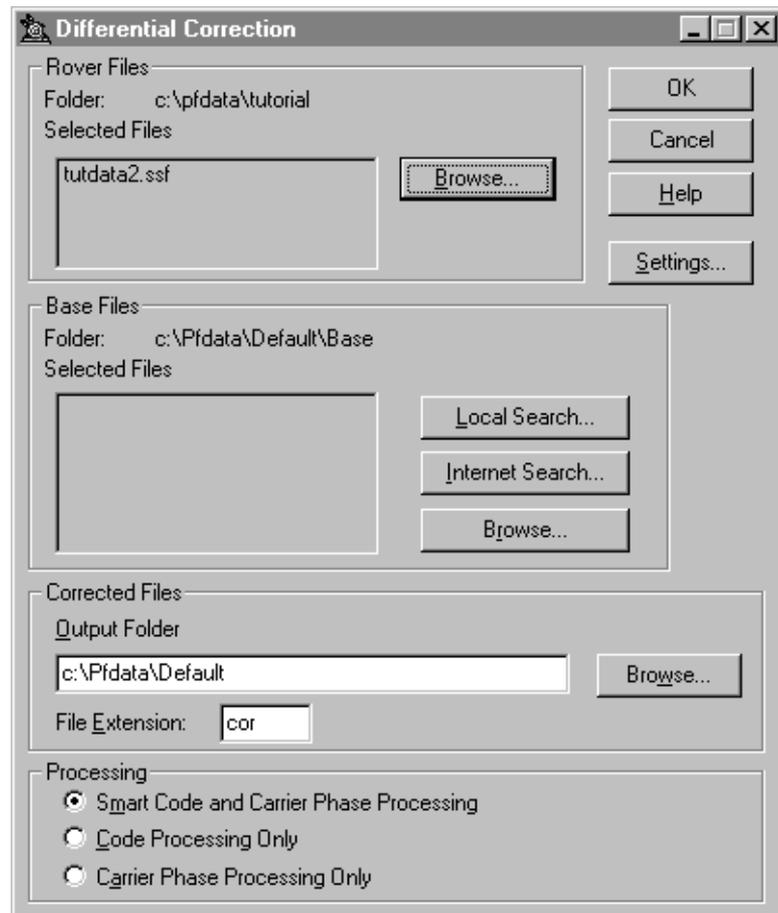
The Differential Correction Utility enables you to remove errors in the GPS data caused by Selective Availability and other factors. It improves the accuracy of GPS positions from approximately 100 meters to between 50 centimeters and 5 meters, depending on the receiver and data collection technique used.

Selecting *Utilities / Differential Correction* from the *Pathfinder Office* menu bar will start the Differential Correction program.



Note – If you have collected carrier phase data files, refer to your Pathfinder Office documentation for further details.

The following dialog appears:

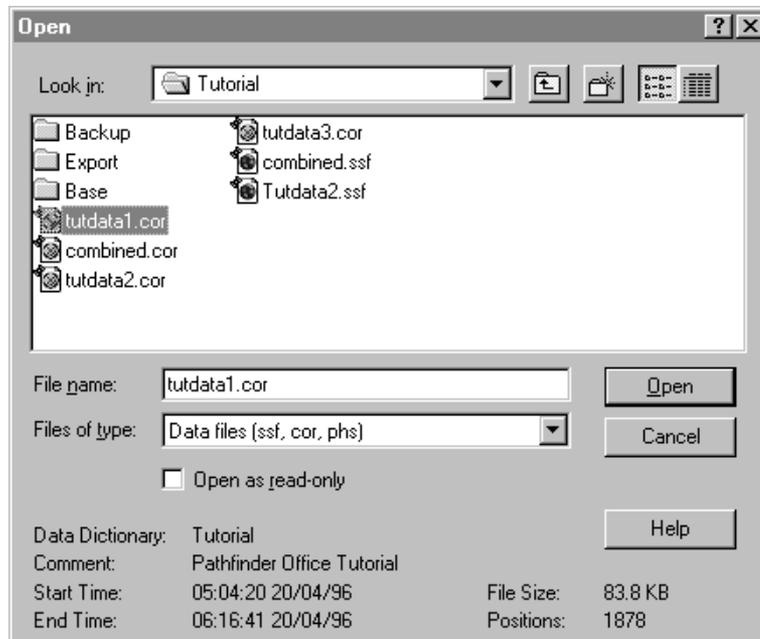


5.3 Displaying Data

The Pathfinder Office *Map* window is the primary means of viewing field data. It allows you to 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. See the Pathfinder Office documentation for details on each *Map* window function.

To display your data:

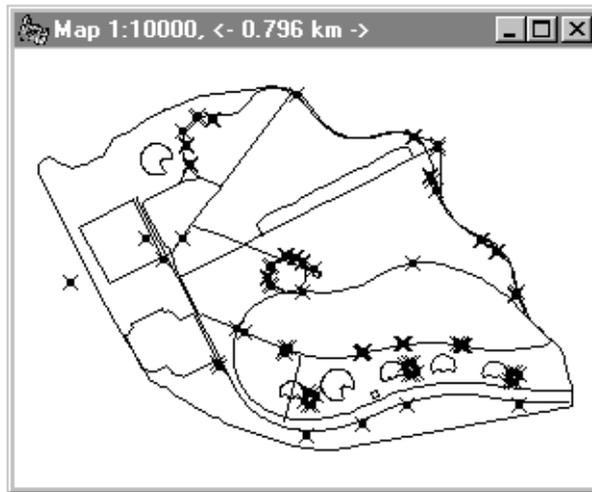
1. Select *File / Open* from the Pathfinder Office menu bar. The following dialog appears:



2. From the Open dialog, select the data file(s) you want to view.
The current project will be the default folder.

3. To change projects, select *File / Projects* from the Pathfinder Office menu bar. Select a project from the drop-down list, or click **New** to create a new project. Click **OK** to close the Select Project dialog.

When the data file is open the *Map* window displays the data as a map:



You can define what elements you want to view on this screen, and you can display positions and features simultaneously or separately by selecting or de-selecting the appropriate check boxes in the dialogs displayed using the *View / Layers* command.

In addition, you can specify the color, symbol and line style for each feature. For example, poles can be one symbol and color, and trees can be a different symbol and color. Instructions to assign colors, symbols and line styles to features are given in the Pathfinder Office documentation.

4. To query a position or feature, select the *Position Properties* or *Feature Properties* command (in the *Data* menu) from the Pathfinder Office menu bar.
5. To measure between positions and features, select *Data / Measure* from the Pathfinder Office menu bar.

To gain more proficiency with the Pathfinder Office *Map* window display, see the Pathfinder Office dos

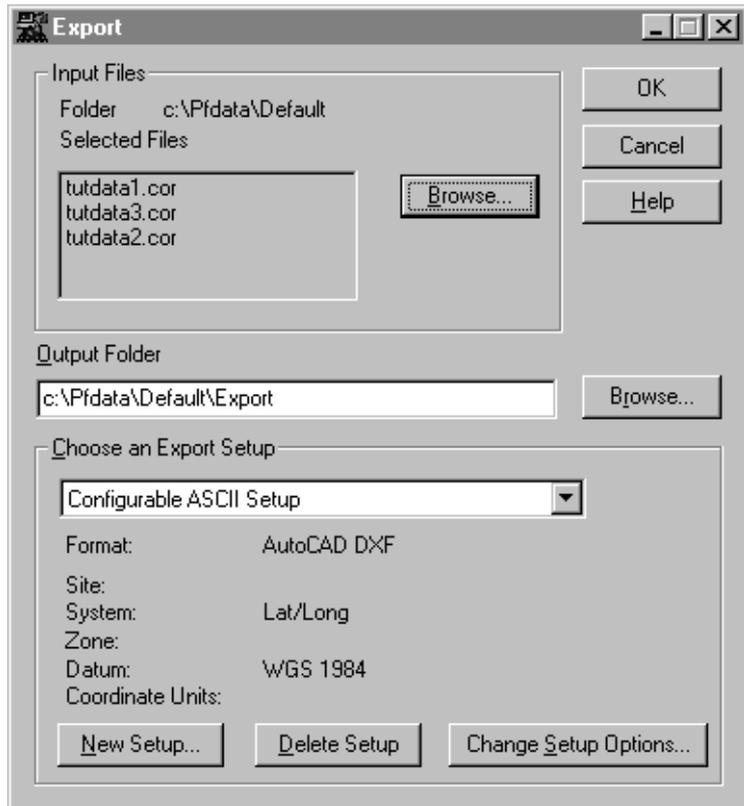
5.4 Exporting Data to a GIS

The Export Utility converts SSF format files into another format that can be read by a GIS or CAD system. It enables you to export point, line and area features, their attributes, raw GPS positions, note and velocity records, and external sensor records to a variety of other formats.

5.4.1 Exporting Data to a GIS or CAD Format

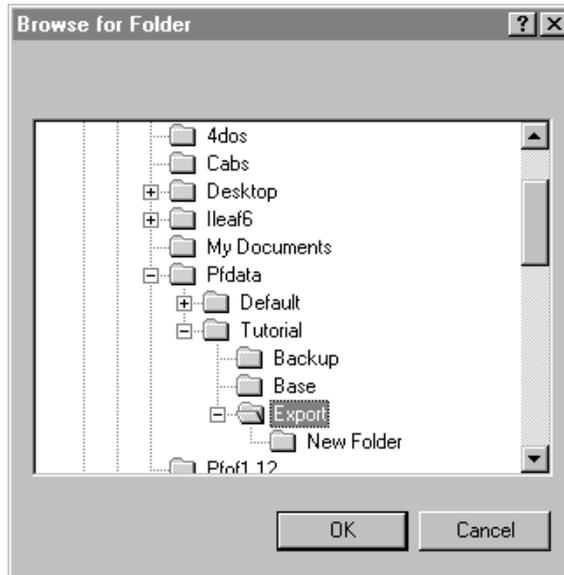
To export data to a GIS:

1. Select *Utilities / Export* from the Pathfinder Office menu bar to run the Export Utility. The following dialog appears:



2. 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. If you want to change the list of selected input files, press **Browse** to find the files you want to export.

3. The default export folder is that specified in the current Pathfinder Office project. If you want to change the export folder, press **Browser**, and the following dialog appears:



4. Select the folder you want to store the exported files in.
5. Choose the *Export Setup* that you want to use for exporting the data. Export supports a number of existing GIS and CAD products such as ARC/INFO, AutoCAD, MGE ASCII loader, and MapInfo. Export can also export data into ASCII format. See the Pathfinder Office documentation for information on how to customize export formats.
6. Click **OK** after choosing an Export setup. A progress bar appears tracking the status of the export process.

5.5 Batch Processor

The batch processor is designed to help you increase productivity by automating repetitive tasks that must be performed when you return from the data capture session. You can come back from the field at the end of the day, start the Batch Processor running, and go home. When you arrive back at work the next morning, your data has been downloaded from the TDC1, 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.

A Pro XRS System

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 receiver uses Trimble's "The Choice" technology, offering you unsurpassed flexibility in choosing a source for real-time corrections. This breakthrough technology combines a 12-channel GPS receiver, a 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.

A.1 Turning the Receiver On

When the receiver and TDC1 are connected as shown in Figure A-1, there is no need to explicitly turn on the Pathfinder Pro XRS; when the TDC1 is turned on the Asset Surveyor software immediately turns on the Pro XRS and starts communicating with it.



Note – The TDC1 draws power from the receiver’s battery when the receiver is turned on.

A.2 Turning the Receiver Off

When you turn off the TDC1, or explicitly disconnect the GPS receiver, the Pro XRS will be automatically turned off. It will cease drawing current from the system battery when turned off.

A.3 Configuring the Receiver to work with Asset Surveyor

No special configuration of the Pro XRS is required in order to get the Asset Surveyor software and Pro XRS to communicate, beyond the usual GPS *Rover options* which should be configured in the Asset Surveyor software. The following section describes the settings required to obtain submeter accuracy from your Pro XRS.

A.4 Operational Aspects Specific to the Pathfinder Pro XRS

The following sections outline the operational aspects specific to the Pathfinder Pro XRS system.

A.4.1 < 50 cm Accuracy

In order to achieve post-processed accuracy with the Pro XRS 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 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 (via RTCM) synchronized measurements, and which is equipped with an EVEREST capable Pro XR, Pro XRS, 4600LS, 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 will result in a degradation in accuracy.

A.4.2 RTCM Input

The Pro XRS supports RTCM Version 2 input. Connect your RTCM link directly to the cable labeled 'RTCM'.

The Pro XRS 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 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 details on the Pro XRS GPS receiver, refer to the *Pro XR/XRS Receiver Operation Manual*.

A.4.3 RTCM Output

The Pro XRS receiver supports RTCM output as a receiver firmware option. Asset Surveyor can configure and control a real time base station provided the receiver is a Pro XL, Pro XR or Pro XRS and has the appropriate firmware option installed.

The Pro XRS 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 data collector when using the Pro XRS 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 will need to have the TDC1 connected to the Pro XRS base station at all times.

If you are using a Trimtalk™ 450, 450S, or 900, a Trimmark™ I and II, or a new Pacific Crest RFM96W with the Pro XRS you will need to purchase the RTCM OUT cable (P/N 32871) which connects to the Pro XRS 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 you will need to 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 or 33346) to the RFM96W radio.

If you are using a non-Trimble radio with the Pro XRS, you will need your own cable to connect from your radio to the supplied NMEA/RTCM cable in Port A.

A.4.4 Overdetermined Positions

The Pro XRS supports the computation of overdetermined GPS positions.

A.4.5 Carrier Phase Mode

The Pro XRS receiver can be operated in carrier phase mode. You enable carrier phase mode via the *Create file* form.

If you are using the integrated GPS/MSK Beacon antenna (P/N 29653-00), then the antenna code ‘MB’ must be entered into the *Type* field in the *Antenna options* form. If you are using a compact dome antenna (P/N16741-00), then enter ‘EC’ as the antenna code.

A.4.6 PPRT Positions (Postprocessable Real-Time)

The Pro XRS receiver can be configured to collect PPRT positions, enabling the user to differentially correct real-time collected data.

A.4.7 Receiver Outputs

The Pro XRS supports TSIP and NMEA output. The Pro XRS does not output PPS.

A.4.8 Cabling Diagram

In order to use the Asset Surveyor software with a Pathfinder Pro XRS receiver, connect the system as shown in Figure A-1.

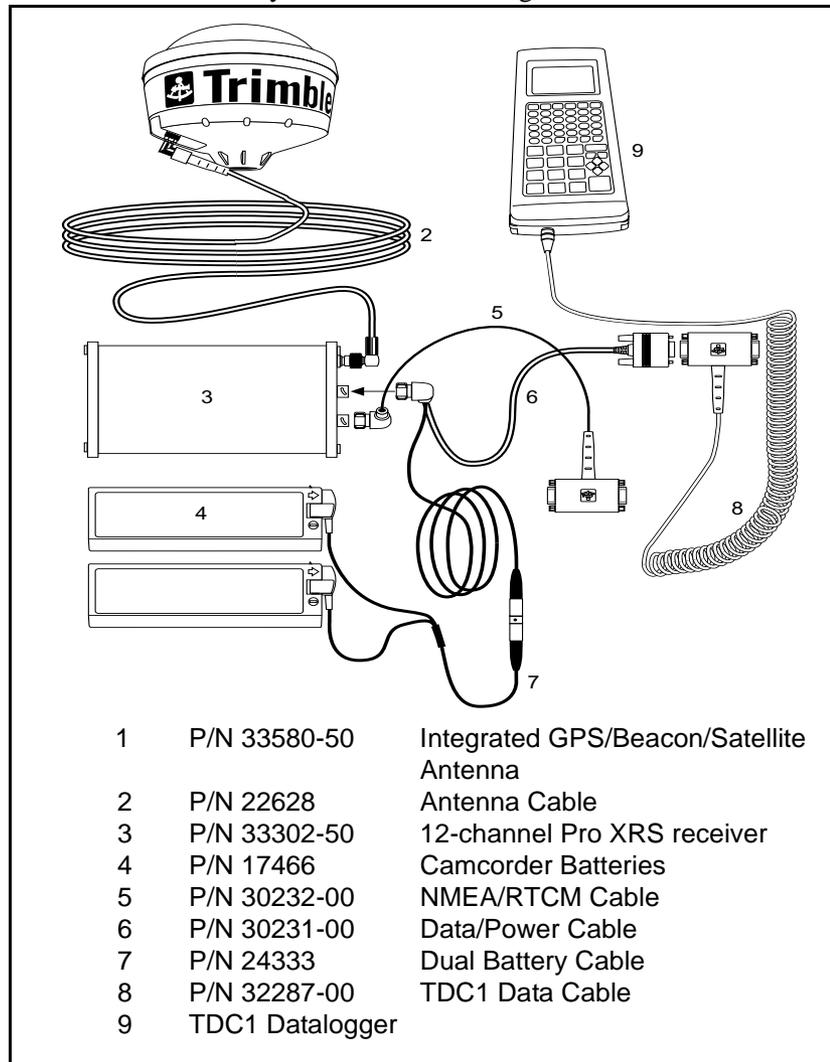


Figure A-1 Cabling for the Pathfinder Pro XRS

A.4.9 Full Equipment List

Table A-2 lists the equipment which may be used in the field when operating a Pathfinder Pro XRS in conjunction with the Asset Surveyor software running on your TDC1.

Table A-2 Equipment List

Part Name	Part Number
Hip-pack Assembly for Pro XRS System with TDC1	31446-17
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
Pathfinder pouch belt for accessories	13274
Pro XRS hard travel case	31789-00

B Pro XR System

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 receiver combines a 12-channel GPS receiver with a fully-automatic dual channel MSK radiobeacon receiver. Use the Pro XR GPS receiver to receive DGPS (Differential GPS) broadcasts conforming to the IALA (International Association of Lighthouse Authorities) standard.

B.1 Turning the Receiver On

When the receiver and TDC1 are connected as shown in the cabling diagram later in this section, there is no need to explicitly turn on the Pathfinder Pro XR; when the TDC1 is turned on the Asset Surveyor software immediately turns on the Pro XR and starts communicating with it.



Note – The TDC1 draws power from the receiver’s battery when the receiver is turned on.

B.2 Turning the Receiver Off

When you turn off the TDC1, or explicitly disconnect the GPS receiver, the Pro XR will be automatically turned off. It will cease drawing current from the system battery when turned off.

B.3 Configuring the Receiver to work with Asset Surveyor

No special configuration of the Pro XR is required to get the Asset Surveyor software and Pro XR to communicate, beyond the usual GPS *Rover options* that should be configured in the Asset Surveyor software. The following section describes the settings required to obtain submeter accuracy from your Pro XR.

B.4 Operational Aspects Specific to the Pathfinder Pro XR

The following sections outline the operational aspects specific to the Pathfinder Pro XR system.

B.4.1 <50 cm Accuracy

In order to achieve accuracy with the Pro XR 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 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 (via RTCM) synchronized measurements, and which is equipped with an EVEREST capable Pro XR, Pro XRS, 4600LS, 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 will result in a degradation in accuracy.

B.4.2 RTCM Input

The Pro XR supports RTCM Version 2 input. Connect your RTCM link directly to the cable labeled 'RTCM'.

The Pro XR 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.

B.4.3 RTCM Output

The Pro XR receiver supports RTCM output as a receiver firmware option. Asset Surveyor can configure and control a real time base station provided the receiver has the appropriate firmware option installed.

The Pro XR 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 data collector 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 will need to have the TDC1 connected to the Pro XR base station at all times.

If you are using a Trimtalk™ 450, 450S, or 900, a Trimmark™ I and II, or a new Pacific Crest RFM96W with the Pro XR you will need to 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). If you are using an old Pacific Crest RFM96W with the Pro XR you will need to 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 or 33346) to the RFM96W radio.

If you are using a non-Trimble radio with the Pro XR, you will need your own cable to connect from your radio to the supplied NMEA/RTCM cable in Port A.

B.4.4 Overdetermined Positions

The Pro XR supports the computation of overdetermined GPS positions.

B.4.5 Carrier Phase Mode

The Pro XR receiver can be operated in carrier phase mode. You enable carrier phase mode via the *Create file* form.

If you are using the integrated GPS/MSK Beacon antenna (P/N 29653-00), then the antenna code 'MB' must be entered into the *Type* field in the *Antenna options* form. If you are using a compact dome antenna (P/N16741-00), then enter 'EC' as the antenna code.

B.4.6 PPRT Positions (Postprocessable Real-Time)

The Pro XR receiver can be configured to collect PPRT positions, enabling the user to differentially correct real-time collected data.

B.4.7 Receiver Outputs

The Pro XR supports TSIP and (in firmware version 2.07 and later) NMEA output.

B.5 Cabling Diagram

In order to use the Asset Surveyor software with a Pathfinder Pro XR receiver, connect the system as shown in Figure B-1.

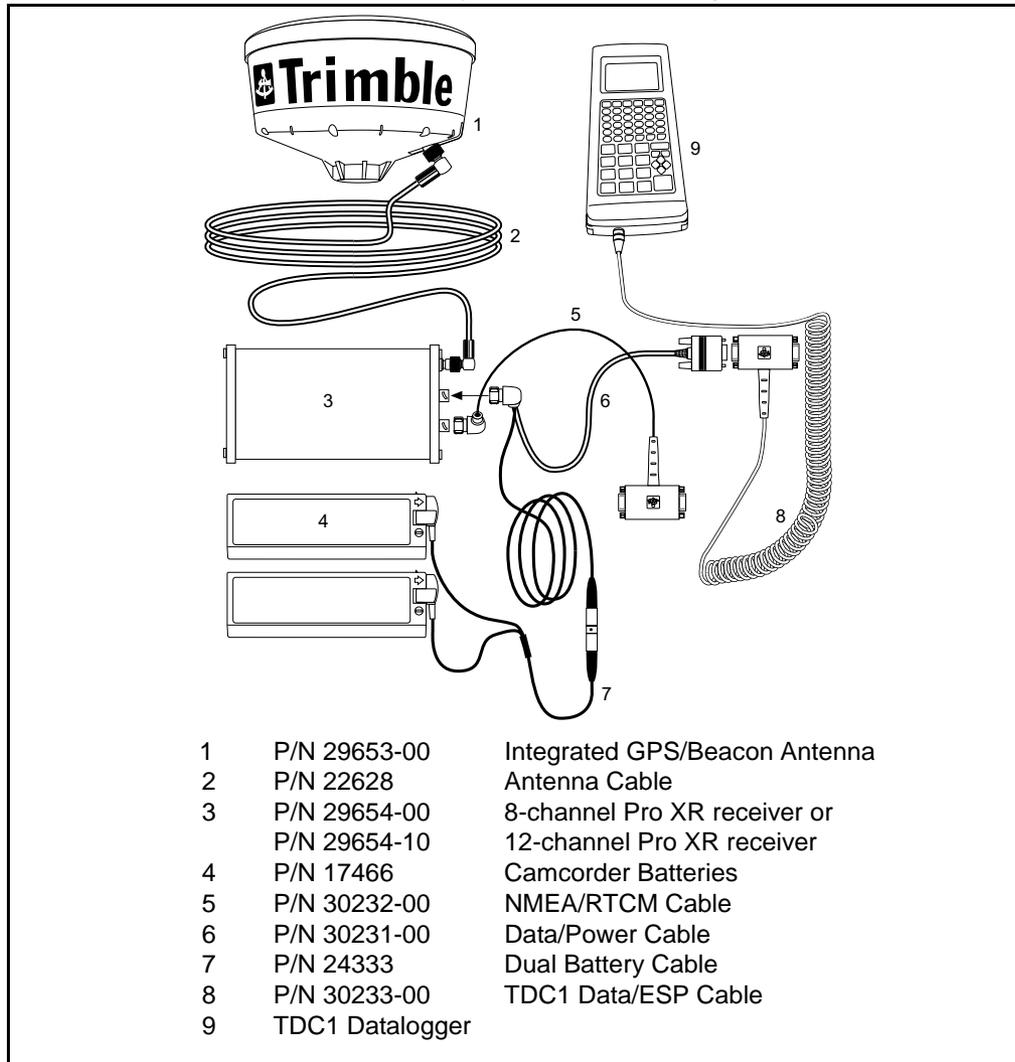


Figure B-1 Cabling for the Pathfinder Pro XR

B.6 Full Equipment List

Table B-2 lists the equipment that you can use in the field when operating a Pathfinder Pro XR in conjunction with the Asset Surveyor software running on your TDC1.

Table B-2 Equipment List

Part Name	Part Number
Hip-pack Assembly for Pro XR System with TDC1	31446-00
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
Pathfinder pouch belt for accessories	13274
Pro XR hard travel case	13000-50
TDC1 Asset Surveyor Quick Reference Guide	28382-00
RTCM output cable	32871
Unattended real-time base station power cable	32247

C Pro XL System

The 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.

C.1 Turning the Receiver On

When the receiver and TDC1 are connected as shown in the cabling diagram later in this section, there is no need to explicitly turn on the Pathfinder Pro XL; when the TDC1 is turned on the Asset Surveyor software immediately turns on the Pro XL and starts communicating with it.



Note – The TDC1 draws power from the receiver's battery when the receiver is turned on.

C.2 Turning the Receiver Off

When you turn off the TDC1, or explicitly disconnect the GPS receiver, the Pro XL will be automatically turned off. It will cease drawing current from the system battery when turned off.

C.3 Configuring the Receiver to work with Asset Surveyor

No special configuration of the Pro XL is required to get the Asset Surveyor software and Pro XL to communicate, beyond the usual GPS *Rover options* which should be configured in the Asset Surveyor software. The following section describes the settings required to obtain submeter accuracy from your Pro XL.

C.4 Operational Aspects Specific to the Pathfinder Pro XL

The following sections outline the operational aspects specific to the Pathfinder Pro XL system.

