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Locus System
Operation Manual

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Printed in the United States of America.
Part Number: 630208-01, Revision A
November, 1998

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Introduction

What is Locus?

Locus is a complete GPS instrument system designed for precision surveying. Each Locus system includes a minimum of two Locus integrated receivers, processing software, and all components required to get the user up and running and producing quality results in a minimum amount of time.

The heart of the Locus System is the Locus, a highly integrated electronic device which incorporates a survey-grade GPS receiver, antenna, and batteries in a compact instrument that mounts on standard tribrachs, tripods, and poles. The Locus collects and records signals broadcast from GPS satellites and stores this information in its internal solid-state memory. Data is extracted from Locus through a wireless infra-red (IR) communications port, a unique feature that eliminates the troublesome cables found in conventional GPS surveying systems.

The Locus System includes the Locus Processor, a complete, easy-to-use software package which handles all aspects of managing and processing Locus data. The Locus Processor yields precise positioning results in report formats that are easily understood by a surveyor. The Locus Processor is Ashtech's newest highly-automated GPS post-processing engine.

The essence of Locus is accuracy, reliability and simplicity -- simple to learn, simple to operate, and simple to produce high quality results.

Surveying with Locus

The basic principle of GPS surveying is that the distance between two or more points can be precisely calculated by simultaneously recording measurements using two or more Locus units (one set up over each point).

Typically, one Locus is located over a point with known coordinates (this is called the Base unit). The other Locus units are located over unknown points (called Rover units) and all Locus units collect data simultaneously for a period of time. After returning to the office, the data files are transferred to a PC. The data from all Locus units are processed in a project and the positions of all unknown points computed. The Locus software automates most aspects of the post-processing procedure.

Locus has two modes of operation: static and kinematic stop-and-go. In static mode, two or more Locus units are placed at the ends of the baselines

being measured and each unit collects data for a period of time (usually 15 - 60 minutes, depending on baseline length). The recorded data are processed using Locus Processor to yield a precision baseline measurement. This process is repeated for a number of lines yielding a set of baselines forming a survey network. The static mode of operation is used for control surveys and boundary surveys.

Locus also supports kinematic surveys often referred to as “stop-and-go.” In this mode, Locus moves through the survey area with a brief stop at each point. The data collected while stationary and in motion are processed together to yield a set of baseline measurements for every point where the Locus was in a fixed position. This operating mode allows for high productivity since many points may be quickly surveyed, and is useful for topographic, as-built, and other types of surveys involving a large number of points over a local region. Kinematic surveying requires purchase of optional components including a kinematic initialization kit and HP-48GX Handheld.

Key Specification Table

Table 1.1 provides key specifications for the Locus.

Table 1.1: Locus Key Specifications

Parameter	Performance
Static Accuracy	Horizontal 5mm + 1ppm, Vertical 10mm + 1ppm
Kinematic Accuracy	Horizontal 12mm + 2.5ppm, Vertical 15mm + 2.5ppm
Survey Types Supported	Static, “Stop-and-Go” Kinematic
Coordinate Systems/Datums	All major standard datums and grid systems including user-defined and local systems
Processing Baseline Length	up to 20 Kilometers
Occupation Time to Achieve Accuracy	15-60 minutes typical
Battery Type	4 C-cell or 4 D-cell
Battery Life	up to 100 hours on D-cells up to 40 hours on C-cells
Weight	2 lbs, 6 oz. (1.1kg) {with C-cells} 3 lbs, 0 oz. (1.4kg) {with D-cells}
Operating Temperature Range	-10 to +60° C
Memory Capacity	4Mb, equivalent to 95 hours of data averaging 6 satellites at a 15 second recording interval

Table 1.1: Locus Key Specifications (continued)

Parameter	Performance
Interfaces	"Cableless" via Infra-Red (IR) port
PC Software Operating System	Windows 95, Windows 98, or Windows NT 4.0
Handheld Computer Option	Handheld with Pre-Loaded Interface Software
Year 2000 Operation	Compliant

Time in the Field

In general, the amount of time required to occupy a point depends on several factors:

1. **The type of survey you are conducting.** Stationary or static surveys provide centimeter level results but requires longer periods of occupation. Kinematic surveys require occupations as short as a few seconds, but with a moderate reduction in accuracy. Kinematic stop-and-go occupations provide centimeter level results, but require careful initialization and field procedures.
2. **The baselines or distance between the base Locus and survey points**. In general, the greater this distance, the longer the occupation time.
3. **Environmental conditions**, or the amount of obstruction or canopy preventing a completely open sky view. Some obstructions may block the reception of the satellite signal, requiring longer occupation times to collect additional data for accurate processing. Too much obstruction prevents Locus (or any GPS receiver for that matter) from receiving enough data to establish quality survey positions.
4. **Satellite Geometry**: This refers to the position of the satellites that are orbiting the earth. If the satellites are positioned poorly (i.e. all on one side of the sky), it is more difficult to get an accurate position. The Mission Planning Tool in Locus Processor assist in planning survey times with optimal geometry.
5. **Time in the Field**: Factors 2, 3, and 4 are addressed by the Occupation Timer feature of Locus. The Occupation Timer takes into consideration the amount of satellites and satellite geometry, and determines when enough data has been collected for a given baseline distance.

What is Included in the Locus System?

Congratulations! You will soon be working with the finest single-frequency GPS survey system available. The Locus system is a response to your requests for an affordable, simple to operate survey grade GPS survey system.

The Locus system includes all the components you need to begin your project (Figure 1.1). With your system you should have received as a minimum the following components:

- 2 - Locus units complete with carrying case
- 8 - D-cell Batteries
- 1 - Infra-Red Communications Device for your PC (Figure 1.2)
- 1 - CD-Rom Containing the Locus Processing Software
- Complete Documentation
- Locus Configuration Guide

Figure 1.1: Locus with Carrying Case

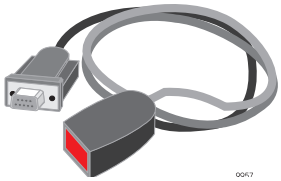

Figure 1.2: IR Communications Device (PC)

Table 1.2 lists the part number for each of these components and for optional components.

Table 1.2: Locus Components and Part Numbers

Part Number	Component
800372	Locus
200414	Extender

Table 1.2: Locus Components and Part Numbers

Part Number	Component
200552	Carrying Case
701083	Tape Measure
630208	Locus System Operation Manual
630209	Quick Reference Card
105633	IR Interface Module
107042	DB25 to DB9 Adapter
701093	Locus Processor Software Kit containing CD-Rom and User's Guide

Where to Find Information

This manual is designed to guide you through the Locus instrument operation procedures as well as provide general reference. In addition to this manual, there are several other forms of documentation serving as supporting documents.

- **Quick Reference Card:** This card details information displayed in the LEDs and provides general information on operation and set-up. This card is intended to accompany the Locus into the field.
- **Locus Processor Tutorial:** This is a walk-through example of the operation of the Locus Processor software. This tutorial in the Locus Processor User's Guide has been designed to provide the user with the information required to successfully run the Locus Processor.
- **On-line Help:** The help system designed into the Locus Processor provides you with answers to questions while operating the software. The help system is accessible at any point in the Locus Processor.
- **Locus Operation Video:** This video walks you through the complete process of conducting a survey with Locus. From setting up in the field data collection and preparing for processing, this video is an excellent introduction to the Locus Survey System.

Obtaining Technical Assistance

The developers of Locus recommend that you begin by consulting Appendix A, **Troubleshooting**. The Troubleshooting section addresses the

difficulties encountered by GPS surveyors and those unfamiliar with the Locus product. If you require further assistance, please contact our highly trained technical support team.

Technical Support

Ashtech Precision Products is committed to providing top technical support and service to our customers worldwide. One of the best ways to do this is to make it as easy as possible for you to get in touch with us. That's why there are now more ways than ever to contact us, and more time during the day to do it. So no matter where you are or what time it is, we're there for you – that's the Ashtech advantage.

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Using Locus

Getting Started

Hardware Description

Locus consists of three parts that make up the integrated unit (Figure 2.1, Figure 2.2, and Figure 2.3).

Figure 2.1: Antenna and Electronics Compartment

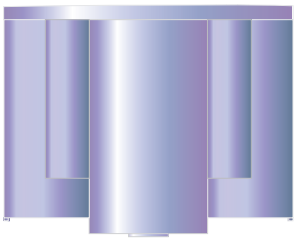


Figure 2.2: Battery Compartment

Figure 2.3: Retainer

Battery Issues

Locus can be powered by either C-cell or D-cell batteries. The battery life is up to 100 hours (50 hours for alkaline C-cells), but battery life is significantly degraded at low temperature (Figure 2.4 and Figure 2.5).

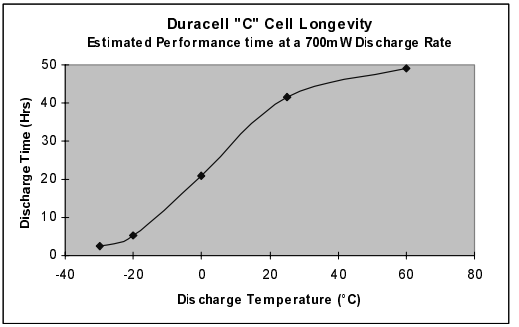


Figure 2.4: C-Cell Longevity

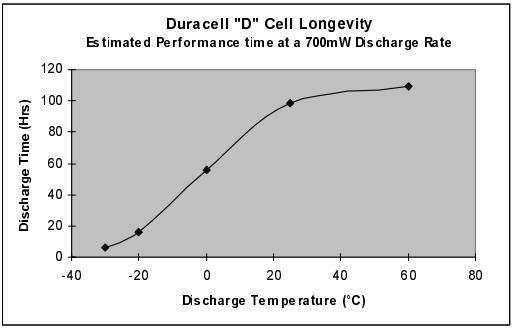


Figure 2.5: D-Cell Longevity

Rechargeable batteries may be used but lifespans differ, and they are not recommended.

Install the batteries carefully by unscrewing the retainer at the base of Locus to separate the three components.

WARNING
Use caution when unscrewing the retainer. The battery compartment and the antenna/electronics compartment are held together with spring pressure.

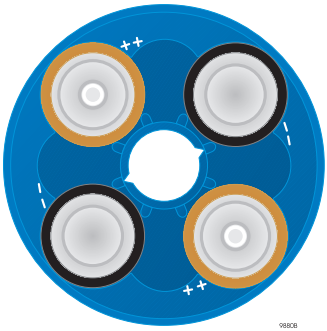


Figure 2.6: Battery Installation

Install the batteries as indicated by the + and - symbols located on the battery compartments (Figure 2.6). The + and - symbols indicate proper polarity of the batteries.

Locus Setup

Locus mounts easily on a tripod or tribrach. Once the tripod is levelled and Locus is firmly mounted, be certain to measure and record the height from the survey marker to the mark on the Extender. Record the setup information manually in field notes or digitally with the Handheld controller. **This is critical**; GPS is based on the exact position of the instrument receiving the satellite signals. Failure to accurately measure the offset between Locus and the actual point being surveyed results in significant errors.

Because of the three-dimensional nature of GPS positioning, errors in height measurements also affect horizontal accuracy.

Refer to Chapter 3, **Locus Field Procedures** for instructions for setup.

The Extender is not required for fixed height tripods or range poles.

Locus also mounts on a range pole for use when conducting a stop-and-go kinematic survey. After initializing Locus, mount it onto the range pole. Again, be certain to accurately measure and record the height. When mounted on a range pole, the instrument height is equal to the pole height plus 0.125 meters to account for the Locus body. Maintain proper levelling during measurement. If using the Kinematic Initialization Bar, be sure to add the additional height.

Locus Operation

Initial Power Up

When the Locus receiver is powered up for the first time, completely reset Locus. To fully reset Locus, press and hold down the power button for approximately 10 seconds (past the power on beeps and clearing the memory beep) until the unit beeps once more. The status panel displays a rolling red pattern. Power the receiver off and on again. After completing this sequence, allow Locus to track satellites for at least 25 minutes before powering down.

Normal Power Up

To power on Locus, depress and hold down the power button until you hear a double-beep and all the LEDs are lit green (Figure 2.7).

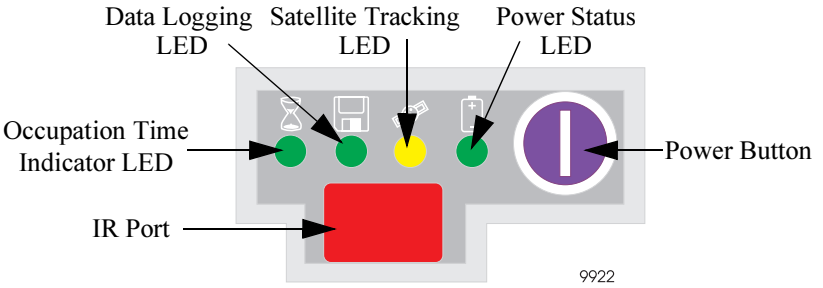


Figure 2.7: Locus Front Panel

Release the power button after the double-beep occurs. If you continue to depress the power button past the double-beep, after 4 seconds, the Memory/Data Logging LED starts blinking red and a series of short beeps occur. This warning indicates that if the button is not released within the next 2 seconds, all data files stored in memory will be erased. If the button is released within these 2 seconds, all LEDs light green indicating files were not deleted and the receiver is on.

WARNING
If the button is not released within these 2 seconds, the Memory/Data logging LED turns solid red and a continuous beep occurs for 1 second indicating all data files are being deleted from memory.

Powering Off

To power off Locus, depress and hold down the power button until the Status Panel turns off and you hear a double beep, after all LEDs flash red.

Status Panel

Once Locus powers on, it immediately searches for satellite signals, then begins tracking satellites and logging data. The Status Panel (Figure 2.7) provides all of the information necessary to successfully monitor surveys. There are four LEDs on the status screen. These LEDs emit either red or green light:

Occupation Time Indicator

The Occupation Time Indicator indicates when enough data have collected for a given baseline.

Flashing green indicates that sufficient data has been logged to accurately calculate a centimeter-level position through post-processing. Since the amount of data required for post processing depends on the length of the baseline, the LED displays a varying number of blinks to indicate sufficient data for various length baselines (see Table 2.1).

Occupation times are approximate. The algorithm takes into account the number of satellites tracked and the changing satellite geometry assuming the base receiver records continuously and has a unobstructed view of the sky. Adverse conditions such as multipath or high levels of ionospheric activity can adversely affect post-processing results. If such conditions are suspect, it is advantageous to wait longer on the point to minimize the possibility that too little data is collected.

Table 2.1: Occupation Time Indicator Display Lengths

Display	Maximum Baseline Lengths
1 blink	5 Km
2 blinks	10 Km
3 blinks	15 Km
solid	20 Km

Data Logging

The Data Logging LED indicates whether Locus is logging data into memory, and the rate.

Blinking green indicates that the receiver is logging data. The light blinks at the data recording interval (default is 10 seconds).

Blinking red indicates that the receiver is logging data but memory is low. The light continues to blink at the recording interval. When the light begins to blink red, approximately 45 minutes of storage remain in the memory at the default recording internal setting. If you turn Locus off, it will not be able to record additional data unless one or more sessions are deleted.

Solid Red indicates the memory is full, NO DATA IS LOGGED.

Satellite Tracking

The Satellite Tracking LED indicates how many satellites Locus is tracking and logging.

Flashing green indicates the number of satellites Locus is tracking and logging.

Flashing red indicates the number of satellites Locus is tracking but not logging. Satellite data may not be logged because the signal is weak, it is positioned too low in the sky or below the mask angle, or not enough time has passed to collect ephemeris.

Solid red indicates no satellites tracked.

Power Status

The Power Status LED indicates available battery power.

A solid green LED indicates that there are more than 16 hours of power at room temperature. New D-size alkaline batteries provide approximately 100 hours of operation (50 hours for C-size).

Flashing red indicates that there are between 3 and 16 hours of power left* (6 hours for C-cells).

Solid red indicates CRITICAL Power, less than 3 hours of power left* (1 hour for C-cells).

* Actual times vary based on operating temperature and battery type.

Figure 2.8 displays the front panel LED operation, also displayed on the Quick Reference Field Card.

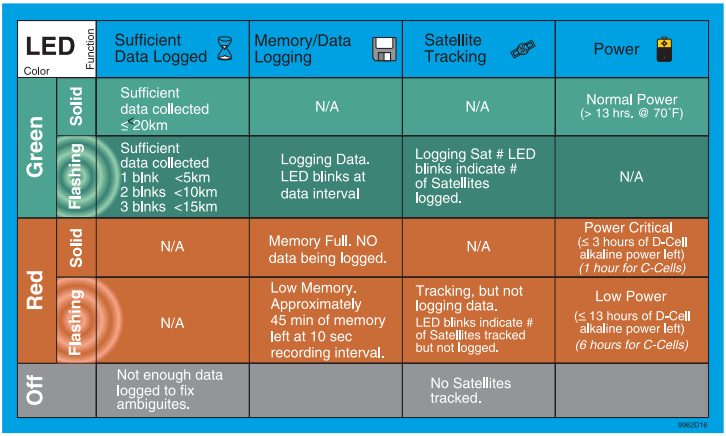


Figure 2.8: Front Panel LED Operation

Battery and Memory Usage Information

Pressing the power button momentarily displays a special sequence on the Status Panel that provides additional information about battery and memory usage.

After you touch the power button the Power Status symbol LED blinks several times indicating battery usage. The LED sequence indicates the length of time the current battery set has been in use. One blink indicates the batteries are fresh (< 25 hours usage). Two blinks indicate the batteries have been used for between 25 and 50 hours. Three blinks indicate the batteries have been used for between 50 and 75 hours, and four blinks indicats that the batteries have been used more than 75 hours. Nominal battery life is 100 hours for D-cells and 50 hours for C-cells.

Note that these times are valid for D or C-cell batteries, so for C-size batteries 3 and 4 blinks never occur.

WARNING
The battery life timer begins counting when the batteries are installed in the unit. Opening the unit after battery installation resets the timer!

Memory usage immediately follows battery usage. Memory usage indicates by the blinking of the Memory Status symbol LED. One blink indicates less than 16 blocks used (<25% of available memory). Two blinks indicate between 16 and 32 blocks used (25-50% of available memory). Three blinks indicate between 32 and 48 blocks used (50%-75% of available memory) and four blinks indicate between 48 and 62 blocks used (75%-100% of available memory).

Each time you record data with Locus a minimum of one block is used (even for short data collection period). Each session can contain more than 1 block. Locus can store up to 62 sessions (62 blocks).

Clearing File Memory in the Field

To clear the file memory in the field:

- Turn Locus OFF
- Press the Power Button and hold for approximately 6 seconds.
- Release the button when the red flashing Data Logging LED becomes solid and the beeping becomes a continuous tone.

The continuous beep and steady red Memory/Data Logging LED indicates that data files are clearing.

WARNING
The process of clearing files from memory consists of individually erasing each one of the 62 blocks of available memory. This process takes approximately 2 minutes. Data recording starts immediately after the first block is cleared, but the memory usage information is not fully updated until all blocks have cleared (approximately 2 minutes after the file deletion process begins). When the file memory has been cleared, all data that was previously stored is permanently lost.

WARNING
To clear file memory, hold the power button for 6 seconds until the Data Logging LED is solid red. DO NOT continue holding the power button down. If the power button is held down for an additional 4 seconds, Locus fully resets (including clearing the file memory) and enters the Load Firmware mode. Although this does not damage the receiver, it slows the acquisition of satellites the next time the receiver is used. To exit Load Firmware mode, hold the power button for 1 second until all of the red lights are on and Locus beeps twice.

Transferring Data to the PC

Locus Processor Software Installation

Locus Processor software must be installed on the PC in order to transfer data from the receiver or Handheld to the PC. Refer to the ***Locus Processor User's Guide*** for more information.

Installation of the Infrared (IR) device

The IR device (Figure 2.9) provides the pathway of communication from the PC to Locus, as well as to the optional Handheld data collector.

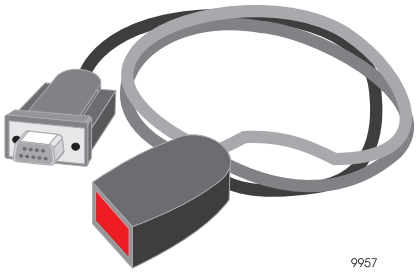


Figure 2.9: Infrared Device

The IR device connects to one of the PC's serial communication ports (COM Ports) with a standard DB9 connector. On some PCs a DB25 connector is required (a DB25 to DB9 converter has been provided in the Locus package).

After plugging the connector into the computer, use Locus Download to connect to Locus or Handheld data collector.

The Download utility in the Locus Processor software may be started a number of different ways. Refer to the *Locus Processor User's Guide* for directions.

If the PC is unable to connect to Locus through the IR device, Locus Download displays an error message (Figure 2.10).

Figure 2.10: Locus Download Warning Dialog Box

If difficulty continues, please refer to “Troubleshooting” on page A-1.

Communicating with the PC

Once Locus has successfully connected to the PC, begin downloading the data (keep in mind that several data file types are downloaded and placed on files in your computers). Place Locus within 24 inches of the IR device and position them so that the IR ports face each other. Although the IR devices can be as close as one half inch, nine inches apart is the minimum distance if both are placed flat on a table (Figure 2.11).

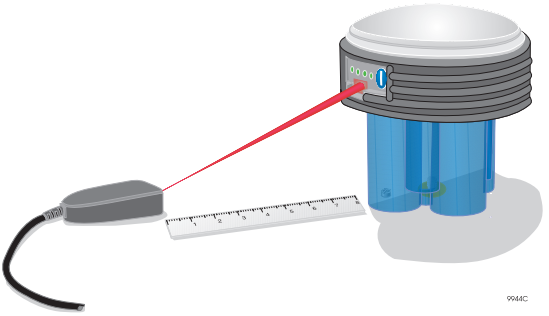


Figure 2.11: Locus Communicating via IR Device

Now that everything is in position, the following steps demonstrate the operation of transferring data to the PC:

1. Verify that a Locus is turned on, the IR device is attached to the computer, and the IR device is close to the receiver IR port (Figure 2.11).

2. Start Locus Download (Figure 2.12).

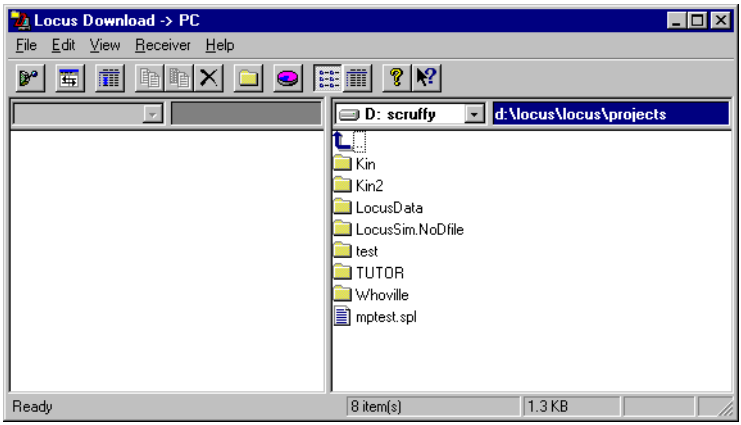


Figure 2.12: Locus Download Main Window

3. Select **Connect** from the **File** menu.
4. Verify the **COM Port** and **Baud Rate** are correct, and click **OK** to connect to the receiver.

   Although any baud rate can be selected, Locus can transfer files quicker at higher baud rates.
5. Verify that the project directory where you want the data downloaded is active in the PC-Pane of the **Locus Download** window.
6. Select the data files to download, and drag them to the PC pane. Locus Download transfers the files to the project.

   During the download process, GREEN rolling lights on the status panel of the receiver indicate a successful connection.The download process can take up to 30 minutes at 57,600 baud.
7. Upon completion, the B-files (data files) and the E-files (ephemeris) are listed in the PC pane.

   Almanac and ionosphere files may be transferred as well.
8. Choose **Switch Data Source** from the **File menu** and continue the downloading process for another Locus.

When Locus Download switches data sources or terminates, Locus Download turns off the Locus power.

9. Click the **Close** box to terminate Locus Download.

If communication between the receiver and PC interrupt during the download process, you must reconnect to the Locus and start the download process again.

Locus Handheld (Optional)

Operation of the Handheld Data Controller is based upon the synchronization of the internal clocks in both the Handheld and Locus at the beginning of the field work. By synchronizing the clocks, relevant field information (i.e. Site ID) can be entered into the Handheld and stored while Locus is occupying a specific point. Throughout the course of the fieldwork, all data are logged and time-tagged. At the end of the field work transfer the data from the Handheld to the Locus Processor and incorporate the data with the GPS data from Locus. During this process, the time tags from the Handheld are matched up with the time tags in the GPS data. This ensures that the field data (i.e. site ID) matches with the final coordinates.

By using this synchronization technique, the Handheld only needs to communicate with the receiver at the beginning of the survey. However, the Locus Handheld has been designed to communicate with Locus in the field to display additional data such as satellite status and receiver parameters such as the current recording interval.

Locus Handheld Kit

The Locus Handheld Kit consist of the following:

- Locus Handheld (HP-48GX)
- Locus Handheld Program Card
- Environmental Pouch for the Handheld.

Battery Issues

The Locus Handheld requires three AAA alkaline batteries. Refer to the HP Manual for battery installation.

Installing the Locus ROM Program Card

The Locus Handheld software is on a ROM program card (Figure 2.13).

Figure 2.13: Locus Handheld ROM Card

The Locus Handheld has two ROM card slots to accommodate two program cards. Use Slot 2 for the Locus Software ROM card. The Locus Software ROM card needs to be installed if you plan to use the Handheld for entering site names in static mode or if you plan to conduct kinematic surveys.

Installing the ROM card:

1. Switch to HOME directory by pressing ↱ and HOME key.
2. Turn off the Handheld.
3. Remove the card component cover as described in the HP manual.
4. Insert the Locus Software ROM card in slot 2 (Figure 2.14).

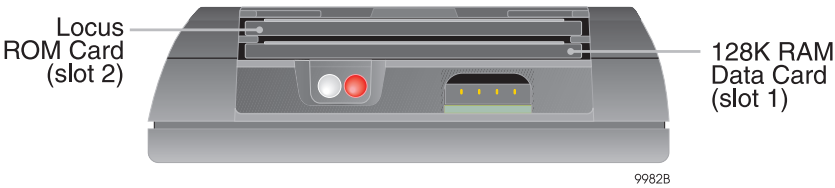


Figure 2.14: Inserting ROM Card Into Slot 2

5. Replace the card component cover.
6. After the Locus ROM card has been installed, power the unit ON, press the α key twice, type **LOCUS** and press **ENTER**. The Locus Handheld software starts.

Installing a 128K RAM Data Card

If you have an additional 128 KByte RAM card, you can use it to increase your Handheld memory and log more points into a D-file.

1. Switch to HOME directory by pressing ↱ and HOME key.
2. Turn off the Handheld.
3. Remove the card component cover as described in the HP manual.
4. Insert the Locus Software ROM card in slot 1 (Figure 2.14).
5. Replace the card component cover.
6. Turn the Handheld back on and press the ↱ key, **LIBRARY** key and **D** (**MERG**) key to completes the process of installing the additional card.

Communicating with Locus

The Handheld communicates with Locus via IR communication.

After the Locus ROM card has been installed, power the unit on, press the α key twice, type **LOCUS** and press **ENTER** to start the Locus Handheld application.

1. When you are ready to communicate, hold the IR ports of Locus and the Handheld **no more than four inches** apart and facing each other (Figure 2.15).

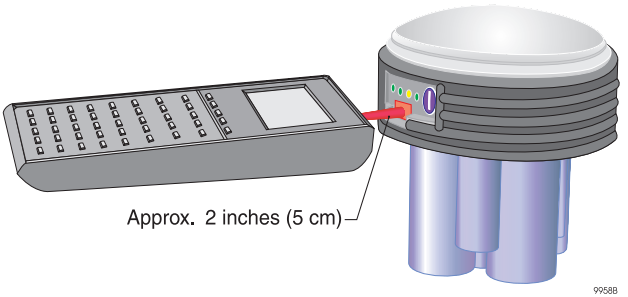


Figure 2.15: Locus and Handheld IR Ports

2. Issue the appropriate command from the Handheld by using the keypad.
3. When successful communication has occurred, Locus emits three short beeps.

4. The Handheld screen confirms successful communication with Locus.
5. If communication fails the Handheld emits one long beep. Repeat the procedures with the Handheld better positioned with Locus.
6. If difficulty persists, consult Appendix A, **Troubleshooting**.

Downloading Files from the Handheld

Although you can directly download a D-file to a PC, commonly data files are loaded directly into a Locus Processor project file. To download files directly to the PC:

1. Ensure the IR device is connected to a COM port and Locus Processor has been installed on your PC.
2. When you are ready to download files from the Handheld to the PC, place the IR ports of the Handheld and the IR device no more than four inches apart (Figure 2.16).

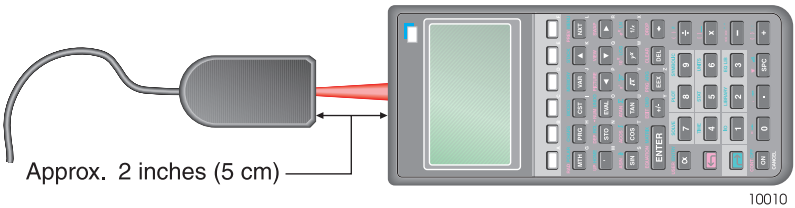


Figure 2.16: Handheld and IR Device Alignment

3. From the Main Menu, press the E (**DNLD**) key on the Handheld.
4. Press the **B** (**STRT**) key on the Handheld to start the download process.
5. The Handheld screen displays the message “Processing Logged Data” indicating the D-file data is being prepared for the download process.

   If this D-file has been previously processed but not downloaded, this step does not repeat. Processing the D-file data before download (step 5) requires approximately 30 to 35 seconds per Kbyte.
6. After the “Processing Logged Data” process is completed, the Handheld displays an instructional message.

Although the Handheld indicates that downloading is in process, downloading of files does not actually occur until Locus Download initiates the process.

7. Start Locus Download on the PC.
8. Select **Connect** from the **File** menu.
9. Select the COM port the IR device is connected.
10. Select 2400 as the baud rate.

    2400 baud is the only rate the HP-48GX can communicate with the PC via the IR port. If you select a different baud rate, Locus Download automatically reverts to 2400 baud upon detecting the HP-48GX.
11. Click **OK** to connect to the Handheld.
12. Locus Download indicates communications with the Handheld.

    If communication fails, repeat the procedures with the Handheld better positioned with the IR device.
13. Highlight D-file in the Handheld pane.
14. Select **Copy to** from the **Edit** menu to not delete the D-file in the HP after download, or **Move** to from the **Edit** menu to delete the D-file from the Handheld after download.
15. Once the file has been copied from the Handheld, the Handheld beeps.
16. Exit Locus Download.
17. Inspect the Handheld for messages. If you choose the **Copy to** option on the PC, you can now delete the D-file from the Handheld. Press **Yes** if you want to delete the D-file.

It is strongly recommended to delete the D-file from the Handheld before starting a new survey session. The Handheld software keeps only one D-file in memory and all new survey points are appended to an existing D-file.

3

Locus Field Procedures

GPS Survey Planning

Before conducting a survey with Locus, visit the site to assess whether the area is suitable for GPS surveying. GPS surveying relies on signals emitted from satellites located across the sky. For this reason, it is important that the survey sites have clear visibility in all directions. Buildings and heavy foliage will block GPS signals and limit the ability of Locus to collect sufficient data. With limited visibility, a GPS survey may still be possible but extra time at each point is required and you may have to conduct the survey at a particular time of the day. Mission Planning, part of the Locus Processor Software, predicts the success of a survey based on satellite information entered and obstruction information.

Setting up Locus

Locus mounts easily on either a fixed height tripod, or standard tripod with tribrach. Once a tripod is correctly positioned over the point and levelled, mount Locus to the tripod. Be certain to document the site ID and other factors (time, date, conditions, etc.) in your field notes.

Measuring Antenna Height

All data collected by Locus is referenced to the GPS antenna located in the top portion of Locus. Therefore it is critical that the height of Locus be accurately measured and recorded. This height is referred to as antenna height, Height of Instrument (HI), or Vertical Offset. Failure to accurately measure the height of Locus from the actual survey marker point results in a 3-dimensional error in position.

When measuring the height, use the Extender that mounts on the top of Locus. From the notch on the edge of the Extender, use the tape measure (Figure 3.1) to measure the distance to the survey mark at ground level (Figure 3.2). Be sure to note if you are measuring slant height or a straight

height. If you measure a slant height, the Locus antenna radius automatically logs.

Figure 3.1: Tape Measure

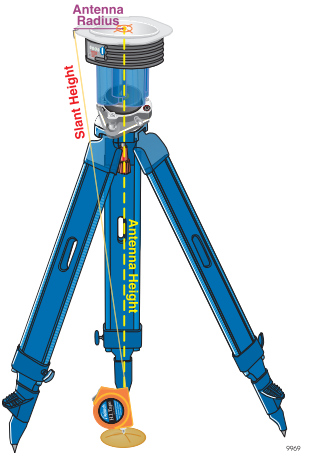


Figure 3.2: Tape Measure In Use

If you are using a true vertical measurement, set the Slant field to zero, and enter the vertical height in the Vertical field. When measuring the true

vertical, be sure to include the 0.125 meter offset created by the Locus case (Figure 3.3).

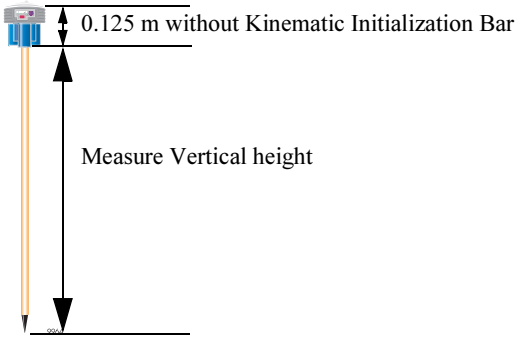


Figure 3.3: Locus on Range Pole

Record the antenna height measurements and site ID for each point observed in the field. This information is required to accurately post-process the data.