C.4.1 Submeter Accuracy

In order to achieve accuracy with the Pro XL 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 (via RTCM) synchronized measurements, and which is equipped with a Pro XL, Pro XR, Pro XRS, 4600LS, Pathfinder Community Base Station (CBS) 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

Table C-1 Recommended Settings (Continued)

SNR mask	6 or more
Elevation mask	15 degrees or more

C.4.2 RTCM Input

The Pro XL supports the RTCM input. Both RTCM version 1 and RTCM version 2 are supported. Connect your RTCM link directly to the cable labeled 'RTCM'.

C.4.3 RTCM Output

The Pro XL supports RTCM output as a non-standard receiver firmware option. Asset Surveyor can configure and control a real time base station provided the receiver is a Pro XL and has the appropriate firmware option installed. Connect your RTCM output link directly to the cable labeled 'RTCM'.

C.4.4 Overdetermined Positions

The Pro XL supports the computation of overdetermined GPS positions.

C.4.5 Carrier Phase Mode

The Pro XL receiver can be operated in carrier phase mode. You enable carrier phase mode via the *Create file* form.

C.4.6 Receiver Outputs

The Pro XL 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.

C.5 Cabling Diagram

In order to use the Asset Surveyor software with a Pathfinder Pro XL receiver, connect the system as shown in Figure C-1.

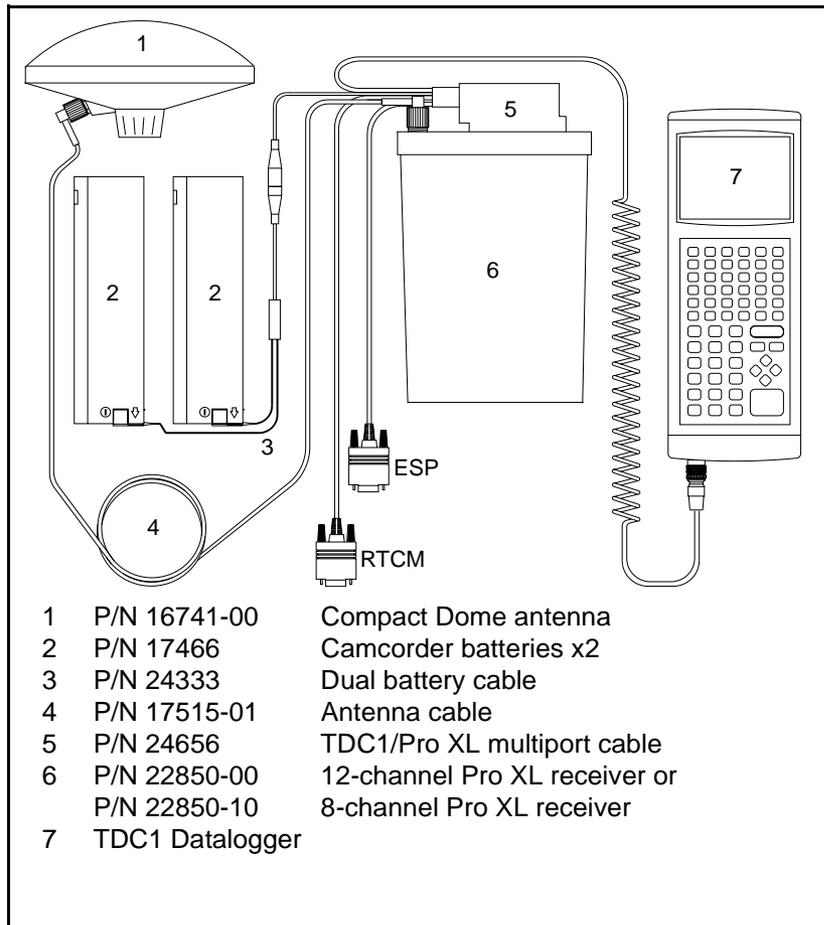


Figure C-1 Cabling for the Pathfinder Pro XL

C.6 Full Equipment List

Table C-2 lists the equipment that you can use in the field when operating a Pathfinder Pro XL in conjunction with the Asset Surveyor software running on your TDC1.

Table C-2 Equipment List

Part Name	Part Number
Pouch Assembly for Pro XL System with TDC1	24491-10
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
Pathfinder pouch belt for accessories	13274
Pro XL hard travel case	13000-30
TDC1 Asset Surveyor Quick Reference Guide	28382-00

D Basic Series

The Pathfinder Basic and Basic Plus are high performance 3- and 6-channel handheld GPS receivers, which are battery-powered and ruggedized for field use.

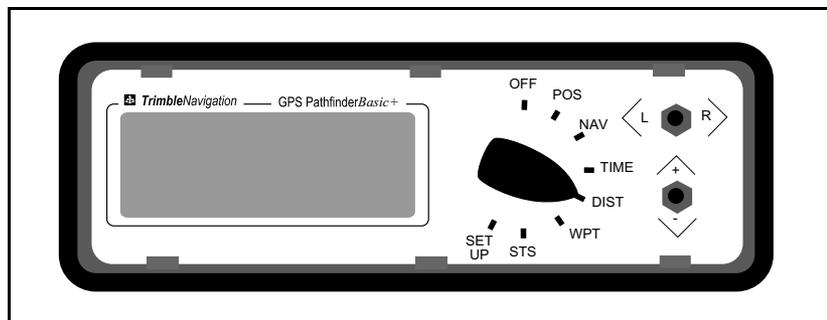


Figure D-1 The Pathfinder Basic Front Panel

You can operate the Pathfinder Basic Series GPS receivers with or without an external antenna, and with or without a datalogger attached. The post-processed differentially corrected accuracy (CEP) for the Pathfinder Basic and Basic Plus receivers is specified at 1 to 5 meters.

The remainder of this section describes the use of a Pathfinder Basic Series receiver in conjunction with the Asset Surveyor software running on the TDC1. All comments refer to the Basic and Basic Plus except where explicitly stated. For brevity, both receiver types will be referred to as the 'Pathfinder Basic'. For further details about the Pathfinder Basic refer to the *GPS Pathfinder Basic Receiver Operating Manual*.

D.1 Turning the Receiver On

The Asset Surveyor software will not turn on the Pathfinder Basic. You must do so manually by turning the rotary knob on the front of the receiver clockwise from the Off position.

Before the Asset Surveyor software can communicate with a Pathfinder Basic receiver, the receiver must be configured to communicate using the TSIP protocol, as described below.

D.2 Turning the Receiver Off

The Asset Surveyor software cannot turn off the Pathfinder Basic. When you turn off the TDC1 or disconnect GPS, the Pathfinder Basic remains turned on (and consuming its battery). You must remember to also turn off the Pathfinder Basic, by rotating its rotary knob anti-clockwise to the Off position.

D.3 Configuring the Receiver to work with Asset Surveyor

The Asset Surveyor software configures all of the internal settings in the Pathfinder Basic, with the exception of the communications protocol itself. You should configure this yourself prior to using the Asset Surveyor software and Pathfinder Basic, as described below:

1. Turn the rotary knob on the Pathfinder Basic to the *Set Up* position.

The Pathfinder Basic displays the *Set Up* screen:

```
LAND/3D HAE- 288ft
TR/ENGLISH /DMS/999
WGS-84
LOC=UTC-8 <more>
```

2. Press the '+/-' switch on the Pathfinder Basic's front panel.

The Pathfinder Basic displays the *Comm* screen:

```
COMM: TSIP
      9600,0,8,1
RTCM: Auto GPS/GPD
Stale: 020 Sec<more>
```

In order for the Asset Surveyor software to communicate with the Pathfinder Basic, the first two lines of the *Comm* screen **must** be as displayed above. Not only must the communications protocol be *TSIP* (as shown on line 1), but the RS232 parameters must be 9600,0,8,1 (as shown on line 2). The *GPS Pathfinder Basic Receivers Operating Manual* describes how to change the communications protocol and RS232 parameters.

Check that the first two lines of the *Comm* screen match those shown above (or change them to match the illustrated screen).

3. You can now use the Pathfinder Basic in conjunction with the Asset Surveyor Software.

Connect your GPS receiver and TDC1 as described later in this section, then turn on the TDC1 (or press the **GPS** key, if the TDC1 is already turned on). The Asset Surveyor software and Pathfinder Basic will start to communicate, and the Asset Surveyor software will begin by configuring the Pathfinder Basic as specified in Asset Surveyor's *GPS Rover options* configuration form.

D.4 Operational Aspects Specific to the Pathfinder Basic

The following sections outline the operational aspects specific to the Pathfinder Basic Series GPS receivers.

D.4.1 Powering the TDC1

Unlike some Trimble GPS receivers, the Pathfinder Basic cannot power the TDC1 from its own battery. When used with a Pathfinder Basic, the TDC1 will draw all operating power from its own internal battery.

When you purchase a TDC1 datalogger as an adjunct to your Pathfinder Basic Series GPS receiver, you will receive one of the following cables:

- Part number 21449 (110 V)
- Part number 21677 (230 V)

Provided you are using rechargeable NiCd batteries inside your TDC1, you can recharge these batteries by connecting the supplied cable to your TDC1 and plugging it into an external power supply.

D.4.2 Minimum Voltage

Asset Surveyor will disconnect from the Pathfinder Basic when the receiver's battery falls below 8.5 V.

D.4.3 RTCM Input

Although the Pathfinder Basic Plus is capable of accepting RTCM input, it cannot handle RTCM and communicate with a datalogger simultaneously.

D.4.4 Receiver Outputs

The Pathfinder Basic Series receivers support ASCII and TSIP output, however these outputs are not available when operating a Pathfinder Basic Series receiver in conjunction with a datalogger.

D.5 Cabling Diagram

In order to use the Asset Surveyor software with a Pathfinder Basic, you should connect up the system as shown in Figure D-2:

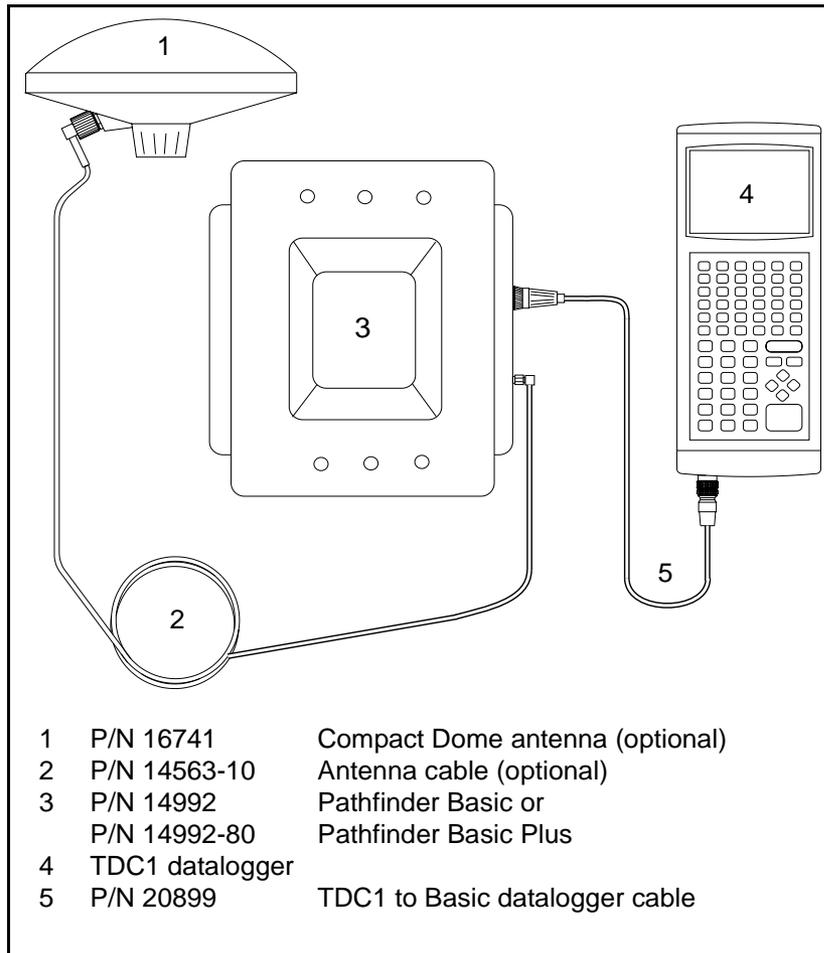


Figure D-2 Cabling for the Pathfinder Basic

D.6 Full Equipment List

The following table lists the equipment that you can use in the field when operating a Pathfinder Basic Plus in conjunction with the Asset Surveyor software running on your TDC1. Standard parts for the Pathfinder Basic Plus that are also available as options for the Pathfinder Basic are indicated with a '†'.

Table D-1 Equipment List

Part Name	Part Number
GPS Pathfinder Basic Plus Receiver	14992-80
External antenna with magnetic mount, cable & pouch†	16788-00
Hard carry case†	13000-01
Black Trimble pouch	16201
Blue belt pouch	13274
Shoulder strap	14909
AA battery pack with insert	14943-00
8 alkaline AA batteries	16197
Ni-Cd battery pack	14903-00
DC adapter pack	14934-00
Pathfinder Basic to TDC1 cable	20899
TDC1 Asset Surveyor Quick Reference Guide	28382-00

The Table D-2 lists the equipment that you can use in the field when operating a Pathfinder Basic in conjunction with the Asset Surveyor software running on your TDC1.

Table D-2 Equipment List

Part Name	Part Number
GPS Pathfinder Basic Receiver	14992
Black Trimble pouch	16201
Shoulder strap	14909
AA battery pack with insert	14943-00
8 alkaline AA batteries	16197
Ni-Cd battery pack	14903-00
DC adapter pack	14934-00
Pathfinder Basic to TDC1 cable	20899
TDC1 Asset Surveyor Quick Reference Guide	28382-00

E Centurion and Trimpack III

The Trimpack III and Centurion are 6-channel military-grade receivers which use a ruggedized version of the Pathfinder Basic case.

The Trimpack III can be operated as essentially a rugged alternative to the Pathfinder Basic Plus. There are no visible aspects of the Asset Surveyor's operation which have been modified to support the Trimpack III.

The Centurion is a dual-frequency P(Y)-code GPS receiver which, when fitted with an active cryptokey, is capable of delivering S/A-free P-code (or Y-code, when the P-code is encrypted) positions. The Trimble Centurion is only available to certain approved customers (generally Federal agencies and specified foreign Governments). A common synonym for C/A-code positions (which are subject to S/A) is SPS (for Standard Positioning System), while a synonym for P(Y)-code positions (which are S/A-free) is PPS (for Precise Positioning System).

E.1 Turning the Receiver On

The Asset Surveyor software cannot turn on the Centurion or Trimpack III. You must do so manually by turning the rotary knob on the front of the receiver clockwise from the OFF position.

Before the Asset Surveyor software can communicate with a Centurion or Trimpack III receiver, the receiver must be configured to communicate using the SLGR protocol, as described below.

E.2 Turning the Receiver Off

The Asset Surveyor software cannot turn off the Centurion or Trimpack III. When you turn off the TDC1 or disconnect GPS, the receiver remains turned on (and consuming its battery). You must remember to also turn off the receiver, by rotating its rotary knob anti clockwise to the OFF position.

E.3 Configuring the Receiver to work with Asset Surveyor

The Asset Surveyor software configures most of the internal settings in the Trimpack III and Centurion, with the exception of the communications protocol itself. You should configure these yourself prior to using the Asset Surveyor software with your Trimpack/Centurion, as described below:

1. Turn the rotary knob on the receiver's front panel to the DPORT position.

The receiver displays the data port setup screen:

```
Dataport: Trimpack3
NORMin:x NORMout:y
Timing: OFF
```

You must configure the data port protocol, the data port mode and the packet setup, as described in the following three steps.

2. Use the CMD and SEL switches to select *Protocol Type* from the data port setup menu. This leads to the following screen:

```
Protocol Type:
TRIMPACK3      ←
<default>     <quit>
```

Press the + or - switch until the selected Protocol Type is SLGR, e.g.

```
Protocol Type:
  SLGR          ←
<default>     <quit>
```

Now press CMD to confirm the selection of the SLGR protocol, and return to the data port setup screen.

3. Use the CMD and SEL switches to select *Dataport* mode from the data port setup menu. This leads to the following screen:

```
Dataport:
  in: NORM out: NORM
<default> <quit>
Use CMD to proceed
```

Ensure that both the in: and out: settings are NORM. Then press CMD to return to the *Dataport* setup screen.

4. Use the CMD and SEL switches to select *Packet Setup* from the *Dataport* setup menu. This leads to the following screen:

```
Packet baudrate:
9600
                <quit>
Use CMD to proceed
```

Set the packet baud rate to 9600, then press CMD. You will proceed to the following screen:

```
TSIP I/O Options:
P 01 V 01 T 00 Aux00
<clear>      <quit>
Use CMD to proceed
```

The Asset Surveyor software actually reconfigures these settings, so their values are not important at this stage. You should just press CMD again to save them and return to the data port setup screen.

Provided you have followed the above instructions carefully, you will now be able to use your Trimpack/Centurion in conjunction with the Asset Surveyor software.

If you are using a Centurion receiver, remember to configure the *P(Y) Options* in the Asset Surveyor software, as described in Chapter 5 of the *Asset Surveyor Software User Guide*.

E.4 Operational Aspects Specific to the Trimpack III

The following sections outline the operational aspects specific to the Trimpack III receiver.

E.4.1 Powering the TDC1

Unlike some Trimble GPS receivers, the Trimpack III cannot power the TDC1 from its own battery. When used with a Trimpack III, the TDC1 will draw all operating power from its own internal battery.

E.4.2 RTCM Input

The Trimpack III does not support RTCM input when operated in conjunction with a datalogger.

E.4.3 Overdetermined Positions

The Trimpack III does not compute overdetermined GPS positions.

E.4.4 Carrier Phase Mode

The Trimpack III cannot be operated in carrier phase mode.

E.4.5 Receiver Outputs

The Trimpack III does not support any receiver outputs when used with an external datalogger.

E.5 Operational Aspects Specific to the Centurion

The following sections outline the operational aspects specific to the Centurion receiver.

E.5.1 Powering the TDC1

Unlike some Trimble GPS receivers, the Centurion cannot power the TDC1 from its own battery. When used with a Centurion, the TDC1 will draw all operating power from its own internal battery.

E.5.2 RTCM Input

The Trimble Centurion does not support RTCM input when operated in conjunction with a datalogger.

E.5.3 Overdetermined Positions

The Trimble Centurion does not compute overdetermined GPS positions.

E.5.4 Carrier Phase Mode

The Trimble Centurion cannot be operated in carrier phase mode.

E.5.5 Receiver Outputs

The Trimble Centurion does not support any receiver outputs when used with an external datalogger.

E.5.6 Disabling the Centurion's Anti-Spoof Protection

The Trimble Centurion is a Precise Positioning System (PPS) receiver. In order to use PPS, it is necessary for the receiver to download cryptovariables.

When cryptovariables have not been loaded or are invalid, or the satellite constellation is not set to Y (encrypted) code, the Centurion is unable to provide a fix due to the startup default setting, 'Anti-Spoof Enabled'.

Anti-Spoof safety allows GPS navigation in the presence of spoofers provided there are Y-code satellites available. In order to navigate using only P or C/A-code in an unspoofed environment, the Anti-Spoof safety must be disabled, using the following procedure:

1. Turn the rotary knob on the receiver's front panel to the SA/AS position.

The following screen will appear:

```
SA/A-S Security:
-- A-S Safety OK
-- Keys Loaded
-- Mission Set
```

This screen will then change to:

```
SA/A-S Mission:
-- Mission Set
-- Keys Loaded
```

2. Click the CMD switch to Cancel A-S Safety?. Click CMD again to cancel Anti-Spoof safety. At this point, the Centurion screen will look like:

```
SA/A-S Security:
-- A-S Safety OK
-- Keys Loaded
-- Mission Set
```

and this screen will change to:

```
SA/A-S Mission:
-- Mission Set
-- Keys Loaded
```

This procedure will be necessary once every 24 hours (GPS time). This allows the Centurion to use Y, P or C/A code without Anti-Spoof (A-S) protection.

E.5.7 Configuring P(Y) Mode

Configuration of the *P(Y) mode* using the **P(Y)** softkey (which appears in the *GPS Rover options* configuration form) is described in Chapter 5 of the *Asset Surveyor Software User Guide*.

E.6 Cabling Diagram

In order to use the Asset Surveyor software with a Trimpack III or Centurion GPS receiver, connect the system as shown in Figure E-1.

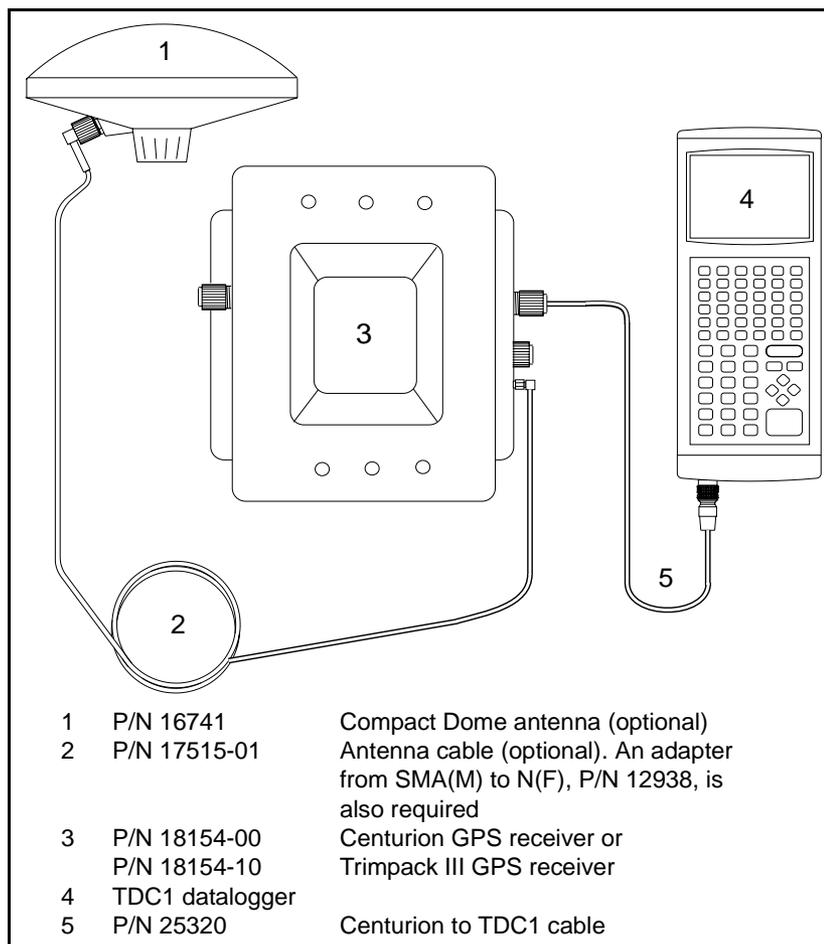


Figure E-1 Cabling for the Centurion or Trimpack III

E.7 Full Equipment List

Table E-1 lists the equipment that you can use in the field when operating a Centurion or Trimpack III in conjunction with the Asset Surveyor software running on your TDC1.

Table E-1 Equipment List

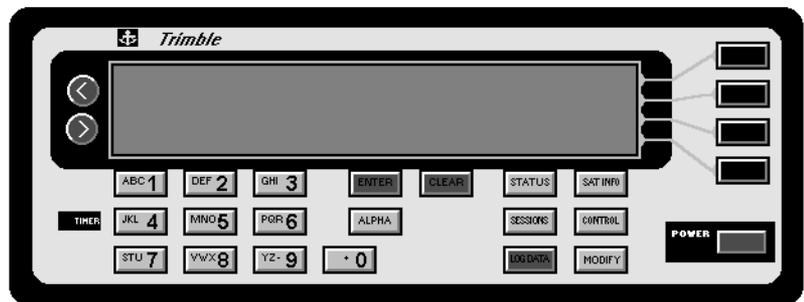
Part Name	Part Number
Centurion or Trimpack III GPS receiver	18154-00 or 18154-10
Centurion to TDC1 datalogger cable	25320
Compact dome antenna (optional)	16741-00
If using a compact dome, you will also require: Antenna cable Adapter SMA(M) to N(F)	17515-01 12938
TDC1 Asset Surveyor Quick Reference Guide	28382-00

F Series 4000

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 capture. Using a Trimble GIS Surveyor system (with EVEREST capable Series 4000 receivers as both the base station and rover) it is possible to achieve accuracies of less than 50 centimeters with just a few measurements.

The Series 4000 receivers have a somewhat different internal architecture to the Pathfinder receivers, as befits their optimization for land survey applications. Figure F-1 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 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.

F.1 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:



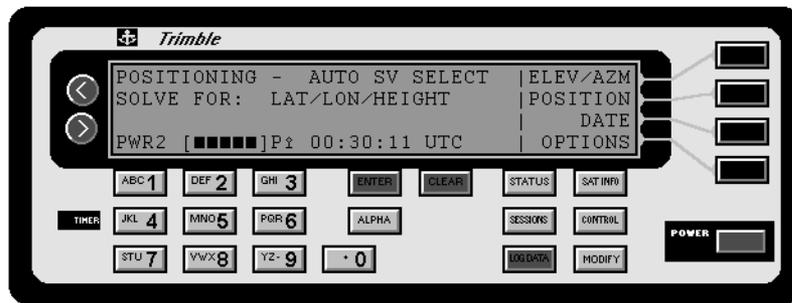
To clear these messages, press the **CLEAR** button on the 4000's front panel.

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 wish to continue recording a survey into the receiver's memory, you should stop the previous survey before proceeding.

Eventually, the Series 4000 receiver will display the following menu on its screen:



Press the **CLEAR** button to avoid starting a survey logging in the memory of the Series 4000 receiver and proceed to the receiver's main status screen:



Once you have connected the TDC1 and Series 4000 receiver as shown later in this section, you can turn on the TDC1 (or press the **GPS** key, if the TDC1 is already turned on) 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 reconfigure the receiver before it will communicate with the Asset Surveyor software. See *Configuring the Receiver to work with Asset Surveyor*, page F-6.



Note – The standard 4000 datalogger cabling provides power to the TDC1 when it is communicating with the Series 4000 GPS receiver.

F.2 Turning the Receiver Off

When you turn off the TDC1 or select *Disconnect* from the *GPS operations* menu, Asset Surveyor will turn off the Series 4000 GPS receiver, to avoid depleting the receiver's batteries. From that point on, the TDC1 will run on its own internal batteries.



Note – The TDC1 cannot turn the Series 4000 receiver back on. You must turn the receiver on using the **POWER** button on the receiver's front panel.

F.3 Configuring the Receiver to work with Asset Surveyor

The Asset Surveyor software configures most aspects of the Series 4000 receiver which concern it when communications between Asset Surveyor and the receiver are established.

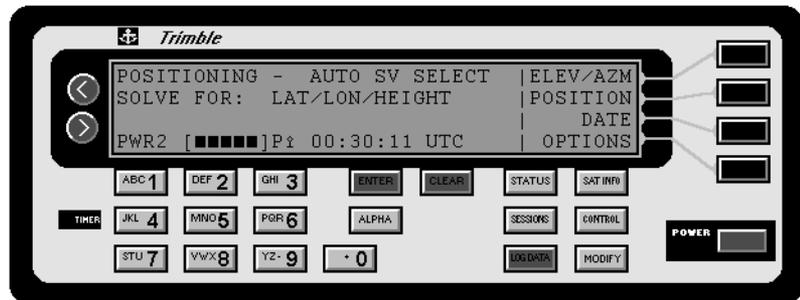


Note – The earliest version of the Series 4000 receiver navigation firmware with which the Asset Surveyor software will work is version 5.64. If you attempt to use Asset Surveyor with a Series 4000 receiver whose navigation firmware precedes version 5.64, Asset Surveyor will display the 'Receiver too old' message. In this event, contact your Trimble Assistance Center to obtain an upgrade to the firmware in your Series 4000 GPS receiver.

In general you do not need to configure any settings on the 4000's front panel.

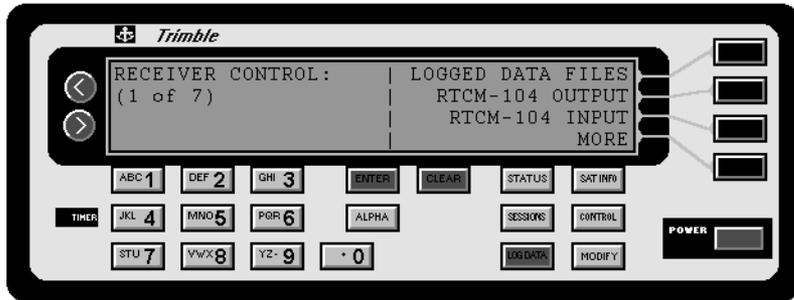
If you have reconfigured the 4000's serial ports, input/outputs, and so forth, then Asset Surveyor may be unable to establish communications with the Series 4000 receiver. If a failure to communicate occurs, check the cabling and retry (press **[GPS]** on the TDC1). If Asset Surveyor fails to communicate with the 4000 a second time, you should use the following procedure to reset the Series 4000 receiver to Default controls (that is, the default or factory settings).

1. If necessary, go to the following screen on the front panel of the Series 4000 receiver:

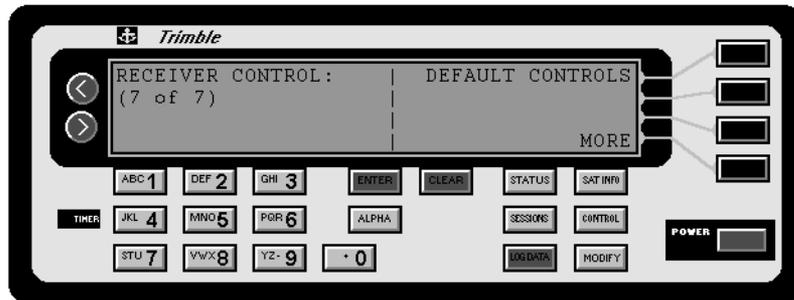


Tip – Press the **CLEAR** button enough times to get back to this screen.

2. Press the **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 will vary depending on the firmware options which have been 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 wish 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 TDC1 as shown in the cabling diagram later in this section. If the cabling is connected correctly and Asset Surveyor 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 will be able to communicate with the GPS receiver.

F.4 Operational Aspects Specific to Series 4000 GPS Receivers

There are a number of aspects in which the Series 4000 GPS receivers differ from the Pathfinder GPS receivers.

F.4.1 RTCM Input

The Series 4000 receivers are capable of accepting RTCM input (RTCM versions 1, 2 and USCG are supported), provided you have purchased the appropriate receiver firmware options.

F.4.2 Overdetermined Positions

The Series 4000 receivers can compute overdetermined GPS positions.

F.4.3 Carrier Phase Mode

You cannot operate a Series 4000 receiver in carrier phase mode in conjunction with Asset Surveyor. You can, however, use a Series 4000 receiver to perform static surveys, provided your receiver has the appropriate firmware options installed.

F.4.4 Base Station Operation

You cannot operate your TDC1 running the Asset Surveyor software as a GPS base station in conjunction with a Series 4000 GPS receiver. The Series 4000 receiver can be operated as a base station logging to its internal memory, or using Trimble's *Universal Reference Station (URS)* software to log base station data to a PC.

Because the Asset Surveyor software does not act as a base station to a Series 4000 receiver, you will not be offered the opportunity of configuring *Base stn options* when connected to a Series 4000 receiver. When you select the *GPS* entry from the Asset Surveyor software's *Configuration* menu, or press the **SETUP** softkey on the *GPS operations* menu, Asset Surveyor will automatically pop up the *GPS Rover options* configuration form. You can only access the *Base stn options* configuration form when using a Pathfinder GPS receiver or when not connected to a GPS receiver at all.

F.4.5 2D Modes

The Series 4000 receivers operate in overdetermined 2D mode, meaning that they can use four or more satellites to compute a 2D position. In the Auto 2D/3D context, the receiver will typically switch to computation of 3D positions whenever four or more satellites are available. It will, however, remain in 2D mode if the 3D PDOP exceeds the configured *PDOP mask*, but the overdetermined 2D PDOP is below the *PDOP mask*.

F.4.6 Other Configuration Options

Some options which can be configured on Pathfinder GPS 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 *Rover options* 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* on Asset Surveyor to a greater value, Asset Surveyor will set the 4000's PDOP mask to 25.4.

F.4.7 Receiver Status

The Series 4000 GPS receivers do not make a TDOP (time dilution of precision) value available to the Asset Surveyor software, so the *TDOP* field on the *Receiver status* form is omitted when connected to a Series 4000 receiver.

When the PDOP value exceeds the configured PDOP mask, the Series 4000 receiver ceases 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.

F.4.8 Almanacs

The Asset Surveyor software does not record an almanac when connected to a Series 4000 receiver, and will not send an almanac to the receiver on startup. The Series 4000 receivers maintain their own internal almanac to ensure rapid acquisition of satellites.

In order to obtain an almanac for use in Mission Planning, you can start a survey on the 4000 receiver's front panel and extract this data from the receiver's internal memory as described in the *GIS Surveyor Operation Manual*.

F.4.9 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 via the Asset Surveyor software.

F.4.10 Velocities

The velocity values which Asset Surveyor logs from a Series 4000 receiver cannot be differentially corrected.

F.5 Cabling Diagram

In order to use the Asset Surveyor software with a Series 4000 GPS receiver, connect the system as shown in Figure F-1.

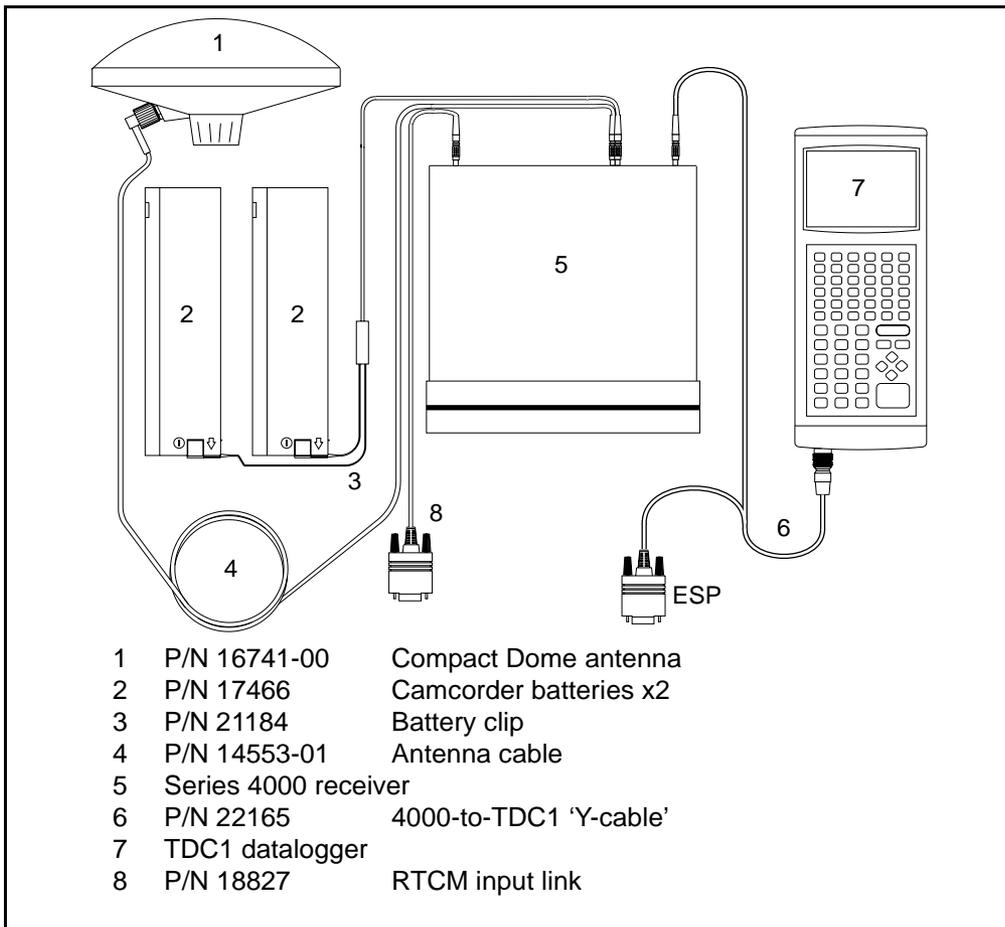


Figure F-1 Cabling for the Series 4000 Receiver

F.6 Full Equipment List

Table F-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 TDC1.

Table F-1 Equipment List

Part Name	Part Number
4000SE, 4000SSE or 4000SSi	Various
Backpack with rigid frame	20966
Range pole	18555
Compact dome antenna kit	18608-00
Battery cable assembly	21184
4 x 12 V Camcorder batteries	17466
Hard carry case	18607
Pole-mounted bracket	20847
TDC1 to 4000 Y-cable	22165
TDC1 Asset Surveyor Quick Reference Guide	28382-00

G 4600LS

The 4600LS Surveyor system 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.

G.1 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 will turn on.

G.2 Turning the Receiver Off

Hold down the large green button on the 4600LS Surveyor control panel for a few seconds. The three LEDs will switch off.

G.3 Configuring the Receiver to work with Asset Surveyor

No special configuration of the 4600LS Surveyor is required in order to use Asset Surveyor software and 4600LS Surveyor together beyond the usual GPS *Rover options* which should be configured in the Asset Surveyor software. The minimum 4600LS receiver firmware should be version 1.10. The minimum Asset Surveyor software should be version 3.03.

The following section describes the settings required to obtain submeter accuracy from your 4600LS Surveyor.

G.4 Operational Aspects Specific to the 4600LS Surveyor

The following sections outline the operational aspects specific to the 4600LS Surveyor.

G.4.1 Submeter Accuracy

If order 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 G-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 (via RTCM) synchronized measurements, and which is equipped with a Pro XR, Pro XRS, Pro XL, 4600LS, Pathfinder Community Base Station 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 Pathfinder Office software suite.

G.4.2 RTCM Input

The 4600LS Surveyor with TDC1 Asset Surveyor supports the RTCM version 2.0 format only.

G.4.3 Overdetermined Positions

The 4600LS Surveyor supports the computation of overdetermined 3D GPS positions.

G.4.4 Carrier Phase Mode

The 4600LS Surveyor receiver can be operated in carrier phase mode. You enable carrier phase mode via the *Create file* form.

The antenna code 'IL' must be entered into the *Type* field in the *Antenna* form.

G.4.5 Receiver Outputs

The 4600LS Surveyor with Asset Surveyor does not transmit any receiver output information.

G.4.6 Base Station Mode

The 4600LS Surveyor may be operated as a base station in two different ways.

1. 4600LS Surveyor with TDC1 datalogger. This is operated in the manner described in the *TDC1 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 Pathfinder Office 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°).

G.4.7 External sensors

You can use external sensors and laser rangefinders with the 4600LS Surveyor and TDC1, provided you connect the TDC1 to the 4600LS via the ESP Y-cable (part # 22165).

G.5 Cabling Diagrams

In order to use the Asset Surveyor software with a 4600LS Surveyor receiver, you should connect up the system as shown in Figure G-1 to Figure G-4:

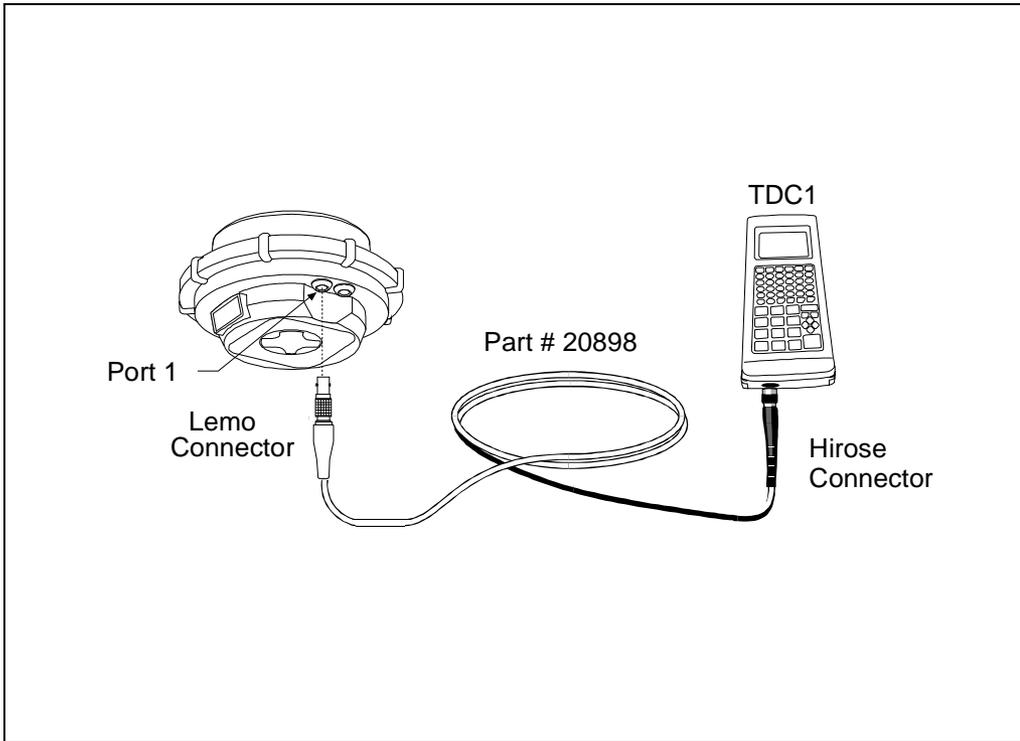


Figure G-1 4600LS Surveyor with TDC1 Asset Surveyor

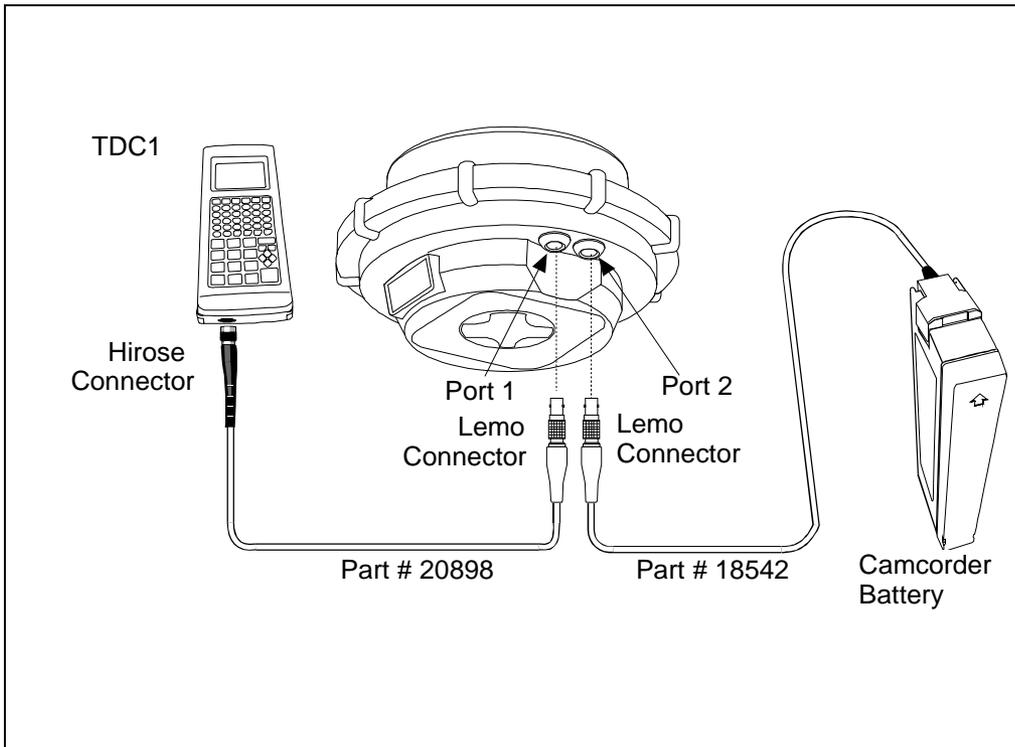


Figure G-2 Two-Port 4600LS Surveyor with Camcorder Battery and TDC1 Asset Surveyor



Note – The TDC1 Asset Surveyor always connects to port 1 on the 4600LS Surveyor.

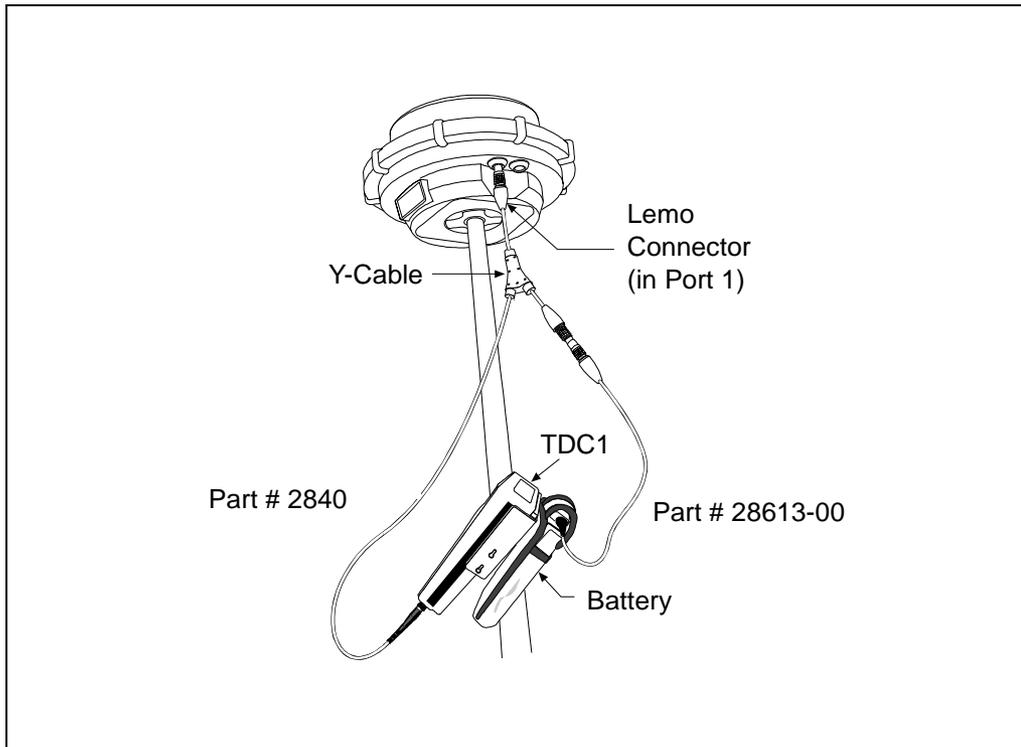


Figure G-3 4600LS Surveyor Mounted on Range Pole with TDC1 Asset Surveyor, Y-Cable, and Camcorder Battery

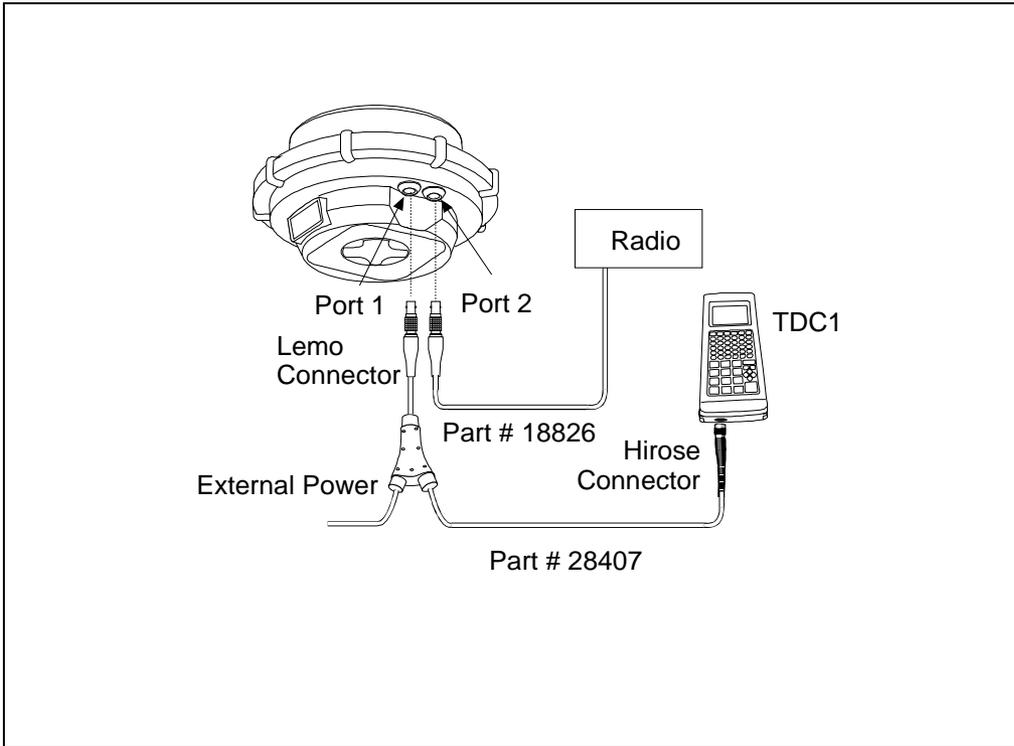


Figure G-4 4600LS Surveyor RTCM Input Configuration with Radio, TDC1 Asset Surveyor, and External Power

G.6 Full Equipment List

Table G-2 lists the equipment that you can use in the field when operating a 4600LS Surveyor in conjunction with the Asset Surveyor software running on your TDC1.

Table G-2 4600LS Surveyor with Asset Surveyor

Part Name	Part Number
8-Channel 4600LS Receiver (Single Port)	28615-10
12-Channel 4600LS Receiver (Single Port)	28615-15
8-Channel 4600LS Receiver (Dual Port)	28615-20
12-Channel 4600LS Receiver (Dual Port)	28615-25
TDC1 to 4600LS Y-Cable	28407
Lemo-to-Hirose Cable	20898
Lemo-to-DB9 Connector	18826
4000/External Sensors Cable	22165
Quick Release Adapter	19847
Quick Release	19493
Camcorder Battery Pouch Kit	28613-00
TDC1 Asset Surveyor Quick Reference Guide	28382-00

H Using Carrier Phase Data

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 new feature, this appendix introduces you to the basic concepts involved and then describes in detail how to collect and use carrier phase data.

H.1 Before You Begin

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



Note – Some of these concepts may be new to you, even if you have used previous versions of Asset Surveyor.

H.1.1 Why Use This Feature?

In a conventional GPS session, Asset Surveyor 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 Asset Surveyor logs carrier phase data, positions collected in the field can be post-processed 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.

H.1.2 What Has Changed?

(Read this section if you have used previous versions of the Asset Surveyor software.)

Before: You could only use carrier phase data to collect point features.

Now: You can use carrier phase data to collect point, line, or area features.



Note – Pathfinder Office v2.0 is required to process line and area features using the Differential Correction Utility.

Before: The only carrier phase data relevant to a feature was the data recorded during the individual feature.

Now: Each feature can benefit from a “span” of useful carrier phase data that might begin before the feature, and end after it. (This is discussed in more detail later.)

H.1.3 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.

H.1.4 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, Asset Surveyor needs to log data from at least *four* satellites for the minimum time specified. However, you will need to log data from at least five satellites for the Differential Correction Utility 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.



Note – 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, Asset Surveyor 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.

H.1.5 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:

- 5 minutes
- 10 minutes (the default)
- 20 minutes
- 30 minutes
- 45 minutes

For details of how to specify the minimum time refer to Chapter 5, Configuring Asset Surveyor, in the *Asset Surveyor Software User Guide*.