Stationary Survey (Static Survey)

Locus has two modes of operations, static and kinematic stop-and-go. In static mode, two or more Locus units are placed on each end of the baselines being measured and each unit collects data for a period of time (usually 15 - 60 minutes). The recorded data is processed using Locus Processor to yield a precision baseline measurement. This process is repeated for a number of lines yielding a set of baselines forming a survey network. The static mode of operation is used for control surveys, boundary surveys, and other applications where Locus can be left on a point while data is collected.

Static surveys provide the highest level of reliability and accuracy because of the large amount of data collected at each point. To assist in determining the occupation time required at each point, Locus has an Occupation Time Indicator LED which blinks to indicate when sufficient data has collected for a given baseline length. See “Occupation Time Indicator” on page 13 for more information.

Field Procedures for Static Survey

Data collection begins as soon as Locus turns on and a sufficient number of satellites acquired. In practice, no interaction with a Locus is required for static surveys. When Locus is turned on, it automatically:

- searches and locks on all satellites available
- makes GPS measurements and computes its position
- opens a file and saves all data into this file

Performing a static survey is very simple. The following steps are required.

1. Set up and level a Locus over a survey mark.
2. Power on Locus.
3. Ensure that the Satellite Tracking LED and Data Logging LED flash green, indicating Locus is tracking satellites and data is being logged into memory.
4. Measure and record antenna height.
5. Record Site ID.
6. The Occupation Timer blinks on the status panel to indicate that sufficient data have collected.
7. Turn off Locus.
8. Proceed to next survey point.

It is very important to keep accurate notes during the survey. You must record the site ID, approximate occupation time, and antenna height of each point either in the Handheld, or on paper. This information is required in Locus Processor to process the data. A suggested GPS Field Observation Log Sheet is presented in Figure 3.4. An electronic copy to print and use is accessible by selecting **Field Log Template** from the **Tools** menu in Locus Processor.

LOCUS FIELD OBSERVATION LOG

PROJECT NAME:	SITE ID: _____ SITE NAME: _____
PROJECT LOCATION:	SITE TYPE: HORZ. CNTRL / VERT. CNTRL / NEW / REOCCUPATION
CLIENT NAME:	RECEIVER ID: _____ RECEIVER SESSION #: _____ HANDHELD USED: YES / NO HANDHELD ID: _____
DATE:	ANTENNA HEIGHT PARAMETERS
OBSERVER'S NAME:	SLANT H.I. START: _____ m / _____ ft; SLANT H.I. END: _____ m / _____ ft; VERT. OFFSET: _____ m / _____ ft; ANT. RADIUS: _____ m / _____ ft

OBSERVATION TIMES AND STATUS

	OBS. TIMER	MEMORY	SATELLITES	POWER
START: _____AM / PM	NA	FLSH GRN / FLSH RED / RED	___ GRN, ___ RED	GRN / FLSH RED / RED
END: _____AM / PM	1 / 2 / 3 / SOLID / NA	FLSH GRN / FLSH RED / RED	___ GRN, ___ RED	GRN / FLSH RED / RED

ALERTS:

SITE SKETCH & NOTES:

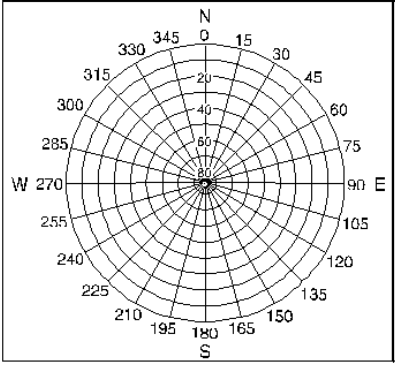
OBSTRUCTION DIAGRAM	MONUMENT RUBBING / DESCRIPTION
	

Figure 3.4: Suggested Worksheet for Recording Survey Data

Using the Handheld for Static Surveying

The Handheld provides the ability to electronically "tag" the site ID, antenna height, and occupation time for each point. This information automatically merges with Locus data when the Handheld information is downloaded into

the Locus Processor. Electronically recording site information is very helpful when dealing with a large number of points.

The following procedure describes how to use the Handheld to tag survey field data.

The Handheld software is used to:

- monitor the progress of the survey
- change parameters if the defaults are not acceptable
- enter pertinent information needed during data processing

Following is the general procedure for conducting a static survey.

1. Turn on Locus. After a few seconds Locus will begin collecting data, as indicated by the satellite LED flashing green.
2. Turn on the Handheld.
3. Press the α key two times. An α should appear at the top center of the screen.
4. Key in **LOCUS** and press **ENTER**. The logo screen appears.
5. Press any key to open the Main Menu.
6. With the IR port of the Handheld positioned level with and within four of the IR port of Locus, press the G (SYNCHRONIZATION) key on the Handheld and then the **B** key. After about 10 seconds the Handheld displays **Synchronization Completed Successfully**. This means that the Handheld clock is synchronized with Locus clock. The Handheld can now be removed from proximity to Locus.
7. Press the **A** (**MAIN**) key on the Handheld to return to the Main Menu.
8. Set up a pole or tripod over the point to be surveyed.
9. Place Locus on the pole or tripod. Locus is now collecting position data for the survey point.
10. Press the **K** (**STATIC SITE LOGGER**) key on the Handheld, opening the Static Site Editor screen.

11. In order to enter alphanumeric data like SITE ID:
    - press **A** (**EDIT**)
    - move cursor using the left and right arrow keys to position the cursor over the characters you want to delete. Press the **Del** key to delete.
    - if you have an empty field (“ ” only) move the cursor to the second ”
    - for typing letters press the α key two times and then enter the letters. Press the α key once to cancel the character mode.
    - press **F** (**OK**) to accept the edited alphanumeric data
12. Key in the Site ID and the antenna height parameters.
13. Press **F** (**OK**) to log the entered data. This action starts the site data collection, and Locus must not be moved while collection is in progress.
14. As Locus collects data, the Occupation Time Indicator LED blinks green indicating sufficient data has been collected to accurately compute a solution. The number of blinks indicates sufficient data for various baseline lengths. Refer to Table 2.1 for display information.
15. Turn off Locus.
16. Move to the next site and turn on Locus.
17. Repeat steps 8 through 16.
18. Continue until all sites have been surveyed.
19. Turn off Locus after surveying the last site.
20. The Locus data (B- and E-files) and Handheld data (D-file) must now be transferred to a PC in the office, as described in the *Locus Processor User’s Guide*.

Static Survey Example

This section describes how to conduct a control survey of monuments A, B, and C (coordinates for C are known). First, understand that the Locus system is critically dependent on time. For a two-unit system to produce usable data, those units have to collect data simultaneously, over the same period of time. This time period is referred to as a session.

To survey the distance or baseline between points A and C, begin by setting up a Locus over each point, and turn them on to collect data. Locus indicates when enough data is collected for the approximated base line distance. After

adequate data has been collected, you can turn both units off. The key point is that **both** Locus units collected data over the same period of time. To attain the baseline between points B and C, move Locus from point A and place it over point B. Turn on Locus units. To start the second session, turn both units on. Again, the units indicate when sufficient data have collected and both can be turned off.

For best results, this survey can be transformed from two baselines into a network by incorporating additional known points and tying them into the project. This is accomplished in the same manner as point C was utilized as the control point in the example above.

Over the course of this survey, it is important to keep good field notes, tracking the start and finish times of each session, the height of the units located over each point, field conditions, and other facts significant to your project. Much of this information can also be logged into the optional Handheld.

When all data have been collected in the field, download the data to a PC utilizing the IR communication device (refer to "Communicating with the PC" on page 18). Use the Locus Processor software to calculate positions and adjust the network. After adjustment, the coordinates of the surveyed points are available in your choice of formats and coordinate systems.

Stop-and-Go Kinematic Surveys

Stop-and-Go Kinematic survey applications include topographical, as-built, and other less rigorous surveys. The main advantage of the stop-and go kinematic is that occupation times can be as short as two recording intervals. Therefore, this approach allows surveyors to collect many points throughout the course of the fieldwork.

The Handheld is required for stop-and-go kinematic surveys.

The similarities between the kinematic and the static survey are in the early stages of the set-up. You are still required to establish a Base unit, set up over a known point. The antenna height measurements and site IDs need to be recorded. However with the kinematic setup, the Rover Locus is likely to be mounted on the kinematic range pole for easy travel (Figure 3.3).

Key considerations for the stop-and-go kinematic survey are environmental factors. Unlike static surveys where Locus is turned off between points, once the kinematic survey begins, Locus MUST MAINTAIN CONTACT with the satellite signals throughout the entire course of the survey session. Therefore, in environments where there is not a clear sky view, the use of the kinematic approach may be limited.

Kinematic Initialization

A unique aspect of the stop-and-go kinematic survey is that Locus must begin the survey after first remaining in a fixed position for several minutes. This is referred to as initialization. To consistently perform the initialization, the kinematic kit includes the Kinematic Initialization Bar (Figure 3.5).

Figure 3.5: Kinematic Initialization Bar

The Kinematic Initialization Bar attaches to the tripod or tribrach of the Base Locus when setting up. At the other end of this short bar is an attachment for the Rover Locus (Figure 3.6).

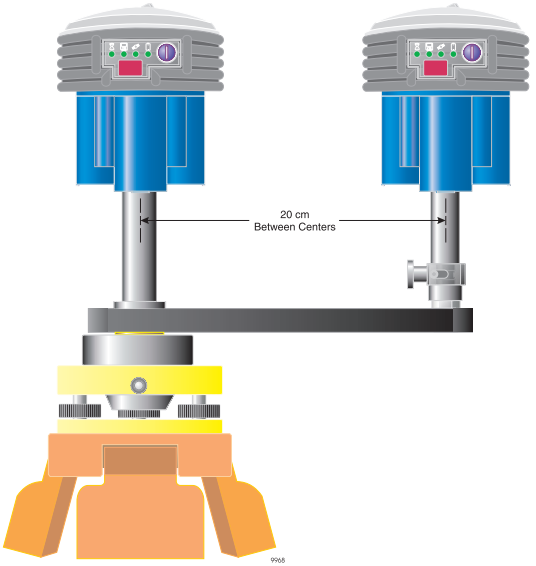


Figure 3.6: Two Units on Initialization Bar

At the start of the survey, set up the base Locus over the known survey mark with the initialization bar attached to the tripod. Make necessary height measurements and record. Attach the Rover Locus to the initialization bar (the height will be the same as the Base Locus). Turn the power on both Locus units. After five minutes, detach the Rover Locus, without turning it off, and attach it to the kinematic pole.

Locus must maintain contact with satellite signals in order for position data to be valid

Measure and record the vertical height. The Rover Locus can now be moved from one unknown point to another. Information must be logged about each point occupied and the time of the occupation noted in the Handheld. Because this is a kinematic survey, the occupation times for each point need only be at least two recording intervals. It is critical that both Locus units maintain tracking satellites throughout the survey.

Recording interval is the rate at which Locus records GPS data. The default value is 10 seconds (for kinematic surveys, 2-5 seconds is recommended).

When moving from one point to another, be certain to indicate the new positions in Locus Handheld by entering site IDs in the Kinematic Site Logger screen.

Performing Kinematic Stop-and-Go Surveys

Base Locus

1. Set up and level the tripod used for the Locus base.
2. Thread the Locus base to the fixed side of the kinematic initialization bar.
3. Attach the Locus base and the initialization bar to the tripod and then power up the unit.
4. Measure and record the antenna height of the base set-up.
5. Turn the Locus Handheld on and press the α key twice, this is the alpha-lock.
6. Key in the text **LOCUS** and press the enter key. The Locus Handheld software starts.
7. Press any key to go to the Main Menu.
8. Press the **G** (**SYNCHRONIZATION**) key on the Locus Handheld
9. Align the IR port of the Handheld unit no more than four inches from the IR port of Locus, and press the **B** key.

   After about 10 seconds the Handheld emits three beeps.
10. Check the Handheld screen to verify that the communication was successful. A successful synchronization should result in the display of the parameters currently set in Locus. If the communication failed, repeat this step until the text "Synchronization Completed Successfully" appears on the Handheld screen.
11. After completing synchronization, the Handheld is ready to accept commands associated with the base Locus. If the current parameters of the base Locus are not the ones intended for the kinematic survey, press the **MAIN** key, then the **PGUP** key and press **M** for Locus set up. Recording intervals from 2-5 seconds are recommended for kinematic operation. If you choose to edit the values, be sure to transmit them to Locus by following the menu prompts.

12. After recording parameters have been set accordingly in the base Locus, press the **A** (**MAIN**) key, and then the **K** key to enter the Static Site Logger screen.
13. Enter the site ID and the antenna Vertical Offset or slant height from the survey mark using the (**EDIT**) function.

Rover Locus

1. Thread the Locus being used as a kinematic rover to the quick-release extension of the kinematic initialization bar. Attach the quick release extension and the rover Locus to the initialization bar already mounted on the tripod and power the unit on.
2. After the rover unit is on the initialization bar, powered up and recording data, synchronize the Locus Handheld to the rover Locus as follows:
3. Press the **G** (**SYNCHRONIZATION**) key on the Locus Handheld.
4. Align the IR port of the Handheld unit no more that four inches from the IR port of Locus. Press the **B** key to begin synchronization between the Locus Handheld unit and the Locus rover. After about 10 seconds the Handheld emits a series of beeps.
5. Check the Handheld screen to verify that the communication was successful. A successful synchronization should result in the display of the parameters currently set in Locus. If the communication failed, repeat this step until the text "Synchronization Completed Successfully" appears on the Handheld screen. After synchronization has been completed, the Handheld is ready to accept commands associated with the rover Locus.
6. If the current parameters of the rover Locus are not the ones intended for the kinematic survey, press the **A** (**MAIN**) key, then the **M** key for Receiver Setup screen.

   The Kinematic Warning field should always be set to **ON** when performing a kinematic survey. Be sure to set the recording interval to the same one that is set in the base Locus. Transmit parameters which have been edited to the rover Locus by following the menu prompts.
7. After recording parameters have been set accordingly in the rover Locus, press the **A** (**MAIN**) key, and then the **L** key to enter the Kinematic Site Logger screen.
8. Enter the Site ID and the antenna Vertical Offset or slant height from the survey mark using the **EDIT** function. Be sure to enter

the same antenna offset as was entered for the base Locus as long as both units are on the Kinematic Initialization Bar.

9. Set the **INI?:** field of the Kinematic Site Editor to **Y** to alert the Locus Processor that the rover Locus is mounted on the Kinematic Initialization Bar.
10. Set the "Time on Site" if you want to occupy a point for more than 300 seconds. Press the **OK** key and then press the **STRT** key to begin the observation.
11. The Logging Status screen automatically appears showing the progress of the occupation. When the message "Site Logged" appears in the Logging Status screen the initialization is complete. Press the **OK** key.
12. Being careful to maintain satellite lock, transfer the Rover Locus with the quick release extension to the kinematic range pole (Figure 3.7) and measure and record the antenna height of the rover setup. Press the **EDIT** key of the Kinematic Site Logger screen.

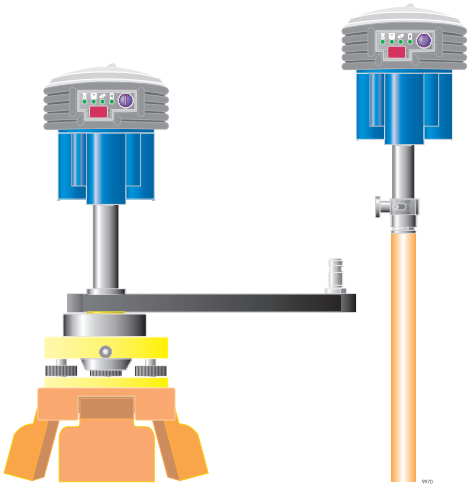


Figure 3.7: Rover From Initialization Bar to Range Pole

13. Level the kinematic range pole and Locus over the new point to be surveyed.
14. Set the Site ID of the point to be surveyed using the "Kinematic Site Editor."

15. Set the "Time on Site" to a minimum of two full recording intervals (in seconds). Press the **OK** key and then press the **STRT** key to begin the observation.
16. When the observation is finished press the **OK** key.
17. While keeping satellite lock at all times, continue steps 13-16 until all sites have been surveyed.
18. Turn off Locus after the last site is surveyed.
19. The Locus data (B & E-files) and the Locus Handheld data (D-file) can now be transferred to a PC, as described in the *Locus Processor User's Guide*.

Kinematic Alarm

As mentioned above, once the kinematic survey has begun, Locus MUST remain keep a line-of-sight to the satellite signals throughout the course of the survey session. If any units cannot maintain continuous lock with at least five satellite signals, the kinematic alarm sounds. The kinematic alarm indicates loss of satellite signals and you must re-initialize the survey. The data collected up to the point of the alarm is usable. To continue the survey, re-initialize before you can accurately survey more points. Environments where there is not a clear sky view, such as heavily forested areas, the use of the kinematic approach may be limited.