Counter

A counter in Asset Surveyor 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 Asset Surveyor 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 periods will generally give more precise positions.

Assuming that enough satellites are available, Figure H-1 shows the relationship between the time taken to collect carrier phase measurements and the precision of the positions generated during postprocessing.

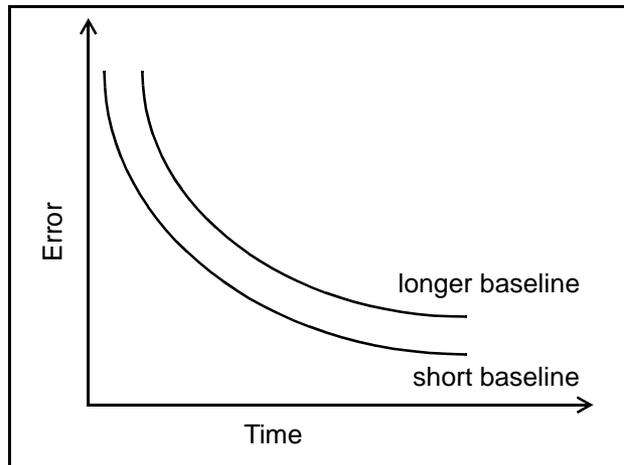


Figure H-1 Precision Achieved Relative to Time Elapsed

H.1.6 What Is a “Block” of Data?

When you start a file, Asset Surveyor 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.

Asset Surveyor continues to create blocks of data throughout the file. These blocks together constitute the measurement data for the entire session. The length of time of a block determines the precision of the features within that block.

Opening and reopening files

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

If you use Asset Surveyor 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 H-2 shows how the Asset Surveyor software creates distinct blocks of carrier phase data as the number of satellites changes.

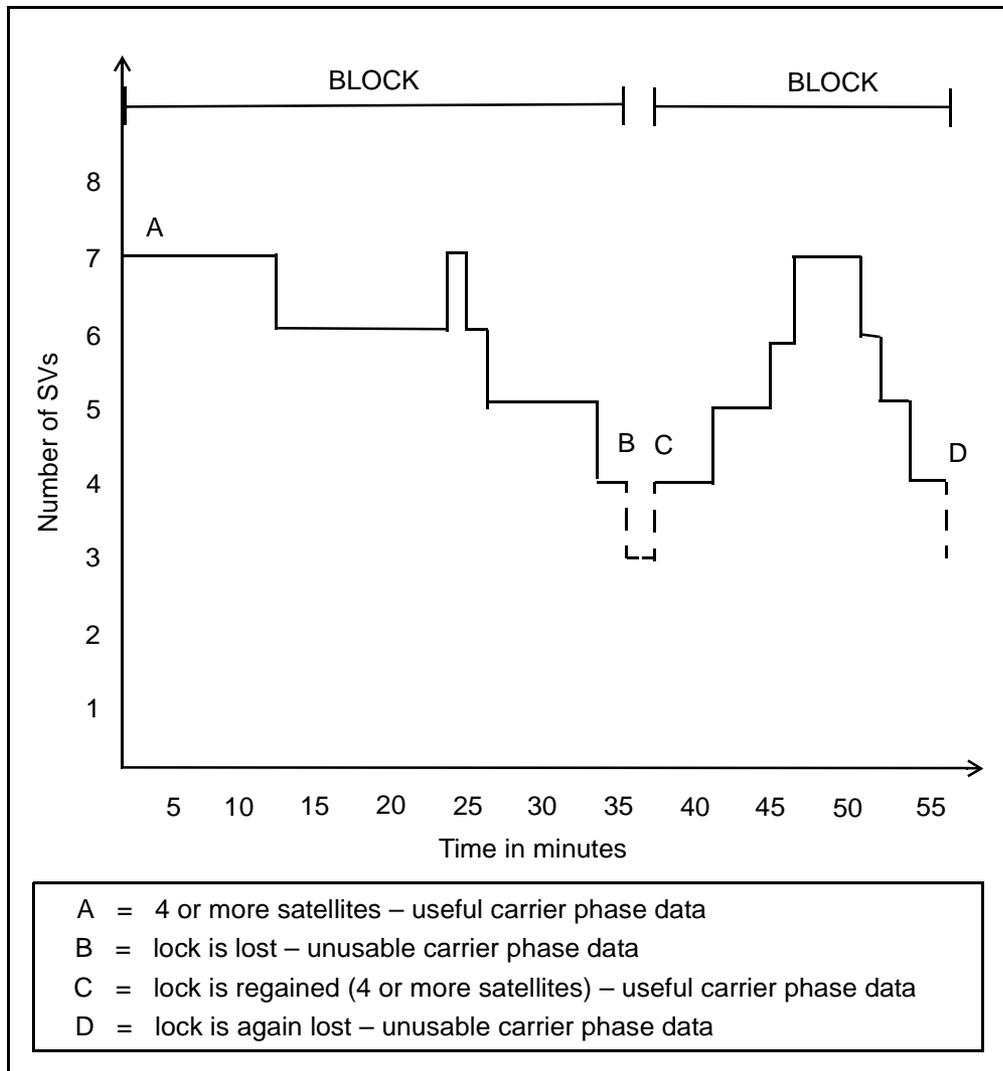


Figure H-2 Blocks of Carrier Phase Data Relative to Satellite Lock

In Figure H-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), Asset Surveyor 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 again 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.

H.1.7 Recording Features

While Asset Surveyor captures 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 H-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 H-3 shows how individual features benefit from blocks of carrier phase data stored at the time they were recorded.

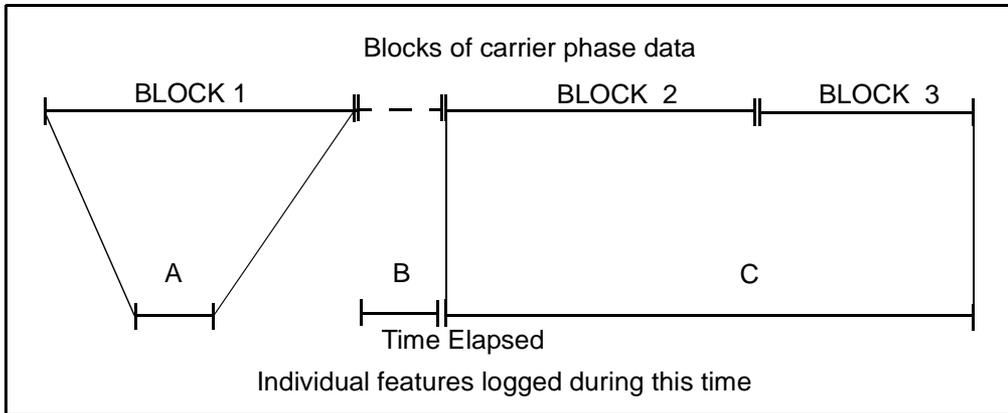


Figure H-3 Features Relative to Blocks

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 will 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 H-3, should achieve the desired precision. However, the second portion of the data, associated with Block 3 may not achieve the desired precision.



Caution – Only move to the next feature before the minimum time has elapsed 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 recapture 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 will depend on the precision required.

H.1.8 Postprocessing

Postprocess all data using an office PC running version 2.0 of the Pathfinder Office software.

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

During postprocessing, the Pathfinder Office 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 merely serves to assist with the arrangement of the new positions.

The software computes the estimated precision of the generated positions. You can query the precisions in the Feature Properties and Position Properties windows of the Pathfinder Office software. You can export these precisions as generated attributes using the Export Utility.

H.2 Configuring Asset Surveyor

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

1. From the *Configuration* menu, select *GPS*. The *Configure GPS* screen appears.
2. Select *Rover options*. Set the *Minimum time* field to the minimum time you require.



Note – Trimble recommends that you set the *Pos Mode* field to *Overdetermined 3D* when logging carrier phase data. This will ensure that five satellites are used to generate each position. This also ensures that precision statistics can be computed by the phase processor software.

H.3 In The Field

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

H.3.1 Creating a New Data File

Select *Create rover file*. The *Create file* screen appears:

```
      Create file
File:      R020315a
Data dict: Generic
Carrier mode: Off
Free space: 490 kB

TIME
```

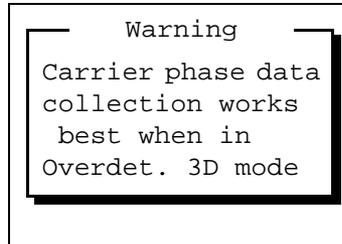
In the *File* field, accept the default filename suggested or type a name.

In the *Data dict* field, accept the default or choose another data dictionary to be associated with the file.

Set the *Carrier mode* field to On.

Press to create the new data file. Asset Surveyor opens the file for logging.

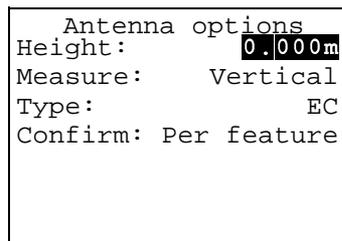
If you did not set the position mode to Overdetermined 3D (see the note on page H-14) the following warning appears:



Decide whether to open the *GPS rover options* form from the *Configuration* menu and change the position mode or not.

H.3.2 Starting to Log Data

When you open (or reopen) a carrier phase data file, the *Antenna options* screen appears.



Make sure that the *Height* and *Type* fields contain the correct details for the antenna you are using.

For more information about antenna types, see Chapter 5 of your *TDC1 Asset Surveyor Software User Guide*.

Press to proceed.

Asset Surveyor now starts to log data to the file you have opened. You must now choose which feature you want to record.

H.3.3 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 H-15).

Antenna options screen

When you choose a feature, the *Antenna options* screen appears. It appears every time you begin a new feature. Make sure that it contains the correct details, then press to proceed.



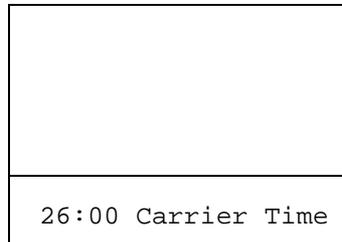
Tip – If the antenna configuration is unlikely to change during the session, you can set the *Confirm* field to Per file or Never. If you do this, the *Antenna options* screen will not appear every time you begin a new feature.

Asset Surveyor now starts to log data for the feature.

H.3.4 Capturing Carrier Phase Data

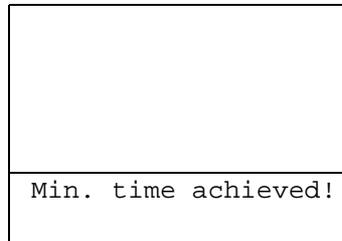
As you log carrier phase data, Asset Surveyor displays the time elapsed since the current block of data started. This is referred to as “carrier time”.

The carrier time appears in the status line at the configured feature logging interval and shows the amount of data in minutes and seconds:



(This value also appears in the *Carrier time* field in the *Receiver status* screen.)

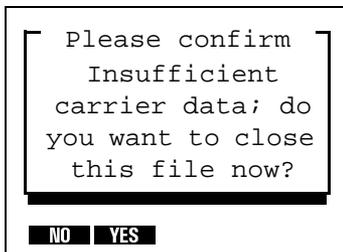
When Asset Surveyor has logged carrier phase data continuously for the time specified in the *Minimum time* field, the success beep sounds and the following message appears in the status line:



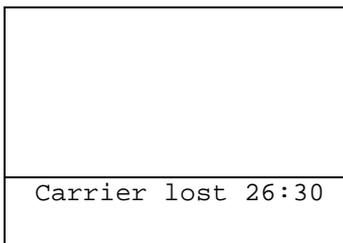
You have logged sufficient carrier phase data to achieve the precision required for the features captured since the counter was last reset, and until it is again reset.

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 H-10.

If you attempt to close a file before the minimum time is up, Asset Surveyor asks you to confirm that you wish to close the file:



As you proceed, Asset Surveyor also warns you whenever your GPS receiver loses lock. A message appears in the status line, for example:



The Carrier lost message tells you how long the last continuous block was at the time that lock was lost.

When the counter is reset, the *Carrier time* field shows 00:00. In addition, Asset Surveyor writes a note to the data file, for example:

```
Review note
Carrier lock lost
Carrier time 26:30
09:16:20 am
```

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 Pathfinder Office timeline).

If the minimum time has not been reached, you can choose whether to reoccupy the affected features or move on.

H.3.5 Quickmarking

Capturing Quickmarks while capturing carrier phase data will not increase the accuracy of the quickmarked positions. Quickmarks are computed using code-phase positions.

H.4 Back In the Office

To transfer your data from the datalogger to your office PC, see Chapter 5 of this manual.

Then process your files using the Pathfinder Office software. For detailed instructions, see the Pathfinder Office documentation.

I Laser Rangefinders

Laser Technology Inc. produces a range of laser ranging devices. This chapter outlines these.

I.1 Laser Technology Criterion 300 and 400

The Criterion 300 and 400 are both suitable for use with 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.

I.1.1 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 (1500 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 will work when the unit is tilted at up to 15° to the horizontal. The compass is rated at $\pm 0.5^\circ$ under laboratory conditions. In typical GIS data capture conditions, compass accuracy is typically around $\pm 1-2^\circ$. 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 $\pm 60^\circ$, 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 $+50^{\circ}\text{C}$ (-22°F to $+122^{\circ}\text{F}$). 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 will withstand 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.

I.1.2 Accessories

The Criterion 300 and 400 laser rangefinders can be used in four ways:

- As a hand-held instrument
- As a hand-held 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 capture 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 hand-held 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.

I.1.3 Cabling for Use with Asset Surveyor

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 9-pin connector.

The 9-pin connector is cabled as shown in Table I-1.

Table I-1 Cable Connections

Criterion Laser (5-pin Lemo)	(9-pin female D type)
5 Ground	5 Ground
4 Transmit	2 Receive
3 Receive	3 Transmit

The 9-pin connector can be plugged directly into the ESP port of a Pro XL, Pro XR or Pro XRS, the EXT port of a ProLite receiver or the GIS Surveyor Y-cable.

I.1.4 Configuration for Use with Asset Surveyor

This section provides instructions for configuring the Criterion laser rangefinder itself. See page I-12 for details of configuring the Asset Surveyor software to work with the Criterion laser rangefinder.

I.1.5 Entering Survey Mode

The Criterion 300 and 400 laser rangefinders both support a SURVEY mode of operation. This is the mode in which they will take range, azimuth and inclination measurements and can export these to your TDC1 datalogger.

The following instructions describe the procedure to enter SURVEY mode:



Note – Each time you turn the Criterion laser rangefinder on, you will have to re-enter SURVEY mode.

1. Turn on the Criterion by pressing the POWER button (the bottom-left button on the back of the unit).

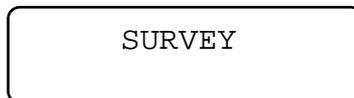
If you have a Criterion 400, the main menu will appear with the TREE entry visible:



If you have a Criterion 300, the main menu will appear with the HEIGHT entry visible:



2. Press the ↑ or ↓ arrow buttons until the SURVEY menu appears:



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 will appear:

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 which may make the Criterion laser rangefinder easier to use and/or obtain better results. They may, however, be skipped if you wish to immediately proceed to test the laser rangefinder with your Trimble GPS system.

Specifying Units

The Criterion laser rangefinder allows you to 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 allow you to 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 will appear:

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 Errors

Laser Technology Inc. recommend that new users of the Criterion enable measurement error messages. By default, these messages are disabled. Once measurement error messages have been enabled, the rangefinder will inform you whenever a measurement is invalid for some reason.

Once you become experienced with the Criterion rangefinder, you can disable measurement errors if you wish.

To enable or change the measurement errors setting, follow this procedure:

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 will be displayed:



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 will display an error code on its LCD. The meaning of each code is indicated in the 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 $\pm 60^\circ$.
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 $\pm 15^\circ$.

You must press the CLEAR button to clear the error message.

Entering a Compass Offset

The Criterion laser rangefinders allow you to specify two compass offsets:

- A *Declination Offset*, which can be used to specify the local difference between magnetic North and true North, and
- A *Fixed Offset*, which can be used to ensure accurate alignment of the compass with the laser unit.

Your Criterion laser rangefinder will have an accompanying Certificate of Calibration, which lists the pre-entered 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. You should 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:

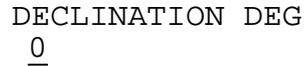
1. Select the top-level SYSTEM menu from the Criterion's main menu.
2. Press the ↑ or ↓ arrow buttons to scroll down to the COMPASS OFFSETS entry:



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.



Caution – You will probably wish to use the Criterion laser rangefinder separately from your TDC1 Asset Surveyor datalogger. If this is the case, you will 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 Asset Surveyor's *Magnetic decl.* field to 0°, to avoid the declination being applied twice. If you use your Criterion laser rangefinder exclusively with the TDC1 Asset Surveyor datalogger, it is best to leave the laser's DECLINATION set to 0 and modify Asset Surveyor's *Magnetic decl.* field; this enables Asset Surveyor to correctly convert other magnetic bearings to true north (for example, when navigating, checking the positions of satellites, and so forth).



Caution – If you specify a local declination offset, you **must** ensure 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.

I.1.6 Using the Criterion with Asset Surveyor

As mentioned previously, the practical accuracy of the fluxgate compass in typical field trials is around $\pm 1-2^\circ$. 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).

I.1.7 Cabling for the Pro XRS

If you have a Pro XRS GPS receiver, connect the Criterion laser rangefinder to the receiver and datalogger as shown in Figure I-1.

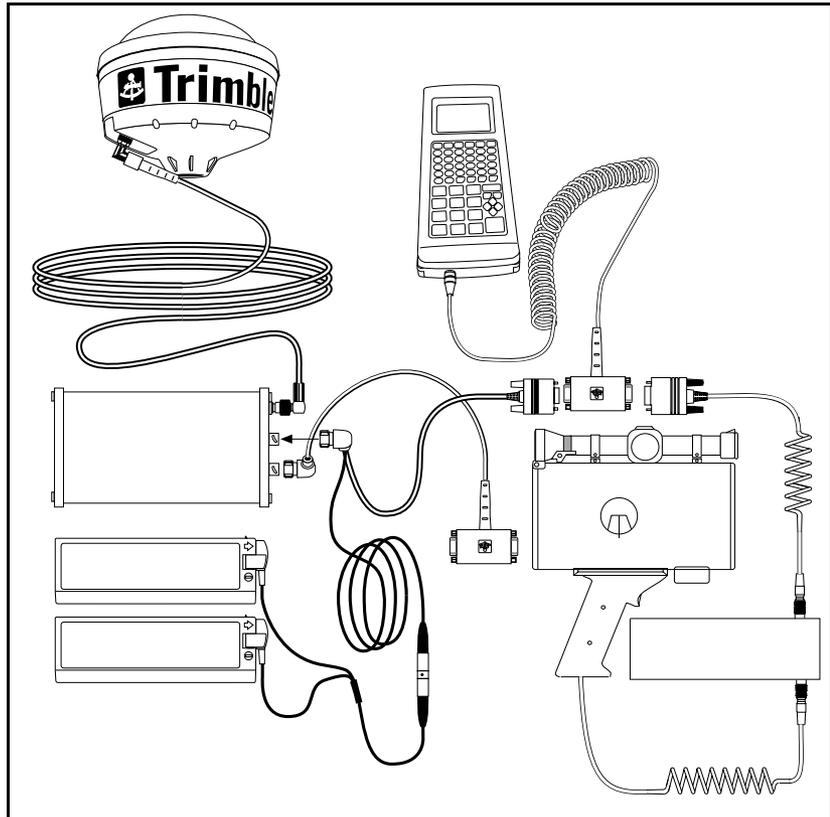


Figure I-1 Criterion Laser Rangefinder Cabling Diagram for Pro XRS with TDC1

I.1.8 Cabling for the Pro XR

If you have a Pro XR GPS receiver, connect the Criterion laser rangefinder to the receiver and datalogger as shown in Figure I-2.

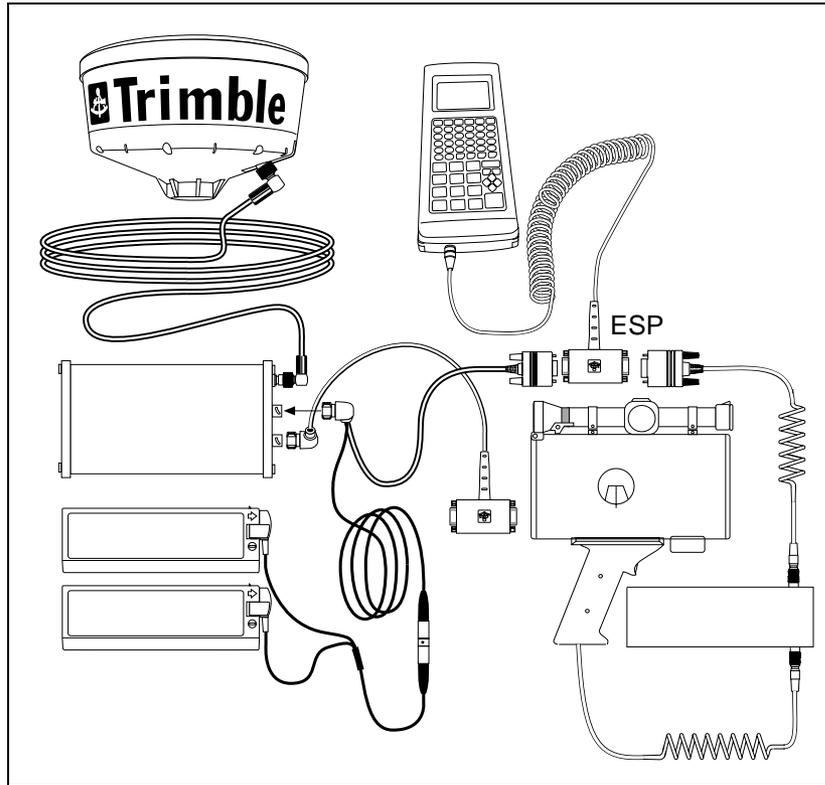


Figure I-2 Criterion Laser Rangefinder Cabling Diagram for Pro XR with TDC1

I.1.9 Cabling for the Pro XL

If you have a Pro XL GPS receiver, connect the Criterion laser rangefinder to the receiver and datalogger as shown in Figure I-3.

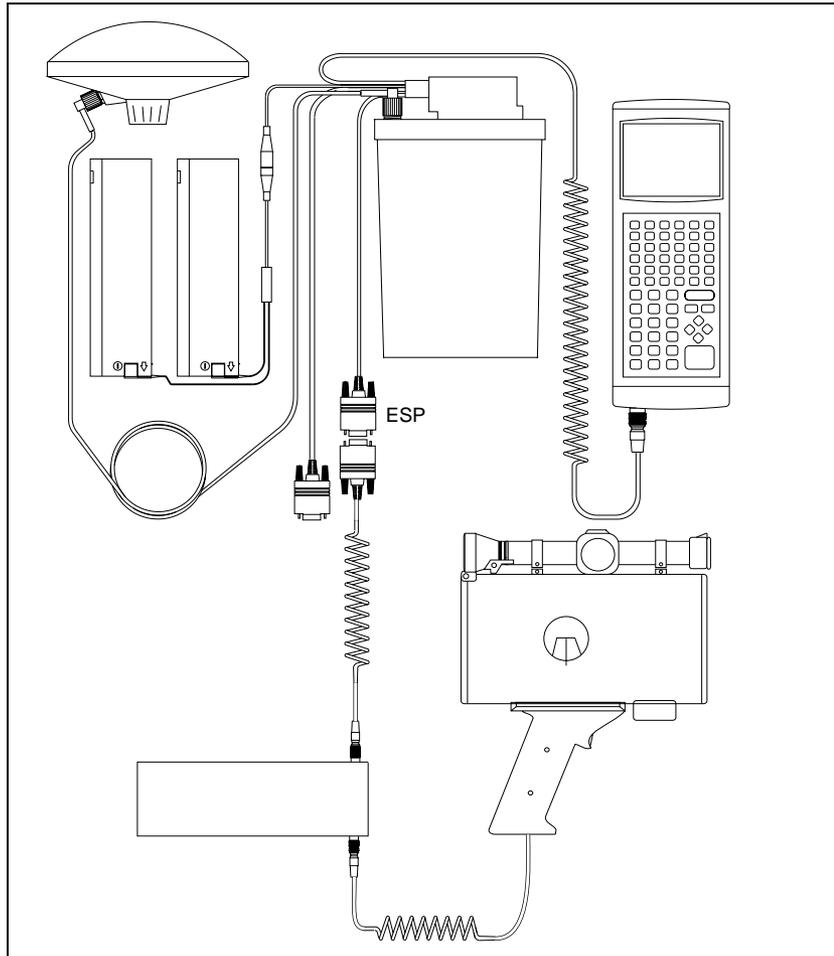


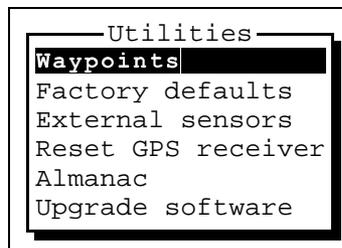
Figure I-3 Criterion Laser Rangefinder Cabling Diagram for Pro XL with TDC1

Connect the Criterion to its battery pack. Connect one end of the Criterion's download cable to the battery pack and plug the other end into the GPS receiver's ESP port.

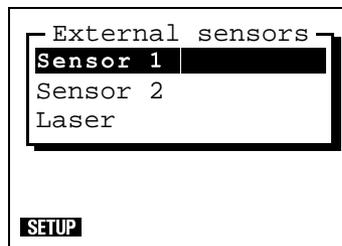
I.1.10 Testing

When you first connect the Criterion 300 or 400 to your Trimble GPS system, you should 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 Asset Surveyor's *Utilities* menu:



Select *External sensors* and the menu of available sensors appears:



I.1.11 Configuring Asset Surveyor

You should configure the special *Laser* sensor to work with the Criterion 300 or 400. To do this, press the **SETUP** softkey. The *Laser rangefinder* configuration form appears:

```

Laser rangefinder
Type: Criterion 300
Auto-connect: No

```

Set the *Type* field to either Criterion 300 or Criterion 400. If you will generally be using a Criterion rangefinder when capturing data, and if you will typically *not* be using any other type of external sensor, then set the *Auto-connect* field to Yes.