To re-initialize Locus:

1. Go back to a previously surveyed point.
2. Re-enter the site ID for that point into the Handheld.
3. Wait five minutes
4. Continue surveying

Locus Handheld for Kinematic Surveys

Getting Started

With the memory card installed, start the Handheld software:

1. Turn on the Handheld by pressing the **ON** key. The opening screen appears (Figure 3.8).

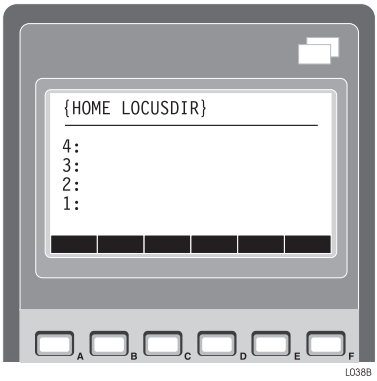


Figure 3.8: Opening Screen

2. Press the α key two times, and verify that α appears near the top center of the display. The Handheld is now in the Character Mode, allowing you to enter alphabetical characters from the keyboard. In the character mode, 26 of the keys can be used to enter the alphabetical characters that appear at the lower right corner of the keys.
3. Key in **LOCUS** (Figure 3.9).

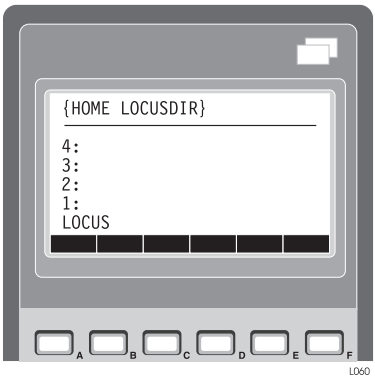


Figure 3.9: Key in LOCUS

4. Press **ENTER**. The logo screen appears (Figure 3.10).

Figure 3.10: Logo Screen

5. Press any key to go to the Main Menu, or wait a few seconds and the Main Menu appears (Figure 3.11).

   On the Handheld panel, note the six function keys labeled **A** through **F**. These six function keys are almost directly below six black rectangles spread across the bottom of the display. The function keys are linked to the rectangles on the screen, and initiate the action indicated by the mnemonic that appears in the corresponding rectangle. As you use the software, various mnemonics will appear in these rectangles. The mnemonics indicate what operations you can control in each mode.

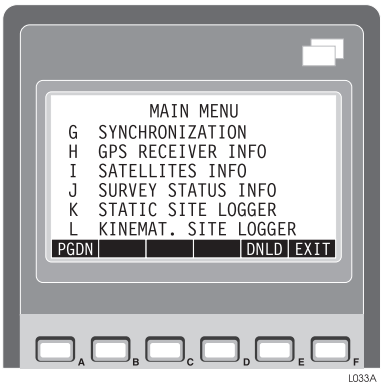


Figure 3.11: Page 1 of Main Menu

Use the Main Menu to call other menus that control the various operations you need to do. Some of these menus are:

G - SYNCHRONIZATION - press the **G** key to call the Synchronization Menu

H - GPS RECEIVER INFO - press the **H** key to call the GPS RECEIVER Info Menu

I - SATELLITE INFO -Press the **I** key to call the Satellite Info screen

and so on. At the bottom of the Main Menu are three mnemonics: **PGDN** (page down), **DNLD** (download), and **EXIT**. Notice that **PGDN** is directly above the **A** key. Press the **A** key to call page 2 of the Main Menu (Figure 3.12) with additional selections.

Figure 3.12: Page 2 of Main Menu

Notice that the **PGDN** button on the screen has changed to **PGUP** (page up).

6. Press the **A** (**PGUP**) key to return to page 1 of the Main Menu.

All functions from G to P are active on both pages of the Main Menu.

Handheld Setup

Three parameters may be defined before using the Handheld to change the default values:

- Units - Units of antenna measurement in feet (FT), meters (M) or international feet (IFT)
- Time format - 12 or 24 hour
- Minutes to obsolete data - The elapsed time when data are considered valid; data collected prior to the specified interval is not displayed. For example, if from the Main Menu, the **I** and then the **B** keys are pressed to obtain satellite information from Locus, this information will be available in the Handheld for up to the "MINS TO OBS DATA" time (10 minutes by default). If within the "MINS TO OBS DATA" time after the **I** and **B** keys were pressed, the **I** key is pressed again, the previously requested satellite information displays. If the **I** key is pressed after the "MINS TO OBS DATA" time has expired, the screen displays a message indicating information is not available and needs to be obtained again by pressing the **B** key.

To set these parameters, press P (HANDHELD SETUP) in the Main Menu. The Handheld Setup screen appears (Figure 3.13).

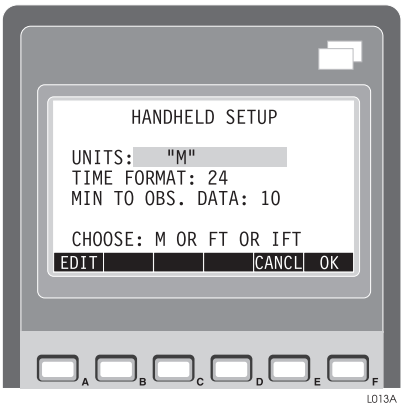


Figure 3.13: Handheld Setup Screen

1. The **UNITS** measurement parameter is in meters, feet, or international feet; the default is meters (M), as shown on the display. If you want to use the default, meters, press the down arrow ▼ key to move the active field down one line, and go to step

7. If you want to use feet (FT) or international feet (IFT), press the A (EDIT) key. An M enclosed in quotes appears at the lower left corner of the screen. Note that the cursor occupies the same space as the left quote.

2. Press the right arrow key ▶ one time to move the cursor one place to the right.
3. Press the **DEL** key once to delete the M.
4. Press the α key two times and verify that a small α appears near the top center of the screen. The Handheld is now in Character Mode.
5. Key in the measurement units you want to use: F and T for feet, or I, F, and T for international feet.
6. After keying in the desired characters, press the α key to disable the Character Mode, and press the **ENTER** key to save the change. The active field shifts down one line to **TIME FORMAT**.
7. The default time format is 24. If you want to use the default 24, press the down arrow and go to step10. If you want to change **TIME FORMAT** to 12 hour, press the **A** (**EDIT**) key. A 24 appears in the lower left corner of the display.
8. Press the **DEL** key twice to remove the 24.
9. Key in **12** and press **ENTER** or **F (OK)**. Note that, since you are keying in numbers, not letters, you do not need to press the α key.
10. The active field drops one line to MIN TO OBS. DATA, and the display asks you to enter a number for the minutes to obsolete data. The default is 10. If you want to use the default, press **F (OK)** to return to the Main Menu. If you want to change the default, press the **A (EDIT)** key.
11. A 10 appears in the lower left corner of the display.
12. Press **DEL** twice to remove the 10.
13. Key in the numbers you want to use, and press **ENTER** or **F (OK)** to save the change.
14. Press the **F** (**OK**) key to accept the changes and return to the Main Menu or press the **E** (**CANCL**) key to return to the Main Menu, without any changes (all three parameters remain as they were before you entered this screen).

Synchronization

In synchronization, the Handheld queries Locus to determine Locus serial number, receiver parameters and synchronize its internal clock with the Locus clock. This information is crucial for accurate results, and is required

later when the Processor software correlates a D-file in the Handheld with B- and E-files in Locus. Knowing the Locus serial number, the Processor software can determine which Locus recorded the data. Before synchronizing, make sure Locus is on and receiving satellite data; this is indicated by the blinking green satellite LED on the Locus control panel. You must synchronize the Handheld before starting to log data. Synchronization data are valid for **8 hours** (full working day), but you must synchronize the Handheld each time you switch to a different Locus, so the Handheld can obtain the serial number of the new Locus.

WARNING
The Locus Handheld software uses the internal clock of the Handheld. If the system time of the Handheld changes, the Handheld is no longer in sync with the Locus time. If this occurs, resynchronize the Handheld.

1. With the Main Menu displayed (Figure 3.11), press the **G** (**SYNCHRONIZATION**) key to call the Synchronization opening screen (Figure 3.14).

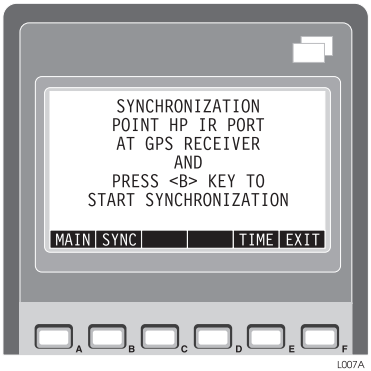


Figure 3.14: Synchronization Opening Screen

2. Hold the Handheld IR port no more than four inches from the Locus IR port, and press the **B** (**SYNC**) key. Hold the Handheld in position.

3. After 10-15 seconds, the Synchronization Completed Successfully screen appears (Figure 3.15).

Figure 3.15: Synchronization Completed Successfully Screen

If the receiver was not tracking satellites when synchronization took place, the Synchronization Failed/Data Not Available screen appears (Figure 3.16).

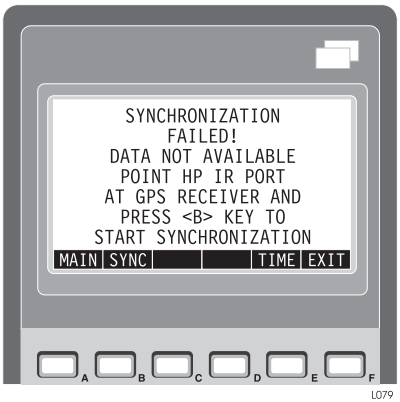


Figure 3.16: Synchronization Failed/Data Not Available

If synchronization failed, because of date transmission error, the Synchronization Failed screen appears (Figure 3.17).

Figure 3.17: Synchronization Failed Screen

If synchronization failed, try placing the Handheld IR port closer to the Locus IR port, then press the **B** key to restart. Otherwise, proceed to the next step.

4. If the Handheld program detects a new Locus, the following message appears (Figure 3.18).

Figure 3.18: New Receiver Warning

If this screen appears, press the **C** (**MORE**) key for more information (Figure 3.19).

Figure 3.19: Serial Numbers INFO Screen

The Old Receiver's Ser.# is the serial number of the last-used Locus. The New Receiver's Ser.# is the serial number of the Locus currently being used. The Handheld uses these serial numbers to correlate data with the Locus that recorded the data.

The Warning: New Receiver Detected message and the **MORE** function are also available on the Locus Info and Survey Status Info screens if a new Locus serial number is detected.

The **MORE** button and function is available until static or kinematic data are logged into the D-file using the Kinematic or Static Site Logger functions. At that point, the program assumes that units were switched intentionally and the old/new receiver information are not available anymore

5. Press the **F** (**RTRN**) key to return to the Synchronization screen.

6. Press the **E** (**TIME**) key to check how long ago the data were obtained. The Time screen appears (Figure 3.20).

Figure 3.20: Time Screen

7. Press the **F** (**RTRN**) key to return to the Synchronization Screen.

   The Time function is not unique to the Synchronization screen. You can find it also in Receiver Info, Survey Status Info, Satellite Info, Receiver Setup, and Files Info functions. Time displayed on the Time screen refers to the age of data related to one of the above functions.

Receiver Setup

The default recording interval for Locus is 10 seconds. The default for kinematic warning is off. After successful synchronization the current receiver values for the above parameters are displayed on the Synchronization screen. To change one or both of these values:

1. Press the **M** (**RECEIVER SETUP**) key on the Main Menu. The Receiver Setup screen appears (Figure 3.21).

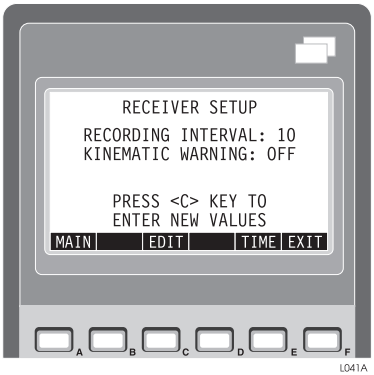


Figure 3.21: Receiver Setup Screen

This screen displays the recording interval and kinematic warning values currently set in the receiver (as of the last synchronization, or the last time the settings were changed using this Locus Setup function).

2. To enter new values, press the **C** (**EDIT**) key. The Receiver Setup Editor screen appears (Figure 3.22)

Figure 3.22: Receiver Setup Editor Screen

3. To edit the recording interval, with the NEW REC INT: field highlighted, press the **A** (**EDIT**) key. If you do not want to edit this

field use the down arrow key to move the cursor to the kinematic warning flag field and go to step 7.

4. Press **DEL** as many times as necessary to erase the current value.
5. Key in the desired value in the editable field. Valid values are from 2 to 999 seconds.
6. Press **ENTER** or the **F** (**OK**) key to accept the value.
7. To edit the kinematic warning flag, with the NEW KIN WARN. field highlighted, press the **A** (**EDIT**) key. If you do not want to edit this field, go to step 11.
8. Using the right arrow, move the cursor to the second **"** mark.
9. Press the α key two times.
10. Type **ON** or **OFF** and press **ENTER** to accept the value.
11. Press **F** (**OK**) to save the edited values and return to the Receiver Setup screen, or press **E** (**CANCL**) to cancel editing and return to the Receiver Setup screen.

    After you edit the parameters, a screen similar to Figure 3.23 displays.

Figure 3.23: Edited Locus Parameters

If one of the parameters was not edited, the NEW field associated with that parameter is empty. If old values are not available, the N/A indicator displays.

With the Handheld IR port pointing towards the Locus IR port, press the **B** (**SEND**) key. After a few seconds one of the following screens is displayed.

When the receiver gets the correct message it beeps once.

If the transfer is successful, a display similar to Figure 3.24 appears.

Figure 3.24: Transfer Successful

The Receiver Setup screen indicates that Locus accepted the new values.

If the transfer failed, or if one or both requests to change a value are rejected a screen similar to Figure 3.25 displays.

Figure 3.25: Transfer Failed

If both values were edited in the Receiver Setup screen, and Locus accepted only one of them, there will be additional information on the above screen, either NEW REC.INT.ACCEPTED, or

KIN.WARNING ACCEPTED displayed below the OPERATION FAILED! line.

Reading GPS Receiver Information

The Handheld can read the current internal condition of Locus.

1. Call the Main Menu, and press the **H** (**RECEIVER INFO**) key. When data are not available (never requested), or when data are too old (time since this data was requested is older than the MIN TO OBS DATA: the Handheld Setup screen), the GPS Receiver Info, Data Not Available screen appears (Figure 3.26).

Figure 3.26: GPS Receiver Info Screen - Data Not Available Screen

2. Hold the Handheld IR port not more than four inches from the Locus IR port, and press the **B** (**DATA**) key; keep the Handheld in

this position. After about 15 seconds, the GPS Receiver Info screen appears (Figure 3.27).

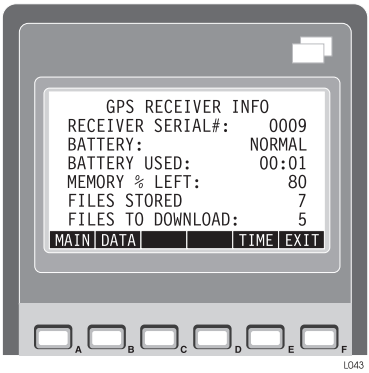


Figure 3.27: GPS Receiver Info Screen with Information from a Locus

Reading Satellite Information

To check the current status of the satellite constellation, call the Main Menu and press the **I** (**SATELLITES INFO**) key. When data are not available, or when data are too old, the Satellites Info screen appears (Figure 3.28).

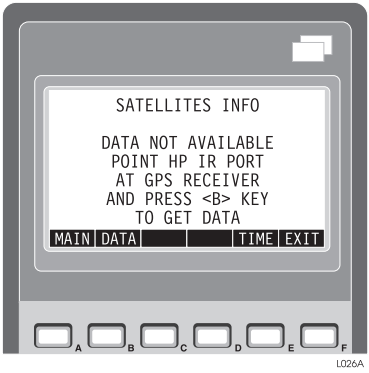


Figure 3.28: Satellites Info Screen Before Reading Information

1. Hold the Handheld IR port no more than four inches from the Locus IR port, and press the **B** (**DATA**) key. Keep the Handheld in

this position. After about 15 seconds, the satellite information appears (Figure 3.29).

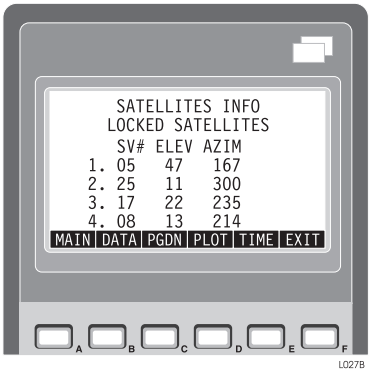


Figure 3.29: Satellite Info Screen

The **PGDN** button on the screen is blank if no more than four satellites are locked.

2. Press the **D** (**PLOT**) key to view the Satellite Configuration Sky Plot (Figure 3.30).

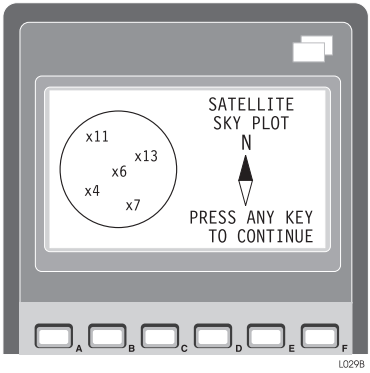


Figure 3.30: Satellite Sky Plot

3. Press any key to return to the Satellites Info screen.

Entering Static or Kinematic Site ID

When collecting position data, you must enter a four-character identification code for each site that you occupy.

1. Call the Main Menu
2. For a Static survey, press the **K** (**STATIC SITE LOGGER**) key to display the Static Site Logger screen (Figure 3.31), and then press the **A** (**EDIT**) key to enable the Edit Mode.

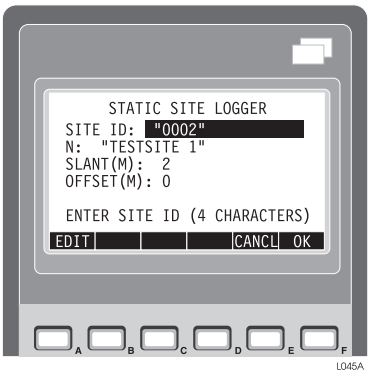


Figure 3.31: Static Site Logger Screen

3. For a Kinematic survey, press the **L** (**KINEMAT. SITE LOGGER**) key to display the Kinematic Site Logger screen (Figure 3.32), and then press the **E** (**EDIT**) key to display the Kinematic Site Editor screen (Figure 3.33).

From the Kinematic Site Editor, press the **A** (**EDIT**) key to enable the Edit Mode.

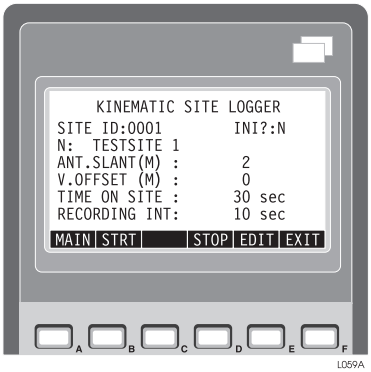


Figure 3.32: Kinematic Site Logger Screen

Figure 3.33: Kinematic Site Editor Screen

The procedure is similar for entering either static or kinematic site information. Use the following steps for static site editing.

1. From the Static Site Logger screen (Figure 3.31), press the **A** (**EDIT**) key. An editable field appears in the lower left corner of the display. The editable field consists of quotation marks enclosing space for four characters. Note that the blinking cursor occupies the same space as the left quote.
2. Press the right arrow key ► once to move the cursor one space to the right.

3. Press DEL as many times as necessary to delete the information currently in the field. Do not delete the quotation marks.
4. If you are using numbers for your site ID, key in the numbers and go to step 6. If you are using letters, press the α key two times to place the Handheld in the character mode.
5. Key in the letters of the Site ID.
6. Press ENTER to save the new Site ID. The active field drops down one line to the N parameter, SITE NAME.
7. Press the **A** (**EDIT**) key. An editable field appears in the lower left corner of the display, with a data area enclosed by quotation marks.
8. Press the right arrow key once to move the cursor one place to the right. As in step 4, press the α key two times to shift the Handheld to the character mode, then key in the site name.
9. Press **ENTER** to save the site name. The active field drops down one line to SLANT. The SLANT field lets you specify the distance from the edge of the Locus antenna ground plane to the survey marker (Figure 3.34). When the Slant value is non-zero, the

antenna radius is automatically set and logged as 0.1 m in the D-file.

Figure 3.34: Measuring Slant and Offset

10. Press the down arrow key if you do not want to edit the slant value. To edit the SLANT value, press the **A** (**EDIT**) key. An editable field displaying the current slant appears in the lower left corner of the display. Press **DEL** as many times as necessary to erase the current value, then key in the new value.
11. Press **ENTER** to save the new slant value. The active field drops down one line to OFFSET. OFFSET is the vertical distance from the antenna to the survey marker. Antenna Vertical Offset is composed of the height of the pole plus 0.125 meters to account for Locus. Do not enter the Offset Value (or set it to zero) if you entered a SLANT value.
12. To change the OFFSET value, press the **A** (**EDIT**) key. An editable field appears in the lower left corner of the display.
13. Press **DEL** as many times as necessary to erase the current value, then key in the new value.

14. Press **ENTER** to save the changes and return to the top of the screen.
15. Press the F (OK) key to log the static site data into the D-file. The display indicates **SITE ID ACCEPTED** (Figure 3.35).

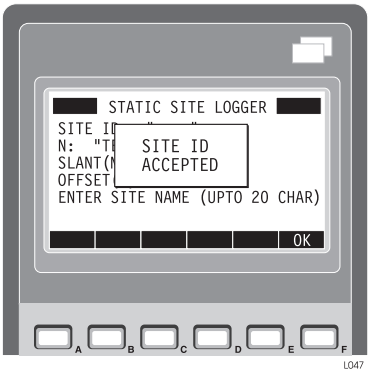


Figure 3.35: Site ID Accepted Message

On the Kinematic Site Editor screen there are two additional values that can be edited: the TO INI? field and the TIME ON SITE field.

The TO INI? field indicates if the current occupied site is being used or not for the initialization. If set to Y, it is being used. The TIME ON SITE field indicates the amount of time in seconds that Locus occupied the current point. When the current point is used for initialization, the TIME ON SITE value defaults to 300 seconds (recommended time for initialization), or can be changed to any value over 300 seconds.

In the Kinematic Site Editor screen, when the **F** (**OK**) key is pressed to accept all entered values, the screen returns to the Kinematic Site Logger screen (Figure 3.32). to log a point, press the **B** (**STRT**) key. When the **B** key is pressed, the Logging Status screen appears, indicating the TIME ON SITE parameter set in the Kinematic Site Logger screen and the TIME REMAINING on this point before the TIME ON SITE is reached. When the TIME REMAINING field reaches 0 (indicating the TIME ON SITE has been completed), the message SITE XXXX LOGGED appears. At this point, all requited kinematic site information has been logged into the D-file and you can continue with the next point. Press the **F** (**OK**) key to return to the Kinematic Site Logger screen.

While logging a point, the **D** (**STOP**) key can be used to interrupt the logging process. The message LOGGING STOPPED displays. Press the **F** (**OK**) key to return to the Kinematic Site Logger screen.

After the static or kinematic site information for a point is logged, the SITE ID parameter auto-increments. If the other site parameters remain the same for the next site to be logged, no parameter editing is required and logging can start as soon as the user is ready for the next site logging.

There are memory limitations for D-file size. The maximum size depends on user configuration and files that user stores in memory. Maximum D-file size is calculated every time the user logs new static or kinematic site data.

When you reach a limit for D-file size a screen displays (Figure 3.36).

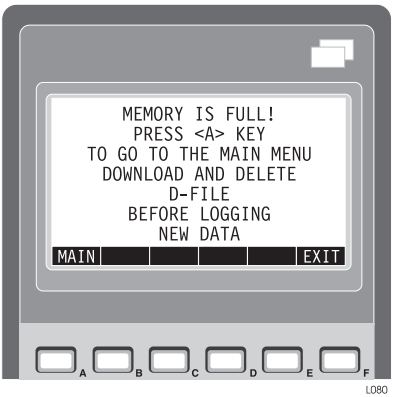


Figure 3.36: Memory is Fell Screen

The above screen does not mean that there is no free memory in the system, but it means that all free memory available for D-file was used. The remaining memory is required for the download process.

If you are using the Handheld solely for Locus software with no other files stored on the system, the Handheld can store 250 to 300 points, depending on the length of site names. You can more than double the number of points by installing an additional 128K RAM memory card (see “Installing a 128K RAM Data Card” on page 22). In order to take advantage of this additional memory, install the additional card before the memory fills up.

After Figure 3.36 appears for the first time, this screen displays every time you enter Static or Kinematic Logging functions (functions **K** and **L** or Main Menu), the D-file has been downloaded and deleted.

Receiver Files Information

Use the following procedure to check the current status of the data files stored in Locus:

1. From the Main Menu, press the **N** (**RECEIVER FILES**) key to open the Receiver Files Info screen (Figure 3.37).

Figure 3.37: Receiver Files Info Screen Data - Not Available

2. Hold the Handheld IR port no more than four inches from the Locus IR port, and press the **B** (**DATA**) key.

   The time to access file data depends upon the number of files stored in Locus. If there are many files, this operation can take a few minutes. Transmitted data are processed, and the information about the first file displays (Figure 3.38).

Figure 3.38: Locus Files Info - Data Available Screen

3. Once the Handheld accesses the file information, you can move the Handheld away from the Locus IR port.

4. Use the up/down arrows to move to the previous or next file. The left arrow moves to the first file, the right arrow moves to the last file on the list.

   Download flag **Y** or **N** indicates if this particular file was already downloaded.

   To delete file, press the **C** (**DEL**) key. The Delete File screen appears (Figure 3.39).

Figure 3.39: Delete File Screen

Hold the Handheld IR port no more than four inches from the Locus IR port, and press the **B** (**EXEC**) key to send a request to Locus to delete a file. Upon deleting the file, a FILE DELETED message displays. Locus beeps when it receives the request.

The **C** (**RTRN**) key opens the Receiver Files Info screen.

5. To close the current file in Locus (and open a new file), press the **D** (**CLOS**) key in the Receiver Files Info screen. The Close File screen appears (Figure 3.40).

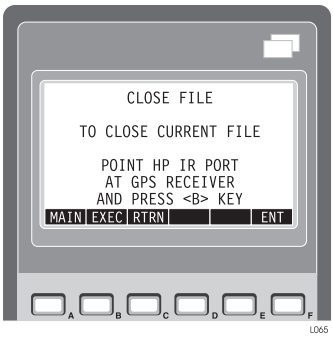


Figure 3.40: Close File Screen

6. Hold the Handheld IR port no more than inches from the Locus IR port and press the **B** (**EXEC**) key to send a a request to Locus to close the file. Upon successful completion a message FILE CLOSED displays.
7. Press **C** (**RTRN**) to return to the Receiver Files Info screen.

Survey Status Information

Use the following procedure to read the current status of the survey

1. From the Main Menu press the **J** (**SURVEY STATUS INFO**) key. The Survey Status Info screen appears (Figure 3.41).

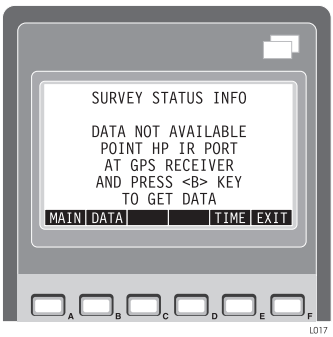


Figure 3.41: Survey Status Info Screen - Data Not Available Screen

2. Hold the Handheld IR port no more than four inches from the Locus IR port, and press the **B** (**DATA**) key. After about 10 seconds, the display indicates the status of the survey (Figure 3.42).

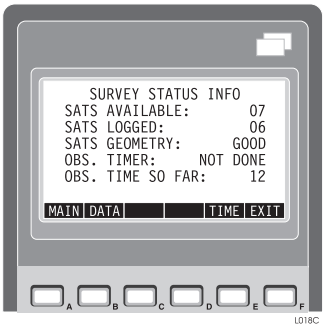


Figure 3.42: Survey Status Info Screen - Data Available Screen

3. After noting the information of interest, press the **A** (**MAIN**) key to return to the Main Menu.

D-File Information

1. To examine the D-file, go to the Main Menu, and press the **O** (**D-FILE INFO**) key, calling the D-File Info screen (Figure 3.43).

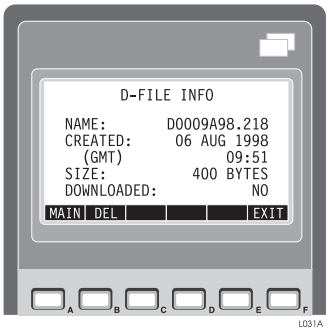


Figure 3.43: D-File Info Screen

2. To delete D-file, press the **B** (**DEL**) key and then the **Y** key to confirm that the delete.
3. Press the **A** (**MAIN**) key to return to the Main Menu.

Handheld Screens

Main Menu

The Main Menu (Figure 4.1) is the starting point. Table 4.1 describes the functions displayed on the Main Menu. When function key **A** (**PGDN**) is pressed, the display changes (Figure 4.2) with additional operations.

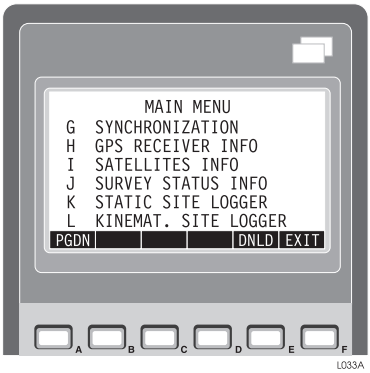


Figure 4.1: Main Menu - Page 1

Table 4.1: Main Menu

Field	Description	Page
MAIN MENU PAGE 1		
G SYNCHRONIZATION	Pressing the **G** key calls the Synchronization screen	73
H GPS RECEIVER INFO	Pressing the **H** key calls the Receiver Info screen	76
I SATELLITES INFO	Pressing the **I** key calls the Satellites Info screen	78
J SURVEY STATUS INFO	Pressing the **J** key calls the Survey Status Info screen	81
K STATIC SITE LOGGER	Pressing the **K** key calls the Static Site Logger screen	83

Table 4.1: Main Menu (continued)

Field	Description	Page
L KINEMAT. SITE LOGGER	Pressing the **L** key calls the Kinematic Site Logger screen	83
PGDN (Function Key A)	Pressing the **A** Function Key calls page 2 of the Main Menu	-
DNLD (Function Key E)	Pressing the B Function Key calls the Download D-File screen	67
MAIN MENU PAGE 2		
M RECEIVER SETUP	Pressing the **M** key calls the Receiver Setup screen	88
N RECEIVER FILES INFO	Pressing the **N** key calls the Receiver Files Info screen	92
O D-FILE INFO	Pressing the **O** key calls the D-File Info screen	97
P HANDHELD SETUP	Pressing the **P** key calls the Handheld Setup screen	98
PGUP (Function Key A)	Pressing the **A** key calls page 1 of the Main Menu	-
DNLD (Function Key E)	Pressing the **E** function key calls the Download D-File screen	67
EXIT (Function key F)	Pressing the F function key exits the program.	-

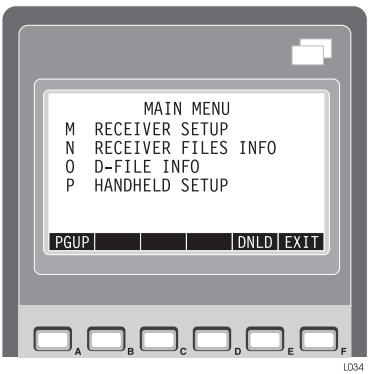


Figure 4.2: Main Menu - Page 2

Download D-File

When the **E** (**DNLD**) key in the Main Menu is pressed, to download a D-file from the Handheld to the PC. If there is no D-file stored in the Handheld, Figure 4.3 appears.

Figure 4.3: Download D-file, No D-File Screen

After the **E** (**DNLD**) key in the Main Menu is pressed, and there is a D-file stored in the Handheld, Figure 4.4 appears.

Figure 4.4: Processing Logged Data Screen

This operation processes D-file data to store them in a format suitable for IR transmission to the PC. Processing requires 30-35 seconds per K Byte, thus if the D-file is large several minutes may be required. It is not necessary to process data immediately before downloading them to the PC. After

processing, Figure 4.5 appears. Table 4.2 describes the Download D-file screen parameters.

Figure 4.5: Download D-File Screen

Table 4.2: Download D-File Parameters

Field	Description
POINT HP IR PORT.....	Instructions for establishing communication with PC via Handheld IR port and PC IR port.
MAIN (Function Key A)	Calls Main Menu and terminates the download
STRT (Function Key B)	Starts download process.
EXIT (Function Key F)	Exit the program

You can start the Download function just after finishing logging your last point or on the return trip to the office. After processing, the Handheld automatically turns off, and the processed data are ready to download to the PC. This can save time when downloading data in the office.

If the D-file stored in the Handheld had been downloaded, Figure 4.6 appears instead of Figure 4.5.

Figure 4.6: D-File Downloaded Screen

When processing is finished Figure 4.7 appears instead Figure 4.4.

Figure 4.7: Download D-File

Place the Handheld IR port and the IR device on a flat surface no more than four inches apart, and press the B (STRT) key to start the download.

Start Locus Download on the PC and connect to the Handheld.Select the D-file to download and select **Copy To** or **Move To** from the **Edit** menu to start downloading.

There is no time-out for download if no connection with PC, use the **CANCEL** function (**D** key), to exit download mode. If the PC connects to the Handheld, 5 minutes of inactivity of IR port (no messages coming to the

Handheld IR port) causes a time-out and as a result, the program returns to the main DOWNLOAD D-file screen.

When you press the **D** key, Figure 4.8 displays.