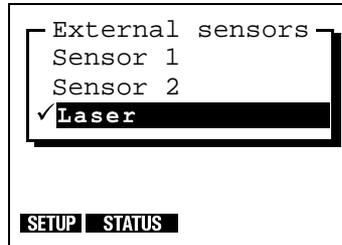


Caution – The RS232 protocols used by the Criterion 300 and 400 rangefinders are different. You must specify the correct rangefinder in the *Type* field, otherwise Asset Surveyor will fail to communicate with your rangefinder.

Press **OK** to save these settings and return to the *External sensors* menu.

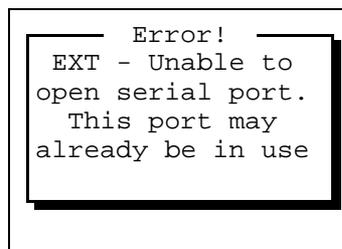
I.1.12 Activating the Laser Interface

You can indicate to the Asset Surveyor software that you wish it to accept input from the laser rangefinder by selecting the *Laser* entry from the *External sensors* menu. When you do this, the *Laser* entry will be checked, to indicate that the rangefinder interface has been activated:



Once the rangefinder interface has been activated (and so long as the *Laser* entry in the menu is highlighted), one further **STATUS** softkey appears. Once the rangefinder interface has been activated, Asset Surveyor will accept communications from it. You can configure Asset Surveyor to automatically activate the laser rangefinder interface when you start data capture by setting the *Auto-connect* field to Yes, as described above.

If you attempt to activate the laser rangefinder interface and the EXT serial port is already in use by another sensor, Asset Surveyor displays the following message:



and refuses to activate the rangefinder interface.

I.1.13 Checking the Laser Interface

When the laser rangefinder is active (and highlighted in the list of external sensors), you can press **STATUS** to pop up a status form for the rangefinder:

Criterion 400	
Bearing:	?
Slope dist:	?
Inclination:	?
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 will appear on the status form, replacing the previous reading.

You can take a reading with the Criterion rangefinder and transmit it to Asset Surveyor 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, you should 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 will be displayed on the Criterion's LCD, for example:

```
HD: 40.89 M
AZ: 330.3 DEG
```



Caution – You can press the ↑ and ↓ arrow buttons to view other values such as the vertical angle, slope distance, and so forth. You **must** return to the screen showing HD and AZ before performing step 5 (below), otherwise the Criterion will **not** send the full measurement details to Asset Surveyor.

5. Press the ENTER button on the Criterion to transmit this measurement to Asset Surveyor.

If you were viewing the laser rangefinder **STATUS** form, you would see the measurement arrive on the TDC1's screen:

```
Criterion 400
Bearing: 300.7° T
Slope dist: 40.890m
Inclination: 1.3°

FORMAT
```

Asset Surveyor 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 ref* 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 decl.* is Auto, Asset Surveyor's internal magnetic declination model is used to convert the magnetic laser bearing to a true north bearing. Otherwise, the manually entered declination will be used for this conversion.



Tip – You can press the Criterion's ENTER button multiple times to send the same measurement to Asset Surveyor repeatedly. Use this technique to re-send a measurement if you discover that you had not connected all equipment or configured Asset Surveyor before taking the measurement with the laser.

I.1.14 Capturing Data

The following sections outline the capture of data.

Activating the Laser Interface

Within data capture, the laser rangefinder interface can be activated in one of two ways:

- Automatically, if you had pre-configured the *Laser* sensor's *Auto-connect* field to Yes.
- Manually, via the **EXT** softkey.

Checking the Laser Interface

You can also use **EXT** to access the *External sensors* to reconfigure the laser rangefinder interface, or to check that the laser and Asset Surveyor are communicating correctly, as described above.

Recording an Offset

Whenever you are capturing 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 pop up 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.

I.2 Laser Atlanta ProSurvey 1000

The ProSurvey 1000 produced by Laser Atlanta is a lightweight, hand-held laser device, suitable for use with Asset Surveyor for the automated recording of offsets.

I.2.1 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 2500 ft) to uncooperative surfaces. For cooperative targets (for example, a reflector), the range of the laser is extended to 3050 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 capture 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.

I.2.2 Cabling for Use with Asset Surveyor

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 or Pro XRS the EXT port of a ProLite switching box or the DB-9 connector of a GIS Surveyor Y-cable.

I.2.3 Configuration for Use with Asset Surveyor

This section provides instructions for configuring the ProSurvey 1000 laser rangefinder itself. See Section H.2.4 for details of configuring the Asset Surveyor software to work with the ProSurvey 1000 laser rangefinder.

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 Asset Surveyor, 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)`, and
- `range_opcode`, which *must* be set to `New ProSurvey format`.

If any of these settings is incorrect, the ProSurvey 1000 will not output information about each laser shot in a form that can be interpreted by Asset Surveyor. The most likely symptom is that Asset Surveyor will emit 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, you should *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, pipe-line, overhead or underground power cable, and so forth). 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 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 will be 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 will indicate the next point of the compass.

3. After aiming in the 315° direction and squeezing the trigger, the rear panel of the ProSurvey 1000 will indicate a Noise value, ranging from 0 to 9.

The higher the value, the better the calibration. If the Noise value is below 5, you should 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 to ensure that compass readings are locally consistent. If you wish to account for an error in the compass’s determination of magnetic north, you should do this by entering a new value for the *Magnetic decl.* field in Asset Surveyor’s *Units and display* configuration form.

I.2.4 Using the ProSurvey 1000 with Asset Surveyor

As mentioned previously, the practical accuracy of the fluxgate compass in typical field use is around $\pm 1\text{--}2^\circ$. 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).

I.2.5 Cabling for the Pro XRS

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.

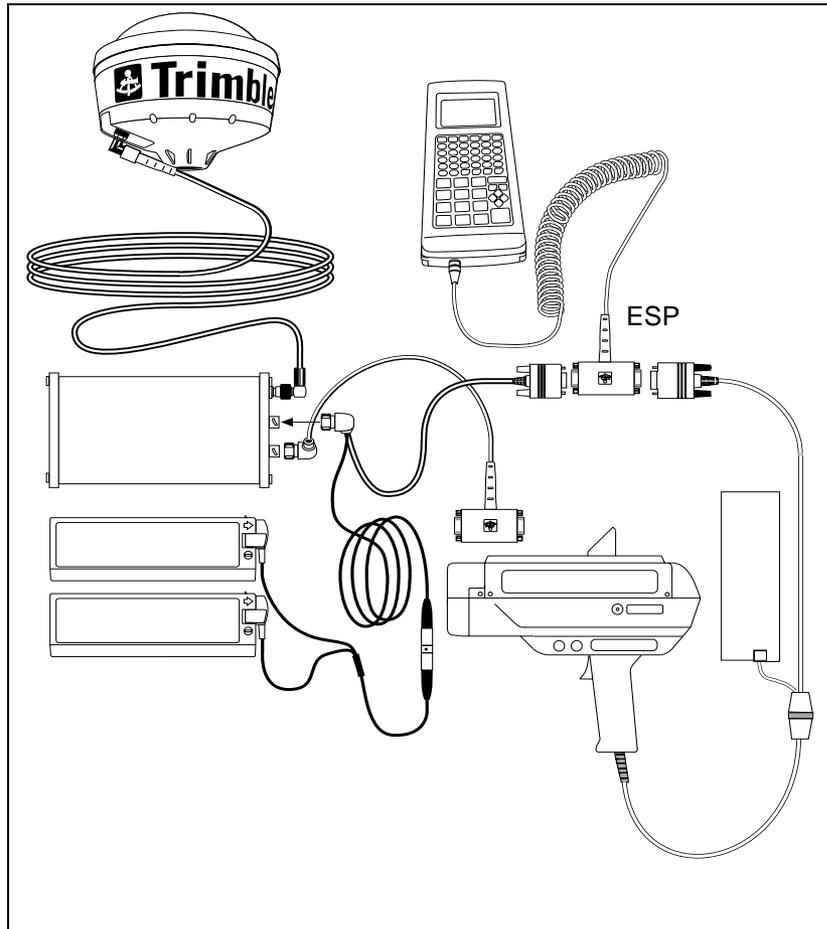


Figure I-4 ProSurvey 1000 Laser Rangefinder Cabling Diagram for Pro XRS with TDC1

I.2.6 Cabling for the Pro XR

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.

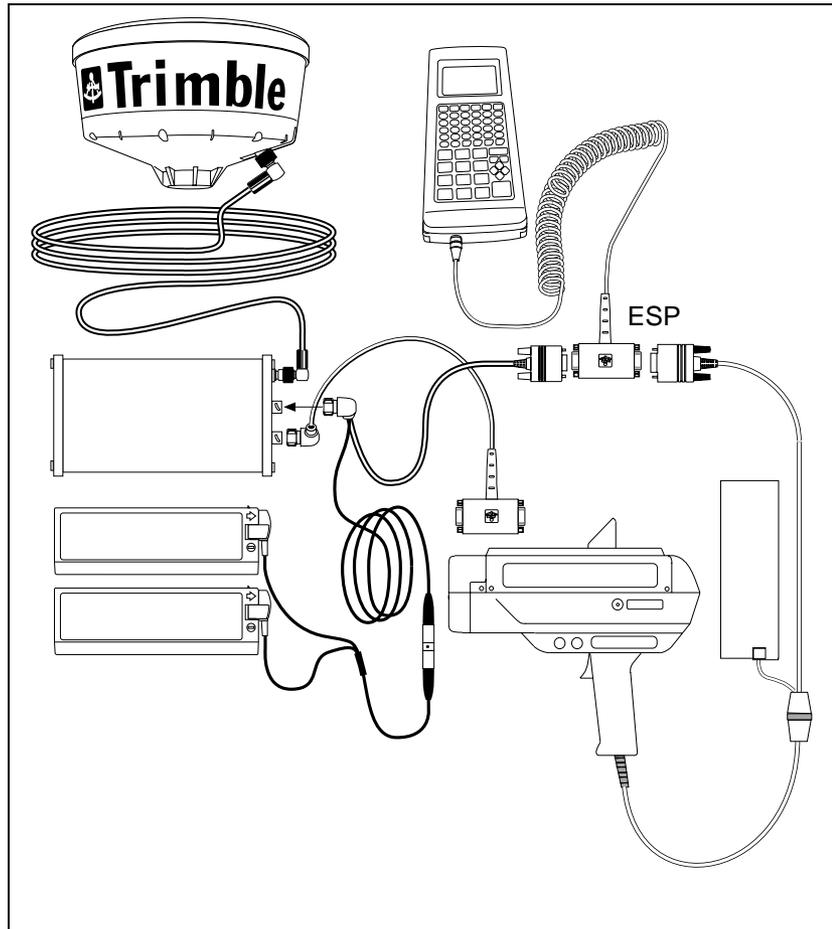


Figure I-5 ProSurvey 1000 Laser Rangefinder Cabling Diagram for Pro XR with TDC1

I.2.7 Cabling for the Pro XL

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.

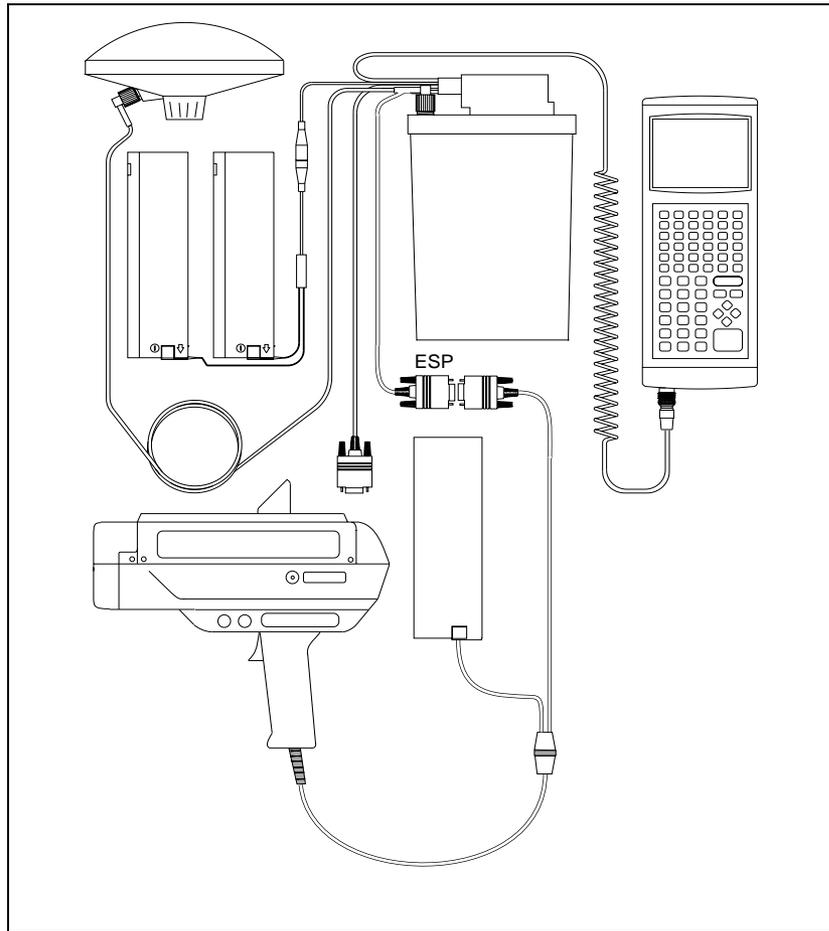


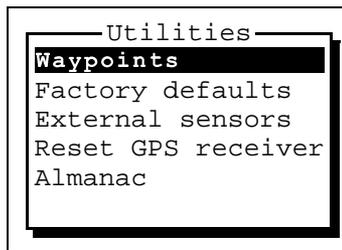
Figure I-6 ProSurvey 1000 Laser Rangefinder Cabling Diagram for Pro XL with TDC1

Connect the ProSurvey 1000 to its battery pack, and plug the 9-pin connector into the GPS receiver's ESP port.

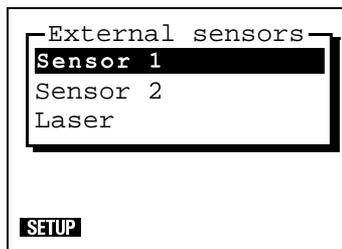
1.2.8 Testing

When you first connect the ProSurvey 1000 to your Trimble GPS system, you should test that it is correctly configured and that all components are working correctly.

Select the *Utilities* entry from Asset Surveyor's *Main menu*:



Select *External sensors* from the *Utilities* menu. The menu of available sensors appears:



I.2.9 Configuring Asset Surveyor

You should configure the special *Laser* sensor to work with the ProSurvey 1000. To do this, press the **SETUP** softkey. The *Laser rangefinder* configuration form appears:

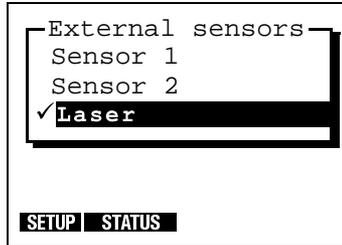
Laser rangefinder	
Type:	ProSurvey 1000
Auto-connect:	No

Set the *Type* field to *ProSurvey 1000*. If you will generally be using the ProSurvey 1000 rangefinder when capturing data, and if you will typically *not* be using any other type of external sensor, then set the *Auto-connect* field to Yes.

Press to save these settings and return to the *External sensors* menu.

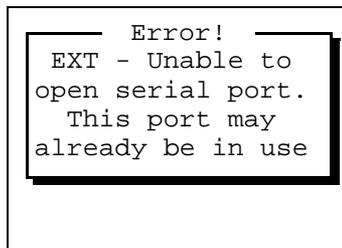
I.2.10 Activating the Laser Interface

You can indicate to the Asset Surveyor software that you wish it to accept input from the laser rangefinder by selecting the *Laser* entry from the *External sensors* menu. When you do this, the *Laser* entry will be ticked, to indicate that the rangefinder interface has been activated:



Once the rangefinder interface has been activated (and so long as the *Laser* entry in the menu is highlighted), one further **STATUS** softkey appears. Once the rangefinder interface has been activated, Asset Surveyor will accept communications from it. You can configure Asset Surveyor to *automatically* activate the laser rangefinder interface when you start data capture by setting the *Auto-connect* field to Yes, as described above.

If you attempt to activate the laser rangefinder interface and the EXT serial port is already in use by another sensor, Asset Surveyor displays the following message:



and refuses to activate the rangefinder interface.

I.2.11 Checking the Laser Interface

When the laser rangefinder is active (and highlighted in the list of external sensors), you can press **STATUS** to pop up a status form for the rangefinder:

ProSurvey 1000	
Bearing:	?
Slope dist:	?
Inclination:	?
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 will appear on the status form, replacing the previous reading.

You can take a reading with the ProSurvey 1000 and transmit it to Asset Surveyor 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.



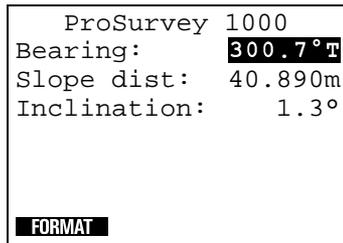
Caution – If you do not wait until the bearing in the head-up display settles down before pulling the laser’s trigger then the compass measurement may be seriously inaccurate.

3. Keeping a steady hold on the instrument, aim through its scope and carefully pull the trigger.

The distance to the target point will now be displayed on the ProSurvey 1000’s head-up display. The bearing and inclination are displayed on the LED.

- Release the trigger. When you do this, the ProSurvey 1000 sends its measurement to the TDC1.

If you were viewing the laser rangefinder **STATUS** form, you would see the measurement arrive on the TDC1's screen:



Asset Surveyor 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 ref* 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).

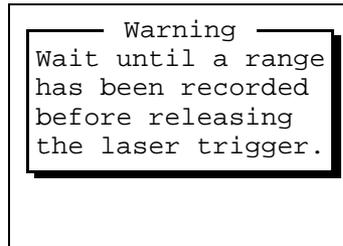


Note – If the configured *Magnetic decl.* is *Auto*, Asset Surveyor's internal magnetic declination model is used to convert the magnetic laser bearing to a true north bearing. Otherwise, the manually entered declination will be used for this conversion.



Caution – The ProSurvey 1000 always emits compass bearings relative to magnetic north. You **must** either specify your local magnetic declination or set the *Magnetic decl.* field to *Auto*, otherwise Asset Surveyor will 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 Asset Surveyor receives a message from the ProSurvey 1000 which lacks a distance measurement, the following warning message is displayed:

A rectangular box with a thin black border containing a warning message. The message is centered and reads: "Warning" followed by a horizontal line, then "Wait until a range has been recorded before releasing the laser trigger." followed by a horizontal line.

```
Warning  
-----  
Wait until a range  
has been recorded  
before releasing  
the laser trigger.  
-----
```

I.2.12 Capturing Data

The following sections outline the capture of data.

Activating the Laser Interface

Within data capture, the laser rangefinder interface can be activated in one of two ways:

- Automatically, if you had pre-configured the *Laser* sensor's *Auto-connect* field to Yes.
- Manually, via the **EXT** softkey.

Checking the Laser Interface

You can also use the **EXT** to access the *External sensors* menu to reconfigure the laser rangefinder interface, or to check that the laser and Asset Surveyor are communicating correctly, as described above.

Recording an Offset

Whenever you are capturing 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 pop up the offset entry form for that feature.

I.3 Laser Atlanta Advantage

The Advantage produced by Laser Atlanta is a lightweight, hand-held laser device, suitable for use with Asset Surveyor for the automated recording of offsets.

I.3.1 Hardware Specifications

The following sections detail the hardware specifications of the Laser Atlanta Advantage.

Dimensions

The laser itself measures 25.4 cm (including grip) × 8.4cm × 27.9 cm (10" × 3.3" × 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 2500 ft) to uncooperative surfaces. For cooperative targets (for example, a reflector), the range of the laser is extended to 12190 m (40000 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 $\pm 0.5^\circ$ under laboratory conditions. In typical GIS data capture conditions, the compass tends to be accurate to around $\pm 1^\circ$. 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.

I.3.2 Cabling for Use with Asset Surveyor

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, a Pro XR, or a Pro XRS, and the EXT port of a ProLite switching box, or the DB-9 connector of a GIS Surveyor Y-cable.

I.3.3 Configuration for Use with Asset Surveyor

This section provides instructions for configuring the Advantage laser rangefinder itself. See Section H.3.4 for details of configuring the Asset Surveyor software to work with the Advantage laser rangefinder.

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 Asset Surveyor, it is critical that two of the EEPROM settings be correctly configured. These are:

- `range_mode`, which *must* be set to Standard (averaged),
- Serial Format, *must* be set to Trimble Pro XL.

If any of these settings is incorrect, the Advantage will not output information about each laser shot in a form that can be interpreted by Asset Surveyor. The most likely symptom is that Asset Surveyor will emit 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, you should *calibrate* the Advantage'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, pipe-line, overhead or underground power cable, and so forth.). 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 will be 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, you should 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 to ensure that compass readings are locally consistent. If you wish to account for an error in the compass's determination of magnetic north, you should do this by entering a new value for the *Magnetic decl.* field in Asset Surveyor's *Units and display* configuration form.

I.3.4 Using the Advantage with Asset Surveyor

As mentioned previously, the practical accuracy of the fluxgate compass in typical field use is around $\pm 1^\circ$. 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).

I.3.5 Cabling for the Pro XRS

If you have a Pro XRS GPS receiver, connect the Advantage laser rangefinder to the receiver and datalogger as shown in Figure I-7.

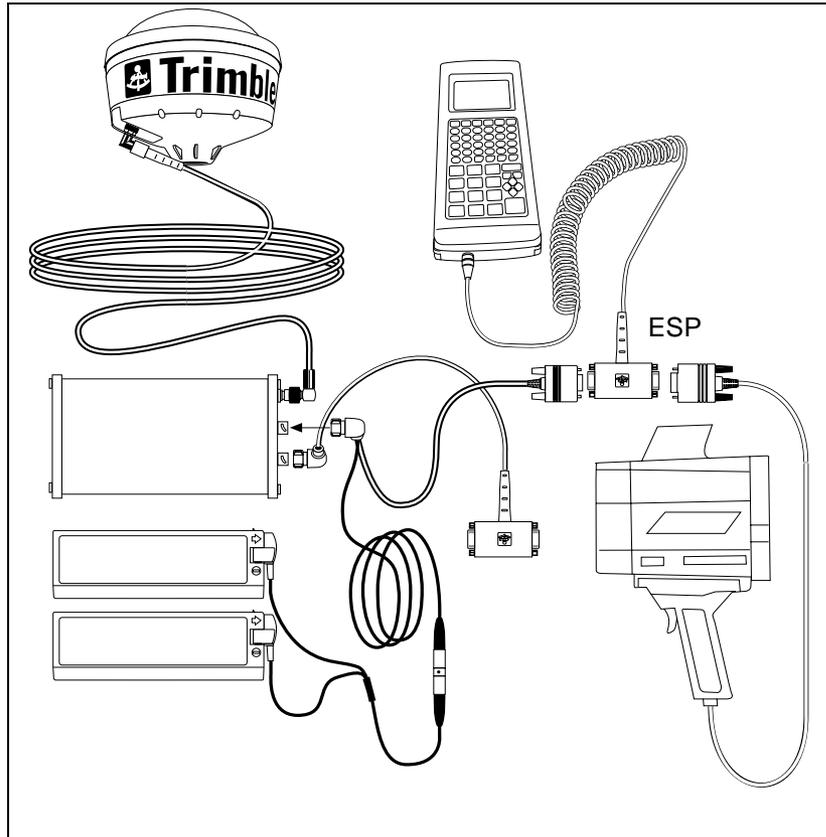


Figure I-7 Advantage Laser Rangefinder Cabling Diagram for Pro XRS with TDC1

I.3.7 Cabling for the Pro XL

If you have a Pro XL GPS receiver, connect the Advantage laser rangefinder to the receiver and datalogger as shown in Figure I-9.

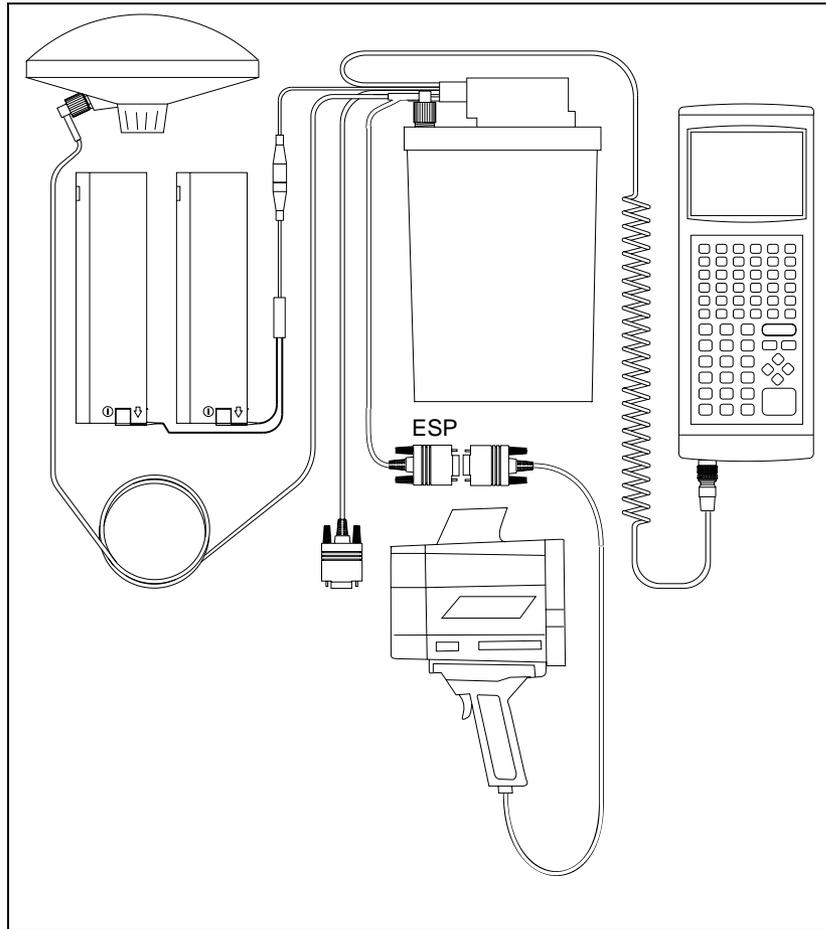


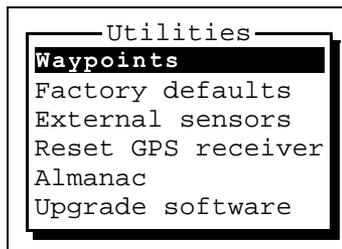
Figure I-9 Advantage Laser Rangefinder Cabling Diagram for Pro XL with TDC1

Connect the Advantage to its battery pack, and plug the 9-pin connector into the GPS receiver's ESP port.