Figure 4.8: Download Interrupt by the User Screen

Upon successfully completing a download, either Figure 4.9 or Figure 4.10 appears.

When you use a COPY TO function on the PC to download a D-file, the D-file is not deleted automatically from the Handheld. After a successful download, delete the D-file from the Handheld.

Figure 4.9: Download D-File Screen

Press either the **A** (**YES**) key to delete a D-file from the Handheld, or the **F** (**NO**) key and a D-file remains in the Handheld. Additionally logged data is

appended to the end of the current D-file. A D-file can be deleted later, if you choose the NO option, from the Handheld in the D-FILE INFO screen.

When deleting a D-file, Figure 4.10 appears.

Figure 4.10: D-File Deleted Successfully Screen

When you use the MOVE TO function on the PC to download a D-file, the D-file is automatically deleted from the Handheld after successful download, and Figure 4.11 displays immediately after the finished download.

Figure 4.11: D-file Download Successful Screen

If the Handheld cannot communicate with the PC, Figure 4.12 displays. Check the positioning of the handheld and the PC IR device and press **B** (**STRT**) to repeat the procedure.

Figure 4.12: Download Failed Screen

When you press the **B** key, Figure 4.13 displays.

Figure 4.13: Downloading D-File Data Screen

Selection G - Synchronization

Use the synchronization screen (Figure 4.14) to synchronize the Handheld internal time with the Locus time. Open this screen by selecting **G** from the Main Menu. Table 4.3 describes the screen parameters.

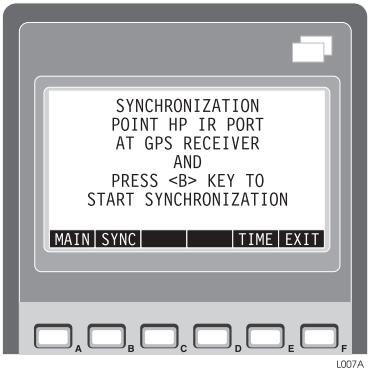


Figure 4.14: Synchronization Screen

Table 4.3: Synchronization Parameters

Field	Description
POINT HP.....	Instructions to start synchronization
MAIN (Function Key A)	Calls Main Menu
SYNC (Function Key B)	Starts synchronization when the Handheld IR port points at Locus IR port
TIME (Function key E)	Displays time elapsed since last synchronization
EXIT (Function Key F)	Exit the program

New Serial Number

After the **B** (**SYNC**) key is pressed, if the software detects a new Locus for synchronization, the Handheld presents the warning screen (Figure 4.15).

Figure 4.15: New Receiver Detected Screen

Figure 4.15 is just for information. The synchronization process completed successfully.

Press the **F** (**OK**) and the **C** key to access the Serial Numbers Info screen (Figure 4.16).

Figure 4.16: Serial Numbers Info Screen

This screen displays two Locus serial numbers, 002 is the serial number stored in the Handheld for the Locus previously used, and 004 is the Locus serial number for the current synchronization.

Press function key **F** (**RTRN**) to return to the Synchronization screen.

Although nominally subordinate to the Synchronization screen, these two screens are not unique to the synchronization process, but appear any time the software detects a new Locus (i.e., new serial number).

Time

The Time screen (Figure 4.17) displays time elapsed since the last data transfer. The example illustration indicates that the last data transfer occurred 5 minutes ago.

Figure 4.17: Time Screen

Selection H - GPS Receiver Info Screen

When there is no valid Locus data information in the Handheld, Figure 4.18 appears after pressing the **H** key in the Main Menu. Table 4.4 describes the screen parameters.

Figure 4.18: GPS Receiver Info Screen - Data Not Valid

Table 4.4: GPS Reveiver Info Parameters

Field	Description
MAIN (Function Key A)	Return to Main Menu
DATA (Function Key B)	Starts transfer of data between the Handheld and receiver (Handheld IR port must be aligned with receiver)
TIME (Function Key E)	Displays the time elapsed since last data transfer
EXIT (Function Key F)	Exit the program

When data are valid, or when the **B (DATA)** key is pressed, the Receiver Info screen presents the information (Figure 4.19). Table 4.5 describes the parameters for the data valid condition.

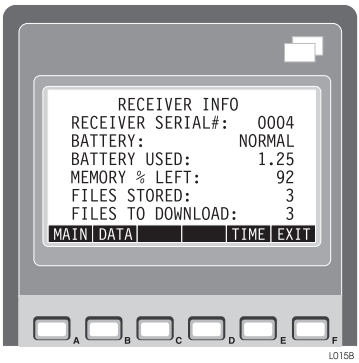


Figure 4.19: Receiver Info Screen - Data Valid

Table 4.5: Receiver Info Screen Parameters - Data Valid

Field	Description
RECEIVER SERIAL #	Displays 4-digit Locus serial number
BATTERY	Displays battery condition. Three possible indications: NORMAL (between 16 to 100 hours left for D size batteries), LOW (between 3 to 16 hours left for D-size batteries), CRITICAL (less than 3 hours left for D-size batteries).
BATTERY USED	Displays time in hours and minutes since the battery compartment was last opened.
MEMORY % LEFT	Displays in percent the amount of memory left for file storage. For closed files, the whole memory block where a file is stored is used. A part of the currently open file is free, as well as blocks not used to the present time.
FILES STORED	Displays the total number of files in Locus memory
FILES TO DOWNLOAD	Displays the number of files in Locus memory which have not been downloaded to a PC.
MAIN (Function key A)	Return to Main Menu
DATA (Function key B)	Starts transfer of Receiver Info Parameters from Locus when Handheld IR port is presented to Locus IR port.
TIME (Function key E)	Displays the time elapsed since last data transfer.
EXIT (Function key F)	Exit the program

If data transfer fails, Figure 4.20 appears.

Figure 4.20: Locus Info Screen - Transfer Failed

Selection I - Satellites Info Screen

The Satellite Info screen is called by selecting **I** from the Main Menu. When there are no valid satellite data, Figure 4.21 appears. Table 4.6 outlines the function keys. In this situation, place the HP IR port no more than four inches away from the Locus IR port, and press the **B** function key to start the data transfer.

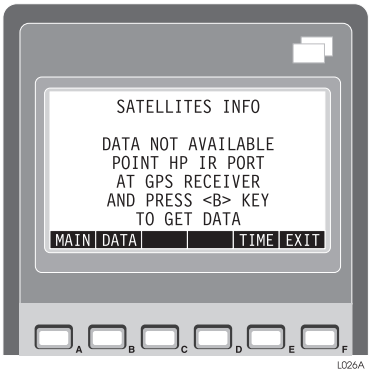


Figure 4.21: Satellites Info Screen - Data Not Valid

Table 4.6: Satellites Info Parameters

Field	Description
MAIN (Function Key A)	Return to Main Menu
DATA (Function Key B)	Starts transfer of the Satellite Info data between Handheld and Locus via IR port
TIME (Function Key E)	Displays the time elapsed since last data transfer
EXIT (Function Key F)	Exit the program

When the Locus Handheld have valid satellite information Figure 4.22 appears. Table 4.7 describes the information presented in the Satellite Info Screen.

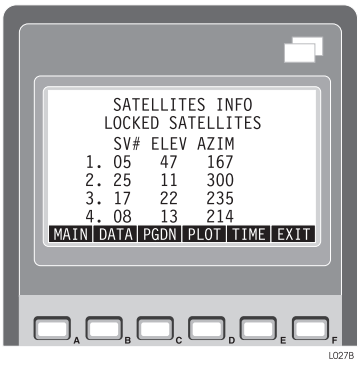


Figure 4.22: Satellites Info Screen - Data Valid

Table 4.7: Satellites Info Parameters - Data Valid

Field	Description
SV#	Two-digit satellite PRN number
ELEV	Two-digit satellite elevation angle, 0 to 90 degrees
AZIM	Three-digit satellite azimuth angle, 0 to 360 degrees
MAIN (Function Key A)	Return to Main Menu
DATA (Function Key B)	Starts transfer of the Satellite Info data between Handheld and Locus via IR ports
PGDN (Function Key C)	Calls second page of Satellite Info screen. Active only when more than 4 satellites are locked
PLOT (Function Key D)	Calls Satellite Plot screen

Table 4.7: Satellites Info Parameters - Data Valid

Field	Description
TIME (Function key E)	Displays the time elapsed since last data transfer.
EXIT (Function key F)	Exit the program

When the **C** (**PGDN**) key is pressed in the Satellite Info screen, page 2 appears (Figure 4.23).

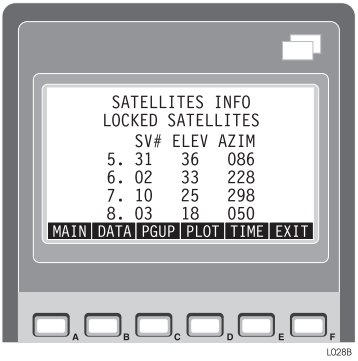


Figure 4.23: Satellites Info Screen - Data Valid

This screen displays information for satellites 5 through 8. **PGUP** returns to page 1 of the screen.

Satellites Sky Plot

To access the Satellite Sky Plot screen (Figure 4.24), from the Satellite Info screen press the **D** (**PLOT**) key. The Satellites Sky Plot screen presents a rough display of the current satellite configuration. In the circle, the numbers

are the satellite PRN numbers, and the location in the circle approximates the location in the sky. North is at the top of the display.

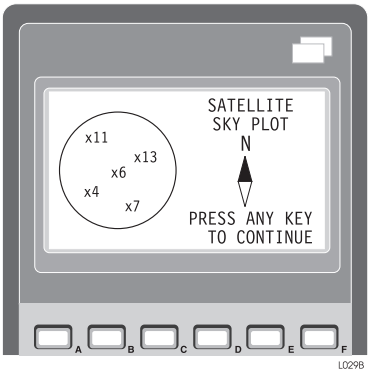


Figure 4.24: Satellites Sky Plot Screen

Selection J - Survey Status Info Screen

Access the Survey Status Info screen selecting **J** from the Main Menu. Figure 4.25 appears when there is no valid survey information in the Handheld. In this situation, place the Handheld IR port no more than four inches from the Locus IR port and press the **B** function key to start a data transfer.

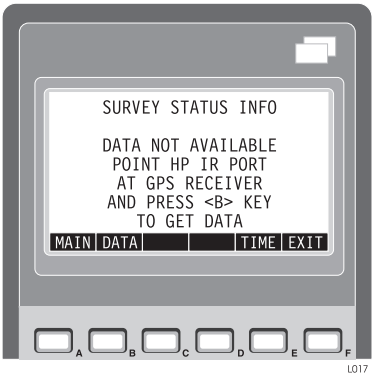


Figure 4.25: Survey Status Info Screen

When there is valid survey information in the Handheld, Figure 4.26 appears. Table 4.8 describes the parameters.

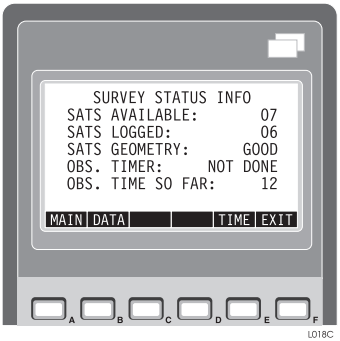


Figure 4.26: Survey Status Screen - Data Valid

Table 4.8: Survey Status Screen - Data Valid Screen Parameters

Field	Description
SATS AVAILABLE	Displays the number of available satellites
SATS LOGGED	Displays the number of healthy satellites above elevation mask, logging to memory
SAT. GEOMETRY	Displays PDOP code. GOOD if PDOP is less than 4, FAIR if PDOP is 4 to 8, POOR if PDOP greater than 8
OBS. TIMER	Displays 1 of 5 messages: NOT DONE, OK FOR 5KM, OK FOR 10KM, OK FOR 15KM, OK FOR 20 KM. Choice of message is based on the AMBIGDOP value
OBS. TIME SO FAR	Displays time in minutes elapsed from start of AMBIGDOP calculations
MAIN (Function Key A)	Return to Main Menu
DATA (Function Key B)	Starts transfer of survey status data from Locus when Handheld IR port is presented to Locus IR port
TIME (Function Key E)	Displays the time elapsed since last data transfer
EXIT (Function Key F)	Exit the program

Selection K - Static Site Logger Screen

Selection K on the Main Menu calls the Static Site Logger screen. When synchronization of the Handheld has never been performed, the screen appears as shown in Figure 4.27.

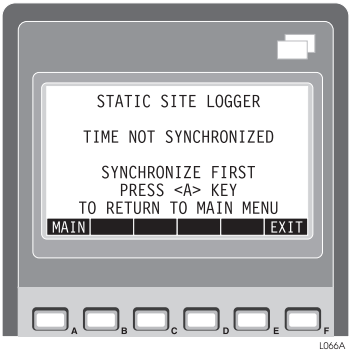


Figure 4.27: Static Site Logger Screen - Time Not Synchronization

When the data from synchronization is older than 8 hours, Figure 4.28 appears.

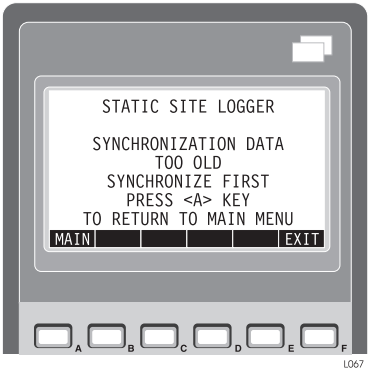


Figure 4.28: Static Site Logger Screen - Synchronization Data Too Olds

When the synchronization is current, Figure 4.29 appears.

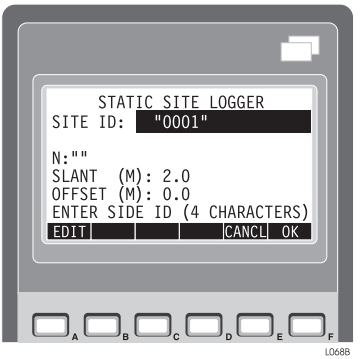


Figure 4.29: Static Site Logger Screen - Synchronization Current

Table 4.9 describes the Static Site Logger Screen parameters.

Table 4.9: Static Site Logger Screen Parameters

Field	Description
SITE ID	Editable field lets you enter a four-character site ID
N	Editable field lets you enter a 20-character site name
SLANT	Editable field lets you enter antenna slant value: US foot, International foot, meters (as set in Handheld Setup), up to 3 decimal places
OFFSET	Editable field lets you enter antenna vertical offset value: US foot, International foot, meters (as set in Handheld Setup), up to 3 decimal places
EDIT (Function Key A)	Allows you to edit highlighted field. Press **F** (**OK**) key or **ENTER** when finished.
CANCL (Function Key E)	Cancels operation (restores old values) and returns program to Main Menu.
OK (Function Key F)	Finishes entering data and logs a static site (writes data to D-file).

Units for SLANT and OFFSET are set through the P (HANDHELD SETUP) screen.

After all values are edited and the **F** (**OK**) key is pressed, all data are saved in the D-file, and the message “Site ID Accepted” displays. To acknowledge this message press the **F** (**OK**) key or **ENTER** to the Main Menu.

If any of the entered values are not correct (values out of range), an ERROR WARNING window displays with information about the incorrect values. You must correct the values in order to use the **F** (**OK**) key and log the site information into the D-file.

All entered values are stored and displayed as starting values the next time you use this screen. Only the site ID auto-increments (digits and letters).

Selection L - Kinematic Site Logger Screen

Select **L** in the Main Menu to access the Kinematic Site Logger screen. If synchronization of the Handheld has not occurred, Figure 4.30 appears.

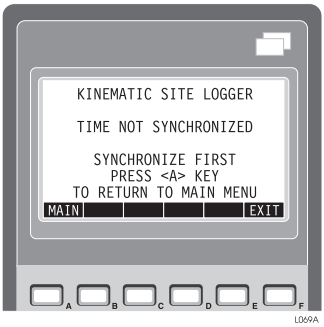


Figure 4.30: Kinematic Site Logger Screen - Time Not Synchronized

When the data from synchronization is older than 8 hours, Figure 4.31 appears.

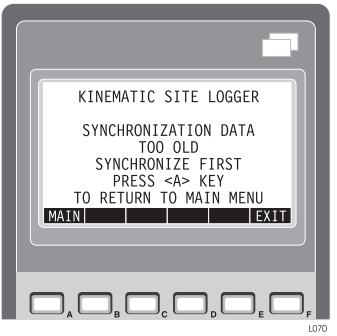


Figure 4.31: Kinematic Site Logger - Synchronization Data Too Old

When the synchronization data are current, Figure 4.32 appears.

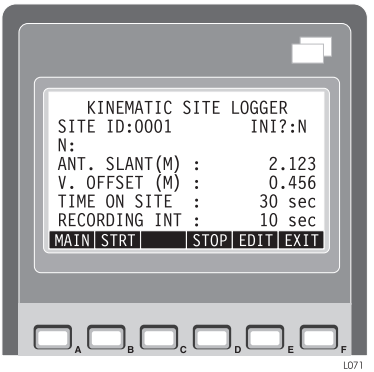


Figure 4.32: Kinematic Site Logger - Synchronization Data Current

Table 4.10 describes the Kinematic Site Logger screen parameters.

Table 4.10: Kinematic Site Logger Screen Parameters

Field	Description
SITE ID	Editable field lets you enter four characters site id
INI?	Editable field Y or N; a flag indicating if the current site is used for kinematic initialization

Table 4.10: Kinematic Site Logger Screen Parameters (continued)

Field	Description
N	Editable field lets you enter a 20 character site name
ANT. SLANT	Editable field lets you enter antenna slant parameter: US foot, international foot, meters up to 3 decimal places
V. OFFSET	Editable field lets you enter antenna vertical offset parameters: US foot, international foot, meters, up to 3 decimal places
TIME ON SITE	Editable field sets the duration (seconds) of data collection at site
RECORDING INT	Non-editable field. Displays the current recording interval set in the receiver in seconds, default 10
MAIN (Function Key A)	Return to Main Menu (Not available when logging data)
STRT (Function Key B)	Writes data to the D-file and calls the next screen, logging status (Not available when logging data)
STOP (Function Key D)	Active only when logging data, stops logging data
EDIT (Function Key E)	Access the Kinematic Site Editor Screen to change values for the current site. (Not available when logging data)
EXIT (Function Key F)	Exit the program (Not available when logging data)

Units for ANT. SLANT and V. OFFSET are set through the P (Handheld SETUP) screen.

To log date into the data D-file, press the **STRT** key, and Figure 4.33 appears.

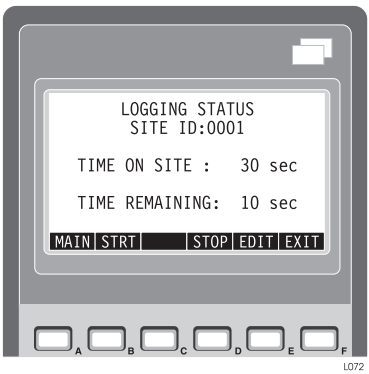


Figure 4.33: Logging Status Screen

The Logging Status screen displays the TIME ON SITE parameter set in the Kinematic Site Editor screen and the TIME REMAINING on the current point before the TIME ON SITE is reached. When the TIME REMAINING field reaches 0, the receiver beeps and the message SITE 0001 LOGGED displays. At this point, all required kinematic site information has been logged into the D-file. When the **F** (**OK**) key is pressed, the program auto-increments the SITE ID field.

The **D** key is the only active key in the Logging Status screen. If the **D** (**STOP**) key is pressed while the TIME REMAINING field is counting down, the logging process is terminated. The site ID is written into the D-file and the message "LOGGING STOPPED" is displayed. Press the **F** (**OK**) key to clear the message and return to the Kinematic Site Logger screen.

While in the Kinematic Site Logger screen, the E (EDIT) key is pressed, the Kinematic Site Editor screen is displayed.

Figure 4.34: Kinematic Site Editor Screen

Use this screen to edit the parameters in the Kinematic Site Logger screen. To edit a parameter, highlight the parameter using the arrow keys and then press the **A** (**EDIT**) key. After editing all necessary values, press the **F** (**OK**) key to save the changes or the **E** (**CANCL**) key to cancel the changes and return to the Kinematic Site Logger screen.

Selection M - Receiver Setup Screen

The Receiver Setup screen displays the current recording interval, and the current kinematic warning flag, and use it to set new values for these parameters and send them to Locus.

Access the Receiver Setup screen by selecting **M** in the Main Menu. When no valid Locus information is available, Figure 4.35 appears.

Figure 4.35: Receiver Setup Screen - No Data

When the Locus information is valid and available, Figure 4.36 appears. This screen displays the current recording interval and kinematic warning flag for the most recent Locus synchronized, or the last time these parameters were updated using the Receiver Setup screen.

Figure 4.36: Receiver Setup Screen - Data Available

Table 4.11 describes the function keys in the Receiver Setup screen.

Table 4.11: Receiver Setup Function Keys Descriptions

Field	Description
MAIN (Function Key A)	Return to Main Menu
EDIT (Function Key C)	Call the Receiver Setup Editor screen, Figure 4.37
TIME (Function Key E)	Displays the time elapsed since last data transfer
EXIT (Function Key F)	Exit the program

To edit the recording interval and/or kinematic warning parameters, press the **C** (**EDIT**) key. The RECEIVER SETUP EDITOR screen (Figure 4.37) appears.

Figure 4.37: Receiver Setup Editor Screen

Table 4.12 describes the fields in the Receiver Setup Editor screen.

Table 4.12: Receiver Setup Editor Descriptions

Field	Description
NEW REC. INT	Set new recording interval, 2 - 999 seconds
NEW KIN. WARN	Set kinematic warning flag ON or OFF
EDIT (Function Key A)	Edit the highlighted field. Press the **F (OK)** key or **ENTER** when finished with each field.

Table 4.12: Receiver Setup Editor Descriptions

Field	Description
CANCL (Function Key E)	Cancels operation and returns to the Receiver Setup screen.
OK (Function Key F)	Accepts entered data, and returns to Receiver Setup Screen. If the data format is not correct, an "**Error Warning**" small window appears. Change the value, or exit with **CANCL**.

After parameters have been edited press the **F** (**OK**) key to save the new settings (Figure 4.38).

Figure 4.38: Receiver Setup Screen After Editing

If one of the two parameters was not edited, the **NEW** field associated with that parameter will be empty. If the **OLD** value for one parameters is not available, the **N/A** indicator is displayed.

Table 4.13 describes the fields for the Receiver Setup screen displayed in Figure 4.28.

Table 4.13: Receiver Setup (After Editing) Menu Descriptions

Field	Description
MAIN (Function Key A)	Return to the Main Menu
SEND (Function Key B)	Send parameters to receiver when the Handheld IR port points at receiver IR port.
EDIT (Function Key C)	Allows you to edit highlighted field.
TIME (Function Key E)	Displays time elapsed since last synchronization.
EXIT (Function Key F)	Exit the program

When you present the Handheld IR port to the receiver IR port and press the B (SEND) key, receiver parameters will be transmitted. A successful transmission, or a failed transmission are shown in Figure 4.39 and Figure 4.40 respectfully.

Figure 4.39: Receiver Setup Screen - Transmission Successful

Figure 4.40: Receiver Setup Screen - Transmission Failed

Selection N - Receiver Files Info Screen

The N selection on the Main Menu calls the Receiver Files Info screen to acquire and display information on the data files stored in Locus, delete

files, and close files.Figure 4.41, which appears when no Locus information is available, instructs you to establish IR communication with Locus.

Figure 4.41: Receiver Files Info Screen - No Data

Place the Handheld no more than four inches from the Locus IR port and press the **B** (**DATA**) key.

After the file information has successfully transferred and displays the file information on the screen, the Handheld beeps three times. Table 4.14 describes the Receiver Files Info screen parameters.

Figure 4.42: Receiver Files Info Screen - Data Valid

Table 4.14: Receiver Files Info Screen

Field	Description
NAME	Displays the file name
START	When the first record in the date file was stored (date and time)
END	When the last record in the date file was stored (date and time)
SIZE	File size in KB
DOWNLOAD FLAG	Y or N indicates if file has been downloaded
FILE X of Y	Indicates which file the displayed information belongs
Up arrow	This key scrolls up one file
Down arrow	This key scrolls down one file.
Right arrow	This key scrolls to the last file
Left arrow	This key scrolls to the first file
MAIN (Function Key A)	Return to the Main Menu
DATA (Function Key B)	Starts data transfer between Handheld and GPS receiver via IR ports
DEL (Function Key C)	Calls the Delete File screen. Which allows you to delete one of the listed files from the receiver
CLOS (Function Key D)	Calls the Close File screen. Which allows you to close the active file
TIME (Function Key E)	Displays the time elapsed since last data transfer
EXIT (Function Key F)	Exit the program

If the data transfer fails, a screen with information repeat the transfer by pressing **B (DATA)** key when Handheld and receiver IR ports are properly positioned.

Delete File

Use the Receiver File Info Screen to delete a data file from Locus.

1. Select the data file to delete using the arrow keys.
2. Press the **C (DEL)** key to access the Delete File screen (Figure 4.43). Table 4.15 describes the Delete File screen parameters.

3. Align the IR ports not more than four inches apart and press the **B** (**EXEC**) key.

Figure 4.43: Delete File Screen

Table 4.15: Delete File Parameters

Field	Description
TO DELETE FILE.	Instructions for deleting file
xxxxxx	Name of file to be deleted
MAIN (Function Key A)	Return to Main Menu
EXEC (Function Key B)	Sends request to receiver to delete file xxxxxxReturn. This command works only if the Handheld IR port is presented to the receiver IR port. The receiver beeps when it gets a request. Based on results of operation, one of three screens is displayed: FILE DELETED, OPERATION REJECTED, or TRANSMISSION FAILED
RTRN (Function Key C)	Return to the Receiver Files Info screen
EXIT (Function Key F)	Exit the program

Close File

Use the Receiver File Info Screen to close a data file in Locus.

1. Select the data file to close using the arrow keys.
2. Press the **D** (**CLOS**) key to access the Close File screen (Figure 4.44). Table 4.16 describes the Close File screen parameters.

Align the IR ports not more than four inches apart and press the **B** (**EXEC**) key.

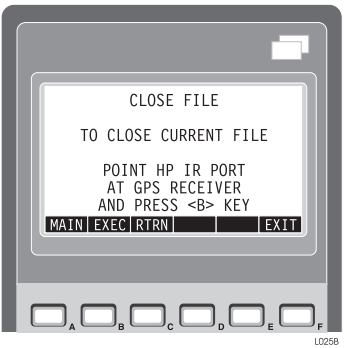


Figure 4.44: Close File Screen

Table 4.16: Close File Parameters

Field	Description
TO CLOSE	Instructions for closing file.
MAIN (Function key A)	Return to Main Menu
EXEC (Function key B)	Sends request to receiver to close currently open file (when HP IR port is presented to receiver IR port). The receiver closes the file and automatically opens a new one. Based on the result of the operation, one of three screens is displayed: FILE CLOSED, OPERATION REJECTED, or TRANSMISSION FAILED. The receiver beeps when it receives the request
RTRN (Function key C)	Return to the Receiver Files Info screen
EXIT (Function key F)	Exit the program

Selection O - D-File Info

The D-File Info screen (Figure 4.45) displays administrative information about the current D-file. Access The D-File Info screen by selecting **O** in the Main Menu. Table 4.17 describes the D-File screen parameters.

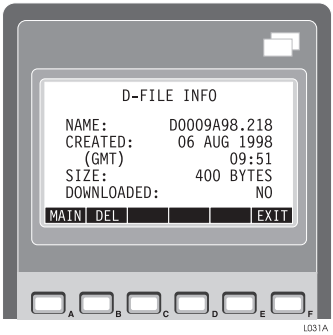


Figure 4.45: D-File Info Screen

If D-file information is not available, Figure 4.46 appears

Figure 4.46: D-file Info Not Available

Table 4.17: D-File Info Parameters

Field	Description
NAME	Name of D-file, based on recently used receiver serial number and day of year. Standard DOS format, 8 characters with 3-character extension
CREATED	Day and time when the file was created. The time format (12 or 24 hours) for this field is set in the HANDHELD SETUP screen. Default is 24 hours.
SIZE	Current size of D-file in Bytes
DOWNLOADED	Indicates whether the file has been downloaded (YES) or (NO). If any part of the data have not been downloaded, this flag is NO.
MAIN (Function Key A)	Return to Main Menu
DEL (Function Key B)	Opens the Delete D-file screen. To delete a D-file, press **A** (**YES**) key on that screen.
EXIT (Function Key F)	Exit the program

Selection P- Handheld Setup Screen

Use the Handheld Setup screen (Figure 4.47) to specify antenna and time parameters. Access this screen by selecting **P** in the Main Menu. Table 4.18 describes the fields in this screen.

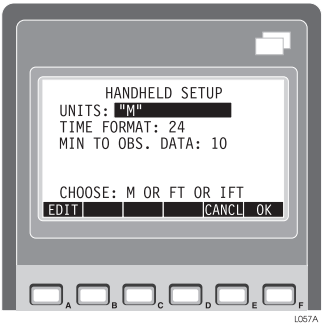


Figure 4.47: Handheld Setup Screen

Table 4.18: Handheld Setup Parameters

Field	Description
UNITS	Editable field for units of antenna parameters. Units are M (meters), IFT (international feet), and FT (US survey feet).
TIME FORMAT	Editable field for time display format. Formats are 12 hours (with AM/PM indication), and 24 hours.
MIN TO OBSOLETE DATA	Editable numeric field to set time limit for validity of receiver and file status information acquired from Locus. After that time, the Handheld does not display any receiver information until communicating with Locus via the IR to update the information. The default is 10 minutes. The maximum is 60 minutes.
EDIT (Function Key A)	Edit a highlighted field. Press the **A** (**OK**) key or **ENTER** when finished with each field.
CANCL (Function Key E)	Cancels operation and returns to the Main Menu without any changes.
OK (Function Key F)	Accepts entered data (if values are correct) and returns to the Main Menu. If the data values are not correct, a small window will be displayed with an error message. You must change the value to the proper one to exit this screen using the **OK** key, or you can exit with **CANCL**.

Troubleshooting

Table A.1: Troubleshooting Locus

Symptom	Possible Cause	Solution
Locus will not track satellites	Poor satellite visibility	Move to open space clear of buildings and obstructions. The receiver will not work indoors.
	Last position in memory is wrong by >500km (receiver has been moved)	Perform System Reset to clear last position *. Unit will “cold start”.
Data recording LED solid red	Memory is full	Delete files using download or handheld or perform file memory clear by holding the down button through red flashing LED on power up.
Locus can not communicate through IR port	IR device placement	Move the IR device to between 6 and 18 inches for PC, 2 - 4 inches for handheld (see Figure “Locus and Handheld IR Ports” on page 22). Make sure no other IR devices are in operation.
	IR device setup problem	Re-verify COM port. Make sure no IRDA drivers are installed. Try a different COM port or a different computer.
	Internal software error	Perform System Reset to clear internal RAM. Unit will “cold start”. *
LED’s stuck	Internal software error	If unit won’t turn-off remove batteries. If the problem persists perform System Reset to clear internal RAM. Unit will “cold start”.*
Unit won’t start after Full Memory Reset	Batteries too low	Replace with fresh batteries
	Firmware corrupted.	Contact Ashtech Precision Products Customer Support
* To perform a System Reset, turn the unit off, then back on by holding the power button down until you enter the firmware update mode (refer to “Updating Firmware” on page 2).		

Global Product Support

If you have any problems or require further assistance, Ashtech Precision Products Customer Support can be reached through the following:

- telephone
- email
- Internet

Please refer to the documentation before contacting Customer Support. Many common problems are identified within the documentation and suggestions are offered for solving them.

Ashtech Precision Products Customer Support:

Sunnyvale, California, USA

800 Number: 800-229-2400

Direct Dial: (408) 615-3980

Local Voice Line: (408) 615-5100

Fax Line: (408) 615-5200

Email: support@ashtech.com

Ashtech Europe Ltd. Oxfordshire UK

Tel: 44 1 753 835 700

Fax: 44 1 753 835 710

When contacting customer support, please ensure the following information is available:

Table B.1: GPS/GIS Product Information

Information Category	Your actual numbers
Receiver serial #	
Software version #	
Software key serial #	

Table B.1: GPS/GIS Product Information (continued)

Information Category	Your actual numbers
Firmware version #	
A clear, concise description of the problem.	

Updating Firmware

Firmware is the code that runs Locus. Periodically Ashtech Precision Products up dates the firmware. The firmware files, PC installation software and additional information will be made available from Ashtech precision products Customer Support.

To enter the Load Firmware mode, press and hold the power button down for ten seconds past the power on beeps and clearing file memory beep until Locus beeps once more. The Status panel lights display a rolling red pattern. You are now in Load Firmware mode and have 3 minutes to begin to upload firmware.

To exit Load Firmware mode, hold the power button for 1 second until all of the red lights are on and Locus beeps twice.

Glossary

3D
Three dimensional

A

Acquisition
The process a GPS receiver goes through to find and lock onto a GPS satellite. Once a GPS receiver has acquired 4 or more satellites, it can begin to compute positions.

Adjusted position
The final position of a survey point derived from an adjustment of the measurements used to derive the position.

Almanac
Data transmitted by a GPS satellite which includes orbit information on all the satellites, clock correction, and atmospheric delay parameters. These data are used to facilitate rapid satellite acquisition. The orbit information is a subset of the ephemeris data with reduced accuracy.

AmbigDOP
A calculated quantity used to determine the ability of the post processor to compute integer ambiguities.

Ambiguity
The unknown integer number of cycles of the reconstructed carrier phase contained in an unbroken set of measurements from a single satellite pass at a single receiver. Also known as integer ambiguity and integer bias.

Antenna
The antenna is the component of a GPS system that collects the analog signal from the GPS satellite and sends this signal to the GPS receiver for processing. There are a variety of GPS antennas ranging from simpler microstrip devices to complex choke ring antennas that mitigate the effects of multipath scattering.

ASCII
American Standard Code for Information Interchange. A set of characters (letters, numbers, symbols) used to display and transfer digital data in standard English format.