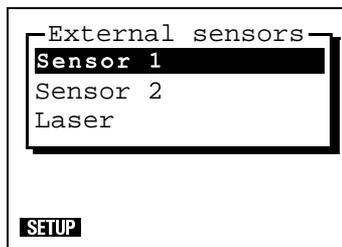
I.3.8 Testing

When you first connect the Advantage to your Trimble GPS system, you should test that it is correctly configured and that all components are working correctly.

Select the *Utilities* entry from Asset Surveyor's *Main menu*:



Select *External sensors* from the *Utilities* menu. The menu of available sensors appears:



I.3.9 Configuring Asset Surveyor

You should configure the special *Laser* sensor to work with the Atlanta Advantage. To do this, press the **SETUP** softkey. The *Laser rangefinder* configuration form appears:

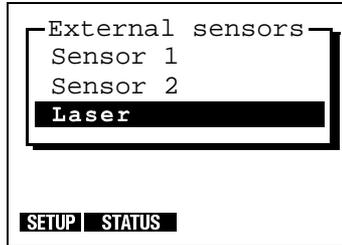
```
Laser rangefinder
Type: Atlanta Advantage
Auto-connect: No
```

Set the *Type* field to *Atlanta Advantage*. If you will generally be using the Advantage rangefinder when capturing data, and if you will typically *not* be using any other type of external sensor, then set the *Auto-connect* field to Yes.

Press to save these settings and return to the *External sensors* menu.

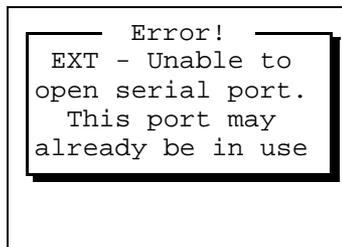
I.3.10 Activating the Laser Interface

You can indicate to the Asset Surveyor software that you wish it to accept input from the laser rangefinder by selecting the *Laser* entry from the *External sensors* menu. When you do this, the *Laser* entry will be ticked, to indicate that the rangefinder interface has been activated:



Once the rangefinder interface has been activated (and so long as the *Laser* entry in the menu is highlighted), one further **STATUS** softkey appears. Once the rangefinder interface has been activated, Asset Surveyor will accept communications from it. You can configure Asset Surveyor to *automatically* activate the laser rangefinder interface when you start data capture by setting the *Auto-connect* field to Yes, as described above.

If you attempt to activate the laser rangefinder interface and the EXT serial port is already in use by another sensor, Asset Surveyor displays the following message:



and refuses to activate the rangefinder interface.

I.3.11 Checking the Laser Interface

When the laser rangefinder is active (and highlighted in the list of external sensors), you can press **STATUS** to pop up a status form for the rangefinder:

Atlanta Advantage	
Bearing:	?
Slope dist:	?
Inclination:	?
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 will appear on the status form, replacing the previous reading. You can take a reading with the Advantage and transmit it to Asset Surveyor 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.



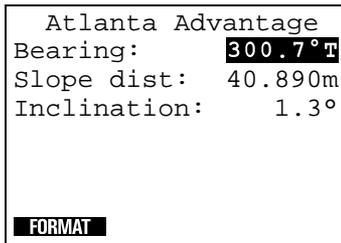
Caution – If you do not wait until the bearing in the head-up display settles down before pulling the laser’s trigger then the compass measurement may be seriously inaccurate.

3. Keeping a steady hold on the instrument, aim through its scope and carefully pull the trigger.

The distance to the target point will now be 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 TDC1.

If you were viewing the laser rangefinder **STATUS** form, you would see the measurement arrive on the TDC1's screen:



Asset Surveyor 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 ref* 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).

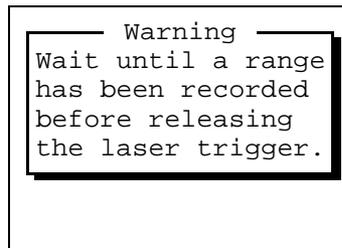


Note – If the configured *Magnetic decl.* is *Auto*, Asset Surveyor's internal magnetic declination model is used to convert the magnetic laser bearing to a true north bearing. Otherwise, the manually entered declination will be used for this conversion.



Caution – The Advantage always emits compass bearings relative to magnetic north. You **must** either specify your local magnetic declination or set the *Magnetic decl.* field to *Auto*, otherwise Asset Surveyor will 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 Asset Surveyor receives a message from the Advantage which lacks a distance measurement, the following warning message is displayed:



I.3.12 Capturing Data

Activating the Laser Interface

Within data capture, the laser rangefinder interface can be activated in one of two ways:

- Automatically, if you had pre-configured the *Laser* sensor's *Auto-connect* field to Yes.
- Manually, via the **EXT** softkey.

Checking the Laser Interface

You can also use the **EXT** to access the *External sensors* menu to reconfigure the laser rangefinder interface, or to check that the laser and Asset Surveyor are communicating correctly, as described above.

Recording an Offset

Whenever you are capturing 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 pop up the offset entry form for that feature.

I.4 LEDHA-GEO Laser Binoculars

The Ledha-Geo produced by Jenoptik is a hand-held laser device used very much like a pair of binoculars. The Ledha-Geo is suitable for use with Asset Surveyor for the automated recording of offsets.

I.4.1 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"). It weighs 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 capture conditions, this compass tends to be accurate to around ± 0.5 cm. In environments where magnetic interference is high (e.g 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 $+50^{\circ}\text{C}$ (-4°F and 122°F). When the temperature exceeds these limitations, the Ledha-Geo will automatically switch off.

I.4.2 Cabling for Use with Asset Surveyor

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, a Pro XR, or a Pro XRS, and the EXT port of a ProLite switching box, or the DB-9 connector of a GIS Surveyor Y-cable.

I.4.3 Cabling for the Pro XRS

If you have a Pro XRS GPS receiver, connect the Ledha-Geo laser binoculars to the receiver and datalogger as shown in Figure I-10.

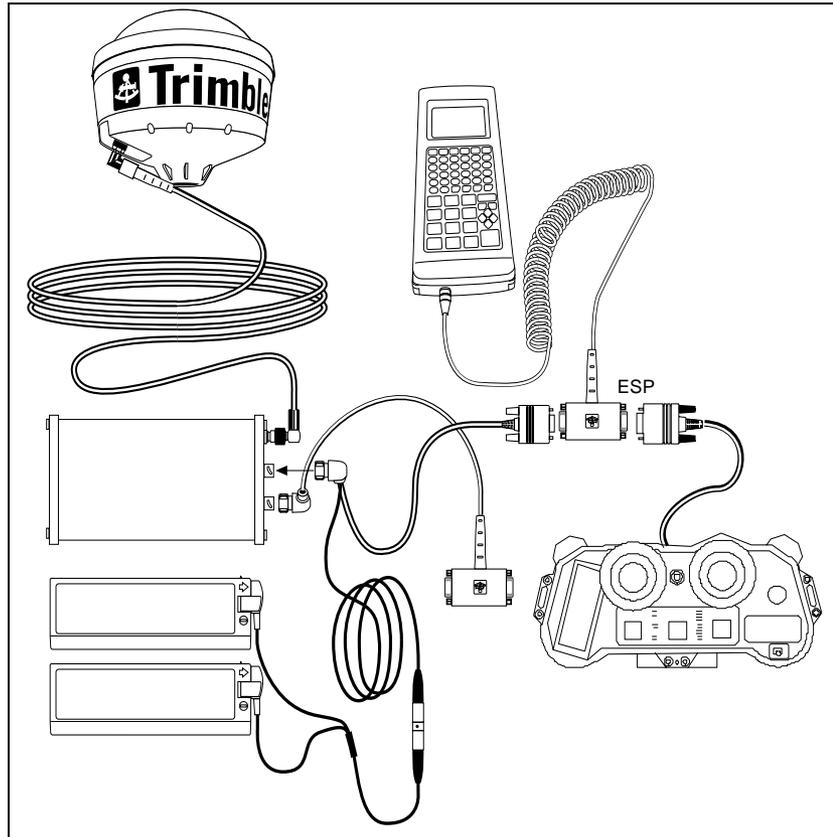


Figure I-10 Ledha-Geo Laser Binoculars Cabling Diagram for Pro XRS with TDC1

I.4.4 Cabling for the Pro XR

If you have a Pro XR GPS receiver, connect the Ledha-Geo laser binoculars to the receiver and datalogger as shown in Figure I-11.

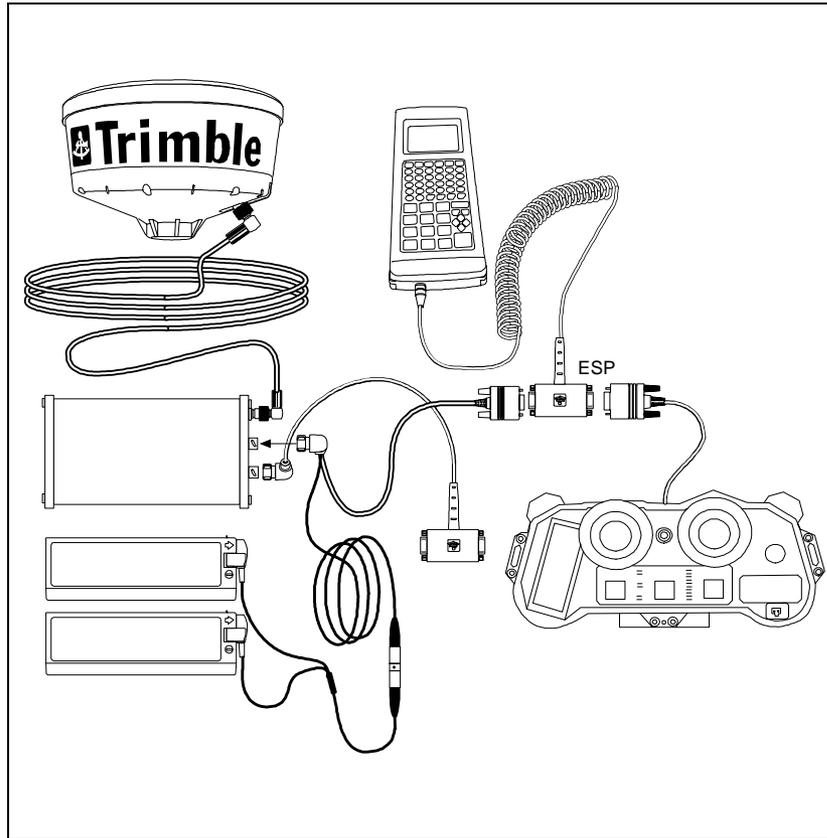


Figure I-11 Ledha-Geo Laser Binoculars Cabling Diagram for Pro XR with TDC1

I.4.5 Cabling for the Pro XL

If you have a Pro XL GPS receiver, connect the Ledha-Geo laser binoculars to the receiver and datalogger as shown in Figure I-12.

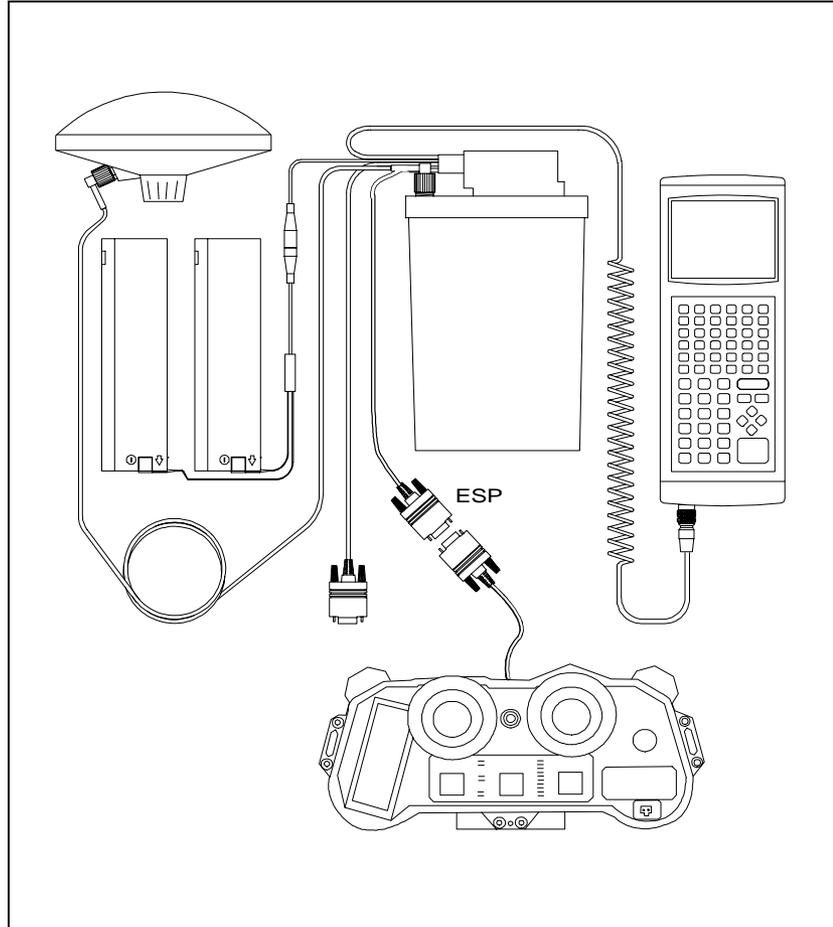


Figure I-12 Ledha-Geo Laser 1

Binoculars Cabling Diagram for Pro XL with **TDC1**

I.4.6 Configuration for Use with Asset Surveyor

This section provides instructions for configuring the Ledha-Geo laser binoculars for use with the Asset Surveyor software.

1. In Asset Surveyor'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 Asset Surveyor (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 Asset Surveyor.

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 Asset Surveyor.

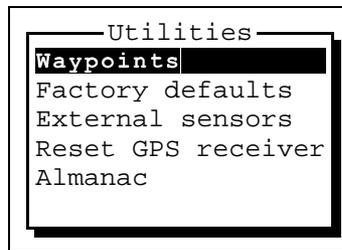
I.4.7 Using the LEDHA-GEO with Asset Surveyor

The following sections outline how to use the Ledha-Geo with Asset Surveyor.

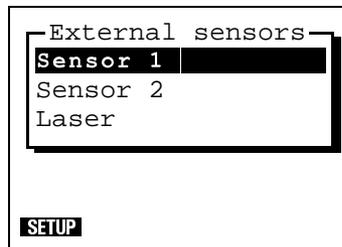
I.4.8 Testing

When you first connect the Ledha-Geo to your Trimble GPS system, you should test that it is correctly configured and that all components are working correctly.

Select the *Utilities* entry from Asset Surveyor's *Main menu*:



Select *External sensors* from the *Utilities* menu. The menu of available sensors appears:



I.4.9 Configuring Asset Surveyor

You should configure the special *Laser* sensor to work with the Ledha-Geo. To do this, press the **SETUP** softkey. The *Laser rangefinder* configuration form appears:

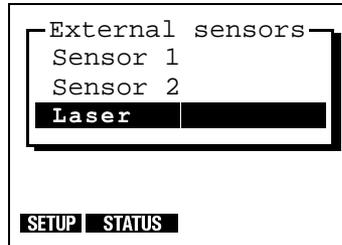
Laser rangefinder	
Type:	LEDHA-GEO
Auto-connect:	No

Set the *Type* field to *LEDHA-GEO*. If you will generally be using the Ledha-Geo laser binoculars when capturing data, and if you will typically *not* be using any other type of external sensor, then set the *Auto-connect* field to Yes.

Press **OK** to save these settings and return to the *External sensors* menu.

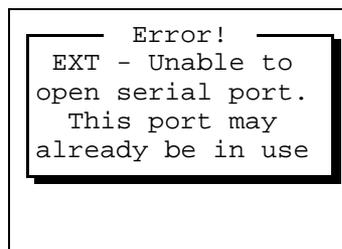
I.4.10 Activating the Laser Interface

You can indicate to the Asset Surveyor software that you wish it to accept input from the laser rangefinder by selecting the *Laser* entry from the *External sensors* menu. When you do this, the *Laser* entry will be ticked, to indicate that the rangefinder interface has been activated:



Once the rangefinder interface has been activated (and so long as the *Laser* entry in the menu is highlighted), one further **STATUS** softkey appears. Once the rangefinder interface has been activated, Asset Surveyor will accept communications from it. You can configure Asset Surveyor to *automatically* activate the laser rangefinder interface when you start data capture by setting the *Auto-connect* field to Yes, as described above.

If you attempt to activate the laser rangefinder interface and the EXT serial port is already in use by another sensor, Asset Surveyor displays the following message:



and refuses to activate the rangefinder interface.

I.4.11 Checking the Laser Interface

When the laser rangefinder is active (and highlighted in the list of external sensors), you can press **STATUS** to pop up a status form for the rangefinder:

LEDHA-GEO	
Bearing:	?
Slope dist:	?
Inclination:	?
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 will appear on the status form, replacing the previous reading.

You can take a reading with the Ledha-Geo and transmit it to Asset Surveyor 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 TDC1. (There will be about a 2 second delay between the time you press the **Meas** button to when the measurement is received by the TDC1.)

If you were viewing the laser rangefinder **STATUS** form, you would see the measurement arrive on the TDC1's screen:

LEDHA-GEO	
Bearing:	300.7°T
Slope dist:	40.890m
Inclination:	1.3°
FORMAT	

Asset Surveyor 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 ref* 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).

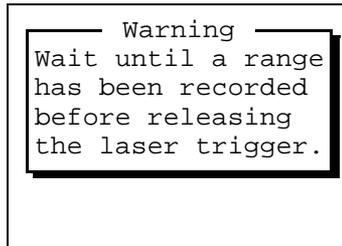


Note – If the configured *Magnetic decl.* is *Auto*, Asset Surveyor's internal magnetic declination model is used to convert the magnetic laser bearing to a true north bearing. Otherwise, the manually entered declination will be used for this conversion.



Caution – The Ledha-Geo always emits compass bearings relative to magnetic north. You **must** either specify your local magnetic declination or set the *Magnetic decl.* field to *Auto*, otherwise Asset Surveyor will 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 Asset Surveyor receives a message from the Ledha-Geo which lacks a distance measurement, the following warning message is displayed:



I.4.12 Capturing Data

The following sections outline the capture of data using the Ledha Geo with Asset Surveyor.

Activating the Laser Interface

Within data capture, the laser rangefinder interface can be activated in one of two ways:

- Automatically, if you had pre-configured the *Laser* sensor's *Auto-connect* field to Yes.
- Manually, via the **EXT** softkey.

Checking the Laser Interface

You can also use the **EXT** to access the *External sensors* menu to reconfigure the laser rangefinder interface, or to check that the laser and Asset Surveyor are communicating correctly.

Recording an Offset

Whenever you are capturing 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 pop up the offset entry form for that feature.

To take a laser measurement for Asset Surveyor, aim the LEDHA at the target and press the **Meas** button. There will be a short delay (1-2 seconds) and then the measurement will appear in Asset Surveyor. When taking a measurement hold the laser as steady as possible.

J External Sensors

The following 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 Asset Surveyor's ESP 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.

J.1 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 will be 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 Asset Surveyor 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.

J.2 Data Dictionary Configuration

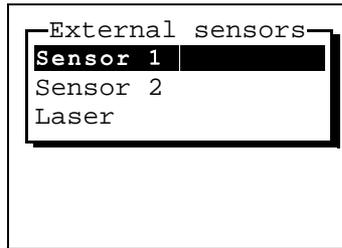
In order to make the best use of the heights transmitted by the Criterion rangefinders, you should set up a data dictionary with a Height attribute in each feature whose height concerns you. The Height attribute should be a numeric attribute with two decimal places and appropriate maximum and minimum values.



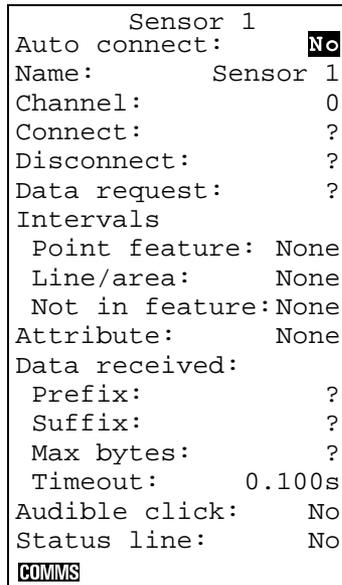
Note – The attribute's name does not have to be Height. It is, however, good practice for each attribute's name to reflect the nature of the data which you plan to record into it. The attribute name *must* be the same for each type of feature whose height you wish to record using your rangefinder.

J.3 Asset Surveyor Configuration

You should now configure an external sensor interface to receive height data from the Criterion. From the Asset Surveyor *Configuration* menu, select *External sensors*:



Select *Sensor 1* from this menu. The configuration form for external sensor number 1 will appear:



Change the fields in this form as indicated 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:	All
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 Asset Surveyor to peel off the packaging characters which surround the actual height measurement. The checksum, carriage-return and linefeed characters are then ignored by Asset Surveyor.

Press **COMMS** to pop up the configuration form for serial communications (RS232) parameters, and enter the following values:

```
Sensor 1
Serial port:  EXT
Baud rate:   4800
Data bits:   8
Stop bits:   1
Parity:      None
```

Press **OK** to save the communications settings, then press **OK** to save the sensor configuration details. Asset Surveyor will return you to the *External sensors* configuration menu, but will have re-named the first entry using the name which you specified for the sensor:

```
External sensors
Height sensor
Sensor 2
Laser
```



Tip – After configuring an external sensor interface, it is recommended that you always test this interface. Select *External sensors* from Asset Surveyor's *Utilities* menu, and activate the *Height sensor*.

J.4 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 Asset Surveyor opens this file, it will automatically activate the pre-configured external sensor interface (as the *Auto-connect* field was set to Yes in the previous section).

Asset Surveyor 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 will be used to store heights recorded by the Criterion 300.

3. Enter attribute values for the feature while Asset Surveyor 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 TDC1.

Provided you have configured your external sensor interface correctly, and have connected and operated the Criterion 300 correctly, you will see a value like 15.4 appear as the *Height* attribute for your feature.

6. Press to save the feature.

From this point on, Asset Surveyor will treat the *Height* attribute as if it had been entered manually. It has no special properties.

J.5 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 Asset Surveyor 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 *External sensors* menu (accessible under the **EXT** softkey when capturing data).



Tip – Don't configure both the *Height sensor* and the *Laser* to auto-connect; if you do this, only the *Height sensor* will be activated and an error message will appear when Asset Surveyor attempts to automatically activate the *Laser* interface.

J.6 Intelligent Barcode Wands

You can use a barcode wand to quickly enter attribute values (for menu-type attributes). A barcode wand is available as an option with all Asset Surveyor systems.

You can also use a *smart* barcode wand (a wand with its own built-in intelligence) to swipe and record other barcode types, and you can configure an external sensor interface to read and store these swiped barcodes as attribute values. This may be of particular value in asset management applications where each asset (be it a meter, power pole, street lamp, manhole, and so forth) can easily be identified by a unique code and this code can be stamped or fixed onto the asset as a tag featuring a machine-readable barcode).

The barcode wand available as a TDC1 option is not 'smart', in the sense that the decoding of barcodes is performed by a driver inside the TDC1 itself (rather than by the wand itself). This wand can only be used to swipe barcodes which have been printed by Pathfinder Office and which match the current data dictionary. It is possible, however, to purchase a smart barcode wand (such as the HP Smartwand (HBCR-8300) from Hewlett Packard®) and use this as an external sensor with the TDC1.

The HP Smartwand can be used to swipe barcodes in the following formats:

- Codabar
- Code 11
- Code 39 (also called Code 3 of 9)
- Code 128
- Interleaved 2 of 5
- MSI Code
- UPC/EAN/JAN.