Autonomous position
Also known as a point, position or raw position. The position derived from a single receiver without using any differential correction. This is the least accurate method of positioning.

B

Baseline
The three-dimensional vector distance between a pair of stations for which simultaneous GPS data

has been collected and processed with differential techniques. The most accurate GPS result.

Base Station
In differential positioning, the end of the baseline that is assumed known and its position fixed.

B-file
Raw data binary file, generated by the receiver, containing carrier phase, code phase and computed receiver position for every epoch, along with health flags indicating the confidence of the measurements.

C

C/A code
The Coarse/Acquisition (or Clear/ Acquisition) code modulated onto the GPS Ll signal. This code is a sequence of 1023 pseudorandom binary biphase modulations on the GPS carrier at a chipping rate of 1.023 MHz, thus having a code repetition period of one millisecond. This code was selected to provide good acquisition properties.

Carrier frequency
The hardware in a receiver that allows the receiver to detect, lock-on, and continuously track the signal from a single satellite. The more receiver channels available, the greater number of satellite signals a receiver can simultaneously lock-on and track.

Carrier phase
The phase of either the L1 or L2 carrier of a GPS signal, measured by a receiver while locked-onto the signal (also known as integrated Doppler).

Cartesian coordinates
Values representing the location of a point in a plane in relation to three mutually perpendicular coordinate axes which intersect at a common point or origin. The point is located by measuring its distance from each axis along a parallel to the axis.

Channel
The hardware in a receiver that allows the receiver to detect, lock-on and continuously track the signal from a single satellite. The more receiver channels available, the greater number of satellite signals a receiver can simultaneously lock-on and track.

Code phase
Term used in reference to C/A or P-code data.

Confidence level
The goal of any measurement is to find the true value. Since all measurements contain error, the true value is never observed. In order to qualify measurements, an error estimate is statistically derived for each measurement. An error estimate has a confidence level associated with it which gives the probability that the true value of a measurement falls within the range generated by subtracting and adding the error estimate to the measured value.

For example, if a measurement of 50.5 meters has an error estimate of 0.1 meters at the 95% confidence level, then there is a 95% probability that the true value is between 50.4 – 50.6 meters.

Constellation
The collection of orbiting GPS satellites. The GPS constellation consists of 24 satellites in 12-hour circular orbits at an altitude of 20,200 kilometers. In the nominal constellation, four satellites are spaced in each of six orbital planes. The constellation was selected to provoke a very high probability of satellite coverage even in the event of satellite outages.

Cycle slip
A loss of count of carrier cycles as they are being measured by a GPS receiver. Loss of signal, ionospheric interference, obstructions, and other forms of interference cause cycle slips to occur (see carrier phase). To properly compute a vector between data collected from two GPS receivers, all cycle slips must be corrected. This task is normally performed automatically by the software. At times, a cycle slip will go undetected by the software, resulting in an incorrect determination of the vector.

D

Datum
See Geodetic datum

D-file
ASCII descriptor file containing feature and attribute data downloaded from the receiver. This file gives time in seconds of week (measured from midnight Saturday).

Differential positioning
Determination of relative coordinates of two or more receivers which are simultaneously tracking the same satellites. Dynamic differential positioning is a real-time calibration technique achieved by sending corrections to the roving user from one or more reference stations. Static differential GPS involves determining baseline vectors between pairs of receivers.

Dilution of Precision (DOP)
The geometry of the visible satellites is an important factor in achieving high quality results. The geometry changes with time due to the relative motion of the satellites. A measure for the geometry is the Dilution of Precision (DOP) factor.
DOP is a description of the effect of satellite geometry on position and time computations. Values considered 'good' are small, say 3. Values greater than 7 are considered poor. Thus, small DOP is associated with widely

separated satellites
Standard DOP terms for GPS include:

Table Gloss.1: Dilution of Precision

GDOP Geometric Dilution of Precision	GDOP is a composite measure reflecting the effects of satellite geometry on position and time computations.
PDOP Position Dilution of Precision	PDOP reflects the effects of satellite geometry on position computation.
HDOP Horizontal Dilution of Precision	HDOP reflects the effects of satellite geometry on the horizontal component of the position computation.
VDOP Vertical Dilution of Precision	VDOP reflects the effects of satellite geometry on the vertical component of the position computation.
TDOP Time Dilution of Precision	TDOP reflects the effects of satellite geometry on the time computation.

E

E-file
Binary ephemeris file downloaded from a receiver. Unlike an almanac file, which gives information on all satellites, an ephemeris file applies only to the satellite which sent ephemeris data. The file is a record of the broadcast message comprising accurate orbit parameters and time corrections for all tracked satellites during the data recording period. This information is used for computing the satellite position. The ephemeris data are deciphered and configured into a readable structure.

Elevation
Height above a reference datum. The reference datum may be an ellipsoid (ellipsoidal elevation), a geoid (orthometric elevation), above mean-sea-level, or above a locally defined reference plane.

Elevation mask angle
An adjustable feature of GPS receivers that specifies that a satellite must be at least a specified number of degrees above the horizon before the signals from the satellite are to be used. Satellites at low elevation angles (five degrees or less) have lower signal strengths and are more prone to loss of lock thus causing noisy solutions.

Ephemeris
A list of (accurate) positions or locations of a celestial object as a function of time. Available as "broadcast ephemeris" or as post-processed "precise ephemeris"

Epoch
Time stamp for a measurement interval or data frequency, e.g., 15 seconds, 30 seconds.

F

Firmware
The electronic heart of a receiver, where coded instructions relating to receiver function, and (sometimes) data processing algorithms, are embedded as integral portions of the internal circuitry.

Fixed solution
Processing of GPS vectors produces many solutions for the vector at different stages of the processing. One of the parameters being solved for during the processing is the integer ambiguites. A fixed solution is a vector solution where the integer ambiguities have been correctly determined and held fix. The fixed solution for a vector is most often the best solution. If for some reason the ambiguities could not be solved for, the final solution for the vector will be a float solution.

Float solution
Processing of GPS vectors produces many solutions for the vector at different stages of the processing. One of the parameters being solved for during the processing is the integer ambiguites. A float solution is a vector solution where the integer values for the ambiguities could not be determined, therefore they are not fixed to a specific integer value (left to float as a whole number.

G

Geodetic coordinates
A coordinate system where the position of a point is defined using the elements latitude, longitude and geodetic height.

Geodetic height (ellipsoidal height)
The height of a point above an ellipsoidal surface. The difference between a point's geodetic height and its orthometric height (height above ellipsoid) equals the geoidal separation.

Geoid
A gravity based surface used to best represent the physical surface of the earth. The center of the geoid coincides with the true center of the earth and its surface is an equipotential surface, meaning that at any point the geoid is perpendicular to the direction of gravity. The geoid can be visualized by imagining that the earth were completely covered by water. This water surface is an equipotential surface since the water flows to compensate for any height difference that occurs.

Geoid height

Geoidal separation
The height difference between the ellipsoidal height and orthometric height at a given point on the earth's surface. Worded differently, it is the separation between the geoid surface and ellipsoid surface at a given point on the earth's surface.

Geometric Dilution of Precision (GDOP)
See Dilution of Precision

Global Positioning System (GPS)
Passive, satellite-based navigation

system operated by the Department of Defense. It's primary mission is to provide passive global positioning/ navigation for land-, sea-, and air-based operations.
GPS consists of-

- a space segment (up to 24 NAVSTAR satellites in 6 different orbits)
- the control segment (5 monitor stations, 1 master control station and 3 upload stations) the user segment (GPS receivers)

NAVSTAR satellites carry extremely accurate atomic clocks and broadcast coherent simultaneous signals.

GPS time
The time system upon which GPS is based. GPS time is an atomic time system and is related to International Atomic Time in the following manner:
International Atomic Time (IAT) = GPS + 19.000 sec

GPS week
GPS time started at Saturday/ Sunday midnight, January 6, 1980. The GPS week is the number of whole weeks since GPS time zero.

Greenwich mean time (GMT)
Time based on the Greenwich Meridian as reference. In distinction from time based on a local meridian or the meridian of a time zone.

H

HI
Height of Instrument

Horizontal Dilution of Precision (HDOP)
See Dilution of Precision

Horizontal relative accuracy
The horizontal component of the relative accuracy between two points. See Relative Accuracy.

I

Integer Ambiguities (Integer bias)
See Ambiguity

Ionosphere
The layers of ionized air in the atmosphere extending from 70 kilometers to 700 kilometers and higher. Depending on frequency, the ionosphere can either block radio signals completely or change the propagation speed. GPS signals penetrate the ionosphere but are delayed. This delay induces error in the GPS measurements that can result in poor survey results. Most GPS receivers/processing software model the ionosphere to minimize its affects. Also, the effects of ionosphere can be nearly eliminated by using dual frequency receivers which can calculate the delay due to ionosphere.

Ionospheric delay
A wave propagating through the ionosphere [which is a non-homogeneous (in space and time)

and dispersive medium] experiences delay. Phase delay depends on electron content and affects carrier signals. Group delay depends on dispersion in the ionosphere as well, and affects signal modulation (codes). The phase and group delay are of the same magnitude but opposite sign.

K

Kinematic initialization bar
A metal attachment of fixed length (0.2 meters) used to expedite the initialization process of a kinematic survey. Two Locus receivers are attached to the kinematic initialization bar, one over a known location. They act as a fixed baseline and allow the receivers to initialize (accurate position/ambiguity resolution) more rapidly than if the receivers were to initialize across a baseline of unknown length.

Kinematic surveying
A form of continuous differential carrier-phase surveying requiring only short periods of data observations. Operational constraints include starting from or determining a known baseline, and tracking a minimum of four satellites. One receiver is statically located at a control point, while others are moved between points to be measured.

L

L1
The primary L-band signal radiated by each NAVSTAR satellite at 1575.42 MHz. The Ll beacon is modulated with the C/A and P codes, and with the NAV message.

L2
The secondary L-band signal radiated by each NAVSTAR satellite at 1227.60 MHz and is modulated with the P code and the NAV message.

Latitude
Angle generated by the intersection of the semi-major axis of the datum reference ellipsoid and the ellipsoid normal (line running perpendicular to the ellipsoid surface) at the point of interest. Latitude is one of the positional elements when defining the geodetic coordinates of a point.

Longitude
The length of the arc or portion of the Earth's equator between the meridian of a given place and the prime meridian expressed in degrees west or east of the prime meridian to a maximum of 180 degrees.

M

Multipath
The reception of a satellite signal both along a direct path and along one or more reflected paths. The reflected signals are caused by

reflecting surfaces near the GPS antenna. The resulting signal results in an incorrect pseudorange measurement. The classical example of multipath is the ghosting that appears on television when an airplane passes overhead.

Multipath error
A GPS positioning error resulting from the use of reflected satellite signals (multipath) in the position computation.

N

Navstar
The name of GPS satellites, built by Rockwell International, which is an acronym formed from Navigation System with Time And Ranging.

O

Observable
In GPS surveying, the observable is another name for the raw data being collected (observed) by the GPS receiver.

Observation
The act of recording (GPS) data at a site. An example usage of the term would be, 'The observation at point 0001 lasted 1 hour'. Observation is usually interchangeable with the term occupation.

Obstruction
Physical feature that blocks the satellite direct line of site from the point of observation. GPS signals are very weak. They can be blocked from reaching the GPS antenna by objects between the antenna and the satellites. Classic examples of obstructions are trees and buildings.

Occupation
The period of recorded data for a site. For example, a 1-hour period of data collection on a survey point is considered an occupation. Occupation is usually interchangeable with the term observation.

Orthometric elevation (orthometric height)
The height of a point above the geoid. Orthometric elevation is often equated with mean-sea-level elevation.

P

P-Code
The protected or precise code used on both LI and L2 GPS beacons. This code will be made available by the DOD only to authorized users. The P code is a very long (about 1014 bits) sequence of pseudo-random binary biphase modulations on the GPS carrier at a chipping rate of 10.23 MHz which does not repeat itself for about 38 weeks. Each satellite uses a one-week segment of this code which is unique to each GPS satellite, and is reset each week.

Phase center
The phase center of a GPS antenna is the physical location on the antenna where the raw GPS signals are observed. This is the physical location where the computed position will be determined. GPS antennas are manufactured to place the phase center as closely as possible to the physical center of the antenna housing. To determine the position of a survey marker on the ground, the GPS antenna (and thus the phase center) is centered over the marker and the HI is measured to the survey marker for use during processing.

Point positioning
See Autonomous position.

Position Dilution of Precision (PDOP)
See Dilution of Precision.

Post-processed position
The position of a survey point obtained from the processing of GPS raw data observed simultaneously between this point an another point of known position.

Post-processing
The reduction and processing of GPS data after the data was actually collected in the field. Postprocessing is usually accomplished on a computer in an office environment where appropriate software is employed to achieve optimum position solutions.

PPM
Part per million

PRN number
Satellite identification number

Pseudorange
A measure of the apparent propagation time from the satellite to the receiver antenna, expressed as a distance. Pseudorange is obtained by multiplying the apparent signal-propagation time by the speed of light. Pseudorange differs from the actual range by the amount that the satellite and user clocks are offset, by propagation delays, and other errors.
The apparent propagation time is determined from the time shift required to align (correlate) a replica of the GPS code generated in the receiver with the received GPS code. The time shift is the difference between the time of signal reception (measured in the receiver time frame) and the time of emission (measured in the satellite time frame).

R

Raw data
GPS data which has not been processed or differentially corrected.

Recording interval
The time interval between the recording of GPS raw data to the GPS receiver memory. For example, a recording interval of 10

seconds indicates that GPS raw data will be stored to the GPS receiver memory once every 10 seconds.

Reference Station
A point (site) where crustal stability, or tidal current constraints, have been determined through accurate observations, and which is then used as a standard for the comparison of simultaneous observations at one or more subordinate stations. Certain of these are known as Continuous Operating Reference Stations (CORS), and transmit reference data on a 24-hour basis. Data from these sites are available for public use and can be retrieved in one hour increments from the internet at: http://www.ngs.noaa.gov/cors/cors-data.html .

Relative positioning
The process of determining the relative difference in position between two marks with greater precision than that to which the position of a single point can be determined. Here, a receiver (antenna) is placed over each spot and measurements are made by observing the same satellite at the same time. This technique allows cancellation (during computations) of all errors which are common to both observers, such as satellite clock errors, propagation delays, etc.

RINEX
Receiver INdependent EXchange format. A set of standard definitions and formats to promote the free exchange of GPS data and facilitate the use of data from any GPS receiver with any software package. The format includes definitions for three fundamental GPS observables: time, phase, and range. A complete description of the RINEX format is found in the Commission VIII International Coordination of Space Techniques for Geodesy and Geodynamics "GPSBULLETIN" May-June,1989.

Root-Mean-Square (RMS)
A statistical measure of the scatter of computed positions about a "best fit" position solution. RMS can be applied to any random variable.

Rover
The GPS receiver that moves from site to site during a kinematics GPS survey.

S

Seed coordinate
When processing GPS raw data collected simultaneously between two points, the processing requires that the coordinates of one of the two points be held fixed. Normally, these are the known coordinates for one of the points. These coordinates are referred to as seed coordinates.

Selective Availability (SA)
A Department of Defense program to control the accuracy of pseudorange measurements, whereby the user receives a false pseudorange which is in error by a controlled amount. Differential GPS techniques can reduce these effects for local applications.

Session
A session is a group of simultaneously collected GPS raw data. For example, if 4 GPS receivers collected data simultaneously on 4 points, the entire data set is considered a session. Within a session, GPS vectors can be computed between all points.

Site
A location or survey point where GPS data is collected.

Site ID
A four character alpha-numeric identifier for s survey point. Each survey point must have a unique site ID. Otherwise, the processing will have problems determining which point certain observations belong to.

Site pair
Two survey points between which exists a GPS vector. The term site pairs is used when analyzing the quality and accuracy of measurements between survey points.

Slant height
The distance from the survey marker to the edge of the antenna ground plane. Using the slant height and radius of the GPS antenna, the true vertical height or HI of the antenna can be determined. The HI is used in the processing to determine the location of the survey marker on the ground.

Static surveying
A method of GPS surveying that involves simultaneous observations between stationary receivers. Post-processing computes the vector between points.

SV
Satellite vehicle or space vehicle.

T

Time Dilution of Precision (TDOP)
See Dilution of Precision.

U

UTC
Time as maintained by the U.S. Naval Observatory. Because of variations in the Earth's rotation, UTC is sometimes adjusted by an integer second. The accumulation of these adjustments compared to GPS time, which runs continuously, has resulted in an 11 second offset between GPS time and UTC at the start of 1996. After accounting for leap seconds and using adjustments contained in the navigation message, GPS time can

be related to UTC within 20 nanoseconds or better.

V

Vector
The spatial line, described by 3D components, between two points. In GPS surveying, a vector is the product of processing raw data collected on two points simultaneously.

Vertical Dilution of Precision (VDOP)
See Dilution of Precision.

W

WGS84
WGS84 is the datum that GPS positions and vectors are referenced to. This datum is basically equivalent to the NAD83 datum used in the United States. The difference is too small to have any impact on GPS positions and vectors.

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Y