In order to use the HP Smartwand with the TDC1, you will have to construct a cable which supplies the barcode wand with power (+5 V and about 150 mA of current; see the HP Smartwand specifications for details). The HP Smartwand emits a message each time a recognized barcode is swiped. This message is emitted at 9600 baud, with 7 data bits and two stop bits and even parity, and consists of the barcode itself (of variable length), followed by carriage-return and line-feed characters. For example, swiping:



causes the Smartwand to emit the following message (the A prefix is part of the scanned barcode):

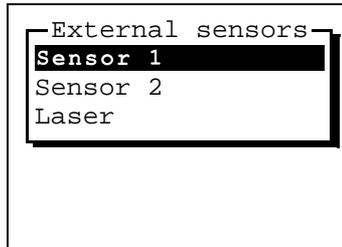
A715535132507

CR

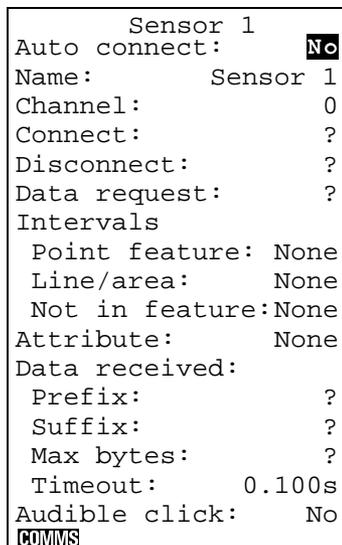
LF

You can configure an Asset Surveyor external sensor interface to recognize these messages and store them into an ID attribute as follows:

1. From the Asset Surveyor *Configuration* menu, select *External sensors*:



2. Select *Sensor 1* from this menu. The configuration form for external sensor number 1 will appear:



3. Change the fields in this form as indicated below:

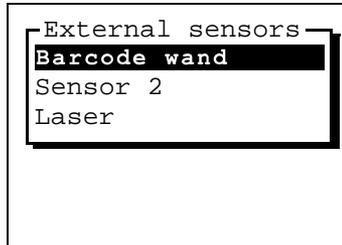
Sensor 1	
Auto connect:	Yes
Name:	Barcode wand
Channel:	0
Connect:	?
Disconnect:	?
Data request:	?
Intervals	
Point feature:	All
Line/area:	All
Not in feature:	All
Attribute:	ID
Data received:	
Prefix:	?
Suffix:	\0D\0A
Max bytes:	?
Timeout:	0.100s
Audible click:	Yes
COMMS	

4. Press **COMMS** to pop up the configuration form for serial communications (RS232) parameters, and enter the following values:

Sensor 1	
Serial port:	EXT
Baud rate:	9600
Data bits:	7
Stop bits:	2
Parity:	Even

5. Press **OK** to save the communications settings, then press **OK** to save the sensor configuration details.

Asset Surveyor will return you to the *External sensors* configuration menu, but will have renamed the first entry using the name which you specified for the sensor:



Note – The barcode wand is connected to the com port at the top of the TDC1, not to the ESP port on the TDC1 Data/ESP cable.



Note – The barcode wand will not operate if connected after the TDC1 has been turned on. Connect the barcode wand then restart the TDC1.

J.7 Digital Cameras

Certain digital cameras can be controlled via 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 which can be used subsequently to identify the photographic image which was recorded by the camera.

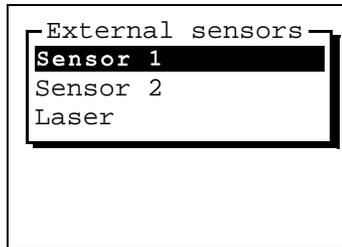
A hypothetical camera communicates at 9600 baud with 8 data bits, 1 stop bit and odd parity. It is triggered either by pressing a button on the camera itself or by sending the ASCII character '*' to the camera. When the camera is mounted on a vehicle it is typically easier to trigger the camera via an RS232 message. Each time the camera takes a photograph (whether triggered manually or via 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
```

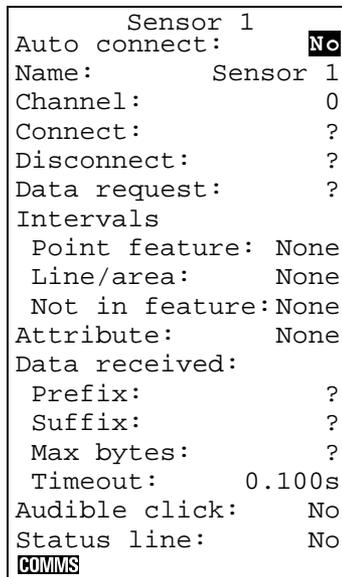
where the number nn indicates the number of the stored image (1 to 64).

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. The configuration form for external sensor number 1 will appear:



3. Change the fields in this form as indicated below:

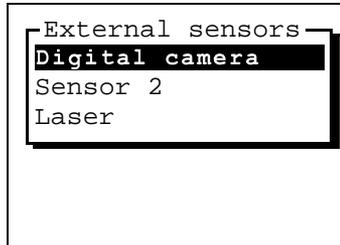
Sensor 1	
Auto connect:	Yes
Name:	Digital camera
Channel:	0
Connect:	?
Disconnect:	?
Data request:	*
Intervals	
Point feature:	None
Line/area:	None
Not in feature:	None
Attribute:	Photo
Data received:	
Prefix:	\$PIC,
Suffix:	\0D\0A
Max bytes:	?
Timeout:	0.100s
Audible click:	Yes
COMMS	

4. Press **COMMS** to pop up the configuration form for serial communications (RS232) parameters, and enter the following values:

Sensor 1	
Serial port:	EXT
Baud rate:	9600
Data bits:	8
Stop bits:	1
Parity:	Odd

5. Press **OK** to save the communications settings, then press **OK** to save the sensor configuration details.

Asset Surveyor will return you to the *External sensors* configuration menu, but will have renamed the first entry using the name which you specified for the sensor:



J.8 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 will configure Asset Surveyor to log each message from the echo sounder as an UNINTERPRETED_SENSOR_DATA record (which will not be associated with a feature).

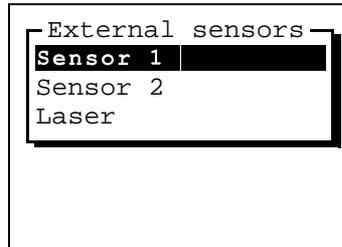
A hypothetical echo sounder might measure the sea's depth and transmit this information once per second at 4800 baud, with 8 data bits, 2 stop bits and no parity. Each measurement is emitted as a message with the following format:

XXXX.X

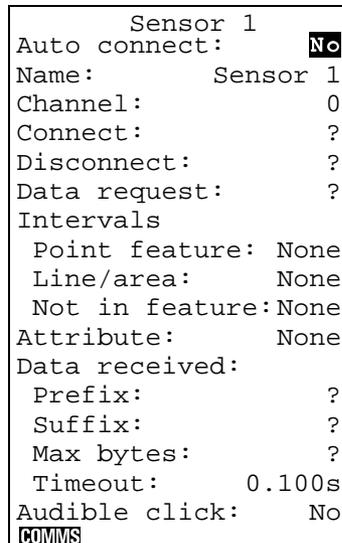
where XXXX.X is the depth of the sea at the point the measurement was taken. There are no delimiting characters which identify the start or end of each message, so Asset Surveyor will have to rely on timing information and the maximum length of 6 characters to isolate each message.

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*:



2. Select *Sensor 1* from this menu. The configuration form for external sensor number 1 will appear:



3. Change the fields in this form as indicated 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
Attribute:	None
Data received:	
Prefix:	?
Suffix:	\0D\0A
Max bytes:	8
Timeout:	0.100s
Audible click:	No
COMMS	



Note – By configuring Asset Surveyor 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 provides assurance that data is being logged continuously from the sensor.



Tip – You can maximize the TDC1'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 pop up the configuration form for serial communications (RS232) parameters, and enter the following values:

```
Sensor 1
Serial port:  EXT
Baud rate:   4800
Data bits:   8
Stop bits:   2
Parity:      None
```

5. Press **OK** to save the communications settings, then press **OK** to save the sensor configuration details.

Asset Surveyor will return you to the *External sensors* configuration menu, but will have renamed the first entry using the name which you specified for the sensor:

```
External sensors
Echo sounder
Sensor 2
Laser
```



Tip – You should configure and activate Asset Surveyor’s external sensor interface *before* switching on the echo sounder. If you switch on the echo sounder before activating Asset Surveyor’s sensor interface, the first measurement from the sensor may be interpreted incorrectly (because Asset Surveyor has no way to distinguish a partial message from a complete one due to the lack of a prefix or suffix on each message).

K The ASSETED Utility

You can load the ASCOORD.DAT file of pre-defined coordinate systems onto your TDC1 using the Pathfinder Office software. This file contains definitions for most popular coordinate systems, datums and zones.



Note – You cannot create, edit or delete coordinate systems, datums or zones on your TDC1.

Before loading ASCOORD.DAT onto your TDC1, you can use the ASSETED utility to delete or edit pre-defined coordinate systems and to create further custom coordinate systems as required. You can easily set up the ASCOORD.DAT file for your field crew so that only the coordinate systems used in your area are contained in ASCOORD.DAT. Not only will this reduce the risk of confusion in the field, but it will ensure that the ASCOORD.DAT file is as small as possible, thereby maximizing data storage space on your TDC1.

K.1 Installation



Caution – You cannot use a previous version of ASSETED with the ASCOORD.DAT file which ships with Asset Surveyor version 3.30. You must use the new ASSETED program (version 3.30).

The ASSETED program is supplied on the Asset Surveyor distribution disk. To install it on your PC, follow these instructions:

1. Insert the Asset Surveyor distribution disk in your PC's 3½" drive.
2. On your PC, log to your hard disk drive and create a new folder for ASSETED.

For example, to create a new folder called C:\ASSETED, type the commands:

```
C:  
MKDIR \ASSETED
```

3. Change to the newly-created folder.

For example, type the command:

```
CD \ASSETED
```

4. To copy the required files from the distribution diskette, type the following commands:

```
COPY A:\ASSETED.*.  
COPY A:\*.LNG  
COPY A:\ASCOORD.DAT
```

If your PC's 3½" disk drive is drive B:, specify **B:** instead of **A:** in each of the above commands.

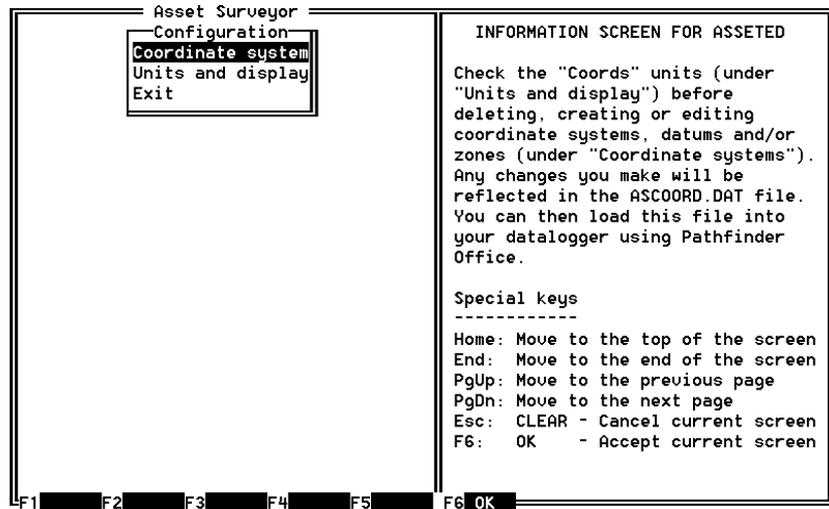
You can now run the ASSETED utility, as described in the following section.

K.2 Basic Operation

Once you have installed ASSETED onto your PC, you can run the ASSETED program by changing to the ASSETED folder and typing the command **ASSETED** on your PC. For example:

```
C:
CD \ASSETED
ASSETED
```

The ASSETED program will execute, and will display its main *Configuration* menu, which is as follows:



The ASSETED program has a user interface which is similar to that of the Asset Surveyor software, so you should find it reasonably familiar. The panel to the right of the PC's screen provides information about special keys. The most important keys to remember are the **[ESC]** key (which acts like the *Clear* key on the TDC1) and the **OK** softkey (which acts like **OK** on the TDC1).

The primary function of the ASSETED program is to allow you to customize the ASCOORD.DAT file, which can then be loaded onto one or more TDC1s. Select *Coordinate system* from the *Configuration* menu to define and manage coordinate systems. You can also configure ASSETED by selecting the *Units and display* entry from the *Configuration* menu. You can exit the ASSETED program by selecting *Exit* from the *Configuration* menu or by pressing the **[ESC]** key.

K.2.1 Units and Display

If you select *Configuration / Units and display*, the following configuration form will appear:

Asset Surveyor		INFORMATION SCREEN FOR ASSETED			
Units and display					
Units	Meters(m)	Check the "Coords" units (under "Units and display") before deleting, creating or editing coordinate systems, datums and/or zones (under "Coordinate systems"). Any changes you make will be reflected in the ASCOORD.DAT file. You can then load this file into your datalogger using Pathfinder Office.			
Coords*	Meters(m)				
Height:	Meters(m)				
Distance:	Meters(m)				
Uelocity:	Km/Hour(km/h)				
Angles:	Degrees(°)				
Angle fmt:	DD.MMSSss				
Order:	Lat/Lon				
Altitude ref:	MSL				
North ref:	True				
Magnetic decl:	Auto	Special keys ----- Home: Move to the top of the screen End: Move to the end of the screen PgUp: Move to the previous page PgDn: Move to the next page Esc: CLEAR - Cancel current screen F6: OK - Accept current screen			
Null string:	?				
Language:	English				
F1	F2	F3	F4	F5	F6 OK

This is identical to the *Units and display* configuration form in the Asset Surveyor software. Only some of the fields in this form are relevant to the operation of the ASSETED program:

- The *Coords* unit field is used to determine how certain coordinate system zone definition fields are displayed.



Caution – If you create new datums or zones and specify coordinate values using the wrong units, the coordinate system definitions you create may be seriously inaccurate. It is important to configure the Coords units correctly before creating datums or zones.

- The *Angle fmt* field is used to determine how latitude and longitude angles are entered when defining certain coordinate system zones.
- The *Order* field determines the order of *North/East* and *Lat/Long* fields when defining certain coordinate system zones.
- The *Null string* field determines the way in which null (un-entered) values will be displayed by ASSETED.
- The *Language* field determines which supported language the ASSETED program will display in.

The other fields on this form are completely ignored by the ASSETED program.

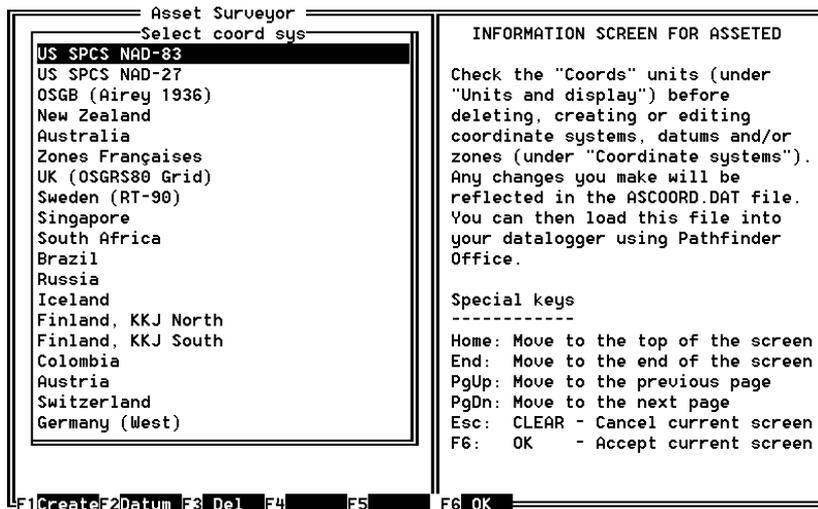
Once you have configured *Units and display* fields to suit your requirements, press the **OK** softkey to save the form and return to the *Configuration* menu. Any changes will take place immediately. Refer to Chapter 5 of the *TDC1 Asset Surveyor Software User Guide* for further details of the various fields on the *Units and display* form.



Note – Changes made to *Units and display* will only affect the operation of the ASSETED program. They will not have any effect on the operation of the Asset Surveyor software running on your TDC1.

K.3 Customizing Coordinate Systems

If you select the *Coordinate system* entry from the *Configuration* menu, a menu of available coordinate systems will appear:



Initially, this is the full set of pre-defined coordinate systems in the supplied ASCOORD.DAT file. If you delete unwanted coordinate systems, or create further custom coordinate systems, these changes will be reflected in the contents of the ASCOORD.DAT file. Once you have arranged the coordinate systems appropriate to your application requirements, you can use Pathfinder Office to load the ASCOORD.DAT file onto your datalogger(s).



Tip – If you delete a pre-defined coordinate system by mistake, you can re-copy the original ASCOORD.DAT file from the Asset Surveyor distribution diskette and start modifying it using ASSETED again.

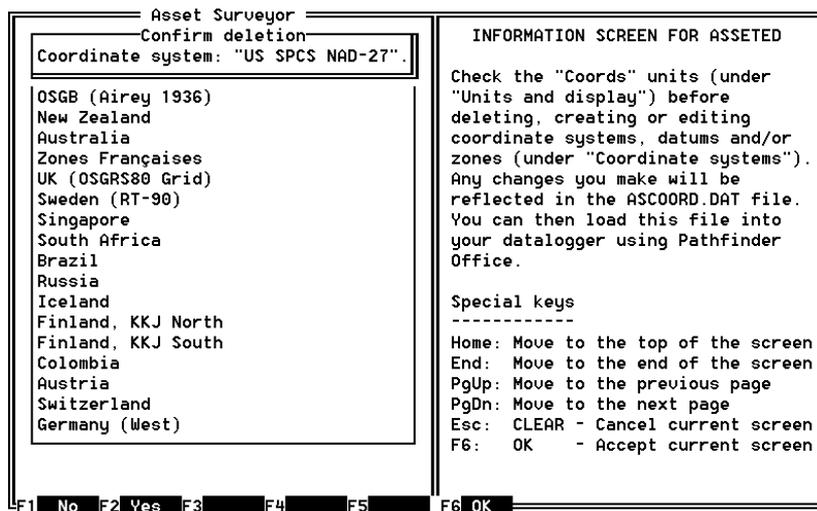
K.3.1 Deleting Unwanted Coordinate Systems

The most common modification to the distributed ASCOORD.DAT file is to remove any unwanted coordinate systems. The reasons for doing so are as follows:

- A smaller ASCOORD.DAT file will consume less data storage space on your TDC1, thereby freeing up more space for storage of data files.
- By eliminating unwanted coordinate systems, there is less opportunity for a field crew to choose the wrong coordinate system by mistake.
- A smaller ASCOORD.DAT file makes selection of a coordinate system quicker and easier.

As an example, presume that the default ASCOORD.DAT file contains the coordinate systems shown in the diagram on the previous page. Presume that your applications all require only the U.S. State Plane coordinate systems based on the NAD-83 datum. You can delete the unwanted coordinate systems as follows.

Move the highlight to the first unwanted coordinate system (US SPCS NAD-27). Now press **DEL**. The ASSETED program asks you to confirm that you wish to delete this coordinate system, in case you pressed **DEL** by mistake:



Press **YES** to delete the unwanted coordinate system. It will disappear from the menu of coordinate systems. Now move the highlight to the next unwanted coordinate system and press **DEL** again. Repeat this procedure until the only remaining coordinate systems are those required by your applications.



Note – When you delete a coordinate system, all of the zones for that coordinate system will also be deleted.

Press **ESC** to exit the *Coordinate system* menu. When you exit the *Coordinate system* menu and return to the ASSETED *Configuration* menu, ASSETED will spend some time compressing the ASCOORD.DAT file so that it takes as little space as possible when loaded onto your TDC1.

K.3.2 Creating New Coordinate Systems

You can create a new coordinate system and add it to the menu of available coordinate systems by pressing the **CREATE** softkey on the menu of coordinate systems:

When you press **CREATE**, ASSETED displays the *Create zone* form, which requires you to name the new coordinate system and to select a datum for it:

Asset Surveyor	
Create coord system	
Name:	?
Datum:	?
F1 BACK F2 HOME F3 END F4 PgUp F5 PgDn F6 OK	

INFORMATION SCREEN FOR ASSETED	
Check the "Coords" units (under "Units and display") before deleting, creating or editing coordinate systems, datums and/or zones (under "Coordinate systems"). Any changes you make will be reflected in the ASCOORD.DAT file. You can then load this file into your datalogger using Pathfinder Office.	
Special keys -----	
Home:	Move to the top of the screen
End:	Move to the end of the screen
PgUp:	Move to the previous page
PgDn:	Move to the next page
Esc:	CLEAR - Cancel current screen
F6:	OK - Accept current screen



Note – An Asset Surveyor coordinate system is a collection of zones which all refer to the **same** datum. You cannot have two or more datums within a coordinate system.

Type in a name for your new coordinate system, and select the correct datum. Press **OK** to save the form. The coordinate system which you have created will be added to the menu of available coordinate systems. You should now create one or more zones for that coordinate system, as described in the following section.

K.4 Customizing Zones

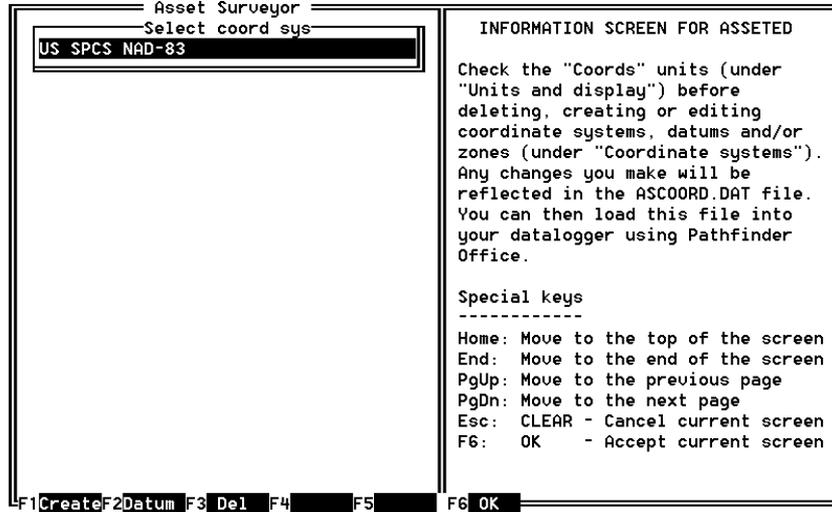
The following sections outline customizing zones.

K.4.1 Deleting Unwanted Zones

After deleting unwanted coordinate systems, you may also wish to delete unwanted zones within a particular coordinate system. The reasons for doing so are essentially the same as the reasons for deleting unwanted coordinate systems:

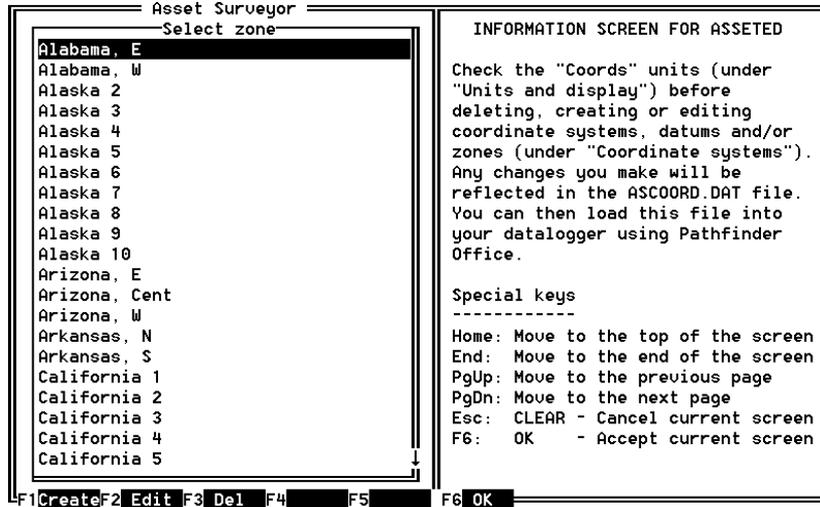
- A smaller ASCOORD.DAT file will consume less data storage space on your TDC1, thereby freeing up more space for storage of data files.
- By eliminating unwanted zones, there is less opportunity for a field crew to choose the wrong zone by mistake. Zones within a U.S. State Plane have similar names, and it can be easy to confuse two zones.
- A smaller ASCOORD.DAT file makes selection of a particular zone quicker and easier.

As an example, presume that you have deleted all but the U.S. State Plane coordinate systems for NAD-83:



Presume that you usually work in the state of Oregon, but that you occasionally have call to work in any of the Western coastal states of the U.S. You can delete all of the NAD-83 State Plane zones apart from those for Washington, Oregon and California as follows.

Select the US SPCS NAD-83 coordinate system from the *Coordinate system* menu. The menu of all NAD-83 State Plane zones will appear:



For each unwanted zone, highlight that zone and press **DEL**. The ASSETED program asks you to confirm your intentions. Press **YES** to delete the unwanted zone. Continue to delete all of the other unwanted zones by repeating the above procedure. When only the zones you require remain, press **ESC** to return to the menu of coordinate systems.

K.4.2 Creating New Zones

Whenever you create a new coordinate system and select it, or whenever you are looking at the menu of zones for a coordinate system, you can press **CREATE** to create a new zone for that coordinate system.

Asset Surveyor		INFORMATION SCREEN FOR ASSETED
Create zone		
Name:	US SPCS NAD-83	Check the "Coords" units (under "Units and display") before deleting, creating or editing coordinate systems, datums and/or zones (under "Coordinate systems"). Any changes you make will be reflected in the ASCOORD.DAT file. You can then load this file into your datalogger using Pathfinder Office. Special keys ----- Home: Move to the top of the screen End: Move to the end of the screen PgUp: Move to the previous page PgDn: Move to the next page Esc: CLEAR - Cancel current screen F6: OK - Accept current screen
Projn:	?	
F1 F2 F3 F4 F5 F6 OK		

The *Create zone* form requires you to name the zone and select the type of map projection to use for the zone. Then, depending on the projection selected, you may be required to enter a number of parameters defining that projection.

Asset Surveyor supports the following types of map projections:

- 1-Parallel Lambert
- 2-Parallel Lambert
- New Zealand Map
- None
- Planar
- Spherical Mercator
- Transverse Mercator.

Once you have named the new zone and selected a projection type, entry of the zone's other fields proceeds as described in the following sections, one for each projection type.



Note – The order and units for these fields depend on the settings in the *Units and display* configuration form.

K.4.3 None Projection

For a *None* projection, there are no further parameters:

Asset Surveyor		INFORMATION SCREEN FOR ASSETED	
Create zone			
Name:		NewZone	
Projn		None	
		<p>Check the "Coords" units (under "Units and display") before deleting, creating or editing coordinate systems, datums and/or zones (under "Coordinate systems"). Any changes you make will be reflected in the ASCOORD.DAT file. You can then load this file into your datalogger using Pathfinder Office.</p> <p>Special keys ----- Home: Move to the top of the screen End: Move to the end of the screen PgUp: Move to the previous page PgDn: Move to the next page Esc: CLEAR - Cancel current screen F6: OK - Accept current screen</p>	
F1	F2	F3	F4
F5	F6	OK	

Just press **OK** to save the new zone and return to the menu of zones for this coordinate system, to which the new zone will have been added.

If a zone defined on a *None* projection is selected, Asset Surveyor will display all positions as latitudes and longitudes on the datum associated with that coordinate system. This is essentially the same as selecting the *Latitude/Longitude* coordinate system and choosing the appropriate datum, but has the advantage that you can insert a zone with the *None* projection into any coordinate system, and give it a specific name.

K.4.4 Planar Projection

A *Planar* map projection provides a very simple way to compute inexact North and East coordinates where the coefficients of the official map projection for the area are not known. The 'Planar' projection defines an origin point, whose latitude, longitude, north and east are known. When given the latitude and longitude of a point of interest, it computes the distance and bearing from that point to the origin, using only latitudes and longitudes. It then applies this distance and bearing to the north and east coordinates of the origin to obtain north and east coordinates for the point of interest. These are then scaled and optionally rotated around the origin to yield the final north and east coordinates of the point.



Note – A *Planar* map projection takes no account of the earth's curvature, and should therefore only be applied to points which are relatively near the origin.

The fields required to fully define a zone using a *Planar* map projection are the following:

Asset Surveyor Create zone		INFORMATION SCREEN FOR ASSETED
Name:	NewZone	Check the "Coords" units (under "Units and display") before deleting, creating or editing coordinate systems, datums and/or zones (under "Coordinate systems"). Any changes you make will be reflected in the ASCOORD.DAT file. You can then load this file into your datalogger using Pathfinder Office.
Projn:	Planar	
Scale:	1.000000000000	
Origin		
North:	0.000000m	
East:	0.000000m	
Lat:	0°00'00.000000"N	
Lon:	0°00'00.000000"E	Special keys ----- Home: Move to the top of the screen End: Move to the end of the screen PgUp: Move to the previous page PgDn: Move to the next page Esc: CLEAR - Cancel current screen F6: OK - Accept current screen
Rotation:	0°00'00.000000"	
F1 F2 F3 F4 F5 F6 OK		

Once you have entered values for each of the fields in this form, press **OK** to save the newly defined zone and return to the menu of zones for this coordinate system, to which the new zone will have been added.

K.4.5 Transverse Mercator Projection

The *Transverse Mercator* projection type provides a full Mercator map projection from a local datum to the map plane. This type of projection is widely used for intrastate maps. Country-wide maps are more likely to use the Universal Transverse Mercator (UTM) projection.

The Transverse Mercator projection works best close to the equator, and becomes greatly distorted near to the poles.



Note – To avoid computational problems, Asset Surveyor insists that the origin latitude be at least 2° from either pole.

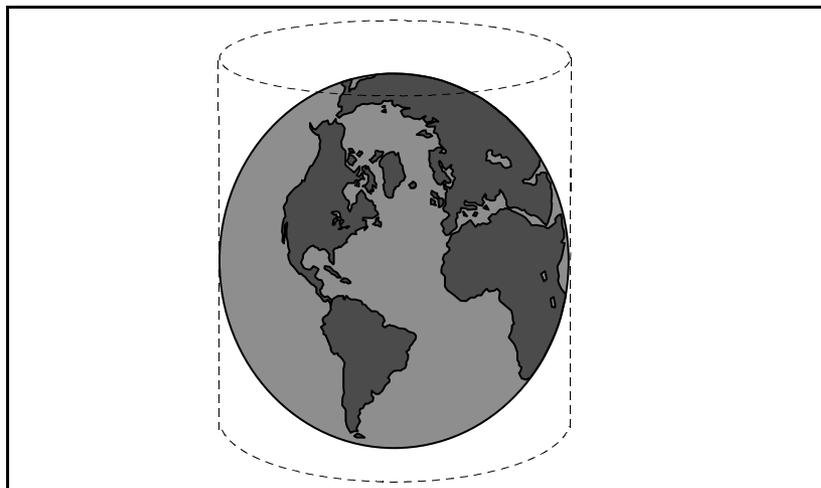


Figure K-1 The Transverse Mercator Projection

The fields required to fully define a zone using a *Transverse Mercator* map projection are the following:

Asset Surveyor		INFORMATION SCREEN FOR ASSETED	
Create zone			
Name:	NewZone	Check the "Coords" units (under "Units and display") before deleting, creating or editing coordinate systems, datums and/or zones (under "Coordinate systems"). Any changes you make will be reflected in the ASCOORD.DAT file. You can then load this file into your datalogger using Pathfinder Office. Special keys ----- Home: Move to the top of the screen End: Move to the end of the screen PgUp: Move to the previous page PgDn: Move to the next page Esc: CLEAR - Cancel current screen F6: OK - Accept current screen	
Projn:	Transverse Mercator		
Scale:	1.000000000000		
Origin			
North:	0.000000m		
East:	0.000000m		
Lat:	0°00'00.000000"N		
CM:	0°00'00.000000"E		
F1	F2		F3
F4	F5		F6 OK

After entering the *Scale* factor, enter the location of the origin as *North* and *East*. Finally, enter the *Latitude* of the origin and the longitude of the transformation's central meridian (CM). Press **OK** to save the new zone and return to the menu of zones for the current coordinate system, to which the new zone will have been added.

K.4.6 Spherical Mercator Projection

The *Spherical Mercator* projection type provides a simplified Mercator projection from a sphere to a plane. This formula assumes that the earth is spherical, rather than ellipsoidal, and makes no allowance for the earth's equatorial bulge.

The fields required to fully define a zone using a *Spherical Mercator* map projection are the following:

Asset Surveyor		INFORMATION SCREEN FOR ASSETED	
Create zone			
Name:	<input type="text" value="NewZone"/>	Check the "Coords" units (under "Units and display") before deleting, creating or editing coordinate systems, datums and/or zones (under "Coordinate systems"). Any changes you make will be reflected in the ASCOORD.DAT file. You can then load this file into your datalogger using Pathfinder Office.	
Projn:	Spherical Mercator		
Scale:	1.000000000000		
Origin			
North:	0.000000m		
East:	0.000000m	Special keys ----- Home: Move to the top of the screen End: Move to the end of the screen PgUp: Move to the previous page PgDn: Move to the next page Esc: CLEAR - Cancel current screen F6: OK - Accept current screen	
F1 <input type="text"/> F2 <input type="text"/> F3 <input type="text"/> F4 <input type="text"/> F5 <input type="text"/> F6 <input type="text" value="OK"/>			

After entering the *Scale* factor, and the location of the origin as *North* and *East*, press to save the new zone and return to the menu of zones for the current coordinate system, to which the new zone will have been added.

K.4.7 1-Parallel Lambert Projection

There are two *Lambert Conformal* map projections, called the 1- and 2-Parallel Lambert projections. Both of these projections map the surface of an ellipsoid to a conic surface; the difference between the two projections is that with the 1-Parallel projection the conic surface is tangential to the earth's surface, while with the 2-Parallel projection the conic surface actually slices through the earth.

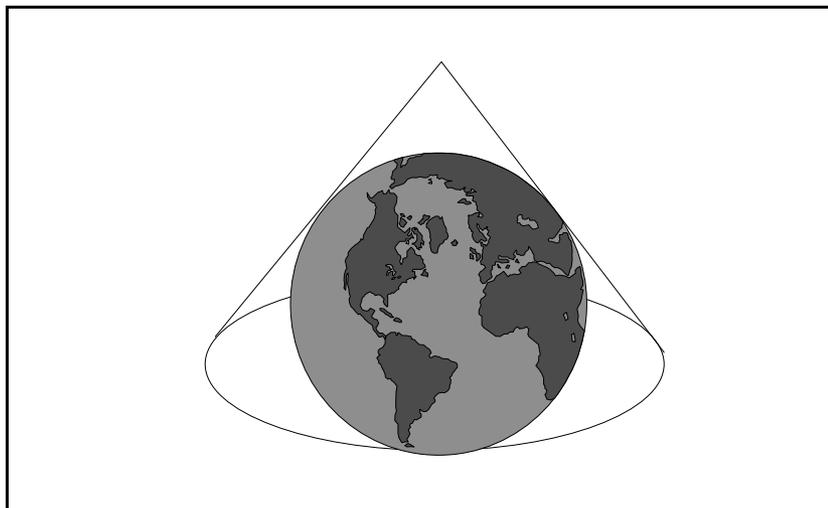


Figure K-2 The 1-Parallel Lambert Projection

The Lambert map projections are most appropriate for use near the poles, and become greatly distorted near the equator.



Note – To avoid computational problems, Asset Surveyor ensures that neither parallel is closer than 10° to the equator, and that the parallels are not coincident.

The fields which describe a 1-Parallel Lambert projection are as follows:

Asset Surveyor		INFORMATION SCREEN FOR ASSETED			
Create zone		Check the "Coords" units (under "Units and display") before deleting, creating or editing coordinate systems, datums and/or zones (under "Coordinate systems"). Any changes you make will be reflected in the ASCOORD.DAT file. You can then load this file into your datalogger using Pathfinder Office. Special keys ----- Home: Move to the top of the screen End: Move to the end of the screen PgUp: Move to the previous page PgDn: Move to the next page Esc: CLEAR - Cancel current screen F6: OK - Accept current screen			
Name:	NewZone				
Projn:	1 Parallel Lambert				
Scale:	1.000000000000				
Origin					
North:	0.000000m				
East:	0.000000m				
Parallel:	0°00'00.000000"N				
Lon:	0°00'00.000000"E				
F1	F2	F3	F4	F5	F6 OK

Enter the *Scale* factor and the *North* and *East* of the origin point. Finally, enter the standard parallel (latitude) and the longitude of the origin. Press **OK** to save the newly defined zone and return to the menu of zones for the current coordinate system, to which the new zone will have been added.

K.4.8 2-Parallel Lambert Projection

The second of the two *Lambert Conformal* map projections is called the 2-Parallel Lambert projection. It is similar in many ways to the 1-Parallel Lambert projection (see above for details).

The fields which describe a 2-Parallel Lambert projection are as follows:

Asset Surveyor Create zone		INFORMATION SCREEN FOR ASSETED
Name:	NewZone	Check the "Coords" units (under "Units and display") before deleting, creating or editing coordinate systems, datums and/or zones (under "Coordinate systems"). Any changes you make will be reflected in the ASCOORD.DAT file. You can then load this file into your datalogger using Pathfinder Office. Special keys ----- Home: Move to the top of the screen End: Move to the end of the screen PgUp: Move to the previous page PgDn: Move to the next page Esc: CLEAR - Cancel current screen F6: OK - Accept current screen
Projn:	2 Parallel Lambert	
Origin		
North:	0.000000m	
East:	0.000000m	
Lat:	0°00'00.000000"N	
Lon:	0°00'00.000000"E	
Parallel		
1st:	0°00'00.000000"N	
2nd:	0°00'00.000000"N	
F1 <input type="checkbox"/> F2 <input type="checkbox"/> F3 <input type="checkbox"/> F4 <input type="checkbox"/> F5 <input type="checkbox"/> F6 <input type="checkbox"/> OK		

Enter the *Scale* factor, then the *North*, *East*, *Latitude* and *Longitude* of the origin point. Finally, enter the two parallels (as latitudes) and press **OK** to save the newly defined zone and return to the menu of zones for the current coordinate system, to which the new zone will have been added.

K.4.9 New Zealand Map Grid

The *New Zealand Map Grid* is a custom map projection designed to closely model the geometry of the North and South Islands of New Zealand.

For the *New Zealand Map Grid* projection, no further fields need to be entered:

Asset Surveyor Create zone		INFORMATION SCREEN FOR ASSETED
Name:	NewZone	Check the "Coords" units (under "Units and display") before deleting, creating or editing coordinate systems, datums and/or zones (under "Coordinate systems"). Any changes you make will be reflected in the ASCOORD.DAT file. You can then load this file into your datalogger using Pathfinder Office.
Projn:	New Zealand Map	
		Special keys -----
		Home: Move to the top of the screen
		End: Move to the end of the screen
		PgUp: Move to the previous page
		PgDn: Move to the next page
		Esc: CLEAR - Cancel current screen
		F6: OK - Accept current screen
F1	F2	F3
F4	F5	F6 OK

Just press **OK** to save the new zone and return to the menu of zones for this coordinate system, to which the new zone will have been added.

K.4.10 Editing Zones

Whenever you are browsing through a menu of zones for a particular coordinate system, you can highlight a zone and press **EDIT** to view the definition of the zone and optionally edit it. ASSETED display the *Edit zone* form, showing each of the fields for the zone and permitting you to change one or more of them. For example:

Asset Surveyor		INFORMATION SCREEN FOR ASSETED			
Edit zone					
Name:	Alabama, E	Check the "Coords" units (under "Units and display") before deleting, creating or editing coordinate systems, datums and/or zones (under "Coordinate systems"). Any changes you make will be reflected in the ASCOORD.DAT file. You can then load this file into your datalogger using Pathfinder Office. Special keys ----- Home: Move to the top of the screen End: Move to the end of the screen PgUp: Move to the previous page PgDn: Move to the next page Esc: CLEAR - Cancel current screen F6: OK - Accept current screen			
Projn:	Transverse Mercator				
Scale:	0.999960000000				
Origin					
North:	0.000000m				
East:	200000.000000m				
Lat:	30°30'00.000000"N				
CM:	85°50'00.000000"W				
F1	F2	F3	F4	F5	F6 OK

You can change any or all of the fields for a zone, including its name and projection type. If you change one or more fields, press **OK** to save these changes and return to the menu of zones.

If you are just viewing a zone's definition, press **ESC** to return to the menu of zones (and to ensure that any changes made by accident will not be saved).



Caution – You should not change the values of pre-defined zones.

K.5 Customizing Datums

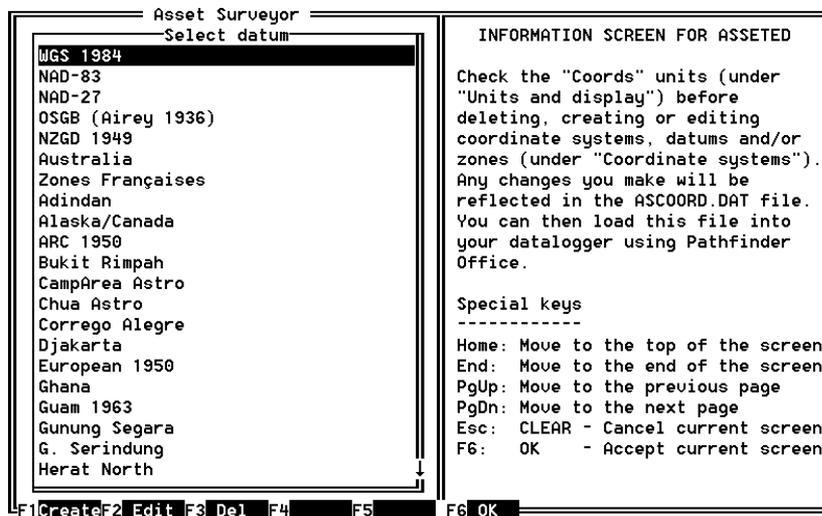
The following sections outline customizing datums.

K.5.1 Deleting Unwanted Datums

After deleting unwanted coordinate systems and zones, you may also wish to delete unwanted datums to reduce the size of the ASCOORD.DAT file and avoid confusion when selecting a datum on the TDC1.

As an example, presume that you require no datums other than NAD-83. You can delete all other datums from the ASCOORD.DAT file (apart from the WGS-84 datum, which cannot be deleted) as follows:

Press the **DATUM** softkey on the menu of coordinate systems. The menu of datums will appear:



Highlight the first unwanted datum (NAD-27) and press **DEL**. ASSETED will ask you to confirm your intention. Press **YES** to delete the unwanted datum. Continue to delete all of the other unwanted datums by repeating the above procedure.



Note – ASSETED will not allow you to delete a datum which is currently referenced by one or more coordinate systems. You must first delete these coordinate systems before you will be permitted to delete the datum. Because Asset Surveyor's *Latitude/Longitude* coordinate system, which cannot itself be deleted, uses the WGS-84 datum, you will never be able to delete *WGS-84* from the list of datums.

When only the datums you require remain, press **[ESC]** to return to the menu of coordinate systems.

K.5.2 Creating New Datums

The supplied ASCOORD.DAT file contains most common datum definitions and most of the coordinate systems commonly used in the North America, Western Europe and Australasia. If you work outside of these areas, or if you use a special-purpose local coordinate system, you may need to define one or more coordinate systems or datums yourself.

A datum is defined by describing a datum transformation from the WGS-84 datum used by GPS to the desired datum. Asset Surveyor supports three formulae for datum transformations:

- *None*. This is used simply to describe the WGS-84 datum itself. It represents no transformation at all.
- *7-Parameter*. This is a full datum transformation, consisting of a three dimensional translation, a three dimensional rotation and the application of a scale factor.
- *Molodensky*. This is an approximation to a full 7-parameter datum transformation which employs a scale factor of zero and performs no rotations. Molodensky transformations ignore height differences between datums.



Tip – Sometimes datum transformations are described as having only three parameters (the translation in three dimensions). If you have figures for such a transformation, choose a 7-parameter transformation as your formula and then leave the other parameters null or 0.



Tip – Your choice of datum formula will be influenced by the formula used by your GIS, or by the maps which you are referring to. If you have the choice of a 7-parameter datum transformation and a Molodensky transformation, you should always choose the 7-parameter transformation. The Molodensky transformation was originally developed to reduce the number and complexity of manual computation steps needed to perform approximate datum transformations. With the advent of computers, it is preferable to use the more accurate 7-parameter transformation whenever possible.

If you change the *Formula* field, ASSETED will display the appropriate fields for the chosen formula. If the chosen formula is None, there will be only *Name* and *Formula* fields, as the null transformation requires no further description. The following two sections describe the further steps in creating a datum using the 7-parameter formula and the Molodensky formula.

K.5.3 Creating a Molodensky Datum

When you specify the Molodensky formula, the *Create datum* form will expand to include the following fields:

Asset Surveyor Create datum		INFORMATION SCREEN FOR ASSETED
Name:	Molodensky	Check the "Coords" units (under "Units and display") before deleting, creating or editing coordinate systems, datums and/or zones (under "Coordinate systems"). Any changes you make will be reflected in the ASCOORD.DAT file. You can then load this file into your datalogger using Pathfinder Office. Special keys ----- Home: Move to the top of the screen End: Move to the end of the screen PgUp: Move to the previous page PgDn: Move to the next page Esc: CLEAR - Cancel current screen F6: OK - Accept current screen
Formula:	6378137.0000m	
Radius:	298.2572235630	
(1/f):		
Origin		
X:	0.000000m	
Y:	0.000000m	
Z:	0.000000m	
F1 F2 F3 F4 F5 F6 OK		

The fields of this form are as follows:

- The *Radius* you should enter is the radius of the ellipsoid which you are defining, in meters. The default value is the radius for the GRS-80 ellipsoid (which is used by both the WGS-84 and NAD-83 datums).
- The *(1/f)* field is where you specify the flattening of the ellipsoid which you are defining. This is a measure of the eccentricity of the ellipsoid (in relation to a perfect sphere). Because the earth is very nearly spherical, this flattening figure is quite small, and is therefore entered as the reciprocal of the true value. This flattening is a coefficient, rather than a measured value, and hence it has no associated units. The default flattening value applies to the GRS-80 ellipsoid (and hence to the WGS-84 and NAD-83 datums).

- The *X*, *Y* and *Z* coordinates of the *Origin* define a transformation in 3D space from the origin of the WGS-84 datum to the origin of the datum which you are defining. These values will be displayed in meters, but can be entered in any other convenient distance units.

After entering the radius, flattening and origin of the Molodensky datum, press **OK** to save the datum and return to the menu of available datums, to which this new datum will have been added.

K.5.4 Creating a 7-Parameter Datum

When you specify the 7-parameter formula, the *Create datum* form will expand to include the following fields:

Asset Surveyor Create datum		INFORMATION SCREEN FOR ASSETED
Name:		Check the "Coords" units (under "Units and display") before deleting, creating or editing coordinate systems, datums and/or zones (under "Coordinate systems"). Any changes you make will be reflected in the ASCOORD.DAT file. You can then load this file into your datalogger using Pathfinder Office. Special keys ----- Home: Move to the top of the screen End: Move to the end of the screen PgUp: Move to the previous page PgDn: Move to the next page Esc: CLEAR - Cancel current screen F6: OK - Accept current screen
Formula:	7 Parameter	
Radius:	6378137.0000m	
(1/f):	298.2572235630	
Origin		
X:	0.000000m	
Y:	0.000000m	
Z:	0.000000m	
Rotation		
X:	0°00'00.000000"	
Y:	0°00'00.000000"	
Z:	0°00'00.000000"	
Scale(ppm):	0.00000000	
F1 F2 F3 F4 F5 F6 OK		

The first eight fields of this form are identical to those for a Molodensky datum (although they may be treated slightly differently). Refer to the previous section for instructions on the entry of values for these fields.

After entering the radius, flattening and origin of the datum, you could press **OK** to save the datum. A datum transformation which defines no rotation or scale factor parameters is known as a 3-parameter datum transformation. If the datum you are defining does have rotation and scale factor parameters (that is, it is a full 7-parameter datum), you should proceed to enter these before pressing **OK**.

The remaining fields are as follows:

- The angles of *Rotation* along the *X*, *Y* and *Z* axes. These are the angles through which the Cartesian axes of the GRS-80 ellipsoid must be rotated to align it to the axes of the local ellipsoid being defined. ASSETED will check that the angles do not exceed 1° in any direction, but typically they will be far smaller than that (a few seconds at most).



Note – The angle of rotation is positive for a counter-clockwise rotation about each axis, viewed from the positive end of the axis.

- The *Scale factor* in parts per million. ASSETED verifies that the scale factor is between plus and minus 1000 parts per million, but usually this value will be between plus and minus 10 parts per million.



Caution – Any error in the supplied scale factor will cause significant (but plausible) errors in the coordinates transformed to the new datum. Be very careful to ensure that the scale factor is entered as a parts-per-million value, and that it is correct.

Once you have entered each of the values defining your new datum, and have checked the values you have entered, press **OK** to save the new datum and return to the menu of datums, to which this new datum will have been added.

K.5.5 Editing a Datum

You can view the definition for a datum, and optionally edit any of its fields, by highlighting that datum in the menu of available datums and pressing **EDIT**. ASSETED will display the *Edit datum* form, showing the fields for the datum and permitting you to change one or more of them. For example:

Asset Surveyor		INFORMATION SCREEN FOR ASSETED			
Edit datum					
Name:	NAD-83	Check the "Coords" units (under "Units and display") before deleting, creating or editing coordinate systems, datums and/or zones (under "Coordinate systems"). Any changes you make will be reflected in the ASCOORD.DAT file. You can then load this file into your datalogger using Pathfinder Office. Special keys ----- Home: Move to the top of the screen End: Move to the end of the screen PgUp: Move to the previous page PgDn: Move to the next page Esc: CLEAR - Cancel current screen F6: OK - Accept current screen			
Formula:	7 Parameter				
Radius:	6378137.0000m				
(1/f):	298.2572221009				
Origin					
X:	0.000000m				
Y:	0.000000m				
Z:	0.000000m				
Rotation					
X:	0°00'00.000000"				
Y:	-0°00'00.345630"				
Z:	-0°00'00.454540"				
Scale(ppm):	0.00000000				
F1	F2		F3	F4	F5



Caution – You should not need to change the values of pre-defined datums.

K.6 Loading ASCOORD.DAT onto the TDC1

Once you have configured the coordinate systems appropriate to your application requirements, you can use Pathfinder Office to load the ASCOORD.DAT file onto your TDC1. See the Pathfinder Office documentation for details of how to transfer the ASCOORD.DAT file onto your TDC1.

L NMEA Output Messages

NMEA output is available from some Trimble GPS receivers; this appendix describes the NMEA messages which are available from the Pro XL, Pro XRS and Pro XR 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.
- VTG: Actual track made good and speed over ground.
- ZDA: UTC day, month, year, and local time zone offset.

L.1 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
```

L.1.1 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

L.1.2 Direction

Direction; north, south, east, or west; is represented by a single character: *N*, *S*, *E*, or *W*.

L.1.3 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.

L.2 Messages

When NMEA-0183 output is enabled, the following messages can be produced to aid integration with other sensors.

L.2.1 ALM: GPS Week, SV Health, & 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.

L.2.2 GGA: Time, Position, & 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.

L.2.3 GLL: Position Fix, Time of Position Fix, & 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

L.2.4 GSA: GPS Receiver Operating Mode, SVs used for Navigation, & 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 2-D or 3-D
 - A = Automatic, 3-D/2-D
- Fix Status:
 - 1 = Fix not available
 - 2 = 2-D
 - 3 = 3-D
- Fields 3 to 14 = PRNs of SVs used in position fix (null for unused fields)
- Field 15 = PDOP
- Field 16 = HDOP
- Field 17 = VDOP.

L.2.5 GSV: Number of Visible SVs, PRN Numbers, Elevation, Azimuth & 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/N₀) 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.

L.2.6 VTG: Actual Track Made Good & 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.

L.2.7 ZDA: UTC Day, Month, Year, & 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
- 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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